Orthodontie chez les enfants et adolescents

KCE reports 77B

Federaal Kenniscentrum voor de Gezondheidszorg
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PREFACE

L'orthodontie est une discipline relativement jeune à laquelle un intérêt de plus en plus grand est accordé dans les soins dentaires. Les traitements orthodontiques sont partiellement remboursés par l'assurance maladie pour les plus jeunes et font souvent aussi l'objet d'une intervention des assurances complémentaires offertes par les mutuelles. Malgré ces remboursements, les familles doivent encore souvent y aller de leur portefeuille.

Le présent rapport examine le rôle que peut remplir l'assurance maladie obligatoire dans ces traitements chez les enfants et les adolescents. Les soins de santé sont destinés à traiter les maladies, les lésions ou les souffrances psychologiques (ou à les prévenir dans toute la mesure du possible). Mais l'orthodontie constitue-t-elle bien une intervention médicale ou relève-t-elle plutôt de l'esthétique ? Est-il justifié qu'un traitement médicalement justifié soit en grande partie à charge du patient ? Et les traitements orthodontiques actuellement remboursés, doivent-ils l'être indépendamment de leur fondement médical ou esthétique ?

Fidèle à ses principes, le KCE tente d'aborder ces questions difficiles à partir d'une approche fondée sur des preuves. Pour quelles affections l'efficacité d'un traitement orthodontique est elle démontrée dans la littérature ? Une comparaison internationale de l'organisation et des systèmes de remboursements belges et étrangers apporte également un éclairage utile.

Les auteurs du présent rapport tiennent à remercier ceux et celles qui ont contribué de manière fructueuse à ce projet et particulièrement les experts en orthodontie pour leur apport scientifique, la Mutualité Chrétienne, DKV (Deutsche Krankenversicherung) et l'OCM (Office de Contrôle des Mutualités) pour l'apport de leurs données et informations, les dentistes et orthodontistes qui ont participé à l'enquête nationale ainsi que les associations d'orthodontistes à l' étranger pour leur collaboration à l'enquête internationale.

Jean-Pierre Closon
Directeur général adjoint

Dirk Ramaekers
Directeur général

Résumé

OBJECTIFS DU RAPPORT

L'objectif de la présente étude est de fournir un tour d'horizon complet des données probantes existantes relatives à l'orthodontie chez les enfants et les jeunes adolescents et d'analyser la situation actuelle en Belgique. Tout d'abord, l'étude comporte une revue de la littérature portant sur les indications et les contre-indications du traitement orthodontique. Pour quels patients peut-on parler réellement d'un besoin de traitement médical et pour lesquels l'orthodontie est-elle davantage une question d'esthétique ? Par ailleurs, l'étude fournit un large aperçu du secteur en Belgique, en ce compris l'organisation et la densité des praticiens, les schémas de consommation actuels, les politiques de remboursement de l'assurance nationale et de l'assurance complémentaire, ainsi que les coûts à charge du patient. Ensuite, la situation belge fait l'objet d'une comparaison avec un certain nombre de pays triés sur le volet : les Pays-Bas, la France, l'Allemagne, le Royaume-Uni, la Suède, la Suisse et les États-Unis.

METHODOLOGIE

Afin d'évaluer l'orthodontie selon le principe du fondement sur les données probantes ("evidence-based"), une étude de la littérature scientifique existante a été réalisée. Afin de décrire la situation belge, nous avons investigué un certain nombre de sources d'informations, notamment des données émanant de l'INAMI, de l'AIM, de la MC et de la compagnie d'assurances privée DKV. Un questionnaire a également été envoyé aux orthodontistes belges pour obtenir un tableau plus clair des pratiques actuelles. La comparaison internationale se fonde sur deux sources. Tout d'abord, la littérature grise a été examinée en détails et ensuite, les présidents des organisations professionnelles d'orthodontie des pays précités ont complété un questionnaire.

RESULTATS DE LA REVUE DE LITTERATURE

Peu d'études scientifiques de bonne qualité ont été retrouvé dans la littérature. Pour cette raison les conclusions doivent être traitées avec prudence.

INDICATIONS ET CONTRE-INDICATIONS DU TRAITEMENT ORTHODONTIQUE

Sur base des données probantes actuellement disponibles, l'absence de traitement des malocclusions n'induit que peu d'effets médicaux indésirables. Il existe des données probantes de qualité moyenne quant à un risque accru de traumatisme en cas de surplomb incisif important. Des données probantes de qualité médiocre mettent en évidence un risque plus élevé de résorption radiculaire dans le cas d'un positionnement ectopique des dents. La malocclusion n'est pas associée à un nombre plus élevé de caries (données probantes de qualité médiocre). Des études supplémentaires restent nécessaires, notamment en ce qui concerne la relation entre les malocclusions dentaires non traitées et les troubles parodontiques, de la mastication ou de l'élocution ou encore les problèmes au niveau de l'articulation temporomandibulaire.

A l'heure actuelle, du point de vue de nombreux patients ou parents, la première indication du traitement orthodontique n'est pas un souci de nature médicale, mais plutôt le désir d'obtenir une amélioration d'ordre esthétique. Une malposition dentaire aurait en effet un impact psychosocial délétère. Une évaluation scientifique nous apprend que les données probantes sur la relation de causalité entre les malocclusions de sévérité modérée et une estime de soi négative chez les enfants et les adolescents de 11 à 14 ans sont contradictoires (données probantes de qualité médiocre).

Le statut bucco-dentaire à l'âge adulte est apparu comme revêtant une importance mineure par rapport à l'estime de soi globale, dans un modèle d'étude incluant d'autres variables psychologiques (données probantes de qualité médiocre).

RISQUES INHERENTS A UN TRAITEMENT ORTHODONTIQUE

En soi, un traitement orthodontique semble relativement sûr (données probantes de qualité médiocre): le seul effet secondaire avéré étant la résorption radiculaire qui se produit chez 11 à 28% des patients. Les informations relatives aux conséquences à long terme d'une résorption radiculaire majeure font encore défaut et les répercussions d'une interruption du traitement restent floues. En cas d'hygiène bucco-dentaire lacunaire, des tâches de décalcification peuvent apparaître sur les dents. Il est probable qu'un rinçage régulier avec un bain de bouche fluoré pourrait prévenir leur apparition. Les données probantes ne fournissent aucun argument allant dans le sens d'une augmentation du nombre de caries, de la sensibilité au nickel ou de problèmes au niveau de l'articulation temporomandibulaire, suite à un traitement orthodontique.

ÉVALUATION DU BESOIN EN TRAITEMENT ORTHODONTIQUE

Selon le consensus existant entre les experts, un dépistage des problèmes orthodontiques au cours de la première phase transitionnelle de la perte des dents lactéales serait idéal. Nous ne disposons d'aucune preuve quant à la mise en œuvre de ce dépistage.

Les indices de besoin en traitement tels que l'IOTN, le PAR, l'ICON sont bien acceptés au niveau international en ce qui concerne leur utilité dans l'évaluation du besoin en traitement orthodontique ainsi que pour l'audit, la recherche et la prise de décision. Les données probantes font défaut pour tirer des conclusions à propos de la validité (à savoir, si un outil mesure ce qu'il est censé mesurer) des indices.

EFFICACITE D'UN TRAITEMENT ORTHODONTIQUE

S'agissant de plusieurs options thérapeutiques importantes en orthodontie, l'absence d'études cliniques rend impossible tout jugement de valeur.

Toutefois, des données probantes de qualité médiocre montrent que le meulage des dents de lait en cas d'occlusion croisée postérieure (prévalence comprise entre 9 et 23% des enfants de race blanche) peut empêcher le maintien de l'occlusion croisée en dentition définitive, éventuellement en association avec une expansion du maxillaire. En revanche, le soulagement de l'encombrement des incisives inférieures grâce à l'extraction des canines lactéales inférieures pourrait ne pas être efficace, mais ceci demande confirmation. Nous ne disposons pas de données probantes suffisantes permettant de se prononcer sur l'effet des mainteneurs d'espace chez les jeunes enfants, pas plus que sur le traitement de la béance antérieure.

Dans la denture mixte, l'éruption forcée des canines incluses (prévalence +/- 2%), associée à l'orthodontie, réduit le risque de résorption radiculaire des dents adjacentes (données probantes de qualité médiocre). Aucune décision n'a été prise quant au traitement le plus efficace dans ce cas. Des études supplémentaires sont indispensables sur le traitement des dents surnuméraires (prévalence < 2%) ou des agénésies dentaires (+/- 5%).

Dans le cas d'une malocclusion classe III d' Angle, peu fréquente en Europe occidentale (prévalence 3-6%), le port d'un masque facial de protraction est efficace (données probantes de qualité moyenne), de préférence avant l'âge de 10 ans.

Les malocclusions classe II,1 sont fréquentes et elles représentent la majorité des malocclusions de classe II, dont la prévalence est comprise entre 23 et 63% des enfants de race blanche. Dans ces malocclusions, le traitement des incisives supérieures prominentes est efficace (données probantes de qualité moyenne), mais le traitement précoce n'est pas plus efficace qu'un traitement orthodontique au début de l'adolescence de l'enfant.

Toutefois, la prévention d'un traumatisme, en cas de surplomb incisif sévère et l'avantage psychosocial en cas de tracasserie excessif, constituent des exceptions à cette règle. Le traumatisme potentiel - effet préventif d'une correction précoce - reste à vérifier par des études contrôlées réalisées chez des enfants, sur la denture mixte précoce.

Aucun essai clinique randomisé ou contrôlé concernant le traitement de la malocclusion de classe II,2 n'ayant pu être trouvé, il n'est pas possible de formuler de recommandation.

Les avantages d'un traitement orthodontique chez les patients souffrant d'une fente labiale et/ou de fente palatine (1,5 sur 1000 naissances) de même que les autres patients médicalement compromis souffrant d'autres pathologies congénitales craniofaciales ou dentales sont généralement reconnus.

CONTENTION ET STABILITE APRES LE TRAITEMENT

Une fois le traitement terminé, le résultat obtenu doit être préservé dans le long terme. Le chevauchement des incisives inférieures peut se manifester à l'age adulte de même que le surplomb incisif peut récidiver (données probantes de qualité médiocre). Cette éventualité n'est pas prédictible au niveau individuel. Les données probantes sont insuffisantes pour formuler des conclusions sur la stabilité après le traitement d'autres anomalies morphologiques de même qu'à propos de la satisfaction du patient à long terme (au moins 5 ans) après un traitement orthodontique.

LIEN AVEC LES FACTEURS SOCIO-ECONOMIQUES

La littérature ne contient pas de données probantes concluantes sur la corrélation entre les facteurs socio-économiques et l'administration d'un traitement orthodontique. Les patients qui rendent régulièrement visite à leur dentiste sont davantage susceptibles de bénéficier d'un traitement orthodontique.

LE TRAITEMENT ORTHODONTIQUE EN BELGIQUE

On estime que 40% des enfants belges reçoivent un traitement orthodontique. Le traitement touche généralement le groupe d'âge des 10-14 ans. La proportion d'enfants traités s'élève à 46% au nord du pays, à 32% au sud et à 30% en région bruxelloise. Environ 64% des traitements sont entre les mains d'un orthodontiste, le solde chez un dentiste normal. La plupart des dentistes et orthodontistes ne sont pas conventionnés auprès de l'INAMI et déterminent dès lors librement leurs tarifs. Le coût total situe souvent au-delà de 2000 EUR. Selon les estimations, l'INAMI rembourse en moyenne 30% de la facture totale, tandis que l'assurance complémentaire rembourse encore presque 20% de plus. Au total, le patient finance donc environ 50% du traitement ou un peu plus de 1000 EUR. La durée du traitement joue un rôle important dans le coût réel du traitement. Les données de l'AIM montrent que la durée médiane d'un traitement est de 18 séances pendant 26 mois. Environ 25% des patients ont moins de 11 séances et 25% d'entre eux plus de 24.

COMPARAISON INTERNATIONALE

ORGANISATION DES PRATICIENS

Par rapport aux 6 pays européens inclus dans l'étude, la Belgique se situe dans la fourchette supérieure en ce qui concerne la densité des dentistes et des orthodontistes ; elle est proche de la moyenne au niveau du flux entrant annuel de nouveaux praticiens.

On a constaté que le recours à du personnel auxiliaire (assistants dentaires, hygiénistes bucco-dentaires et secrétaires) pourrait réduire le coût moyen par patient. Dans la plupart des autres pays étudiés, les dispensateurs emploient un nombre significativement plus important de personnes auxiliaires auxquelles ils peuvent déléguer les tâches routinières.

Toutefois, les praticiens ont très peu recours à ce type de personnel en Belgique. Une première initiative visant à soutenir un recours plus systématique aux auxiliaires en Belgique a été récemment prise par le VDAB et le FOREM via la mise en place d'une formation pour les assistants dentaires.

DETERMINATION DU BESOIN EN TRAITEMENT ORTHODONTIQUE

Dans beaucoup des pays, il existe une obligation d'attribuer, à chaque patient, une appréciation du besoin en traitement orthodontique. Tel est le cas, entre autres, au Royaume-Uni, en Allemagne et en Suède. Divers indices sont utilisés aux fins de cette appréciation. Au Royaume-Uni, le traitement du NHS se fonde sur l'index IOTN combiné à une Composante esthétique pour les cas limites en ce qui concerne l'index IOTN. La Suède utilise un index suédois à 4 niveaux, issu par le « Swedish Medical Health Board ». L'Allemagne également possède son propre système d'appréciation du besoin de traitement, le KIG ("Kieferorthopädische Indikations Gruppen").

TARIFS ET REMBOURSEMENT AU NIVEAU NATIONAL

Dans les autres pays, on constate qu'il existe des systèmes d'honoraires fixes et variables. Aux Pays-Bas, les honoraires sont fixes. En Allemagne et au Royaume-Uni (NHS), les honoraires sont fixes sauf pour les patients couverts par une assurance privée. En France et en Suède, comme en Belgique, les honoraires sont libres. Des honoraires distincts pour les orthodontistes par rapport aux dentistes n'existent qu'aux Pays-Bas depuis 2004.

Dans tous les pays étudiés, le remboursement national du traitement orthodontique est tributaire d'un âge limite pour le début du traitement. La limite la plus basse est de 15 ans, en Belgique. Dans les autres pays, cette limite varie de 16 ans en France à 19 ans en Suède.

Les critères nationaux de remboursement sont très diversifiés. Dans certains pays comme les Pays-Bas et la Suisse, il n'existe un remboursement national que pour un petit nombre de patients présentant des anomalies spécifiques (notamment les fentes labiales et/ou palatines, autres malformations craniofaciales et les agénésies multiples), ainsi que pour les patients dysgnatiques répondant à certains critères. Au Royaume-Uni, le NHS rembourse tous les cas de IOTN supérieur ou égal à 3.6, en combinaison avec un index de composante esthétique pour les cas limites. En Allemagne, le remboursement national est limité au KIG 3, 4 et 5. En France, comme en Belgique, le remboursement n'est pas influencé par la gravité de la malocclusion. En conséquence, tous les traitements orthodontiques respectant la limite d'âge bénéficient d'un remboursement partiel. En Suède, tous les traitements orthodontiques dans la limite d'âge sont entièrement remboursés.

RECOMMANDATIONS POLITIQUES

Remboursement différencié en fonction de la nécessité du traitement

- Le système de soins de santé actuel ne fait pas de distinction entre les patients présentant des malpositions mineures (esthétiques), moyennes ou graves (du type surplomb incisif extrême, overbite avec traumatisme palatin ou gingival, surplomb inversé, dents ectopiques ou incluses, occlusion croisée antérieure ou postérieure avec shift mandibulaire, agénésies) ou ceux se trouvant dans une situation médicalement précaire (notamment ceux qui souffrent d'une fente labiale et/ou palatine, d'autres malformations craniofaciales congénitales ou d'oligodontie). Nous recommandons une différenciation de la politique de remboursement en fonction de la sévérité des déviations dentofaciales et des malocclusions.
- L'utilisation d'un index de besoin du traitement orthodontique représente sans conteste un premier pas sur la voie de l'identification claire des différents besoins au sein de la population des patients. En dépit de ses lacunes et de l'absence de validation, l'utilisation d'un index est généralement acceptée à des fins organisationnelles. Parmi les indices, on peut recommander l'IOTN (Index of Orthodontic Treatment Need), le PAR (Peer Assessment Ratio) et l'ICON (Index of Complexity, Outcome and Need).
- En ce qui concerne le contrôle et la vérification des appréciations, deux options sont possibles. Première possibilité: c'est l'orthodontiste qui évalue le patient. Dans ce cas, un contrôle a posteriori réalisé par l'INAMI sur un échantillon de patients est requis. Seconde option: le contrôle a priori. Dans ce cas, ce sont les caisses d'assurance maladie qui attribuent en toute objectivité un score à tous les moulages dentaires (ou 3D photographies des moulages). Dans les deux options, il convient de prévoir une formation et des lignes directrices sur la manière d'attribuer un score.
- Dans le cas des patients en situation médicalement précaire présentant un besoin élevé en traitement, il semble logique d'offrir un remboursement national complet (ou significativement supérieur). Selon les estimations, ce cas de figure concerne 260 patients nés chaque année. S'agissant des autres patients, nous recommandons un remboursement différencié selon que les malocclusions sont sévères, modérées ou mineures. Sur base de la littérature clinique et psychosociale, il n'est pas possible de recommander un niveau unique de seuil de remboursement optimal. Concernant l' IOTN, les experts s'accordent en général à dire que dans les cas IOTN 1 et 2, il n'existe d'ordinaire pas de nécessité de traitement que ce soit médical ou dentaire et que dans les cas IOTN 4 et surtout 5, il existe un besoin réel, le consensus est nettement moindre surtout sur les cas IOTN 3.
- Pour répondre à la question relative aux seuils de remboursement, la seule solution consiste à organiser un débat sociétal à propos du rôle du système national d'assurance maladie (par rapport aux assurances complémentaires et privées) dans les soins orthodontiques, à des fins médicales, psychosociales et esthétiques. Une option éventuelle serait de suspendre le remboursement national pour les enfants sans nécessité de traitement médical ou dentaire (dans le cas de IOTN groupe 1 et 2), de maintenir le remboursement actuel pour les enfants avec une malocclusion modérée (dans le cas IOTN groupe 3), d'augmenter de manière significative celui pour les enfants avec une malocclusions sévère (dans le cas IOTN groupe 4 et 5) et de rembourser les patients médicalement compromis de 100%.

Dossier

- Pour mettre en place un remboursement différencié, l'établissement d'un dossier des fiches orthodontiques au début du traitement serait préconisé. Pour réunir toutes les garanties en matière de qualité, nous recommandons également qu'un dossier soit établi en fin du traitement, incluant les empreintes dentaires finales et la photographie clinique. À terme, l'enregistrement constitue une condition préalable à la mise en place d'un système d'audit ou de révision par les pairs.

Âge maximum du remboursement par le système d'assurance maladie

- Il est généralement admis que le traitement orthodontique des patients souffrant d'une fente labiale ou palatine et des autres patients atteints d'affections médicales se poursuit souvent après l'âge de 15 ans.
- En ce qui concerne les autres patients, il n'est pas possible de tirer des conclusions claires en ce qui concerne l'âge maximum pour un traitement. En conséquence, aucune recommandation ferme ne peut être formulée. Afin d'avoir la certitude que les patients soient référés à heure et à temps, et compte tenu du fait que tous les enfants ne sont pas vus régulièrement par un praticien dentiste, nous recommandons que les médecins de l'inspection médicale scolaire assurent un suivi systématique dans le but de référer les enfants pour un traitement orthodontique.

Tarifs

- Les honoraires conventionnés étant nettement en deçà des tarifs appliqués, les praticiens ne signent généralement pas la convention, avec pour corollaire, une variation importante des honoraires et une transparence limitée. Néanmoins, l'étude ne permet pas de conclure si une augmentation des honoraires conventionnés aurait pour résultat une application plus large de ceux-ci. Pour suivre l'exemple des Pays-Bas, une solution pourrait être d'imposer des tarifs fixes. Toutefois, gageons que cette option se verrait opposer une vive résistance de la part du groupe des praticiens. Si une augmentation du remboursement devait être introduite pour les patients à besoin élevé, un honoraire conventionné adapté pourrait être proposé pour ces cas spéciaux.
- L'utilisation d'une offre écrite et d'un consentement éclairé devrait être obligatoire à chaque début de traitement. De la sorte, toute surprise au niveau du prix effectivement payé par le patient serait évitée.

Questions organisationnelles

- Par rapport aux autres pays, il n'est pas nécessaire d'accroître l'influx de nouveaux dentistes ou orthodontistes en Belgique.
- Afin de préserver la qualité, il pourrait également être envisagé de réserver exclusivement aux spécialistes en orthodontie le soin de réaliser une série de traitements spéciaux, notamment chez les patients médicalement compromis. Nous n'avons pas trouvé de lignes directrices ou de règles claires en matière de référence des patients dans d'autres pays.
- Il convient d'investiguer la question du rôle potentiel des auxiliaires, de voir comment ce rôle pourrait être davantage encouragé et quelle formation serait nécessaire pour assurer l'arrivée sur le marché de ce personnel auxiliaire.
- Plus de recherche sur la pratique actuelle en Belgique et en particulier la qualité et les résultats des soins orthodontiques, est recommandée.

Scientific summary

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LIST OF ABBREVIATIONS

AAO	American Association of Orthodontists
AC	Aesthetic Component
ALD	Arch Length Discrepancy
ANAES	Agence Nationale d' Accréditation et d' Evaluation en Santé
BBNO	Belgische Beroepsvereniging van Nederlandstalige Orthodontisten
BBUSO	Belgische Beroepsvereniging van Universitair opgeleide Specialisten Orthodontie
BEMA	Einheitlicher Bewertungsmaßstab für zahnärztliche Leistungen
BUOS	Belgian Union of Orthodontic Societies
CANAM	La caisse d'assurance maladie des professions indépendantes
CCMSA	La Caisse Centrale de la Mutualité Sociale Agricole
CLP	Cleft Lip and Palate
CMU	Couverture Maladie Universelle
CNAMTS	Caisse Nationale d'Assurance Maladie des Travailleurs Salariés
CoTS	Courses of Treatment
CPQ	Child Perceptions Questionnaire
CRD	Centre for Reviews and Dissemination
DAI	Dental Aesthetic Index
DDM	Dysharmonie Dento-Maxillaire
DDS	Dents de Sagesse, Wisdom teeth
DHC	Dental Health Component
DKV	Deutsche Krankenversicherung
DMH	Danish Ministry of Health
EBM	Evidence Based Medicine
EFOSA	European Federation of Orthodontic Specialists Associations
ENT	Ear Nose Throat
EPSDT	Early and Periodic Screening, Diagnostic and Treatment benefit
FFS	Fee For Service
FIHII	Federal Institute of Health and Invalidity Insurance
FTE	Full Time Equivalent
GDC	General Dental Council
GDP	General Dental Practitioner
GP	General Practitioner
HAS	Haute Autorité de Santé
HLD	Handicapping Labio-Lingual Index
HMAR	Handicapping Malocclusion Assessment Record
HMO	Health Maintenance Organization
HRQL	Health Related Quality of Life
ICON	Index of Complexity, Outcome and Need
IMA-AIM	InterMutualistisch Agentschap - Agence Intermutualiste
IOTN	Index of Orthodontic Treatment Need
IQR	Inter Quartile Range
KIG	Kieferorthopädische IndikationsGruppen
NDS	Swedish Public Dental Service
NHS	National Health Service
NIS	National Institute for Statistics
NOTI	Need for Orthodontic Treatment Index
NZa	Nederlandse Zorgautoriteit
OHCP's	Orthodontic Health Care Providers
OHRQL	Oral Health Related Quality of Life

OIIRR	Orthodontically Induced Inflammatory Root Resorption
OSAS	Obstructive Sleep Apnea Syndrome
OT	Orthodontic Treatment
PAR	The Peer Assessment Ratio
PCDs	Professionals Complementary to Dentistry
PCTs	Primary Care Trusts
PDS	Public Dental Service
PICO	Patient Population-Intervention-Comparison-Outcomes
RCT	Randomized Controlled Trial
RIZIV/INAMI	Rijksinstituut voor Ziekte- en Invaliditeitsverzekering/Institut National d'Assurance Maladie-Invalidité
RME	Rapid Maxillary Expansion
RPE	Rapid Palatal Expansion
SBU	Swedish Council on Technology Assessment in Health Care
SCHIP	State Children's Health Insurance Program
SOI	Summers' Occlusal Index
SSO	Swiss Dental Association
TMD	Temporo Mandibular Disorders
TPI	Treatment priority index
U.N.C.A.M.	L'Union Nationale des Caisses d'Assurance Maladie
UFOB	Union Francophone des Orthodontistes Belges
VAV	Vrije Aanvullende Verzekering
VBVO	Vlaamse BeroepsVereniging van Orthodontisten
VVT	Vereniging voor Vlaamse Tandartsen
VWO	Voorgezet Wetenschappelijk Onderwijs
WFO	World Federation of Orthodontists
WHO	World Health Organization
WIGW	Weduwen, Invaliden, Gepensioneerden en Wezen

GLOSSARY OF ORTHODONTIC TERMS

Aesthetic component	Part of the IOTN index, see photographs in Appendix of Ch 2
Agenesis	Congenitally missing tooth. When 2-5 permanent teeth are congenitally missing, this is called hypodontia. More than 6 permanent teeth missing -excluding the wisdom teeth- is called oligodontia.
Anterior	Situated in the front, a term commonly used to denote the incisor to canine region.
Appliance	A device, fixed or removable, which is used to change the position of teeth or jaws
Dental arch	The ensemble of teeth in the upper and lower jaw mostly in a horseshoe shape
Band	A thin strip of metal which is placed around a tooth, mostly a molar with dental cement in order to attach the appliance
Banding	Placing a band on a tooth with dental cement
Wax bite	An imprint of the teeth in wax, in order to examine the relationship between upper and lower teeth on study models.
Brackets	Or braces, small metal appliances bonded on the tooth with a composite in order to have an attachment on each tooth to be able to move them.
Bruxism	Grinding of the teeth during sleep, which causes abrasion of the tooth enamel and can cause TMJ disorders.
Buccal segments	The side view of the bite
Caries	Dental decay
Dental cast	A study model, in plaster, of the teeth of upper and lower arch. Recently also digital study models have been developed.
Cephalometric X- Ray	An X-Ray of the head and jaw bones that shows how the teeth and jaws are aligned and whether they are growing properly
Class I malocclusion	The teeth of upper and lower jaw meet correctly in sagittal direction but show irregularities.
Class II malocclusion	The teeth of the upper jaw protrude relative to the teeth of the lower jaw and the teeth may also show irregularities.
Class III malocclusion	The teeth of the lower jaw protrude relative to the teeth of the upper jaw and the teeth may also show irregularities.
Cleft Palate	A congenital non-closure of the palate, it may involve the hard or soft palate or both.
Cleft Lip	A congenital non-closure of the lip.
Congenital	Present at birth
Cross Bite	A malocclusion where the upper teeth bite inside the lower teeth. This type of malocclusion can occur in the lateral part of the mouth and can be unilateral or bilateral; or can occur in the front region of the mouth.
Crowding	The type of malocclusion where the teeth are in irregular position due to a lack of space in the dental arch.
Deciduous teeth	Baby or primary teeth which fall out and are replaced by the permanent teeth. There are 10 deciduous teeth in each jaw, 20 in total.
Deep bite	Excessive overbite in the front region, which may cause damage to the palatal or buccal gingiva.
Dental health	The overall health of the mouth, teeth, gums and supporting tissues.
Disto-occlusion	A tooth occluding in a position distal to normal. Synonym: distal-occlusion, postnormal occlusion, retrusive occlusion, distal occlusion.
Erosion	A defect on the surface of the tooth. It is usually a result of the chemical action of acids in soft drinks.

Eruption	Emergence of the tooth through the gums
Extra-oral	Outside the mouth
Fixed appliance	The brackets bonded and the bands banded on the teeth, which are joined with an orthodontic wire in order to move the teeth.
Functional appliance	A special removable appliance which changes the way the teeth and jaws bite together.
Functional treatment	Treatment with –in most of the cases- a removable appliance that joins both lower and upper jaw in order to change the relationship between both jaws; this treatment can also be carried out by a fixed appliance constructed for this goal
Interceptive treatment	A treatment that is carried out at an early age to prevent more complex features to develop and to allow the more definitive treatment to be more easily completed at a later age
Gingiva	The part of the gum which surrounds the teeth
Gingivitis	Inflammation of the gums, which are swollen and bleed easily.
Impacted tooth	A tooth that is embedded in the jaw and is prevented from erupting normally.
Intra-oral	Inside the mouth.
Intra- oral traction	Attaching elastics or other devices to the upper and lower teeth to produce the force to move teeth.
IOTN	Index of Orthodontic Treatment Need
Lingual	The lingual surface of the tooth is the surface adjacent to the tongue.
Low friction brackets	Fixed appliance system (of bracket and wire system) recently introduced which claims to produce tooth movements with less friction than conventional bracket system, so far these claims were not supported by scientific evidence.
Malocclusion	Abnormal occlusion of the teeth or a jaws.
Mandible	The lower jaw
Maxilla	The upper jaw
Mesio-occlusion	Occlusion in which the mandibular teeth articulate with the maxillary teeth in a position anterior to normal. Synonym: prenormal occlusion, mesial occlusion.
Myofunctional disorder	Refers to a disorder of the muscles of the mouth and face, especially the tongue and the lips during swallowing or in restposition. A collection of terms concerning myofunctional problems are tongue thrust, tongue thrust swallow, infantile swallow, wrong infantile swallowing, tongue- and lip habits , tongue habit, lip habit, tongue interposition.
Neutro-occlusion	An arrangement of teeth such that the maxillary and mandibular first permanent molars are in normal anteroposterior relation. Neutral occlusion
Occlusion	The meeting together of the upper and lower teeth, also called ‘bite’.
Open bite	A malocclusion in which the teeth do not meet together.
Orthodontics	The field of orthodontics comprises the development and growth of the face and the jaws, and the positioning of the teeth in the dental arches and the occlusion (the bite).
Overbite	The vertical overlap of the upper over the lower teeth.
Overjet	The horizontal distance between the upper teeth over the lower teeth in the front.
Palatal	The palatal surface of the tooth is the surface adjacent to the tongue.
Permanent teeth	The secondary or adult teeth, the wisdom teeth included there are 32 permanent teeth (16 in each jaw)
Plaque	A deposit formed by the action of bacteria on the food residue, this can cause caries.
Posterior	Situated in the back of the mouth, refers to the premolar and molar area.

Protrusion	Tooth that are placed too far forward in the jaw.
Radiograph	A type of photograph using x-rays which shows the teeth and jaws.
Relapse	The return of features towards the original malocclusion following orthodontic treatment.
Retainer	A fixed or removable appliance for maintaining the positions of the teeth and jaws after orthodontic treatment.
Retruded	Further back than ideal
Reverse overjet	Lower front teeth bite in front of upper front teeth
Space maintainer	An appliance used to prevent adjacent and opposing teeth from moving into the space left by the loss of a deciduous tooth.
Speech therapist	A person specialised in correcting speech deviations and disorders
Supernumerary tooth	An extra tooth
Temporomandibular Joint (TMJ)	The joint formed by the mandibular condyle and the base of the skull
Tooth displacement	Abnormal or incorrect position of a tooth
Tracing	A drawn line of a cephalometric X-Ray which helps the orthodontist in diagnosis and treatment planning
Trauma	An injury of the teeth or jaws
Treatment plan	An outline of the clinical steps which will be followed to correct the initial malocclusion towards a normal occlusion.
The third molars	Wisdom teeth

OVERVIEW OF USED RIZIV/INAMI CODES

305594-305605	Orthodontic treatment demand
305631-305642 305675-305686	Appliance - at the start of the treatment - after 6 months of treatment
305616-305620 305653-305664 305712-305723	Monthly regular treatment: - max 2 per calendar month and 6 per six calendar months - regular treatment after which an interruption starts of more than 6 months - regular treatment after which non-reimbursable regular treatment follows
305830-305841	Orthodontic advice or investigation, with report
305852-305863 305896-305900	Contention check - max. 4 per calendar year - check after which an interruption of more than 6 months follows

1 GENERAL INTRODUCTION

1.1 THE FIELD OF ORTHODONTICS

The field of orthodontics comprises the development and growth of the face and the jaws, and the positioning of the teeth in the dental arches and the occlusion. Diagnostics, preventive treatment, and treatment of congenital or acquired malocclusions are included. Orthodontic treatment requires the use of fixed or removable orthodontic appliances to affect the jaws and their growth and to move teeth that are incorrectly positioned so that the dental arch fits betters with the "ideal" or "normal" occlusion. Orthodontic treatment can be carried out for functional reasons, providing the patient with a functionally improved bite, but it can also be carried out for purely aesthetic reasons, solely improving the general appearance of a patients' teeth and face. Orthodontic deviations seldom represent pathological conditions. Exceptions are when they form a subpart of congenital craniofacial deviations (e.g. congenital malformations or dysmorphic syndromes), or other oral handicapping conditions like cleft lip and palate or oligodontia.

1.2 HISTORICAL BACKGROUND

Although 'modern' orthodontics with fixed appliances has its direct roots from the end of the 19th century in the United States of America, archaeological excavations in Etruscan settlements lead to the discovery that orthodontic devices were already used in that era.

While in the United States of America orthodontics was already defined and close to licensing as a specialisation of dentistry by the end of the 19th century (first by Bonwill and later by E.H. Angle, who was well known through his article The Classification of Malocclusion in The Dental Cosmos of 1899). Parallel to this evolution, 'modern' orthodontics was also being developed in Europe by some visionaires like Andresen, Haupl, Petrik, Balters ... It would however take until after World War II before the first legal licensings became a fact in Europe, like this was the case in 1953 for orthodontics in The Netherlands. It was probably due to Edward H. Angle and due to favourable circumstances and coincidences that fixed appliances (with brackets) and headgears (extra-oral appliances) were first developed in the USA, while removable and functional appliances were being developed in "the old world" (Europe). A number of European pioneers, after having received an education in predominantly removable appliance therapy in Europe, after the WW II went to the USA, where they learned to work with fixed appliances and brought this back to "the old continent". Since then, extra-oral and functional appliances are often combined and in the meanwhile the education in all types of orthodontic treatment procedures in the European education centres have become at least as competitive as the education in the USA. Also, many new technological advances (e.g. intra-osseous anchorage systems, in - and onplants,...) have been introduced in the field.

1.3 IMPORTANCE OF THE STUDY

In 2005, 6% of the dental care budget was spent on orthodontic care or 0.18% of the total national health insurance expenditures. From 1995 to 2005, national health insurance expenditures on orthodontics have increased by 56% from €19.8 million in 1995 to €30.9 million in 2005 (a compound annual growth rate of 4.6%). In the same period, the total expenditures for all RIZIV/INAMI nomenclature have increased by 64% from €10.2 billion in 1995 to €16.8 billion in 2005 (a compound annual growth rate of 5.1%).

In order to investigate whether these public funds are well spent, it is the aim of this study to provide a comprehensive overview of the current evidence regarding orthodontics for children and young adolescents (for which patients can we speak of actual medical treatment need and for which patients is orthodontics a rather aesthetic matter?) and to analyze the current situation and practices of orthodontics in Belgium, compared to other countries.

1.4 SCOPE AND STRUCTURE OF THE STUDY

1.4.1 Current scientific evidence on orthodontic treatment: a survey of the clinical literature (Chapter 2)

This chapter focuses on the evidence based indications and contra-indications as well as the risks and benefits of orthodontic treatment. Furthermore it includes evidence on the instruments to assess the orthodontic treatment need and orthodontic treatment complexity. It also gives an overview of the scientific literature on effectiveness of orthodontic treatment, on the timing of treatment, prevention versus interception of orthodontic problems and retention and stability. Finally an overview is given on epidemiology and etiology of orthodontic problems. The literature search is reported on orthodontic problems, including cleft lip and palate (CLP) and oligodontia, in the age group of children and young adolescents.

1.4.2 Comparative international study based on scientific and grey literature review and on an international questionnaire (Chapter 3)

In order to analyse the sector of orthodontics and to compare the actual Belgian situation with current other systems, an international comparative study is performed in 7 European countries (including Belgium) and the USA by means of a questionnaire sent to the presidents of the professional orthodontic organizations.

In this chapter, an overview is given first, by country, of the following aspects:

- Orthodontics supply, including the density of dentists and orthodontists, the legal licensing of orthodontic specialty, the required training for orthodontists and the importance and role of dental auxiliaries
- Fee-for-service for orthodontic acts
- Orthodontic reimbursement basket, including both national insurance coverage and private or complementary insurance

Although a previous survey has been carried out on the state of orthodontics within the individual European countries, with the same research questions as posed in this study, an update of this information was necessary and therefore a new questionnaire survey was undertaken which was based partially on the EFOSA - questionnaire of 2002. The original EFOSA-questionnaire as well as our adapted form are added in the Appendix of Chapter 3. Specific countries were selected with health care systems that differed from the Belgian situation in order to be able to compare the strengths and weaknesses of the different systems.

1.4.3 Belgian situation: organization, regulation and density of practitioners in the orthodontic sector (Chapter 4)

The current Belgian situation for orthodontics is put into historical perspective and a description is provided on how it evolved into its present organization and regulation. Based on data provided by the RIZIV/INAMI, the density and distribution of orthodontic care providers - specialists and non-specialists - in Belgium, per region and per province are analysed. This way an idea is given on the current availability of orthodontic health care (number of acts and the consumption of different orthodontic acts) and its geographical spread over the country. This represents an indication for the availability of orthodontic care, provided by specialists and by non-specialist orthodontic health care providers.

1.4.4 Belgian situation: estimates on fees, reimbursement and out-of-pocket payments (Chapter 5)

In this chapter an overview is given of the basic reimbursement policy by the RIZIV/INAMI and the complementary reimbursement policies of the sickness funds, for orthodontic treatment in 'normal' patients as well as for orthodontics in specific craniofacial conditions, like cleft lip and palate, oligodontia or other craniofacial congenital deviations.

The actual fees are estimated based on anonymous data from DKV - a private health care insurer. Based on the fees and the reimbursement data, the out-of-pocket payments by type of treatment are estimated.

The role and participation of the different stakeholders in the costs of orthodontic care for the patients is analysed in order to increase the transparency on the financing and reimbursement of orthodontic treatment.

1.4.5 Belgian situation: RIZIV/INAMI expenditures (Chapter 6)

Data provided by RIZIV/INAMI give us an overview of the consumption of orthodontics by type of practitioner (specialist or non-specialist), by age group, sex, region and province.

1.4.6 Belgian situation: orthodontic practices (Chapter 7)

The sector of orthodontic health care providers was questioned through a questionnaire. Based on this questionnaire, an overview is given of actual practices, including amongst other, the duration of orthodontic treatments, the use of indices and the application of specific orthodontic techniques. For estimates on the duration of treatment, also data of the CM/MC, IMA and DKV are analysed in this chapter.

1.4.7 Belgian situation: some epidemiological estimates (Chapter 8)

Based on data obtained from the InterMutualistic Agency (IMA) and our questionnaire some estimates are made on the importance of interceptive versus orthopaedic and fixed appliance treatments, as well as on the proportion of patients with IOTN 4-5 and the proportion of patients with specific congenital disorders, especially cleft lip and palate and oligodontia patients.

2 CURRENT EVIDENCE ON ORTHODONTIC TREATMENT: A SURVEY OF THE CLINICAL LITERATURE

2.1 INTRODUCTION

2.1.1 Malocclusion, orthodontics and dentofacial orthopaedics: general definitions

The field of orthodontics or orthodontia is sometimes also called dental or dentofacial orthopaedics. The latter however represents a broader field, comprising also the influence on the growth of the face, on the jaws and on the occlusion (or "the bite"), while in a strict sense orthodontics only covers tooth movement. As by moving the teeth, part of the jaws is also remodeled (ie the alveolar process), the delineation between orthodontics and dentofacial orthopaedics is often not so clear.

The definition of orthodontics as adopted by the American Association of Orthodontic practitioners in 1981[a], was "Orthodontics (or Dentofacial Orthopedics) is the area of dentistry concerned with the supervision, guidance and correction of the growing and mature dentofacial structures, including those conditions that require movement of the teeth or correction of malrelationships and malformations of related structures by the adjustments of relationships between and among teeth and facial bones by the application of forces and/or the stimulation and redirection of the functional forces within the craniofacial complex. Major responsibilities of orthodontic practice include the diagnosis, prevention, interception and treatment of all forms of malocclusion of the teeth and associated alterations in their surrounding structures; the design, application and control of functional and corrective appliances; and the guidance of the dentition and its supporting structures to attain and maintain optimum relations in physiologic and esthetic harmony among facial and cranial structures."

The term “orthodontics” comes from the Greek word “ortho”, which means "straight", and “odons”, which means tooth. The straightening of irregular teeth, or orthodontic treatment, requires the use of fixed, removable or mixed orthodontic and/or orthopaedic appliances to affect the jaws and their growth and to move teeth that are malpositioned so that the dental arches get harmonized with each other towards a “normal” (sometimes “ideal”) occlusion (see Glossary list; Appendix to Chapter 2). Treatment of congenital or acquired malocclusions are included[a].

The term "occlusion" refers to the relationship in the sagittal, vertical and transverse dimensions of the upper dental arch to the lower dental arch; in the "ideal" occlusion none of the parameters to be fulfilled in a perfect dentition is deviating (ie no teeth missing, perfectly aligned and positioned teeth in perfect contact to eachother in the arch and the upper teeth fitting perfectly to the lower teeth, no tooth size or arch length discrepancies, perfect overbite and overjet etc), while in a "normal" occlusion some deviations are present (like slight rotations/ malpositions, no perfect alignment, slightly increased overjet and/or overbite, good contacts but not perfectly fitting occlusion etc) which are generally accepted as "normal occlusal variation".

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[a] Proffit W. R. and Henry W. Fields, Jr (2000). The Orthodontic Problem. Malocclusion and Dentofacial Deformity in Contemporary Society. In Contemporary Orthodontics, 2000; Eds Proffit, with Henry W. Fields, Jr Mosby , St Louis, Philadelphia, et al

Deviations of the normal occlusion - called malocclusions - are generally categorized in intra-arch deviations, inter-arch deviations and functional deviations[b]. The presence of an objectively manifest malocclusion in an individual is however not the only factor to determine whether this individual should be treated orthodontically. Although it is estimated that e.g. in the Netherlands one third of the total population presents with an indication for orthodontic treatment[l] as scored by IOTN, ICON and/or DAI, not all these malocclusions should be treated as orthodontic treatment often is elective. As will be further outlined, not only are there risks in certain oral environments, like in patients with bad oral hygiene, or with pre-existing periodontal damage and root resorption, and risks for relapse in certain functional conditions and with specific malocclusions. There are also risks that can not be predicted (like root resorption and pulp damage) and often patients seem to have unrealistic expectations towards the esthetic results that can be achieved (possibly due to influence of presentations of new technological developments in the media). Therefore, methods to scientifically relevant determination of objective orthodontic treatment need are necessary.

2.1.2 Development of occlusion; preventive, interceptive and corrective orthodontics

The development and growth of the teeth and the jaws is accepted to be essentially governed by genetic factors.[c] During occlusal development, external factors like the oral functions, can also have significance; examples of these are the mode of breathing, deglutition, speech, phonation, mastication, sucking habits and mandibular movements which were exhaustively described in a publication by the ANAES (HAS) in 2002-2003[d]. A well-known example is that prolonged sucking on the fingers or the use of a pacifier can cause displacements of the teeth.

The occlusion develops under a long period, from the time the first deciduous teeth emerge at 6–8 months of age to when all 28 permanent teeth have erupted at 12–14 years of age. While the jaws grow, space is created, and the face increases mainly in forward and downward direction. After the face ceases to grow, tooth positions as well as occlusal relationships continue to undergo minor alterations.

In most cases, a normal well-functioning occlusion develops. In some people however, the relation between the jaws is not what is considered to be “normal”. The direction of tooth eruption can deviate or lack of space can be present, for example, if the jaws are small compared to the width of the teeth.

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[b] In contrast to 'morphological' deviations (meant by inter- and intra-arch deviations), 'functional' sometimes also called 'myofunctional' deviations refer to the origins of the observed deviations (ie. the impairment of functions and muscle activities or positions), like mouth breathing, tongue positioning during speech, deglutition and in rest.

[c] SBU-SE-2005-Malocclusions_Orthodontic.pdf

[d] Indications de l'Orthopédie Dento-faciale et Dentomaxillofaciale chez l'enfant et l'adolescent (2002) et Recommendations pour la pratique clinique. Les critères d'aboutissement du traîtement d'Orthopédie dento-faciale (2003). Publication par l' Agence Nationale d'Accréditation et d'Evaluation en Santé (ANAES), Service des recommandations professionelles, 159 rue Nationale 75640 Paris-Cedex 13 - Tel 01 42 16 72 72 - Fax 01 42 16 73 73

Table 1: Prevalence of common occlusal anomalies (%).

Intra-arch traits		*Interarch-traits*	
Hypodontia		*Overjet*	
Permanent teeth (except third molars)	6	<0	3
Upper lateral incisors	1-2	+ ve < 5 mm	76
Premolars	1	5-7 mm	14
		>7 mm	8
Hyperdontia			
Supernumerary teeth	0.1-4	*Overbite*	
		>5 mm incisal coverage	11-24
Ectopic eruption		>7 mm incisal coverage	3
One or more	4	Traumatic	1
One or more	2	Open bite	2-4
Intraocclusion, deciduous molars	14		
		Cross-bite	
Dentoalveolar disproportion		Buccal	
Deciduous		Unilateral	10
Spacing (age)	90-95	Bilateral	2
Permanent		Anterior	7
Spacing >2 mm	9	with displacement	75
Crowding		Lingual	7-8
>2 mm	16-26		
>3 mm	25	*Miscellaneous*	
>6 mm	7	Digit/dummy sucking	
>9 mm	3	Age 3 years	42
		Age 12 years	7
Median diastema			
Before eruption	95		
After eruption	25		

Source: Shaw W.C and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227- 237; Chapter 9f in Community Oral Health, Ed: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co, Ltd, London, Berlin, Chicago et al

These morphological discrepancies (also called malocclusions) as well as the less prevailing pathological and oral handicapping conditions (like severe hypodontia and cleft lip and palate), often have a demonstrated genetic background (some with high heritability or with known genes), but there can be environmental causes too.

The cause of the increasing prevalence of malocclusions in post-industrialized populations, is not yet elucidated.

Estimates of the frequency of different traits of malocclusion are available from a number of different surveys, mainly North European and North American. Direct comparison between surveys is not generally possible due to their different examining protocols, but in Table 1[e], a synopsis of a number of surveys is given. The presence of a malocclusion is however not synonymous with a need for treatment.

When occlusal development is unfavorable, it can be interrupted or influenced, either through preventive or through interceptive measures. An example of a ***preventive*** measure is to interrupt a sucking habit before an occlusal deviation is established. ***Interceptive*** measures are performed in the primary occlusion or the early mixed dentition and means that an unfavorable occlusal development is interrupted and that occlusal development can thereafter continue in an unobstructed manner for the individual. If malocclusions are established in the permanent occlusion, ***corrective*** treatment may be necessary. Such treatment requires removable or fixed orthodontic appliances, otherwise also known as braces. Some treatments with removable appliances can be done by a general dental practitioner while corrective (regular or comprehensive) treatment with fixed appliances is usually performed by specialists in orthodontics and requires a treatment period of 1–2 years.

Most orthodontic treatments aim to move teeth into a more "normal" position and occlusion. Some malocclusions require a combination of surgical and orthodontic treatment. The evaluation of the need for orthodontic treatment is a delicate task. Because the "ideal" or normal bite has come to be regarded as a norm for how occlusions should look, insignificant discrepancies can also be experienced as something that must be remedied, while in actuality they are merely an expression of individual variations in appearance. The latter of course again does not include the pathological conditions of CLP and oligodontia. Children often desire orthodontic treatment, and their parents perhaps even more so for their child. As dentists in general practice see the young patients with their parents in their practices every six months for oral examination, they play an important role in the decision process.

Orthodontic treatment nowadays begins at 12–14 years of age (corrective orthodontics), the time in life when appearance begins to be important. The reason for beginning treatment at this age, among others, is that all permanent teeth have erupted. The individual has also reached an age when she or he is considered to have achieved autonomy and is able to desire or decline orthodontic treatment.

Proponents of early treatment argue that a large part of the growth of the facial bones has occurred by the age of 12-14 years and therefore might not be influenced anymore with orthopaedic appliances in later stages. Often early treatment results in two phase treatment with the first part intended for the orthopedic effects (influence on facial growth) at early treatment and the second part for the orthodontic (tooth movement) corrections when all permanent teeth have erupted.

Another argument for early intervention is provided by speech therapists who claim that oral functions - like deglutition, speech and tongue position - can only be 'intercepted' with the help of orthodontic appliances if applied at a young age and not at the age of 12-14 year anymore.

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[e] Shaw W.C and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227- 237; Chapter 9f in Community Oral Health, Ed: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co, Ltd, London, Berlin, Chicago et al.

2.1.3 Current orthodontic practice in Belgium and other Western countries

Traditionally, orthodontic practitioners have assumed that their work enhanced dental health and function, thus providing greater assurance for the longevity of the dentition. Five decades ago, the British Dental Association in 1954 gave a definition of the aims of orthodontic treatment, stating "The aim of orthodontic treatment is to produce improved function by the correction of irregularities and to create not only greater resistance to disease, but also to improve personal appearance, which later will contribute to the physical well-being of the individual". Although the merit of these aims remains unquestionable, there is still controversy as to which occlusal irregularities require correction and the interpretation of these aims are still being debated[f].

The goal of contemporary orthodontics according to Proffit and Fields (2000)[g] can be summed up as the creation of the best possible occlusal relationships, within the framework of acceptable facial esthetics and stability of the occlusal result.

In the contemporary orthodontic practice in Belgium and other Western countries, some of the current generally accepted indications for orthodontic treatment are:

- preventing damage to the dentition by trauma
- to camouflage congenitally missing teeth (by reciprocal displacement of neighbouring teeth);
- to close diastemata from teeth that were lost due to trauma,
- to upright or spread teeth preprosthetically (so that restorations like crown and bridgework, or fillings and other restorations can be made in an easier way - or more tooth structure saving way).
- to desimpact impacted or retained teeth
- to make other dental or surgical treatments easier (dental and occlusal indications)
- to improve function (like speech and mastication)
- to improve the dentofacial appearance (psycho-social indications, esthetics)
- or a combination of the above mentioned

As will be further discussed in section 2.3, there have also been evidenced some adverse effects or side-effects of orthodontic treatment in the last 15 years[h], notably

- gingival and periodontal problems
- root resorption
- decalcifications
- non-improvement
- relapse.

Besides these purely orthodontic objectives and indications (as well as possible adverse effects) in 'regular' patients, orthodontic treatment is also highly indicated for the selected age category in children (and mostly beyond adulthood) with specific congenital craniofacial conditions of which orofacial clefts are the most prevailing.

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f Shaw W.C and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227- 237; Chapter 9f in Community Oral Health, Ed: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co, Ltd, London, Berlin, Chicago et al

g Proffit W. R. and Henry W. Fields, Jr (2000). The Orthodontic Problem. Malocclusion and Dentofacial Deformity in Contemporary Society. In Contemporary Orthodontics, 2000; Eds Proffit, with Henry W. Fields, Jr Mosby , St Louis, Philadelphia, et al

h Proffit W. R. and Henry W. Fields, Jr. (2000). The biologic basis of orthodontic therapy. In Contemporary Orthodontics, 2000; Eds Proffit, with Henry W. Fields, Jr Mosby , St Louis, Philadelphia, et al

Orthodontic treatment of patients with orofacial clefts takes place in a multidisciplinary context (mostly in a university clinic) but also in private practice under the supervision of a coordinating multidisciplinary Cleft Palate Team.

Besides an orthodontist, who in the international context often is the coordinator of the CLP-Team, the members of such a team consist of a Ear Nose Throat (ENT) specialist, a plastic or maxillofacial surgeon, a paediatrician, a psychologist, a speech therapist, a dentist, a geneticist ... who together define the treatment protocol for the patients.

Of the group of patients with congenital craniofacial deviations presenting high orthodontic treatment need (IOTN 5), the patients with CLP form the largest group.

It is estimated that more than of 99 % of these patients need orthodontic treatment, but with a variable duration depending on the specific problems from birth/young age to adulthood.

In the combined treatments of patients with orofacial clefts, orthodontic treatment is consecutively needed[i]:

- immediately after birth in preparation of surgical lip closure,
- around 6-8 yrs for early cross bite correction or orthopedic maxillary protraction with reversed headgear in case of midfacial hypoplasia
- round 8-9 yrs of age as a preparation of bone transplantation,
- around 10-11 yrs as a preparation for tooth transplantation,
- as anchorage preparation,
- as 'regular' orthodontic treatment (around 12-16 yrs) or
- as preparation for orthognathic surgery for distraction osteogenesis.

So far, these specific indications of orthodontic treatment and needs are not very clear in the Belgian situation, nor does there exist adequate nomenclature to treat these patients orthodontically.

2.1.4 Objectives of the clinical part of the literature research

This chapter aims to give an overview of the available literature evidence, in order to give a scientific underpinning for the current orthodontic practice in Belgium. The following points will be considered, as well in the 'normal' population as in the specific population of patients with congenital craniofacial deviations, including mainly CLP patients:

- Indications and contra-indications of orthodontic treatment
- Risks of orthodontic treatment
- Instruments for assessing orthodontic treatment need and treatment complexity
- Orthodontic treatment timing
- Epidemiology and etiology of orthodontic problems
- Orthodontic treatment outcome in routine practice evaluated by orthodontic practitioners and patients
- Prevention versus interception of orthodontic problems
- Retention and stability

[i] http://www.uzleuven.be/schisisteam/

2.2 METHODOLOGICAL APPROACH TO THE CLINICAL PART OF THE LITERATURE STUDY

2.2.1 Locating studies

2.2.1.1 Guidelines and electronic databases

First, guidelines and systematic reviews were looked for on websites from international institutes using evidence-based medicine in their general approach. Two interesting publications were found: one guideline[j] (HAS) and one systematic review (SBU) [2]. Also the guideline of the American Academy of Pediatric Dentistry[k] was retained, but it should be noted that the literature review of this guideline is not conform the EBM criteria.

Next, meta-analyses, other (systematic) reviews or original studies were looked for by searching several databases. Starting from the research questions in 2.1.4, more detailed search questions (PICO's) were formulated as a basis to find appropriate search terms (for PICO's, see Appendix to Chapter 1)

2.2.1.2 Electronic searches

The following databases were searched:

- Ovid-Medline ®
- Embase
- Cochrane database of Systematic Reviews
- Tripdatabase

OVID SEARCH ENGINE FOR MEDLINE :

In Ovid following searches were performed (1950 – 27 october 2007):

Orthodontics, orthodontic$ and exp orthodontics, needs assessment, health services needs and demand, health services accessibility, treatment need, IOTN, ICON, PAR, treatment outcome, quality of life, malocclusion, cleft lip or cleft palate or cleft face, eruption or ectopic, patient satisfaction, self esteem, attitude to health, patient compliance, health behaviour or health behaviour, patient participation, syndrome and abnormalities, multiple and congenital abnormalities, malocclusion Angle II, retention or retain$ or stabilise$ or stabilize$, orthodontics, interceptive, orthodontics, corrective, orthodontics, preventive, open bite, cross bite, tooth crowding

The articles were limited from 1987-2007 (In one search (see Appendix to chapter 2), due to a redundancy of articles, time limit was put from 1997 – 2007, because it was felt that this corresponded to the most recent evolutions in this field).

The articles were also limited according to the type of study, excluding studies of low quality like case-reports; the following search terms were used: epidemiological study, epidemiological study, epidemiological studies, epidemiological studies, randomized controlled trial, randomized controlled trials, controlled clinical trial, controlled clinical trials, review or review$, guideline or guideline$, systematic review or systematic reviews, meta-analysis.

Overall and after removal of the duplicates 4144 articles were found.

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j http://www.has-sante.fr/portail/display.jsp?id=c_6737&id=c_5443&catName=true&searchInFiles=true&text=orthodontie&portlet=c_39085&opSearch=OK&replaceFileDoc=true

k http://www.aapd.org/

EMBASE SEARCH

The search in Embase was performed on the 24th of September, 8th of October and 22nd of October 2007. Following search terms were used in analogy with the search in Medline, but using the Emtree tools: Orthodontics, needs assessment, health services needs and demand, IOTN, ICON, PAR, treatment outcome, treatment need, quality of life, malocclusion, jaw malformation, cleft lip or cleft palate or cleft face, tooth disease, patient satisfaction, self esteem, attitude to health, patient compliance, health behaviour, patient participation, patient outcome, outcome assessment, health care delivery, malocclusion, syndrome, newborn disease, multiple malformation syndrome, abnormality multiple, tooth disease, ankylosis, open bite, cross bite, tooth crowding, tooth malformation, jaw malformation, maxilla hypoplasia or pathology, mandible prognathia or prognatism, mandible hypoplasia. An overall of 4312 articles were found.

COCHRANE DATABASE

The search in the Cochrane library was performed on the 21th october 2007. Following Mesh terms and free terms were used to perform the search: Orthodontics, needs assessment, IOTN, ICON, PAR, quality of life, self esteem, attitude to health health behaviour, patient participation, patient satisfaction, tooth ankylosis, tooth eruption ectopic, tooth impacted, tooth injuries, tooth loss, tooth resorption, tooth unerupted, diastema, malocclusion Angle Class I, Angle Class II, Angle Class III,

Cross bite, tooth crowding, tooth abnormalities, mandible, maxilla, dental arch, prognatism, retrognatism, retention, jaw abnormalities, cleft lip and cleft face, syndrome, abnormalities (congenital), abnormalities multiple. A total of 112 articles were initially found. As a result 33 articles were retrieved for further assessment. After discarding the duplicates still 24 articles needed to be assessed.

TRIP DATABASE

In the TRIP Database, being a small database, only a search with the term orthodontics was performed on 2007 October 22nd. As a result a total of 81 references were found: Evidence based synopsis: 5, Clinical questions: 17, Systematic reviews: 40, Guidelines: 19. Of these after discarding duplicate references, 10 citations were retrieved for further study.

Taken all databases together, a total of 8490 articles were found and needed to be assessed. After a first elimination (reference-sifting, see Appendix Chapter 2) on title and abstract according to the in- and exclusion criteria (see 2.2.1.2), and after removal of duplicates between the different searches, still 603 articles were retrieved for further study.

More studies were identified by hand searching, based on screening of the reference lists of the retrieved articles.

2.2.1.3 *In- and exclusion criteria*

Following inclusion criteria were used throughout the evaluation of title-abstract (literature sifting):

Terms:	Orthodontic, treatment need, indications orthodontic treatment, syndromes, perception: patient and clinician (orthodontic practitioner), expectation patient, social desirability, subjective treatment need, quality of life
Population:	Newborn, Baby, Child, Adolescent, developed Western countries
Language:	Nederlands, Français, English, Deutsch
Design:	Epidemiological studies, RCTs, Reviews, Guidelines, Meta-analyses
Following exclusion criteria were used :	Population: Age > 15 years, non-Western countries (e.g. Tanzania, Nigeria…)
Language	all except those in criteria for inclusion
Design:	case reports, pilot studies, animal studies, editorials, comments, articles published in abstract from or conference proceedings.
Topic:	articles only dealing with technical aspect of the treatment (e.g. comparison of two types of adhesives); orthodontics as minor treatment in case of surgical procedures.

2.2.1.4 *Selecting studies*

For the review of the literature epidemiological studies, randomized controlled trials, controlled clinical trials, reviews, systematic reviews, guidelines or meta-analysis were assessed. If studies with high levels of evidence were not found, consideration was also made to include study designs with lower levels of evidence to reflect the best level of evidence available on this subject.

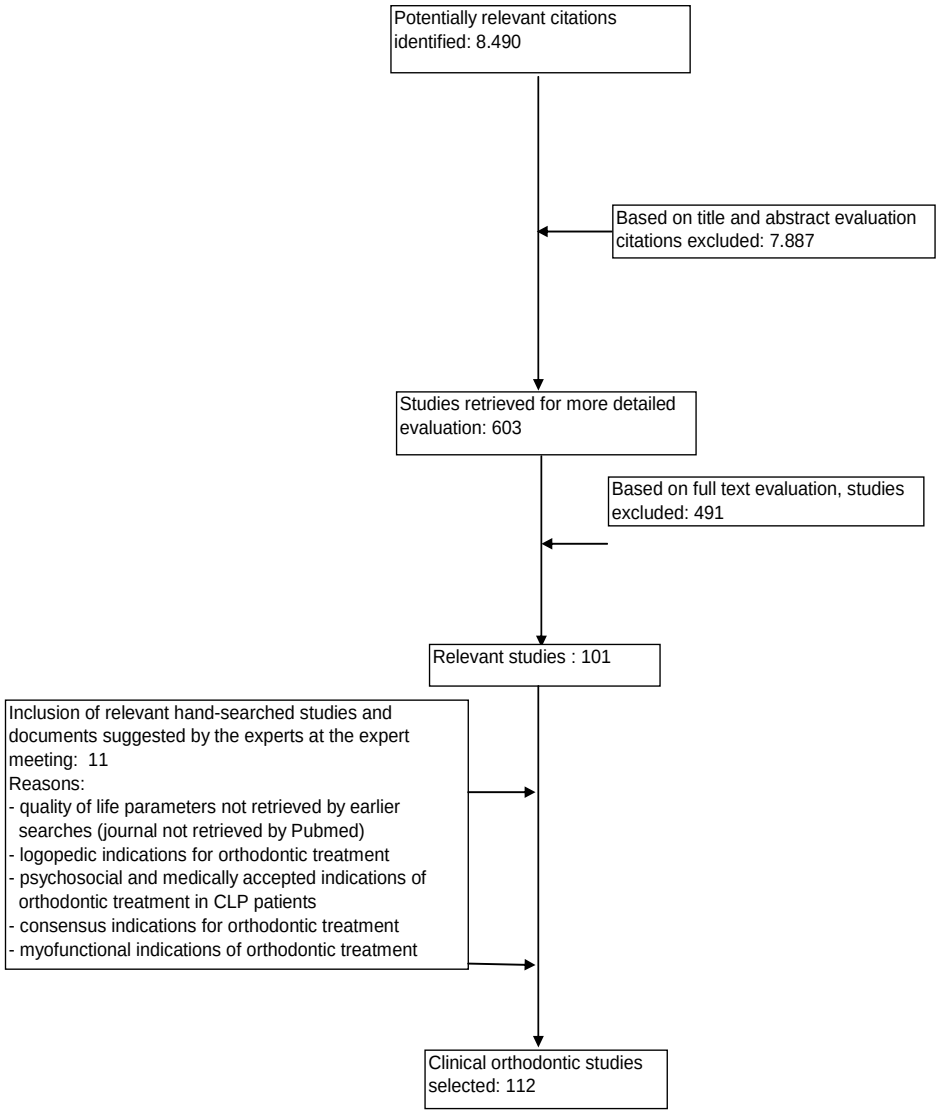
Exclusion criteria were used as mentioned above.

Overall and after discarding duplicate references, 603 citations were retrieved for further study. They were read in full and critically appraised as described below.

2.2.1.5 *In- and exclusion*

Additional to the HAS-guideline and the SBU-study (see 2.2.1.1), the search of the electronic databases yielded the following numbers of publications:

Figure 1: Flowchart of included and excluded studies



2.2.2 Critical appraisal of the evidence

The methodological quality of clinical evidence was assessed according to the system proposed by Guyatt et al., 2006 [3] This system considers the level of evidence (as well as the grade of recommendation), and is further explicated in Table 2.

The quality of evidence can be:

- High:

further research is very unlikely to change our confidence in the estimate of effect

- Moderate:

further research is likely to have an important impact on our confidence in the estimate of the effect

- Low:

further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; or any estimate of effect is very uncertain.

This system assessing the quality of the evidence was not applied to individual studies, but to the body of evidence relating to a specific pathology or research question. In this report, the production of grades of recommendations was considered to be beyond the scope of the study.

Table 2: Levels of evidence and grade recommendations (*Source: Guyatt et al. (2006)* [3])

Grade of Recommendation/ Description	Benefit vs Risk and Burdens	Methodological Quality of Supporting Evidence	Implications
1A/Strong recommendation, high-quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	RCTs without important limitations or overwhelming evidence from observational studies	Strong recommendation, can apply to most patients in most circumstances without reservation
1B/Strong recommendation, moderate quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	RCTs with important limitations (inconsistent results, methodological flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies	Strong recommendation, can apply to most patients in most circumstances without reservation
1C/Strong recommendation, low-quality or very low-quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	Observational studies or case series	Strong recommendation but may change when higher quality evidence becomes available
2A/Weak recommendation, high-quality evidence	Benefits closely balanced with risks and burden	RCTs without important limitations or overwhelming evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patients' or societal values
2B/Weak recommendation, moderate-quality evidence	Benefits closely balanced with risks and burden	RCTs with important limitations (inconsistent results, methodological flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patients' or societal values
2C/Weak recommendation, low quality or very low-quality evidence	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk, and burden may be closely balanced	Observational studies or case series	Very weak recommendations: other alternatives may be equally reasonable

2.2.3 Data extraction, tables of evidence and level of evidence

First the studies retrieved for more detailed evaluation were assessed according to the Cochrane checklists, where possible. An excel file was completed for every article and again where possible the level of evidence was added. One example of the exhaustive procedure is added in the Appendix of Chapter 2.

2.3 RESULTS OF THE CLINICAL PART OF THE LITERATURE STUDY

2.3.1 Indications and contra-indications of orthodontic treatment

When orthodontic provision is seen as a part of the health service, it is important to critically analyse the benefits of changing malocclusions towards the norm of "ideal" occlusion. If, for instance, untreated malocclusions lead to adverse effects or induce medical complications, it is obvious that orthodontic treatment should aim at preventing these complications. In the literature several indications are given to start an orthodontic treatment.

The question is, which of these indications are based on pure medical-biological reasons (e.g. cleft palate, prevention of trauma,…), and which of them are based on other reasons, like psychosocial wellbeing. According to the Constitution of the WHO published in 1946[l], 'health' should be defined as "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

So, from a bio-psycho-social point of view, psycho-social aspects also contribute to health, but it is up to society to judge to which extent such indications for treatment should be financed by the government; more specifically by the national health care insurance.

Nowadays, an indication for an orthodontic treatment is often based on purely morphological considerations.

The treatment priority indices, that are used today, are mainly based on morphological descriptions. However, as will be shown below, more evidence on the severity of malocclusion and the consequences of not treating malocclusions is still needed [4]. Consequences of malocclusion with regard to psychosocial, physical or functional well-being have seldom been seriously taken into consideration. Recent years have seen the transcendence of a psycho-social justification for orthodontic treatment -the enhancement of psycho-social well-being through improvements in appearance, thus 'self-concept' [m]-, and research has suggested that orthodontic treatment may have significant benefits in improving the 'Oral Health Impact' on life-quality. Orthodontic treatment ought to be motivated by the benefits the treatment is supposed to produce for the patient [4], the morphological alteration being merely the tool to reach the goal.

The supposed benefits yielded by orthodontic treatment should always be weighted against the risk of iatrogenic damage, inconvenience to the patient,…

2.3.1.1 Adverse effects of untreated malocclusions

CLEFT LIP AND PALATE

Orofacial clefts have a severe impact on facial aesthetics, on orofacial function and on psycho-social development and well being of the affected individual[5, 6]

Effects of the cleft on the facial appearance and dentition become apparent in different stages of life: the primary effects are apparent immediately after birth, secondary effects in the teenage years, and tertiary effects, after the completion of growth, in adulthood. According to consensus clinical expert opinion (and as it is ethically not justifiable to not treat these patients), orthodontic treatment is an important aspect of the multidisciplinary treatment planning of cleft lip and/of palate patients[7] and has a high impact not only on their malocclusion, but also on Oral Health Quality of Life parameters [8].

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l World Health Organization. Constitution. Geneva: WHO, 1946

m Shaw W.C and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227- 237; Chapter 9f in Community Oral Health, Ed: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co, Ltd, London, Berlin, Chicago et al.

PERIODONTAL PROBLEMS

Some malocclusion features such as crowding with displacement of the contact-points of the teeth and large overjet and some habits such as mouth breathing have been related to gingivitis. However the strength of these associations is only weak to moderate[4]. It should be noted that search description nor appraisal criteria of this review were given. Probably there is a significant association between these features and gingivitis, when the oral hygiene is fairly average to poor, as was revealed in a study of Ainamo (1972)[4], [n]

The systematic review of the Swedish Council on Technology Assessment in Health Care[2] found insufficient evidence to conclude on the relationship of untreated malocclusions and periodontal problems.

Because the lack of good evidence, the need for further randomized controlled trials is urgent in this field.

MALOCCLUSION AND CARIES

Sometimes it is claimed that persons with certain types of malocclusion, e.g. crowding, are more prone to caries because of more difficulties with brushing and oral hygiene as a whole. In these cases, it is assumed that orthodontics can help to prevent caries.

However, the systematic review of the Swedish Council on Technology Assessment in Health Care [2] found evidence, but only of low quality, for the statement that malocclusion is not associated with a higher frequency of caries.

MALOCCLUSION AND SPEECH PROBLEMS

The relation between major speech disturbances and malocclusion can rarely be observed. Consequently a speech disturbance is seldom an indication for the onset of an orthodontic treatment. Children with a speech deviation should preferably be referred to a phonetician or speech therapist [4]

In a review Johnson et al (1999) stated that although it is accepted that teeth play an important role in speech production, the relationship between tooth position and speech remains controversial. There was found no definitive proof that alteration of tooth position can improve articulation disorders and this while certain dental irregularities show a relationship with speech disorders, this does not appear to correlate with the severity of the malocclusion. The most consistently reported traits are Class III arch relationship, anterior open bite, increased overjet, and spacing. However, there is no clear evidence of a direct relationship between severity of malocclusion and severity of misarticulation (Johnson et al, 1999).

The systematic review of the Swedish Council on Technology Assessment in Health Care[2] found insufficient evidence to conclude on the relationship of untreated malocclusions and speech problems (only one good quality study).

MALOCCLUSION AND RISK ON TRAUMA OF THE FRONT TEETH

Some limited scientific evidence was found that in patients with a large overjet and an upper lip that does not protect the front teeth, the incidence of trauma to the anterior teeth of the maxilla is higher [2], [9].

More specifically Nguyen et al (1999)[10] found that children with an overjet larger than 3 mm were approximately twice as much at risk of injury to their anterior teeth as were children who had an overjet of less than 3 mm. Furthermore with increasing overjet the risk of injury increased. There was also a difference between girls and boys, namely that the effect of injury to anterior teeth is less for boys than for girls in the same overjet group. This meta-analysis is of good quality. However the conclusions should be considered with some caution because of the heterogenity in outcome of some of the selected studies, the sizes of the control groups which were even lacking in some of the

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[n] This is confirmed in the review of van Gastel J et al. (2007), which was published in 2007, Nov., after the database search of this report had been closed.

primary studies, and because it was not stated if studies in languages other than English were included [9].

MALOCCLUSION AND CHEWING

Factors like experienced poor biting or chewing ability may be important indications for treatment in some individuals. Some studies have indicated that chewing capacity is proportional to the tooth surface area.

Convincing evidence for the benefit of good occlusion in case of chewing problems is still not available[4].

MALOCCLUSION AND TEMPOROMANDIBULAR DISORDERS

In order to find scientific evidence for a correlation between specific untreated malocclusions and symptomatic temporomandibular joint disorders, the conclusion is that there is insufficient evidence[2]. In consequence an orthodontic treatment can not be justified as an effective manner to prevent TMD, but it may be indicated to reduce existing signs and symptoms of TMD in certain carefully selected cases[4].

ECTOPIC TOOTH ERUPTION AND IMPACTED TEETH: RISK OF ROOT RESORPTION

Low scientific evidence exists for the positive association between impacted maxillary canines, that are incorrectly positioned in the jaw before their eruption, and the risk of damage to the roots of the front teeth as they emerge (ectopic eruption) (Low scientific evidence)[2]. The greatest risk for resorption of incisor roots is produced by the mesial and palatal displacement of maxillary canines[4]. Root resorption as a consequence of orthodontic treatment was also found in the literature review of [11]Killiany DM of 1999 (the quality of the evidence was low).

PSYCHO-SOCIAL WELL-BEING

The relationship between physical appearance and the impact of an aesthetic deviation on self-esteem and body image are considered to be important issues in determining the benefits from orthodontic treatment.[12]

Generally it seems that a visible irregularity of teeth is the major reason for seeking orthodontic treatment [4]. Similarly, it is stated in the SBU study [2] that an advice to start orthodontic treatment in most cases is given by the general dental practitioner (low evidence) and that the appearance of the teeth is the patients' most important reason for seeking orthodontic treatment (low evidence) (see also section 2.3.2.1).

The importance of psycho-social factors in a health perspective has already been stressed in the definition of 'health' in the Constitution of the WHO (1946).

The major indication for orthodontic treatment, from the view of a patient and/or parent is a desire for aesthetic improvement and a belief that well aligned teeth may facilitate the contacts with other people and also will help finding a job in the future [4]. Malposition of the teeth is one of the most common reasons for teasing.

On the contrary, the SBU study in Sweden [2] reports that a relationship has not been found between moderate malocclusions and negative effects on self-esteem in 11-14 year olds (low quality evidence).

However, the same study also finds low evidence that adults with untreated malocclusions express more dissatisfaction with the appearance of their bite than adults without malocclusions (Low quality evidence).

This seems to be confirmed by Shaw W et al in 2007 [13]. This large 20 year prospective cohort study found that lack of orthodontic treatment where there was a prior need did not lead to psychological difficulties in later life. Participants with a prior need for orthodontic treatment as children who obtained treatment had better tooth alignment and satisfaction as an adult.

However, dental status in adulthood, whilst statistically significant, appeared to be of minor importance to overall self-esteem in a model that included other psychological variables (low quality evidence).

In addition Birkeland et al. found that [14]some patients with a great need for orthodontic treatment do not express orthodontic concern, whereas others with near ideal occlusion express concern. This seems in contrast with another conclusion of the same study, that there was also found an association between orthodontic concern and orthodontic treatment need assessed by IOTN. However this confirms that there is a difference in opinions between laypersons and orthodontic practitioners.

A possible explanation of some discrepancies between the perception of laypersons and the specialists' perception given by the author is that it is difficult for laypersons to register some malocclusion traits [14]

OBSTRUCTIVE SLEEP-APNEA SYNDROME

Although orthodontic treatment can be indicated in patients with Obstructive Sleep Apnea Syndrome (OSAS), the topic is not considered relevant in the present age group, as the most common treatment for OSAS in children is adenotonsillectomy and the use of orthodontic appliances for OSAS in children, e.g. with craniofacial malformations, is very rare.

WHAT ARE, IN THE OPINION OF DENTAL PRACTITIONERS AND ORTHODONTIC PRACTITIONERS, THE BENEFITS OF ORTHODONTIC TREATMENT?

As concluded from the literature review in the SBU-study [2], untreated deviations from a normal occlusion have been linked by dental health professionals to deterioration in oral health, oral function or both.

General dental practitioners and orthodontic practitioners rated psychosocial gain from orthodontic treatment higher than its dental health gain, however both groups still felt that orthodontic treatment reduces susceptibility to dental disease [15].

ADVERSE EFFECTS OF UNTREATED MALOCCLUSIONS

- **According to consensus clinical expert opinion, orthodontic treatment is an important aspect of the multidisciplinary treatment planning of cleft lip and/of palate patients.**
- **Low quality of evidence was found that malocclusion is not associated with increased prevalence of caries.**
- **Moderate quality of evidence was found on the correlation between a large overjet with incomplete lipseal and the risk on trauma of the upper front teeth.**
- **Low quality of evidence was found for the correlation between incorrectly positioned maxillary canines before their eruption and the risk on damage on the roots of adjacent teeth.**
- **There is conflicting evidence on the relationship between moderate malocclusions and negative self-esteem among children and teenagers of 11-14 years old (Low quality of evidence).**
- **Low quality of evidence was found on the fact that adults with untreated malocclusions express more dissatisfaction with their appearance of their bite than adults without malocclusions.**
- **However, dental status in adulthood, whilst statistically significant, appeared to be of minor importance to overall self-esteem in one study model that included other psychological variables (Low quality evidence).**
- **There is no concluding evidence on the relation between untreated malocclusion and periodontal problems, chewing or speech problems, and temporomandibular disorders.**

2.3.1.2 Evidence for treatment of several types of malocclusion

Orthodontic treatment is almost unique in the medical and dental fields because in most cases it is not directed towards the prevention or the cure of a pathological process but toward correction of (sometimes extremes of) normal biological variation.

Traditionally the aims of orthodontic treatment are to improve (oral) health and (dental and facial) aesthetics, thereby resulting in an improvement in an individual's bio-socio-psychological well-being.

Except for patients with orofacial clefts, other medically compromised patients, like patients with craniofacial syndromes, growth disturbances and oligodontia, orthodontic treatment most of the time is elective and often not urgent.

The evaluation of the need for orthodontic treatment is a delicate task. Occlusal indices can be used to assess the cases in which orthodontic treatment is indicated.

Probably because of the great variety in these indices, it appears that they often are not used in the studies that review indications and contra-indications of an orthodontic treatment.

Most orthodontic treatments aim to move the teeth into a more "normal" occlusion. Although very old, Angle's classification of Malocclusion is still widely used. Many reviews and studies found in this field use this classification to assess the malocclusions. Angle's classification is founded on the description of the sagittal relationship between maxillary and mandibular dental arches. Intra-arch deviations can occur additionally, i.e. on top of the sagittal malocclusion; or can be found as separate deviations within a sagittally normal set of teeth.

The following problems will be dealt with:

- Class I malocclusion
- Class II division1 malocclusion
- Class II division 2 malocclusion
- Class III malocclusion
- Anterior open bite
- Posterior crossbite
- Tooth crowding and extraction of deciduous teeth
- Disturbances in number(1): dental agenesis
- Disturbances in number(2): supernumerary teeth
- Disturbances in eruption(1): ectopic teeth eruption
- Disturbances in eruption(2): impacted canines
- Orthodontic anchorage for space closure
- Orofacial clefts and other medically compromised patients (craniofacial syndromes, growth disturbances, oligodontia…)

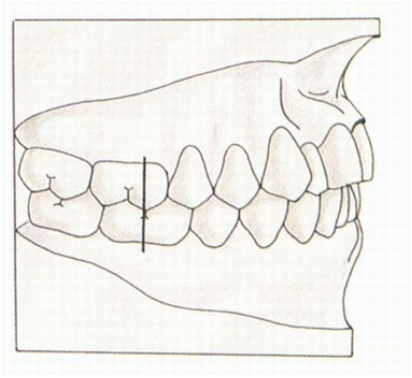
CLASS I MALOCCLUSION[o]

The malocclusion Classes according to Angle are illustrated in Figure 2, 3, 4 and 5 by means of drawings of dental casts with the teeth in occlusion.

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[o] http://www.mond-kaak-aangezichtschirurgie.be/Default.aspx?PageID=36&Culture=nl; accessed in January 2008

Figure 2: Class I malocclusion

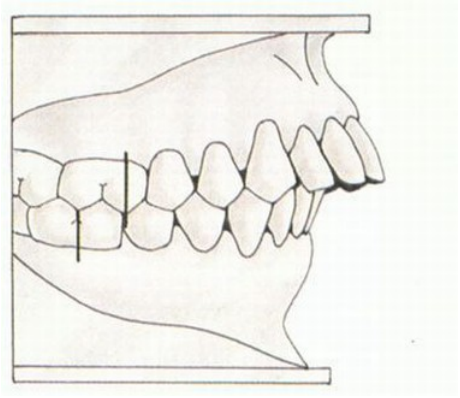


In a Class I malocclusion, a normal sagittal occlusion at the molars and the canines is present (Figure 2.). According to Angle's classification, Class I malocclusions can comprise all intra-arch deviations superimposed on the normal sagittal occlusion (crowding, impaction, spacing, ankylosis, rotations....). The treatment of Class I malocclusions is comprised in the different treatment types for these different features and will be discussed further. However, all intra-arch deviations can occur in the different types of Angle's malocclusion.

CLASS II DIVISION 1 MALOCCLUSION

In a Class II division 1 malocclusion, the lower molars and canines occlude too far distally relative to the upper molars: this type of occlusion is also called a disto-occlusion (Figure 3). Besides the deviation in the sagittal occlusion, all intra-arch deviations can also be superimposed on Cl II, div 1 malocclusions.

Figure 3: Class II division 1 malocclusion



For many decades already, Class II division 1 malformation is one of the most common features seen by orthodontic practitioners in North Western Europe. The upper front teeth may be in normal position or proclined in combination with a lower lip interposition, a retruded mandible and/or a prominent maxilla. The appearance of prominent upper front teeth is often a cause for teasing. An increased overjet, may increase the risk for trauma of the upper front teeth (see section 2.3.1.1).

A Cochrane review about the orthodontic treatment for prominent upper front teeth in children was published in 2007.

The evidence suggests that providing early orthodontic treatment (Phase I) for children with prominent upper front teeth is no more effective than providing one course of orthodontic treatment when the child is in early adolescence (Phase II).

Evidence from 3 trials found that when orthodontic treatment is provided for children with prominent upper front teeth, when they are aged 7 to 9 years old (early treatment, Phase I),

this results in clinically and statistically significant reduction in incisor prominence (-4.04 mm (95% CI -7.47 to -0.6) for functional appliance; -1.07 mm (95% CI -1.63 to -0.51) for headgear; no significant difference is found between the two treatment types. This treatment also resulted in some changes in the relationship of the upper and lower jaws. However, while these changes or differences were statistically significant they were unlikely to be clinically significant.

As these studies were of high/moderate quality, carried out in several different countries, using different functional appliances on children who were representative of the population, the resuls are generalisable.

When the final outcome of treatment (4 studies) was considered at the end of a second phase of treatment when the child was in early adolescence (Phase II), it was found that the treatment was effective, in that incisor prominence had been reduced. There were no differences in treatment outcome between the groups of children who had received one or two phases of treatment. As a result, it appears that two-phase treatment does not have any advantages over one phase treatment in early adolescence. Two studies measured the effect of treatment with functional appliance versus untreated controls. The analysis revealed that the treatment resulted in a significant reduction of overjet (-5.22 mm; 95% CI -6.51 to -3.93). Several investigators compared the effect of the Twin Block functional appliance against other similar appliances, for example, the Bionator and Herbst appliances, but no significant differences were found. The quality of the trials in this review was fair with 50% being considered at low risk of bias, the remainder at moderate risk. This was mainly due to the lack of blinding of the outcome assessors. [16].

Cozza et al [17] found in their systematic review of the literature 4 RCT's as well as 18 prospective and retrospective controlled clinical trials of Class II treatment and with a control group of untreated subjects that 2/3 of the samples in the 22 studies reported a clinically significant supplementary elongation in total mandibular length as a result of overall active treatment with functional appliances. The amount of supplementary mandibular growth appears to be significantly larger if the functional treatment is performed at the pubertal peak in skeletal maturation. None of the 4 RCT's [17] reported a clinically significant change in mandibular length induced by functional appliances (moderate quality).[P]

The quality of evidence for clinically significant effect after treatment of prominent upper front teeth in Class II division 1, can be considered moderate.

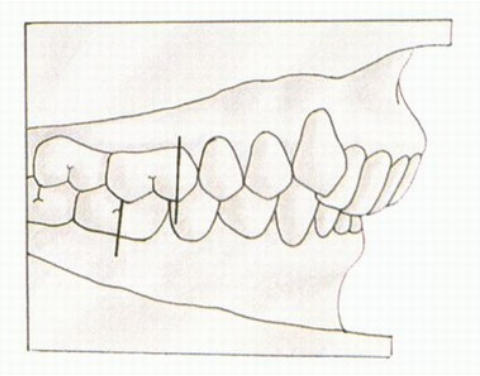
Early treatment of this malocclusion is no more effective than providing one course of orthodontic treatment when the child is in early adolescence. The quality of evidence for this statement is moderate.

CLASS II, 2 MALOCCLUSION

Despite a similar occlusal pattern in the buccal segments (molars and canines also show a distal occlusion as in Cl II division 1 malocclusions), the upper front teeth are retroclined in case of Cl II division 2 malocclusion (Figure 4). Besides the deviation in the sagittal occlusion, all intra-arch deviations can also be superimposed on Cl II, div 2 malocclusions.

P Much debate is going on in the literature on the long term effects of functional appliances, especially on bone growth. The "Council on Scientific Affairs" or COSA published a meta-analysis on this subject in the "Reader's Forum" of the Am J Orthod Dentofacial Orthop 2005; 128:271-272. It reviewed 5 publications and concluded that there is no evidence that functional appliances significantly increase horizontal growth of the mandibula when evaluated in the long term.

Figure 4: Class II division 2 malocclusion



A Cochrane review about the orthodontic treatment for deep bite and retroclined upper front teeth in children, the so called Class II,2 malocclusion according to Angle's classification, was published in 2006.

In patients with a Class II, 2 malocclusion often due to the deep bite a palatal or lower labial gingival trauma is detected[18];furthermore there exists an aesthetic impairment. It seems to be likely that a greater percentage of upper permanent canines are impacted in patients with a Class II, 2 malocclusion.

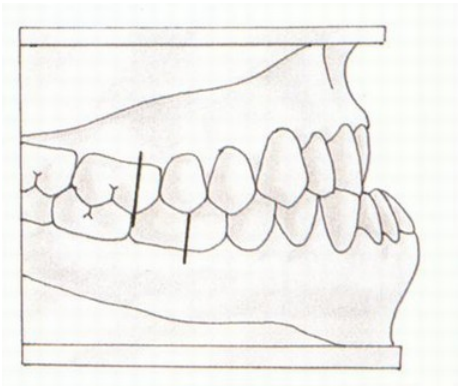
Different treatments may be used to correct this malocclusion. It is not possible to provide any evidence-based guidance to clinicians with respect to a Class II, 2 malocclusion due to the fact that no randomised controlled trial or controlled clinical trial was identified. [18] Although no clinical evidence was found on this topic, it is clear that from a dental health point of view gingival trauma should be avoided.

No randomized or controlled clinical trials were found concerning the treatment of Class II,2 treatment and no recommendation can be made.

CLASS III MALOCCLUSION

In a Class III malocclusion, the lower molars and canines occlude too far mesially relative to the upper molars: this type of occlusion is also called a mesio-occlusion (Figure 5). Besides the deviation in the sagittal occlusion, all intra-arch deviations can also be superimposed on Cl III malocclusions.

Figure 5: Class III malocclusion



Only a protocol for a Cochrane systematic review exists. Therefore the treatment of Class III malocclusions is discussed by means of other original articles.

In a meta-analysis Kim et al. [19] evaluated the effectiveness of maxillary protaction with orthopaedic appliances for the treatment of Class III patients. The conclusion drawn from this meta-analysis was that protraction face mask therapy is effective in growing patients, but to a lesser degree in patients older than 10 years, and that protraction combined with an initial period of expansion might provide more significant skeletal effects.

However the results of this meta-analysis should be regarded with caution, because there was a lack of standardization of the design of various studies and the necessity to use all studies that met the inclusion criteria[19]. Jager et al. [20] came to a similar conclusion in their meta-analysis on the treatment effects of maxillary protraction on the craniofacial growth of patients with Angle Class III malocclusions. Maxillary protraction could modify the skeletal and dental components of the face, thus it seems that protraction treatment is effective in growing patients but to a lesser degree in patients older than 10 yrs and that protraction combined with an initial period of expansion might provide more significant skeletal effects. The weakness of this study was the limited literature search in only one database (MEDLINE), the fact that a specially designed test for Meta Analysis was performed adds strength to this study.

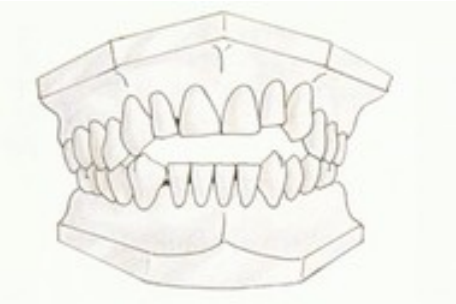
Although moderate quality of evidence exists for treatment of class III malocclusions before the age of 10 years, early treatment of Class III malocclusions in cases with an increased lower face height and minimal overbites is generally not successful[19],[20].

The level of evidence for the effectiveness (especially before the age of 10 years) of protraction face mask therapy in Class III malocclusions is moderate.

ANTERIOR OPEN BITE

In patients with an anterior open bite no vertical overlap or contact between the maxillary and mandibular incisors is present (Figure 6). This vertical malocclusion can not only be superimposed with any type of sagittal malocclusion (Cl II,1 Cl II,2, Cl III), but also with all types of intra-arch deviations.

Figure 6: Anterior open bite malocclusion



A Cochrane review on the orthodontic and orthopaedic treatment for anterior open bite in children has been published in 2005[21]

The causes of open bites are considered multifactorial. It can be due to a combination of skeletal, dental and soft tissue effects.

The prevalence of an open bite ranges from 17 to 18% of the children in the mixed dentition. When associated with sucking habits the prevalence increases to 36.3% [21]

Low evidence was found that a Frankel's function regulator-4 (FR-4) with lip seal training, or a removable appliance with palatal crib associated with high-pull chincup, are able to correct open bite in children. Given that the two included trials have a potential bias, these results must be viewed with caution.

Therefore it should be concluded that there is no clear evidence on which to make a clinical decision of the type of intervention to use in correcting an anterior open bite in children. [21]

In a systematic review on early treatment of skeletal open-bite malocclusion Cozza et al [22], the quality level of the studies was not sufficient enough to draw any evidence-based conclusions. Most of the studies had serious problems of lack of power because of small sample size, bias and confounding variables, lack of method error analysis, blinding in measurements, and deficient or lack of statistical methods. This was in agreement with the Cochrane Review of 2005.

The evidence for treatment of anterior open bite is insufficient and no recommendation can yet be made.

POSTERIOR CROSSBITE

Posterior crossbite is defined as any abnormal bucco-lingual relation between opposing molars and/or premolars in centric relation. A difference should be made between an unforced and a forced posterior crossbite. The latter represents a unilateral posterior crossbite as a result of a functional displacement of the mandible.

Figure 7: Posterior crossbite



Posterior crossbites may develop or improve at any time from when the baby teeth come into the mouth to when the adult teeth come through. Most treatments have been used at each stage of dental development [23]. Posterior crossbites in the primary dentition are relatively common and their causes are numerous. The etiology of a posterior crossbite can include any combination in dental, skeletal and neuromuscular functional components [24]. A posterior crossbite associated with a functional shift of the mandible towards the crossbite side (forced crossbite) occurs in 80 to 97 % of the posterior crossbite cases [24] The frequency of self-correction is 0% to 9%.

A forced crossbite is generally considered to be one of the few malocclusions which should be considered for correction in the primary dentition.

In 2001 a Cochrane review on the orthodontic treatment for posterior crossbites has been published.[23] The evidence (only from two trials) suggests that removal of premature contacts in the deciduous teeth is effective (in 28/71 treated cases; versus 12/66 untreated cases) in preventing a posterior crossbite from being perpetuated to the mixed and adult dentitions. When grinding alone is not effective, using an upper expansion plate to expand the upper dental arch will decrease the risk of a posterior crossbite from being perpetuated to the mixed and adult dentition. [23]. Because of the small amount of studies, the evidence is only low.

In a more recent meta-analysis of immediate changes with rapid maxillary expansion (RME) Lagravere concluded that the greatest change from rapid maxillary expansion are dental and skeletal transverse changes and these changes are clinically relevant [25]. In another systematic review it is also concluded that the long-term stability of transverse skeletal maxillary increase is better in skeletally more mature individuals (pubertal and postpubertal growth peak) than in skeletally less mature (prepubertal growth peak) individuals. Long term transverse skeletal maxillary increase was found to be approximatively 25 % of the total appliance adjustment (dental expansion) in prepubertal children [26].

Another systematic review by the same author on the long term dental arch changes after RPE concluded that a clinically significant long-term maxillary molar arch width increase (3.7 - 4.8mm) and a more consistent maxillary cuspid arch width increase (2.2 – 2.5 mm) can be achieved and this to a similar degree in adolescents and adults. Less mandibular molar and cuspid arch width expansion was attained in adults compared to adolescents. A significant overall gain was found in the maxillary (6mm) and mandibular (4.5mm) arch perimeter in adolescents treated with RPE and edgewise fixed appliances [27]The results of this systematic review are based on 3 studies that all had some methodological flaws; hence the conclusions should be viewed with caution.

No strong conclusions on dental or skeletal changes that occurred after slow maxillary expansion treatment, also due to methodological flaws.

Another systematic review on the early orthodontic treatment of unilateral posterior crossbite was performed by Petren et al[28] and found 12 studies meeting inclusion criteria of which only 2 RCT's (which were also included in the 2001 Cochrane review). They found that the treatment strategies Quad-Helix (QH), expansion plates and RME are effective in the early mixed dentition at a high success rate, but they concluded that due to many methodological weaknesses in the studies, there is no scientific evidence available to show which of the treatment modalities grinding, QH, expansion plates or rapid maxillary expansion is the most effective[28]. Further randomised clinical trials should be performed on the management of crossbites and a difference should be made between an unforced and a forced posterior crossbite.

There is evidence for the effectiveness of treatment of posterior crossbite in deciduous teeth; the quality is low.

There is evidence for the long-term skeletal effectiveness of rapid maxillary expansion; the quality is low.

TOOTH CROWDING AND EXTRACTION OF DECIDUOUS TEETH

A protocol for a Cochrane review on the subject of the orthodontic treatment for crowded teeth in children was published in 2007.

Crowded teeth develop when there is a lack of space in the jaws for the teeth to erupt in a proper well-aligned manner. Crowded teeth are a common feature for which a patient is seen by an orthodontic practitioner.

Throughout the whole orthodontic literature crowding of teeth has been accepted as one of the major (psychosocial, aesthetic) indications for orthodontic treatment by lay people[q] as well as professionals[r].

Little evidence on how to deal with this problem seems to be available yet. One RCT was found on extraction of deciduous canines for crowding in the mixed dentition [29].

According to the results, the amount of lower incisor crowding was reduced to a greater extent in the extraction group, suggesting that the molars had migrated forward. However, as there is only 1 chance in 20 that the amount of crowding will improve in the permanent dentition when extractions of deciduous canines are performed, the benefits of extracting lower deciduous canines for the "relief" of lower incisor crowding are questionable [29]

DISTURBANCES IN NUMBER(1): DENTAL AGENESIS

In the permanent dentition, mandibular secondary premolars are affected most frequently, followed by maxillary lateral incisors and maxillary second premolars[s]. Bilateral agenesis of maxillary lateral incisors is more frequent than unilateral agenesis.

No studies other than case series were found, so no evidence is available on this subject.

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q Original IOTN: aesthetic index for lay people (however not validated)

r Indications de l'Orthopédie Dento-faciale et Dentomaxillofaciale chez l'enfant et l'adolescent (2002) et Recommendations pour la pratique clinique. Les critères d'aboutissement du traîtement d'Orthopédie dento-faciale (2003). Publication par l' Agence Nationale d'Accréditation et d'Evaluation en Santé (ANAES), Service des recommandations professionelles, 159 rue Nationale 75640 Paris-Cedex 13 - Tel 01 42 16 72 72 - Fax 01 42 16 73 73

s Clinical guideline on management of the developing dentition and occlusion in pediatric dentistry. American Academy of Pediatric Dentistry - Professional Association. 2001 (revised 2005). 18 pages. NGC:004439

DISTURBANCES IN NUMBER(2): SUPERNUMERARY TEETH

No references on this topic were retrieved within the preset inclusion criteria.

DISTURBANCES IN ERUPTION(1): ECTOPIC TEETH ERUPTION

Although every tooth can be placed ectopically, due to its eruption path and/ or a lack of space in the dental arch, only one relevant study was found on ectopic maxillary first molars [30]

Impacted canines (incorrectly positioned in the jaw before their eruption) are known to increase the risk of root resorption of neighbouring teeth as they erupt ectopically (see section 2.3.1.1). In this observational study of good quality, it was shown that forced eruption with orthodontics largely decreases this risk (90/92 cases). For 46 children, treatment of the ectopically erupted tooth with a cervical headgear (46 cases) was studied prospectively. After an average treatment of 9 months, the first permanent molars were uprighted to good occlusion and in about 70% of the children sufficient space for the second premolars could be obtained. In the long-term follow-up, 10 years after treatment, the effects of the eruption disturbance had been corrected and all negative side effects of the treatment were eliminated[30] (low quality of scientific evidence).

These results remain to be confirmed by other studies.

DISTURBANCES IN ERUPTION(2): IMPACTED CANINES

Impacted permanent canines can be treated by extraction of the primary canine and creation of excess of space, or by surgical exposure followed by orthodontic treatment.

Most studies concerning the outcome of these procedures, are of low quality (retrospective cohort or case-control studies). The age at the time of recognition and referral seems to be the most important factor for the final outcome, and the position of the canine can be a compromising factor as well [31]. Nevertheless, the esthetic outcome of both these treatments are satisfying to the majority of patients [32], [33]. The results also seem to be clinically acceptable: there is no long-term difference between impacted teeth and control teeth regarding shape, colour or position, and the periodontal conditions and the occlusal function are similar [34],[32],[35]. Only for lateral movements of the mandible, significant differences in contact pattern were found between sides with normally erupted canines and sides with impacted canines [32]. Duration of treatment is dependent on the distance of the impacted crown to the occlusal plane, and bilateral impaction requires on average 6 months more to treat than unilateral impaction[36].

Relapse by vertical displacement (intrusion) was more frequent after surgical exposure and orthodontic treatment than after extraction of the deciduous canine and creation of excess of space[33]. Further investigation is necessary[34].

Impacted canines can be treated by extraction of the residual deciduous tooth and space retaining, or by orthodontic treatment after surgical exposure. Both treatment modalities are probably satisfying, but more evidence is needed. Time of referral is an important factor in outcome.

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Both treatment modalities are probably satisfying, but more evidence is needed. Time of referral is an important factor in outcome.

ORTHODONTIC ANCHORAGE

An attempt was made in one systematic review[37] to examine, in an evidence-based way, what kind of orthodontic anchorage is the most effective. Because of contradictory results and the vast heterogeneity in study methods, the scientific evidence was too weak to evaluate anchorage efficiently during space closure. Further RCT's are needed to determine which anchorage system is the most effective.

Also a Cochrane review on this item [38] found only one study on the reinforcement of anchorage during orthodontic brace treatment with implants or other surgical methods. A limited level of evidence was found that mid-palatal implants are an acceptable alternative to headgear reinforced anchorage in orthodontic patients. However, at the present there are insufficient research data on which to base the clinical practice [38].

OROFACIAL CLEFTS AND OTHER MEDICALLY COMPROMISED PATIENTS

The benefits of orthodontic treatment in CLP patients and other medically compromised patients (craniofacial syndromes, growth disturbances, oligodontia…) are generally accepted by professionals and lay persons. They should be followed up and treated when necessary, from birth throughout childhood and teenage years, and even after the completion of growth, in adulthood.

EVIDENCE FOR ORTHODONTIC TREATMENT OF SEVERAL TYPES OF MALOCCLUSION

- **The benefits of orthodontic treatment in CLP patients and other medically compromised patients are generally accepted.**
- **The level of evidence for clinically significant effect after treatment of prominent upper front teeth in Class II division 1, can be considered moderate.**
- **Early treatment of this malocclusion is no more effective than providing one course of orthodontic treatment when the child is in early adolescence. The level of evidence for this statement is moderate.**
- **No randomized or controlled clinical trials were found concerning the treatment of Class II,2 treatment and no recommendation can be made. It is clear that, from a dental health point of view, gingival trauma should be avoided.**
- **The level of evidence for the effectiveness (especially before the age of 10 years) of protraction face mask therapy in Class III malocclusions is moderate.**
- **The evidence for treatment of anterior open bite is insufficient and no recommendation can yet be made.**
- **There is evidence for the effectiveness of treatment of posterior crossbite in deciduous teeth by grinding; the quality is low. There is also low quality evidence for the long-term skeletal effectiveness of rapid maxillary expansion.**
- **Forced eruption with orthodontics decreases this risk of root resorption in case of incorrectly positioned impacted canines (low quality of evidence).**
- **Crowding of teeth has been generally accepted as one of the major indications for orthodontic treatment, but evidence on how to deal with this problem is scarce.**
- **The benefits of extracting lower deciduous canines for the "relief" of lower incisor crowding are questionable, but this remains to be confirmed.**
- **More studies are needed on the outcome of (different) orthodontic treatment options for ectopic eruption of teeth as well as for missing teeth.**
- **More evidence is still needed on treatment by means of orthodontic anchorage.**

2.3.1.3 Predictors of an orthodontic treatment uptake and equity

In several studies an attempt was made to find predictors for which children would start an orthodontic treatment.

It could be presumed that there could be a socio-economic factor in whether or not children were uptaken for an orthodontic treatment[39, 40].

It was found that child's age, dentist-population ratio and child's normative need as measured by IOTN are predictors of the use of orthodontic services and conversely, socio-dental consumer based measures did not have an influence [39].

Some evidence was found that adolescents, who visited their dentist regularly are more likely to receive orthodontic treatment [41], [42], [43], [44].

No significant relationship between the influence of socioeconomic status and uptake for orthodontic treatment was found in some studies [45], [42] but this is in contrast with the findings of other studies. An influence of socio-economic factors on orthodontic treatment provision and unmet orthodontic treatment need was seen in another study[46] and in correspondence with these findings is the finding that normative orthodontic treatment need (IOTN) is greater in deprived socio-economic groups and the desire for orthodontic treatment need is greater in deprived socio-economic groups[47].

For example in Northern Ireland, where orthodontics for children is provided free by the State, not all children who need orthodontic treatment receive it. Those adolescents with good dental health and who regularly visited a dentist and whose mother had regularly dental appointments were more (to 8.7 times more) likely to receive orthodontic treatment [45], [42].

Neither was there a significant relationship between local availability of orthodontic practitioners and the level of untreated malocclusion.

Nor was anxiety about dental treatment a significant barrier for orthodontic treatment. Breistein et al concluded that no inequity was found in orthodontic care in Northern Ireland [45]

In a dental care system, where children visit their dentist regularly, awareness of the parents of orthodontic problems agrees fairly well with the orthodontic assessment of an orthodontic treatment need. However both over- and unconcerned parents need to be informed carefully after the professional assessment of the malocclusion and the treatment need of their child [43].

A relation is shown of the dental health need of a patient and the gender of the patient related to the uptake for an orthodontic treatment socio-economic status and ethnicity influence a child's desire for orthodontic treatment, self-assessed need, and judgements of aesthetics. A clinician should be able to detect such differences can improve patient cooperation with treatment [48].

Minority groups and infrequent dental attenders may experience disparities in unmet orthodontic treatment need[42]. Most patients who were accepted for an orthodontic treatment had a definite treatment need [49].

These conflicting results are the conclusion from only a few studies. Also for this item more well-designed studies should be undertaken.

- **A low evidence was found that patients who visited their dentist regularily are more likely to receive orthodontic treatment .**
- **There is no concluding evidence on the correlation between socioeconomic factor and uptake for orthodontic treatment.**

2.3.2 Risks of orthodontic treatment

As with most medical interventions orthodontic treatment is not without significant risks. During an orthodontic treatment undesirable side-effects may occur such as caries and periodontitis (related with a poor oral hygiene), root resorption and hypersensitive reactions on appliances.

WHITE SPOTS, CARIES AND PERIODONTITIS

White spots, caries and periodontitis can be seen as a risk of an orthodontic treatment, however in most cases these side effects are rare. As mentioned above there is a possible link with a poor or average oral hygiene [4].

In the same context it was mentioned that stainless steel wires that were attached to the back of the anterior teeth of the mandible by etching (retainer) would give a risk to caries, however this was not found in a 5 year perspective. (Low scientific evidence) [2]

A Cochrane review has been published on the effect of fluorides for the prevention of white spots on teeth during fixed brace treatment.

It was stated that the major cause of the white spots is a poor or average oral hygiene, were dental plaque remains on the tooth surface around the brace attachments. Fluoride plays an important role in the prevention of dental decay. In this review some evidence was found that regular rinsing with a fluoride mouthwash is effective for reducing the severity of white spots in people undergoing orthodontic treatment. But the evidence was low. However, based on research carried out in a non orthodontic population, it was recommended that daily rinsing with 0.05% sodium fluoride mouthwash is done during an orthodontic treatment with braces and this until high quality trials are conducted. [50].

REDUCTION OF THE BONE LEVEL BETWEEN THE TEETH

Furthermore moderate evidence was found that an orthodontic treatment can cause a reduction of the bone level between the teeth but the scope of this reduction, however is so small that it lacks clinical relevance.

Orthodontic treatment can cause a reduction of the bone level between the teeth; the scope of this reduction, however is so small that it lacks clinical relevance (Moderate quality of evidence)[2]

Another side effect may be that by resolving the crowding and aligning the teeth, black triangles occur [4]

PAIN

Tooth movement can cause pain and soreness during different phases of the treatment. Pain can also occur in the initial phase of an orthodontic treatment with fixed appliances, as well as when separators or new arch wires are placed. For these risks moderate evidence could be found [2].

NICKEL SENSITIVITY

The literature review has not shown that an orthodontic treatment with fixed appliances, containing nickel would lead to an increase in the incidence of nickel sensitivity (Moderate evidence)

ROOT RESORPTION

One of the most common complications of an orthodontic treatment is root resorption. Root resorption is a condition characterized by a partial loss of root cementum and dentin. The consequence can be an apical root shortening. Low evidence exists on the fact that root resorptions up to one-third of the length of the root occur in 11-28 percent of the patients who have undergone orthodontic treatment [2]. Factors that are associated with the onset of a clinically significant root resorption are the duration of treatment; the magnitude of force applied, the direction of tooth movement (more with intrusive forces), the method of force application (continuous versus intermittent), the orthodontic movement [51]. However there are also patient related risk factors like an individual susceptibility, systemic factors, root or dental anomalies and alveolar bone density, endodontic treatment and previous trauma and severity and type of malocclusion.

Recently, meta–analyses indicated that orthodontically induced inflammatory root resorption (OIIR) is correlated to the extent of tooth displacement.

The conclusion made in this study was that the magnitude of force during teeth movement should be controlled, the orthodontic movement should have a minimal duration and be intermittent. Periodical radiographs of the patient should be taken during the treatment in order to detect root injuries at an early stage, so that there can be a re-evaluation of both treatment goals and treatment plan [51]

Information on the long-term consequences of root resorption due to orthodontic treatment is lacking [2]. Teeth with incomplete root development are resorbed to a lesser degree than fully developed teeth. But in both cases only limited levels of evidence were found.

It is often assumed that open bite cases possess significantly greater degrees of resorption, but no evidence for this statement is found yet. Scientific evidence is insufficient for conclusions on what effect a suspension of treatment has on root resorptions during ongoing orthodontic treatment.

TEMPOROMANDIBULAR JOINT DISORDERS

In the SBU-study[2], side effects such as temporomandibular joint disorders have not been demonstrated in connection with orthodontic treatment (low evidence).

Kim et al [52]also studied the the relationship between TMD's in patients and orthodontic treatment. The data included in this meta-analysis, and evaluated by CRD-reviewers, do not indicate that traditional orthodontic treatment increases the prevalence of TMD. It is apparent that a reliable and valid diagnostic classification system for TMD is needed for future research. A definitive statement concerning the relationships between orthodontic treatment and TMD's could not be made[9]. However, according to the CRD-review, the quality of this meta-analysis is low mainly because of a limited search strategy, as well as selection and appraisal strategy; and because of these methodological weaknesses it is concluded that no conclusions can be drawn from this review.

NON-ACHIEVEMENT OF THE ORTHODONTIC TREATMENT GOAL

Another risk is the non-(complete) achievement of the pre-set orthodontic treatment goals; this is often due to non-compliance of the patient. In this respect, the most important feature is the lack of sufficient oral hygiene. There seem to be no good predictors for non-compliance.

RISKS: CONCLUSION

There is evidence for the following risks:

- **A reduction of the bone level between the teeth caused by orthodontic treatment; the scope of this reduction, however, is so small that it lacks clinical relevance in most patients (Moderate scientific evidence).**
- **Root resorptions up to one-third of the length of the root occur in 11-28 percent of the patients who have undergone orthodontic treatment (Low scientific evidence). Information on long-term consequences of this is lacking.**

There is evidence that the following risks do not occur:

- **Stainless steel wires attached to the back of the anterior teeth of the mandible by etching (retainer) have not been found to give rise to caries in a 5-year perspective (Low scientific evidence)**
- **Orthodontic treatment with fixed appliances that contain nickel have not been found to increase the incidence of nickel sensitivity (Low scientific evidence).**
- **Side effects such as temporomandibular joint disorders (TMD) have not been demonstrated in connection with orthodontic treatment (Low scientific evidence)**
- **Some low quality scientific evidence was found on the fact that the major cause of the white spots is a poor or average oral hygiene, were dental plaque remains on the tooth surface around the brace attachments.**
- **Some evidence was found that regular rinsing with a fluoride mouthwash is effective for reducing the severity of white spots in people undergoing orthodontic treatment. (Low scientific evidence)**

There is no conclusive evidence on the following risk:

- **What effect a suspension of treatment has on root resorptions during ongoing orthodontic treatment**

2.3.3 Instruments for assessing orthodontic treatment need and treatment complexity

Although little evidence is found for the validity of orthodontic indices, their usefulness of in audit, research, decision making, and in assessing orthodontic treatment need is well accepted internationally.

Because of the great variation in approach on this subject, it appeared to be quite impossible to undertake an extensive and comprehensive review. Therefore an attempt was made to review the literature starting from the gain of importance of orthodontic indices during the last decades.

HISTORY

In the 60's a great number of indices have been developed to asses the need for orthodontic treatment, such as: Summers' Occlusal index, Grainger's Treatment priority index (TPI) and Salzmann's Handicapping Malocclusion Index (HMAR). However none of these indices have been widely accepted for screening patients to determine treatment need[5353].

A breakthrough was established in 1989, when Brook and Shaw developed the Index of Orthodontic Treatment Need (IOTN)[t] in the UK.

This index categorizes patients in five categories; from "no need" for orthodontic treatment to "definite need" for orthodontic treatment. In 1990 the "Need for Orthodontic Treatment Index" (NOTI) was introduced in Norway (Espeland LV et al.,1992). The purpose of its development was the differentiation in reimbursement for orthodontic treatments by the National Health Insurance system (NHS). In this index the different dentofacial and morphological characteristics are categorized in 4 groups, according to the need of treatment (low or no treatment need to very high treatment need). A similar index is used by the "Swedish Medical board".

Around the same period other indices were proposed in different countries: for example the Dental Aesthetic Index (DAI) which was developed at the University of Iowa and which is valid to use in populations other than white north Americans (Hispanics and Black Americans)[1], the Danish Ministry of Health (DMH) screening system.

The Peer Assessment Ratio (PAR) was primarily developed as a treatment outcome index, but is sometimes used as a treatment need index. In Germany the so called KIG–index (Kieferorthopädische Indikationsgruppen = Orthodontic Indication Groups) is used since the 1 January 2000 [54].

Most indices of treatment need are health based; i.e. the underlying assumptions are that malocclusion and its features are associated with ill health in later life. Some indexes are based on aesthetic impairment because the assumed psychosocial consequences of malocclusion are the most significant sequelae. A few indices, like the IOTN, combine the presumed dental health components of malocclusion with the aesthetic components [55], [1]. The IOTN and the NOTI have a cut-off point between an acceptable occlusion and a malocclusion needing treatment [21].

Later in the 90's the Index of Complexity, Outcome and Need (ICON) was developed. [56], [1], [57]. This index appears to be a reasonable means of assessing the standard of orthodontic treatment in terms of complexity, need and outcome rather than using various indices. Use of the ICON will encourage international comparison and professional standardization [58].

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[t] One of the shortcomings for the IOTN is that it can not be used in young patients f.e. in the mixed dentition.

EVALUATION IN THE LITERATURE OF THE DIFFERENT INDICES

In the systematic review of the SBU (The Swedish Council on Technology Assessment in Health Care) in 2005 [2] no scientific evidence was found to conclude on the validity (that is, if a tool measures what it is intended to measure) of morphological priority indices (indices based on deviations in the bite and the dental arch from an established norm) and an insufficient evidence was found for the conclusions concerning the validity of aesthetic indices from a sociodental perspective.

Notwithstanding this, many studies have been published that focus on evaluation and comparison of different treatment indices.

In some studies, opinions of orthodontic practitioners and lay people were compared for specific indices (e.g. Hunt et al[59], Johanson et al [57]).

The results of evaluation studies on the Index of Complexity, Outcome, and Need (ICON) supported the use of the ICON as index of orthodontic treatment need [60]. A comparison between the ICON, on one side and the PAR and IOTN, on the other side, revealed that ICON does reflect the UK opinion and this study provides some evidence that ICON may effectively replace IOTN and PAR as means of determining need and outcome [61].

Another study that compared the same three indices found that ICON is the most critical index [62], but up to now it has not been used in many countries already (see Chapter 3). Another study claimed that the IOTN, among others (HLD (Handicapping Labio-Lingual Index) and HMAR (Handicapping Malocclusion Assessment Record)) provided valuable information for determining orthodontic treatment need. In a comparison between PAR and Summers' Occlusal Index (SOI) it was concluded that PAR index was found to be as reliable as Summers' Occlusal Index [63].

Another study showed that the DAI was simple in use. However, this index showed some limitations, such as an under-estimation of the treatment need in malocclusions with displaced canines, a deep overbite, unsatisfactory aesthetics of anterior teeth due to incisor rotations and an over-estimation of the treatment need in cases with an increased overjet in otherwise well aligned arches [64].

The DAI index has the unique aspect that it is linking people's perceptions of aesthetics with anatomic trait measurements [65].

The same study found the DMH a somewhat complex and subjective index to score. The DHC of the IOTN was found to be over-sensitive in cases with increased overjet and contact point displacements greater than 2 mm. The AC of the IOTN under-estimated treatment need in cases with excessive overjet and buccally displaced canines, and over-estimated treatment need in cases with spaced arches and deep overbite[64].

Despite obvious shortcomings treatment need indices are commonly used in several countries. In the United States public health planners in fifteen states have developed several occlusal indexes, using arbitrary cut-off scores, as the basis for eligibility for public funds for orthodontic treatment [66]. In Germany the KIG index is used for this purpose. In the UK, NHS reimbursement is based on the IOTN, and Norway also uses the IOTN.

It should be noted that HAS[u], the French National Authority for Health, nor the American Academy of Pediatric Dentistry in their recommendations[v] on orthodontic treatment, give the advice to use a certain index.

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[u] Indications de l'orthopedie dento-faciale et dento-maxillo-faciale chez l'enfant et l'adolescent. Juin 2002. Agence Nationale d'Accréditation et d'Évaluation en Santé (ANAES; nowadays HAS)

[v] Clinical guideline on management of the developing dentition and occlusion in pediatric dentistry. American Academy of Pediatric Dentistry - Professional Association. 2001 (revised 2005). 18 pages. NGC:004439

The arguments of HAS are that no index measures all aspects of treatment needs, that the reproducibility from one professional to another of some indices (e.g. the PAR) is not sufficient; and that even when using an index, the treatment need varies largely from one country to another.

PATIENT'S PERCEPTION OF TREATMENT NEED

Assessing orthodontic treatment need is a complex issue. Whether a patient should undergo an orthodontic treatment is not only the decision of the orthodontic practitioner, who should give advice about an as objective as possible need for orthodontic treatment, but is also the decision of the patient/parents. This implies also a subjective component, namely patients' and parents' perception for orthodontic treatment need.

Subjects with a definite need for orthodontic treatment perceived their dentitions less attractive than subjects with no or borderline need; on the other hand there are subjects expressing an orthodontic treatment need in cases where this is not confirmed by the orthodontic practitioner and vice versa [14]. Also, there is conflicting evidence on the relationship between malocclusions and negative self-esteem among children and teenagers of 11-14 years of age; and dental appearance is only a limited factor in global self-esteem among adults (see section 2.3.1.1). These findings reinforce the importance of correctly assessing each patient's perception of their malocclusion prior to the start of an orthodontic treatment [67], and on the other hand to inform patients correctly about the evolution their treatment desire can make during life [68].

CONCLUSION

The wide variety of indices makes it outmost difficult to compare them and to have a uniform assessment of orthodontic treatment need. The conclusion should be that a large international cohort study and further randomised controlled trials are required to establish the most usable, correct and worldwide acceptable index and to validate it.

Following classifications can be made for orthodontic indices:

- Diagnostic index: e.g. Angle's classification
- Epidemiological indices: e.g. Summers' Occlusal Index
- Treatment need (priority) indices, e.g.:
  - Handicapping Labio-Lingual Deviation Index
  - Grainger's Treatment Priority Index
  - Salzmans' Handicapping Malocclusion Assessment
  - OTN or ICON index
- Treatment outcome indices: PAR, DAI, ICON
- Treatment complexity index: ICON
- Morphological priority indices (based on deviations in the bite and the dental arch from an established norm): e.g. DHC of IOTN

INSTRUMENTS FOR ASSESSING ORTHODONTIC TREATMENT NEED AND TREATMENT COMPLEXITY

- **Several classifications can be made for orthodontic indices: diagnostic indices, epidemiological indices, treatment need (priority) indices, treatment outcome indices, treatment complexity indices (only one index exists), morphological priority indices.**
- **Scientific evidence is lacking for conclusions concerning the validity (that is, if a tool measures what it is intended to measure) of morphological (part of) indices**
- **Scientific evidence is also insufficient for conclusions concerning the validity of the aesthetic (part of) indices**
- **Amongst the indices, the IOTN, PAR and ICON can be recommended. The IOTN combines both health and aesthetic factors, is relatively easy to score, but is restricted to measuring the treatment need only.**
- **The PAR is apt to measure outcome and can complement the IOTN.**
- **The ICON measures not only treatment need, but also the complexity of the treatment and the treatment outcome. However, this latter index takes more effort to score than the IOTN. As an index can only be successfully implemented when the scoring can be checked, it may be recommended to limit the aesthetic factors in the index as these are most difficult to check afterwards.**

2.3.4 Orthodontic treatment timing

The "ideal" timing for the start of an orthodontic treatment remains one of the most difficult decisions an orthodontic practitioner has to make. Although most of the time the developmental stage of the dentition is focussed, psychological issues may also play a role.

For expert-based and generally accepted guidelines on orthodontic evaluation at different stages of the developing dentition, the reader is referred to the guidelines of the American Academy of Pediatric Dentistry, as well as to the publication of DiBiase and Sandler [69]. In the following, the different aspects of treatment timing as found in the literature review (see section 2.3.1.2), will be discussed.

CROSSBITES

As already pointed out, it is suggested by low quality evidence (see section 2.3.1.2) that removal of premature contacts in the deciduous teeth is effective in preventing a posterior crossbite from being perpetuated to the mixed and adult dentitions [23].

Although there is no clear evidence available on the possible adverse effects of untreated posterior crossbites, in ideal conditions children should be screened for orthodontic treatment during the first transitional phase of the teeth, when the posterior occlusion has been established by the eruption of the first permanent molar. This advice is endorsed by the American Academy of Pediatric Dentistry[w], who advises a screening before the age of six years. Orthodontic screening at this early stage allows good planning for ideal correction of a malocclusion. Correction of many orthodontic problems is preferably performed in the permanent dentition[70]. No evidence exists on how to implement this screening practically.

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[w] Clinical guideline on management of the developing dentition and occlusion in pediatric dentistry. American Academy of Pediatric Dentistry - Professional Association. 2001 (revised 2005). 18 pages. NGC:004439

CLASS II, 1 MALOCCLUSION AND LARGE OVERJET

A two phase treatment divided in an early orthodontic treatment (Phase I), followed by a later phase of treatment (Phase II) when the child is in early adolescence, - a so called two phase treatment -does not appear to have any advantages over treatment that is provide in one phase when the child is in early adolescence. (moderate evidence)[16].

However, an overjet of at least 3 mm, as often present in class II, 1, predisposes for tooth trauma (moderate evidence) (see section 2.3.1.2). As such, prevention of trauma can be an indication to perform an early orthodontic treatment around the age of 9 years and is indeed accepted by the American Academy of Pediatric Dentistry for this indication.

However, the possible trauma – preventive effect of early overjet correction has to be verified by randomised controlled studies in children in the early mixed dentition [4].

Although literature evidence on psychosocial effects of malocclusions in children up to the age of 14 years is inconclusive (see section 2.3.1.2), teasing can also be a psychosocial indication for early treatment and is accepted for this indication by the American Academy of Pediatric Dentistry.

CLASS III MALOCCLUSIONS

The correction of an anterior crossbites in the mixed dentition may prevent the loss of periodontal attachment of the lower incisors. This is only possible in Class I and mild skeletal Class III relationships.

Although moderate quality of evidence exits for treatment of class III malformations before the age of 10 years (see section 2.3.1.2), early treatment of Class III malocclusions in cases with an increased lower face height and minimal overbites is generally not successful [19;20].

CLP AND OTHER MEDICALLY COMPROMISED PATIENTS

There is general agreement on the fact that orthodontic treatment for CLP or other medically compromised patients often still occurs after the age of 15 years and even during adulthood.

ORTHODONTIC TREATMENT TIMING

- **According to a general consensus among experts, screening for orthodontic problems during the first transitional phase of teeth would be ideal. No evidence exists on how to implement this practically.**
- **For Class II, 1 malocclusions a moderate level of evidence exists that a one phase treatment is preferable concerning the efficiency, and the morphological outcome. However, trauma prevention and psycho-social benefit of the patients in case of teasing could be exceptions to this rule.**
- **Further, treatment should be recommended at an early age for forced posterior cross-bites, and for treatment of a Class III malocclusion with a protraction face mask.**
- **There is general agreement that orthodontic treatment for CLP or other medically compromised patients often still occurs after the age of 15 years and even during adulthood.**

2.3.5 Epidemiology and etiology of orthodontic problems

2.3.5.1 Epidemiology of orthodontic problems

Since no large epidemiological survey has been detected over the last 20 years, appropriate epidemiological data are hard to find.

Some studies, which try to give epidemiological data about the different orthodontic features, were found.

However it is very difficult to compare these date, because all studies used different terminologies or indexes to asses the prevalence, such as the different Angle Classes of malocclusion and the IOTN index. Because of this reason, only an enumeration of the different studies is given. An overview of prevalence of common occlusal anomalies, as mentioned by Shaw and Turbill in 2007 in "Public Health aspects of oral diseases", has already been given in section 2.1.2. In the next paragraph, the references retrieved through the literature search will be discussed. Results are generally in line with the prevalences given by Shaw and Turbill.

Only one study was found for Belgium [71], with an attempt to asses the prevalence of orthodontic malocclusion, but due to a selection bias in the sample, utmost caution has to be given to the results.

The sample consisted of patients referred to the orthodontic department of the University Hospital Leuven (a tertiary referral hospital) for eventual orthodontic treatment. In this study, with 40% males and 60% females, no statistically significant difference between both sexes was found.

When the prevalence of the different Angle classes of malocclusion was assessed, following results were found: Angle Class I: 31%; Angle Class II,1: 52%; Angle Class II,2:11%; Angle Class III: 6%. The results of this study showed that in this biased orthodontic sample 63 % of the patients showed a high need for orthodontic treatment (IOTN grades 4-5).

Prevalence of some malocclusions in the Netherlands for 11 year old children were a deep bite in 34%, a mandibular overjet 1%, crowding in upper front region in 23%, crowding in lower front region in 26 %, Class II malocclusion in 36% , Class III malocclusion in 3% and finally problems in transversal occlusion in 13% of the children [72]. Boer reported that 48% of mandibular arches and 34% of the maxillary arches were crowded in another study of Dutch children [73].

In Germany according to the KIG the treatment need at the age of 9-11: KIG 1,2 (= self paid treatment) in 58.6 % of the cases; KIG 3 in 10.6% , KIG 4 in 29.4 % and KIG 5 in 1.4 % of the cases (KIG 3.4,5 = insurance -paid treatment) [54].

Table 3: Epidemiological data from Germany (KIG)

Germany	KIG 1-2	KIG 3	KIG 4	KIG 5
Chestnutt (2006)[54]	58.6%	10.6%	29.4%	1.4%

In a study in the UK in 1988-89, Holmes stated that 32% had great or very great orthodontic treatment need (grades 4 or 5 of IOTN), 33.2% had moderate orthodontic treatment need (grade 3), and 34.8% had no or little treatment need [74]. Some years later, in another study, performed in the UK (2003), it was found that at the age of 12, the overall treatment need was 43% (35% had an orthodontic treatment need and 8% was wearing an appliance), and at the age of 15, still 21% had an unmet treatment need and 14% was wearing an appliance. This suggests that the overall treatment need is about 50% [46]. The incidence of Class II, 2 is reported to be about 10% in the UK population [18]. In the UK nearly half of the 12 year old children are affected by crowding [74]

In a study in France 21% of the children presented an objective need for orthodontic treatment (IOTN, Dental Health Component).

The malocclusion status of French school children was lower than that recorded in epidemiological studies of European children. No significant differences between males and females were found. [75].

In Sweden the frequency of Class II malocclusion was 48%. Mean frequencies for anterior and posterior cross bites were 11.6 % and 16.6 % respectively. Frequency of hypodontia was 5.5 %. A high frequency of need for orthodontic treatment still exists with 39.5 % with IOTN grades 4 and 5 [76]. Another study in Sweden found 77% Class I, 23% Class II and only 1 child Class III, 13 % large overjet > /= 6 mm

(of these children 71% incompetent lip closure), 19 % overjet>/= 4.5mm(of these 52 % incompetent lip closure), 27% deep bite >/= 5mm, open bite only in 3 children [77].

Table 4: Epidemiological data on Angle Class I, II and III

	Angle Class	I	II	III
Belgium[x]	Willems et al (2001)[71]	31%	63% (of which 52% II,1 and 11% II,2)	6%
Netherlands	Kalsbeek et al (2002)[72]	61%	36%	3%
Sweden	Joseffson et al (2007)[76]		48%	
Sweden	Mohlin et al (2002)[77]	77%	23%	0%

Table 5: Epidemiological data on deep bite, overjet and transversal occlusion

		deep bite	Reversed overjet	transversal	Overjet >6mm	Overjet >4.5
Netherlands	Kalsbeek et al (2002)[72]	34%	1%	13%		
UK	Holmes (1992)[74]					
Sweden	Mohlin et al (2002)[77]	27%			13.0%	19.0%

Table 6: Epidemiologic data on crossbites and hypodontia

		anterior crossbite	post.crossbite	hypodontia
Sweden	Joseffson et al (2007)[76]	11.6%	16.6%	5.5%

In the United Kingdom approximately one third of the 11-12 year olds are in need for orthodontic treatment [78]. In a large study, Hoffding and Kisling reported that 79.9 % of the children examined in two Danish municipalities had at least one sign of malocclusion [73]

The NHANES III study (US) revealed that only 35 % of adults have well-aligned mandibular incisors. In 15 % the irregularity is severe enough that both social acceptability and function could be affected. About 20% of the population have deviations from the ideal bite relationship. The IOTN treatment need index revealed a need for treatment in 57-59% of the population to some degree [79].

Table 7: Epidemiological data on IOTN

	IOTN 1-2	IOTN 3	IOTN 4-5
Belgium, Willems et al (2001)[71y]			63%
UK, Holmes (1992)[74]	34.8%	33.2%	32.0%
Sweden, Joseffson et al (2007)[76]			39.5%

x tertiary referral hospital

y tertiary referral hospital

Table 8: Epidemiological data from US (Proffit)

Percent of U.S. Population Estimated to Need Orthodontics, 1965-1970 vs 1989-1994										
	White				Black				Hispanic**	
	Child		Youth		Child		Youth		Child	Youth
Age	6-11	8-11	12-17		6-11	8-11	12-17		8-11	12-17
Year	1965-70	1989-91	1965-70	1989-91	1965-70	1989-91	1965-70	1989-91	1989-91	1989-91
Index	TPI	IOTN	TPI	IOTN	TPI	IOTN	TPI	IOTN	IOTN	IOTN
No treatment need (TPI 0-1, IOTN 1)	28.7	36.6	20.0	48.7	39.7	48.0	24.3	53.9	59.7	55.0
Minimal need (TPI 2-3, IOTN 2)	33.9	22.1	25.1	21.9	28.4	11.5	27.3	13.7	16.8	5.1
Moderate need (TPI 4-6, IOTN 3)	23.7	41.3	25.7	28.9	15.0	40.3	21.0	31.3	23.5	39.9
Definite need (TPI >6, IOTN 4-5)	13.7	10.2	29.2	13.5	16.9	13.1	27.4	21.5	3.8	11.9
Had orthodontic treatment	2.5*	10.5	10.7*	27.4		3.6		6.2	1.4	11.7

Data from NHANES I and III; *White/black combined; ** No data for 1965-1970. Source: Proffit W. R. with Henry W. Fields, Jr . The Orthodontic Problem. Malocclusion and Dentofacial Deformity in Contemporary Society, pp 28 in Contemporary Orthodontics, 2000; Eds Proffit, with Henry W. Fields, Jr Mosby , St Louis, Philadelphia, etc

The prevalence of ***cross-bites*** in the primary dentition of Caucasian children varies from 9-23%.

In Germany 8.3% lateral and 7.9 % anterior cross bites were detected respectively. Among the patients with a lateral cross bite, the less favourable unilateral form was recorded 4 times more often than the bilateral form [80]. Incidence of posterior crossbite ranges from 7% to 23 % of the population [24].

In the US the NHANES III study found posterior crossbite in about one third of the population [79].

Lateral crossbites in mixed dentition, as well as increased overjet and frontal openbite in primary and early mixed dentitions appear significantly more frequent in children with orofacial dysfunctions (Grabowski 2007, Part III).

Stahl [81] found also in a study on the occlusal relationships and ***myofunctional disorders*** that the frequency of myofunctional disorders is statistically significantly higher in children with increased maxillary overjet, frontal open bite, lateral crossbite and mandibular prognatism. Moreover a statistically significant increase is seen in the prevalence of orofacial dysfunctions (such as habitual open mouth which expresses hypotonia in the perioral muscles and such as a visceral swallowing pattern…) from primary to mixed dentitions.

Polder et al (2004)[z] found that the prevalence of ***dental agenesis*** for both sexes was higher in Europe (males 4.6 % and females 6.3%) and Australia (males 5.5% and females 7.6 %) than in North American Whites (males 3.2% and females 4.6%)

In addition the prevalence of dental agenesis in females is 1.37 times higher than in males for all 3 continents. Mandibular secondary premolars were affected most frequently, followed by maxillary lateral incisors and maxillary second premolars.

Bilateral agenesis of maxillary lateral incisors was more frequent than unilateral agenesis and the opposite was found for maxillary and mandibulary second premolars and maxillary first premolars. For severe oligodontia (missing more than 6 permanent teeth with exclusion of the molars), the international literature reports average incidence rates of 0.00085% to 0.001%[82].

Table 9: Epidemiological data on dental agenesis

DENTAL AGENESIS		
	Males	**Females**
Europe	4.6%	6.3%
Australia	5.5%	7.6%
N. American whites	3.2%	4.6%

The prevalence of ***impaction of maxillary canines*** is about 2% of the population. [83] The risk of palatal canine displacement was significantly higher in patients with hypoplasia, peg shape or congenital aplasia of upper lateral incisors, further impacted and congenitally missing teeth and cover-bite [84],[85].

Patients with a transverse discrepancy are more likely to have an impacted canine than are patients without a transverse discrepancy; however they do not have a greater likelihood of having bilateral impactions [86]

The prevalence of ***ectopic eruption of the maxillary first permanent molar*** was found to be 4.3% for the population and 21.8% for cleft children. In sibs the prevalence of two children with ectopic eruption was 19.8%, indicating a genetic background. The main etiological factors were the greater mesial angulation and the greater width of the ectopically erupted first permanent molar.

In conclusion, it should be clear that the paragraph above is merely an enumeration of prevalence numbers found in different studies and it is very difficult to compare them.

As in most items in this literature review, far the only conclusion that can be made is that there is the need for a large prospective survey of children and adolescents in order to assess the prevalence of orthodontic malocclusions.

CLEFT LIP AND PALATE

Orofacial clefts occur in around 1 in 500 live Caucasian births, more frequently in oriental people, and less in black people. However the reliability of ascertainment is variable and is surrounded by many methodological concerns[aa].

The overall incidence rate of cleft lip and palate in Europe ranges from 1.30 to 1.94 per thousand of births. For Belgium (with +/-111 000 births a year) this means about +/-130 newborns with CLP every year (including livebirths, stillbirths, abortions) [87].

The prevalence of malocclusions in CLP patients in their later development - from the emergence of the deciduous dentition to the permanent dentition and until adulthood when facial growth is finished - is almost 100%. Part of the components of the

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[z] Polder BJ, Van't Hof MA, Van der Linden FP, Kuijpers-Jagtman AM. A meta-analysis of the prevalence of dental agenesis of permanent teeth. Community Dent Oral Epidemiol. 2004 Jun;32(3):217-26

[aa] Shaw W.C. and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227-237 ; Chapter 9f in "Community Oral Health", Editors: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co Ltd, London et alias.

malocclusions in CLP patients are caused by intrinsic developmental deficiencies, other by functional distortions and other also by iatrogenic factors[88]. The need for orthodontic treatment is very high in CLP patients, always scoring 5 with the Index of Orthodontic Treatment Need.

EPIDEMIOLOGY OF ORTHODONTIC PROBLEMS

- **Class I malocclusions are common in Caucasian children (more than 30-77%).**
- **Class II malocclusions are common in Caucasian children (23-63%) of which the largest part is Class II, 1.**
- **Class III malocclusions seem to be relatively uncommon in Caucasian children (3-6%).**
- **Cross-bites are found in 9-23% of Caucasian children.**
- **Hypodontia is found in 5.5% of Caucasian children. In a ranking of agenetic teeth from the most frequently affected to the least frequently affected: mandibular secondary premolars, maxillary lateral incisors, maxillary second premolars. Bilateral agenesis of maxillary lateral incisors is more frequent than unilateral agenesis.**
- **The prevalence of impaction of maxillary canines is about 2%.**
- **The overall incidence of cleft lip and palate in Europe ranges between 1.30 and 1.94 in 1000 births.**
- **In Belgium +/-130 babies with an orofacial cleft are born every year.**

2.3.5.2 Etiology of orthodontic problems

Despite the fact that it is generally recognized that genetics play an important role in the etiology of malocclusions, the percentage contribution of genes and environmental factors in the etio(patho)genesis of malocclusion is still debated.

For certain dentofacial traits, a major genetic and heriditary component has been ascertained, like for mandibular prognathism. An autosomal dominant inheritance pattern has been demonstrated and genetic links to specific parts of chromosomes have been demonstrated recently. For other dentofacial deviations and pathological conditions, like certain syndromes (Apert's and CCD) and like oligodontia, single gene mutations have been found to be the cause of the deviating phenotype. E.g. for oligodontia so far causal mutations in three genes have been found (MSX1, PAX9, AXIN2) which are also transmitted to the next generation in an autosomal dominant way.

For most other dentofacial characteristics - including non-syndromal orofacial clefts - multifactorial inheritance patterns have been demonstrated, including multiple genetic factors, interacting with each other as well as with environmental factors as the composing the etiology of malocclusions[bb].

As far as the malocclusions in CLP patients are concerned, these are partially determined by intrinsic developmental deficiencies, others can be attributed to functional distortions and other also by iatrogenic factors[cc88].

Some twins and siblings studies have however revealed that the role of genetic factors in the etiology of malocclusions may not be as decisive as previously thought. These authors indicate that a major portion of the occlusal variation may be environmentally regulated, and owing that many malocclusions may be acquired rather than inherited.

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bb Mossey PA.The heritability of malocclusion: Part 1--Genetics, principles and terminology.Br J Orthod. 1999 Jun;26(2):103-13
Mossey PA. The heritability of malocclusion: part 2. The influence of genetics in malocclusion. Br J Orthod. 1999 Sep;26(3):195-203.

cc Shaw W.C. and Turbill E.A. (2007). Public Health Aspects of Oral Diseases and Disorders - Dentofacial Irregularities. pp 227-237 ; Chapter 9f in "Community Oral Health", Editors: Cynthia Pine and Rebecca Harris, Quintessence Books, Quintessence Publishing Co Ltd, London et alias.

Corruccini[dd] hypothesizes that the increasing prevalence of Cl II,1, crowding and open bites, is due to the decreasing food consistency in our modern soft diet. Reduced need for mastication on the food, reduces the activity of the masticatory muscles as well as the forces on the occlusion.

The genetic determination of the maxillary components has been found low compared to the genetic control of the mandible[83].

Arch length discrepancies (ALD) in the mixed and permanent dentition may be due to caries of deciduous teeth and the premature extraction of these teeth.

Etiological factors associated with unerupted premolars are arch length deficiency, mechanical blockage, ectopic positioning, malformed teeth, ankylosis of the premolar, over-retention of the deciduous molar or ankylosed deciduous molars, trauma and systemic diseases.

Concerning impaction of upper canines, genetic factors seem to contribute more than local environmental factors as was recently demonstrated in patients and their first and second degree relatives[89].

Non - nutritive sucking habits have an effect on the development of malocclusion in the primary dentition and if the sucking habits persists into mixed dentition on the further development of malocclusion. This is an important etiological factor in anterior open bites and posterior cross bites in the primary dentition.

The consequences of this habit on the occlusion is related to the intensity and duration of the habit[83]. Continuing sucking habits is almost always associated with an anterior open bite due to a reduction in vertical growth of the anterior parts of the alveolar processes[83].

Tongue-thrusting during swallowing is almost always associated with an anterior open bite [83].

Stahl found also in a study on the occlusal relationships and myofunctional disorders that the frequency of myofunctional disorders is statistically significantly higher in children with increased maxillary overjet, frontal open bite, lateral crossbite and mandibular prognatism. Moreover a statistically significant increase is seen in the prevalence of orofacial dysfunctions (such as habitual open mouth which expresses hypotonia in the perioral muscles and such as a visceral swallowing pattern…) from primary to mixed dentitions.

The evidence on the etiology of late crowding remains inconclusive, which is not altogether surprising in view of its multifactorial nature [90].

ETIOLOGY OF ORTHODONTIC PROBLEMS

- **Most malocclusions are caused multifactorially.**
- **Some dentofacial characteristics/features (like mandibular prognathism) were shown to be inherited in an autosomal dominant way.**
- **For a small number of dentofacial deviations and syndromes, causal genes have been demonstrated.**
- **There is still debate on the contribution of environmental factors (e.g. food consistency) in post-industrial populations, concerning the etiology and the increased prevalence of certain malocclusions.**
- **Non-nutritive sucking habits are important etiological factors in the development of anterior open bites and posterior cross-bites in the primary (and mixed?) dentition.**

[dd] Corrucini R. (1999). How anthropology informs the orthodontic diagnosis of malocclusion's causes. Mellen Studies in Anthropology, Volume 1; Editor: The Edwin Mellen Press, Lewiston . Queenston . Lampeter, UK

- **Tongue-thrusting during swallowing is almost always associated with an anterior open bite.**
- **The frequency of myofunctional disorders is statistically significantly higher in children with increased maxillary overjet, frontal open bite, lateral crossbite and mandibular prognathism.**

2.3.6 Orthodontic treatment outcome in routine practice evaluated by orthodontic practitioners and patients

Orthodontic practitioners in clinical practice can use an occlusal index for measuring the difference between pre- and post- treatment stages if they want to evaluate the treatment outcome of their patients. Although there is not enough scientific evidence available to conclude on the validity of this kind of indices (see section 2.3.3), their use for this indication is generally accepted in the literature. Two indices, the PAR and the ICON index, can be used to score orthodontic treatment outcome. Since the ICON index is a relatively new index, the available literature studies concerning routine orthodontic outcome, still mostly use the PAR index.

THE PEER ASSESSMENT RATIO (PAR): A TREATMENT OUTCOME INDEX

As mentioned above the Peer Assessment Ratio (PAR) is sometimes used as a treatment need index, but it is also internationally recognised and accepted as an index for treatment outcome. It is an easy and a relatively quick method for assessing treatment outcome and improvement in clinical practice[91], [92].

The PAR Index provides a single summary score for all the occlusal features (on dental casts) and may be used for all types of malocclusions, treatment modalities and extraction/non-extraction cases. The score provides an estimate of how far a case deviates from the presumed normal occlusion; and the differences in scores for pre- and post – treated cases reflects the perceived degree of improvement and therefore the success of treatment[93], [91]. The PAR index should be validated according the orthodontic standard of the country involved [93]. The components of the PAR Index (see Appendix to Chapter 2) have been weighted to reflect current British dental opinion more closely[92]. It can also be used in studies investigating the effectiveness of orthodontic treatment that are based in the US [94]. A disadvantage of the PAR index is that the treatment outcome for each malocclusion Class is heavily dependent on the number of greatly improved cases in the group. A new more sensitive method has been suggested which utilizes a combination of point and percentage reduction in PAR scores and a new weighting system in accordance with the clinical characteristics of each malocclusion[95].

Using this index it was revealed that at least 30% reduction was needed for a case to be judged improved and a change of score of 22 to bring about a change as "greatly improved" [91].

The advantage of occlusal indices as measures of outcome for orthodontic treatment resides in the standardized assessment of dento-occlusal aspects of orthodontic results. However, changes in facial profile, cephalometric parameters that reflect the skeletal component of malocclusion, root resorption, decalcification of enamel and the likely stability are not considered in this quantitative occlusal evaluation [91], [96].

TREATMENT OUTCOME MEASURED WITH THE PAR

Notwithstanding the shortcomings mentioned above, some studies in which the PAR has been used to measure outcome show interesting results.

It was shown that dual arch fixed appliances are more consistent in achieving lower finish PAR, independently from start PAR and with less influence from other variables. Number of arches treated (non dual arch fixed) was not significant in multivariate analysis[40].

A longer orthodontic treatment was associated with a marginally lower residual malocclusion.

In the same study social class of practice area small differences in finish PAR were shown but this appeared to be of little clinical significance[40],[97] (see also section 2.3.1.3).

Also in this study, the age of the patient and the stage of development had no significant effect on outcome. Given the results of other studies (see section 2.3.1.2) these findings might be questionable. In a study of Turbill[98] it was concluded that some cases as "greatly improved" or "improved" by PAR still had a residual malocclusion and/or residual need for treatment. PAR low weighting of buccal occlusion and residual buccal spaces is seen as a disadvantage[98].

Several studies on the outcome of orthodontic treatments have been performed to measure differences in outcome between different settings. Due to the heterogeneity of the samples and settings used in these studies, some caution must be taken into account in drawing conclusions from these studies. However some interesting results were shown: O'Brien et al. showed that the treatment outcome was influenced by the grade of the operator, the choice of treatment methods and by departmental attitudes and aspirations[99].

The outcome of orthodontic treatments at 17 hospital-based orthodontic departments showed a mean change in PAR score of 67.6%. In the same study 8% of the patients were allocated to worse or no different group[99]. The mean outcome of orthodontic treatments in a university clinic was 68.9 %, which is comparable with the previous outcome[93].

ORTHODONTIC TREATMENT, PATIENT SATISFACTION AND ORAL HEALTH RELATED QUALITY OF LIFE

Clinicians have one set of perceived goals to define success, but their definition of success may not necessarily be shared by the patient [96]. It is important not only to base a need for orthodontic treatment on normative measures but to have additional information derived from consumer based measures[100], [101]. There is emerging interest in orthodontics in consumer expectations and satisfaction, but the measurement technology is not well developed [96].

Satisfaction with dental appearance appears to be a significant predictor of orthodontic patients' expectations of an orthodontic treatment, in the way that the more a patient is dissatisfied with his/her dentofacial appearance the more improvement in appearance he/she expects from an orthodontic treatment[102].

Related to the concept of patients' satisfaction is the concept of "health related quality of life" (HRQL). In the last 10 – 20 years, HRQL evaluations have been seen increasingly in medical literature. In orthodontics there should be interest in oral health related quality of life (OHRQL). Oral health is a standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being (Department of Health, 1994). There is still little research in the field of orthodontics and OHRQL [103].

Cunningham stated that a comprehensive understanding of the effect of orthodontics on OHRQL is essential and orthodontic practitioners must be able to show that benefits are derived from treatment[ee]. However, O'Brien et al. (1998) stated that orthodontic treatment is different compared to most other medical treatments in that it aims to correct a variation from an arbitrary norm. The fact that an orthodontic treatment is usually undertaken during adolescence, when the individual undergoes major changes anyway, makes it difficult to asses which changes are due to orthodontic treatment and which are not[104].

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ee http://www.angle.org/anglonline/?request=get-abstract&issn=0003-3219&volume=077&issue=01&page=0181 L. Bondemark; Anna-Karin Holm; Ken Hansen; Susanna Axelsson; Bengt Mohlin; Viveka Brattstrom; Gunnar Paulin; Terttu Pietila.(2007) Long-term Stability of Orthodontic Treatment and Patient Satisfaction. A Systematic ReviewAngle Orthod. 2007 Jan;77(1):181-91.

Given that most orthodontic patients are children and adolescents, Jokovic et al. (2002) developed a CPQ11-14 (Child Perceptions Questionnaire), a measure for the OHRQoL for children aged from 11-14 years and tested it for validity and reliability[105], [106]. In 2006

O'Brien concluded that the child perception questionnaire (CPQ11-14) is a valid measure with an acceptable reliability for malocclusions in the UK, and that it is likely to be a useful measure in orthodontic clinical trials[107]. To use the CPQ as an outcome measure in routine clinical situations further research is still necessary.

PSYCHOSOCIAL HEALTH GAIN FROM ORTHODONTIC TREATMENT

In a longitudinal study between orthodontically treated and untreated patients at the age of 11 years (T1) and 15 years (T2) Birkeland[12] found that the children treated with fixed appliances had better dental aesthetics than in both other groups, namely patients treated with removable appliances and non-treated patients. The average PAR reduction was 71.6 % and satisfaction with their own or, if asked to the parents, their child's dental appearance increased significantly. The untreated group showed increased malocclusions, but the children expressed higher satisfaction with their dental appearance at T2 than T1, the parent's satisfaction level was unchanged. However, the study revealed that improvement in self-esteem from 11-15 years was not correlated with treatment changes and a gender difference was not found.

There was found an indication that both children and parents rate pleasant aesthetics as an important factor of psychosocial well-being[12]. Also, ten to twelve year olds report a significantly positive effect of early orthodontic treatment on the facial appearances of their peers.[ff]

A prospective longitudinal cohort study[108] revealed that the observed effect of orthodontic treatment on self-esteem at outcome was accounted for by self-esteem at baseline. So when prior need for treatment was taken into account there was little objective evidence to support the assumption that orthodontics improves long-term psychological health[108].

This was confirmed by Shaw et al[13], who observed that, while dental status in adulthood is statistically significant, it appears to be of minor importance in a model that included other psychological variables.

ORTHODONTIC TREATMENT OUTCOME IN ROUTINE PRACTICE EVALUATED BY ORTHODONTIC PRACTITIONERS AND PATIENTS

- **The studies on outcome of orthodontic treatment as evaluated by orthodontic practitioners show a large degree of heterogeneity, so the results must be regarded with caution.**
- **The mean outcome of an orthodontic treatment in such studies was a change in PAR score of approximately 68% (only from 2 studies)**
- **Dual arch fixed appliances seemed to be more effective (this remains to be confirmed).**
- **There is an increased interest in patients' satisfaction after orthodontic treatment. Oral Health Relating Quality of Life (OHRQoL) measuring instruments are being developed.**

2.3.7 Prevention versus interception of orthodontic problems

Except for general preventive measures like prevention of caries decay, of trauma, of tooth loss and of thumbsucking not a lot can be done to prevent the development of an orthodontic problem, as the origin of the features constituting a malocclusion are largely determined by genetic factors.

[ff] O'Brien K (2008). *Hot off the Press! Three short presentations of new high level evidence studies*. Scientific lecture by prof O'Brien as a Guest speaker at the annual meeting of the Angle Society of Europe, January 2008. Reference was made to the results of a RCT, which was accepted for publication in the American Journal of Orthodontics and Dentofacial Orthopedics

Measures can however be taken to prevent a malocclusion to be aggravated by environmental factors like tooth loss due to bad oral hygiene and trauma, ... Also functional factors like tongue habits during deglutition, during speech and in rest, are claimed to play a role in the development / maintenance of orthodontic problems. The decreasing use of bite force during mastication due to modern food consistency led to the hypothesis that the increasing prevalence of malocclusions in present Western populations is due to increasing soft diet consumption (Corrucini, 1999)[gg]. On the other hand, Australian research in twins suggested an increasingly genetic determination of malocclusion, explained by the environmental withdrawal theory[hh]. Those theories remain to be confirmed.

Most measures that can be taken are thus not strictly preventive (to avoid the malocclusion to develop), but they are interceptive, i.e. already corrective in an early stage of the primary or mixed dentition in order to 'prevent' a worse situation later on in the permanent dentition.

The purpose of such measures is thus to prevent more complex malocclusions to develop and to reduce the need and/or complexity of any orthodontic treatment later in the permanent dentition[80], [83]. Basic principles of early intervention are technically simple and aim to eliminate any primary etiological factors, to manage arch length discrepancies and to correct mild skeletal deviations[83].

The percentages of children who would benefit from interceptive orthodontics[109] varies from 15-20% to even 49%.

These numbers should be treated cautiously, since the review of Wong et al was not performed systematically, and no critical appraisal of the included references was performed. In another study[110], that was performed prospectively, it was estimated that 33% of the children had an interceptive treatment need. However, the evaluation was performed by orthodontic practitioners, and it has been described that in this case overestimation of treatment need is not exceptional[74, 76].

Although many authors claim that the most favourable ages for interception are between 9 to 11 years, some propose interceptive measures between 4 and 8 years of age[ii]. The American Academy of Pediatric Dentistry advises a first screening for orthodontic need before the age of 6 years.

The most important way to prevent orthodontic problems is a screening around the age of 9 years, combined with regular dental visits [110]. Some authors propose an earlier screening between 4 and 6 years of age[jj]. The preservation of a healthy primary dentition until the time of normal shedding is of outmost importance of the normal eruption of premolars and canines [83].

The interceptive treatment possibilities for crowding include space maintenance, space management and extractions [110]. However there is poor evidence to recommend for or against space maintainers [83], [73].

Also large overjets > 6 mm, which may predispose for traumatic injuries of the upper front teeth and forced lateral and protral cross bites are features that may benefit from interceptive treatment[110], [109].

But it was found that the early reduction of an increased overjet was not very productive [77].

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gg Corrucini R. (1999). How anthropology informs the orthodontic diagnosis of malocclusion's causes. Mellen Studies in Anthropology, Volume 1; Editor: The Edwin Mellen Press, Lewiston . Queenston. Lampeter, UK

hh Corrucini R. (1999). How anthropology informs the orthodontic diagnosis of malocclusion's causes. Mellen Studies in Anthropology, Volume 1; Editor: The Edwin Mellen Press, Lewiston . Queenston. Lampeter, UK

ii Personal communication, Prof dr M Limme at Expert meeting KCE, the 11th of December 2007.

jj Personal communication, Prof dr M Limme at Expert meeting KCE, the 11th of December 2007.

The possible trauma-preventive effect of early overjet correction has to be verified by randomised controlled studies in children in the early mixed dentition[4].

There is a general acceptance of the need for early treatment of forced posterior cross bites [83].

The consequence of an untreated posterior cross bite is an asymmetric condular position, which may result in a craniofacial asymmetry and some studies indicate a possible association with an increased risk of temporomandibular disorders [83].

However, taken all malocclusions together, low evidence exists that there is no increase in TMD (see section 2.3.1.2). The correction of a posterior cross bite by maxillary expansion may be postponed to the early mixed dentition, because the transverse relations may have the capacity to normalize due to a favourable change in function [83].

Open bites due to sucking habits usually correct spontaneously after breaking the habit [83], [109]. There is no conclusive evidence on how to treat persistent open bites or open bites due to other causes (see section 2.3.1).

The prolonged retention of deciduous teeth may be due to ankylosis or failure of the permanent successor to resorb the roots of the deciduous tooth. The preventive measure to take is the extraction of the deciduous tooth[109].

The limitations of early orthodontic treatment are unfavourable craniofacial growth, persistent habits, severe ectopic eruption and congenitally malformed or missing permanent teeth[109]. The goals of early orthodontic treatment should always be kept in mind in order to avoid unnecessary two – phase treatment[109], since a second phase of treatment with fixed appliance is often required in adult dentition, due to recurrence of the malocclusion[109].

There is poor evidence to recommend for or against the use of space maintainers to prevent or reduce the severity of malocclusion in the permanent dentition[73]

The early reduction of an increased overjet was not very productive[77]. The possible trauma –preventive effect of early overjet correction has to be verified by randomised controlled studies in children in the early mixed dentition[4].

Systematically applied early treatment may have contributed to a significant reduction of treatment need from 8 to 12 years, but this remains to be confirmed. If no treatment need existed at the age of 8, the prognosis for no treatment need at the age of 12 seemed good[111].

Evidence on the efficiency of early orthodontic treatment is rare [80]. One study was found that stated that the age of 12 is too early to make a decision about orthodontic treatment on aesthetic grounds both from psychological and physical viewpoint [77]

PREVENTION VERSUS INTERCEPTION OF ORTHODONTIC PROBLEMS

- **Large overjets > 6 mm, which may predispose for traumatic injuries of upper front teeth and forced crossbites may benefit from an interceptive treatment. The possible trauma-preventive effect of early overjet correction has to be verified by randomised controlled studies in children in the early mixed dentition.**
- **The extraction of lower deciduous canines for the 'relief' of lower arch crowding is questionable.**
- **There is a no evidence to recommend for or against the use of space maintainers to prevent or reduce the severity of malocclusion in the permanent dentition.**

2.3.8 Retention and stability

Retention is the phase after an active orthodontic treatment with braces in which an attempt is made to keep the teeth in their well-aligned position. Without the retention-phase a relapse may occur or especially in the lower arch tertiary crowding is allowed to progress. The retention can be achieved by fixed or removable retainers or a combination of both.

A Cochrane review was published in 2007 about retention procedures for stabilising tooth position after treatment with orthodontic braces [112]. However, insufficient evidence was available on which to base clinical guidance.

Studies investigating the morphological stability 5 years or more after an orthodontic treatment have shown insufficient scientific evidence for conclusions on stability after treatment of other morphological discrepancies[2]

Orthodontic treatment of crowding aligns the dental arch. However, the length and width of the mandibular dental arch gradually shorten in the long term, and crowding of the anterior teeth can reoccur. This condition cannot be predicted at the individual level (Low scientific evidence) [2]. On the other hand, crowding of the anterior teeth can develop newly during adulthood.

Treatment of a large overjet with fixed appliances according to Herbst normalizes the occlusion. Relapses occur, but cannot be predicted at the individual level (Low scientific evidence)[2]

Scientific evidence is insufficient for conclusions on patient satisfaction in the long term (at least 5 years) after the conclusion of orthodontic treatment. [2].

In conclusion it can be stated that there is an urgent need for more high quality randomised controlled trials.

RETENTION AND STABILITY

- **Treatment of crowding aligns the dental arch. However, the length and width of the mandibular dental arch gradually shorten in the long term and crowding of the anterior teeth can reoccur (or develop newly during adulthood) if not retained. This condition cannot be predicted at the individual level (low quality of evidence).**
- **Treatment of a large overjet with fixed appliances according to Herbst normalizes the occlusion. Relapses occur, but cannot be predicted at the individual level (low quality of evidence).**
- **Scientific evidence is insufficient for conclusions on stability after treatment of other morphological discrepancies.**
- **Scientific evidence is insufficient for conclusion on patient satisfaction in the long term (at least 5 years) after orthodontic treatment.**

2.4 CONCLUSIONS OF THE REPORT OF THE CLINICAL LITERATURE SEARCH

2.4.1 Orthodontics and evidence-based medicine

At the present time only for a few orthodontic topics there is adequately supported evidence. This is in agreement with the findings of other studies[2;9]. Several of the assessed studies, yet included in this review, showed some limitations, which made it impossible to find evidence for them. The main limitations were: publication biases, no homogeneity of primary data, lack of information about sample and control group, the subjects included in the studies had different ages, the pre-treatment and outcome measures were assessed by a widely range of indexes, different types of interventions were compared.

There is an urgent need of well – conducted, randomised controlled trials in orthodontics with comparable samples and methods in other to find evidence for most of the questions asked in this study.

Clinical research in orthodontics has always been complex, because answers must be sought against a background of patient variation, impact on continued growth, a multitude of appliance systems, and variations in patient compliance with the treatment regimes. A randomised clinical trial is the most powerful tool for evaluating therapy.

Although is may not be possible to conduct RCT's to investigate all aspects of clinical orthodontics, most studies that compare appliances, materials or treatment strategies could be conducted in this way.

Despite the obvious shortcomings of the studies involved in this review, an attempt was made to select most valuable studies and reviews in other to outline the available evidence.

2.4.2 Synthesis of the literature research

According to the current state of the evidence in the literature, not treating malocclusions has only few proven medical adverse effects. So far there is only moderate quality of evidence for an increased trauma risk in case of large overjet of the front teeth, and low quality of evidence for an increased risk of root resorption in case of ectopic positioned teeth. On the other hand, malocclusion is not associated with more caries (low quality of evidence). More studies are urgently needed, especially on the relationship between untreated malocclusion and periodontal problems, chewing or speech problems, or temporomandibular problems.

Nowadays, the major indication for orthodontic treatment from the view of many patients or parents, is not a medical concern but a desire for aesthetic improvement. It is assumed that malposition of the teeth has an adverse psychosocial effect in many fields of daily life. However, scientific evaluation learned that evidence on the relationship between moderate malocclusions and negative self-esteem among children and teenagers of 11-14 years old is conflicting (low quality of evidence). Dental status in adulthood, whilst statistically significant, appeared to be of minor importance to overall self-esteem in a study model that included other psychological variables (Low quality evidence).

Orthodontic treatment in itself seems to be fairly safe (low quality of evidence): the only proven side-effect is root-resorption, which occurs in 11-28% of patients. Information of long-term consequences of major root resorption is still lacking, and the effect of suspending the treatment remains unclear. In case of insufficient oral hygiene (by the patient), white decalcification spots might occur which probably can be prevented by regular rinsing with a fluoride mouthwater. Evidence shows no arguments for increase in caries, nickel sensitivity, or temporomandibular joint disorders after orthodontic treatment.

According to a general consensus among experts, screening for orthodontic problems during the first transitional phase would be ideal. No evidence exists on this issue, nor on how to implement this practically.

Treatment indices like IOTN, PAR, ICON… are well accepted internationally as instruments to assess orthodontic treatment need, as well for reimbursement as audit, research or decision making purposes. However, scientific evidence is lacking for conclusions concerning the validity (that is, if a tool measures what it is intended to measure) of the morphological (part of) indices; scientific evidence is also insufficient for conclusions concerning the validity of the aesthetic (part of) indices. There is an increased interest in patients' satisfaction after orthodontic treatment, and Oral Health Relating Quality of Life (OHRQoL) measuring instruments are being developed.

For several important treatment options in orthodontics, a lack of scientific studies makes it impossible to judge their value. More clinical studies of good quality (preferably randomized clinical trials) should be performed in order to elucidate which treatment is to prefer to reach a certain preset treatment goal. Only for the treatment of a few orthodontic features evidence is found in the literature; they are summarized below.

Concerning the deciduous teeth, there is low quality evidence that grinding in case of posterior crossbite (prevalence of 9-23% in Caucasian children) can prevent the perpetuation of the crossbite in the adult dentition, possibly in combination with maxillary expansion. On the contrary, the relief of lower incisor crowding by extracting lower deciduous canines is probably not effective, but this remains to be confirmed. There is insufficient evidence to conclude on the effect of space maintainers in young children, and also on the treatment of anterior open bite.

In the mixed dentition, forced eruption of impacted canines (prevalence +-2%) in combination with orthodontics decreases the risk of root resorption of adjacent teeth (low quality of evidence). Which treatment is the most efficient in this case, remains to be elucidated. More studies are also needed on the treatment of supernumerary teeth (prevalence <1%) or dental agenesis (+-4%).

For Angle Class III malocclusion, an uncommon condition in Western Europe (prevalence of 3-6%), treatment with a protraction face mask is efficient (moderate quality of evidence), preferably before the age of 10 years.

Class II,1 malocclusions are frequent: they represent the largest part of the Class II malocclusions, which have a prevalence of 23-63% in Caucasian children. Treatment of prominent upper front teeth in these malocclusions is efficient (moderate quality of evidence), but early treatment is no more effective than providing one course of orthodontic treatment when the child is in early adolescence. However, trauma prevention at young age and psycho-social benefit in case of severe teasing are probably exceptions to this rule. The possible trauma-preventive effect of early over correction still has to be verified by controlled studies in children in the early mixed dentition.

Despite the fact that several treatment options exist for the treatment of Class II, 2 malocclusions, a rather unfrequent condition in Caucasian children, it is not possible to provide any evidence and any recommendations. This is due to the fact that no randomized or controlled clinical trials were found. In severe Class II,2 malocclusions, a palatal or lower labial gingival trauma can be detected, due to a deep bite. From a dental health point of view, this should be avoided.

The benefits of orthodontic treatment in CLP patients (+- 1.5 per 1000 births) and other medically compromised patients with craniofacial disorders are generally accepted. There is also general agreement that orthodontic treatment for CLP patients or other medically compromised patients often still occurs after the age of 15 years and even during adulthood. This needs to be taken into account when considering adapted reimbursement for these patients.

Once the treatment is finished, the obtained result should be retained in the long term. There is low quality of evidence that crowding of the anterior teeth as well as overjet of front teeth can reoccur; this condition cannot be predicted at the individual level. (On the other hand, it can also newly develop during adulthood.) Scientific evidence is insufficient for conclusions on stability after treatment of other morphological discrepancies. Scientific evidence is also insufficient for conclusion on patient satisfaction in the long term (at least 5 years) after orthodontic treatment.

In the literature, no concluding evidence is available on the correlation between socioeconomic factors and uptake for orthodontic treatment. Low evidence has been found that patients who visited their dentist regularly are more likely to receive orthodontic treatment.

3 ORTHODONTICS ORGANIZATION AND FINANCING: OVERVIEW OF 8 COUNTRIES BASED ON LITERATURE AND INTERNATIONAL QUESTIONNAIRE

3.1 INTRODUCTION

In this chapter, first an overview is given of the organization and financing of orthodontics for the following countries: France, Germany, the United Kingdom, the Netherlands, Sweden, Switzerland and the United States. Furthermore, the results of an International questionnaire are reported and matched to data found in the literature.

3.2 METHODOLOGICAL APPROACH TO THE LITERATURE STUDY

Besides consultation of grey literature, also a systematic search was done in the scientific literature databases. An overview of this systematic search is given below. The PICO's used for this search can be found in the Appendix of Chapter 3.

3.2.1 Searched databases

The following electronic databases were searched: Ovid, Cochrane, CRD and Embase. Grey literature was retrieved via Google and contacts with professional organizations.

Searches were limited in time only articles published between 1987 and 2007 were included.

3.2.2 Search terms

The following searches were executed:

- orthodontics
- orthodontic
- health care economics and orthodontic(s)
- health planning and orthodontic(s)
- organizations and orthodontic(s)
- state dentistry and orthodontic(s)
- technology assessment, biomedical and orthodontic(s)
- quality of health care and orthodontic(s)
- delivery of health care and orthodontic(s)
- behaviour and orthodontic(s)
- patient compliance and orthodontic(s)
- treatment refusal and orthodontic(s)
- behaviour and orthodontic(s) and patient compliance
- treatment refusal and orthodontic(s)
- behaviour and orthodontic(s) and treatment refusal
- health services and orthodontic(s)
- organization and administration and orthodontic(s)
- consumer satisfaction and orthodontic(s)
- patient satisfaction or perception and orthodontic(s)
- organization and orthodontic(s)
- legislation and orthodontic(s)

- reimbursement and orthodontic(s)
- cost and orthodontic(s)
- administration and orthodontic(s)
- financing and orthodontic(s)
- economics and orthodontic(s)

OVID: 2066 articles (before removal of duplicates)

Cochrane library: 554 articles (before removal of duplicates)

CRD: 86 articles (before removal of duplicates)

EMbase: 530 articles (before removal of duplicates)

After removal of the duplicate articles from the OVID searches 1990 articles were kept.

After removal of the duplicate articles from the Cochrane library searches 297 articles were kept.

After removal of the duplicate articles from the CRD searches 62 articles were kept.

After removal of the duplicate articles from the EMbase searches 509 articles were kept.

After removal of the duplicate articles from the OVID, EMbase and Cochrane library searches, the databases were joined and duplicates were removed.

After the removal of duplicates 1558 articles were kept.

3.2.3 Selection of studies

Only articles concerning Belgium, France, Germany, Great-Britain, Sweden, Switzerland, The Netherlands, Finland and USA were kept. 51 articles were retained, but only 10 where actually used in this report[kk].

3.3 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN FRANCE

3.3.1 Health insurance in general

In France there are three main health insurances schemes:

1. The general scheme (le régime général = CNAMTS and CMU).
2. This scheme covers employees in commerce and industry and their families (CNAMTS=Caisse Nationale d'Assurance Maladie des Travailleurs Salariés) and CMU beneficiaries (CMU=Fonds de financement de la protection complémentaire de la couverture universelle du risque maladie). CMU covers people with a taxable income of less than €6 600 per year. These people do not have to pay contributions.
3. The agricultural scheme (la caisse centrale de la mutualité sociale agricole = CCMSA)
4. This scheme covers farmers and agricultural employees and their families.
5. The scheme for non-agricultural self-employed people (la caisse d'assurance maladie des professions indépendantes = CANAM).

This scheme covers craftsmen and self-employed people, including self-employed professionals.[ll]

The French National Union of Health Insurance Funds (U.N.C.A.M.) puts together the three main health insurance schemes.

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kk C:\KCE\Data Sets voor KCE-project\Pico's- inclus-en select-crit-flowcharts (2 pdf files - dd 28-09-2007).

ll Health care systems in transition: France 2004, http://www.euro.who.int/document/e83126.pdf, November 2007.

U.N.C.A.M.'s role consists in running the conventional policy, defining the scope of services eligible for reimbursement and setting up health care reimbursement tariffs.[mm]

All citizens have an equal and constitutional right based on citizenship to receive health care. Every individual is automatically affiliated to one of the three schemes according to their economic status. This compulsory insurance gives them the right to be totally or partially reimbursed for their health expenses including dental treatment for themselves and their dependants.

In general, hospital expenses are paid directly by the sickness funds and primary care costs directly by the patient who is then reimbursed by the sickness funds in part or in full.

Statutory health insurance is financed by employer's contributions, employee's contributions, a general social contribution based on total income, state subsidies, taxes on care usage, taxes on tobacco, taxes on alcohol consumption and taxes on advertising for pharmaceutical products.

The proportion of GDP spent on general health care including dentistry in 2005 was 11.1%. Of this expenditure 79.8% was public. In 2005 health expenditure per capita was USD3 374[nn].

3.3.2 Organization of orthodontic practitioners in France

LICENSING OF ORTHODONTIC SPECIALTY

In France only one dental specialty is licensed: orthodontics. Orthodontics is licensed since 1977.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES[113]

Access to dental studies is open after Baccalaureat (12 years of primary studies). Access to dental faculties is regulated by examination at the end of the first year. The first year is in common with medicine. The number of students admitted to the 2nd year is set annually by the ministry in charge of health together with the ministry in charge of Education. The total duration of dental studies is 6 years. A thesis is necessary to obtain the title of doctor in dental surgery and required to practise. Practitioners need to register and they have to pay an annual charge in order to remain on the register.

There are 16 dental schools in France.

Training for the specialty of orthodontics lasts four years part-time and takes place in university clinics. A national specialist diploma is then awarded by the authority. The professional title is "chirurgien-dentiste spécialiste qualifié en orthopédie dento-faciale".

In France no auxiliaries are allowed to work in the mouth. The only recognised auxiliary personnel are dental assistants, receptionists and dental technicians.

Dental technicians do not need to be registered. They undertake a 3 years training in laboratories and schools. They have no direct contact with patients and they work under the prescription of the dentist.

Dental assistants qualify after 2 years training in dental practice at one of the 7 schools.

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mm Getting informed about health insurance, UNCAM,http://www.ameli.fr/l-assurance-maladie/connaitre-l-assurance-maladie/getting-informed-about-health-insurance/uncam.php, November 2007.

nn OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

3.3.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE [113]

From the age of 13 to 19 years children can benefit for the next three years of their lives from an annual prevention consultation which includes oral hygiene and diet advice, prevention measures such as sealants (till 14 years) and if necessary, a course of conservative treatment. All fees for this care are paid directly by the health insurance to the dentist. If radiographies are necessary, they are also reimbursed on a contract price basis.

For conservative and surgical treatments, the practitioner must charge fees within the agreed convention and the patient can reclaim up to 70%.

For other treatments such as orthodontics and prosthodontics, dental surgeons may set their own fees, having informed the patient of the estimated cost.

The patient pays the whole fee to the dentist or orthodontist and is then issued with a form with which he can reclaim the relevant basic reimbursement amount from the health insurance.

Orthodontic care is only refunded for treatments that started before the 16th anniversary and is subject to a prior approval of the Caisse. This approval needs to be renewed every 6 months.

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES [113]

Approximately 90% of people use complementary insurance schemes, either by voluntary membership or through the CMU to cover all or part of their treatment.

With regard to conservative and surgical care these complementary insurances cover the 30% of the fees not covered by mandatory insurance. For prosthetic and orthodontics, these complementary insurances cover maximum 30% of the fees not covered by mandatory insurance. It is to be noted that some of these schemes may cover more than the responsibility cost of the social security caisses.

3.3.4 Fee-for-service for orthodontic acts

Most oral healthcare is provided by self-employed practitioners according to a convention. Almost all dentists (98%) in France practice within the convention. If a dentist is not in the convention then the patient cannot reclaim all or part of the cost.

All those legally resident in France are entitled to treatment under the convention.

For orthodontic and prosthodontic care to patients not covered by the universal sickness insurance (CMU), dentists and orthodontists may set their own fees, having informed the patient of the estimated cost. For these patients, the estimated cost per semester for orthodontic treatment is €450 and only €193.5 is being reimbursed by the Caisse.[oo].

For patients covered by the universal sickness insurance (CMU) that need orthodontic treatment, the dentist is being paid directly by social security and can only charge a fixed scale of fees.

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oo http://www.hospial.fr/documents/explication_remboursements_ss.doc

Table 10: Scale of fees for treatment of CMU insured patients[pp].

Treatment	basic reimbursement (also for not-CMU patients)	maximum fee for treatment of CMU patients	extra amount reimbursed by social security for treatment of CMU patients
Treatment of malformation per semester (limited to 6 times)			
- without fixed appliance	193,50 €	333,00 €	139,50 €
- with fixed appliance	193,50 €	464,00 €	270,50 €
orthodontic checkup (limited to 2 per semester)	10,75 €	10,75 €	0,00 €
Retention			
- 1st year	161,25 €	161,25 €	0,00 €
- 2nd year	107,50 €	107,50 €	0,00 €
Dento-facial treatment in case of respiratory problems due to maxillary malformations	387,00 €	387,00 €	0,00 €
Orthodontic treatment of CLP			
- Fixed annual fee	430,00 €	430,00 €	0,00 €
- During the waiting period	129,00 €	129,00 €	0,00 €
Dento-facial orthopedic treatment with fixed appliance, irrespective of age, prior to a maxillary surgical intervention for a period of six months	193,50 €	381,12 €	187,62 €

3.3.5 Overview of Public Insurance expenditures on dentistry and/or orthodontics

Total governmental spending on dentistry fees in the general scheme was €2.7 milliard in 2006. This is about 2.25% of the total expenditure on health in the general scheme.[qq]

3.3.6 Conclusions on the international comparative study based on the literature study for France.

- **France has a statutory health insurance system based upon citizenship with sickness funds. There is a widespread use of private insurance schemes for orthodontic care**
- **Ratio orthodontists to population is 1 to 31 600.**
- **Ratio dentists to population is 1 to 1 708.**
- **Orthodontic specialty is legally recognized since 1977.**
- **There is limited use of 3 types of dental auxiliaries.**
- **Orthodontists set their own fees, except for CMU insured patients.**
- **For CMU patients, the full (fixed) fee is paid directly by the social security.**
- **For non-CMU patients, less than 50% of the actual fee is reimbursed by the national insurer.**
- **National insurer coverage for orthodontic treatment only for treatments that started before the age of 16.**

pp « Arrêté du 30 mai 2006 pris pour l'application des articles L. 162-9 et L. 861-3 du code de la sécurité sociale et relatif aux soins dentaires prothétiques ou d'orthopédie dento-facial pris en charge par la protection complémentaire en matière de santé », Journal Officiel de la République Française, 02/06/2006, www.fsdl.fr/docs/tarifs_cmuc_2006.pdf

qq Chiffres & repères, 2006, www.ameli.fr/fileadmin/user_upload/documents/chiffres_reperes_2006.pdf, november 2007.

3.4 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN GERMANY

3.4.1 Health insurance in general

In Germany there is a long-established statutory health insurance system where health insurance depends on membership of a sickness fund. Sickness funds are state-approved health insurance organisations. As well as the state approved sickness funds there are also private insurance organisations.

The majority of the German population is member of a sickness fund, which provides a legally prescribed standard package of health coverage. Employees with incomes less than €3 375 have a mandatory membership with this type of sickness funds. (Their membership became mandatory as of April 1st 2007) The self-employed and those whose income exceeds the minimum when they take up their insurance are excluded from participation in the legal sickness funds.

Most of the people who are not members of a legal sickness fund are members of private insurance schemes. As of July 1st 2007 those private insurance schemes also have to offer a standard premium which is not related to gender and personal health. Apart from that, the private insurance schemes may also offer other kinds of coverage with more flexible packages of care. As of January 1st 2009 this private insurance will be mandatory for those who are not covered by the Statutory Health Insurance.

The actual provision of health care in the statutory system is managed jointly by the sickness funds and the doctors' and dentists' organisations. As of many other aspects of the German government, this takes place at both the Federal level and the regional level of the Länder.[113]

In 2007 a health reform was decided which will be introduced gradually from 2007 until 2010. The 2007 health reform comprises reforms in four major fields[rr].

1. The introduction of universal health insurance.
2. Insurance will be mandatory.
3. The improvement of medical care.
4. This health reform does not involve any restrictions of services or benefits. Quite to the contrary: these will be extended on a targeted basis wherever it is necessary.
5. The modernisation of the statutory and private health insurance funds.
6. More competition and more freedom of choice for the insured through more individual rates in the statutory health insurance, through less bureaucracy and strong insurance funds, through a new tariff system in the private health insurance system (basic tariff as of 2009) and through the portability of old-age reserves.
7. The reform of the financing base: the health fund.
8. With the health fund, the financing of statutory health insurance funds is rearranged in an equitable manner. Consequently more clarity is established for contributors about where their money goes.

The health fund will start in January 2009.

The proportion of GDP spent on general health care including dentistry in 2005 was 10.7%. Of this expenditure 76.9% was public. In 2005 health expenditure per capita was USD3 287 [ss]

[rr] Welcome to solidarity?, information on the 2007 Health Reform, Bundesministerium für gesundheit, http://www.bmg.bund.de/nn_600148/EN/Health/2007-health-reform.templateId=raw,property=publicationFile.pdf/2007-health-reform.pdf, November 2007.

[ss] OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

3.4.2 Organization of orthodontic practitioners in Germany.

LICENSING OF ORTHODONTICS SPECIALTY

In Germany four dental specialties are licensed, although not in all Länder. The four specialties are: oral surgery, orthodontics, periodontology and dental public health. Periodontology is only licensed in Westfalen. [113]

Orthodontics is licensed overall since 1955.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES [113]

To enter dental school a student has to have passed the general qualification for university entrance and has to have a successful result in a Medical Courses Qualifying Test.

There are 31 dental schools. The undergraduate course lasts 5 years.

The main degree which may be included in the register is the state examination certificate in dentistry.

In order to register as a dentist in Germany and provide care within the public health insurance, a German dentist with a German diploma must have two year of approved supervised experience. This is in addition to the five years of university dental training. A dentist can then apply to the admission committee of the Kassenzahnärztliche Vereinigungen.

Training for the specialty of orthodontics lasts four years and takes place in university clinics or recognised training practices. An orthodontist receives the certificate of orthodontist issued by the chamber of dental practitioners of the Länder.

Both dentists, without additional training, and orthodontists are allowed to offer orthodontic treatment in Germany.

In Germany, auxiliary personnel can only work under the supervision of a dentist, who is always responsible for the treatment of the patient. They can not practice independently.

The range of auxiliaries is fairly complex. The main types are dental chairside assistants, dental hygienists and dental technicians. They all need to train for 3 years.

Dental hygienists give advice to and try to motivate patients in prevention and therapeutic measures for prophylaxis and scaling of teeth.

Dental technicians produce prosthodontic appliances according to a written prescription from a dentist. They do not deal directly with the public.

3.4.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

Legislation regulating dental care is relatively detailed. The basic entitlements of the insured to dental care are defined in the German social code (SGB V).

The insured are entitled to prevention, early detection, and treatment of diseases of the teeth, the mouth and the jaw. Consequently only prophylactic treatment, basic dental care and dental prosthetic services are covered by the sickness funds.

The directives of the Federal Joint Committee broadly define when patients are entitled to benefit. They do not define specific items that must be included however. Therefore, the Dental Valuation Committee, which consists of representatives of the federal associations of the sickness funds and the Federal Association of the statutory health insurance dentists defines the Uniform Value Scale for Dentists (BEMA). The BEMA lists services that are reimbursed by the sickness funds, thereby explicitly defining the statutory health insurance benefit catalogue.

The services of dental technicians producing the material needed for orthodontic or prosthetic services are listed in a similar framework, the Uniform Value Scale for Dental Technicians (BELL-II) which is negotiated by the same committee. [114]

Orthodontic treatment, except those for the treatment of abnormalities, are to begin during childhood and are excluded for insured parties over the age of 18 years. To prevent overprovision of services, dentists must prepare a cost schedule that is reviewed by the sickness funds.

The reimbursement of orthodontics depends on the treatment need. KIG-rate 1 and 2 are not reimbursed. For KIG 3, 4 and 5, initially 80% is reimbursed and the remaining 20% is reimbursed at the end of a successful treatment. In total, thus, 100% is reimbursed by the sickness funds.[tt]

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES

Persons not required or not entitled to participate in the statutory scheme can apply for insurance coverage by a private health insurance company. The content of cover is contractually agreed and flexible.

3.4.4 Fee-for-service for orthodontic acts

There is no national fee schedule for orthodontic treatment. Relative values are allotted to the types of treatment in the BEMA and BELL-II lists. It is then upon the regional associations and sickness funds to decide the monetary value of each treatment type in each region.

For private patients (not covered by the statutory scheme), whether insured or not insured, the levels of private fees payable are coordinated by federal law. Under this law the different types of treatment are described and for each a directive value in Euros is set. Depending on the difficulty of treatment required, the dentist may increase the basic value of his invoice by up to 3.5 times the recommended value. 2.3 times is the average fee for an average difficult treatment with extra time needed. Over 2.3 times the invoice must include evidence to justify the increase. An invoice higher than 3.5 times the directive value needs written agreement from the patient. Although there is no direct link between this federal law and the private insurances, the private insurers co-ordinate their fees with the federal law and reimburse for treatment up to 3.5 times the standard fee. [113]

In the appendix of Chapter 3, an overview of orthodontic fees in Bayern is included

3.4.5 Overview of Public Insurance expenditures on dentistry and/or orthodontics

The proportion of the total health care cost for the statutory health insurance spent on dentistry was 7.36% in 2005.[uu] This represents €9.93 billion.

[tt] http://www.kfo-online.de/, accessed March 2008

[uu] Zahnärztliche Versorgung Daten & Fakten 2006, http://www.bzaek.de/list/press/datenfakten/df2006.pdf, november 2007

3.4.6 Conclusions on the international comparative study based on the literature study for Germany.

- **Germany has a statutory health insurance system with sickness funds. There is a widespread use of private insurance schemes. There is an ongoing health reform from 2007-2010.**
- **Ratio orthodontists to population 1 to 31 206.**
- **Ratio dentists to population 1 to 1 006.**
- **Licensing of the orthodontic specialty since 1955.**
- **A wide range of dental auxiliaries is used.**
- **For patients insured by the statutory scheme (low-income), regional associations and sickness funds decide on the monetary value of treatment. For patients privately insured (high-income and self-employed), directive maximum values, set by law, tend to be followed, even though there is no direct link between the law and the private insurers.**
- **There is an obligation to score the treatment need (in "Kieferorthopädische Indikations Gruppen (KIG)").**
- **The reimbursement of orthodontics depends on the treatment need. KIG-rate 1 and 2 are not reimbursed. For KIG 3, 4 and 5, initially 80% is reimbursed. The remaining 20% is reimbursed at the end of a successful treatment. In total, thus, 100% is reimbursed by the sickness funds for KIG 3, 4 and 5.**
- **Statutory coverage for orthodontic treatment is limited to children until 18 years of age.**

3.5 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN THE UNITED KINGDOM

3.5.1 Health insurance in general

The vast majority of health care in the United Kingdom is provided by the National Health Services, commonly referred to as "the NHS". The NHS is the publicly funded health care system of the UK.

Care by NHS is provided to all permanent residents of the UK.

The NHS is not funded by insurance. Instead, it is funded directly from taxation. The large majority of NHS services are provided without a further charge to the patient, but a contribution for drug and dental costs has to be made by the patients. The costs of running the NHS are met directly from general taxation. The estimated cost for 2007-2008 are £104 (€144) billion.[vv]

The NHS is committed to providing quality care that meets the needs of everyone, is free at the point of need, and is based on a patient's clinical need, not their ability to pay. The NHS will not exclude people because of their health status or their ability to pay.[ww]

[vv] HM Treasury (2007-03-21). Budget 2007, http://www.hm-treasury.gov.uk/media/3/4/bud07_completereport_1757.pdf, November 2007.

[ww] About the NHS, core principles, http://www.nhs.uk/aboutnhs/CorePrinciples/Pages/NHSCorePrinciples.aspx, November 2007.

There are several types of NHS trust:

- Primary Care Trusts (PCTs) which administer primary health care and public health.
- NHS Hospital Trusts which administer treatment centres and specialists in NHS hospitals
- NHS Ambulance Service Trusts
- NHS Care Trusts
- NHS Mental Health Services Trusts

Private health care, paid for largely by private insurance, has continued parallel to the NHS, but is used only by a small percentage of the population, and generally as a top-up to NHS services.[xx]

The proportion of GDP spent on general health care including dentistry in 2005 was 8.3%. Of this expenditure 87.1% was public. In 2005 health expenditure per capita was USD 2 724 [yy]

3.5.2 Organization of orthodontic practitioners in the United Kingdom

LICENSING OF ORTHODONTICS SPECIALTY

In the UK nine dental specialties are licensed. The specialties are: oral surgery, endodontics, orthodontics, periodontics, restorative dentistry, prosthodontics, dental public health, surgical dentistry and paediatric dentistry.

Orthodontics is licensed since 1998.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES [113zz]

To enter dental school a student must normally have passed at least 3 A-level subjects and, because of the competition for places, these would normally all have to be at the highest pass level. It takes 5 years of study to become a dentist.

All dentists who wish to practise dentistry in the UK have to be registered with the General Dental Council (GDC). The GDC maintains the register of dentists as well as those on the specialist list.

In order to practice in the NHS in the UK a dentist must complete a period of supervised vocational training in a practice, a public health clinic or hospital.

All dentists must participate in continuing education.

Besides regular dentists there are also dentists with special interests in orthodontics. A dentist with special interests in orthodontics is a primary care dentist with all round experience and training in general dental practice, who has developed a special interest in orthodontics. They gained additional training and/or experience in orthodontics. He or she is not a specialist. They can treat straightforward cases themselves, but they will refer complex cases to a specialist orthodontist[aaa].

Training for specialist in orthodontics takes 3 years. The GDC administers the list of registered dentists who have been given the right by the GDC to use a specialist title.

In the UK, dental auxiliaries are known as Professionals Complementary to Dentistry (PCDs). There are 6 types of dental auxiliaries:

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xx National Health Service, http://en.wikipedia.org/wiki/NHS, November 2007.

yy OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

zz NHS careers, http://www.nhscareers.nhs.uk.

aaa Guidelines for the appointment of dentists with special interest in orthodontics, http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4133858, November 2007.

- Dental nurses
- Dental hygienists
- Dental technicians
- Dental therapists
- Orthodontic therapists
- Clinical support workers in dentistry

Dental nurses support the dentist in all aspects of patient care, this includes getting the appropriate instruments ready, mixing materials and ensuring patient comfort.

Dental nurses can train for a qualification taking full-time or part-time courses.

Dental nurses will be able to work unregistered until 30 July 2008, after which they will need an approved qualification in order to register with the GDC.

Dental hygienists have a vital role in helping to prevent problems form arising. Dental hygienists may only work under the direction of a dentist. The training usually takes 2 years on a full-time basis and is offered by dental schools. Dental hygienists must be registered with the GDC.

Dental technicians make dentures, crowns, bridges and dental braces. There are four kinds of dental technicians: prosthodontic technicians, conservation technicians, orthodontic technicians and maxillo-facial technicians. Training is provided by universities, colleges, hospitals or health authorities. Training usually takes 4 years, with an additional training of 2 years for more specialised work. All dental technicians must be registered with the GDC by 30 July 2008.

Dental therapists play an important role in promoting dental health. They can carry out a wide range of procedures. A registered dentist must examine the patient and indicate clearly in writing the course of treatment that the dental therapist needs to carry out. Training takes about 27 months and is offered by dental hospitals and dental schools. In order to practice, a dental therapist must be registered with the General Dental Council.

Orthodontic therapists assist dentists in carrying out orthodontic treatment and provide some aspects of the treatment themselves. Orthodontic therapists also carry out treatments to assist patients in an emergency by relieving pain or making appliances safe. In order to train as an orthodontic therapist, individuals needs to be qualified in dental nursing, dental hygiene, dental therapy or dental technology and also need to have a period of post-qualification experience. The GDC is working with training providers to develop courses in orthodontic therapy.

Clinical support workers in dentistry work under the supervision of a dentist or a dental nurse and may also work with dental hygienists and dental therapists. They greet patients, reassure nervous people, make appointments, give basic advice about dental care and keep records.

3.5.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

The NHS provides subsidized dental services through private dental practises. Private dentists accepting NHS funding for a patient can only charge the patient a the standard NHS rate.

Every orthodontist or dentist has to negotiate his contract with the NHS. A dentist or orthodontist receives somewhere between £1 200 (€1 664) and £1 400 (€1 941) for an NHS treatment from the NHS (the NHS funding).

Any treatments that a dentist feels a patient needs to keep his teeth, gums and mouth healthy, are available on the NHS.

As of 1 April 2007, if a patient is not exempt from charges, a patient pays one of the following rates:

- Band 1 course of treatment: £15.90 (€22.30)

This covers an examination, diagnosis (e.g. x-rays), advise on how to prevent future problems and a scale and polish if needed. Urgent treatment also costs £15.90.

- Band 2 course of treatment £43.60 (€60.68)

This covers everything listed in Band 1 plus any further treatment such as fillings, root canal work and taking out teeth.

- Band 3 course of treatment £194.00 (€269.97)

This covers everything listed in Bands 1 and 2 plus crowns, dentures or bridges.

- Urgent treatment: £15.90 (€22.30)

These are the only dental charges a dentist can charge for when the patient is having NHS treatment. If a patient chooses to have private treatment, then private charges will apply.

All charges apply to an overall course of treatment and not the individual items within the course of treatment. A patient only has to pay one charge for each course of treatment even if he needs to visit his dentist more than once to finish it.

If a patient needs more treatment within the same charge band within two months of completing a course of treatment, he does not have to pay anything extra.

Patients do not have to pay to have their dentures repaired or for having stitches taken out. Neither do patients have to pay if a dentist only needs to write out a prescription.

If a patient is referred to another dentist as part of an existing course of treatment, he will only pay one charge. However, a dentist may ask for his patient to be treated by another local dentist for a course of a specialist treatment such as orthodontics, this is a new course of treatment and means he will need to pay two sets of charges, one to the dentist and one to the orthodontist.

Free NHS dental treatment is available if the patient, when the treatment starts, :

- is aged under 18
- is aged 18 or more and in full-time education
- is staying in an NHS hospital and his treatment is carried out by the hospital dentist
- is an NHS Hospital Dental Service outpatient.
- is getting or his partner is getting income support, income based jobseeker's allowance or a pension credit guarantee credit.
- has the right to, or his name is on, a valid NHS tax credit exemption certificate
- has the right to full help under the NHS low income scheme.

Treatment criteria for orthodontic treatment have been drawn up in April 2006 to assess which cases should be treated on the NHS. Only patients falling into index of treatment need (IOTN) categories 3.6 and up will get access to NHS treatment. The NHS does realise that some children need orthodontic treatment just because their teeth look really bad. The Aesthetic Component (AC) is a scale of 10 colour photographs showing different levels of dental attractiveness.

The grading is made by the orthodontist matching the patient to these photographs. In the NHS, the AC is used for border-line IOTN cases. If the case has a high AC score, NHS treatment is permissible.[bbbccc]

[bbb] What is IOTN, British Orthodontic Society, http://www.bos.org.uk/aboutorthodontics/whatisiotn.htm, November 2007.

[ccc] Guidelines for the appointment of dentists with special interest in orthodontics, http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4133858, November 2007.

If a patient does not need orthodontic treatment according to NHS standard, only private treatment can be given to the patient.

Orthodontic treatment for children is free of charge. NHS treatment for adults is not commonly funded by NHS.

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES

In the UK approximately 3% of the population uses private care plans or insurance schemes to pay for the costs of dental care. Those complementary insurance policies are paid either directly by the patient or by employers as a fringe benefit.

3.5.4 Fee-for-service for orthodontic acts[dddeee]

The standard NHS charge for the patients for orthodontic treatment is currently £194.00 (Band 3).

Fees for private orthodontic treatment vary widely. Average fees for a complete course of treatment are probably around £2 500 to £4 000 (€3 466 to €5 547), but the fee is much affected by the complexity of the case, the locality, the facilities of the practice and the experience of the practitioner. Certain techniques are much more expensive than others.

3.5.5 Conclusions on the international comparative study based on the literature study for the UK.

- **The UK has a statutory health insurance system based upon permanent residence: NHS. There is limited use of private insurance schemes.**
- **Ratio orthodontists to population is 1 to 46 615.**
- **Ratio dentists to population is 1 to 2 424.**
- **Orthodontic specialty is legally recognized since 1998.**
- **6 types of dental auxiliaries are used.**
- **Coverage for orthodontic treatment under the NHS program for children until 18 years of age and IOTN-score 3.6 and up. The Aesthetic Component is used for borderline IOTN cases.**
- **Scoring is done by the dentist or orthodontist themselves and the controlling party is the NHS.**
- **Fixed orthodontic fees are set for NHS treatments. In private practices, fees are free.**

3.6 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN THE NETHERLANDS

3.6.1 Health insurance in general

Health insurance is provided by a government-regulated system of health insurance.

As of January 1st 2006 the new Dutch national health insurance system became effective. Every person who works and/or lives in the Netherlands is obliged to be insured for essential medical care. The insurance for essential medical care is called the Basic Insurance. Apart from that every person can take a complementary private insurance policy. What is considered to be essential medical care is defined by the Dutch government. A general framework is set out by the social security law[fff] and round up with several Royal and Ministerial Decrees (ref: http://wetten.overheid.nl).

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ddd What will it cost?, British Orthodontic Society, http://www.bos.org.uk/aboutorthodontics/whatwillitcost.htm, November 2007.

eee Also information from an orthodontist for the university of Leuven temporary working at an orthodontic practice in the UK.

fff http://wetten.overheid.nl/cgi-bin/deeplink/law1/title=zorgverzekeringswet

Those decrees regularly update the definition of what is considered to be essential medical care.

The basic insurance offers insurance for essential and curative medical care. There are two types of basic insurance policies: a restitution policy or an insurance policy in kind.

In case of an insurance policy in kind the insurance company has agreements with certain doctors, hospitals, dentists…. If a patient goes to one of these doctors or hospitals the bills will be paid directly by the insurance company.

If a patient decides to go to a doctor or hospital without an agreement, the insurance company will only reimburse a restricted amount of the bills.

In case of a restitution policy, the patient is free to choose any hospital or doctor. In this case the patient has to pay the bill himself and can be refunded, most of the time partially, by the insurance company.

Every person who works and/or lives in the Netherlands from 18 years onwards has to pay a nominal contribution that has to be paid directly to the insurance company. This nominal contribution amounts to €1 100 for 2006.

Besides the nominal contribution, the citizens also have to pay a wage-dependent contribution. This contribution amounts to 6.5% of the wages for 2006. This contribution has to be deducted from the wages by the employers and transferred to the government.[ggg]

The proportion of GDP spent on general health care including dentistry in 2005 was 9.2%. Of this expenditure 62.5% was public. In 2005 health expenditure per capita was USD3 094[hhh]

3.6.2 Organization of orthodontic practitioners in the Netherlands

LICENSING OF ORTHODONTICS SPECIALTY

In the Netherlands two dental specialties are licensed: oral and maxillo-facial surgery and orthodontics. Orthodontics is licensed since 1953.

95% of the orthodontists work in a private practice.

AGREEMENTS WITH INSURANCE COMPANIES

An article in the NRC Handelsblad of June 14th 2006 mentions that 90% of the dentists refuse to enter into an agreement with the insurance companies because they want to avoid that the insurance companies will decide what kind of materials and/or techniques they will have to use in the future[iii]

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES

In the Netherlands it takes 5 years to become a dentist. In order to be admitted to the programme the candidates need a VWO-certificate (pre-university education) which includes chemistry and physics; biology and English are recommended.

The number of new students to be admitted is fixed. For 2006 the influx of 1st year students was 300, for 2007 this was 270 and for 2008 the influx will be 240.[jjj]

After the first 3 years one obtains the bachelor degree of Bachelor of Science. After an additional 2 years one obtains a master degree in general dentistry.

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ggg Nieuw zorgstelsel 2006 http://www.vakcentralemhp.nl/docs/zorgstelsel.pdf, 17/10/2007

hhh OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

iii "Tandartsen weigeren massaal contacten met zorgverzekeraars"; http://www.nrc.nl/binnenland/article348941.ec

jjj http://www.tandartsennet.nl/

As of 2010 it will take 6 years to become a dentist, from that year onwards it will take 3 years to obtain a master degree in general dentistry.[kkk]

To become an orthodontist, candidates need to take part in a postgraduate programme in orthodontics. In order to take part in the course, dentists need to have obtained a dental master degree from a dental school accredited by the European Union. The postgraduate programme in orthodontics is a full-time course requiring four years in active residence.

The training programme leads, upon successful completion of a final examination by a committee of the Dutch Specialists Registration Board, to a certification in orthodontics, valid in the Netherlands and the EU.

In the Netherlands there are dental assistants, dental technicians and two other groups who provide clinical oral health care, oral hygienists and denturists.[113]

Assistants have a wide range of duties but can only carry out 'reserved procedures' when authorised by a dentist who is satisfied that he/she is competent to do so. There were 11 809 dental assistants in 2000. In 2007 there are more or less 18 000 oral hygienists and prevention assistants.[lll]

Dental hygienists are allied health professionals. They form an official profession who are required to be qualified and have a diploma. They train in special hygienist schools (not associated with the dental schools), for 4 years full time.

Most are employees in dental practices, some work in hospitals and centres for paediatric dentistry. However, hygienists may practise in a oral hygiene clinic, independently from a dentist, but all the treatment undertaken must have been referred by a qualified dental practitioner. Approximately 10% do this and there is pressure from the hygienists to acquire the right to work without referral from a dentist.

There is a course where oral hygienists are taught how to provide routine dental treatment e.g. fillings, extractions for children. When the course is completed, a hygienist may practise paediatric dentistry, but again, only after referral from the dentist.

In 2007 there are more or less 2 850 oral hygienists active[115].

Dental technicians train in special schools, for 2-4 years, part time.

They are permitted to produce dental technical work, after prescription by a dentist, but cannot work in the mouth. There are about 1 000 dental laboratories, employing about 3 500 technicians (2002).

Denturists train for 3 years part-time, after completion of training as a dental technician. "Denturist" is a protected title, with an ethical/disciplinary system administered by the Denturist Federation. Denturists are only allowed to provide full dentures and may work in independent practice.

In the Netherlands cooperation between dentists and for example oral hygienists is promoted by the government to control the human resource input and costs. Dental practices with less dentists and more oral hygienists seem to treat more patients per dentist. In these cases most of the routine tasks are transferred to the oral hygienists[115].

According to the committee Linschoten the dentist has to focus on coordinating the dental care and treating complex cases. The dental hygienist can focus on routine tasks and prevention. This represents 50 to 70% of the patients[115].

Most dentists work in individual practices, but 90% of them refers to dental hygienists

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kkk "Brochure tandheelkunde 2008-2009 rijksuniversiteit Groningen http://www.rug.nl/Studiekiezers/_shared/pdf/tandheelkunde.pdf?as=pdf

lll "Hoe is de mondzorg georganiseerd?", http://www.rivm.nl/vtv/object_document/o5550n20334.html, november 2007

Table 11: Type of dental practice based upon cooperation with colleagues[115]

Type of practice	2001	2006
1 dentist and 0 assitants	71%	63%
1 dentist and 1 or more assistants	14%	18%
2 dentists and 0 assistants	10%	14%
2 dentists and 1 or more assistants	5%	5%

Table 12: Characteristics of dental practices[115]

Characteristics	2001	2006
# of dentists per practice	1,5	1,6
# of clinical work per dentist	32,3	31,5
# of hours performed by the dental assistant per week	47,9	54,8
# of hours performed by the prevention assistant per week	4,0	10,5
# of hours perfomed by the dental hygienists per week	6,8	8,1
# of patients per practice	2.700	2.900
# of chairs per practice	2,0	2,3

3.6.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

The basic insurance covers the costs of the following treatments.[mmm].

- Treatment of children until 18 years of age except for orthodontic care and crowns and bridges
- Treatment by a dental surgeon
- A set of dentures
- Special dental care for patients with a handicap or a congenital malformation.

Orthodontic care is thus not covered by the basic insurance, except for patients with a handicap or a congenital malformation.

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES

Orthodontic care is covered by most of the supplemental private insurance policies, where individuals insure themselves and their children by paying premiums directly to the insurance company. It depends on the kind of supplemental insurance policy and insurance company to what extent the orthodontic treatment will be covered. See Appendix of this chapter for an overview of private insurance policies in 2007.

3.6.4 Fee-for-service for orthodontic acts

In the Netherlands dentists as well as orthodontists can perform orthodontic treatments, but they use a different fee-for-service list. As a consequence the fees for orthodontic treatment are different between dentists and orthodontists.

There is a national list of maximum fees. The amounts are set each year by a government appointed body, the "Nederlandse Zorgautoriteit" (NZa).

The NZa decided in 2005 to lower the fees of orthodontists by 29% compared to the situation of 2001. The lowering of the prices is induced in four steps. By 2010 the targeted fees will be reached. In 2005, the fees of orthodontists were lowered a first time with 8% and the fees were frozen.

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mmm "U en uw tandarts in het nieuwe zorgstelsel"; http://www.werkenbijdetandarts.nl/__C1256DE2004732BC.nsf/vlBijlage/NMT_patientenfolder_basisverzekering.pdf/$File/NMT_patientenfolder_basisverzekering.pdf, August 2007

This means that the yearly inflation correction is no longer carried out. As of July 1st 2007 the fees dropped with another 1.5%. In 2008 the fees will drop with 7.5%.

At the moment that the NZa decided to lower the fees for orthodontists they also expressed their intention to lower the prices for orthodontic treatments by dentists too. Their main goal is: one treatment, one fee.

In Table 4 a few examples of the different fees between dentists and orthodontists as of July 1st 2007.

Table 13: Overview of fee-for-service list for orthodontic acts (July 2007) nnnooo

Description	Dentist	Orthodontist
First consultation	18,80 €	22,90 €
Continuation visit	18,80 €	16,00 €
Orthodontic check up	16,70 €	16,00 €
Second opinion	89,00 €	45,80 €
Dental models	33,90 €	34,40 €
Assessment of dental models	69,60 €	70,60 €
Orthopantomogram	47,30 €	34,30 €
Assessment of orthopantomogram	27,80 €	20,10 €
Fixed fee for removalble appliance	156,50 €	174,00 €
Fixed fee for transition from removable to partially fixed appliance	621,00 €	515,00 €
Fixed fee for transition from removable to fixed appliance	951,50 €	777,00 €
Monthly fixed fee until the 24th month	50,00 €	33,40 €
Monthly fixed fee as of the 25th month	50,00 €	NA

One of the consequences of this lowering of prices is that a lot of orthodontists decided to deregister as orthodontist and to start working as a dentist as for the moment there is still a difference in fee between dentists and orthodontists. Some of the Dutch orthodontists register as orthodontist in Belgium.

At the moment the NZa is investigating for a new fee structure for all of the dental care in the Netherlands.

3.6.5 Overview of Public/Private Insurance expenditures on orthodontics

Orthodontic care is not covered by the basic insurance, except for patients with a handicap or a congenital malformation. In 2006 the Dutch government spent €4.1 million on this exception.[ppp]

3.6.6 Conclusions on the international comparative study based on the literature study for the Netherlands.

- **The Netherlands has a statutory health insurance system with only a basic insurance. There is a widespread use of complementary private insurance policies.**
- **Ratio orthodontists to population is 1 to 59 707.**
- **Ratio dentists to population is 1 to 2 028.**
- **Orthodontic specialty is legally recognized since 1953.**
- **There is a wide range of dental auxiliaries. Cooperation between dentists and dental auxiliaries is promoted by the government.**
- **Orthodontic care is not covered by the basic health insurance except for patients with a handicap or congenital malformation.**
- **Orthodontic fees are fixed.**

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nnn Tarievenlijst orthodontie, Nederlandse Zorgautoriteit, http://www.nza.nl/consument/consumentzorgaanbieders/36301.pdf/, October 2007.

ooo Tarievenlijst tandheelkunde, Nederlandse Zorgautoriteit, http://www.nza.nl/consument/consumentzorgaanbieders/36297.pdf/, October 2007.

ppp Source: e-mail from Drs.E.J.A.A. Abbink advisor at the college voor zorgverzekeringen, www.cvz.nl, 14/11/2007.

3.7 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN THE UNITED STATES OF AMERICA

3.7.1 Health insurance in general

The US is the only major industrialized nation in the world lacking universal health care coverage. In the United States around 58% of the citizens have health insurance, either through their employer (53%), purchased individually (5%) or provided by government programs (26%). About 16% of the population, 47 million people, have no health insurance at all.[qqq]

Table 14: Health insurance coverage of the total population, US, 2006

United States	Number
Employer	158,515,473
Individual	14,515,865
Medicaid	37,994,482
Medicare	35,049,875
Other Public	2,986,514
Uninsured	46,994,627

American health care is provided by a diverse array of individuals and legal entities. Individuals offer inpatient and outpatient services for commercial, charitable or governmental entities. The health care system is not fully-publicly funded, but is a mix of public and private funding.

In 2004 private insurance paid for 36% of total personal health expenditures, private out-of-pocket payments were 15%, while federal, state and local governments paid 44%.[rrr]

In 2004 37% of personal health care expenditures were for hospital care, 26% for physician care, 12% for prescription drugs, 7% for nursing home care and the remaining 18% for other personal health care, including visits to non-physician medical providers, medical supplies and other health services[sss].

For individual private insurance, the "fee-for-service" business model is the default legal situation where the patient must pay out-of-pocket in full for all services rendered. Before a patient gets reimbursed anything, he must have already paid the full deductible amount for the year. Deductibles are usually around $250. The higher the deductible, the lower the premium. In case the patient already met his deductible, he pays the bill and can claim about 80% of his bill back from the insurance company. Most of the time the FFS insurances do not cover for check ups and other "well" doctor visits. In a FFS model, the patient can freely choose his or her physician, hospital,….[ttt]

Besides the FFS model there is also the managed care model. Managed care plans are pre-paid health plans that, in many instances, provide the cover as well as the health care itself.

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qqq Health Insurance coverage of the total population 2006, http://www.statehealthfacts.org/comparebar.jsp?ind=125&cat=3, November 2007.

rrr Health, United States, 2006, US department of health and human services, centers for disease control and prevention, National Center for Health Statistics, http://www.cdc.gov/nchs/data/hus/hus06.pdf

sss Health, United States, 2006, US department of health and human services, centers for disease control and prevention, National Center for Health Statistics, http://www.cdc.gov/nchs/data/hus/hus06.pdf

ttt How Health Insurance Works, http://health.howstuffworks.com/health-insurace.htm, November 2007.

The focus of managed care is on preventive health care. Managed care plans use networks of selected doctors, hospitals, clinics and other health care providers that have contracted with the plan to provide comprehensive health services to members. With a primary care physician acting as a gatekeeper, the company can control costs by reducing unnecessary tests and visits to specialists. Because of this, managed care plans are usually more affordable than FFS plans for similar levels of coverage. A Health Maintenance Organization is a typical example of the managed care model. A typical HMO coverage includes access to primary care physician, emergency care, specialists and hospitalization when needed. There are usually no deductibles, but there are small co-payments for each office visit. Managed care plans usually only pay for medically necessary treatments.

Many individuals not covered by private insurance are covered by government insurance programs such as Medicare and Medicaid. In 2006 Medicaid provided health care coverage for 38 million poor Americans and Medicare provided health care coverage for 35 million elderly and disabled Americans. However, the number of physicians accepting Medicaid has decreased in recent years due to relatively high administrative costs and low reimbursements[uuu]. In 1997 the federal government also created the State Children's Health Insurance Program (SCHIP), a joint-federal state program to insure children, up to age 19, in families who earn too much to qualify for Medicaid, but cannot afford health insurance.[vvv] SCHIP covered 6,6 million children in 2006[www].

The proportion of GDP spent on general health care including dentistry in 2005 was 15.3%. Of this expenditure 45.1% was public. In 2005 health expenditure per capita USD was 6 401[xxx]

3.7.2 Organization of orthodontic practitioners in the USA

LICENSING OF ORTHODONTICS SPECIALTY

In the USA nine dental specialties are licensed. The specialties are: dental public health, endodontics, oral and maxillofacial pathology, oral and maxillofacial radiology, oral and maxillofacial surgery, orthodontics and dentofacial orthopaedics, paediatric dentistry, periodontics and prosthodontics[yyy].

Orthodontics is licensed since 1917.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES[zzzaaaa]

Dental school is a four year academic course consisting of two years basic medical and dental sciences, followed by two years of clinical training.

Before graduating, every dental student must successfully complete the National Board Dental Examination part I and II. Part I is usually taken at the end of the second year after the majority of the didactic courses have been completed. Part II is usually taken during winter of the last year of dental school. To practice, a dentist must pass a licensing examination administered by an individual state or region.

To become an orthodontist a dentist must follow a residency program of 2 to 3 years.

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uuu Cunningham P., May J., "Medicaid patients increasingly concentrated among physicians.", Track Rep. 2006 Aug; (16):1_5. PMID 16918046, http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?

vvv SCHIP Overview. U.S. Department of Health & Human Services, Centers for Medicare and Medicaid Services., July 2007.

www SCHIP Ever Enrolled in Year (PDF). U.S. Centers for Medicare and Medicaid Services., http://www.cms.hhs.gov/NationalSCHIPPolicy/downloads/SCHIPEverEnrolledYearGraph.pdf, September 2007.

xxx OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

yyy Dentistry definitions, http://www.ada.org/prof/ed/specialties/definitions.asp.

zzz Dentistry definitions, http://www.ada.org/prof/ed/specialties/definitions.asp.

aaaa Careers in dentistry: dental team careers, http://www.ada.org/public/careers/team/index.asp.

Dentists as well as orthodontists are allowed to provide orthodontic care. [116]

In the US there are only 3 types of dental auxiliaries:

- oral hygienists
- dental laboratory technicians
- dental assistants

Oral hygienists provide oral hygiene care for patients. They motivate and instruct patients on methods to prevent oral disease and to maintain oral health. They train for 2 years.

Dental laboratory technicians create dental prostheses and replacements for damaged or missing tooth structures. There careers can begin without college level courses through on-the-job-training in dental laboratories or dental offices.

Dental assistants assist the dentist during a variety of procedures. They are allowed to take dental radiographs, to sterilize instruments and to take impressions of patients' teeth. There careers can begin without college level courses through on-the-job-training in dental laboratories or dental offices.

3.7.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

Medicaid is the United States health program for individuals and families with low incomes and resources. It is jointly funded by the states and federal government and is managed by the states. Each state runs its own program. As a result, the eligibility rules differ significantly from state to state as well as the coverage, but all states must follow the same basic framework.

Dental services under the Medicaid program are an optional service for the adult population. However, dental services are a required service for individuals under the age of 21, as a component of the Early and Periodic Screening, Diagnostic and Treatment benefit (EPSDT).

EPSDT is Medicaid's comprehensive child health program. The programs' focus is on prevention, early diagnosis and treatment of medical conditions. EPSDT is a mandatory service required to be provided under all state's Medicaid program. Dental services must be provided at intervals that meet reasonable standards of dental practice and if indicated by medical necessity. Services must include at least: relief of pain and infections, restoration of teeth and maintenance of dental health. EPSDT requires that all services coverable under the Medicaid program must be provided to EPSDT recipients if medically necessary. Every state determines medical necessity.

Under EPSDT orthodontic treatment can be covered. To determine medical necessity the Grainger Orthodontic Treatment Priority Index and the South Carolina Orthodontic Screening Index are commonly used. Impaired dental-facial aesthetics can have a profound effect on a child's psychosocial development.

Therefore consultation with a child's physician or psychologist can also be used to help identify children in need of orthodontic care based upon psychosocial needs.[bbbbcccc] If necessary the following orthodontic treatments are covered:

- space maintenance
- eliminating the effects of oral habits (e.g. thumb sucking)
- interceptive orthodontic treatment
- comprehensive orthodontic treatment

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bbbb Medicaid dental coverage, http://www.cms.hhs.gov/MedicaidDentalCoverage/, November 2007.

cccc Guide to Children's Dental Care In Medicaid, http://www.cms.hhs.gov/MedicaidDentalCoverage/Downloads/Dentalguide.pdf, November 2007.

States may elect to provide dental services to their adult (age 21 and older) Medicaid-eligible population or elect not to provide dental services at all. While most states provide at least emergency dental services for adults, less than half of the states provide comprehensive dental care.[dddd]

Dental services under the SCHIP are an optional benefit. However, all states have opted to provide coverage for dental services.

States may choose to expand their Medicaid programs, to design separate child health programs or to create a combination of both. Patient out-of-pocket costs for this program are allowed, but limited.

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES

Some complementary private insurance policies also cover for dental care, but most of them do not cover dental care.

Most of the time an individual will have to take a separate complementary private insurance for dental care, they are called Dental Plans.

Coverage if different for every policy and depends on the premiums.

3.7.4 Fee-for-service for orthodontic acts

In rural areas orthodontic treatment can be found for under $3 000. On the other hand, if a patient lives elsewhere, fee for orthodontic treatment could be $7 000 or more for complex cases.[eeee]

3.7.5 Conclusions on the international comparative study based on the literature study for the USA.

- **In the USA there is a minimal statutory health insurance system. 16% of the population is uninsured. There is limited use of private insurance schemes. 58% of the population is insured through their employer.**
- **Ratio orthodontists to population is 1 to 31 498.**
- **Ratio dentists to population is 1 to 1 705.**
- **Orthodontic specialty is legally recognized since 1917.**
- **Only 3 types of dental auxiliaries are used.**
- **Orthodontic treatment can be covered under the Medicaid program in case of medical or psychosocial necessity.**
- **Orthodontic fees are not fixed.**

3.8 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN SWEDEN

3.8.1 Swedish health care in general

The Swedish health care system is organized on three levels: national, regional and local. The regional level, through the county councils, together with central government, form the basis of the health care system. The county councils plan the development and organization of health care according to the needs of their residents.

The Swedish health care system is primarily funded through taxation. Both county councils and municipalities have the right to levy proportional income taxes on their respective populations. In addition to taxation revenue, financing of health care services is supplemented by the state grants and user charges. User charges are direct, small fees for medical attention payable by patients.

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dddd Medicaid dental coverage, http://www.cms.hhs.gov/MedicaidDentalCoverage/, November 2007.

eeee Questions about the cost of orthodontic care, http://www/bracesinfo.com/parents1.html, November 2007.

These fees are in the form of flat-rate payments. In 2003, 72% of the county council revenues originated from local taxes. The remainder consisted of: state grants, 18% (subsidies and general state grants), user charges, 3% and other sources, 7%.

The social insurance system, managed by the Swedish Social Insurance Agency, provides financial security in case of sickness and disability. No basic or essential health care or drug package is defined within Swedish health care.

Primary health care is mainly publicly provided.

In Sweden, more than in other countries, a relatively large proportion of the resources available for medical services have been allocated to the provision of care and treatment at the hospital level. For highly specialized care, Sweden is divided in six large medical care regions, within which the county councils cooperate to provide the population with highly specialized care.

Every Swede is formally entitled to choose his/her primary care physician, but in most county councils individuals can also seek care directly from hospitals, thereby bypassing primary care.

According to the Health and Medical Services Act, the Swedish system provides coverage for all residents of Sweden, regardless of nationality.[ffff]

The proportion of GDP spent on general health care including dentistry in 2005 was 9.1%. Of this expenditure 84.6% was public. In 2005 health expenditure per capita was USD2 918 [gggg]

3.8.2 Organization of orthodontic practitioners in Sweden

LICENSING OF ORTHODONTICS SPECIALTY

1. In Sweden there is training in 8 main specialities:
2. Orthodontics
3. Oral and Maxillo-facial surgery
4. Endodontics
5. Paediatric dentistry
6. Periodontology
7. Prosthodontics
8. Radiology
9. Stomatognathic physiology

Orthodontics is a licensed specialty since 1965.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES

There are four dental schools, all state owned and financed. The schools are all part of the Faculties of Medicine of the respective universities. To enter dental schools, students must have completed secondary school education. There is no entrance examination. The dental undergraduate course lasts 5 years and there is an annual intake of about 200 to 220 students.[hhhh]

In order to practise as a dentist in Sweden, a qualified dentist must have a licence awarded by the National Board of Health and Welfare unit for Qualification and Education. This body keeps a register of dentists. The Social Insurance Office also keeps a register of practitioners who are affiliated to the national social insurance scheme.

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ffff Health care systems in transition, Sweden, 2005,http://www.euro.who.int/document/E88669.pdf, august 2007.

gggg OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

hhhh Dentistry in Sweden, Swedish Dental Association, http://www.whocollab.od.mah.se/euro/Sweden/data/dentistry_03.pdf, august 2007.

Dentists must be on this register before they can claim social insurance subsidies. Registering for affiliation with the national social insurance scheme only requires the production of a recognised degree, certificate or diploma.

Training for orthodontics takes 3 years after 2 years in general practice. It takes place in university clinics or recognised postgraduate institutions.

The system of use of dental auxiliaries is well developed in Sweden and a large part of oral health care is provided by them. Apart from chairside dental nurses, there are three important types of dental auxiliaries.

Oral hygienists require an academic entry of 2 A levels and then 2-3 years of undergraduate academic education in oral health science at one of the university colleges. They need to be registered and may work independently. Their duties may include diagnosis of caries and periodontal disease, and they may provide temporary fillings and local anaesthesia.

Dental technicians require an academic entry of 2 A levels and then 3 years of lectures and practical training at a dental school. They do not need to be registered. Their duties include the production of fixed and removable prosthetic and orthodontic appliances. The may not deal directly with the patients.

Orthodontic auxiliaries' training lasts 1 year and takes place where orthodontists are trained. This enables them to carry out specified procedures, but they must work under the supervision of an orthodontist.

In Sweden, dentists who practise on their own or in small groups, outside hospitals or schools, and who provide a broad range of general treatments are said to be in "private practice". There are about 3 300 dentists who work in this way. This represents 45% of all dentists registered and practising. Dentists or orthodontists in private practices are self-employed and are remunerated mainly by charging fees for treatments, supplemented with social security subsidies. The most common way of remunerating a dentist is to pay a fee for each treatment. If the treatment is one included in the PDS (Public Dental Service) the dentist gets reimbursed by the dental insurance. Very few dentists, less than 1%, accept only private fee-paying patients.[iiii]

Dentists and orthodontists working in hospitals are salaried employees of the counties.

Dentists and orthodontists working in universities and dental faculties are employees of the universities. They are allowed to combine their work in the dental faculty with part-time work elsewhere and, with permission of the university, may work in private practices outside the faculty.

Most orthodontists work in the Public Dental Service or the universities. A small number work in private practice.[jjjj]

Orthodontic treatment can be done by a general dental practitioner under the supervision of a specialist. However, it is more usual for the patient to be referred to specialists.[kkkk]

3.8.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

In Sweden there is a Public Dental Service (NDS) which provides free dental care to children up to the age of 19. These dental services are mainly delivered in local clinics which are managed by the counties. Children and their parents can choose to attend either the NDS or private practitioners.

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iiii. Dentistry in Sweden, Swedish Dental Association, http://www.whocollab.od.mah.se/euro/Sweden/data/dentistry_03.pdf, august 2007.

jjjj Dentistry in Sweden, Swedish Dental Association, http://www.whocollab.od.mah.se/euro/Sweden/data/dentistry_03.pdf, august 2007.

kkkk. "Malocclusions and orthodontic treatment in a health perspective", http://www.sbu.se/Filer/Content1/publikationer/1/Malocclusions_Orthodontic%20.pdf, august 2007

In Sweden orthodontic treatment is part of the general dental care for children and adolescents that is free of charge for patients up to the age of 19, both when treated by the NDS or by a private practitioner.

Adults and elderly people who are not entitled to free care from the NDS can get subsidised dental care from the NDS or dentists in private practice.

Orthodontic care can be performed on adults, but is not free of charge. The actual cost for treating one patient orthodontically in Sweden can be as much as €3 230[llll].

In Sweden there is an obligation to score the treatment need of the patients. Therefore, a priority index of need for orthodontic treatment has been drawn up by the orthodontic section of the Swedish Dental Society and the Swedish Medical Board (1966). It consists of a four grade index scale and is known as the Index of the Swedish Medical Health Board.[mmmm]

3.8.4 Fee-for-service for orthodontic acts

Sweden deregulated the prices for dental services in 1999. The removal of a price ceiling was the most important part of this deregulation. Before the reform, the national government provided subsidies for dental treatments, conditional on the dentists or orthodontist not setting prices higher than the ceiling. In practice, all dentists and orthodontists charged the maximum price allowed. After the reform, the government subsidies were given regardless of the prices charged.

Public and private providers are subsidized by the government to an equal extent.

The prices used before the price deregulation intended to reflect the costs.

The subsidy covers about one third of the patients' costs, which were the same for both public and private dental services before the reform. Since the reform prices vary widely between providers of dental services, both among public and private providers. The county council sets prices for the public dental services in each county, which gives rise to regional price difference for public dental services. The county councils are not allowed to set prices above or below the costs, since they are not allowed to realize profit on their production.

As there is a very large difference in prices between counties it is questionable whether the price changes reflect differences in costs between the county councils.[nnnn]

The private firms' price setting is strongly influenced by the county councils' prices, i.e. the county councils act as price leaders.

Before the reform, the reimbursement was based on a percentage of the fixed national fee, but now the subsidies are fixed according to the type of treatment involved.

The annual costs per child for orthodontic treatment in the ages 3–19 years (all children in Sweden) was on average SEK 324 (€34.87) with a variation between SEK 243 and SEK 456 (€26.16-€49.08).[oooo]

3.8.5 Overview of Public Insurance expenditures on dentistry and/or orthodontics

Total expenses for orthodontic care within the national health care of Sweden amounted to SEK600 million in 2004. This is more or less 0.25% of the total expenses for health care in Sweden.[pppp]

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llll "Malocclusions and orthodontic treatment in a health perspective", http://www.sbu.se/Filer/Content1/publikationer/1/Malocclusions_Orthodontic%20.pdf, august 2007

mmmm http://www.dohc.ie/issues/dental_research/specialisation.pdf?direct=1, March 2008

nnnn Errikson, R., "Testing for price leadership and for reputation good effects: Swedish Dental Service", http://www.sofi.su.se/wp/wp04-5.pdf, november 2007.

oooo "Malocclusions and orthodontic treatment in a health perspective", http://www.sbu.se/Filer/Content1/publikationer/1/Malocclusions_Orthodontic%20.pdf, august 2007

pppp Source:e-mail SBU Sweden

3.8.6 Conclusions on the international comparative study based on the literature study for Sweden

- **Sweden has a statutory health insurance system based upon residence.**
- **Ratio of orthodontists to population is 1 to 53 529.**
- **Ratio of dentists to population is 1 to 1 248.**
- **Orthodontic specialty is legally recognized since 1965.**
- **There is a well developed system for use of dental auxiliaries (4 types are used).**
- **Orthodontic treatment is part of the general dental care for children and adolescents that is free of charge for patients up to the age of 19, both when treated by a Public Dental Service (NDS) or by a private practitioner.**
- **There is an obligation to score the need for treatment, but this doesn't influence the reimbursement for patients up to the age of 19. A priority index of need for orthodontic treatment has been drawn up by the orthodontic section of the Swedish Dental Society and the Swedish Medical Board (1966). It consists of a four grade index scale and is known as the Index of the Swedish Medical Health Board.**
- **No national fixed fees are set for orthodontic treatment. The county councils set prices for dental services that reflect the costs. This results in regional price differences. The private firms' pricing is strongly influenced by the county councils' prices.**

3.9 ORGANIZATION AND FINANCING OF ORTHODONTIC TREATMENT IN SWITZERLAND

3.9.1 Health insurance in general[qqqq]

The main form of health care provision is compulsory insurance against the effects of disease including accidents. The compulsory insurance is provided by health insurance funds. The health insurance funds are non-profit organizations and need to be recognized by the Federal Department of Home Affairs. They are also able to offer complementary insurance.

Each person pays his or her own premium, known as a "capitation premium". The health insurance funds offer reduced premiums for children and adolescents (from 0 to 18 years) and young adults (19 to 25 years). The premiums are not dependent on a persons income, but vary from one health insurance fund to another and from one canton to another. The average premium for 2006 was CHF306 (+-€186.91) per month.[rrrr] Individuals on a low income are entitled to reduced health insurance premiums.

One can save up to 20% on the insurance premium by opting for HMO (Health Maintenance Organization), the general practitioner model or by choosing a higher standard deductible fee.

- HMO: the policy holder gives up the right to choose doctors and hospitals freely and receives treatment at an HMO centre
- The general practitioner model: one always has to consult a GP first. The GP will then decide whether you need treatment from a specialist. This restriction does not apply in an emergency.

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qqqq "The compulsory health insurance in Switzerland: your questions,, our answers", Swiss Confederation, Federal Office of Public Health FOPH,http://www.bag.admin.ch/themen/krankenversicherung/00300/index.html?lang=en, November 2007.

rrrr http://www.bsv.admin.ch/dokumentation/zahlen/00093/00422/01368/index.html?lang=fr November 2007.

A proportion of treatment costs is paid by the policy-holder. This proportion consists of:

- A standard deductible fee of CHF300 (+-€183.37) per year. Children and adolescents up to 18 years of age do not pay a standard deductible fee.
- A retention fee of 10% of the remaining invoiced amounts up to a maximum of CHF700 (+-€427.85) per year (CHF350 for children and adolescents)

The standard direct contribution to costs is therefore a maximum of CHF1 000 (+-€611.13) per year for adults and CHF350 (€213.90) for children and adolescents.

The proportion of GDP spent on general health care including dentistry in 2005 was 11.6%. Of this expenditure 59.7% was public. In 2005 health expenditure per capita was USD 4 177[ssss]

3.9.2 Organization of orthodontic practitioners in Switzerland

LICENSING OF ORTHODONTICS SPECIALTY

In Switzerland four dental specialties are licensed. The four specialties are: oral surgery, orthodontics, periodontics and prosthetics. [113]

Orthodontics is licensed since 1975.

DENTISTS, ORTHODONTISTS AND DENTAL AUXILIARIES [113]

It takes 5 years to become a dentist. To enter dental schools, students must pass an examination for university ability.

To register as a dentist in Switzerland, a practitioner must have a recognised diploma with a minimum of 5 years' study, evidence of 2 years additional postgraduate experience and be able to demonstrate ongoing participation in continuing education. The additional dental experience can be earned in university clinics, public dental clinics and as a private practitioner.

Training for orthodontics takes 4 years.

In Switzerland there are 5 types of dental auxiliaries:

- Dental chairside assistants
- Oral hygienists
- Dental technicians
- Dental therapists
- Denturists

Dental chairside assistants train for 3 years with a final examination for qualification. This education is federally recognised.

Oral hygienists train for 3 years at a hygienist school. Their duties include scaling, simple gum treatment and the insertion of preventive sealants.

In some cantons they are allowed to administer local anaesthetics. In most of the cantons they may only work under the supervision of a dentist.

Dental technicians train for 4 years. Their duties are the construction of prostheses. They are not allowed to work in the mouth of patients.

Dental therapists are SSO-trained (Swiss Dental Association). They are allowed to undertake simple operative treatments under the supervision of a dentist.

Denturists are only licensed in 3 of 26 cantons. They train under postgraduate modules for dental technicians. They are only allowed to provide removable prostheses.

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ssss OECD in Figures 2007, Http://lysander.sourceoecd.org/vl=8298390/cl=39/nw=1/rpsv/figures_2007/en/page2.htm, November 2007.

3.9.3 Dental and orthodontic health basket

BASIC INSURANCE COVERAGE

The compulsory health insurance program only covers dental treatment for patients who develop a serious mouth or jaw disorder or in connection with a severe generalized disorder (e.g. leukaemia, heart-valve replacement) if this treatment is necessary to support and ensure the success of medical treatment being given.

The compulsory health insurance also covers dental treatment if required after an accident and the patient has no other insurance that will cover the costs.

The insurance does not cover the cost for the correction of malaligned teeth (orthodontic care).

COVERAGE BY COMPLEMENTARY PRIVATE INSURANCE POLICIES

In Switzerland about 10% of the population are members of private insurance schemes which cover some dental care costs, especially orthodontics. All such schemes are personal and premiums are paid directly to the insurance companies. The level of the premium is linked to the cover required.

3.9.4 Fee-for-service for orthodontic acts

Fixed dental fees were introduced in 1976. They are based upon the average cost of a dental practice.

There are fees for over 500 treatments. A certain number of points have been appointed to these treatments. The fee for treatment equals the number of points appointed to the treatment multiplied by the value of one point.

Fee for a treatment = points appointed to the treatment x value of 1 point.

For treatment covered by the compulsory health insurance the number of points appointed to a treatment and the value of a one point are fixed. At the moment the value for one point is CHF 3.10 (€1.89).

For patients and treatments that are not covered by the compulsory health insurance (private patients) there is a scale of points for each treatment. The value of one point is limited to a maximum of CHF5.40 (€3.30).

For example: maximum fee for first orthodontic consultation (treatment 4800)= 34*CHF5.40 = CHF183.60 (€112.03).

Table 15: Orthodontic fees for private patients[tttt]

L : separate invoice with extra costs for work done by a dental technician
M : extra invoice for used materials
Z : extra cost
PP : Number of points appointed to the treatment for private patients
VPT : Value of 1 point with a maximum of 5fr 40.

XI. Orthopédie dento-faciale

Diagnostic		
4800	25-34	Première analyse/consultation
4801	13-17	Anamnèse d'orthopédie dento-faciale
4802	13-1	Etat actuel, hygiène buccale incluse
4803	9,5-13	Analyse fonctionnelle
4804	9,5-13	Diagnostic de la coopération
4805	39-53	Entretien avec patient et parents
4806	36-48	Analyse de la place
L 4807	65-87	Confection d'un set-up diagnostique
4808	38-52	Relevé téléradiographie/appréciation AI
4809	53-71	Analyse céphalométrique compliquée
4810	31-41	Conception appareil amovible/fixe
4811	14-19	Instruction patient et parents
Appareils amovibles		
L 4815	67-91	Plaque avec vis/éléments activables
L 4816	63-86	Plaque de contention
L 4817	112-152	Appareillage bimaxillaire
L 4818	67-91	Gouttière de surélévation
L 4819	53-72	Positionneur individuel
L 4820	52-70	Plaque vestibulaire individuelle
4821	48-65	Plan incliné confectionné en bouche
L 4822	46-62	Fronde crânio-mentonnière individuelle
M 4823	24-32	Fronde crânio-mentonnière préfabriquée
M 4824	35-47	Traction extra orale, TEO Headgear
M 4825	37-51	"TEO (Headgear) inversée" (Hickam)
M 4826	38-52	"TEO (Headgear) inversée" (Delaire)
Appareils fixes		
4830	5-6,5	Séparation, par espace interdentaire
4832	7-9,5	Soudage ou brasage d'élément auxiliaire
M 4833	30-40	Ajustage et scellement d'une bague
M 4834	9-13	Collage d'un bracket/élément auxiliaire
M 4835	43-58	Arc lingual/palatin direct
L 4836	70-95	Arc lingual/palatin indirect
M 4837	22-30	"Lip-bumper"
4838	37-51	Arc d'expansion
4839	34-45	Arc de nivellement
4840	38-51	Arc rond préfabriqué
4841	40-54	Arc à section rectangulaire préfabriqué
4842	72-98	Arc rond avec au moins 3 boucles
4843	53-72	Arc à section rectang. et courbures
4844	82-111	Arc de torsion selon Begg
4845	79-107	Arc à section rectang. avec boucles
4846	34-46	Arc à segments pour ouvrir/fermer d'esp.
4847	27-37	Garde-espace
4848	36-48	Elément de rétention collé, direct
L 4849	50-68	Elément de rétention collé, indirect
L 4850	54-73	"Spring retainer"
L 4851	109-147	Appareil pour expansion forcée
L 4852	70-94	Appareil pour expansion forcée collé
L 4853	148-200	Appareil "Herbst"
Contrôles/Modifications/Réparations		
4860	12-16	Séance de contrôle ordinaire
4861	20-27	Contrôle d'orthopédie dento-faciale
4862	25-34	Pose et dépose d'arcs existants
L 4863	20-27	Réparations et modifications, sans empr.
L 4864	48-65	Réparations et modifications, avec empr.
4865	41-56	Rebasage direct d'appareil amovible
4866	49-66	Surélévation occlusale
4867	77-105	Activation appareil bi-maxillaire, direct
L 4868	56-76	Activation appareil bi-maxillaire, indirect
4869	22-29	Rescellement d'une bague
4870	20-28	Recollage d'un bracket/élément auxiliaire
4871	5-7	Enlèvement d'une bague/élém. auxiliaire
4872	5-6	Fixation adhésive, par point de collage
4873	2	Enlèv. d'une bague/élém. aux. sans nett.
4890	119-161	Cerclage de dent incluse
4891	90-122	Dent supplémentaire avec même incision

[tttt] http://www.sso.ch/doc/doc_download.cfm?uuid=95C51E9FD9D9424C406FCE1663AB8C5D&&IRACER_AUTOLINK&&

3.9.5 Overview of Public Insurance expenditures on dentistry and/or orthodontics

No information available.

3.9.6 Conclusions on the international comparative study based on the literature study for Switzerland.

- **Switzerland has a statutory health insurance system through a compulsory insurance against the effects of disease and disability provided by health insurance funds. There is limited use (10% of the population) of private insurance schemes.**
- **Ratio orthodontists to population is 1 to 37 500.**
- **Ratio dentists to population is 1 to 1 718.**
- **Orthodontic specialty is legally recognized since 1975.**
- **There are 5 types of dental auxiliaries.**
- **Within compulsory health insurance, there is no coverage for orthodontic treatment.**
- **Fixed maximum fees are set for orthodontic treatment.**

3.10 ORTHODONTICS ORGANISATION AND FINANCING: COMPARISON FOR 8 COUNTRIES, BASED ON A QUESTIONNAIRE

3.10.1 Introduction

In 2001 on the impulse of professor van der Linden (from the University of Nymegen, Holland) and the EFOSA (European Federation of Orthodontic Societies Association) a questionnaire with 45 questions was sent to the 19 professional orthodontic specialist organisations in Europe that were members of EFOSA and to three organisations that were not members at that time (among which Belgium, which did not have the specialization at that time). In 2002 the information was checked and updated by officers of the national organisations and their delegates. Remarkable in this large study was that the response rate in this study was 100 per cent.

Since the publication of this previous survey on the state of orthodontics within the individual European countries (Schmiedel, van der Linden and Bijlstra, 2002[uuuu]), van der Linden, Schmiedel and Bijlstra, 2003[vvvv]) some changes have been taking place, within Europe - and also in Belgium - in the field of orthodontics on the one hand, and on the other hand, some other information was also necessary for this study. So therefore, a new questionnaire was developed, which was mainly based on the previous one, but contained less questions and with more emphasis on organization, regulational and financial aspects.

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uuuu http://www.efosa.org/EFOSA_2003/index.php then go to Documents and next to European Orthodontic Specialists 2002

vvvv NTvT januari; 110: 14-19

3.10.2 Methodology

COUNTRY SELECTION

The country selection was mainly motivated by differences - and not by similarities - in health care systems in the Western world, 7 within Europe and 1 (USA) from outside Europe. Belgium, France, Germany, Sweden, Switzerland, The Netherlands, United Kingdom and the USA were selected.

UPDATE OF EFOSA QUESTIONNAIRE

A new questionnaire was developed, which was mainly based on the previous one, but contained less questions and with more emphasis on organization (e.g. the manpower involved), regulation and financial aspects (e.g. charged fees and coverage of fees by the health care institute, health care insurances and possible other health care agencies or Sickness funds) in the functioning speciality of orthodontics.

LOW SCIENTIFIC VALUE OF THE QUESTIONNAIRE

It is important to note that the scientific value of the reported data in this section is low, since they are based on the answers by a single person in each country. The results should therefore be interpreted with great caution.

3.10.3 Results and conclusions

Two questionnaires were made to be sent to the representatives of the professional orthodontic organizations (members of the EFOSA) of 7 European countries on the one hand and of the USA (AAO = American Association of Orthodontists) on the other hand. A slightly different questionnaire was used for the USA than for the European countries with respect to the questions on health care organization and reimbursement (cfr Appendices to Chapter 3). As in the USA, no similar social system with a compulsory health care service and sickness funds is in use, we adapted these sections with the Medicaid and Medicare programs.

Although the response rate was 100%, the majority of the questions in our International Questionnaire were not answered by the representatives of Switzerland and of the USA. The reasons claimed for not answering for Switzerland, were the large policy differences between the cantons within the country. For the USA, the AAO claimed not to collect the requested information.

For Switzerland, data are added that became available in the 2002-EFOSA questionnaire and which were published thereafter[wwww].

3.10.3.1 Cross-country overview of organization of practitioners

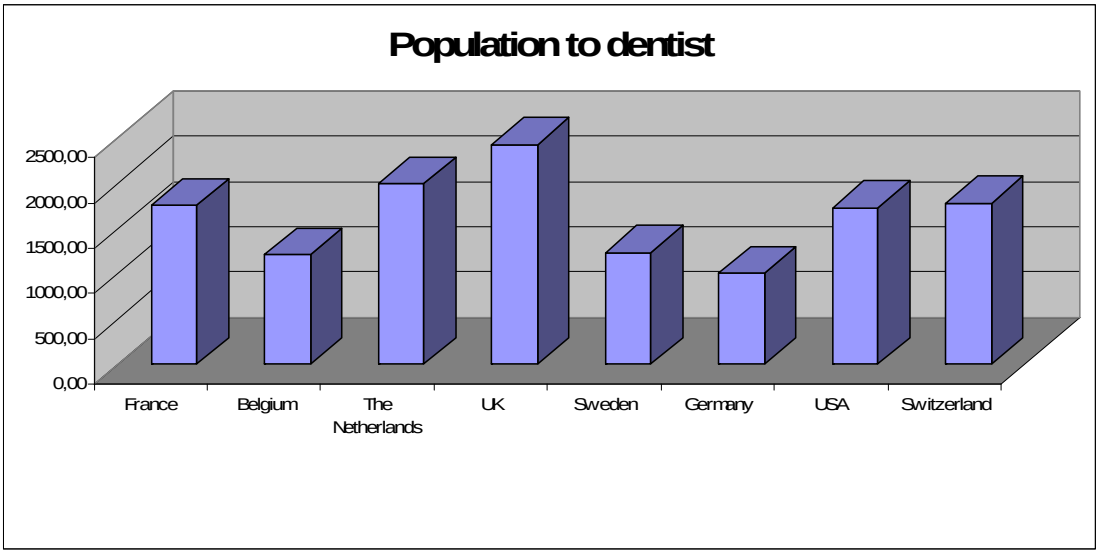
See annex of Chapter 3 for the detailed results on the international questionnaire.

DENSITY OF DENTISTS

With an average density of 67.1 general practitioners per 100 000 inhabitants in Europe, Belgium with its 82.4 dentists per 100 000 inhabitants, has the second highest density of dentists of the selected countries. The densities range between 41.3 (for the UK) and 99.7 (for Germany). According to the International questionnaire data, Belgium is most comparable to the situation in Sweden.

[wwww] NTvT januari; 110: 14-19

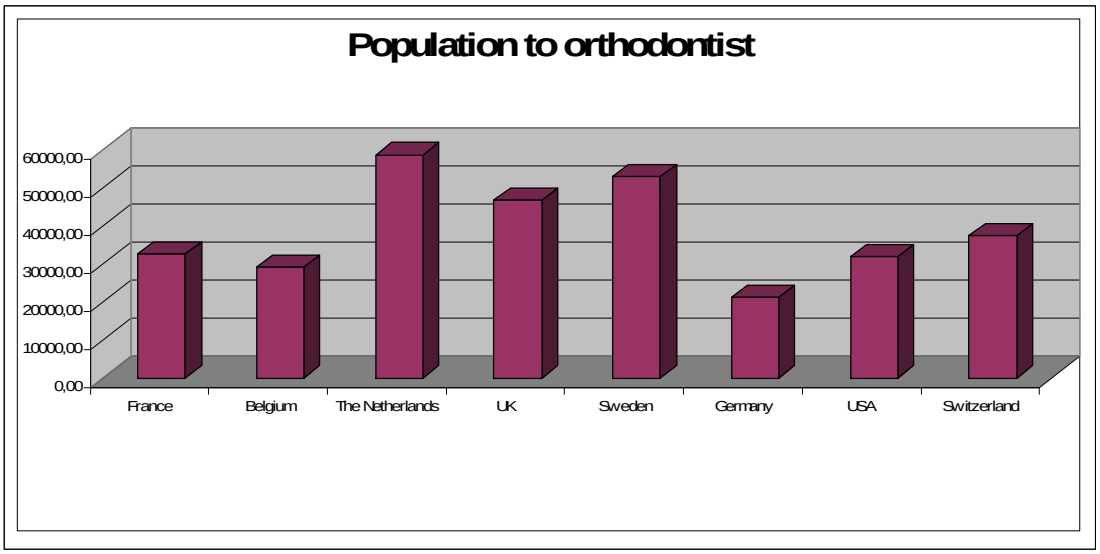
Figure 8: Population to dentist ratio



DENSITY OF ORTHODONTISTS

With an average of 2.9 orthodontists in 100 000 inhabitants in 7 European countries and in the USA, the Belgian density of orthodontists with 3.4 per 100 000 inhabitants is the second highest in the selected countries, after Germany. With the range between 4.7 (for Germany) and 1.7 (for the Netherlands), preceding the USA and France with both a density of 3.1 orthodontists per 100 000 inhabitants. The lowest density in orthodontists is seen in The Netherlands (1.7) followed by Sweden (1.9) and the UK (2.1). This is illustrated in Figure 8.

Figure 9: Population to orthodontists ratio



Source: International Questionnaire. EFOSA-Q 2002 for missing data; cfr Appendix of Chapter 3

According to the International Questionnaire data, Belgium has the highest number of orthodontists per population (1 in 29 167) after Germany with the highest orthodontist to population ratio (1 in 21.128 people) of the selected European countries. The Netherlands have the lowest number of orthodontists per population (1 in 58 608), followed by Sweden (1 in 52 941) and the UK (1 in 52 307).

RATIO NUMBER OF DENTISTS PER ORTHODONTIST

The average ratio between GDP's and orthodontists in the selected countries is 24.2/1 which is very close to the actual ratio in Belgium (24/1) (See Table 16).

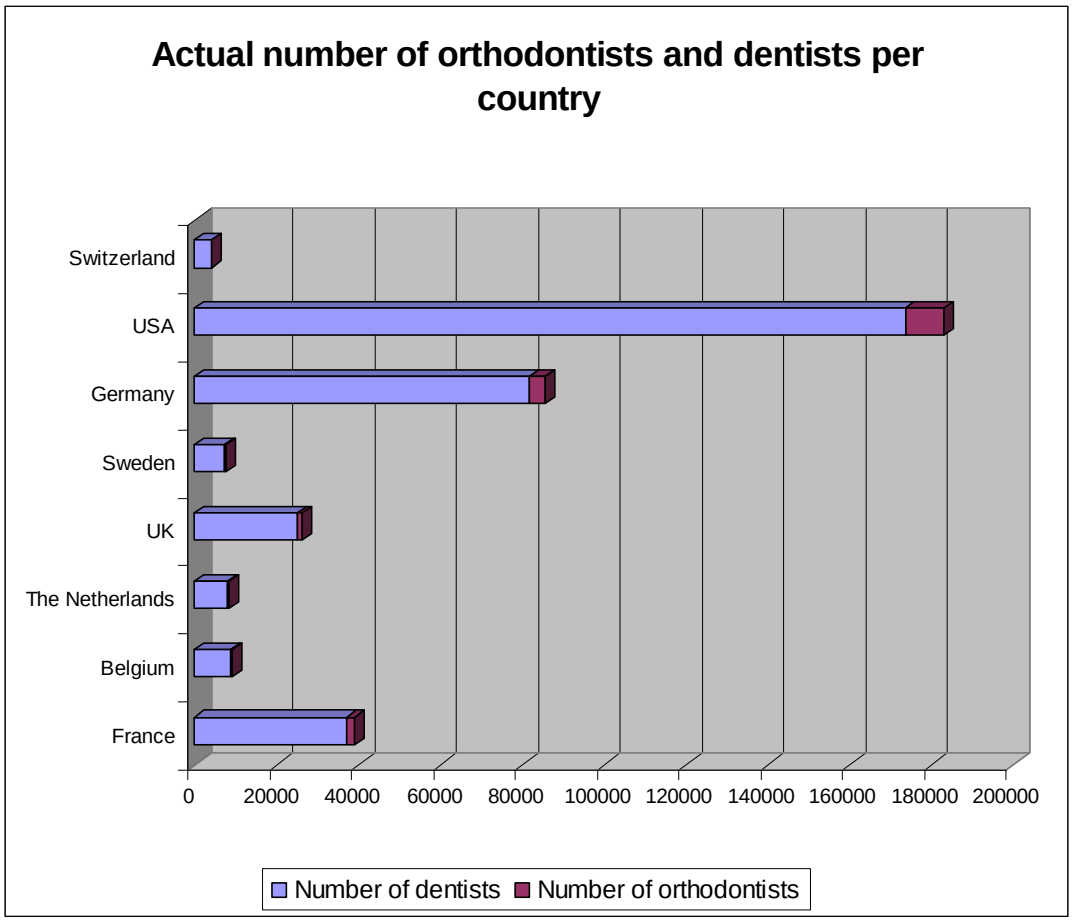
If the ratio dentists to orthodontists is compared in the selected countries, the range (from 18.5/1 to 24/1) is small for France, Belgium, the UK, Germany, the USA and Switzerland, while for the Netherlands (with 29.4/1) and Sweden (with 42.9/1) it is large (Table 13).

Table 16: The ratio between dentists per orthodontist

Variable	FR	BE	NL	UK	SE	DE	USA	CH
Number of GDP's per orthodontist	18.5	24	29.4	19.2	42.9	21.1	18.5	20

Source: International questionnaire. EFOSA-questionnaire 2002 data were used for missing data; cfr Appendix of Chapter 3

Figure 10: Actual number of orthodontists and dentists per country



Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data; cfr Appendix of Chapter 3

INFLUX OF PRACTITIONERS

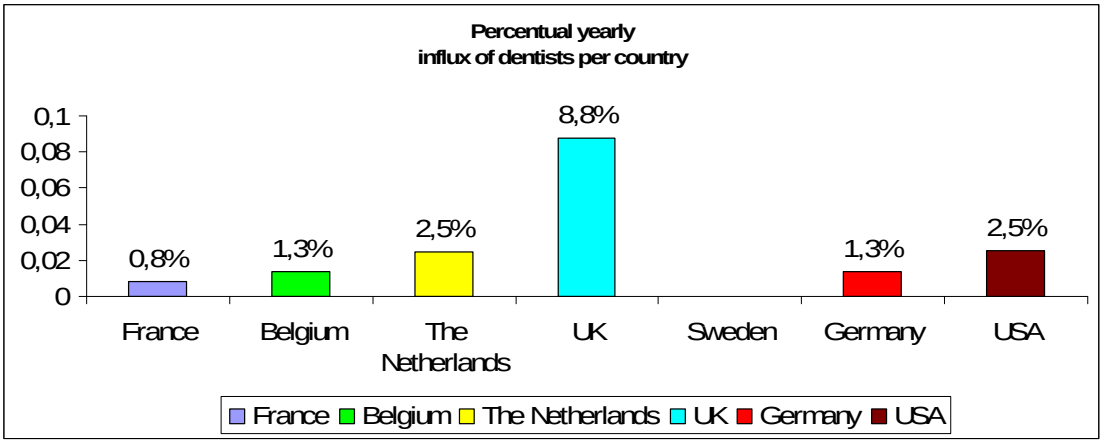
The highest yearly influx of GDP's is reported in the UK (8.8%) and the lowest in France (0.8%) (cfr Figure 6). In view of the low density of GDP's in the UK the high influx of GDP's is a positive evolution. With its 1.3 % increase, Belgium is around the mean of the selected countries (mean is 2.9% yearly influx).

Table 17: Yearly influx of dentists and orthodontists

Variable	FR	BE	NL	UK	SE	DE	USA	CH
Influx of dentists per year	300	116	200	2200	N.A.	1096	4350	80
Influx of orthodontists per year	70	12	16	75	N.A.	50	250	10

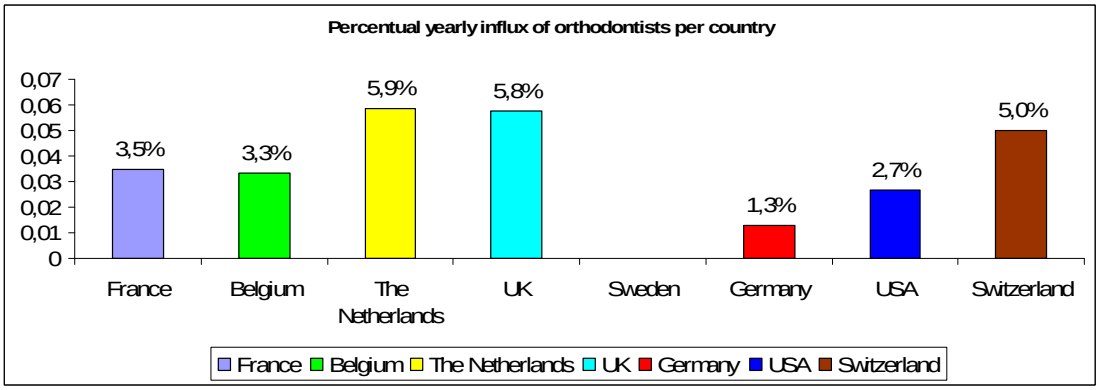
Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data. cfr Appendix of Chapter 3

Figure 11: Percentual yearly influx of dentists



Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data; cfr Appendix of Chapter 3. Note: no information was received from the Swedish representative.

Figure 12: Percentual yearly influx of orthodontists



Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data; cfr Appendix of Chapter 3

The highest reported yearly influx of orthodontists is seen in The Netherlands (5.9% increase) and the UK (5.8%); the lowest in Germany (1.3%).

These three respective changes can be seen as favorable evolutions in view of the current density of the orthodontists in the Netherlands, the UK and Germany. With its 3.3 % increase, Belgium is around the mean of the selected countries (mean is 3.9%).

LICENSING OF ORTHODONTISTS

Table 18: Licensing of orthodontists

Variable	FR	BE	NL	UK	SE	DE	USA	CH
Orthodontic specialty legally recognized	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legally recognized since	1977	2002	1953	1998	1965	1955	1917	1975

Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data

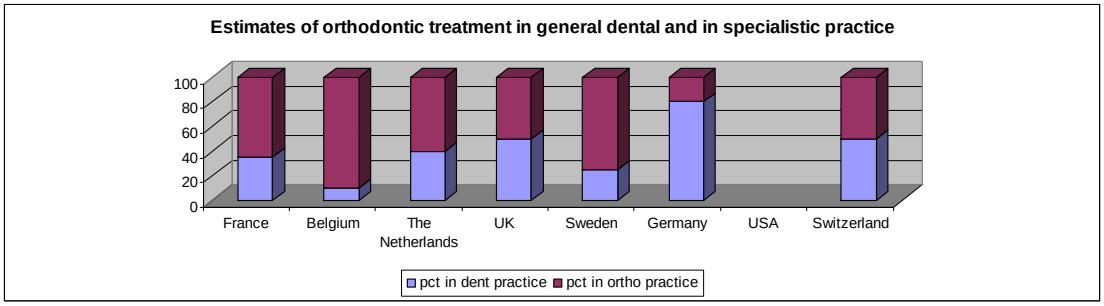
TREATMENT IN ORTHODONTIC VERSUS GENERAL DENTAL PRACTICE

Table 19: Treatment in orthodontic versus general dental practice

	FR	BE	NL	UK	SE	DE	USA	CH
Orthodontic specialists limited to orthodontic treatment	No	Yes	Yes	No	No	Yes	No	No

Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data.

Figure 13: Estimates by representatives of orthodontic treatment performed in general dental and specialist practice



Source: International questionnaire. EFOSA-questionnaire 2002 used for missing data; cfr Appendix of Chapter 3

The estimated range of orthodontics practiced by dentists compared to orthodontists varies between 10% (for Belgium) and 80% (for Germany).

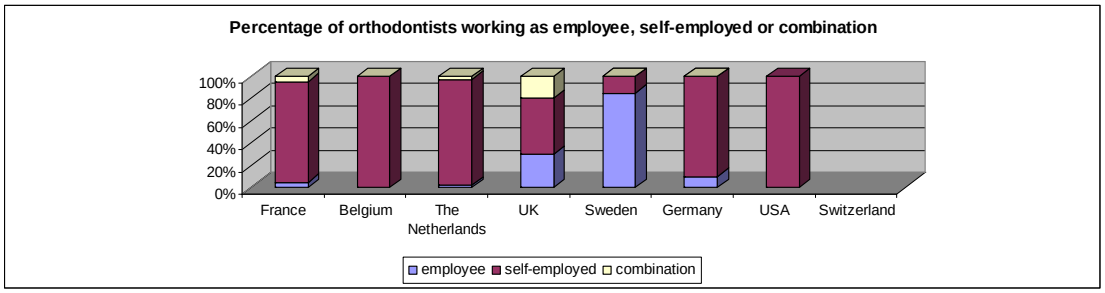
- **Belgium has a relatively high density of dentists and orthodontists: compared to 6 other European countries, only in Germany the ratios are higher**
- **Belgium is close to the average regarding yearly influx of new dentists and new orthodontists as reported by the responding country representatives.**
- **The countries with the lowest density rates - UK and the Netherlands - have the highest influx.**
- **Belgian professional associations estimate that about 90% of orthodontic treatments are provided in a specialist orthodontic practice.**
- **Only in one of the countries - Germany - less than 50% of the orthodontic services are estimated to be provided in specialist orthodontic practices.**

EMPLOYMENT STATUS OF ORTHODONTISTS: SELF-EMPLOYED VERSUS EMPLOYEE

It can be concluded that the vast majority of orthodontists in the responding countries is self-employed, except for Sweden where 85 % works as an employee (see Figure 14). Also in the UK, 30% of the orthodontists work as employees. Only in the USA, there are no orthodontists working as employees. For Belgium the percentage of orthodontists working as employees is estimated to approximate 0

(the only exceptions being some university professors in some university hospitals as well as some orthodontic care providers in polyclinics run by some Sickness funds).

Figure 14: Percentage of orthodontists working as employee, self-employed or a combination



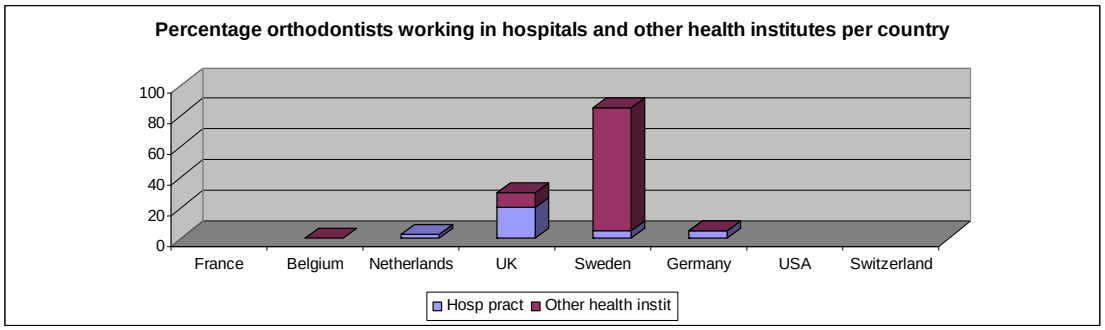
Source: International questionnaire.

In every country a combined employment is reported to be exceptional (< 5% of the orthodontists) except in the UK where the combined employment is adopted by 20% of the practitioners. For the USA, the respondent did not provide information on a combined employment. It is however well known (personal information from a lot of American colleagues working part time at university departments and part time in their own private practice) that there are a few self-employed practitioners who also are lecturers or instructors at university departments as is also the case in the Belgian situation. Of course this probably represents a negligible number of orthodontists, as well for the USA as for Belgium. For orthodontic university departments in the USA this already now represents a problem for the continuity of the postgraduate education in orthodontics as there is no interest in full time academic positions in orthodontics.

INDIVIDUAL VERSUS GROUP PRACTICE

The answers from the questionnaire show that in three of the five responding countries, more than 90 % of the orthodontists work in individual private practices, and that less than 5 % work in group practices. In France a respectable number of orthodontists seems to work in group offices, while in Sweden 80 % of the orthodontists work as employees of the County Council health care institutes[xxxx], 10 % of the orthodontists work in single private offices and 5 % work in group private offices.

Figure 15: Percentage of orthodontists working in hospitals in the different responding countries.



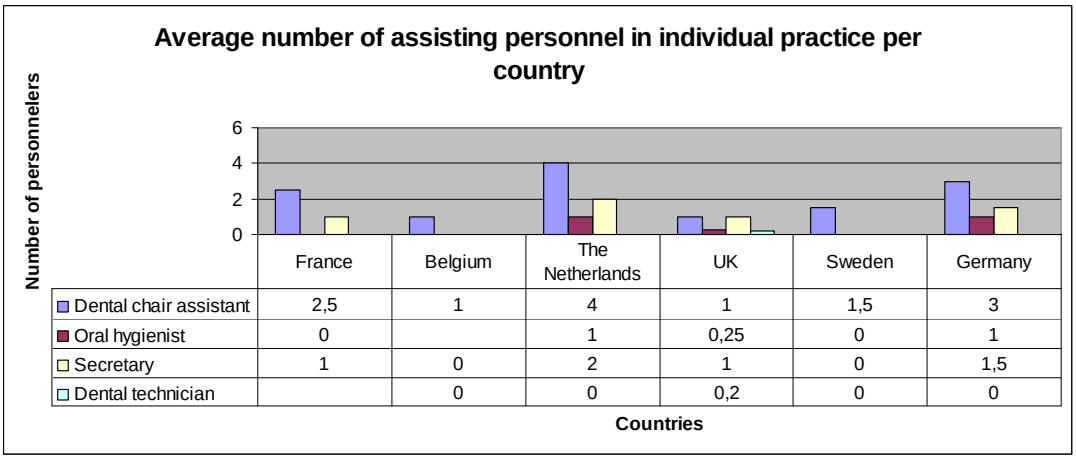
Source: International questionnaire

xxxx In Scandinavian countries special Craniofacial Centers are being created where specialistic orthodontic care is delivered (for patients with cleft lip and palate, oligodontia and other congenital deviations); as this question was not explicitly asked in this questionnaire, this information will still be retrieved in another way.

ASSISTING PERSONNEL

When comparing the assisting personnel in the practices reported by the representatives of the countries of interest, it is striking that Belgium and Sweden have the least assisting personnel (respectively only 1 and 1.5 dental chair assistant) and also the least differentiation in the assisting personnel.

Figure 16: Assisting personnel in the individual orthodontic practice



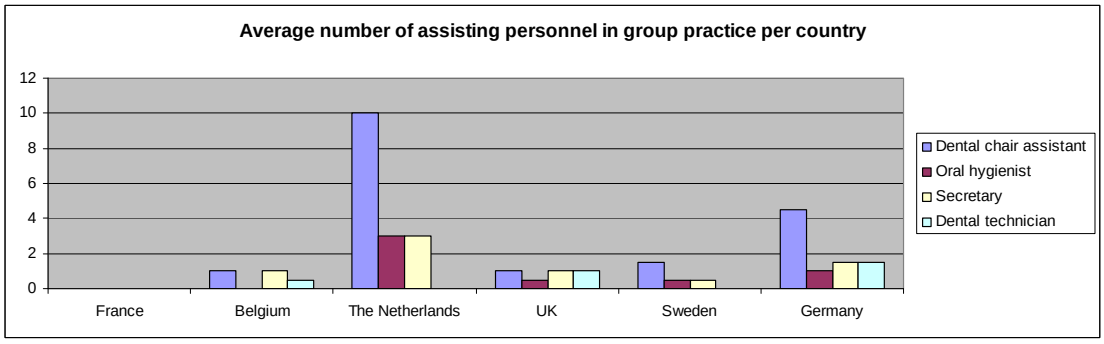
	France	Belgium	The Netherlands	UK	Sweden	Germany
Dental chair assistant	2,5	1	4	1	1,5	3
Oral hygienist	0		1	0,25	0	1
Secretary	1	0	2	1	0	1,5
Dental technician		0	0	0,2	0	0

Source: International questionnaire

While in the other countries it is estimated that there is not only at least 1 (range from 1 to 4) chairside dental assistant[yyyy], an oral hygienist (in 3 of the 6 responding countries), a secretary (range from 1 to 2) and a part time dental technician (only in Germany), in Belgium only one chairside assistant is probably performing a combination of tasks. In the UK the orthodontist employs all the types of functions mentioned in our questionnaire.

In the Netherlands, the orthodontist is the largest employer (at least in numbers) from the responding countries[zzzz]. The most employed function is that of the dental chairside assistant.

Figure 17: Assisting personnel in the orthodontic group practice



Source: International questionnaire. Note that no data were provided for France, Switzerland nor the USA.

Figure 17 depicts the situation of assisting personnel in group practices, probably understanding multidisciplinary practices (and not several orthodontists together).

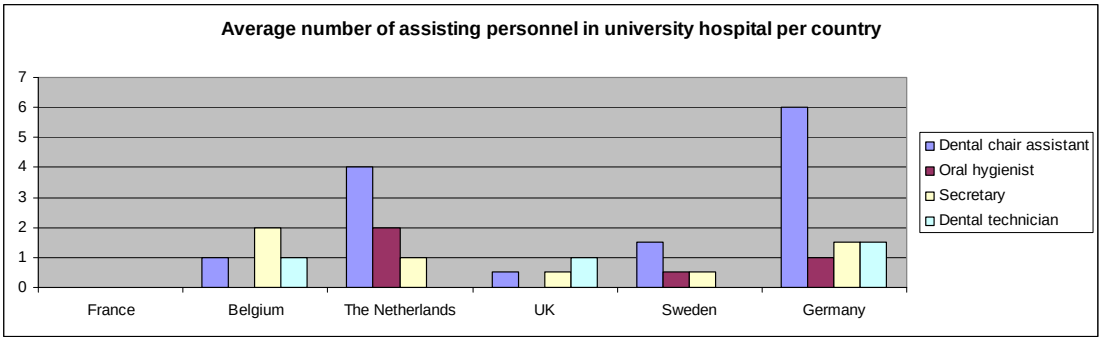
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yyyy In Belgium a daytime training program for dental chair assistants has been created by the VDAB, together with the VVT (Vereniging voor Vlaamse Tandartsen) recently.

zzzz The Netherlands seem to have an interesting fiscal climate to employ assisting personnel in the orthodontic practice.

Together with the multidisciplinarity of the practitioners, the diversity of the assisting team also increases. Not only secretaries are added in Belgium and Sweden, but also dental technicians appear in these group practices as well in Germany as in Belgium. In the Netherlands, the largest number of FTE's of dental chairside assistants are employed in group practices.

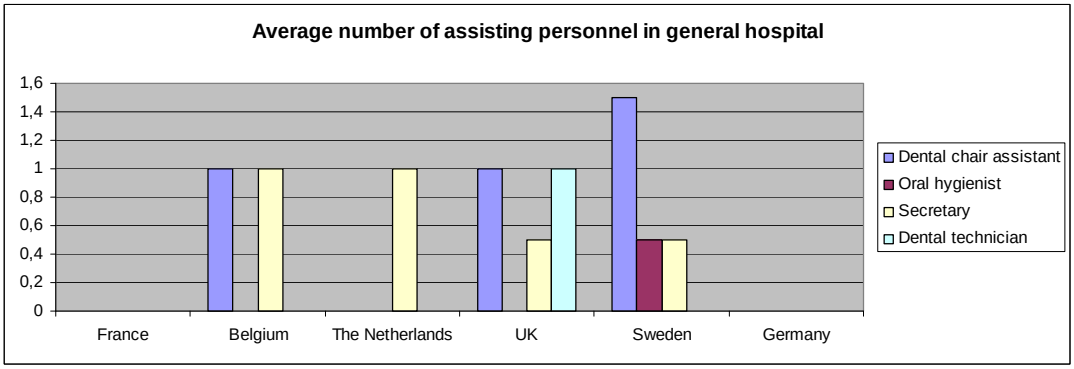
Figure 18: Assisting personnel in the university hospital practice (no data provided for France, Switzerland nor the USA)



Source: International questionnaire

In Germany the number of chairside assistants seems to be significantly higher in the university hospital environment compared to the private practice environment, while in the Netherlands, this seems to be the reverse. In Belgium the difference seems to occur at the level of the employed secretaries (shared employees with other academic personnel) and dental technicians, but not in terms of dental chairside assistants.

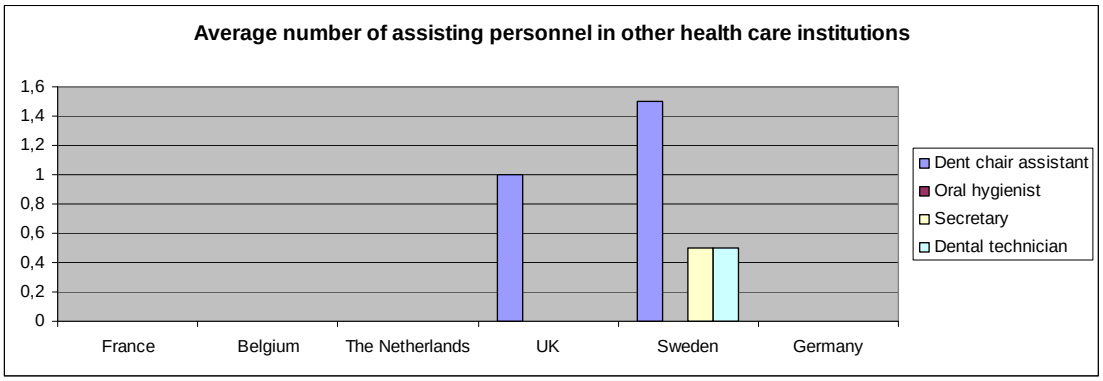
Figure 19: Assisting personnel in a general hospital



Source: International questionnaire. Note that no data were provided for France, Germany, Switzerland nor the USA.

In 4 out of 8 countries, namely Belgium, the Netherlands, the UK and in Sweden, orthodontic treatment sometimes is provided in general hospitals. This is not reflected in the assisting personnel in any of the countries, except in a negative direction in the Netherlands, as there are no dental chairside assistants employed in general hospitals. In Belgium, a secretary is estimated to be at the disposal of the orthodontist in a general hospital. In Sweden, a half time secretary and a half time oral hygienist is present in the general hospital.

Figure 20: Assisting personnel in other health care institutions; only data for Sweden and for the UK were provided.



Source: International questionnaire

Other health care institutions (of significance) in which orthodontic treatments are performed apparently only exist in the UK (National Health Service, NHS) and in Sweden (only the Health Care Centres organized by the County Councils). The respondent of the UK indicates however that the assisting personnel and facilities in the NHS are less comfortable than in the other types of practice organizations. For Sweden, the facilities for personnel remain similar through different types of orthodontic practice, except for the solo private practice, where usually only one dental chairside assistant is estimated to be present.

NUMBER OF PATIENTS TREATED PER ORTHODONTIST

There is a large variation in the estimated number of different patients treated per year per orthodontist in the different countries. The lowest total patient load per orthodontist is in Sweden (160 different patients of which 150 in the selected age category) followed by the UK (with 250 different patients, of which 240 between 0-15yrs of age).

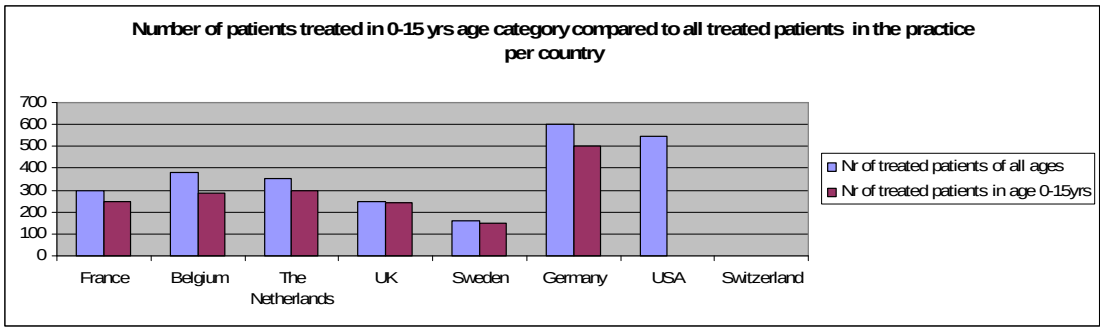
Although similar assisting personnel is active in the practice organization in Sweden and Belgium, the Swedish orthodontist mainly active in the health care centres of the County Council only treats half of the number of patients than the Belgian colleague in a private practice environment. This might be related to his fixed employment situation, maybe not giving enough incentive for a large patient load. Although similar total (sum of reimbursed and non-reimbursed part of the treatment fee) treatment fees are handled in Sweden and Belgium, patients profit of a full reimbursement of these fees in Sweden.

Table 20: Proportion of patients in the age category 0-15 yrs compared to all treated patients

	FR	BE	NL	UK	SE	DE	USA	CH
Average treated number of patients (all ages)	300	380	350	250	160	600	547	N.A.
Average treated number of patients (0-15y)	250	285	300	240	150	500	N.A.	N.A.

Source: International questionnaire.

Figure 21: Number of patients treated in the practice in the age category 0-15 yrs compared to all treated patients



Source: International questionnaire

Figure 21 shows the number of patients in the age category 0-15 yrs in the practice per country. The range between the responding countries is 150 for the Swedish orthodontist and 600 for the German orthodontist (547 patients for the USA). With its 280 estimated patients in treatment, the average Belgian orthodontist is on the 3rd position on 7 for the yearly patient load, and on the 3rd position on 6 for the selected age group of 0-15 yrs of age.

The vast majority of patients treated in the orthodontic practices of the responding countries are children between 0 and 15 yrs of age. In France it is estimated that 17% of the patients do not belong to that age group, in Belgium this is 25%, in the Netherlands it is 14%, in the UK it is 4%, Sweden 6% and in Germany 17%.

- **In 4 of 6 countries, just like in Belgium, 90% or more of the orthodontists work as independent professionals.**
- **In all countries, except in France, only very few orthodontists work in group practice. In France it is estimated that 40% of the orthodontists work in a group practice.**
- **From all the responding countries, Belgium and Sweden are estimated to have the least assisting personnel with respectively only 1 and 1.5 dental chair assistant.**
- **Belgium and Sweden are also estimated to have the least differentiation in the employed assisting personnel.**
- **In Belgium, there generally is only 1 dental chair assistant employed by the orthodontist, whereas in other countries this number varies from 1 up to 4. It is not known however how this relates to the general practitioners providing orthodontic treatment.**
- **It is reported that in general, there is no oral hygienist, no secretary and no dental technician employed by the orthodontist in Belgium. In other countries these profiles are also more frequently employed.**

3.10.3.2 Cross-country overview of fees (total versus reimbursed fees)

FEES FIXED OR FREE

Table 21 depicts the comparison on the fixation of the fees and - in case of fixation - also the authority which is setting the fixation. In each country the situation seems to be different. In France, there are only fixed fees for a minority of patients, notably the CMU-patients. In Belgium and Sweden, the reimbursement fees by the national health care institute are fixed, but not the actual fees handled in orthodontic practice.

Table 21: Actual fees fixed or free

Variable	FR	BE	NL	UK	SE	DE	USA	CH
Fixed fee for orthodontic treatment	No(*)	No	Yes	Yes	No	Yes	N.A.	No
Fixed by public health insurance	-	-	-	Yes	-	Yes	N.A.	-.
Fixed by private insurance	-	-	-	-	-	Yes	N.A.	-.
Fixed by professional organization	-	-	Yes	-	-	-	N.A.	-

Source: International questionnaire. No data were provided by the representative of Switzerland , nor of the USA. For these 2 countries, other sources were used. (*) Fixed fees only for CMU patients.

Although the vast majority of the orthodontists in Belgium do not undersign the convention between the dental health care providers and the RIZIV/INAMI, there is since 1997 a guideline by the Christian Mutuality sickness fund which has been unofficially/unwritten agreed with the professional orthodontic organization at that time - the BBUSO (the Belgische Beroepsvereniging van Universitair opgeleide Specialisten Orthodontie). The fee has yearly been adapted to the index since then and has been reported to be followed by the orthodontists since then.

The situation in France concerning the fees is similar to Belgium and Sweden, as there is no legal obligation for orthodontists to undersign an agreement on fees for orthodontic treatment.

According to the representative for the Netherlands, the fees are fixed by the professional organization. According to literature however, they are being fixed by the Nederlandse Zorgautoriteit, a government appointed body.

In the UK the fees are fixed by the National Health System (NHS), except for private patients.

ACTUAL FEE LEVELS

In Table 22, the actual fees per orthodontic treatment type are shown. In France, the total fee for fixed appliance treatment is estimated between €600 per semester in more rural areas and €800 per semester in the cities. The fee for retention is estimated at €600 per year.

Table 23 shows whether the treatment fee is directly influenced by the severity of malocclusion. In none of the countries this is the case. It needs to be remarked, however, that the duration of treatment is generally an important price driver, which is indirectly linked to the severity of malocclusion.

Table 24 shows the elements that are included in the reported fees. In 3 of the 6 responding countries (i.e. in France, Belgium and the Netherlands) the fees for diagnostic records are not included in the treatment fee; these fees are fixed and reimbursed separately. In the three other responding countries (the UK, Sweden and Germany) the fees for the diagnostic records as well as for the treatment plan, are included in the treatment fee. In Belgium the act of treatment planning is separated from the diagnostic records.

In all responding countries the appliances are included in the fee for the orthodontic treatment.

Table 22: Actual fees per orthodontic treatment type (no data provided by Switzerland nor by the US)

Average fees	FR	BE	NL	UK	SE	DE	USA	CH
For interceptive treatment (€)	600	400	75	305	200	400	N.A.	N.A.
For orthopaedic treatment (€)	600	1200	480	N.A.	700	1900	N.A.	N.A.
For comprehensive treatment (€)	800	2340	1425	N.A.	2500	2400	N.A.	N.A.
For standard treatment with full fixed appliance (€)	N.A.	2940	1830	1200	3000	2600	N.A.	N.A.
For end of treatment (€)	N.A.	N.A.	incl	incl	incl	N.A.	N.A.	N.A.
For retention phase treatment (€)	600	22	N.A.	N.A.	N.A.	400	N.A.	N.A.

Source: International questionnaire. No information available for the USA. Important note: the fees need to be interpreted with caution as the durations for each treatment type differed and it is not clear whether the indicated fees are meant for the full treatment duration or only for the part indicated in our questionnaire.

Table 23: Treatment fee influenced by severity of malocclusion

	FR	BE	NL	UK	SE	DE	USA	CH
Severity of malocclusion influences treatment fee	No	No	No	No	No	No	N.A.	No

Source: International questionnaire. No information available for the USA.

Table 24: Included elements in the actual fees

Included in the fees	FR	BE	NL	UK	SE	DE	USA	CH
Fee for record	No	No	No	Yes	Yes	Yes	N.A.	No
Fee for diagnostic records	N.A.	92	240	0	0	0	N.A.	N.A.
Fee for treatment planning and proposal records	N.A.	113	0	0	0	0	N.A.	N.A.
Fee for appliances	1	1	1	1	1	1	N.A.	N.A.

Source: International questionnaire. No information available for the USA.

Table 25: Appraisal of fees

Appraisal of fees	FR	BE	NL	UK	SE	DE	USA	CH
Comparison of fees with respect to cost	Too low	Too low	Too low	Too high	Fair	Too low	N.A.	Fair
Comparison of fees with respect to fees in other countries	Too low	Too low	Too low	Too low	Too low	Fair	N.A.	Fair
Comparison of fees with respect to other medical specialists	Too low	No opi-nion	Too low	Too low	Too low	Fair	N.A.	Fair

Source: International questionnaire. No information available for the USA.

Table 26: New technologies

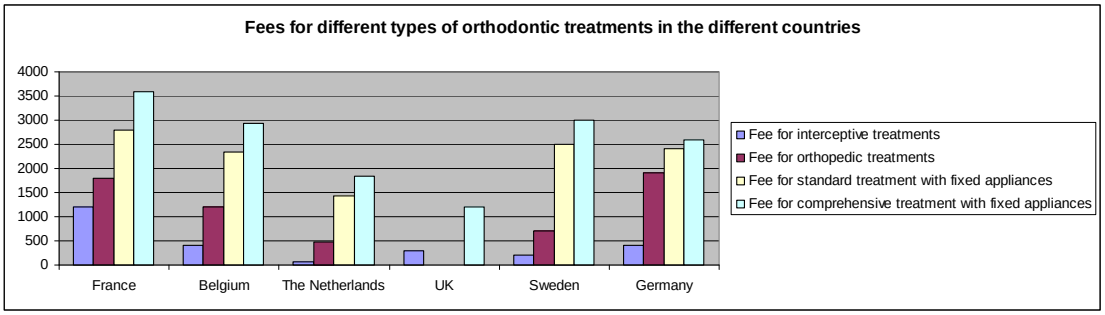
New technologies	FR	BE	NL	UK	SE	DE	USA	CH
New technology applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Supplemental cost for new technologies	Yes	Yes	No	No	No	No	N.A.	Yes
Cost of new technologies included in fee	No	No	Yes	Yes	Yes	Yes	N.A.	No
Cost of new technologies included in fee for fixed appliance	N.A.	N.A.	Yes	Yes	Yes	Yes	N.A.	N.A.
Cost of new technologies included in fee for orthopedic appliance	N.A.	No	No	No	Yes	Yes	N.A.	N.A.

Source: International questionnaire.

Figure 22 and Figure 23 show the actual fees per orthodontic treatment type. The fees need to be interpreted with caution as the durations for each treatment type differed and it is not clear whether the indicated fees are meant for the full treatment duration or only for the part indicated in our questionnaire.

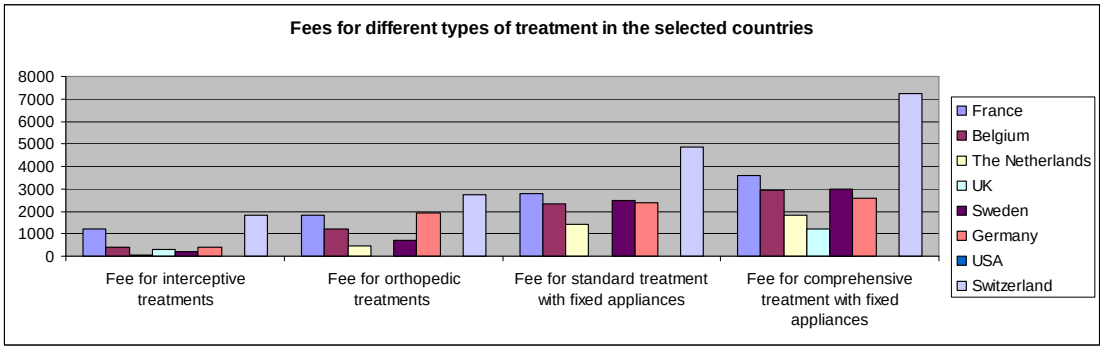
From the responding countries (excluding the fees for Switzerland as these were taken from the EFOSA 2002 data and thus might be outdated), France[aaaaa] seems to have the highest fees for all treatment types.

Figure 22: <u>Actual</u> fees per orthodontic treatment type (no data provided by Switzerland nor by the US).



Source: International questionnaire. Important note: the fees need to be interpreted with caution as the durations for each treatment type differed and it is not clear whether the indicated fees are meant for the full treatment duration or only for the part indicated in our questionnaire.

Figure 23: <u>Actual</u> fees per orthodontic treatment type. No data were provided for the USA nor for Switzerland. For the latter country, data from EFOSA 2002 were extrapolated.



Source: International questionnaire. Important note: the fees need to be interpreted with caution as the durations for each treatment type differed and it is not clear whether the indicated fees are meant for the full treatment duration or only for the part indicated in our questionnaire.

From Table 25 it can be concluded that the fees compared to the costs are perceived as fair by two of the six responding countries (Sweden and Switzerland), too low by three others and too high by one (UK). The representative of the USA (AAO) could not provide this information.

Compared to other countries, the fees are perceived as fair by two of the six responding countries (Germany and Switzerland), and too low by the four others.

Compared to other medical specialities, the fees are perceived as fair by two of the six correspondents (Germany and Switzerland), too low by the three others and the Belgian representative had no opinion about it.

aaaaa source: e-mail from dr Bourdillat to prof dr Vande Vannet, in February 2007

For all the questions except for the one on the use and application of new technologies in the orthodontic practice, the USA (the AAO thus) could not provide the information requested as the professional organization does not collect this type of information.

In all other responding countries new technologies are reported to be applied, and in France, Belgium and Switzerland an extra fee is billed whenever these new technologies are used; in The Netherlands, Sweden, Germany and the United Kingdom no extra-fee can be billed to the patients.

REIMBURSED VERSUS TOTAL FEES

Table 18gives an overview of the reimbursed versus total fees by country.

Table 27: Reimbursed fees versus total fees for orthodontic treatment with fixed appliances for 24 months

	Reimbursed fee for regular fixed appliance treatment of 24 months (€)	Total fee for regular fixed appliance treatment of 24 months (€)
FR	National insurance non-CMU: €772 **** National insurance CMU: full reimbursement **	€2 800 *
BE	National insurance: €979 *** Complementary insurance: €360	€2 340 *
NL	National insurance: €0 (national insurance only for patients with specific disorders) ** Private insurance: €1 425 *	€1 425 * €1 922 **
UK	Full NHS reimbursement for IOTN 3,6 and higher No NHS reimbursement for lower IOTN	€3 466 - €5 547 for private treatment **
SE	National insurance: €2 500 *	€2 500 * €3 230 **
DE	€2 400 * for KIG 3, 4, 5 No reimbursement for KIG 1, 2**	€2 400 *
USA		$3 000 - $7 000 **
CH	National insurance: 0 ** Private insurance: €4 845 *****	€4 845 *****

Source:(*) International questionnaire. (**) Grey literature. (***) RIZIV/INAMI. (****) Mail by dr. C Bourdillat (France) to dr Vande Vannet[bbbbb]. (*****) EFOSA-Q 2002 data[ccccc].

Table 27 needs to be interpreted with caution as the data represent a simplification by the respondent.

The calculation of the exact fee depends on the actual malocclusion in the patient (e.g. whether anchorage is needed and also which type of anchorage in Switzerland) as well as from the category of patient (e.g. in France). In reality there is a range for the actual fee in each country, and the fee forwarded by the respondent of each country, is most likely to be interpreted as the average fee for this type of treatment.

Belgium with the estimated fee of €2 340 (which have been discussed in agreement between the professional orthodontic organization and some sickness funds since 1997; cfr Chapter 5) is close to the average fees of France, the Netherlands, Sweden and Germany (average is €2 281.25). The fee for Switzerland is not taken into the calculation as it is maybe outdated (EFOSA 2002).

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bbbbb e-mail by Dr C. Bourdillat, February 2007

ccccc http://www.riziv.fgov.be/care/nl/nomenclature/chapter03.htm Afd 2 - Art 5 - Tandverzorging, verstrekkingen - regel 1 tot 31 en Afd2 - Art 6 - Tandverzorging, toepassingsregels - regel 1 tot 31 (consulted 10-01-2008)

AVERAGE DURATION OF TREATMENTS

Average duration (months)	FR	BE	NL	UK	SE	DE	USA	CH
Interceptive treatment	12	3	6	N.A.	12	3	N.A.	N.A.
Orthopedic treatment	18	12	12	N.A.	24	48	N.A.	N.A.
Comprehensive treatment	24	24	18	N.A.	24	48	N.A.	N.A.
Standard treatment with full fixed appliance	N.A.	24	30	12-18	36	48	N.A.	N.A.
Retention phase treatment	12	12	N.A.	N.A.	N.A.	24	N.A.	N.A.

Source: International questionnaire.

CONCLUSIONS ON FEES

Fixed versus variable:

- **In the Netherlands, the UK (NHS) and Germany, orthodontic fees are fixed. In the Netherlands, the fees are fixed by a central conglomerate of insurers, also for privately insured patients. In the UK the fees for orthodontic treatment are fixed by the NHS; the fees in private practices outside NHS are free. In Germany fees are fixed by a combination of insurance systems for national insurance, but are free for privately insured patients.**
- **In France and Sweden, like in Belgium, orthodontic fees are variable (only the reimbursed part of the fees is fixed by the national health insurance system).**

Level of total fees:

- **It is important to note that the scientific value of the reported fees is low as they are based on the input from a questionnaire (sent to the country representatives of the orthodontic associations).**
- **For regular fixed appliance treatment, the lowest fees are observed in the Netherlands and the UK (NHS). In the Netherlands they are estimated about 20% lower than the fees in Belgium. The fees in France are estimated 20% higher than the fees in Belgium. The fees in Germany are comparable to the fees in Belgium.**
- **For the fees of different types of treatment, Belgium is estimated the 2nd, 3rd or 4th highest ranked out of 6 countries.**

Reimbursed fees:

- **In the Netherlands and Switzerland, orthodontic treatment is not part of the national health insurance package (only specific disorders are reimbursed). Orthodontics reimbursement is therefore variable and fully dependent on complementary insurance by private insurers,**
- **In other countries, such as Sweden, orthodontic treatment of children is fully reimbursed.**
- **In France, like in Belgium, there is partial reimbursement by the national health insurance. In Belgium, the reimbursed fee for regular fixed appliance treatment is estimated 25% higher than in France.**

Fees of dentists versus orthodontists:

- **Different fees for orthodontists versus dentists are only seen in the Netherlands since 2004.**

3.10.3.3 Cross-country overview on reimbursement of orthodontic care

AGE LIMIT FOR REIMBURSEMENT

Although the age for the application for reimbursement by RIZIV/INAMI via the Sickness funds (or also called Mutualities) for orthodontic treatment has been raised from 14 to 15 years of age in December 2006, Belgium still uses the lowest age limit for reimbursement in comparison to all the questioned countries in Europe.

The next lowest is in France, where the age limit is 16 years of age, while in the other countries it is minimally 18 yrs, and the treatment can then be carried out free for example until 21 yrs of age, like is the case in The Netherlands. In Sweden the age limit is 19 yrs to start the treatment, in Switzerland it is 20 yrs.

Table 28: Age limit for reimbursement

	FR	BE	NL	UK	SE	DE	USA	CH
Age limit for differential reimbursement (year) by national health insurance	16	15	18/21	18	19	18	N.A.	20

BASKET OF REIMBURSED TREATMENTS

Table 29 shows an overview of the orthodontic reimbursement basket in each of the countries.

Table 29: Basket of reimbursed treatments

National reimbursement for…	FR	BE	NL	UK	SE	DE	USA	CH
Interceptive treatment	Yes	No	Yes	Yes	Yes	Yes	N.A.	Yes
Orthopaedic treatment	Yes	Yes	Yes	Yes	Yes	Yes	N.A.	Yes
Standard treatment with full fixed appliances	Yes	Yes	Yes	Yes	Yes	Yes	N.A.	Yes
Comprehensive treatment with full fixed appliance	Yes	Yes	Yes	Yes	Yes	Yes	N.A.	Yes
Orthodontic interceptive treatment covered by national insurance system	Yes	N.A.	No	Yes	No	Yes	N.A.	Yes

Source: International questionnaire.

It is important to note that in the Netherlands and Switzerland there is no reimbursement from the basic health care system for orthodontic treatment, except for patients with CLP, and other congenital craniofacial conditions.

In Belgium, the reimbursed fees by the RIZIV/INAMI are fixed without differentiation for the type of treatment.

In France there is only one reimbursement fee for all types of orthodontic treatment, i.e. €193 per semester; allowance for 6 semesters with a maximum of €193 x 6 = €1 158 reimbursement by the "sécurité sociale" for orthodontic treatment. This is the fee excluding treatment plan (which is reimbursed for €30).

For a social category of patients (comparable to the WIGW in Belgium) €381 per semester is reimbursed but for a standard treatment time of 24 months, this is €772 for an average treatment time of 24 months. There is no reimbursement for procedures at the end of active orthodontic treatment, nor for retention appliances or placement of retention, but there is reimbursement for the "total retention" at a rate of €161 per year.

Table 30: Reimbursement influenced by severity of malocclusion

	FR	BE	NL	UK	SE	DE	USA	CH
Severity of malocclusion influences reimbursement	No	No	No	Yes	N.A.	Yes	N.A.	Yes

REIMBURSEMENT BY TREATMENT TYPE

Table 31: Reimbursement of interceptive treatment

	FR	BE	NL	UK	SE	DE	USA	CH
Orthodontic interceptive treatment reimbursement rate (%)	N.A.	N.A.	N.A.	100	N.A.	N.A.	N.A.	100
Orthodontic interceptive treatment covered by private insurance treatment	No	N.A.	Yes	No	No	Yes	N.A.	Yes
Orthodontic interceptive treatment covered by other	Yes	N.A.	Yes	No	Yes	No	N.A.	No
Orthodontic interceptive treatment for all patients	Yes	No	Yes	Yes	Yes	No	N.A.	No

Source: International questionnaire. No data available for the US.

Table 32: Reimbursement of orthopaedic treatment

	FR	BE	NL	UK	SE	DE	USA	CH
Reimbursement for orthopaedic treatment covered by national insurance system	Yes	Yes	No	Yes	No	Yes	N.A.	Yes
Reimbursement rate for orthopaedic treatment (%)	N.A.	N.A.	0	100	N.A.	N.A.	N.A.	100
Reimbursement for orthopaedic treatment covered by private insurance treatment	No	Yes	Yes	No	No	Yes	N.A.	Yes
Reimbursement for orthopaedic treatment covered by other	Yes	No	Yes	No	Yes	No	N.A.	No
Reimbursement for orthopaedic treatment for all patients	Yes	Yes	Yes	No	Yes	No	N.A.	No

Source: International questionnaire. No data available for the US.

Table 33: Reimbursement of orthodontic standard treatment with fixed appliances

	FR	BE	NL	UK	SE	DE	USA	CH
Reimbursement for orthodontic standard treatment with fixed appliances covered by national insurance system	Yes	Yes	No	Yes	Yes	Yes	N.A.	Yes
Rate of reimbursement for orthodontic standard treatment with fixed appliances (%)	100	100	0	100	20	N.A.	N.A.	100
Reimbursement for orthodontic standard treatment with fixed appliances covered by private insurance treatment	No	Yes	Yes	No	No	Yes	N.A.	Yes
Reimbursement for orthodontic standard treatment with fixed appliances covered by other	Yes	N.A.	Yes	No	Yes	No	N.A.	No
Reimbursement for orthodontic standard treatment with fixed appliances for all patients	Yes	Yes	Yes	No	Yes	No	N.A.	No

Source: International questionnaire. No data available for the US.

Table 34: Reimbursement of comprehensive treatment including fixed and other appliances

	FR	BE	NL	UK	SE	DE	USA	CH
Reimbursement for orthodontic comprehensive treatment including fixed and other appliances covered by national insurance system	Yes	Yes	No	Yes	Yes	Yes	N.A.	N.A.
Rate of reimbursement for orthodontic comprehensive treatment including fixed and other appliances (%)	N.A.	N.A.	N.A.	100	15	N.A.	N.A.	N.A.
Reimbursement for orthodontic comprehensive treatment including fixed and other appliances covered by private insurance treatment	No	Yes	Yes	No	Yes	Yes	N.A.	N.A.
Reimbursement for orthodontic comprehensive treatment including fixed and other appliances covered by other	Yes	N.A.	Yes	No	Yes	No	N.A.	N.A.
Reimbursement for orthodontic comprehensive treatment including fixed and other appliances for all patients	Yes	Yes	Yes	No	Yes	No	N.A.	N.A.

Source: International questionnaire. No data available for US and Switzerland.

Table 35: Reimbursement of congenital malformations

	FR	BE	NL	UK	SE	DE	USA	CH
Treatment of patients with congenital malformations in practice	Yes	Yes	Yes	No	Yes	No	N.A.	No
Specific reimbursement for orthodontic treatment of patients with congenital malformations	Yes	N.A.	Yes	No	Yes	Yes	N.A.	Yes
Reimbursement for orthodontic treatment of patients with congenital malformations covered by national insurance	Yes	Yes	No	N.A.	Yes	Yes	N.A.	Yes
Rate of reimbursement for orthodontic treatment of patients with congenital malformations (%)	100	100	0	N.A.	10000	N.A.	N.A.	100
Reimbursement for orthodontic treatment of patients with congenital malformations covered by private insurance	No	Yes	Yes	N.A.	N.A.	No	N.A.	No
Reimbursement for orthodontic treatment of patients with congenital malformations for all patients	Yes	Yes	Yes	N.A.	Yes	Yes	N.A.	No

Source: International questionnaire. No data available for the US.

On the basis of the answers to the question on the treatment of patients with congenital orofacial malformations (Q26) - like patients with cleft lip, alveolus and/or cleft palate and patients with oligodontia - it can be concluded that these patients are being treated in the private orthodontic practices in France, Belgium, The Netherlands and Sweden, but that this seems not to be the case in the UK, Germany, nor in Switzerland.

In all countries, except the UK and Belgium, specific reimbursement is applied for the treatment of patients with CLP and with oligodontia.

CONCLUSIONS ON THE REIMBURSEMENT OF ORTHODONTIC TREATMENT

Age limit for reimbursement:

- **In Belgium, the age limit to start orthodontic treatment with combined RIZIV and Sickness funds reimbursement, is set at the lowest in Belgium, being 15. In other countries the ages range from 16 in France to 19 in Sweden and 20 in Switzerland, as reported in our international questionnaire.**

Differentiated reimbursement:

- **In the Netherlands and Switzerland, there is only national reimbursement for a small number of patients with specific disorders (such as cleft lip palate and oligodontia) and for orthognathic patients meeting specific criteria.**
- **At the NHS in the UK, all cases with IOTN 3,6 or up, combined with an Aesthetic Component index for borderline cases, receive reimbursement for their treatment.**
- **In Germany, there is only national reimbursement for patients with KIG 3, 4 or 5.**
- **In Belgium, adaptation of the reimbursement level to the severity of malocclusion has been the case for complementary insurance by a large sickness fund for a number of years in the past, but since 2000, this is not the case anymore.**
- **In France, like in Belgium, reimbursement is not influenced by severity of malocclusion, all orthodontic treatments within the age limit get partial reimbursement. In Sweden, all orthodontic treatments, within the age limit, are fully reimbursed.**

Reimbursement level:

- **There is a large variation within the European countries on the level of reimbursement of the orthodontic treatment fees by national health services and by private insurance systems**
- **In Sweden 100% of the orthodontic treatment fees are reimbursed fees by the County Councils.**
- **In Germany, for KIG 3, 4 and 5, initially 80% is reimbursed, and the remaining 20% is reimbursed at the end of a successful treatment. For KIG 1 and 2 there is no reimbursement.**
- **Compared to other countries, especially for fixed appliances, the national reimbursed fee is relatively low in France and in Belgium, as there is only one reimbursement amount, independent from the appliances used.**

Reimbursed treatments:

- **Contrary to other countries, so far in Belgium, there is no separate reimbursement for interceptive / early treatment but this will be introduced in March 2008.**

3.10.3.4 Cross-country overview on treatment need and assessment of treatment need

Of the 7 responding countries, orthodontists in the UK, Sweden, Germany and Switzerland are obliged to score the Need of Orthodontic treatment in all patients eligible for reimbursement. The controlling parties are the National Health Service in the UK, the County Council in Sweden (for the Swedish national health care insurance), the respective national health insurance body in Germany and private health care insurers in Switzerland.

In the UK, NHS reimburses orthodontic treatment for correction of malocclusions with IOTN scores of 3.6 and higher. In the UK and in Germany the outcome of treatment has to be reported to the national health care authorities, respectively the NHS in case of the UK and the local dental insurance agencies in Germany.

In Sweden, a priority index of need for orthodontic treatment has been drawn up by the orthodontic section of the Swedish Dental Society and the Swedish Medical Board (1966). It consists of a four grade index scale and is known as the Index of the Swedish Medical Health Board.

Table 36: Obligation to score the need for orthodontic treatment

	FR	BE	NL	UK	SE	DE	USA	CH
Obligation to score the need for orthodontic treatment?	No	No	No	Yes	Yes	Yes	N.A.	Yes
- For national insurance system	-	-	-	Yes	No	Yes	N.A.	Yes
- For private insurance system	-	-	-	No	No	No	N.A.	No
- For other	-	-	-	No	Yes	No	N.A.	No

Source: International questionnaire. No data available for the US.

Table 37: Obligation to rate orthodontic treatment outcome

	FR	BE	NL	UK	SE	DE	USA	CH
Obligation to rate orthodontic treatment outcome	No	No	No	Yes	N.A.	Yes	N.A.	No
PAR index	-	-	-	Yes	N.A.	Yes	N.A.	-
Other assessment index	-	-	-	No	N.A.	No	N.A.	-

Source: International questionnaire

Table 38: Voluntary scoring of treatment outcome

	FR	BE	NL	UK	SE	DE	USA	CH
Voluntary rate of orthodontic treatment outcome	No	Yes	Yes	N.A.	Yes	No	N.A.	No

Source: International questionnaire

In Belgium, The Netherlands and Sweden, practitioners seem to score the outcome of orthodontic treatment on a voluntary basis, using the PAR index.

According to literature, in the US, medical necessity of orthodontic treatment is commonly determined by the Grainger Orthodontic Treatment Priority Index and the South Carolina Orthodontic Screening Index.

CONCLUSIONS ON THE OBLIGATION OF SCORING ORTHODONTIC TREATMENT NEED

- **In the UK, Germany and Switzerland, there is an obligation to score the need for orthodontic treatment for the health care insurance system.**
- **In Sweden this is obligatory for other than insurance reasons, namely to prioritize the treatment of some handicapping malocclusion types.**
- **Besides the scoring of treatment need, in the UK and Germany it is also mandatory to rate the treatment outcome. In the other countries this is not the case.**
- **The following indices for treatment need are used: in the UK the IOTN, in Germany the "KIG" (5 grade scale), and in Sweden the 'Index of the Swedish Medical Health Board" (4 grade scale).**

3.10.3.5 Cross-country overview on the legal aspects

A system like the Belgian "Convention" does not exist in any of the other selected countries, except in Sweden. In contrast to Belgium however, every orthodontist subscribes the convention, apparently agreeing with the reimbursed fees offered by the national health insurance (represented by the County Council).

3.11 SUMMARY TABLE ON INTERNATIONAL COMPARISON

	Ratio orthodontist to population	Licensing of orthodontic specialty	Fixed/variable fees	Obligation to score treatment need and/or outcome	Reimbursement by national insurance	Age limit for reimbursement
BE	1 to 29 760	2001	Variable fees	No obligation to score treatment need and/or treatment outcome	Partial reimbursement.	15
F	1 to 31 600	1977	Variable fees except for CMU insured patients	No obligation to score treatment need and/or treatment outcome	For CMU insured patients full fixed fee paid directly by national insurance For non-CMU patients there is partial reimbursement of less than 50% of the fee.	16
DE	1 to 31 206	1955	Fixed fees for patients insured by the statutory scheme. No fixed fees for private patients, but directive fees set by law tend to be followed	Obligation to score treatment need and outcome by using KIG	Influenced by treatment need (KIG 3,4,5) and successfulness of treatment up to 100%	18
UK	1 to 46 615	1998	Fixed for NHS-treatment Variable fees for private treatment	Under NHS IOTN and aesthetic component for borderline IOTN cases for scoring treatment need. PAR index for Treatment outcome is scored	NHS reimbursement only for IOTN 3,6 and up and some borderline IOTN cases.	18
NL	1 to 59 707	1953	Fixed fees	No obligation to score treatment need and/or treatment outcome	Orthodontic care is not covered by basic health insurance except for patients with a handicap or congenital malformation.	18/21
SE	1 to 53 529	1965	No national fixed fees. The County Councils set prices for dental services. This results in regional price differences.	Obligation to score the need for treatment controlled by the County Council	Orthodontic treatment is free of charge for patients up to the age of 19 both when treated by a Public Dental Service or by a private practitioner.	19
CH	1 to 37 500	1975	Fixed maximum fees	Obligation to score the need for orthodontic treatment.	No coverage for orthodontic treatment except for patients with congenital malformations	20
U.S.A	1 to 31 498	1917	Variable fees	Medical necessity commonly determined by the Grainger Orthodontic Treatment Priority Index and South Carolina Orthodontic Screening Index	Orthodontic treatment can be covered under the Medicaid program in case of medical or psycho-social necessity	Medicaid only for children < 21

3.12 STRENGTHS AND WEAKNESSES TABLE FOR BELGIUM

Strengths	Weaknesses
- All children partial reimbursement by national insurance - No waiting lists - Density: ratio orthodontists to population - Guided fee tariffs	- No obligation to score for treatment need and treatment outcome: 1. IOTN 1-2 (low need) children risk to be privileged over IOTN 4-5 children needing complex treatment 2. No quality control - Limited transparency on fees

4 BELGIAN SITUATION: ORGANISATION, REGULATION AND DENSITY OF PRACTITIONERS

4.1 INTRODUCTION

4.1.1 Aims

It is the aim of this part of the study:

1. to describe the process of speciality licensing and the changes in the organization of the sector that has occurred since
2. to show the geographical density of the orthodontic health care providers - specialists and non -orthodontic specialists - over Belgium, its regions and its provinces in order to see whether there are still problematic regions or provinces
3. to describe the access to orthodontic treatment and its distribution over the country, the regions and the provinces

4.1.2 Licensing of orthodontics in Belgium

Although orthodontics only recently was recognized as a speciality in Belgium, it has been a *de facto* speciality for a long time as there was for example already a separate Orthodontic clinic in the School for Dentistry and Stomatology in the 1950's. The specialistic programs *avant la lettre* only arose in the Belgian universities around the 1970's, delivering orthodontic care providers who already restricted their clinical activities to orthodontics from that time on. Besides these orthodontic university programs, practitioners and educators were also trained in many other ways, in Belgium as well as abroad, this way increasing their orthodontic expertise and providing orthodontic care to patients that were referred to them by their colleagues either in general dentistry or by stomatologists and maxillo-facial surgeons.

Although the specialistic training and education in orthodontics was already organized in the clinical university setting in Belgium in the 1959's (e.g. in Leuven: by prof dr de Biourge at the French speaking part of the Catholic University in Leuven until 1968, and from 1968 on, by prof dr Reychler for the Dutch speaking part of the Catholic University in Leuven), orthodontics only recently became a specialty of Dentistry.

Orthodontics thus was legally recognized as a specialty on the 28th of May 2001 (cfr Belgisch Staatsblad 10/07/2007[ddddd]; Journal of the Belgian State of the 10th of July 2001). Subsequently, the following Ministerial resolutions became operative on the 1rst of June 2002:

1. the ministerial resolution (M.B., Ministerieel Besluit) for the enactment of the common criteria for the licensing of specialists on the 11th of June 2001)

2. the ministerial resolution for the enactment of the special criteria for the licensing of dental practitioners, entitled with the professional title of specialist in orthodontics, of (coordinating) masters of the practical training of the orthodontic trainees ((coördinerende) stagemeesters / maîtres de stage (coördinateurs)) and of the training centres for the practical orthodontic training (stage centra / centres de stage).

So the relevant committees for licensing have been operative since 1/6/2002 (cr footnote, Belgisch Staatsblad 10/07/2001).

Since December 2006 the age limit for the demands of contribution from RIZIV/INAMI in orthodontic treatment of youngsters has been reset to 15 yrs; prior to this date the age limit was 14yrs.

[ddddd] Belgisch Staatsblad 10/07/2001

From the first of September 2007 a number of changes have been introduced by the Federal Institute of Health and Invalidity Insurance (FIHII), RIZIV/INAMI with the following consequences for the practice of orthodontics in Belgium:

- 1. The assignment of separate RIZIV/INAMI-identification numbers to general dental practitioners (GDP's), to periodontal specialists and to orthodontic specialists. For every dental practitioner the three last positions of the prior RIZIV/INAMI-numbers were changed; for recognized orthodontists the three last numbers were reconverted into "007". This 007-RIZIV/INAMI number can only be used by qualified and recognized orthodontists, while the orthodontic trainees received the "070" appendix. Orthodontic trainees do not have direct access to the RIZIV/INAMI-nomenclature and thus have to attest their acts and activities during there specialist training via their recognized masters of training.

- 2. Since the first of September 2007 the application of a partial differential nomenclature for orthodontic specialists started (cfr letter RIZIV/INAMI dd 29/08/2007 from RIZIV/INAMI in Appendix to Chapter 5). The access to the nomenclature by orthodontists is restricted to the categories VI - Orthodontics and VII - Radiology. The categories III (Extractions), IV (Periodontolgy), V (Conservative Dentistry) and VI (Prosthetics) are no longer accessible for 007-practitioners. From the category II - Preventive Dentistry however, the bi-yearly clinical oral examination can still be used, although this is generally performed by the general dentist. For the "consultation" new numbers have been added for the 007-practitioners, i.e. 301092 (75% reimbursement at age > 12 yrs of age) and 371092 (100% reimbursement < 12yrs of age). These numbers can not be used during orthodontic treatment and can only be used in patients eligible for reimbursement of the RIZIV/INAMI nomenclature. Consequently the consultation numbers 301011 and 371011 can only be accessed by the general dentist and not by the orthodontist anymore.

On the first of September 2007, 359 orthodontists received the 007-addition to their RIZIV/INAMI- identification number as orthodontic specialist. On the 28th of September 2007 379 specialists in orthodontics with the 007-licensing number were recognized in Belgium. The students under training are not included in this number: they carry the 070-addition to their RIZIV/INAMI number.

4.1.3 Orthodontic specialization in Belgium

To become a dentist-specialist in orthodontics (the title in Dutch is: Tandarts-Specialist in de Orthodontie), a 4 year full-time curriculum in a recognised orthodontic training center (Stagecentrum) for in a department of orthodontics in a university hospital, has to be completed. This implies the combination of a Master after Master in Orthodontics and a Postgraduate Clinical Training Program. During the course of this programme, the postgraduate students should have at least 500 hrs of external clinical practice training (stage) in a practice setting for orthodontics with a clinical training supervisor (stagemeester).

At five Belgian universities, the orthodontic specialization training is organized, namely at the KULeuven, UCLouvain, UGent, ULiège and the ULBruxelles. During their training, candidate specialists receive a fair remuneration which is legally fixed.

At the start of the specialist training the candidate trainee sends an application form to the appropriate Licensing Committee for Orthodontics and a yearly report of the progression of his training as well. At the end of his training he presents 20 completely documented cases which he /she has fully treated himself during his training before a mixed jury in part from the university and in part comprising members of the Licensing Committee for Orthodontics.

The procedures and criteria for recognition of the training centers, the training supervisors and the candidates, is described at the website of the Ministry of Health[eeeee] (www.health.fgov.be).

[eeeee] http://www.health.fgov.be/AGP-lex/nl/wetg.../mb erkenning_orthodontie28052001.htm

The education of orthodontic specialists has been regulated and prescribed in a Ministrial Order (Ministerieel Besluit) of the 28th of May 2001, and appeared in the Journal of the State (Staatsblad) of the 10th of July 2001[fffff].

The requirements to be fulfilled to become a licensed Specialist in Orthodontics in Belgium and to be and remain registered as such are:

1. Complete training as dentist (tandarts, dentiste) (5 years), according to the European directives 78/686/CEE and 78/687/CEE
2. Complete training as dentist specialist in orthodontics (4 years full-time). Therefore the candidate has to comply to the MB 28/05/2001 (published 10/07/2001)
3. Fulfil to the general and specific requirements for specialist dentists
4. Perform educational activities after the orthodontic like Peer Reviews and Postacademic permanent education courses to get accredited and to be able to re-register as a specialist after six years of licensing.

4.1.4 Orthodontic specialty organization in Belgium

Since the formal licensing of orthodontics as a specialty in Belgium (2001), the previously existing scientific and professional orthodontic societies have been on the move.

On the 16th of December 2004, the principles of the formation of the Union Francophone des Orthodontistes Belges (UFOB) and the Belgische Beroepsvereniging van Nederlandstalige Orthodontisten (BBNO) were adopted. On January the 5th of 2005, the first general assembly of the BBNO took place and the bylaws of the society were deposited at the registry's office of the Belgian Federal Council (Raad van State van België) with the request to be registered as a legally recognised professional organization.

After some delay, the UFOB was also recognized as a legally recognised professional organization.

The BBNO and UFOB are united in the Belgian Union of Orthodontic Societies (BUOS), with the intention to sustain the contacts with the international professional organizations. The BUOS was recognized by the European Federation of Orthodontists Societies Association (EFOSA) and by the WFO (World Federation of Orthodontists) as the representative society for Belgium.

Active membership of the EFOSA is confined to professional associations or groups of orthodontic specialists exclusively, from countries within the European Union having regulated the profession in accordance with the E.E.C. directives of 1978 and having an official register of specialists. The above also applies to countries that have an arrangement of free movement and the right of free establishment within the EU countries on the basis of mutual speciality licensing. The latter also implied the dissolution of the 'Belgische Beroepsvereniging van Universitaire Specialisten in de Orthodontie - Union Professionnelle Belge des Spécialistes Universitaires en Orthodontie' (BBUSO-UPBSUO), the 'Union Francophone des Orthodontistes spécialistes de Belgique' (UFOBsBE) and the 'Vlaamse Beroepsvereniging van Orthodontisten' (VBVO).

4.2 MATERIAL AND METHODOLOGY

Data were provided by the RIZIV/INAMI in order to be able to (anonymously) locate all the 007 specialist orthodontic care providers in Belgium, per region and per province. From the anonymous RIZIV/INAMI-profiles of all other dental care providers without RIZIV/INAMI-qualification code 007[ggggg],

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fffff Alg artikelen Pers omtrent Gezondheidszorg\Belgisch Staatsblad 10-07-2001 MB 28-5-2001.pdf

ggggg http://www.riziv.fgov.be/care/nl/nomenclature/chapter03.htm

a sample of non-specialist practitioners was extracted, based on a preset amount of selected orthodontic prestations, i.e. at least 16 starts of orthodontic treatments (RIZIV/INAMI-code 305631) for the year 2005. This yielded a comparable number of 351 specialist (with 007 RIZIV/INAMI-addition) and 358 non-specialist orthodontic practitioners.

The total sample represents around 10% of all the Belgian dental practitioners and on the basis of earlier calculations, this sample is expected to cover the vast majority of orthodontic health care for the selected age group in Belgium.

For the total practitioner-sample and its 2 subsamples (specialists and non-specialists), geographical representations are made showing the overall and specific densities in order to be able to differentiate eventual 'problematic' provinces.

Note that for the number of inhabitants per RIZIV/INAMI act, the location of the practitioner is used and not the location of the patient.

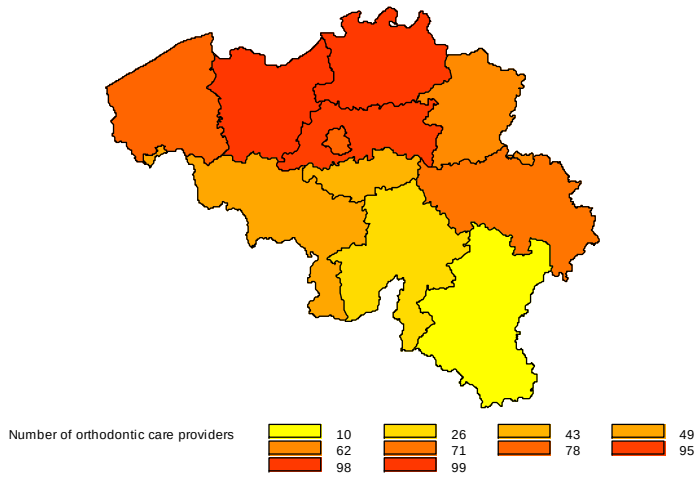
It is also this same selection of practitioners that will be questioned (by means of questionnaires sent out by the KCE in collaboration with RIZIV/INAMI) on their practice in the sector of orthodontics (see further).

For the demographic information of 2005, the most recent information available on the website of the National Institute for Statistics (NIS), now renamed to the FPS Economy-Directorate general of Statistics-Belgium[hhhhh] and (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed in October 2007 and in January 2008 respectively), was used.

4.3 GEOGRAPHICAL DISTRIBUTION OF ORTHODONTIC PRACTITIONERS

Figure 24 shows the geographical distribution of all orthodontic practitioners in Belgium.

Figure 24: Geographical distribution of all practitioners - specialists and non-specialists - over the provinces.



Source: RIZIV/INAMI

The number of practitioners is strikingly different among the provinces, with the smallest number (10) in Luxemburg and the highest number (≥95) in the provinces Antwerp, and East- and West-Flanders.

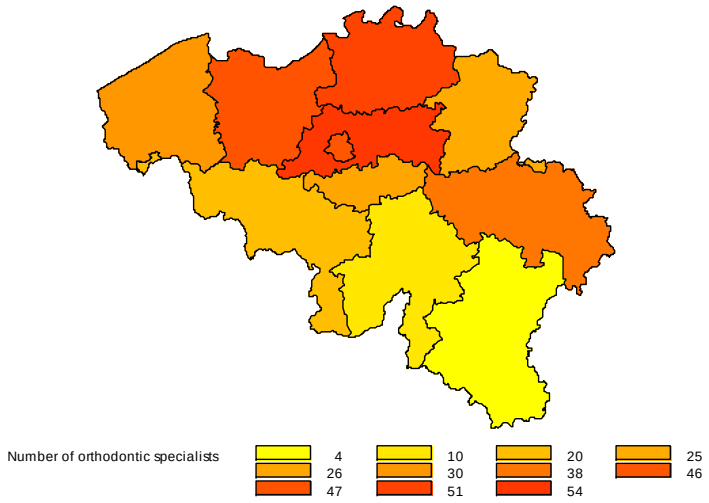
Description of the orthodontic nomenclature is described (Flemish and French version) in the Appendix of Chapter 5.

hhhhh http://statbel.fgov.be/home_en.asp

Looking at the geographical distribution of the practitioners (specialists and non-specialists) is only relevant if it is combined with the demographic information about the inhabitants of the provinces and moreover about the inhabitants of interest within these populations. See section 4.4.

- **The number of the total practitioners differs significantly between the provinces, with a minimal density of 10 practitioners in Luxemburg to over 95 in the provinces Antwerp and East- and West-Flanders. This should however be matched with the relevant populations (see section 4.4).**

Figure 25: Geographical distribution of the orthodontic specialists over the provinces



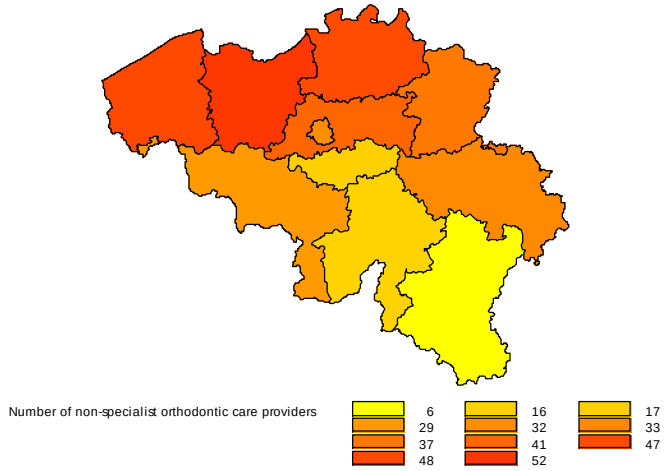
Source: RIZIV/INAMI and NIS

Figure 25 shows the geographical distribution of orthodontic specialists over the provinces. There is also a large difference in numbers of specialists among the provinces, with Luxemburg, having only 4 orthodontists. East Flanders, Antwerp, Flemish Brabant and Brussels have the highest concentration of orthodontists. Among the Walloon provinces, Liege (46) has the highest number of orthodontists.

If the relevant population is considered, and if the starts of treatment in the 0-19yrs of age group in each province are compared, then the picture changes, but some provinces remain problematic concerning the availability of specialistic orthodontic care.

- **For the specialistic practitioners, there also is a large difference in numbers over the provinces: East Flanders, Antwerp, Flemish Brabant and Brussels have the highest number of specialists (in each province more than 45). Luxemburg has also only 4 orthodontists.**

Figure 26: Geographical distribution of the Belgian <u>non-specialist</u> practitioners per province (for the year 2005)



Source: RIZIV/INAMI and NIS

Compared with the overall practitioner densities over the provinces, the non-specialists constitute 60% and 62% of the care providers respectively in Luxembourg, Namur and Hainaut, 40% and 43% in Walloon-Brabant and Flemish-Brabant and around 50% (range 47% to 53%) in the other provinces and in Brussels.

- **Of all orthodontic practitioners, 43% to 62% are non-specialist practitioners. The highest representation of non-specialist practitioners is found in Luxembourg, Namur and Hainaut (around 60%).**
- **Relatively, the smallest representation of non-specialist practitioners is in Walloon and Flemish Brabant (40 and 43% respectively)**
- **The representation of non-specialists is around 50% in the other provinces and Brussels.**

4.4 NUMBER OF INHABITANTS PER PRACTITIONER (SPECIALIST AND NON-SPECIALIST) AND ACCESS TO ORTHODONTIC TREATMENT

In the present study, the relevant populations are the 0-19yr olds on the one hand - which probably completely includes the full eligible orthodontic sample - and the 10-14yr olds, including the 'currently in treatment' population.

The authors are aware of the fact that the age limits of the first sample (0-19 yr olds) are taken very broadly. Zero years of age is indeed an uncommon age for regular orthodontic treatment, but this is except for:

1. patients with a cleft lip and or palate, who are often neonatally treated with a growth guiding orthopaedic treatment;
2. 19year olds will only exceptionally start with an orthodontic treatment, only if a request for post-ponement (aanvraag "ten bewarende titel") of orthodontic treatment has been forwarded to the RIZIV/INAMI/mutuality (presurgical orthodontic treatment) in due time (i.e. before the age of 15 yrs) and this is also often the case for patients with orofacial clefts

- **Two relevant population groups are considered in this chapter:**
- **The age range of 0-19yrs is considered in order to include orthodontic treatment in patients with orofacial clefts at birth and young age as well as the postponed orthodontic treatment in preparation for orthognathic surgery ("ten bewarende titel"), which is also often the case in patients with orofacial clefts.**
- **The age range of 10-14yrs is considered to include the 'currently in treatment' population.**

4.4.1 Number of 0-19 yr old inhabitants per practitioners and access to orthodontic treatment

Table 39: National and regional distribution of practitioners (specialists and non-specialists), number of inhabitants per practitioner, number of 0-19yr olds per practitioner and number of 0-19yr olds per 305631 (start of orthodontic treatment).

Region	Number of orthodontic care providers	Number of inhabitants per orthodontic care provider	Number of 0-19 year olds per orthodontic care provider	305631	Number of 0-19 year olds per 305631
Belgium	709	14733	3405	48020	50
Flemish region	432	13989	3108	30617	44
Walloon region	199	17065	4178	13701	61
Brussels-Capital region	78	12907	3075	3702	65

Source: RIZIV/INAMI and NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp), accessed October 2007

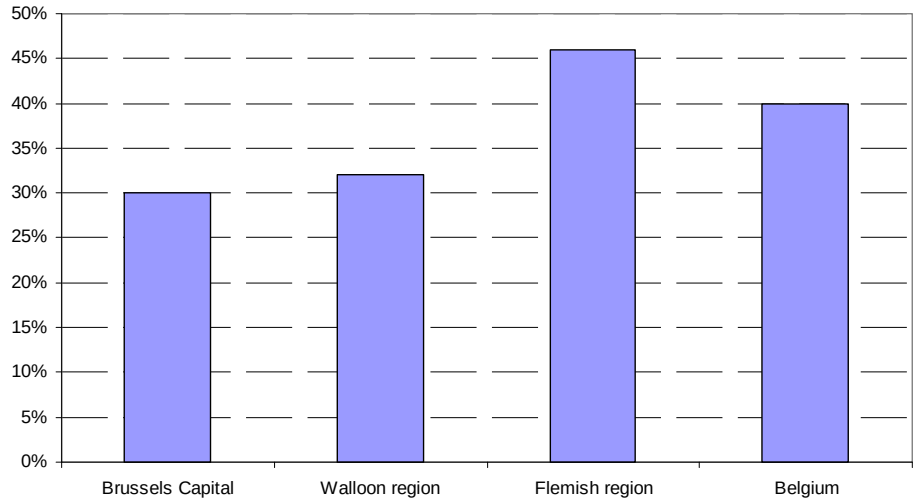
- **The number of inhabitants per practitioner is highest in Walloon region and lowest in Brussels. The density of practitioner per inhabitant is thus highest in Brussels and lowest in Walloon region.**

The access to orthodontic treatment as measured by the starts of treatment (RIZIV/INAMI-prestation number of 305631) for the year 2005 over the regions, ranges from 1 in 65 (1.5%) of the 0-19 year olds in the Brussels Capital region over 1 in 61 (1.6%) in the Walloon region, to 1 in 44 (2.3%) in Flemish region. The average for Belgium is 1 in 50 (2%) of the total of 0-19 year olds.

The general access to orthodontic care, as a combination of specialistic and non-specialistic care, is lowest in Brussels capital region and the highest in the Flemish region.

- **The general access to orthodontic treatment (by specialist and non-specialist practitioners) is highest in the Flemish and lowest in the Brussels Capital region.**
- **The ratio of the number of treatment starts (RIZIV/INAMI-prestation number 305631) for the year 2005, on the population of 0-19 yrs, ranges from 1 in 65 (1.5%) in the Brussels Capital region over 1 in 61 (1.6%) in the Walloon region, to 1 in 44 (2.3%) in Flemish region. For Belgium this ratio is 1 in 50 (2%) of the 0-19 year olds.**

Figure 26b: Estimated proportion of the children and adolescents who ever started an orthodontic treatment (305631) per region (extrapolated based on number of starts in 2005 and population data 0-19yrs)

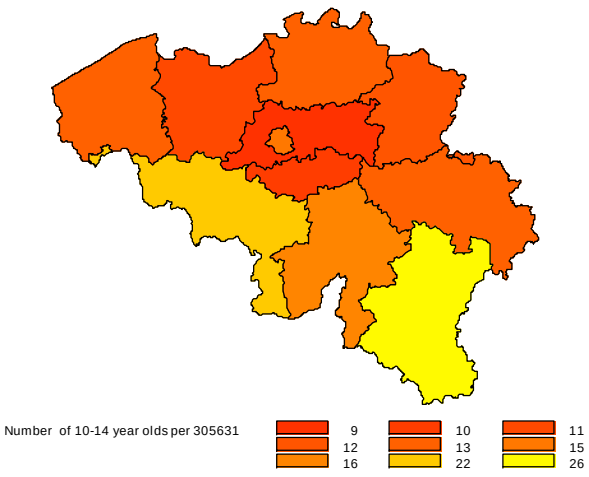


Source: RIZIV/INAMI (2005) and NIS (Jan 2008)

- **RIZIV/INAMI data show that in Belgium on average 40% of children and adolescents ever start a reimbursed orthodontic treatment (before adulthood). In the Flemish region this is the case for 46%, in the Brussels and Walloon region 30% and 32%.**

4.4.2 Number of 10-14 yrs old inhabitants per practitioners and access to orthodontic treatment

Figure 27: Geographical distribution of the number of 10-14 year olds per start of orthodontic treatment in 2005 (act 305631) over the provinces (specialists and non-specialists):



Source: RIZIV/INAMI

Table 40: Calculated percentage of 10-14 yr olds "in treatment" by all practitioners (specialists and non-specialists) in 2005 over the Belgian provinces with the assumption of 2 yr or 3 yr treatment duration.

	305631/10-14yr old	% in OT 2yr duration	% in OT if 3yr duration
Antwerp	7,50%	15%	22,50%
Brussels	6,60%	13,20%	19,80%
East Fl	9%	18%	27%
Flemish Brabant	10,70%	21,40%	32,10%
Hainaut	4,50%	9%	13,50%
Limburg	8,20%	16,40%	24,60%
Liege	7,80%	15,60%	23,20%
Luxemburg	3,80%	7,60%	11,40%
Namur	6,30%	12,60%	18,90%
Walloon Brab	10,50%	21%	31,50%
West Flanders	7,70%	15,40%	23,20%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

- **In 2005, over the provinces, 3.8% to 10.7% of the 10-14 yr old population started an orthodontic treatment. This percentage varied largely between the provinces. This percentage was lowest for Luxemburg (3.8%) and for Hainaut (4.5%). This percentage was highest for Flemish Brabant and Walloon Brabant, with respectively 10.7% and 10.5%.**
- **Based on the number of starts and an assumed treatment duration of 2 to 3 years, it is estimated that 21.40 % to 32.10% of the 10-14 yr olds were in treatment in the year 2005, for Flemish Brabant. At the other end of the spectrum, in Luxembourg, only 7.6% to 11.40% of the 10-14 yrs olds were in treatment in 2005.**

As the percentage of children being in orthodontic treatment recently received a lot of attention in the press, the subgroup of patients aged 10-14 yrs has been selected in this paragraph in order to be able to extrapolate the overall starts of treatment in 2005 towards proportion of treated children. This age group is selected as it is expected to be the age group with most treatment starts.

For the extrapolation of the number children with a treatment start to the number of children actually in treatment, an average duration of an orthodontic treatment of 2 or 3 years is taken into consideration. This allows us to calculate the percentage of 10-14yr olds actually in treatment in 2005 in case of 2 and 3yr treatment duration per region and in Belgium (cfr Table 41). In section 7.9.3.2 we see that the median duration of treatment in months can be estimated at 26 and the mean at 28, based on IMA data.

Table 41: Extrapolation of the degree of 10-14 yr olds 'in treatment' by all practitioners (specialists and non-specialists) with the assumptions of 2 and 3 yr treatment duration.

	305631	Nr 10-14 yr olds	305631/10-14pop	% in OT if 2yr T-duration	% in OT if 3yr T-duration
Flemish region	30617	358003	8,60%	17,20%	25,80%
Walloon region	13701	216626	6,30%	12,60%	18,90%
Brussels capital	3702	56256	6,60%	13,20%	19,80%
Belgium	48020	630885	7,60%	15,20%	22,80%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

- **With the assumption of 2 to 3 yr treatment duration, the proportion of 10-14 yr olds in actual orthodontic treatment in 2005, ranged from 17.2% to 25.8% in the Flemish region, between 12.6% and 18.9% in Walloon region and between 13.2% and 19.8% in Brussels.**
- **For Belgium the percentage thus is between 15.2% to 22.8%.**

4.5 NUMBER OF INHABITANTS PER SPECIALIST PRACTITIONER AND ACCESS TO SPECIALIST ORTHODONTIC TREATMENT

4.5.1 Number of 0-19 yr old inhabitants per specialist and access to specialist orthodontic treatment – overview per region

Table 42: Distribution of specialists over the country and per region and associated demographic data on overall number of inhabitants as well as number of inhabitants in the selected age category of 0-19yr olds per specialist. With the number of 305631 (start of orthodontic treatment), the average access to specialist orthodontic treatment in the regions is calculated.

Region	Number of orthodontic specialists	Number of inhabitants per orthodontic specialist	Number of 0-19 year olds per orthodontic specialist	305631	Number of 0-19 year olds per 305631
Belgium	351	29760	6878	30873	78
Flemish region	207	29194	6487	20290	66
Walloon region	98	34652	8485	8210	101
Brussels-Capital region	46	21886	5213	2373	101

Source: RIZIV/INAMI

In Flemish Brabant the highest amount of orthodontic treatments per 0-19 yr olds were started in 2005, followed very closely by Walloon Brabant. For Flemish and Walloon Brabant respectively 1 in 35 (2.9%) and 1 in 36 (2.8%) of the 0-19 yr olds received a 305631 in 2005.

The access to specialistic orthodontic treatment as measured by the starts of treatment (RIZIV/INAMI-act 305631) for the year 2005, ranges from 1 in 101 (0.99%) of the 0-19 year olds in the Brussels Capital region and in the Walloon region, to 1 in 66 (1.5%) in Flemish region.

The average for Belgium is 1 in 78 (1.3%) of all the 0-19 year olds. The general access to specialistic orthodontic care is the lowest in Brussels capital region and Walloon region and the highest in the Flemish region.

For Brussels there is a higher than average amount of specialists in this region, while the access to specialist care is as low as in the Walloon region (where a significantly lower density of specialists - 2.9 for Walloon region versus 4.6 for Brussels - is found).

- **The average density of orthodontic specialists in Belgium is 3.4 per 100 000 inhabitants. There is a difference over the regions: for the Flemish region, the density is also 3.4 per 100 000. In the Walloon region the density is 2.9 and in the Capital region of Brussels the density is 4.6 per 100 000 inhabitants.**
- **The access to specialistic orthodontic treatment as measured by the starts of treatment (RIZIV/INAMI-act 305631) for the year 2005, ranges from 1 in 101 (0.99%) of the 0-19 year olds in the Brussels Capital region and in the Walloon region, to 1 in 66 (1.5%) in Flemish region. The average for Belgium is 1 in 78 (1.3%) of all the 0-19 year olds.**
- **The general access to specialistic orthodontic care is the lowest in Brussels capital region and Walloon region and the highest in the Flemish region.**

4.5.2 Number of 0-19 yr old inhabitants per specialist practitioner and access to orthodontic treatment – overview per province

Table 43: Distribution of the Belgian orthodontic specialists per province and associated demographic data on number of inhabitants as well as number of inhabitants in the selected age category of 0-19yr olds per specialist. With the number of 305631 (start of orthodontic treatment), the average access to specialist orthodontic treatment in the provinces is calculated for 2005.

Province	Number of orthodontic specialists	Number of inhabitants per orthodontic specialist	Number of 0-19 year olds per orthodontic specialist	305631	Number of 0-19 year olds per 305631
Flemisch Brabant	54	19218	4355	4117	57
Antwerp	51	32880	7393	5257	72
East Flanders	47	29363	6401	5278	57
Brussels	46	21886	5213	2373	101
Liège	38	27211	6485	3159	78
West Flanders	30	37950	8299	3594	69
Walloon Brabant	26	13991	3586	1694	55
Limburg	25	32398	7226	2044	88
Hainaut	20	64314	15518	2037	152
Namur	10	45586	11346	919	123
Luxembourg	4	64001	17010	401	170

Source: RIZIV/INAMI

If a comparison is made between the provinces, it can be concluded from Table 43 that the range is even larger when differentiating between the provinces than for the whole group of practitioners (specialists and non-specialists).

The highest amount of specialistic treatments in 2005 was started in Walloon Brabant, followed closely by Flemish Brabant. For Walloon and Flemish Brabant respectively 1 in 55 (1.8%) and 1 in 57 (1.75%) of the 0-19 yr olds received a 305631 from a specialist in 2005.

The provinces Luxemburg and Hainaut present more outspoken problems in availability of orthodontic care if only specialist care is considered. Without the contribution of non-specialist orthodontic treatment, these provinces would only provide access to respectively 1 in 170 (0.58%) and 1 in 152 (0.66%) of the 0-19 yr olds. If the non specialistic care is added, the accessed orthodontic care doubles for Hainaut to1.15 % and for Luxemburg it increases to 0.97%.

- **In 2005 the highest number of specialistic orthodontic treatments were started in Walloon Brabant, followed closely by Flemish Brabant with respectively 1 in 55 (1.8%) and 1 in 57 (1.75%) of the 0-19 yr olds receiving a 305631 from a specialist in these provinces**
- **The provinces Luxemburg and Hainaut show low access to specialist orthodontic care with respectively 1 in 170 (0.58%) and 1 in 152 (0.66%) of the 0-19 yr olds receiving specialist treatment in 2005. If the non specialistic care is added, the accessed orthodontic care doubles for Hainaut to1.15 % and for Luxemburg it increases to 0.97% in the 0-19 yr olds.**

4.5.3 Number of 10-14 yr old inhabitants per specialist and access to specialist orthodontic care – overview per region

Again the calculation (thus extrapolation) is made for the sample of the 10-14 yr olds in orthodontic treatment in the year 2005, but by specialists (Table 44).

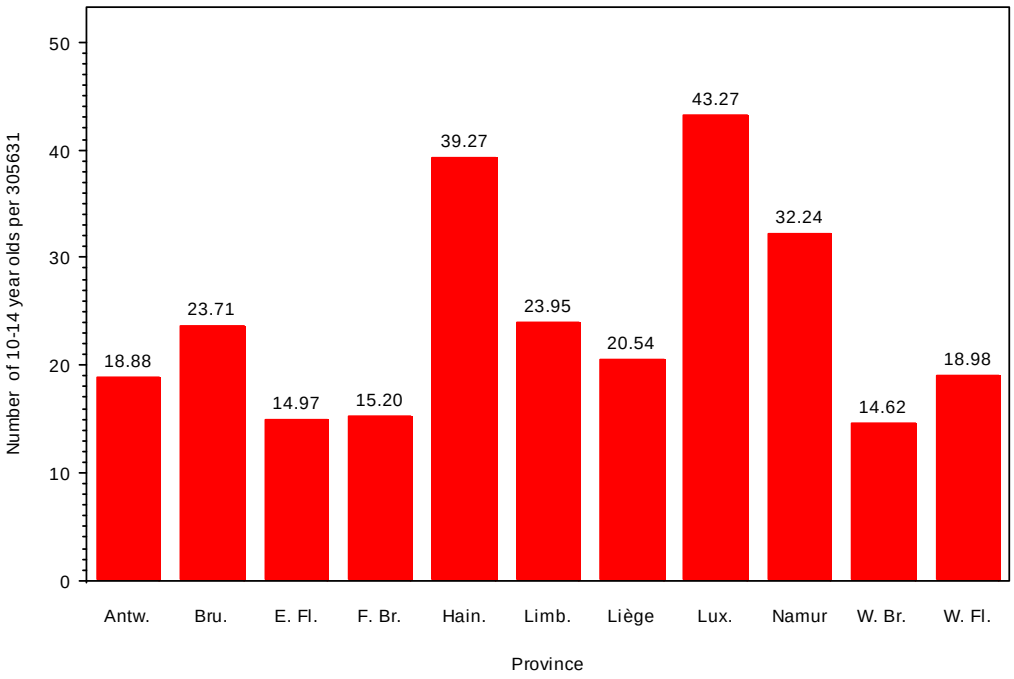
Table 44: Estimated percentage of 10-14 yr olds in treatment by specialists in 2005 in Belgium and its regions with the assumption of 2 yr or 3 yr treatment duration.

	305631	Nr 10-14 yr olds	305631/10-14pop	% in OT if 2yr T-duration	% in OT if 3yr T-duration
Flemish region	20290	358003	5,70%	11,40%	17,10%
Walloon region	8210	216626	3,80%	7,60%	11,40%
Brussels capital	2373	56256	4,20%	8,40%	12,60%
Belgium	30873	630885	4,90%	9,80%	14,70%

- **With the assumption of 2 or 3 yr treatment duration, the proportion of 10-14 yr olds in actual orthodontic treatment in 2005 provided by specialists, in the Flemish region ranges between 11.4% to 17.10%, between 7.6% and 11.4% in Walloon region and between 8.4% and 12.6 in Brussels.**
- **For Belgium the estimated percentage of 10-14yr old in treatment by specialists thus ranges between 9.8% to 14.7%, assuming respectively a 2 or 3 yr treatment duration.**

4.5.4 Number of 10-14 yr old inhabitants per specialist and degree of orthodontic treatment – overview per province

Figure 28: Barplot of the number of 10-14 year olds per start of orthodontic treatment in 2005 (act 305631) over the provinces (orthodontic care provided by specialists).



Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

Table 45: Calculation of degree of 10-14 yr olds in orthodontic treatment by specialists in 2005 over the provinces assuming either 2 or 3 yrs of treatment duration

	% 305616 in specialists	% in OT 2yr duration	% in OT if 3yr duration
Antwerp	5,30%	10,60%	15,90%
Brussels	4,20%	8,40%	12,60%
East Flanders	6,70%	13,40%	20,10%
Flemish Brabant	6,60%	13,20%	19,80%
Hainaut	2,60%	5,20%	7,80%
Limburg	4,20%	8,40%	12,60%
Liege	4,90%	9,80%	14,70%
Luxemburg	2,30%	4,60%	6,90%
Namur	3,10%	6,20%	9,30%
Walloon Brab	6,80%	13,60%	20,40%
West Flanders	5,30%	10,60%	15,90%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

Table 46: Repeated from 4.3.1.7 for comparison:calculated percentage of 10-14 yr olds in treatment by all practitioners (specialists and non-specialists) in 2005 over the Belgian provinces with the assumption of 2 yr or 3 yr treatment duration.

	305631/10-14yr old	% in OT 2yr duration	% in OT if 3yr duration
Antwerp	7,50%	15%	22,50%
Brussels	6,60%	13,20%	19,80%
East Fl	9%	18%	27%
Flemish Brabant	10,70%	21,40%	32,10%
Hainaut	4,50%	9%	13,50%
Limburg	8,20%	16,40%	24,60%
Liege	7,80%	15,60%	23,20%
Luxemburg	3,80%	7,60%	11,40%
Namur	6,30%	12,60%	18,90%
Walloon Brab	10,50%	21%	31,50%
West Flanders	7,70%	15,40%	23,20%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

- **The range of orthodontic treatment starts by specialists over the provinces in 2005 varied between 2.3% (compared to 3.8% by all) to 6.8% (compared to 10.7% by all practitioners) of all the 10-14yr olds.**
- **The percentage was lowest for Luxemburg with 2.3% (3.8% by all) and for Hainaut with 2.6% (4.5% by all) of the 10-14yr olds having accessed to orthodontic treatment in 2005.**
- **The percentage was highest for Walloon Brabant, followed by East Flanders and Flemish Brabant, with respectively 6.8% (10.5% by all), 6.7% (9% by all) and 6.6% (10.7% by all) and starts of orthodontic treatments by the 10-14yr olds in 2005.**
- **The highest degree of treatment in 10-14yr olds by specialists in 2005, is present in Walloon Brabant with a range between 13.6% to 20.40% if a treatment duration of 2 or 3 years is assumed respectively.**
- **At the other end of the spectrum 4.6% to 6.9% of the 10-14 yrs olds in Luxemburg were in treatment by specialists if a treatment time of 2 or 3 years is considered respectively.**

4.6 DISCUSSION ON ACCESSIBILITY TO ORTHODONTIC CARE

Besides the density of practitioners, there are a number of other factors determining the accessibility to orthodontic care. First of all there probably is a cultural factor, in the sense that people living in remote areas of some provinces, probably are less aware and might be less sensible to the advantages of orthodontic treatment. On average this might be more the case in the province of Luxembourg which is a more rural area without any big cities.

Secondly, low evidence has been found in the literature (see section 2.3.1.3) which showed that patients, who regularly visited their dentists, are more likely to receive orthodontic treatment. If the general dentist population is also more scarce in certain area's (like again in Luxemburg), patients will also see their general dentists less frequently and will thus also be less likely be referred for orthodontic treatment.

Thirdly, we suppose that there also could be a financial barrier for patients with a lower socio-economic background to access to orthodontic treatment in Belgium. As there was no concluding evidence in the literature on the correlation between socio-economic factors and the uptake for orthodontic treatment (see section 2.3.1.3), we therefore asked this question also in the questionnaire to the Belgian orthodontic care providers whether there are a lot of patients renouncing to orthodontic treatment due to a financial reason or threshold. This however does not seem to be the case very often though. To answer this question more thoroughly, a well set up epidemiologic research would be necessary. As a first step, IMA/AIM data on treatment by socio-professional characteristics could also be investigated.

4.7 COMPARISON OF NUMBER OF TREATMENT STARTS DONE BY SPECIALIST VERSUS NON-SPECIALIST PRACTITIONERS

4.7.1 Based on population of 0-19 yr olds

Table 47: Percentage of treatment starts by specialists compared to total starts in 2005 in Belgium and its regions for 0-19yr olds.

	305631 in spec	305631 total	% of total OHCP
Flemish region	20290	30617	66,30%
Walloon region	8210	13701	59,90%
Brussels capital	2373	3702	64,10%
Belgium	30873	48020	64,30%

Source: RIZIV/INAMI (Oct 2007). OHCP: orthodontic health care provider: both specialists and non-specialists.

- **The percentage of orthodontic treatments in 0-19 yr olds started by specialists in 2005 is estimated to be 66.3% in the Flemish region, 59.9% in the Walloon region and 64.1% in Brussels.**
- **On average for Belgium this means that in 2005 64.3% of all the orthodontic treatments in the selected age category (0-19yrs of age) were performed by specialists.**

4.7.2 Based on population of 10-14 yr olds

Table 48: Percentage orthodontic treatment starts in 10-14 yr olds in 2005 by all practitioners (specialists and non-specialists)

	overall 305631 in 10-14yr old pop	spec 305631 in 10-14yr old pop	non-spec 305631/10-14yr old pop
Antwerp	7,50%	5,30%	2,20%
Brussels	6,60%	4,20%	2,20%
East Flanders	9%	6,70%	2,30%
Flemish Brabant	10,70%	6,60%	4,10%
Hainaut	4,50%	2,60%	1,90%
Limburg	8,20%	4,20%	4%
Liege	7,80%	4,90%	2,90%
Luxemburg	3,80%	2,30%	1,50%
Namur	6,30%	3,10%	3,20%
Walloon Brab	10,50%	6,80%	3,70%
West Flanders	7,70%	5,30%	2,40%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

Table 49: Percentage of orthodontic treatment starts in 10-14 yr olds for 2005 by specialists and non-specialists over all Belgian provinces and Brussels

	% spec starts OT	% dentists starts OT
Antwerp	70,70%	29,30%
Brussels	63,60%	36,40%
East Flanders	74,40%	25,60%
Flemish Brabant	61,70%	38,30%
Hainaut	57,80%	42,20%
Limburg	51,20%	48,80%
Liege	62,80%	37,20%
Luxemburg	60,50%	39,50%
Namur	49,20%	50,80%
Walloon Brab	64,80%	35,20%
West Flanders	68,80%	31,20%

Source: RIZIV/INAMI (Oct 2007); NIS (http://ecodata.mineco.fgov.be/mdn/bevolking.jsp; accessed January 2007)

Compared to the data on the 0-19yr old sample, this matches rather well with the numbers for treatment in 2005, where 66.3% of the treatment starts were performed by specialists in the Flemish region, 59.9% in the Walloon region and 64.1% in Brussels. For Belgium this was 64.3% on average.

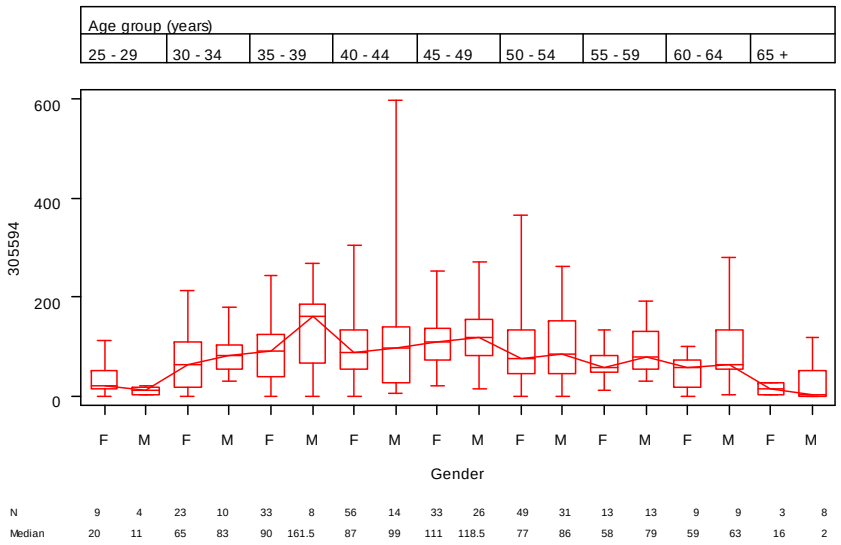
- **The average percentage of treatment starts done by specialists (versus non-specialists) in the 0-14 yr old sample was 65.4% for the Flemish region, 59% for Walloon region and 63.6% for Brussels. For Belgium this was 62.7% on average.**
- **The highest percentage of orthodontic treatment starts by non-specialists was found in Namur (50.8% of all starts); followed by Limburg (48.8% of all starts).**
- **The lowest percentage of orthodontic treatment starts by non-specialists was found in East-Flanders (25.6% of all starts); followed by Antwerp (29.3% of all starts).**

4.8 DESCRIPTION OF PRACTITIONERS PROFILES

4.8.1 Specialists' profiles

See Figure 29 for prescription profiles of the treatmentplanning act by age and sex group of specialist practitioners. The three horizontal lines in the rectangle represent from top to bottom the third quartile, median and first quartile, respectively. The whiskers extend from the minimum to maximum.

Figure 29: Distribution of orthodontic treatmentplanning (act 305594) in orthodontic specialists per age category and per gender



Source: RIZIV/INAMI

The conception of an orthodontic treatment plan for the patient is crucial for the way the patient will be treated. To this end orthodontic records are made; these normally include high quality impressions in alginate, made from the upper and the lower jaw and from which either study models in plaster or converted digitized models, clinical intra-oral and extra-oral photographs, an orthopantomogram, a lateral cephalogram (radiographs), and sometimes a local CT's or other radiographs according to the indications are necessary.

The 305594 act also includes the RIZIV/INAMI application in order to demand the patient's eligibility for reimbursement by the RIZIV/INAMI (form 60: included in the Appendix of Chapter 5).

The treatment planning phase always precedes the discussion with the patient on what the goal of the treatment will be and by which biomechanical means (selection of the appliance(s)) this goal could be reached.

This also implies the information on the prospective treatment timing eventually of the different phases of the treatment. Also the planning for the retention phase is explained before the start of the treatment, so that the patient is fully aware of the consequences also for the future after the active orthodontic treatment.

The range of new treatment plans ranges normally between 0-380, but there seems to be an extreme outlier in the 40-44yr old male group, where there close to 600 treatment planning acts were performed.

The general average seems to lie somewhat over 100 new treatmentplanning acts over the age and gender ranges. There does not seem to be a gender, nor an explicit age effect (no statistical comparison).

- **The 305594 act includes the conception of an orthodontic treatment plan as well as the RIZIV/INAMI application in order to demand the patient's eligibility for reimbursement by the RIZIV/INAMI (form 60).**
- **Scoring of the objective orthodontic treatment need (e.g. IOTN-scoring) could be added to this act.**
- **The treatment planning act phase always precedes the discussion with the patient on:**

  1. what the goal of the treatment can be and

  2. by which biomechanical means (selection of the appliance(s)) this goal could be reached;

  3. the information on the prospective treatment timing

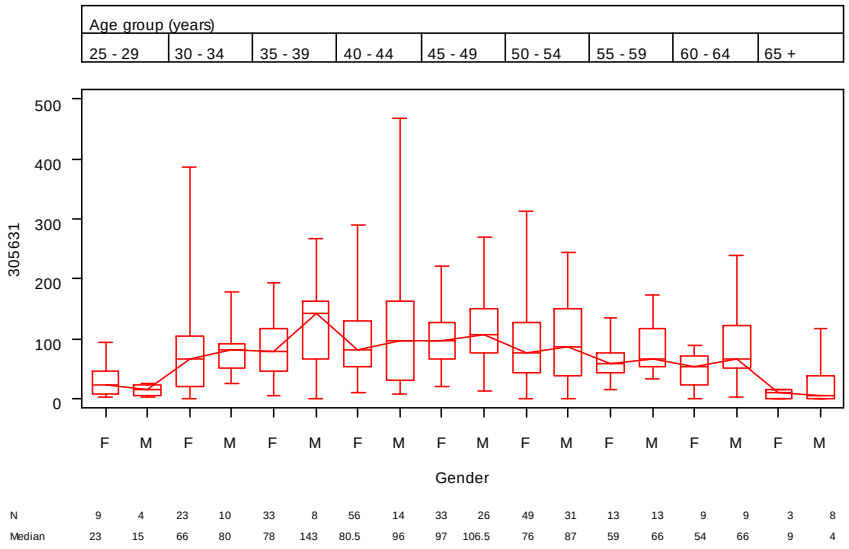
  4. the eventual different phases of the treatment,

  5. the weighing of the risks and benefits of the treatment

  6. the planning of the retention phase and

  7. the explanation on the cost of the treatment
- **All above should be explained to the patient before the start of the treatment, so that the patient is fully aware of the consequences also for the future after the active orthodontic treatment.**
- **The range of new treatment plans seems to range between 0-380 per year, (except extreme outliers), with the median somewhat over 100 new treatmentplanning acts over the age and gender ranges.**
- **There does not seem to be a gender, nor an explicit age effect, but this is not statistically analyzed.**

Figure 30: Distribution of the number of starts of orthodontic treatment (305631) in orthodontic specialists per age category and per gender



Source: RIZIV/INAMI

When comparing the 305594-graph with the graph of the 305631 acts, it can be clearly seen in almost every age category and gender, that the number of treatment planning acts (305594) is not exactly the same as the start of treatment acts (305631), but the difference in general is not extremely large either.

Normally not all patients will start with the proposed orthodontic treatment immediately after the 305594. There can be a lot of reasons why not to do so; there can be reasons suggested by the orthodontist (development of the dentition, the

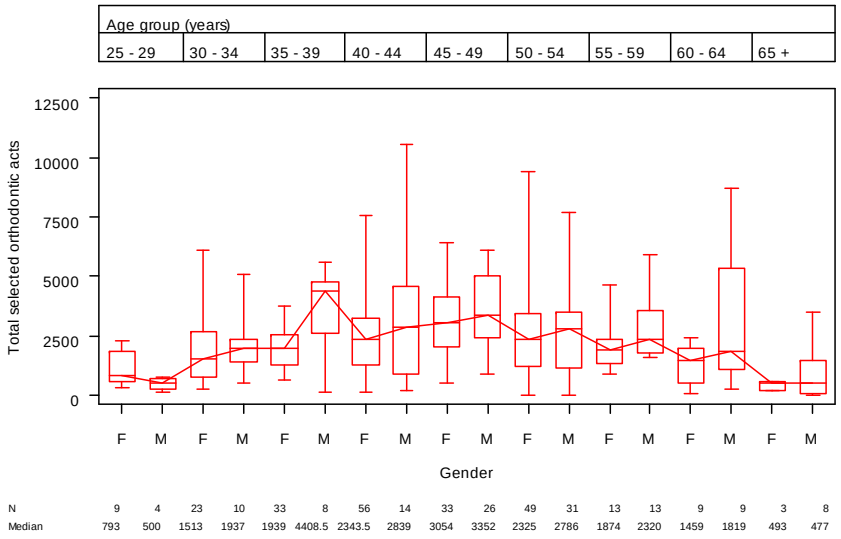
malocclusion is not severe enough to treat, the oral hygiene is not good enough, ...) or the patient can decide not to accept the proposal (no compliance with the type of appliance proposed, duration of the treatment more than expected, cost of the treatment more than expected, other medical problem, ...).

It can also be mentioned that there seems to be a large variation in the number of these acts among the specialists.

When connecting the median values for all the age categories for both acts, the imaginary curve seems to form a bell curve with a flattened top between 35-39 and 45-49 yrs of age, as well for male as for female orthodontists.

Except for the two extreme age categories (very young and old), a smaller median number of treatmentplanning acts, of treatment starts and of the combined orthodontic acts (305594, 305631, 305675, 305616 and 305852), is observed for female specialists than for male specialists.

Figure 31: Distribution of a number of orthodontic acts (305594, 305631, 305675, 305616 and 305852) in orthodontic specialists per age category and per gender



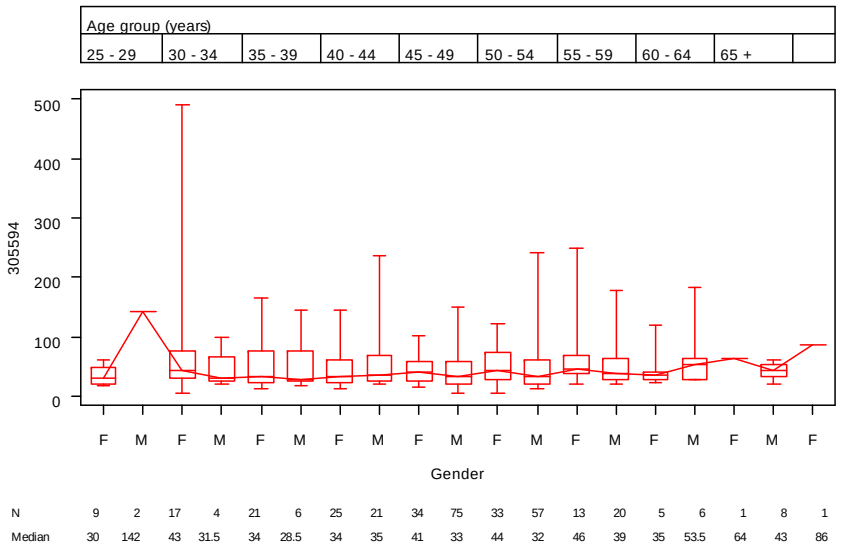
Source: RIZIV/INAMI

For the combined selected orthodontic acts the same flattened top can be seen, with an extension towards the next age category of 50-55 yrs of age for man and women. Here the male group between 60-64 seems to jump out of the rest of the curve.

- **The number of treatment planning acts (305594) do not completely match the start of treatment acts (305631), but the difference in general is not extremely large.**
- **The median values for all the age categories for plans and starts, form a bell curve with a flattened top between 35-39 and 45-49 yrs of age, as well for male as for female specialists.**
- **Except for the extreme age categories, a smaller median number of treatmentplanning acts, of treatment starts and of the combined orthodontic acts (305594, 305631, 305675, 305616 and 305852), is observed for female specialists than for male specialists.**
- **For the combined selected orthodontic acts the same flattened top can be seen, with an extension towards the next age category of 50-55 yrs of age for man and women. The male group between 60-64 seems to jump out of the rest of the curve.**

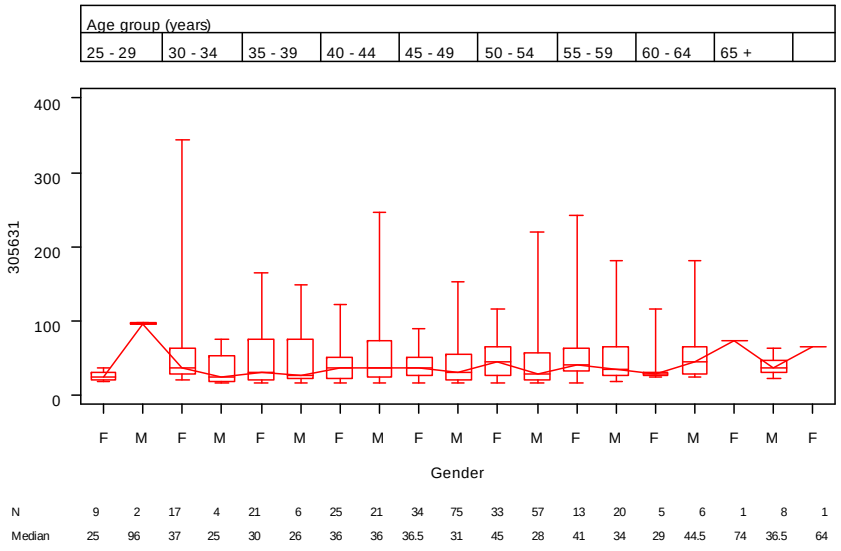
4.8.2 Non-specialist practitioners profiles

Figure 32: Distribution of orthodontic treatmentplanning (act 305594) in <u>non-specialist</u> orthodontic care providers per age category and per gender



Source: RIZIV/INAMI

Figure 33: Distribution of the number of starts of orthodontic treatment (305631) in <u>non-specialist</u> practitioners per age category and per gender



Source: RIZIV/INAMI

In contrast to the specialists, the non-specialists show a homogenous group with a rather flat curve of the career for what concerns the number of orthodontic treatment plans and starts. Although - similar as in the group of specialists - there also seems a high inter-individual variation within the age groups as well for men as for women, the median values of the number of started cases remains flat throughout the age categories and genderwise there do not seem to be large differences.

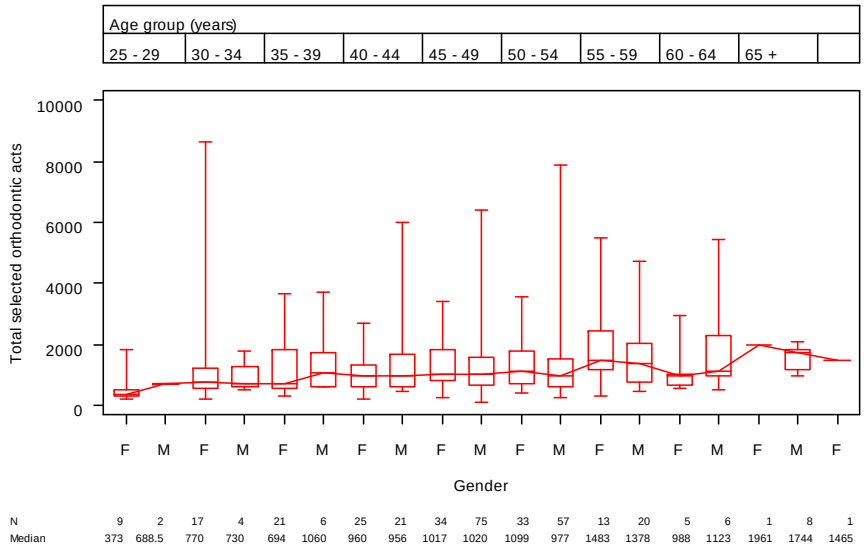
An outlier is spotted in this data-set, the 30 - 34 years females age group, showing a peak in the treatmentplanning (305594) and in the treatment starts (305631).

Close to 500 times 305594 can be noted in this group, while only 350 times 305631 is attested in the same age-gender group in the year 2005.

The median number of orthodontic treatment starts is around 50 cases a year.

- **The non-specialist practitioners show a rather flat curve of the career for what concerns the number of orthodontic treatment plans and starts.**
- **There also seems to be a higher inter-individual variation between the age groups as well between men and women.**
- **The median values of the number of started cases remain flat throughout the age categories and genderwise there do not seem to be large differences in the median.**

Figure 34: Distribution of a number of orthodontic acts (305830, 305594, 305631, 305675, 305616 and 305852) in <u>non-specialists</u> per age category and per gender



Source: RIZIV/INAMI

A similar flat curve can be imagined through the median values of the combined selected orthodontic acts of the non-specialist orthodontic care providers.

4.9 CONCLUSIONS

- **The density of practitioners per inhabitant is highest in Brussels and lowest in the Walloon region.**
- **In Luxembourg, Namur and Hainaut there are significantly more non-specialist than specialist practitioners. In Walloon and Flemish Brabant there are significantly more specialist than non-specialist practitioners. In the other provinces and Brussels, the split is about 50/50.**
- **RIZIV/INAMI data show that in Belgium on average 40% of children and adolescents ever start a reimbursed orthodontic treatment (before adulthood). In the Flemish region this is the case for 46%, in the Brussels and Walloon region 30% and 32%.**
- **In Belgium, on average 2% of the 0-19 yr olds started an orthodontic treatment in 2005. East Flanders, West Flanders and Limburg are very close to the Belgian average of 2% with respectively 2.4%, 2.1% and 2.2%. In Antwerp and Liège the Belgian average of 2% is exactly reached. Namur and Brussels are on the lower side of the spectrum, and in Hainaut and Luxembourg, only 0.97% of the 0-19 yr olds started a treatment in 2005.**
- **The number of specialistic and non-specialistic treatment starts, per inhabitant, is highest in the Flemish region, followed by the Walloon region and the lowest in Brussels capital region. Similarly, the number of non-specialistic treatment starts per inhabitant is the highest in the Flemish region, followed by the Walloon region and the lowest in Brussels capital region.**
- **In general, in the south and east of Belgium there is more non-specialist care than in the northern part of the country.**
- **A smaller median number of treatment planning acts, of treatment starts and of the combined orthodontic acts is observed for female orthodontists than for male orthodontists.**

5 BELGIAN SITUATION: ESTIMATES ON FEES, REIMBURSEMENT AND OUT-OF-POCKET PAYMENTS FOR ORTHODONTIC TREATMENT

5.1 INTRODUCTION

The aims of this chapter are:

- to analyse the contributions of the different players on the orthodontic health care costs. To describe the current reimbursement policy on orthodontic care in Belgium (the basic reimbursement by the national health insurance, the complementary reimbursement by the sickness funds and additional reimbursement by private health insurers)
- to analyse the actual fees applied for orthodontic treatment and the resulting out-of-pocket payments for patients
- to try to find out about equity in the financing of the sector of orthodontics, not only for the patients but also towards orthodontists, both in the perspective of the international context for orthodontics

5.2 CONTRIBUTORS TO THE BELGIAN ORTHODONTIC HEALTH CARE COSTS

At present, the major players contributing to the costs related to orthodontic health care in Belgium for the age group of 0-15yrs of age, are:

- the compulsory national health insurance RIZIV/INAMI
- the sickness funds
- private or employer insurances and
- the patient ('s parents)

Each of these components will be estimated and analysed in this chapter.

5.3 CONVENTION FEES AND REIMBURSEMENT BY THE NATIONAL HEALTH INSURANCE RIZIV/INAMI

Description of the nomenclature related to orthodontic treatment: diagnostics, treatment planning, active treatment and retention by specialist and non-specialist practitioners[iiiii] can be found in the Appendix of Chapter 5. Table 50 shows an overview of the convention fees and according reimbursement fees by the national health insurance.

[iiiii] Circular letter RIZIV/INAMI dd January 2008; cfr also website RIZIV/INAMI: http://www.riziv.fgov.be/care/nl/nomenclature/chapter03.htm

Table 50: Overview of the convention fees and according reimbursement fees by the national health insurance

	Fee codes	Convention fee (€)	Standard reimbursement (€)
Orthodontic treatment			
Orthodontic treatment demand	305594-305605	70.05	52.54
Appliance - at the start of the treatment: - after 6 months of treatment:	 305631-305642 305675-305686	 158.81 158.81	 119.11 119.11
Monthly regular treatment: - max 2 per calendar month and 6 per six calendar months - regular treatment after which an interruption starts of more than 6 months - regular treatment after which non-reimbursable regular treatment follows	 305616-305620 305653-305664 305712-305723	 20.96 	 15.72
Orthodontic advice or investigation, with report	305830-305841	27.59	20.70
Contention check: - Max. 4 per calendar year - check after which an interruption of more than 6 months follows	 305852-305863 305896-305900	15.25	11.44
Fabrication of model, on request of "Technische Tandheelkundige Raad/Conseil Technique Dentaire"	305874-305885	19.06	14.30
Consultations			
Consultation of specialist orthodontist before the age of 12	3x1092-3x1103*	22.63	22.63
Consultation of specialist orthodontist after the age of 12	301092-301103	22.63	18.08
Consultation of dentist at home of patient on demand of doctor, after the age of 12	3x1033-3x1044*	26.17	19.63
Supplement for urgent consultation dentist: - Sat., Sund., Legal holiday from 8am to 9pm - from 9 pm to 8 am (night)	 3x1055-3x1066* 3x1070-3x1081*	 8.14 17.65	 6.11 13.24
Prevention			
Half yearly oral examination with balance and instructions (<18 yrs): - first semester - second semester	 3x1556-3x1560* 3x1571-3x1582*	 20.26	 16.50
Yearly oral examination with balance, incl. intrabuccal RX (18 yrs – 56 yrs): - yearly mouth examination - cephalometric analysis on tele-RX	 301593-301604 305911-305922	 54.16 12.15	 50.81 9.12
Radiology			
extrabuccal RX of one jaw	3x7016-3x7020*	21.54	21.54
intrabuccal RX: first cliché	3x7031-3x7042*	10.77	10.77
intrabuccal RX: next cliché	3x7053-3x7064*	6.63	6.63
OPG	3x7090-3x7101*	36.75	27.57
tele – RX: one cliché	3x7112-3x7123*	33.13	33.13
tele – RX: two clichés	3x7134-3x7145*	45.56	45.56

* x: 0 (dentist) or 7 (specialist orthodontics). Source: RIZIV/INAMI, Circular letter VI nr 2007/, of the 11th of December 2007 3910/ applicable from 01/01/2008

5.4 ESTIMATES ON ACTUAL FEES

For this section, a number of sources are explored to estimate the actual fees. First of all, the historical guiding fees with the Christian Mutuality are presented. Secondly, a dataset from the private insurer DKV is shown. Furthermore, also our national questionnaire covered a number of questions regarding actual fees, but given the very low response rate for these questions, no solid data could be retreived. For further research on this topic, also the written offers at the sickness funds could be explored.

5.4.1 Historical guiding fees

As the majority of the practitioners do not undersign the convention between the dental health care providers and the RIZIV/INAMI, the fees are "free". However, since 1997 there has been a guideline on fee setting, unofficially agreed between the practitioners and the mutualities. The first guideline on a guiding fee tariff for orthodontic treatment was made between the Christian Mutuality and the president of Belgian professional orthodontic organization of university trained specialists (Belgische Beroepsvereniging van Universitaire Specialisten in de Orthodontie, BBUSO) at that time. Since 1997, this guiding tariff was adapted yearly to the index and has been reported to be accepted as guideline by the orthodontists since then.

The index of the month of November was used since 1997 to determine the guiding tariff of the year after. The last guiding tariffs of 2006 was performed in the month November of 2005. As there was doubt about some legal aspects, the professional organization decided to discontinue the publication of the guiding fee setting, and from 2007 on orthodontists can individually apply the tariff indexation of 1.62% (index of November of 2007) to the tariffs of 2006 in order to determine their tariffs for 2007 (cfr Appendix Chapter 5).

Table 51: Extrapolation of historical guiding fees of 2006 to 2007

1. Vooronderzoek en advies		
301011 + 307090 + 307112 (> 12 jr)	91.5 €	
371011 + 377090 + 377112 (< 12 jr)	91.5 €	
305830 + 307090 + 307112	97.9 €	
305594 + 305991	113 €	
305830	27 €	
2. Apparatuurforfaits		
Forfait apparatuur RPE (317925)		200 €
APPARATUUR (1ste en 2de deel) (305631 + 305675)		1079 €
(min/max)		(1025 € - 1133 €)
Retentieapparatuur	217 €	
Plaatsen retentiedraad 6 elementen	106 €	
3. Controles		
Controles 305616 x 6		296 €
Na 24x (bij idem practicus)		
305616 x 6	157 €	
Contentiecontrole 305852/305896	20 €	

(gez. Index nov 2005 116.82)

(De terugbetaling wordt geïndexeerd aan 2.6 % volgens het akkoord NCTZ)
Source: Communication from ex-Voorzitter Belgische Beroepsvereniging van Nederlandstalige Orthodontisten (BBNO)

5.4.2 Data on total fees from DKV

The private health insurer DKV offers additional reimbursement, not on a fixed-fee basis, but proportionally to the total fee of treatment. As they thus collect information on the total fee, we contacted the insurer for data. DKV makes sure that health care providers charge the same fee, regardless of the insurance status of a patient (whether or not a patient has a private health insurance). To that end, DKV settles agreements with health care providers and implements the necessary controls. The anonymous data that could be retrieved, under supervision of C. Burtin-Vivien at DKV, are presented in this section.

5.4.2.1 Description of the DKV orthodontic patients sample

The data from DKV provides information on the orthodontic treatment of a sample of 93 patients, 46 males and 47 females with a median age of 11.6 yrs (range 6.4 to 14.6 yrs; Inter Quartile Range (IQR): 10.5-13.1yrs). Most of the patients insured by DKV, live in the centre of the country (Brussels, 16%; Walloon Brabant, 16% and Flemish Brabant,14%) or in Antwerp (14%). For a detailed description of the DKV patient sample, see Table 52.

Table 52: Description of the DKV sample by age, gender, geographical origin of the patient and of the orthodontist (scient sum 5.6.1)

Variable	Statistic	Total
Number of patients	N	93
Gender		
Male	n/N (%)	46/93 (49.46%)
Female	n/N (%)	47/93 (50.54%)
Age (years)	N	93
	Mean	11.6
	Median	12.1
	Std	1.90
	IQR	(10.5; 13.1)
	Range	(6.4; 14.6)
Province of patient		
Antwerp	n/N (%)	14/93 (15.05%)
Flemish Brabant	n/N (%)	15/93 (16.13%)
West Flanders	n/N (%)	4/93 (4.30%)
East Flanders	n/N (%)	7/93 (7.53%)
Hainaut	n/N (%)	7/93 (7.53%)
Liège	n/N (%)	9/93 (9.68%)
Luxembourg	n/N (%)	3/93 (3.23%)
Namur	n/N (%)	2/93 (2.15%)
Brussels	n/N (%)	16/93 (17.20%)
Walloon Brabant	n/N (%)	16/93 (17.20%)
Province of orthodontist		
Antwerp	n/N (%)	12/93 (12.90%)
Flemish Brabant	n/N (%)	11/93 (11.83%)
West Flanders	n/N (%)	3/93 (3.23%)
East Flanders	n/N (%)	9/93 (9.68%)
Hainaut	n/N (%)	5/93 (5.38%)
Liège	n/N (%)	11/93 (11.83%)
Limburg	n/N (%)	1/93 (1.08%)
Luxembourg	n/N (%)	1/93 (1.08%)
Brussels	n/N (%)	23/93 (24.73%)
Walloon Brabant	n/N (%)	17/93 (18.28%)
Orthodontic specialist		
No	n/N (%)	20/93 (21.51%)
Yes	n/N (%)	73/93 (78.49%)
Class		
1	n/N (%)	25/93 (26.88%)
2	n/N (%)	64/93 (68.82%)
3	n/N (%)	4/93 (4.30%)

Source: DKV, February 2008

The geographical location of the practices of their practitioners is also either in Brussels (23.74 %) or in Walloon Brabant (18.28%), followed by Antwerp (12.90%) and Flemish Brabant (11.83%). Both in Limburg and Luxemburg, DKV provided payment for orthodontic treatment only for one patient, representing each 1%, in this sample.

This patient sample has also been classified in terms of treatment options. The classification was based on the available DKV data. Concerning the description of the treatment options in the DKV-sample, 13 patients (14%) received at least one extraction. From these 13 patients, 46.15% of the patients received four extractions, 30.8% had two extractions and 15.4 % had only one extraction before the start of the orthodontic treatment (cfr Table 53).

Concerning the type of malocclusion for which reimbursement was requested, 37.63% of the patients presented a dento-maxillary dysharmony, 19.35% presented an increased overjet, 32.26% an increased overbite, 9.68% of orthodontic deviations were called 'non-occlusions' and in the sample 9.68% of the patients had an agenesis. In 20.43% of the sample a cross-bite was present.

Table 53: Description of the DKV sample by orthodontic diagnosis and treatmentplanning

Variable	Statistic	Total
Number of patients	N	93
Number of therapeutic extractions		
1	n/N (%)	3/13 (23.08%)
2	n/N (%)	4/13 (30.77%)
4	n/N (%)	6/13 (46.15%)
Estimated duration of treatment (months)	N	93
	Mean	26.3
	Median	24.0
	Std	8.15
	IQR	(18.0; 36.0)
	Range	(6.0; 36.0)
DDM		
No	n/N (%)	58/93 (62.37%)
Yes	n/N (%)	35/93 (37.63%)
Overjet		
No	n/N (%)	75/93 (80.65%)
Yes	n/N (%)	18/93 (19.35%)
Overbite		
No	n/N (%)	63/93 (67.74%)
Yes	n/N (%)	30/93 (32.26%)
Non occlusion		
No	n/N (%)	84/93 (90.32%)
Yes	n/N (%)	9/93 (9.68%)
Cross Bite		
No	n/N (%)	74/93 (79.57%)
Yes	n/N (%)	19/93 (20.43%)
Agnesis		
No	n/N (%)	84/93 (90.32%)
Yes	n/N (%)	9/93 (9.68%)
Extraction of DDS (Dents de Sagesse)		
No	n/N (%)	72/90 (80.00%)
Yes	n/N (%)	18/90 (20.00%)
Surgery		
No	n/N (%)	90/93 (96.77%)
Yes	n/N (%)	3/93 (3.23%)

Source: DKV, February 2008

5.4.2.2 *Description of the fees in the DKV sample*

Table 54: Statistics on the amounts billed for orthodontic treatment to DKV clients and on the amounts paid by the mutualities

Variable	Statistic	Total
Number of patients	N	93
Amount billed (euro)	N	77
	Mean	2229.1
	Median	2035.0
	Std	808.50
	IQR	(1720.0; 2610.0)
	Range	(720.0; 4331.0)
Intervention by mutualities		
No	n/N (%)	13/93 (13.98%)
Yes	n/N (%)	80/93 (86.02%)
Amount paid by mutualities (€)	N	80
	Mean	293.3
	Median	371.0
	Std	166.64
	IQR	(250.0; 375.0)
	Range	(0.0; 625.0)

Source: DKV, February 2008

Financial data about the orthodontic fees in 77 patients of this sample showed that a median fee in these patients is estimated to be €2 035 (mean €2 229; std of €808.5); the IQR is between 1720 and 2610€; the min-max fee ranges from €720 to €4 331.

For 80 patients in this sample a median reimbursement by the sickness funds was €371 (mean €293.3; std €166.64) was reported, the IQR being €250 and €375.

The differences in treatment duration certainly account for a part of the variation of the fee for orthodontic treatment, and thus the fee for the reimbursement, but a major component is expected from the type of treatment (orthopaedic, fixed or comprehensive fixed appliances), which is not provided as information. This might explain the largest part of the variation.

The maximum fee of €4 331 (cfr Range in Table 54) can only be justified if it would concern a patient with congenital craniofacial deviations, in which long and complex treatment is common. This cost is not exceptional in those cases.

According to the data, the median reimbursement by the sickness funds & RIZIV/INAMI is €371. In 14% of the cases, however, there was no intervention by the sickness funds & RIZIV/INAMI.

5.4.3 Data from the questionnaire

In our questionnaire to Belgian orthodontic practitioners (see further in Chapter 7), also a number of questions regarding fees were included. Unfortunately however, this question had only a very low response rate, and since they would not be representative at all, the results are not reported here.

5.5 COMPLEMENTARY REIMBURSEMENT POLICIES BY THE SICKNESS FUNDS

The second major contributors to the expenses of orthodontic treatment in patients up to 21 yrs of age are the sickness funds, on the condition that the demand for reimbursement (form 60) has been sent to the RIZIV/INAMI by the practitioner before the age of 15 yrs.

There are a lot of different sickness funds and it is up to the individual choice of the patients of which sickness fund they want to become a member.

To be able to provide maximal reimbursement of medical costs, individual free additional insurance premiums ("Vrije Aanvullende Verzekering" VAV) are installed for some specific health care items, like for orthodontic treatment.

In the matrix below (Table 55), an overview is given of all the different regulations and different reimbursements of the different sickness funds. As at most sickness funds the members are obliged to take the complementary insurance (only at the neutral sickness funds this is optional), virtually all Belgians (that pay their sickness fund correctly) have access to extra reimbursement. The exact reimbursement is however different for each sickness fund, and should be calculated individually.

Each particular sickness fund reimbursement is added to the standard national RIZIV/INAMI reimbursement (see Table in paragraph 5.3).

Most sickness funds provide an extra contribution for patients with specific congenital malformations and syndromes, who benefit of special reimbursement. An extra-form should in this case be filled out by the practitioner in order for the patient to become eligible for this extra reimbursement.

Table 55: Overview of complementary reimbursement by Belgian sickness funds

		Regular reimbursement		Extra reimbursement for special indications			
Sickness fund	Fixed (F) or % (P)	Gewone tegemoetkoming (€)	Max when P	Indications for which extra reimbursement	Extra reimbursement €	Use of index	max reimburs.
(101) (104) (105) (108) (110) (111) (112) (113) (120) (121) (126) (131)*	F	370 € zijnde - 185 € bij 305631 - 185 € bij 18e x 305616		- craniofaciale dysplasieën; - craniofaciale dysplasie met dyschondrose; - craniofaciale dysplasie van andere oorsprong; - congenitale agenesie van min. 3 blijvende tanden met uitzondering van de wijsheidstanden	370 € bij 6e nr 305616	nee	740 €
MC du Hainaut Oriental (128)	F	250 €					250 €
MC Hainaut Picardie (129)	F	75 €		IOTN-index = 4 or 5	322 € zijnde - 161€ après 6e forfait - 161€ après 18e forfait	ja	377 €
MC de Liège (130)	P	50% du supplément facturé hors nomenclature sur les frais d'achat d'un appareil orthodontique	400 €				
MC de la province de Luxembourg (132)	F	200 € bij start 200 € na zes maanden behandeling		cas prévus par la nouvelle réglementation AMI	200 € tot max 400 €: - 3e forfait de 200 € - 4e forfait de 200 €		800 €
MC de la province de Namur (134)	F	1) apparaat: - Appareil amovible: 50 € - Appareil fixe une arcade: 225 € - Appareil fixe deux arcades: 375 € 2) behandeling: que dans le cas de placement d'un appareil fixe: 300 €					300 €
Mutualité Saint-Michel (135)	F	indien geen akkoord: 1 x 150 € na 6 maanden behandeling indien wel akkoord: 370 € zijnde - 185 € bij 6 x 305616 - 185 € bij 18e x 305616					370 €
Landsbond van de Neutrale Ziekenfondsen (200)	F	750 € zijnde - 150 € bij start- 150 € na 6 raadplegingen- 150 € na 12 raadpl. - 150 € na 30 raadpl.- 150 € na 36 raadpl.					750 €
Federatie van Socialistische Mutualiteiten van Brabant (306)	F	372 € zijnde: - 186 € bij 305631 - 186 € na 12 x 305616		- retrograde en prograde dysmorfismen - hazelip	372 €		742 €
Mutualis (380/02)	F	- 225 € max pour les soins orthod. - 200 € pour 1er forfait appareil avec plafond de 400 € pour les 2 forfaits					625 €

M.O.B. Solidariteit (380/03)	F	372 € zijnde - 186 € bij 305631 - 186 € min 1 jaar na terugbetaling 1e schijf		- craniofaciale dysplasieën; - craniofaciale dysplasie met dyschondrose; - craniofaciale dysplasie van andere oorsprong; - congenitale agenesie van minstens drie blijvende tanden met uitzondering van de wijsheidstanden	372 €		742 €
Landsbond van Liberale Mutualiteiten (400)	F	372 € zijnde - 186 € bij 305631 - 186 € na 18e 305616		indien akkoord Technisch Tandheelkundige Raad voor verder zetten behandeling na 36e vast maandbedrag	372 €		
Landsbond van de Onafhankelijke Ziekenfondsen (500)	P	60% van het bedrag dat ten laste blijft van de aangeslotene	Vanaf 3e jaar van aansluiting: 1000€				
Onafhankelijk Ziekenfonds 501 (501)	F	375 € tot max 450 € indien IOTN score = 5		- craniofaciale dysplasieën; - craniofaciale dysplasie met dyschondrose; - craniofaciale dysplasie van andere oorsprong; - congenitale agenesie van minstens drie blijvende tanden met uitzondering van de wijsheidstanden	370 €	ja	740 €
Mutualité professionnelle et libre de la Région wallonne (506)		250 €					
Euromut - Onafhankelijk Ziekenfonds (509)	F	325 € bij AV		indien AV+	275 €		600 €
Freien Krankenkasse (515)	F	125 € (in 2002) 250 € (vanaf 2003)					
Ziekenfons Securex (516)	F	150 € per orthod. behandeling 400 € bij score 4 IOTN 700 € bij score 5 IOTN				ja	700 €
Partena - Onafhankelijk Ziekenfonds Vlaanderen (526+527)		375 €		- dysplasies craniofaciales - dysplasies craniofaciales avec dyschondrose, - dysplasies d'autres origines - agénesie congénitale d'au moins trois dents restantes à l'exception des dents de sagesse	425 €	ja	800 €

Note: *(101): Christelijke Mutualiteit van het Arr. Antwerpen; (104): Christelijke Mutualiteit van het Arr. Mechelen); (105): Christelijke Mutualiteit van het Arr. Turnhout; (108): Christelijk Ziekenfonds - Sint-Pietersbond; (110): Christelijke Mutualiteit Brugge; (111): Christelijke Mutualiteit Zuid-West-Vlaanderen; (112): Christelijke Mutualiteit Oostende-Veurne-Diksmuide; (113): Christelijke Mutualiteit Roeselare-Tielt; (120): CM Midden Vlaanderen); (121): Christelijke Mutualiteit van het Land van Waas en Dendermonde; (126): Christelijk Ziekenfonds Sint-Michielsbond; (131): Christelijke Mutualiteit Limburg. Note also that the policies of "Maatschappijen van onderlinge bijstand" that do not cooperate with sickness funds and that cover personnel of a specific company or profession group or not described in this matrix.

5 Source: based on statutory clauses of sickness funds provided by CDZ-OCM (Controle Dienst voor de Ziekenfondsen – Office de Contrôle des Mutualités)

5.6 ESTIMATES ON OUT OF POCKET PAYMENTS FOR ORTHODONTIC TREATMENTS

With the information on the reimbursement for orthodontic treatment from different sources, it still remains very difficult to make an estimate of the out of pocket payments for orthodontic treatment. Not only do the billed fees vary strongly (with treatment duration and type of treatment), but also the reimbursed contributions of the sickness funds and other health care insurers (like DKV) are variable as well. Based on the data on total fees from DKV, we estimate an average out-of-pocket payment (total fee minus national and complementary, but not private insurance) of €1 060 for a frequent treatment duration of 24 treatment sessions.

5.7 CONCLUSIONS

- **The RIZIV/INAMI reimbursement for active orthodontic treatment is composed of two times €119.11 (=€238.22) and X (6-48*) times €15.72 (=€94.32-€754.56). (*if two year prolongation is admitted by the controlling physician).**
- **If the minimum of 6 months treatment versus the maximum of 48 months treatment are considered, there is a range in national reimbursement of €212.43 to €992.78 (in exceptional conditions).**
- **All the sickness funds have complementary reimbursement, but the policies vary. For normal, non-medically compromised patients, around €360 is reimbursed at the largest sickness funds (for treatments with more than 12 or 18 sessions). For medically compromised patients, there is an extra reimbursement at most sickness funds of around €300-400.**
- **As at most sickness funds, members are obliged to take the complementary insurance, most Belgians (that pay their sickness fund correctly) have access to this complementary reimbursement.**
- **Data from a private insurance reveal a large range in actual total fees; the reported minimum and maximum fee range from €720 to €4 331 and a median of €2 035.**
- **The out of pocket payment for the patient varies largely and is depending on the reimbursement of the RIZIV/INAMI (duration of treatment), the membership of the sickness fund of choice and/or the potential extra private insurance. Based on data on total fees from DKV an average out-of-pocket payment (total fee minus national and complementary (but not private) reimbursement) for a frequent treatment duration of 24 sessions is estimated at €1 060.**

6 BELGIAN SITUATION: RIZIV/INAMI EXPENDITURES

6.1 INTRODUCTION

It is the aim of this part of the study:

- to analyse the evolution of the RIZIV/INAMI-registered treatments (in number and in expenses) in the past
- to analyse the RIZIV/INAMI-expenses over the sexes, the age categories, the regions and the provinces[jjjjj]

6.2 MATERIAL AND METHODS

On the basis of data provided by the RIZIV/INAMI, the evolution of the overall orthodontic RIZIV/INAMI-acts as well as the RIZIV/INAMI-expenses from 1975 to 2005 will be described. Note that, since for the historical data, only data by 'date of facturation' are available, no data by 'date of actual treatment' are presented here. For the data on consumption by age group, gender and region/province facturation data of the year 2006 are presented.

6.3 EVOLUTION OF OVERALL ORTHODONTIC RIZIV/INAMI-ACTS AND EXPENDITURES FROM 1975 TO 2005

6.3.1 Evolution of all orthodontic acts

Looking at the total number of acts, we can see that in 30 years (1975 to 2005) the total number of acts was almost the triplicate from 428 998, namely 1 284 391.

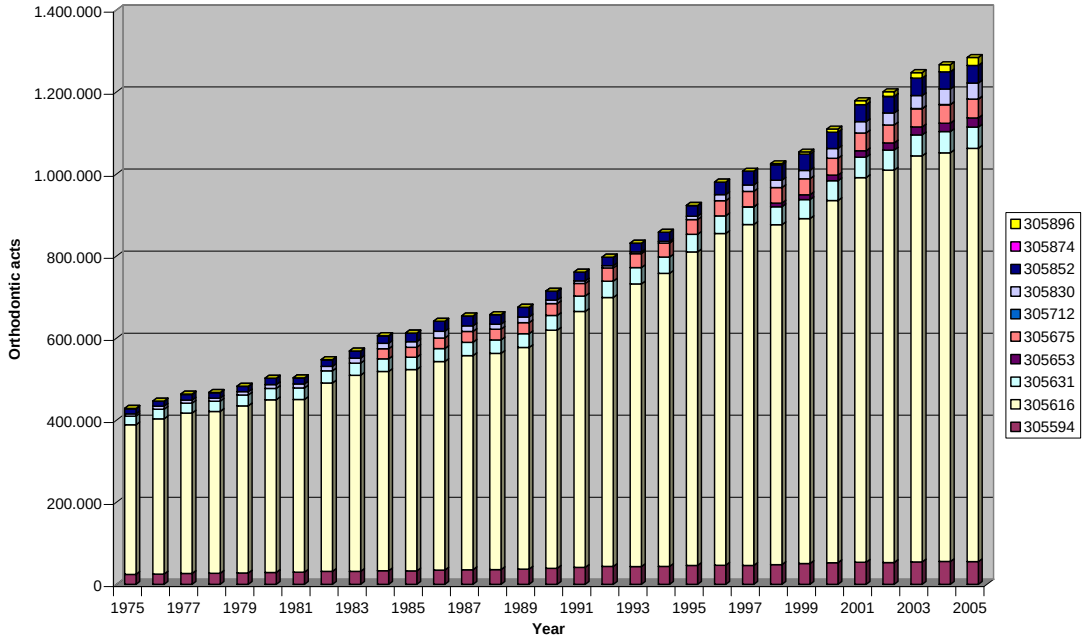
The orthodontic RIZIV/INAMI prestation 305616 ("forfait for monthly regular treatment", also called monthly activation visits for controlling evolution and for activating the appliance for the next month) by far exceeds all other orthodontic acts; it is the major occupation of the orthodontist in his daily practice. In Figure 35 with the transposed costs of these orthodontic acts since 1988, it can be calculated that the total RIZIV/INAMI-expenses for orthodontic acts in the years 1988,1998 and 2005 respectively amount 10 179 919.9 €, 21 968 420.72€ and 30 873 832.6 €. From 1988 to 1998 this represents an increase with 53.7% and from 1998 to 2005 an increase with 40.54%.

Also in terms of expenses, the 305616 act also represents the highest cost in the total of the RIZIV/INAMI-costs for orthodontic treatment. In 1988, the cost for 305616 (ie 4 853 613 €) already represented 48% of the total budget (10 179 920 €). In 2005 the cost for 305616 (i.e. 15 131 186 €) represented 49% of the orthodontic budget (ie 30 873 833 €).

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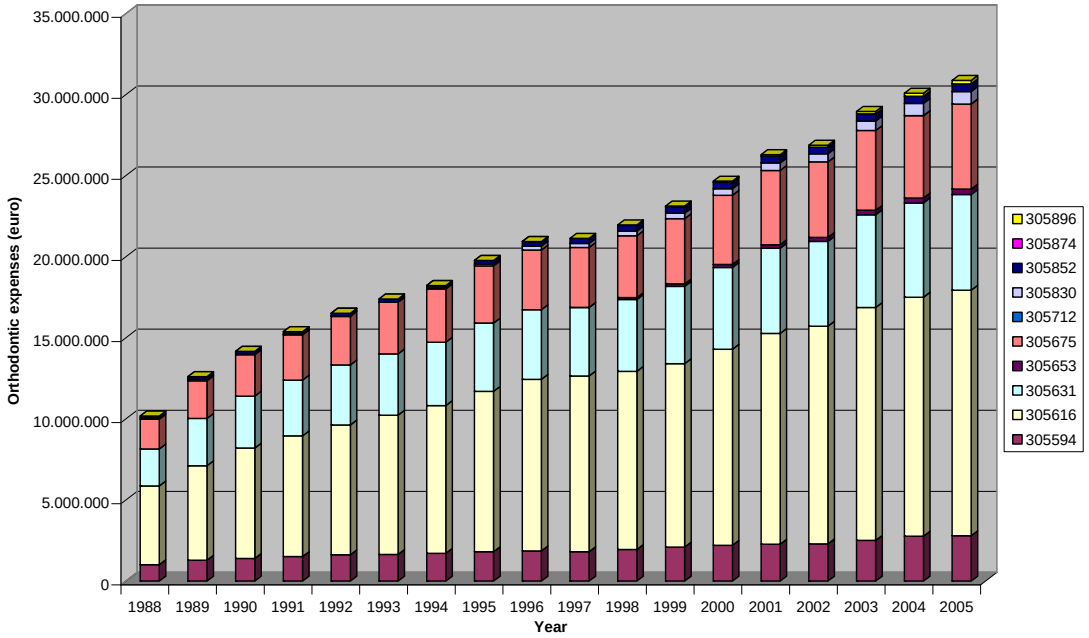
jjjjj Note: so far no historical comparison is possible between the orthodontic care provided by specialists and non-specialist orthodontic care providers, as no distinction could be made between them at the level of the RIZIV/INAMI for the past years. Moreover, the data provided in the annual year reports of the RIZIV/INAMI so far have always been a mixture of dental and stomatological care providers reported.

Figure 35: Evolution of all orthodontic RIZIV/INAMI acts, between 1975 and 2005 (incl 305616)



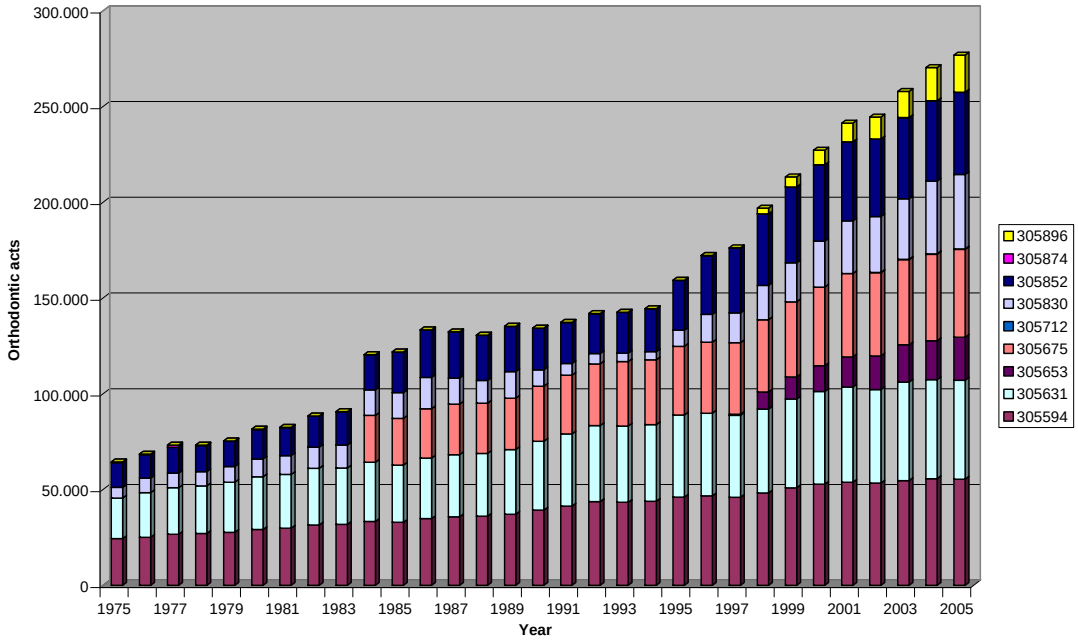
Source: RIZIV/INAMI

Figure 36: Orthodontic RIZIV/INAMI-expenses (in €) for all orthodontic prestations between 1975 and 2005



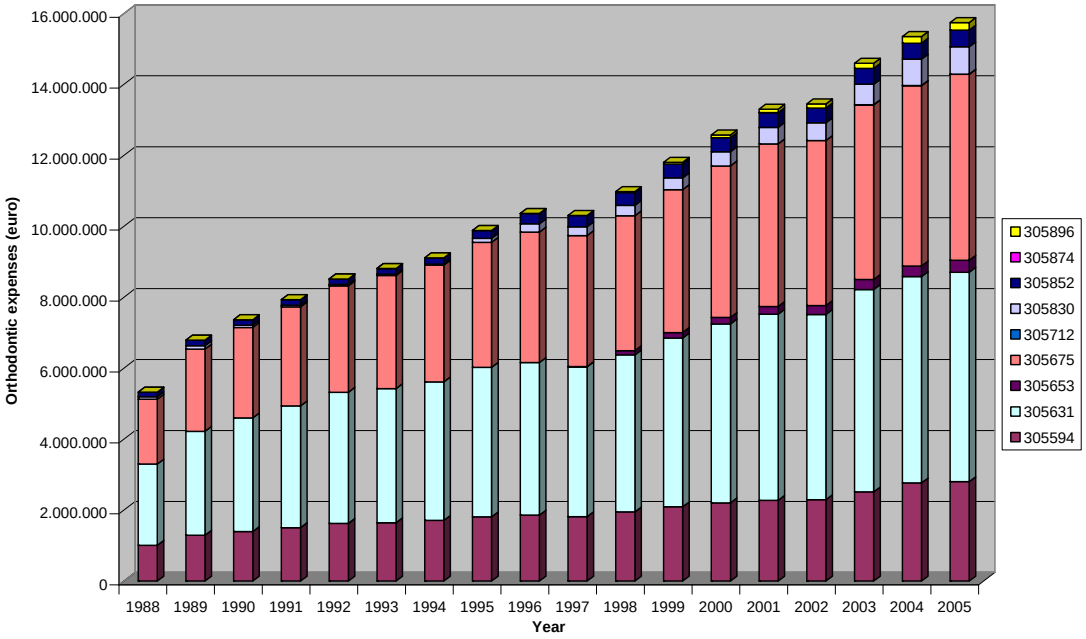
Source: RIZIV/INAMI

Figure 37: Evolution of all orthodontic RIZIV/INAMI acts between 1975 and 2005 (excl 305616)



Source: RIZIV/INAMI

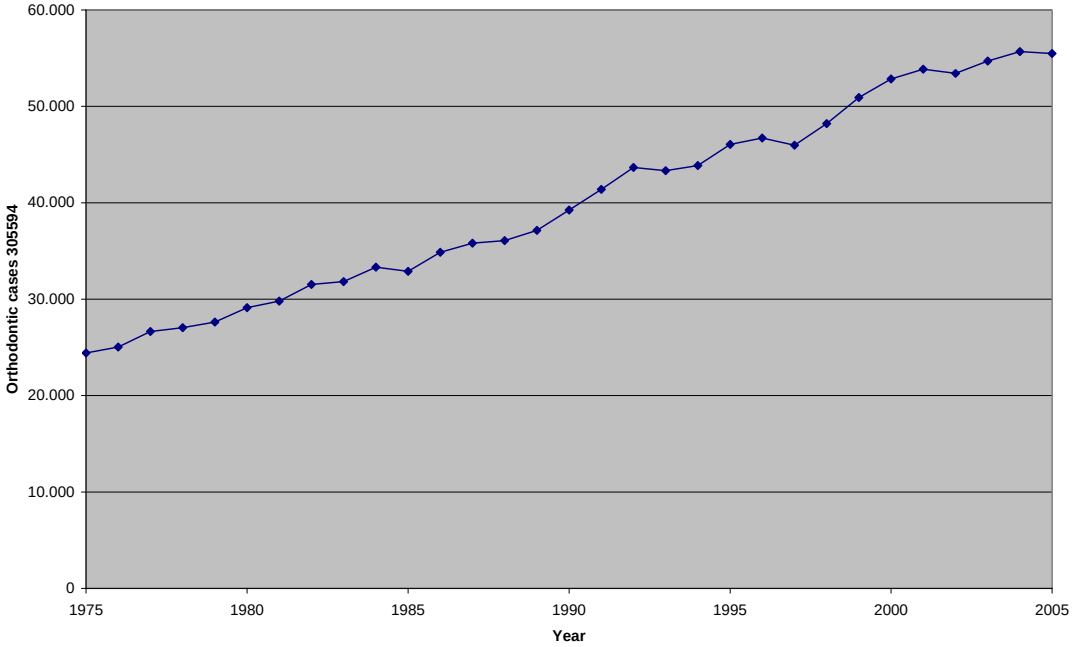
Figure 38: All orthodontic RIZIV/INAMI-expenses (in EUR) for all orthodontic prestations (excl. 305616) between 1975 and 2005



Source: RIZIV/INAMI

6.3.2 Evolution of orthodontic treatment demands (305594)

Figure 39: Number of orthodontic treatment demands (305594) at RIZIV/INAMI between 1975 and 2005



Source: RIZIV/INAMI

It would be interesting to superimpose the evolution of the RIZIV/INAMI number 305631 (start of treatment) on the treatmentplanning, in order to see how many patients decline treatment after a treatment demand at RIZIV/INAMI.

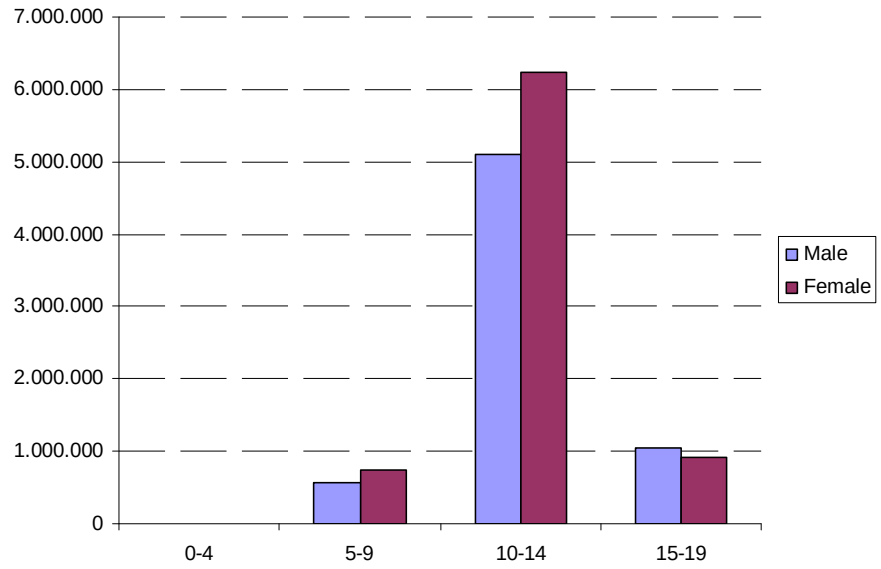
6.4 DESCRIPTION OF THE ORTHODONTIC RIZIV/INAMI-EXPENSES PER AGE CATEGORY, PER GENDER AND PER REGION/PROVINCE

In this section, an overview is given of the expenditures on three acts:

- 305594: treatmentplanning
- 305631: orthodontic appliance at the start of treatment
- 305675: orthodontic appliance after 6 months of treatment

6.4.1 Overview of 305594, 305631 and 305675 acts per age category and per gender

Figure 40: Orthodontic RIZIV/INAMI expenses for a combination of 305594, 305631 and 305675, per age category and per gender (2006)



Source: RIZIV/INAMI

In all age categories, the expenses over the country for planning orthodontic treatment and for two parts of appliances are larger for girls than for boys, except in the 15-19 age category where the orthodontic costs are higher for boys than for girls. The fact that boys have their pubertal growth later than girls, might be one of the explanations for this phenomenon.

The age group of 10-14 yrs is by far, the highest consuming age category for orthodontic treatment over the country if girls and boys expenses are combined. If the gender categories are looked at separately, then the age-category of 15-19 years for boys represents a higher cost in this category than in the 10-14 yrs category.

A small number of patients - 25 boys and 52 girls - is being treated orthodontically in the 0-4 age category (Table 56). A double amount of girls than boys is treated in this young age category.

Table 56: Orthodontic RIZIV/INAMI expenses for selected prestations in children between 0 and 4 years old (2006)

		305594		305631		305675		Total	
		N	Expenses (€)	N	Expenses (€)	N	Expenses (€)	N	Expenses (€)
0 yr	Male	0	0	0	0	0	0	0	0
	Female	0	0	1	115.31	0	0	1	115.31
1 yr	Male	1	50.86	2	265.65	1	153.74	4	470.25
	Female	0	0	0	0	0	0	0	0
2 yr	Male	2	101.72	0	0	0	0	2	101.72
	Female	1	50.86	0	0	0	0	1	50.86
3 yr	Male	2	101.72	1	115.31	0	0	3	217.03
	Female	3	169.53	2	269.05	1	153.74	6	592.32
4 yr	Male	13	661.18	3	345.93	0	0	16	1007.11
	Female	24	1233.85	17	1990.20	3	384.36	44	3608.41

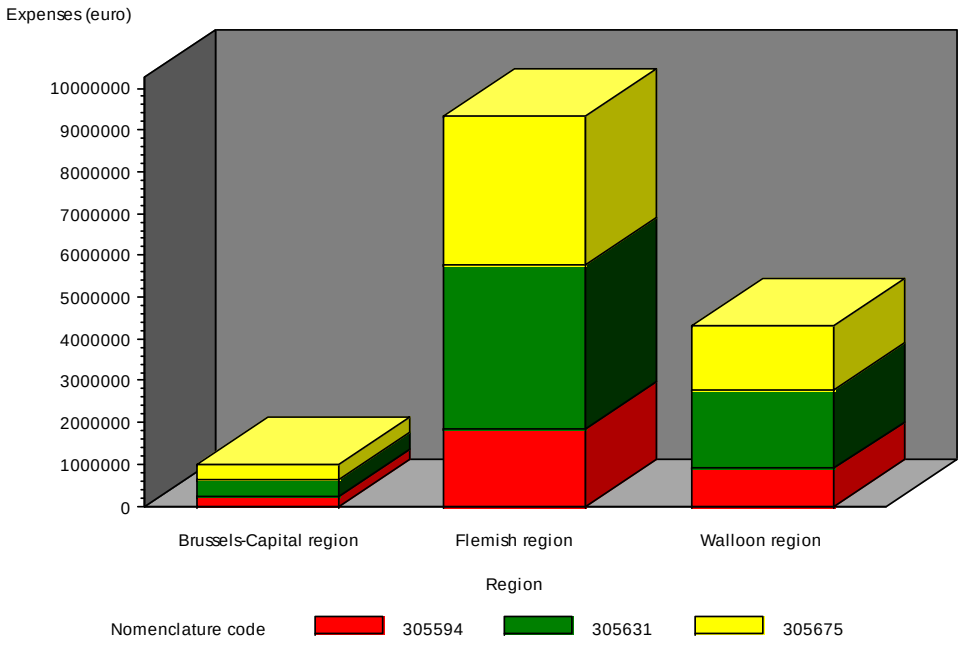
Source: RIZIV/INAMI

It would be interesting to know whether in some instances, neonatal treatments in CLP patients is included in the orthodontic treatment in this age category.

Data from the secretariat of the Selection committee of the MacDonalds Child Fund revealed that of the 894 demands for financial interventions in (predominantly) orthodontic treatment in 6 years, 708 have been advocated, for a total of 1 million of costs (personal communication of mrs Clapuyt, secretary of Prof C. Malevez, Chairperson of the Committee).

6.4.2 Overview of 305594, 305631 and 305675 acts per region

Figure 41: Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675, per region (2006)

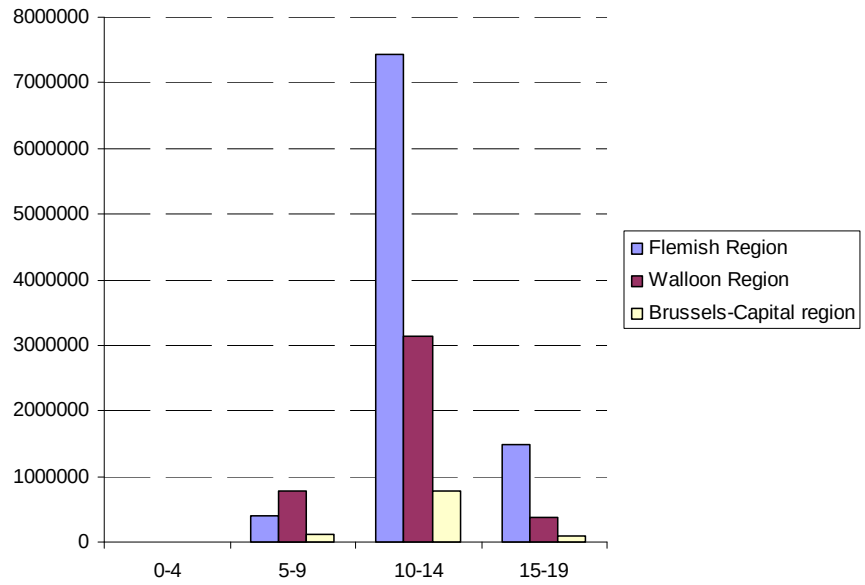


Source: RIZIV/INAMI

As the total relevant populations of the 0-19 yrs of age in 2005 in the Flemish, Walloon and Brussels region represent 1.342.718 (55,6%), 831.504 (34,4%) and 239.819 (9,9%) respectively, a standardization of the expenses for the year 2005 results in approximately 6,9 € expenses per capita in the Flemish region, 5,05 € expenses per capita for the Walloon region and 4,2€ expenses per capita for Brussels.

6.4.3 Overview of 305594, 305631 and 305675 acts per age category per region

Figure 42: Orthodontic RIZIV/INAMI expenses for a combination of three acts 305594, 305631 and 305675, per age category, by region (2006)

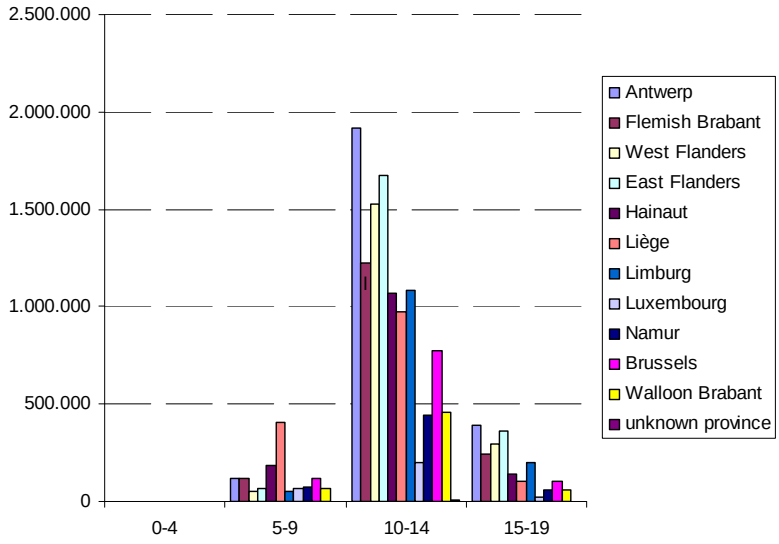


Source: RIZIV/INAMI

Similar age phenomena occur for girls versus boys as over the country - i.e. girls consuming more orthodontics than boys over all age categories except for the age category of 15-19 yrs -, but in Brussels this applies over the whole range of ages.

6.4.4 Overview of 305594, 305631 and 305675 acts per age category per province

Figure 43: Orthodontic RIZIV/INAMI expenses for a combination of three acts (305594, 305631 and 305675) per age category, by province (2006)



Source: RIZIV/INAMI

The expenses for orthodontic treatment over all provinces are higher for girls than for boys, except for the 15-19 age category where the orthodontic costs are systematically higher for boys than for girls. In Brussels and in Walloon Brabant the expenses in the 15-19 year age group are equal or remain a little higher for girls than for boys.

In boys, the possibility to postpone orthodontic treatment in view of a combined orthodontic and orthognathic treatment, might be more prevailing than in girls. The fact that boys also present later pubertal growth (also of their jaws; predominantly the mandible can grow late), could also explain this systematic finding in the RIZIV/INAMI data.

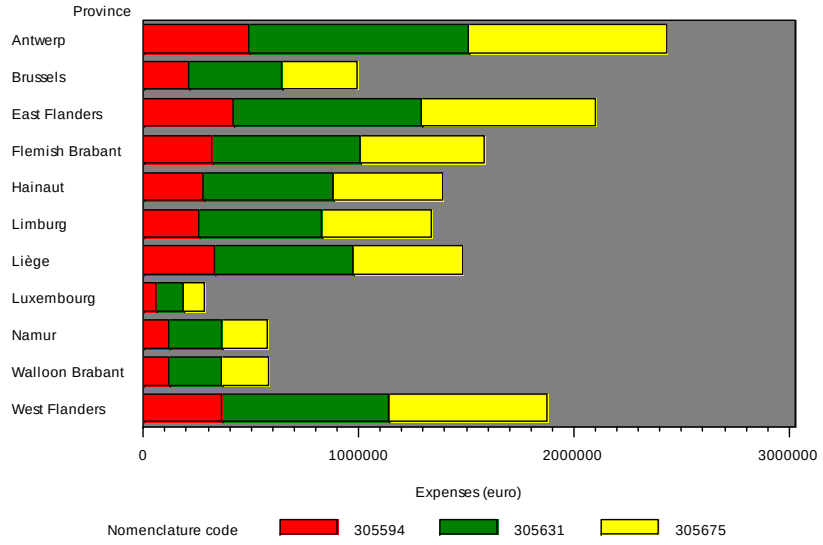
The age group of 10-14 yrs is by far, the highest consuming age category for orthodontic treatment over all the provinces.

A smaller number of boys than girls is being treated orthodontically at young age in the 0-4 age category over these provinces. Walloon Brabant is also the only place in Belgium where of the age group of 0-4 aged children, more boys were treated than girls in 2005.

The findings per country and per region mentioned earlier seem to be consistent for the other provinces.

6.4.4.1 Overview of 305594, 305631 and 305675 acts per province for 0-19 yrs

Figure 44 Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675 acts per province 0-19 years (2006)

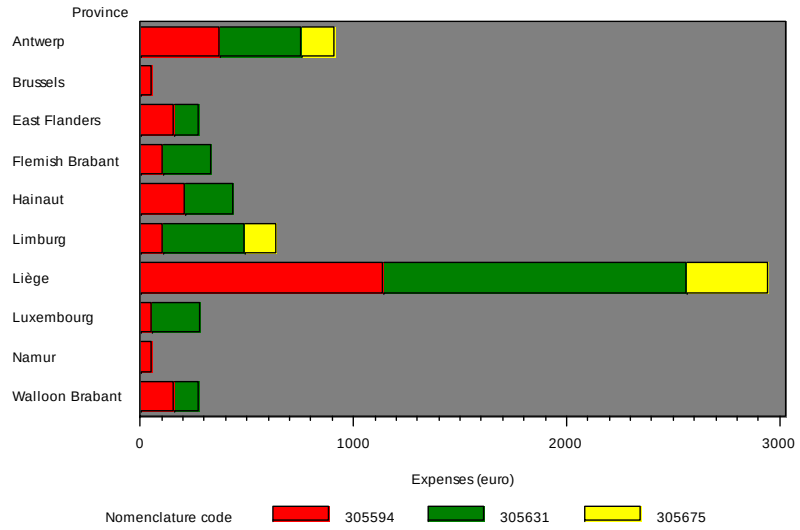


Source: RIZIV/INAMI

The provinces with least expenses for orthodontics are Luxemburg, Walloon Brabant and Namur. At the other end, the province of Antwerp is the biggest consumer of orthodontic selected nomenclature.

6.4.4.2 *Overview of 305594, 305631 and 305675 acts per province for 0-4 yrs*

Figure 45: Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675 acts for age category 0-4 yrs per province (2006)

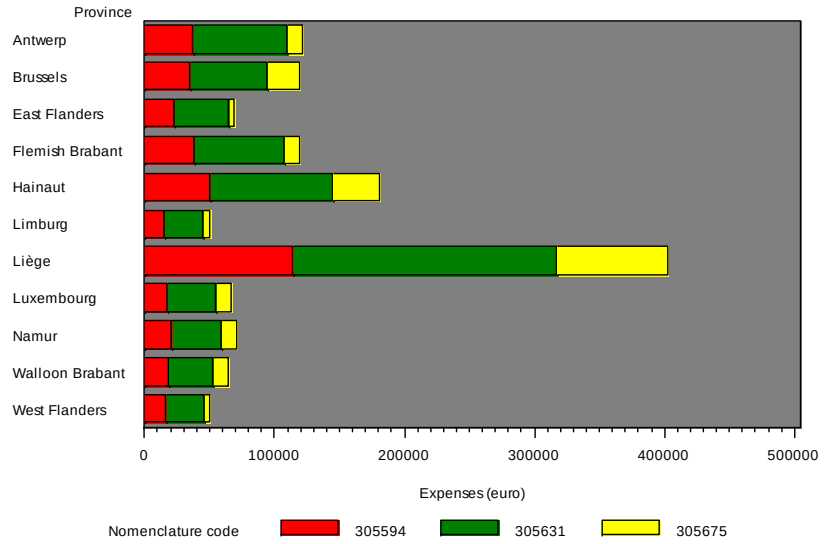


Source: RIZIV/INAMI

For the age group of 0-4 yrs, the orthodontic RIZIV/INAMI-expenses for Liège are by large the highest of all Belgian provinces. As during the orthodontic education at the University of Liège a lot of attention is paid to functional problems (like deglutition and speech problems) at an early age, this might be one of the explanations why a rather large amount of children in the province of Liège are being orthodontically treated in the age group 0-4 yrs of age compared to this age group in the other provinces.

6.4.4.3 *Overview of 305594, 305631 and 305675 acts per province for 5-9 yrs*

Figure 46: Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675 acts, for age category 5-9 yrs per province (2006)

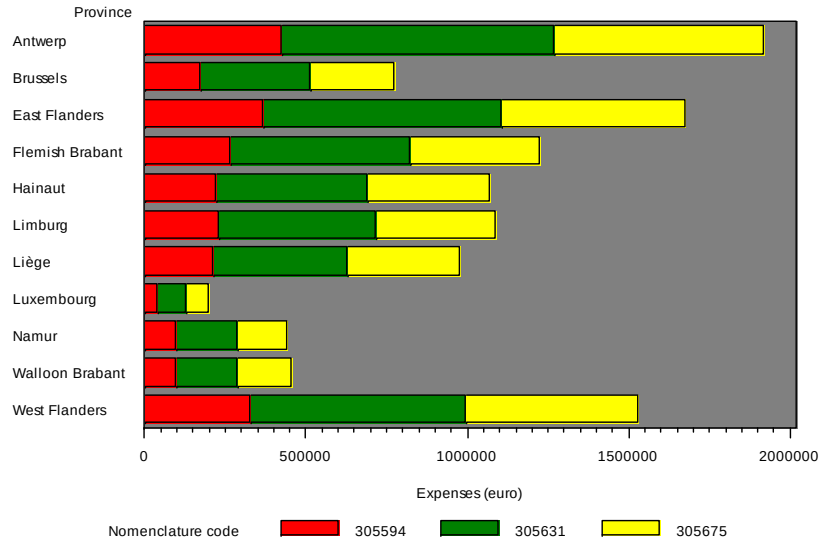


Source: RIZIV/INAMI

For the age group of 5-9 yrs, the "Liege-effect" remains visible in the orthodontic RIZIV/INAMI-expenses of this province relative to the other provinces.

6.4.4.4 *Overview of 305594, 305631 and 305675 acts per province for 10-14 yrs*

Figure 47: Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675 acts, for age category 10-14 yrs per province (2006)

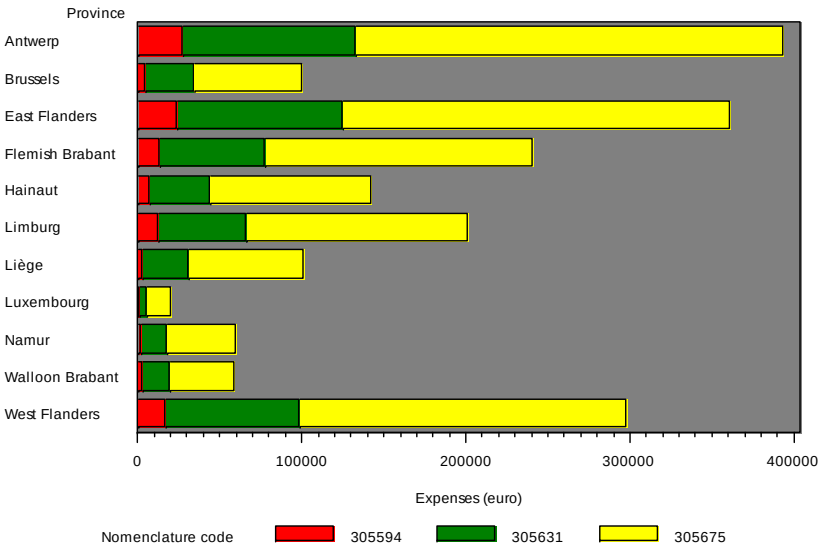


Source: RIZIV/INAMI

In the typical orthodontic age - the 10-14yr olds - Antwerp takes the lead in the orthodontic RIZIV/INAMI-expenses and there it remains also for the next age-group of the 15 -19yr olds. There it is closely followed by East-Flanders and West-Flanders as well.

6.4.4.5 *Overview of 305594, 305631 and 305675 acts per province, for 15-19 yrs*

Figure 48: Orthodontic RIZIV/INAMI expenses for combined 305594, 305631 and 305675 acts, for age category 15-19 yrs by province (2006)



Source: RIZIV/INAMI

For the separate acts of 305594, 305631 and 305675, the same exercise has been performed; and the Tables can be consulted in the Appendix of Chapter 6.

6.5 RIZIV/INAMI ORTHODONTIC HEALTH CARE EXPENSES RELATIVE TO THE TOTAL DENTAL AND MEDICAL NATIONAL EXPENSES

In 2005, 6% of the dental care budget was spent on orthodontic care or 0.18% of the total national health insurance expenditures. From 1995 to 2005, national health insurance expenditures on orthodontics have increased by 56% from €19.8 million in 1995 to €30.9 million in 2005 (a compound annual growth rate of 4.6%). In the same period, the total expenditures for all RIZIV/INAMI nomenclature have increased by 64% from €10.2 billion in 1995 to €16.8 billion in 2005 (at a compound annual growth rate of 5.1%). In the Appendix of Chapter 6, an overview of expenses for medical, dental and orthodontic care per capita in the age group of interest for the year 2005 is given.

6.6 CONCLUSIONS

- **In 2005, 6% of the dental care budget was spent on orthodontic care or 0.18% of the total national health insurance expenditures.**
- **From 1995 to 2005, national health insurance expenditures on orthodontics have increased by 56% (average growth rate of 4.6%). In the same period, the total expenditures for all RIZIV/INAMI nomenclature have increased by 64% (average growth rate of 5.1%).**
- **Looking at the total number of orthodontic RIZIV/INAMI acts, we observe that in 30 years (1975 to 2005) the total number of acts was almost the triplicate from 428 998, namely 1 284 391.**
- **The total RIZIV/INAMI-expenses for orthodontic acts in the years 1988, 1998 and 2005 respectively amount €10 179 919.9, 21 968 420.72 and €30 873 832.6. From 1988 to 1998 this represents an increase with 53.7% and from 1998 to 2005 an increase with 40.54%.**
- **Also in terms of expenses, the 305616 act represents the highest cost in the total of the RIZIV/INAMI-costs for orthodontic treatment.**
- **In 1988, the cost for 305616 (ie €4 853 613) already represented 48% of the total orthodontic budget (€10 179 920). In 2005 the cost for 305616 (i.e. €15 131 186) represented 49% of the budget (ie €30 873 833).**
- **In all age categories, RIZIV/INAMI data show that the orthodontic expenses are larger for girls than for boys, except in the 15-19 age category where it is the reverse.**
- **RIZIV/INAMI data reveal that the age group of 10-14 yrs is by far, the highest consuming age category for orthodontic treatment over the country.**
- **RIZIV/INAMI data show that a double amount of girls than boys is treated in the 0-4 age category.**
- **RIZIV/INAMI data show that the provinces with least expenses for orthodontics are Luxemburg, Walloon Brabant and Namur and that the province of Antwerp is the biggest consumer of the selected orthodontic nomenclature.**

7 BELGIAN SITUATION: ORTHODONTIC PRACTICES

7.1 INTRODUCTION

As one of the scopes of this study was to analyse the actual orthodontic practice in Belgium and as the sector of orthodontics was never questioned before, it was decided to design a questionnaire to be sent out to all orthodontic specialists and to general dental practitioners with a minimal number of orthodontic prestations in the year 2005.

Based on data in this questionnaire, it was the intention to give an overview of all aspects of the actual orthodontic practice in the specialist as well as the non-specialist settings, including amongst other, the duration of orthodontic treatments, the use of indices and the application of specific orthodontic techniques. For the description of the duration of treatment, also data from IMA/AIM, CM/MC and DKV are analysed.

7.2 METHODOLOGY

An extensive questionnaire was sent out to a total of 709 practitioners consisting of all 351 specialists (orthodontists) to date (October 2007) and 358 non-specialist practitioners, (general dental practitioners with significant orthodontic activity, meaning more than 15 starts of orthodontic treatment (305631 RIZIV/INAMI acts) in the year 2005).

The original questionnaire and the tables with the results are included in the Appendix of Chapter 7.

7.3 RESPONSE RATE OF THE QUESTIONNAIRE

It was the hope of the research team to collect a major part of the information about the Belgian practice of orthodontics, from the questionnaires, but from the 709 sent questionnaires, only 184 (26%) were returned. For 10 respondents it was not possible to determine whether they belonged to the specialist or non-specialist group. They were excluded in the analysis comparing specialists vs non-specialists. For the remaining 174 respondents, the response rate was higher in the non-specialist group (26.5%) than in the specialist group (22.5%).

It was remarkable, that two periodontists were represented in the group of non-specialists, as it is expected (by law) that specialists are practicing their specialty exclusively.

On the question about the gender of the respondents, 1 of the 79 specialists and 1 of the 95 non-specialists did not complete this question. The ratio of percentage female / male was 62% / 38% for the orthodontic specialists and 44% / 56% for the non-specialists. For the non-specialists the response rate was higher for males, whose representation was also higher in this group.

7.4 STATISTICAL LIMITATIONS OF THE QUESTIONNAIRE RESULTS

Due to the rather limited response rate, results should be interpreted with great caution. The potential bias could be large. Furthermore, not all respondents filled out the questionnaire completely.

This results for some questions in a very low response rate. Because the reason for non-responding is unknown, it is impossible to determine the direction and magnitude of the potential bias. Keeping these serious limitations in mind, the answers to the questions asked in this questionnaire have to be assessed with great caution.

7.5 REPRESENTATION OF AGE GROUPS IN THE QUESTIONNAIRE

Concerning the representation after graduation, a rather good distribution was present for the orthodontists over the range: 18.42% of them graduated for less than 10 yrs; 34.21% between 10 tot 20yrs and 47.37% graduated over 20yrs ago. In the non-specialist group the great majority (74.19%) of the responders graduated over 20 yrs ago, while only 8.6% graduated less than 10yrs ago.

7.6 TYPE OF PRACTICE IN ORTHODONTICS

Fifty one per cent of all respondents - specialists and non-specialists - are reporting to work in a solo practice. Forty six percent (45.57%) of the responding specialists work in a group practice (with one or more colleagues), while this is reported to be the case in 55.79 % of the non-specialists.

7.7 AGREEMENT WITH THE CONVENTION

Concerning the convention, 83% of the specialist respondents did not undersign the agreement, while 8.11% of the respondents did and another 8.11% did partially. Of the non-specialist respondents, 40.43% did not undersign the convention while 41.49% undersigned the agreement partially and 18.09% of the non-specialist respondents fully agreed with the convention tariffs.

7.8 TYPES OF TREATMENT

The median number of orthodontic treatment starts provided by the responding specialists in 0-15yr olds is 97.5 vs 50 in comparison with the responding non-specialists. The median number for all age groups is 101 cases in the specialists and remains 50 in the non-specialists. There is a contradiction for the non-specialists, as it seems that they only treat 0-15yr olds, while this does not seem to be the case in the further percentage of the reported distribution (ranging between 3.13% and 43.75%).

While the median percent of orthopedic treatment is higher for orthodontists relative to general practitioners (15% vs 10%), the median percent of non-complex treatments provided non-specialists is much higher than for orthodontic specialists (59.5% vs 32.5%). Some bias can be included as no definition of the different types of treatment is given.

7.9 DURATION OF TREATMENT

On the one hand this item will be answered by means of the responses to the questionnaire; on the other hand some data were provided by the CM/MC sickness fund and by DKV, a private health insurance company and finally by the Common Sickness Funds Agency (IMA/AIM).

7.9.1 Questionnaire

Taking the limitations and the poor response rate into consideration, there are some indications of differences between the specialist and non-specialist practitioners.

The results of the questionnaire on the duration of an orthodontic treatment show that for the duration of the different treatment types the specialist on average needs fewer consultations than a non-specialist.

For an interceptive treatment performed by an orthodontic specialist the mean duration is 6.5 months in which the patient has on average 6 consultations (305616 RIZIV/INAMI acts or treatment visits). The median duration for the same treatment by a non-specialist is 12 months with a median of 8 consultations (305616 RIZIV/INAMI-acts).

For an orthopaedic treatment the answers of both groups are similar and the duration of this type of treatment has a median of 12 months (12 consultations).

A non-complex orthodontic treatment has a median treatment time of 18 months (18 consultations) when performed by an orthodontic specialist and 20 months (20 consultations, i.e. 305616 RIZIV/INAMI-acts) when carried out by a non-specialist.

For a complex orthodontic treatment both groups answered to need a median of 24 months but the specialist needs a median of 24 consultations and the non-specialist 30.

7.9.2 DKV data

In the treatment time reported by DKV, the median estimated treatment duration in a sample of 93 patients (cfr Table DKV1 in Appendix Chapter 5) was exactly 24 months (mean: 26.3 months and std: 8.15 months), the InterQuartile Range (IQR) being 18-36 months. The question is whether this was the demand/request of the practitioners rather than the effective treatment time determined after the end of treatment. For the treatment demands (cfr the 60 form for demand of reimbursement by RIZIV/INAMI-sickness funds) this would indeed be logical, as 24 months (treatment months, ie 305616 RIZIV/INAMI-acts) has been the standard for a long time. More recently, the demand for 36 months has been allowed by some sickness funds, this way probably also introducing this treatment demand procedure for the private health insurers, like DKV (cfr the IQR).

Table 57: duration of treatment of DKV sample (in months)

	Mean	Median	91	93
Duration	26,3	24,0	18	36

7.9.3 IMA/AIM data

Data on the duration of orthodontic treatment were also obtained from the national InterMutualistic Agency (IMA/AIM). On our request, IMA/AIM has provided data drawn from the permanent sample from the entire sickness funds' database, i.e. 1 out of 40 (2.5%) of the Belgian population younger than 64 years and 1 out of 20 (5%) of the Belgian population over 65

(for a detailed description of the sampling procedure see reference in footnote[kkkkk]). This way a sample of 1256 patients was selected in which orthodontic treatment was started (305631 RIZIV/INAMI act; cfr Appendix to Chapter 5) in 2002. Data were available until December 2006. No earlier data than 2002 were available.

Results from the selected sample revealed that the median age of patients who started an orthodontic treatment, was 12 yrs, the IQR being between 11 and 13 yrs, pointing to the fact that 50% of the patients in 2002 started their orthodontic treatment between these ages. The full age range for starting an orthodontic treatment was from 5yrs to 19yrs of age, showing a wide distribution.

7.9.3.1 Description of the IMA/AIM sample

Description of a sample of 1256 patients who started an orthodontic treatment in 2002 (305631 RIZIV/INAMI act) is shown in Table 58, with the mean age, the median age (and standard deviation; st d), the age at first and third quartile and the age range (minimum and maximum age) of the patients at the start of the orthodontic treatment.

Table 58: Statistic on age distribution of the sample

Mean age	Median age	Std age	q1 age	q3 age	Min age	Max age
11,9	12	2,0	11	13	5	19

Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

kkkkk Sectoraal Comité van de Sociale Zekerheid;c 2005. Beraadslaging nr. 05/033 van 19 juli 2005 met betrekking tot het project 2004-21 "impact van het innen van supplementen op de toegankelijkheid van de gezondheidszorg". Available from: http://ksz-bcss.fgov.be/documentation/nl/organisation/sc2005/05-033-n94.pdf)

The median age for treatment start is 12 yrs ; the age at first and third quartile 11 yrs and 13 yrs respectively, with a minimum age of 5 and a maximum of 19 yrs of age (demand for postponement).

7.9.3.2 Total treatment duration (in real months)

Table 59 shows the descriptive statistics on the total treatment duration (in 'real' months) from start of treatment until last 305616 RIZIV act; with the mean and median treatment duration (with std), the first and third quartile and the treatment duration range (minimum and maximum duration).

The median total treatment duration in real months for this sample was 26.4 months and an IQR of 17.8 to 39.9 months. See Table 59. It is worth noticing that there is a minimum treatment duration of 0 (zero) months, which implies that the orthodontic treatment start (305631 RIZIV/INAMI act) has been prescribed, but the treatment itself (305616 acts) did not take place (possible explanation: prescription of first part of appliance - 305631 - without any follow up or treatment start without treatment?).

The maximum registered duration of treatment (until December 2006) is of 59.2 months. Although 4 yrs (almost 60 months) of orthodontic treatment is no exception in the longitudinal follow up of treatment in CLP patients between 0 to 20 yrs of age, this should be more the exception than the rule in 'regular' orthodontic treatment of normal orthodontic patients.

An explanation in the normal population, could thus be that a two phase treatment is planned, including an interruption in the active treatment (305653 act).

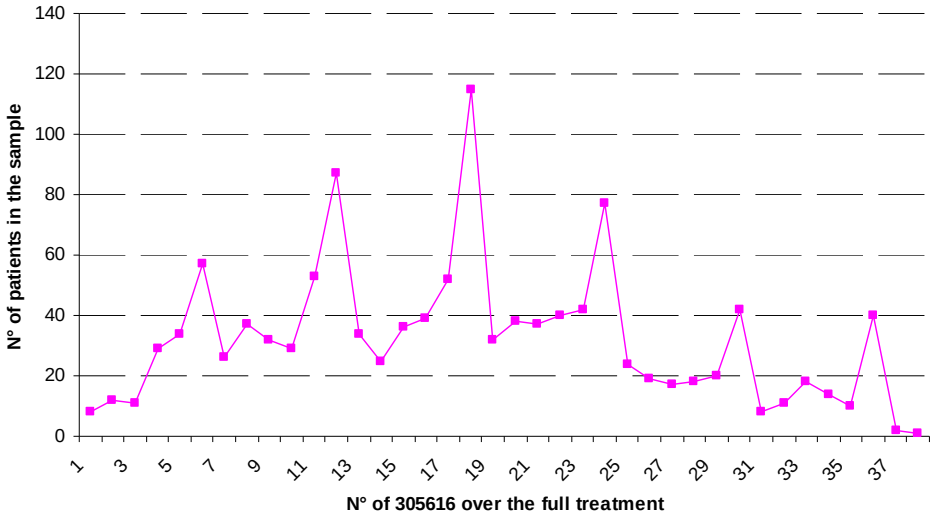
Table 59: Statistics on the total treatment duration (in 'real' months) from start of treatment until last 305616 RIZIV act

Mean duur	Median duur	Std duur	q1 duur	q3 duur	Min duur	Max duur
28,3	26,4	14,5	17,8	39,9	0,03	59,2

Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

7.9.3.3 Total treatment duration (in number of 305616 codes)

Figure 49: Number of 305616 codes over the full treatment



Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

In Table 60, a description of the IMA sample is given with the statistics on the total treatment duration (in 'treatment' months, 305616 RIZIV/INAMI acts) from start of treatment until last 305616 RIZIV/INAMI act; with the mean (and std) and median treatment duration, the first and third quartile and the treatment duration range (minimum and maximum duration)

Table 60: Number of 305616 codes over full treatment

FREQ	Mean 305616	Median 305616	Std 305616	q1 305616	q3 305616	Min 305616	Max 305616
1226	17,6	18,0	8,7	11,0	24,00	59,2	41,0

Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

The median total treatment duration in treatment months (305616 RIZIV-acts) for this sample was 18 months and an IQR of 11 and 24 months. It is worth noticing that there is a minimum number of treatment months of 1 (zero) month, which implies that the orthodontic treatment start (305631 act) has been prescribed together with 1 305616 act and that thereafter the orthodontic treatment (305616 acts) did not take place. (Possible explanation: prescription of first part of appliance - 305631 - without any follow up? treatment start without treatment?).

The maximum registered treatment months to date (December 2007?) is 41 treatment months. Although 3.5 yrs (42 months) of orthodontic treatment is no exception in the longitudinal follow up of treatment in CLP patients between 0 to 20 yrs of age, this should be more the exception than the rule in 'regular' orthodontic treatment of normal orthodontic patients. An explanation in the normal population, could be on the one hand that a two phase treatment is planned, including an interruption in the active treatment (305653 act).

On the other hand the difference can also be due to the fact that the practitioner does not treat the patient every real month: the regulation is that a maximum of six 305616 RIZIV/INAMI acts can be prescribed within a six month period and with a maximum of 3 months of inter-treatment check (a maximum of 3 months time may be lapsed between two 305616 treatment visits).

Both factors can explain the difference between the duration of the treatment in real months (median is 26.4 months) and in treatment months (median is 18 months).

The treatment duration of orthodontic treatments (305616) with the largest frequency corresponds to a course of 18 treatment months; this treatment duration is present for 9,38% of the cases, followed by 12 months (7,1%), and then 24 treatment months for 6,28 % of the cases.

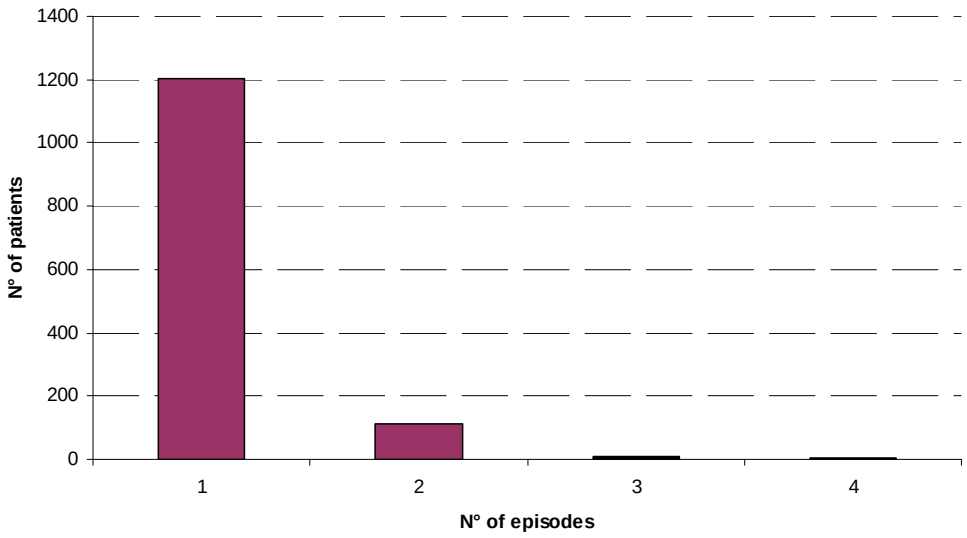
3,26% of the treatments are finished at 36 months while only 0,08 % of the treatments need 41 months (which is acceptable in cases of CLP-treatments).

- **A course of 18 treatment months (305616) is the most frequent (9,38% of the cases); followed by 12 months (7,1%), and then 24 months of treatment (6,28).**
- **3.26% of the treatments are finished at 36 months while only 0.08 % of the treatments need 41 months (which is acceptable in cases of CLP-treatments).**

7.9.3.4 Number of treatment phases in a full treatment

A treatment phase is defined as the phase between a start code (305631) – or interruption code (305653) and consecutive interruption code (305653). By far the largest majority of the patients (1203 out of 1256, or 95.78%) who started their treatment in 2002, were treated in 1 treatment phase; only 8.91% (112 in 1256) was treated in 2 phases, 5 patients in 1256 (0.40%) in three phases and just 1 patients in four phases.

Figure 50: Number of treatment phases in patients who started an orthodontic treatment (305631 RIZIV act) in 2002



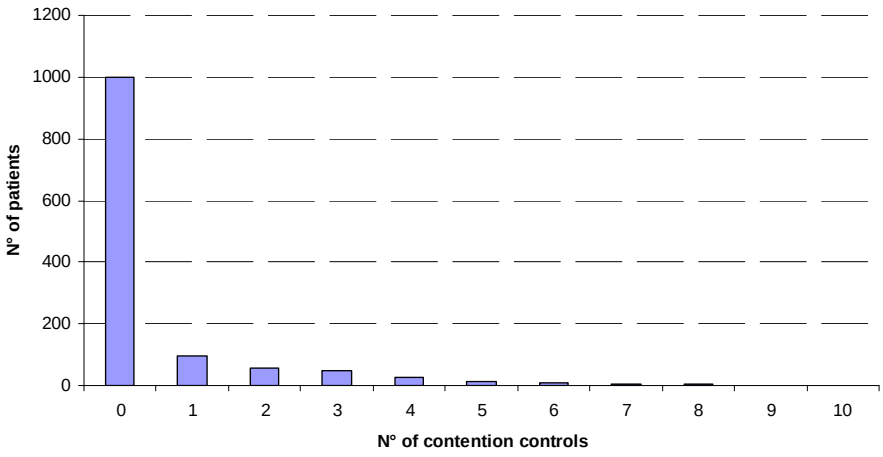
Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

7.9.3.5 Number of retention visits after treatment

By far, the largest majority of the patients (999 out of 1256, or 79.54%) who started their treatment in 2002, so far did not receive any retention visit (305852 RIZIV/INAMI act); only 7.64% of the patients (96 in 1256) received just 1 retention visit, 4.38% (55 in 1256) received 2 retention visits, 3.74% (47 out of 1256) patients received 2 retention visits. Only 3 patients received the 8 retention visits that can be prescribed for patients out of their active orthodontic appliance therapy. Each of only two patients respectively received 9 and 10 retention visits.

As orthodontic data were previously not collected, it can not be concluded whether erosion has occurred in the number of control visits after active treatment. It could however be that with the increased use of fixed cuspid to cuspid retainers, less retention controls / visits have been prescribed to patients.

Figure 51: Number of retention ("contention") visits after active treatment in the IMA/AIM sample.



Source: Data from Permanent Sample of the Common Sickness Funds Agency (IMA/AIM), February 2008

7.9.3.6 Interval duration between prestation 305631 and 305675

Table 61 shows the mean and median number of days lapsed between 305631 and 305675 acts (2nd part of orthodontic appliance, can be prescribed only after at least 6 treatment months of active treatment (6 times 305616)), with the standard deviation (st d), the IQR as well as the minimum and maximum range.

Table 61: Number of days lapsed between 305631 and 305675 acts (2nd part of orthodontic appliance, can be prescribed only after at least 6 treatment months of active treatment (6 times 305616))

mean int 305675	median int 305675	std int 305675	q1 int 305675	q3 int 305675	min int 305675	max int 305675
291,9	219,5	218,3	183	301	56	1699

Source: Common Sickness Funds Agency (IMA/AIM), February 2008

The median interval duration until the "second part of appliance" (prestation of 305675, which can be attested after 6 treatment months, i.e. around after 180 days) is 219.5 days, which is after +- 7 real months; the IQR range is from 183 to 301 days.

Concerning the minimum interval, a mistake must have occurred as it is not legal to perform the 305675 act, before an interval of at least 180 days. For the maximum interval of 1699 days, a plausible explanation could be that the treatment is interrupted by the practitioner and restarted at a later stage. As this implies an interruption of 56. 6 months (or 4.7 years), this is a rather long period for an interruption of the treatment.

- **The median interval duration between prestation 305631 and 305675, which can be attested after 6 treatment months, is 219.5 days (approximately 7 months).**
- **The median "treatment month" has a duration of 36.6 days**
- **A treatment interval has an interquartile range from 183 to 301 days.**
- **As the 305675 act can legally only be performed after an interval of at least 180 days, a minimum interval of 56 days is not possible.**
- **For the maximum interval of 1699 days, a plausible explanation could be that the treatment is interrupted by the practitioner and restarted at a later stage. An interruption of 56.6 months (or 4.7 years), is however extreme.**

7.9.4 CM/MC data

For the assessment of treatment duration, data were also provided from a third source, namely the Christelijke Mutualiteit / Mutualité Chrétienne (CM/MC).

Table 62 shows the General orthodontic consumption of prestation 305631 (start of orthodontic treatment) and monthly activation visits (305616 RIZIV/INAMI-acts) by a sample of 3 to 18 year olds who started their orthodontic treatment in the year 2000 (representative sample from 4.3 million CM/MC-members)

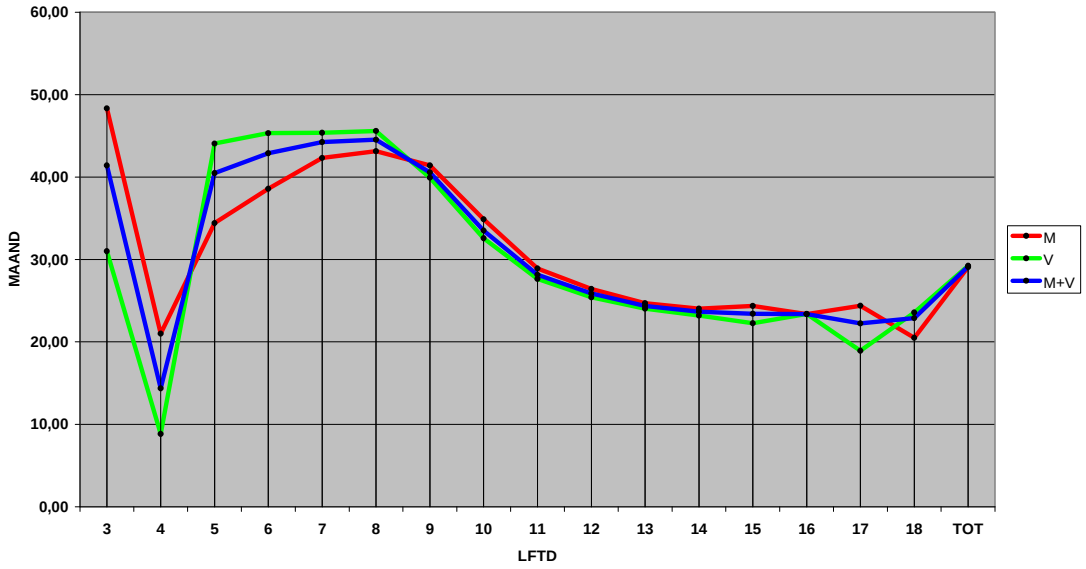
Table 62: Duration of treatment according to CM/MC data: number of actual months and number of 305616 codes ("treatment months")

	% tov ledental			Interval in Maand			Gem aantal 305616		
LFTD	M	V	M+V	M	V	M+V	M	V	M+V
3	0,01%	0,01%	0,01%	48,33	31,00	41,40	17,33	10,50	14,60
4	0,04%	0,05%	0,04%	21,00	8,83	14,36	11,70	5,67	8,41
5	0,07%	0,13%	0,10%	34,42	44,06	40,47	14,79	16,59	15,92
6	0,20%	0,38%	0,29%	38,57	45,34	42,89	17,22	18,48	18,03
7	0,92%	1,61%	1,26%	42,32	45,37	44,23	18,60	21,24	20,26
8	2,38%	3,22%	2,79%	43,13	45,59	44,52	20,58	21,90	21,33
9	2,82%	3,94%	3,37%	41,41	39,93	40,57	21,49	23,13	22,42
10	3,73%	5,91%	4,79%	34,88	32,59	33,50	22,65	22,12	22,33
11	6,39%	9,93%	8,11%	28,90	27,65	28,16	21,50	21,34	21,41
12	9,97%	12,36%	11,13%	26,42	25,40	25,87	21,02	20,46	20,71
13	10,68%	10,75%	10,72%	24,70	24,03	24,37	20,12	19,63	19,88
14	5,53%	4,56%	5,05%	24,02	23,19	23,66	19,43	18,71	19,11
15	0,85%	0,73%	0,79%	24,37	22,26	23,42	18,66	17,73	18,24
16	0,23%	0,15%	0,19%	23,38	23,38	23,38	20,11	18,28	19,40
17	0,07%	0,05%	0,06%	24,40	18,92	22,24	18,05	16,85	17,58
18	0,01%	0,03%	0,02%	20,50	23,57	22,89	20,00	21,00	20,78
TOT	2,77%	3,39%	3,07%	29,09	29,24	29,17	20,69	20,74	20,71

	% tov ledental			Interval in Maand			Gem aantal 305616		
LFTD	M	V	M+V	M	V	M+V	M	V	M+V
11+12+13	9,00%	11,01%	9,97%	26,34	25,64	25,97	20,78	20,46	20,61

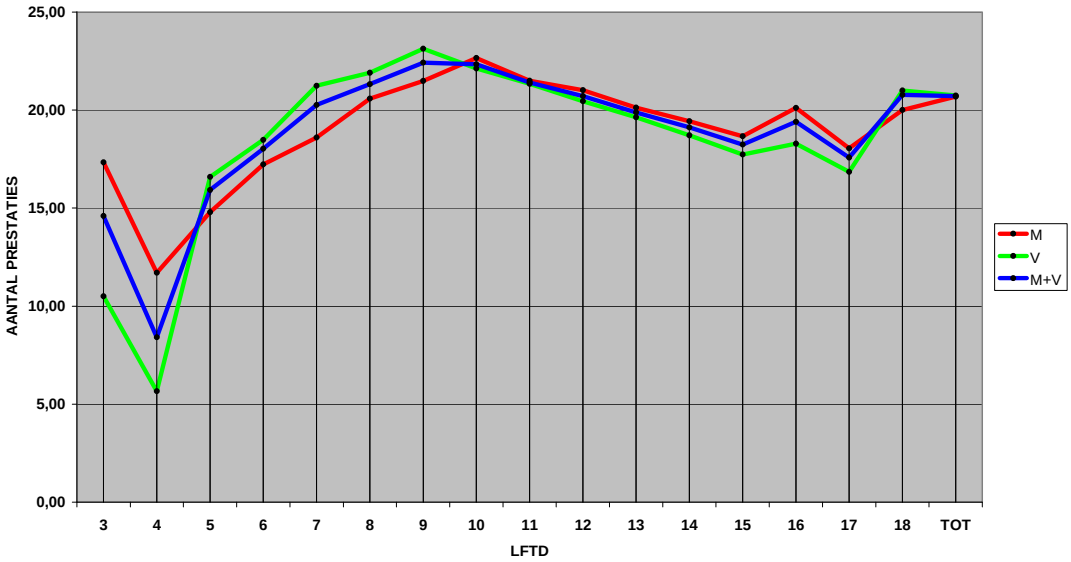
Source: CM/MC, January 2008. Note that « Interval in Months » are actual months ». The last row presents average figures over the age groups 11, 12 and 13 years.

Figure 52: Average treatment time (in real time months) from the start of treatment (305631 in 2000) until the last monthly activation visit (last 305616).



Source: Mutualité Chrétienne/Christelijke Mutualiteit, January 2008

Figure 53: Average number of 305616-prestations (ie monthly activation visits) from the start of treatment (305631 in 2000) until the last monthly activation visit (last 305616) in patients starting at different ages (3-18 yrs of age).



Source: CM/MC, January 2008

Looking at the time lapsed between the start of the orthodontic treatment (OT) (305631) and the last monthly activation visit (305616), it can be concluded that the total treatment time is longer if the patient is younger at the start of treatment.

For example the maximum of the average OT-time in real time is 45.59 months for female patients started with an OT at 8 years of age and 48.33 months for boys who started their treatment at 3 yrs of age.

- **According to the 4 sources, used to analyse the orthodontic treatment duration in Belgium, the median or the mean (if the median was not available) orthodontic treatment duration expressed in real months varies between 26 months (median, according to IMA/AIM), 24 months (median, according to DKV), 12-24 months (medians according to the questionnaire) and 26 (mean months) according to the CM/MC.**
- **Expressed in number of "treatment months" (treatment visits or 305616 RIZIV/INAMI acts), 18 treatment visits were measured by IMA/AIM, 21 treatment visits (according to the CM) and 8 - 30 treatment visits were reported in the questionnaire.**
- **From the questionnaire it appeared that for the different types general practitioners systematically seem to need more treatment time in months and in treatment visits.**

7.10 USE OF WRITTEN OFFERS AND INFORMED CONSENT FORMS

Of the 75 responding orthodontic specialists who filled out this question, 86.67% uses a costing. Furthermore 73 of the 75 responding orthodontists answered positively to the question whether the patient or his/her parents receive a written costing.

For the non-specialists respectively 89 and 88 of providers answered these questions and the rates for the use of a costing and a written consent are respectively 85.39% and 81.82 %.

- **Taking the limits of questionnaire into account, these results confirm that it is rather common in Belgium that a patient and his/her parents are informed about the cost of an orthodontic treatment prior to the start of this treatment.**

7.11 USE OF NEW ORTHODONTIC TECHNOLOGIES

Distraction osteogenesis is used by 46.75% (36/77) of the orthodontic specialists and 22.73% (20/88) of the non-specialists also do. It is surprising that such a high number a distractions is in use, as this technology is still rather new, and has not yet been thoroughly investigated as to its advantages and disadvantages on the short as well as the long term. Although we did not specifically ask for it in the questionnaire, the mostly used distraction probably is a kind of transpalatal distractor.

In the use of orthodontic implants again half as much of the non specialists (20.45%, 18/88) uses orthodontic implants in comparison with the orthodontic specialists (40.26%, 31/77) and less than half of the non-specialists (17.05%, 15/88) uses orthodontic bone anchors when using distraction compared to the orthodontic specialists (45.45%, 35/77)

The use of rapid maxillary expansion (RME) is widely spread with 62.34% (48/77) of the orthodontic specialists and 42.05% (37/88) of the non specialists using this device.

The low friction bracket again is more commonly used by the orthodontic specialist (37.66%, 29/77) than by the non-specialist (17.24%, 15/87).

Invisalign is used by about 12% of the practitioners in both groups (10/77 and 10/87, respectively).

7.12 USE OF INDICES

Respectively 82.05 (64/78) and 86.02% (80/93) of the whole group of practitioners have knowledge of an index for indication. In addition more than 90 % of the practitioners in both groups (63/65 and 77/83, respectively) know how to use the IOTN index. In contrast only 15.38% (10/65) of the orthodontic specialists and no one (0/83) of the non-specialists have knowledge about the ICON index.

Respectively 76.09% (35/46) of the orthodontic specialists and 58.97% (23/39) of the non-specialists are familiar with the PAR index.

Of the 78 specialists who responded to this question, 19 (24.35%) use an index for treatment planning, but 18 of these (94.74%) seem to use the IOTN index for this purpose, whereas no one uses the ICON and only 4 of the 76 responding specialists to the question use an index assessing treatment result and only 3 of the 19 (5.32%) responding on the use of PAR answered affirmatively and 1 of the 19 uses another index assessing the treatment result.

Also in the non-specialist group we see a wide range of answers. Forty out of 92 respondents of the non-specialists (43.47%) report to use an index for treatment need and all of these would use the IOTN and none the ICON. Of the 90 responders in this group on the use of an index for assessing the result of a treatment, 10 % does so. Of the 24 who filled out if they used the PAR index 25.00% confirmed they do. And only 1 of 24 non-specialists uses another treatment result index.

7.13 USE OF COMPUTER PROGRAM

Of the non-specialists, 68.42% (65/95) uses as specific dental program, while this is the case in 48.72 % (38/78) of the specialists. Dentists report their preference for the Superdent (36.92%, 24/65) and the Balthes program (29.23%, 19/65).

7.14 CONCLUSIONS

- **From the 709 sent questionnaires, 184 (26%) were returned by all practitioners.**
- **For 10 practitioners it was not possible to determine whether they belonged to the specialist or non-specialist group. They were excluded in the analysis comparing specialists vs non-specialists.**
- **For the remaining 174 practitioners, the response rate was higher in the non-specialist group (26.5%) than in the specialist group (22.5%).**
- **Due to the rather limited response rate, results of the questionnaires should be interpreted with great caution.**
- **A rather good distribution was present for the orthodontists over the graduation range: 18.42% of them graduated for less than 10 yrs; 34.21% between.**
- **In the non-specialist group the great majority (74.19%) of the responders graduated over 20 yrs ago, while only 8.6% graduated less than 10yrs ago 10 tot 20yrs and 47.37% graduated over 20yrs ago.**
- **Forty six percent (45.57%) of the responding specialists work in a group practice (with one or more colleagues), while this is reported to be the case in 55.79 % of the non-specialists.**
- **83% of the specialist respondents did not undersign the convention agreement; 8.11% of the respondents did and another 8.11% did partially.**
- **Of the non-specialist respondents, 40.43% did not undersign the convention while 41.49% undersigned the agreement partially and 18.09% of the non-specialist respondents fully agreed with the convention tariffs.**
- **The median number of orthodontic treatment starts provided by the responding specialist practitioner in 0-15yr olds is 97.5 vs 50 in comparison with the responding non-specialists.**
- **Taking the limits of questionnaire into account, these results confirm that it is rather common in Belgium that a patient and his/her parents are informed about the cost of an orthodontic treatment prior to the start of this treatment.**
- **Distraction osteogenesis is used by 46.75 % (36/77) of the orthodontic specialists and by 22.73% (20/88) of the non-specialists.**
- **Of the non specialists 20.45% (18/88) uses orthodontic implants in comparison with 40.26%(31/77) of the orthodontic specialists**
- **Less than half of the non-specialists (17.05%, 15/88) uses orthodontic bone anchors compared to 45.45% (35/77) of the orthodontic specialists (**
- **The use of rapid maxillary expansion (RME) is widely spread with 62.34% (48/77) of the orthodontic specialists and 42.05% (37/88) of the non specialists using this device.**
- **The low friction bracket is more commonly used by the orthodontic specialist (37.66%, 29/77) than by the non-specialist (17.24%, 15/87).**
- **Invisalign is used by about 12% of the practitioners in both groups (10/77 and 10/87, respectively).**
- **82.05 (64/78) and 86.02% (80/93) of the whole group of practitioners have knowledge of an index for indicating orthodontic treatment**
- **Only 15.38% (10/65) of the orthodontic specialists and no one (0/83) of the non-specialists have knowledge about the ICON index.**
- **76.09% (35/46) of the orthodontic specialists and 58.97% (23/39) of the non-specialists are familiar with the PAR index.**

- **Of the responding specialists, 19 (24.35%) uses an index for treatment planning, but 18 of these (94.74%) seem to use the IOTN index for this purpose and no one uses the ICON.**
- **Only 4 of the 76 responding specialists use an index to assess treatment result and only 3 of the 19 (5.32%) responding on the use of PAR answered affirmatively and 1 of the 19 uses another index assessing the treatment result.**
- **Of the non-specialists, 40 out of 92 (43.47%) report to use an index for treatment need and all of these would use the IOTN and none the ICON.**
- **Of the 90 responders in this group, 10 % uses an index for assessing the result of a treatment does so. Of the 24 who filled out if they used the PAR index 25.00% confirmed they do. Only 1 of 24 non-specialists uses another treatment result index.**
- **Conclusions on duration of treatment**
- **According to the 4 sources used to analyse the orthodontic treatment duration in Belgium, the median or the mean (if the median was not available) orthodontic treatment duration expressed in real months varies between 26.41 months (median, according to IMA/AIM), 24 months (median, according to DKV), 12-24 months (range, according to the questionnaire) and 25.97 months (median) according to the CM/MC**
- **Expressed in number of "treatment months" ("treatment visits" or 305616 RIZIV acts), 18 treatment visits were measured by IMA/AIM, 20.61 treatment visits (according to the CM/MC) and 8 to 30 treatment visits were reported in the questionnaire.**
- **From the questionnaire it appeared that for the different types of treatment, general practitioners systematically need more treatment time, in months and in treatment visits.**
- **IMA/AIM data show that a course of 18 treatment months (305616) is the most frequent (9,38% of the cases); followed by 12 months (7,1%), and then 6,28 % of treatment months.**
- **IMA/AIM data show that 3.26% of the treatments are finished at 36 months while only 0.08 % of the treatments need 41 months (which is acceptable in cases of CLP-treatments).**
- **IMA/AIM data show that the median interval duration between prestation 305631 and 305675, which can be attested after 6 treatment months, is 219.5 days (approximately 7 months).**
- **The median "treatment month" (= in between two treatment sessions) has a duration of 36.6 days.**

8 BELGIAN SITUATION: SOME EPIDEMIOLOGICAL ESTIMATES

In this chapter, data provided by the CM/MC are used to estimate the epidemiology of orthodontic deviations in Belgium.

Based on the distribution of the IOTN-severity scores/grades found in epidemiological studies in other populations and allowing some assumptions, estimates are calculated for a distribution of the IOTN-severity scores in Belgium by means of extrapolation of these data.

8.1 GENERAL EPIDEMIOLOGICAL DATA FROM CM/MC

Table 63: Numbers of male (M) and female (V) CM/MC-members born in 1988 who received 305631 (start of orthodontic treatment) at different ages between 5 and 18 years of age.

LFTD	M	V	M+V
5	6	12	18
6	51	69	120
7	225	298	523
8	564	635	1.199
9	694	883	1.577
10	986	1.367	2.353
11	1.634	2.369	4.003
12	2.647	3.002	5.649
13	2.869	2.615	5.484
14	1.627	1.299	2.926
15	277	206	483
16	58	57	115
17	16	14	30
18	10	8	18
TOTAAL	11.664	12.834	24.498

LFTD	M	V	M+V
5	0,05%	0,09%	0,07%
6	0,44%	0,54%	0,49%
7	1,93%	2,32%	2,13%
8	4,84%	4,95%	4,89%
9	5,95%	6,88%	6,44%
10	8,45%	10,65%	9,60%
11	14,01%	18,46%	16,34%
12	22,69%	23,39%	23,06%
13	24,60%	20,38%	22,39%
14	13,95%	10,12%	11,94%
15	2,37%	1,61%	1,97%
16	0,50%	0,44%	0,47%
17	0,14%	0,11%	0,12%
18	0,09%	0,06%	0,07%
TOTAAL	100,00%	100,00%	100,00%

geb.jaar 1988	51.899	47,20%

Source: Mutualité Chrétienne/Christelijke Mutualiteit, January 2008

The CM/MC has a total of 51 899 members born in the year 1988, of which to date (December 2007) a total of 24 498 (11 664 boys and 12 834 girls), received a start of orthodontic treatment, between 5 and 18 years of age. This means that 47.2% of the total population of CM/MC members born in 1988 received an orthodontic treatment. Up to 13 years of age, OT was carried out significantly more in girls than in boys, but from 14 yrs on, slightly more boys than girls were treated. See more general epidemiological data from CM/MC in Appendix of this chapter.

8.2 IOTN DATA FROM CM/MC

As the CM/MC have differentiated their complementary reimbursement for a number of years based on the IOTN score, the Study Center of the national alliance of the CM/MC has been contacted for epidemiological data. The data that could be retrieved, under supervision of Dr Laurent, are presented in this section.

It is important to note that the treatment need was scored by the internal administration at the CM/MC and not by the practitioners. As such, there is no practitioners' bias in the scoring (if the scoring would have been done by practioners, the scoring could be higher as practitioners could be asked by the patient to rate a higher score in order to get a higher reimbursement). Furthermore, the reimbursement intervention must be requested by the member. There is no automatic intervention and not all members do actually submit a request.

Although again the data were not representative for the whole Belgian population of interest in this study - as it were also data on patients of which an orthodontic treatment was already requested to the CM/MC sickness fund by the patient,

together with the practitioner - some descriptions, comparisons and extrapolations could be made on IOTN with reference to the Belgian and the international literature

With respect to the inherent limitations, the data provided by the CM/MC are described below.

8.2.1 Data from CM Ghent

Table 64: Number of CM/MC-members in Ghent (250.000 CM/MC members) per age who received 305631 in 1999, 2000 and 2001 respectively whom a score of IOTN 4-5 (code 970023-970034) was given

Jaar	IOTN 4-5	aantal 305631	% IOTN 4-5
1999	920	1.418	64,88%
2000	940	1.512	62,17%
2001	833	1.535	54,27%

Source: Mutualité Chrétienne/Christelijke Mutualiteit, January 2008

For the 3 consecutive years 1999, 2000 and 2001, data were provided on the percentage of orthodontic treatment starts which were classified as scoring an IOTN of 4-5 (high treatment need) in a CM/MC member population of 250 000 in Ghent.

An IOTN 4-5 scoring was obtained over the 3 years (60.44% on average for 3 yrs in CM/MC members in Ghent vs 63% for Leuven). This might be indicative for the fact that in an orthodontic population (i.e. patients who have expressed their desire to be orthodontically treated, or who have been advised for orthodontic treatment by their dentist or referred for orthodontic treatment to their orthodontist , who have consented to send a demand to the RIZIV/INAMI (form 60)) around 60% might fall into the grade of IOTN 4-5 (Severe or Extreme need of orthodontic treatment (cfr Scale of IOTN Grades[IIIII] in the Appendix of Chapter 8), also called handicapping malocclusions).

8.2.2 Data from MC du Centre, de Charleroi et de Thudinie

Table 65: Number of MC-Hainaut Oriental members per age who received 305631 in 2003 and whom a score of IOTN 4-5 (code 970023-970034) was given

	305631			970023 - 970034					
LFTD	M	V	M+V	M	V	M+V	M	V	M+V
5	1	3	4				0,00%	0,00%	0,00%
6	3	1	4				0,00%	0,00%	0,00%
7	10	12	22	3	3	6	30,00%	25,00%	27,27%
8	18	27	45	6	5	11	33,33%	18,52%	24,44%
9	37	41	78	7	20	27	18,92%	48,78%	34,62%
10	43	57	100	15	23	38	34,88%	40,35%	38,00%
11	65	88	153	27	37	64	41,54%	42,05%	41,83%
12	71	78	149	26	35	61	36,62%	44,87%	40,94%
13	83	68	151	36	25	61	43,37%	36,76%	40,40%
14	34	22	56	11	11	22	32,35%	50,00%	39,29%
15	6	2	8	1		1	16,67%	0,00%	12,50%
16	1		1				0,00%	0,00%	0,00%
	372	399	771	132	159	291	35,48%	39,85%	37,74%

Source: CM/MC, January 2008

In the age group of 5 to 6 yrs and 16 yrs, no IOTN 4-5 was scored. This can be explained by the fact that IOTN can only be scored in the permanent dentition. The IOTN 4-5 scores ranged from 12.50% for the 15 yr olds and 41.83 % for the 11 yr olds.

[IIIII] Brook PH and Shaw W.C. The development of an index for orthodontic treatment priority. Eur. J. Orthod. 11: 309-332, 1989

8.2.3 Data from MC Hainaut Picardie

Table 66: Number of MC-Hainaut Picardie members per age who received 305631 in 2003 and whom a score of IOTN 4-5 (code 970023-970034) was given

	305631			995234					
LFTD	M	V	M+V	M	V	M+V	M	V	M+V
4	1	0	1	1	0	1	100,00%	0,00%	100,00%
5	0	1	1	1	1	2	0,00%	100,00%	50,00%
6	0	3	3	1	5	6	0,00%	60,00%	50,00%
7	3	5	8	13	19	32	23,08%	26,32%	25,00%
8	11	13	24	29	24	53	37,93%	54,17%	45,28%
9	8	22	30	22	46	68	36,36%	47,83%	44,12%
10	13	30	43	33	56	89	39,39%	53,57%	48,31%
11	27	26	53	53	61	114	50,94%	42,62%	46,49%
12	27	24	51	53	65	118	50,94%	36,92%	43,22%
13	29	37	66	47	61	108	61,70%	60,66%	61,11%
14	18	11	29	46	27	73	39,13%	40,74%	39,73%
15	1	0	1	3	6	9	33,33%	0,00%	11,11%
TOT	138	172	310	302	371	673	45,70%	46,36%	46,06%

Source: CM/MC, January 2008

IOTN 4-5 was attributed to one 4-year old boy and one 5-year old girl (representing 100% 305631 in those age groups). In the "normal" age groups, 13 yr olds receiving start of treatment (305631) with IOTN 4-5 motivation represented 61.11%.

8.3 EPIDEMIOLOGICAL INPUT FROM LITERATURE

So far no epidemiological study on malocclusions (and other dentofacial deviations giving rise to potential orthodontic treatment need), has been carried out in the Belgian population of interest in this study, namely the 0 to +-19 yr olds.

There is only one study by Willems et al (2001)[mmmmm], reporting on the prevalence of dentofacial characteristics in a Belgian population, but there was a considerable sample bias as the population was recruited from the files of patients who previously received an orthodontic treatment at the Department of Orthodontics of the University Hospitals of the KULeuven.

Table 67: Table combining IOTN distribution data presented in Table 7 and Table 8 from Chapter 2

	IOTN 1-2	IOTN 3	IOTN 4-5
USA (Proffit, 2000)	58,6%	28,9%	13,5%
UK (Holmes [74])	34.8%	33.2%	32.0%
Sweden (Josefsson et al [76])			39.5%
Belgium (Willems et al[71])*			63%*

*Data from a tertiary referral hospital

The results in this study show that in a population of patients referred for orthodontic treatment in a university hospital, 63 % of the patients showed an IOTN 4-5 indicative for definite treatment need. Compared to other orthodontic samples referred to in Chapter 2 of this study (cfr repeated Table 67), this appeared to be a high percentage of

[mmmmm] Willems G, De Bruyne I, Verdonck A, Fieuws S, Carels C. Prevalence of dentofacial characteristics in a Belgian orthodontic population. Clin Oral Investig. 2001 Dec;5(4):220-6.

patients with high treatment need, which seems logical due to the fact that it concerns a tertiary referral hospital .

In other studies looking at the IOTN distribution in (non-referred) populations in the UK [74] and Sweden {Josefsson, 2007 #58} the IOTN 4-5 categories represent 32 to 39.5 percent of the analysed populations. In both studies however, the IOTN-scoring was performed by orthodontists and it was shown by Shaw et al.(1991), that when children and orthodontists were asked to score the aesthetic component of the IOTN, orthodontists systematically gave a higher IOTN-score than the children.

The results of two important epidemiological studies were reported in Proffit's book [nnnnn](Contemporary Orthodontics, 2000). In Table 8 (see section 2.1.2) reproduced from this book, an overview is given on the distribution of the Treatment Priority Index in the NHANES I study carried out between 1965 and 1970 in the United States, and on the distribution of the IOTN grades in the US population in the NHANES III study between 1989 and 1994 respectively. The problem with these data however is that if the sum is made of the percentages of the IOTN groups, this addition results in 110 percent (for the group of 8-11 yr olds) and in 113 % (for the group of the 12-17 yr olds), and thus extrapolation of these data should be interpreted carefully.

We see that in the USA, the estimated percent of IOTN-grade 4-5 does not differ a lot between the age groups of 8-11 yrs and 12-17yrs. For the Belgian population we can make the same assumption. Also, the percentage of Blacks and Hispanics can be assumed to be much lower in Belgium than in the USA, so only the numbers of American Whites will be taken into account. We also assume that the USA population of youngsters of some 18-15 years ago (NHANES III sample of 1989-1994) does not differ significantly from our present Belgian children population concerning malocclusions.

It should be noted that the numbers presented by Proffit, exceed 100% (Child 8-11yrs: 110% and Youth 12-17yrs: 113%), possibly due to methodological problems; to calculate the Belgian numbers, the given percentages were calculated back to 100%.

8.4 EPIDEMIOLOGICAL ESTIMATES ON BELGIAN POPULATION

For the extrapolation to the Belgian situation, the Belgian birth rate of 110 000 children is considered. This results in an estimated number of patients falling into the IOTN 4-5 group (high treatment need) of 12 100 per year, for the IOTN 3 group (medium treatment need) this results in an estimated number of 36 300 per year and for the IOTN 1-2 group (low or no treatment need) an estimated number of 61 000 individuals a year.

With a prevalence in Belgium for oligodontia of 0.001% for oligodontia and 0.0014 for CLP, (1.4 in 1000 live births), we are confronted there with 110 new oligodontia and 154 new CLP patients a year.

This results in an estimated total number of patients to start an orthodontic treatment in a certain year of:

IOTN	**N° of starts yearly**
IOTN 5 oligodontia	110
IOTN 5 CLP	154
IOTN 4-5	12 100 minus 264 = 11 836
IOTN 3	36 300
Estimated number of patients to be treated	**48 400**
IOTN 1-2	61 000

nnnnn Proffit W. R. with Henry W. Fields, Jr . The Orthodontic Problem. Malocclusion and Dentofacial Deformity in Contemporary Society, pp 28 in Contemporary Orthodontics, 2000; Eds Proffit, with Henry W. Fields, Jr Mosby , St Louis, Philadelphia, et al

If we look at the total number of patients treated in the year 2005, the RIZIV/INAMI data showed (cfr paragraph 4.4.1, pp 117 of this report) that 2% of the Belgian 0-19yr olds was being treated orthodontically, which at first glance fits exactly to the expected population to be treated on the basis of the Belgian birth rate. However, as so far there are no data available on the severity of the malocclusions of the treated children - and thus on which IOTN-scores are represented in the 2% treated 0-19 yr olds in 2005 - we can not judge whether the correct population is treated or not. Undertreatment of children with IOTN 4-5 or overtreatment of children with IOTN 1-2 could both have taken place.

Again this is an indication that there is a high need for epidemiological orthodontic data.

Concerning the geographical distribution, it was shown by the RIZIV/INAMI data that the uptake of orthodontic treatment varies between the regions, with 2,3% of the 0-19 yr olds being treated in the Flemish region, 1,5% in the Brussels Capital region and 1,6% in the Walloon region.

For the year 2007, CM/MC data on 43 local sickness funds showed that all the localities, where more than 50% of the 19 yr olds were treated, were located in Flanders, while all the localities with less than 40% treated 0-19 yr olds, are located in the Walloon Region or in Brussels Capital Region (cfr data in the Appendix of Chapter 8).

8.4.1 Estimated proportion of population with specific craniofacial disorders

8.4.1.1 Patients with specific craniofacial anomalies, orofacial clefts and oligodontia:

There has been a consensus since the early 50ies that a multidisciplinary team in a centre should care for children with CLP and other craniofacial anomalies[ooooo]. The team should function as an organization and each member of the team should have an understanding of the different aspects of treatment. The team provides multidisciplinary treatment and usually includes specialists from the following disciplines: paediatrics, plastic and reconstructive surgery, orthodontics, genetics, social work, ENT, speech therapy, maxillofacial surgery , prosthetic dentistry and psychology.

The aim of the team approach is to create the conditions that allow the affected child to grow up with an aesthetically pleasing face, good hearing and speech, properly functioning and aesthetically pleasing dentition. and an harmonious social- psychological development. The role of the orthodontist is essential in the treatment of CLP patients.

As patients with cleft lip and/or palate 1/ are the most frequent congenital anomalies involving the face and the teeth[ppppp] (cfr Figure 54 for birth rate in Flanders) 2/ for which the highest orthodontic treatment need (IOTN 5) always applies and 3/ as the costs for the orthodontic treatment of these patients are calculated to be 2.5 to 3 times the costs for a regular orthodontic treatment (cfr Chapter 3 on the International comparison of this study, The Netherlands), special attention is paid to these patients.

In the RIZIV/INAMI acts, there is no specific reimbursement for these patients so far. On the contrary, sickness funds are providing special financial support for patients with special anomalies.

Data from CM/MC show the proportion of patients with specific craniofacial abnormalities at 4 sickness fund divisions. It concerns requests for craniofacial dysplasia, craniofacial dysplasia with dyschondrosis, other craniofacial dysplasia, congenital agenesis of minimum 3 permanent teeth with exception of the wisdom teeth.

[ooooo] http://www.who.int/genomics/anomalies/en/

[ppppp] http://www.uzleuven.be/schisisteam/

Table 68: Number of patients with specific craniofacial abnormalities in 4 CM/MC local mutualities: 101 (Antwerpen), 104 (Mechelen), 108 (Leuven) and 120 (Midden Vlaanderen) (2005-2006)

	2005	2005 & 2006	
ZF	PR 305631	PR 979941	%
101	2.648	12	0,45%
104	1.277	2	0,16%
108	1.612	0	0,00%
120	3.170	14	0,44%

Source: CM/MC, January 2008

Only from 4 CM/MC divisions, a small number of data is available on patients with specific craniofacial anomalies. In the represented divisions there is a reported basis range from 0.0% to 0.45% of the CM/MC members receiving an extra-reimbursement for specific craniofacial anomalies[qqqqq] in the years 2005 or 2006 who started an orthodontic treatment in 2005.

The information in Table 68 shows the same range of included patients (specific craniofacial anomalies for which extra-reimbursement is provided by the sickness funds) as already described in the general literature (incidence CLP: 1.5 on 1000 births).

No differential diagnosis on the type of craniofacial anomalies could be retrieved in Belgium.

From the international literature average incidence rates for oligodontia (missing more than 6 permanent teeth with exclusion of the molars) of 0.85 to 1 in 1 000 live births have been reported[rrrrr].

8.4.1.2 Epidemiological data on incidence of Cleft Lip and Palate (CLP) in Belgium

The worldwide prevalence rates of craniofacial congenital deviations, is very low, compared to the common orofacial clefts, which vary between 0.5 and 3 live births and stillbirths per 1 000 births, with considerable variation between gender, populations and geographic regions. About 10 tot 20% of the children with clefts have associated malformations. This is particularly true for patients with an isolated cleft palate.

Orofacial clefts thus are the most prevailing congenital anomaly including the teeth and the face. As virtually all CLP patients need orthodontic treatment in the age period of interest (0-15yrs) in this study, specific attention is paid here to this special care group. Moreover, the treatment in these patients takes a long time (on average 6 years, mostly interrupted) with a phase of neonatal presurgical treatment in case of cleft lip.

Based on the birth rate in Belgium (110 000), around 154 new affected patients are born per year. Although this does not represent a large amount, and as these patients need a multidisciplinary approach, including the ear-nose-throat speciality, orthodontics, maxillo-facial surgery, speech therapy, genetic counselling, paediatrics, paediatric dentistry and all other dental disciplines, three to five reference centers in a university setting for Belgium should be sufficient.

Figure 54: Birth rate of babies with Cleft Lip and/or Palate in the Flemish region from 1994 to 2005

Geboortecijfers van Vlaanderen											
	1994	1995	1996	1997	1999	2000	2001	2002	2003	2004	2005
Geboortes Vlaanderen	63.851	63.372	63.550	63.599	61.349	62.128	60.813	60.048	60.406	62.657	64.228
Pasgeborenen Schisis Vlaanderen	55	100	93	93	81	69	85	80	79	78	87

Source: The Leuven Cleft Lip and Palate Team and www.kindengezin.be

qqqqq Specific craniofacial anomolies: craniofacial dysplasias (with dyschondrosis or of other etiology); congenital agenesis of minimally 3 permanent teeth (except wisdom teeth)

rrrrr Nordgarden H, Jensen JL, Storhaug K. Reported prevalence of congenitally missing teeth in two Norwegian counties. Community Dental Health. 2002 Dec;19(4):258-61

With an average birth rate of 83 new CLP affected babies in 62 364 births between 1994 and 2005, the incidence rate in Flanders is 1.3 in 1000 births (cfr Table 54). In three quarter of them, a cleft lip - either uni- or bilaterally - is present, and thus also a neonatal presurgical treatment is needed, using either specific extra-oral traction devices or sometimes plate appliances.

In the RIZIV/INAMI nomenclature for Stomatologists and Maxillo-Facial Surgeons, 3 codes have temporarily (from the first of January 1985 to the first of February 2004) been in use to provide this neonatal treatment (A: 317332, H: 317343) for these patients, either by making individual impressions (A: 317354; H: 317365) and then providing individual plates (A:317310, H 317321). If patients are treated in multidisciplinary context, it mostly is the orthodontist who provides this treatment, but nowadays (since February 2004 on) there is no nomenclature for this treatment anymore, although neonatal guidance prior to lip surgery is desirable for the different parties (surgeon, patient and his parent). Sometimes, a start of orthodontic treatment (305631 act) is therefore used in these cases now, but this is not a correct interpretation and application of the RIZIV/INAMI regulations, as this mostly does not include the placement of a typical ortho"dontic" appliance, as no teeth are already present in the mouth at birth.

Table 69: Description of the codes which were provided for neonatal orthopaedic treatment.

A or H	RIZIVcode	Created	Deleted	Label
A	317310	01-janv-85	01-févr-04	Maxillo-faciale orthopedische behandeling bij de pasgeborene : per plaat
H	317321	01-janv-85	01-févr-04	Maxillo-faciale orthopedische behandeling bij de pasgeborene : per plaat
A	317332	01-janv-85	01-févr-04	Volledige behandeling, maximum
H	317343	01-janv-85	01-févr-04	Volledige behandeling, maximum
A	317354	01-août-88	01-févr-04	Vervaardigen van de afgietsels van de afdruk van de tandboog naar aanleiding van een maxillo-faciale behandeling bij de pasgeborene . De verstrekking 317354 - 317365 mag één keer worden aangerekend naar aanleiding van het aanrekenen van de verstrekking
H	317365	01-août-88	01-févr-04	Vervaardigen van de afgietsels van de afdruk van de tandboog naar aanleiding van een maxillo-faciale behandeling bij de pasgeborene . De verstrekking 317354 - 317365 mag één keer worden aangerekend naar aanleiding van het aanrekenen van de verstrekking

Source: RIZIV/INAMI, January 2008

Table 70: Number of cases for the neonatal treatment of CLP-babies between 1985 and 2004

Boekjaar	317310	317321	317332	317343	317354	317365	241732	241743
1990	55	14	19	7	35	4		
1991	58	7	27	10	55	5		
1992	43	9	30	16	39	12		
1993	40	3	20	11	31	4		
1994	25	13	16	5	21	18		
1995	34	7	26	4	32	17		
1996	45	2	24	4	44	9		
1997	28	7	22	8	28	9		
1998	13	7	15	4	30	7		
1999	31	6	15	2	61	4	1	16
2000	26	8	7	3	54	8	2	14
2001	12	3	11	2	30	7	1	14
2002	8	6	10	3	15	6	1	
2003	12	4	13	1	17	4		
2004	5	1	4		7	1		
2005			1					

Source: RIZIV/INAMI, January 2008

The full treatment as well ambulant as during hospitalisation, apparently was the treatment of choice, when CLP babies were treated. Individual plates were applied less frequently. From the announcement of withdrawal of these acts in babies with cleft (end of 2003), practitioners did not use this number anymore.

Since 6 years the Children McDonalds Fund "Smile" provides funding for predominantly orthodontic treatment in patients with orofacial clefts. The Chairperson of the Selection Committee (prof dr Chantal Malevez) provided the following information from the Fund. The Mac Donalds Fund for children attributed in 6 years 1 000 000 € to treatment of children with CLP or a craniofacial syndrome aged between 0 and 18yrs. Of the 894 requests, 708 had a favorable response; although most of the attributed money was for orthodontic treatment, also surgical (distractions, etc) or the non-refundable part of medical expenses of all other types of treatment (implants, bridges, logopedics, psycho-therapy, ...) is attributed to these children and their parents.

As the contributions are only paid by receipt of the invoice, the exact amount paid by the Fund, is however not known.

Of all the requests ever performed, there were 487 treatments accorded for 2 yrs, 86 requests for 4 years and 5 requests for 6 years of treatment. For every two years of orthodontic treatment a supplementary reimbursement of 1.300€ on top of the sick funds reimbursement, is accorded. For an individual orthodontic treatment of 6 years in CLP children, the maximum reimbursement of around 1 200€ by the sick funds in these cases is supplemented by 3.900€ from the Mc Donalds Children Fund.

8.5 CONCLUSIONS

- **When Proffit's data on IOTN distribution in the US population are extrapolated to the Belgian situation with a birth rate of 110 000, this results in an estimated number of patients falling into the IOTN 4-5 group (high treatment need) of 12 100 per year, an estimated number falling into the IOTN 3 group (medium treatment need) of 36 300 per year and an estimated number falling into the IOTN 1-2 group (low or no treatment need) of 61 000 individuals a year.**
- **With a prevalence in Belgium for oligodontia of 1 in 1 000 live births and 1.4 in 1 000 for CLP, it is estimated that there are 110 new oligodontia and 154 new CLP patients a year.**
- **This results in a total estimated number of 48 800 patients (i.e. 2% of the 0-19 yr olds) to start an orthodontic treatment every year, composed of**

  IOTN 5 oligodontia : 110

  IOTN 5 CLP: 154

  IOTN 4-5: 12 100 minus 264 = 11 836

  IOTN 3: 36 300
- **Although RIZIV/INAMI data showed that in 2005 48 800 children Belgian children between 0-19yr old started an orthodontic treatment, it is not known whether the correct patient group (IOTN 4-5 and IOTN 3) is included in this treated population. To clarify this, an epidemiological study on IOTN distribution in Belgium is necessary.**
- **For children with CLP and other craniofacial anomalies multidisciplinary teamwork should preferably take place in - or in close cooperation with - a university setting.**
- **The team for cleft lip and palatae treatment should function as an organisation and each member of the team should have an understanding of the different aspects of treatment. The team provides multidisciplinary treatment and usually includes specialists from the following disciplines: paediatrics, plastic and reconstructive surgery, orthodontics, genetics, social work, ENT, speech therapy, maxillofacial surgery, prosthetic dentistry and psychology.**
- **In the represented CM/MC mutualities there is a reported basis range from 0.0% to 0.45% of the members receiving an extra-reimbursement for specific craniofacial anomalies and who started an orthodontic treatment in 2005**
- **From the international literature average incidence rates for oligodontia (missing more than 6 permanent teeth) of 0.85 to 1 in 1 000 live births have been reported. With a birth rate of 110 000, this results in 110 new children with oligodontia (IOTN 5) per year in Belgium.**
- **With an average birth rate of 83 new CLP affected babies in 62 364 live births between 1994 and 2005, the prevalence in Flanders is 1.3 in 1 000 births. The prevalence for Belgium has been previously determined to be 1.4 in 1 000 births; with a birth rate of 110 000 births in Belgium this gives 154 new affected CLP children (within the IOTN 5 group) per year.**

9 BELGIAN SITUATION: COST ANALYSIS AND BUDGET IMPACT CALCULATIONS

In our questionnaire, a number of questions regarding the cost of an orthodontic practice were included. As the response to the questionnaire overall, and definitely for the cost questions was low, the data have not been found valid to use for a proper cost analysis.

Also no budget impact calculation has been included in this study, as it would be based on too many assumptions without solid scientific grounds.

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Dépôt légal : D/2008/10.273/21

KCE reports

1. Efficacité et rentabilité des thérapies de sevrage tabagique. D/2004/10.273/2.
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29. Recommandations nationales Collège d'oncologie : A. cadre général pour un manuel d'oncologie B. base scientifique pour itinéraires cliniques de diagnostic et traitement, cancer colorectal et cancer du testicule. D2006/10.273/13.
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52. Rapid Assessment: Prévention cardiovasculaire primaire dans la pratique du médecin généraliste en Belgique. D/2007/10.273/04.
53. Financement des soins Infirmiers Hospitaliers. D/2007/10 273/06
54. Vaccination des nourrissons contre le rotavirus en Belgique. Analyse coût-efficacité
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