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Orthodontists' views on indications for and timing of orthodontic treatment in Finnish public oral health care

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SUMMARY The aim of this study was to analyse the variation in the views of Finnish orthodontists on the indications for orthodontic treatment, timing of orthodontic assessment, and treatment methods used. The views were elicited by a questionnaire that was sent to all 146 specialist orthodontists under 65 years of age living in Finland in 2001. The response rate was 57 per cent. The association between an orthodontist's experience and timing of treatment was tested by Fisher's exact test. Stepwise logistic regression analysis was used to estimate the association between the demographic characteristics of orthodontists and the tendency to start Class II division I treatment early.

Most orthodontists recommended that the first assessment of occlusion should be carried out before 7 years of age. A crossbite was mentioned as the most frequent indication for treatment in the primary and early mixed dentition, and a severe Class II division I malocclusion with an increased overjet as the most frequent indication in the late mixed dentition. Most respondents preferred early treatment, but there was a wide variation in the choice of appliances and in the timing of treatment of malocclusions other than crossbite and Class II malocclusions. A quadhelix, headgear, and the eruption guidance appliance were the most frequently used appliances in early treatment, with fixed appliances being most frequently used during the late mixed and permanent dentition phase.

Orthodontists working full time in municipal health centres tended to prefer early treatment more often than those working part-time or outside health centres. There was no statistically significant association between an orthodontist's experience and timing of Class II division I and Class III treatment ($P = 0.142$ and $P = 0.296$, respectively). The preference for an early start in Class II division I treatment might be related to differing professional decisions, but no explaining factors could be found in the regression analysis.

Introduction

In Finland, dental care, including orthodontic treatment for children, has been carried out in municipal health centres from the early 1970s, and these services are free of charge for children under 18 years of age. There is general consensus in Finland on the significance of orthodontic care of children and adolescents as part of the public oral health care system. Nevertheless, the main concern in public discussions has been the wide variation in the availability and extent of orthodontic services among different health centres (Pietilä *et al.*, 1997). There are no national regulations guiding the extent of public orthodontic care. However, in 2001, the Finnish governmental authorities proposed that national recommendations should be established to reduce the disparities in access to orthodontic care.

In Finland, the first specialist orthodontists were registered in 1975, and the first specialists graduated from a 3-year full-time postgraduate programme in 1988. The majority of orthodontists work in the cities and towns. Every fifth health centre employs an orthodontist, covering half of the Finnish population. Most rural municipal health centres do not employ a full-time orthodontist, but the expertise is purchased from consultant orthodontists, who plan and supervise the orthodontic treatment provided by general dentists (Pietilä *et al.*, 1992, 1997). Both salaried and consultant orthodontists play an important role in introducing professional views to dental health workers and decision makers. The level of agreement among orthodontists may thus have an effect on the provision of orthodontic care.

In 1988, the Finnish National Board of Health recommended the application of a 10-grade scale for assessment of orthodontic treatment need (Heikinheimo, 1989). The scale is a modification of the Treatment Priority Index (Grainger, 1967), which ranks the indications for orthodontic treatment according to the severity of the deviation, with the emphasis on functionally disturbing occlusal deviations. According to Svedström-Oristo *et al.* (2000, 2001), Finnish orthodontists pay considerable attention to the functional characteristics of occlusion.

In Finnish health centres, the starting age for orthodontic treatment in children is, on average, 9.5 years, but there is a wide variation in the timing of treatment (Pietilä *et al.*, 1997). In health centres, orthodontists and general dentists work together in the same organization, thus facilitating joint action and a flexible work division. The screening for orthodontic treatment is usually undertaken by general dentists, who refer a child with a treatment need to the orthodontist. In most cases, the orthodontist makes the

diagnosis and formulates treatment plan (Pietilä *et al.*, 1992, 1997).

In Finland, orthodontic treatment given in the primary or early mixed dentition is regarded as early treatment. The application of early treatment was recently studied by Väkiparta *et al.*, (2005). They found a significant reduction in orthodontic treatment need from 8 to 12 years in a group of Finnish children treated systematically by early intervention. In their study, the main indications for early treatment were anterior and lateral crossbites, increased overjets, deep overbites, and crowding. The same indications for early orthodontic treatment were also found by Keski-Nisula *et al.* (2003) and Tausche *et al.* (2004) during the early mixed dentition period.

Kiyak *et al.* (2004) recently reported orthodontists' perceptions on timing of treatment for certain occlusal and skeletal deviations in three countries, Italy, Turkey, and the United States of America (USA). In all three countries, the vast majority of orthodontists preferred to treat malocclusions, such as an anterior crossbite and severe arch constriction, during the primary or early mixed dentition, while there were more obvious differences in the preferred timing of treatment of other malocclusions, e.g. large overjets and severe crowding. Orthodontists in Italy preferred two-stage treatment more often than those in the United States of America and Turkey.

The timing of Class II division 1 treatment was recently studied in the USA in three clinical trials (Ghafari *et al.*, 1995; Keeling *et al.*, 1998; Tulloch *et al.*, 1998). The findings showed that changes in several dental and skeletal discrepancies could be achieved by early intervention when compared with controls, but at the end of the two-stage treatment the differences between the early and late treatment groups had, to a great extent, disappeared. In those studies, it was not possible to identify any factors which could predict which of the children would benefit from early intervention. When reporting their final results, it was stated that the optimal timing for treatment of a Class II malocclusion remains controversial and that the decision for early treatment should be based on individual indications for each child (Tulloch *et al.*, 2004).

The choice of treatment methods reflects the educational tradition and professional preferences in each country. Traditionally, European orthodontists have shown a greater preference for functional appliances compared with their American colleagues (Graber, 1998), but increasing collaboration between professionals from different countries has lessened the differences. According to a survey in the early 1990s, the most frequently used appliances in Finnish health centres were quadhelix and headgear at 7 years of age and fixed appliances and headgear at 13 years of age (Pietilä *et al.*, 1997). In the early 2000, the same three appliances were, according to Svedström-Oristo *et al.* (2003), still the most frequently used.

The purpose of this study was to analyse the variation in the views of Finnish orthodontists concerning the indications for orthodontic treatment, timing of orthodontic assessment, and the treatment methods used.

Subjects and methods

In April 2002, a semi-structured questionnaire was sent to all 146 specialist orthodontists under 65 years of age living in Finland in 2001, 76 per cent of them being female. The names and addresses of the orthodontists were obtained from the statistics of the Finnish Dental Society. The geographic distribution of the orthodontists was even, with the exception of the most northern area, the County of Lapland (Table 1).

In the questionnaire, the structured questions concerned the orthodontists' living area, type of employment, working experience, and where their postgraduate training was carried out. In open questions, the respondents were asked to consider at what age they liked to assess a child's occlusion for the first time and then for a second and third time. They were asked to report according to which indications they would like to start orthodontic treatment in a child in the primary, early mixed, late mixed, or permanent dentition, and in adulthood. They were also asked which orthodontic appliances they preferred when treating children during the primary (4–6 years), early mixed (7–9 years), late mixed (10–13 years), or permanent (14–18 years) dentitions by mentioning the three appliances they have used most often in those age groups.

Table 1 Geographic distribution of specialist orthodontists under 65 years of age in Finland in 2001, the total number of 0- to 18-year-old subjects per specialist orthodontist and the percentage of responding specialists in this study.

	County					
	Southern Finland	Western Finland	Eastern Finland	County of Oulu	County of Lapland	Total
Total number of specialists	65	49	15	16	1	146
Total number of 0- to 18-year-olds per specialist	7320	8570	8470	7400	43 390	8109
Percentage of responding specialists	54	57	47	44	100	57

Statistical analysis

The association between an orthodontist's experience and timing of Class II division 1 and Class III treatment was tested by Fisher's exact test. Stepwise logistic regression analysis, with the backward elimination method, was used to estimate the association between the demographic characteristics of the orthodontists and the tendency to start Class II division I treatment early.

Results

Description of respondents

Type of employment. The questionnaire was returned by 83 orthodontists (57 per cent). Seventy-seven respondents worked actively in clinical work. The majority of respondents (76 per cent) worked in the southern and western parts of Finland, where the majority of the country's inhabitants live. Of the 77 actively working orthodontists, 12 (16 per cent) also undertook other dental treatment in addition to orthodontic therapy. Two-thirds of actively working orthodontists worked as salaried orthodontists in a municipal health centre and half as private practitioners. Several respondents worked in more than one employment sector (Table 2).

The percentage of males was similar among respondents and non-respondents (22 versus 27, respectively). The percentage of orthodontists working in health centres was higher among respondents than non-respondents (66 versus 44, respectively) and the percentage of private practitioners and university teachers was lower among respondents (15 and 8, respectively) than non-respondents (25 and 18, respectively).

Orthodontic education. Thirty-seven respondents (47 per cent) had graduated earlier, i.e. were registered as orthodontists in the years 1975–1987, and 41 (53 per cent) had graduated later, i.e. in 1988 or later. Five respondents did not answer this question. The percentage of those who earlier graduated was lower (47) among respondents than non-respondents (55).

Table 2 Distribution of actively working respondents by type of employment (Several respondents worked in more than one employment sector).

Type of employment ($n = 77$)	Respondents
Salaried in a municipal health centre	51 (66%)
Full time	31
Part-time	20
Consultant in a municipal health centre	37 (48%)
2–20 consultant days per year	18
24–60 consultant days per year	16
65–94 consultant days per year	3
Private clinic	38 (49%)
Central hospital	18 (23%)
University clinic	14 (18%)

Almost one-third (n = 27) had graduated from the University of Helsinki, one-third ($n = 34$) from the University of Turku, and 17 from the Universities of Oulu and Kuopio. Only three respondents had received their postgraduate education abroad, two in Norway and one in the USA.

Respondents' views

Indications for treatment. The majority of respondents (88 per cent) mentioned a lateral crossbite as the most frequent indication for treatment during the primary dentition. During the early mixed dentition, the most frequently mentioned indication was an anterior crossbite (73 per cent), followed by a lateral crossbite (67 per cent). A severe Class II division I malocclusion with an increased overjet was mentioned as the third most frequent indication for treatment in the early mixed dentition (53 per cent) and as the most frequent (42 per cent) in the late mixed dentition (Table 3).

Opinions on timing of orthodontic assessment. Most orthodontists (81 per cent) recommended the first assessment of the occlusion before 7 years of age, and only two respondents recommended it later than this. However, the

Table 3 The most frequently mentioned indications for orthodontic treatment during each developmental stage of occlusion (total number of respondents $n = 83$).

Developmental stage of occlusion and age	Indication for treatment	%
Primary dentition (4–6 years)	Lateral crossbite	88
	Anterior crossbite	78
	Scissorbite	34
	Open bite caused by sucking habits	29
	Hypodontia	29
	Severe Class II division I, increased overjet	29
	Severe deep bite	19
	Maxillary hypoplasia	16
Early mixed dentition (7–9 years)	Anterior crossbite	73
	Lateral crossbite	67
	Severe Class II division 1, increased overjet	53
	Class II division 2, severe deep bite	52
	Crowding of incisors	45
	Scissorbite of primary or first molars	30
	Eruption disturbances	27
	Maxillary hypoplasia, progenia	27
Late mixed dentition (10–13 years)	Severe Class II division 1, increased overjet	42
	Severe crowding	40
	Class II division 2, severe deep bite	40
	Moderate crowding	30
	Impacted canines	23
	Skeletal open bite	16
Permanent dentition (14–18 years)	Moderate crowding	28
	Impacted canines	22
	Severe crowding	19
	Severe Class II division 1, increased overjet	16
	Scissor-bite of premolars and second molars	13
	Class II division 2, severe deep bite	12
Adult dentition	Orthognathic cases	75
	Maxillary hypoplasia, progenia	17
	Skeletal open bite	12

optimal age ranged from 3 to 10 years. The second assessment ranged from the early mixed to the late mixed dentition and the third from the late mixed to the permanent dentition (Table 4).

Selection of appliances. The orthodontists reported that in the primary dentition the most frequently used appliance was a quadhelix, followed by an eruption guidance appliance. In the early mixed dentition, the most frequently used appliances were headgear and quadhelix. The quadhelix was not mentioned for age groups over 9 years. A functional appliance was used in the age range of 7–9 years upwards and was the second most frequently used appliance in the 10- to 13-year-old age group and 14- to 18-year-old age group. A fixed appliance was used most frequently in the 10- to 13-year-old age group, and it was also the appliance predominantly used in the permanent dentition (Table 5).

Timing of orthodontic treatment. Orthodontists who had graduated between 1975 and 1987 tended to favour early treatment more often than those who had graduated more recently, i.e. 49 per cent of those who had graduated earlier preferred to start Class II division 1 treatment during the early mixed dentition, while this was the case for only 34 per cent of those who had graduated more recently. This difference was not statistically significant (P = 0.142, Fisher's exact test). The same tendency was seen in connection with Class III treatment, 32 versus 24 per cent (P = 0.296, Fisher's exact test). No differences were seen in the timing of treatment of Class II division 2 malocclusions.

Approximately 50 per cent of the orthodontists who worked full time in municipal health centres preferred to start Class II division 1 treatment during the early mixed dentition, a view agreed on by 28 per cent of those working part-time and 41 per cent of those working other than in health centres. Correspondingly, the respondents emphasizing early treatment of Class III malocclusions was 35 per cent among full-time working orthodontists, 24 per cent among part-time working orthodontists, and 22 per cent among those working outside health centres. Early initiation in the case of Class II division 2 treatment was preferred by all three groups (92 versus 72 versus 67 per cent, respectively).

When consultant orthodontists were compared, similar differences were seen only in connection with Class II division 1 treatment. More than half (58 per cent) of those working as consultants at least twice a month preferred to start treatment during the early mixed dentition, a view agreed on by 17 per cent of the orthodontists who worked less often as consultants.

Explaining factors. Sixty per cent of the respondents preferred to start Class II division 1 treatment early. Logistic regression analysis was used to determine the characteristics of the respondents for the differences in the opinions on timing of Class II division 1 treatment (Table 6). The characteristics of orthodontists were experience, graduated early (1975–1987) or late (1988–2002), graduation institution, working at a health centre, and working as a consultant. None of the chosen explaining factors had a significant association with opinion on the timing of Class II division 1 treatment.

Table 4 The respondents' opinions on the ideal timing for orthodontist's assessment (number of respondents in parenthesis).

	Ideal age for an orthodontist's assessment	
	Mean (years)	Range (years)
First assessment (n=77)	5.5	3–10
Second assessment (n=77)	8.2	6–12
Third assessment (n=70)	11.2	9–16

Table 5 The frequency of appliances used by the orthodontists in the different age groups (number of respondents in parenthesis).

	Number of answers		
	First	Second	Third
First, second, and third most frequently used orthodontic appliances			
4–6 years of age (n=64)			
Quadhelix	44	12	1
Eruption guidance appliance	6	17	20
Removable plate	5	2	2
Headgear	4	5	2
Facemask	1	13	10
7–9 years of age (n = 74)			
Headgear	33	14	15
Quadhelix	20	18	7
Functional appliance/activator	5	18	12
Fixed appliance	5	9	16
Eruption guidance appliance	4	7	9
10–13 years of age (n = 75)			
Fixed appliance	37	26	11
Headgear	29	15	11
Functional appliance/activator	7	26	30
14–18 years of age (n = 74)			
Fixed appliance	72	1	—
Functional appliance/activator	2	18	8

Discussion

The large variation in access to treatment has been thought to be related to professional decisions (Wennberg *et al.*, 1982). Consequently, it was considered important to study Finnish professionals' opinions on decisions linked to the initiation of orthodontic treatment. The initiative concerning orthodontic treatment in publicly funded health services is most often decided by professionals (Pietilä and Pietilä, 1994).

Because of the small number of specialist orthodontists in Finland, it was possible to send the questionnaire to all orthodontists of working age. The focus of the questionnaire

Table 6 Variables associated with the tendency to start Class II division 1 treatment early (stepwise logistic regression analysis).

	B	SE	Wald	df	Sig. = *P*	Exp(B)
Experience	−0.481	0.505	0.905	1	0.341	0.618
University	0.343	0.495	0.478	1	0.489	1.409
Salaried	−0.006	0.533	0.000	1	0.992	0.994
Consultant	−0.238	0.493	0.234	1	0.629	0.788
Constant	−0.174	0.594	0.086	1	0.770	0.840

Experience, experience as a specialist orthodontist; University, institute of orthodontic graduation; Salaried, working in a health centre as a salaried orthodontist; Consultant, working as a consultant orthodontist in health centre/centres.

was on the municipal orthodontic services concentrating on the treatment of children and adolescents. It is therefore understandable that orthodontists who worked only in the private sector or in universities were less interested in responding than those working in health centres. On the other hand, many respondents worked in several sectors: in public health, hospital or university clinics, and in private practice. The geographic distribution of the respondents corresponded well with the distribution of orthodontists in the country. Very few respondents had received their specialist education outside Finland, and it could be expected that this would decrease the variation in treatment practices.

Finnish orthodontists generally favoured early treatment. However, the wide range of opinions on timing revealed differences in respondents' treatment practices. The fact that the orthodontists prefer assessments during both the early mixed and late mixed dentition shows that early treatment is used only for some subjects. Even though more than half of health centres use the same 10-grade scale for the assessment of treatment need (Pietilä *et al.*, 1997), it is obvious that each health centre has its own age schedule for referring children to an orthodontist for assessment.

Anterior and lateral crossbites were the most frequently mentioned indications during both the primary and early mixed dentition, followed by features connected with Class II malocclusions. The same indications were also mentioned most frequently during early mixed dentition in the studies by Kiyak *et al.* (2004) and Väkiparta *et al.*, (2005). On the other hand, severe crowding and skeletal open bites were mentioned most frequently during the late mixed and permanent dentition.

The selection of appliances was compatible with the indications for treatment. The most frequently used appliances during both early and late treatment were logical choices, e.g. for treatment of crossbites, Class II malocclusions, and crowding. Furthermore, the selection of appliances was almost the same as in the survey from the early 1990s (Pietilä *et al.*, 1997). The only exception was the eruption guidance appliance, which was not mentioned at all in the early 1990s. This reveals that adoption of this appliance has occurred relatively quickly, because in this study it was mentioned as the second most frequently used appliance during the primary dentition and the fifth most frequently used during the early mixed dentition.

Finnish orthodontists seemed to emphasize the treatment of crossbites, and that the timing of correction should be undertaken early. This is shown by the fact that a quadhelix was mentioned among the three most frequently used appliances only during the primary and early mixed dentitions. Furthermore, other expanding appliances, such as the rapid maxillary expansion appliance, were not mentioned at all in the late mixed or permanent dentition.

Headgear, which was the preferred appliance during the early mixed and also during the late mixed dentition, was most often used in the treatment of Class II malocclusions. Treatment with headgear has been investigated in several Finnish studies (Kirjavainen *et al.*, 2000; Kirjavainen and Kirjavainen, 2003; Mäntysaari *et al.*, 2004; Pirttiniemi *et al.*, 2005). According to their findings, headgear is effective both in expansion of the maxillary arch and in inhibition of forward growth of the maxilla, which agrees well with the indications mentioned by the respondents.

Fixed appliances were mentioned for all age groups except for children under 7 years, and they were the most frequently used appliances after 10 years of age. This shows that the choice between fixed and removable appliances, which has been an issue of debate, e.g. in the United Kingdom (Turbill *et al.*, 1999), is not an important question in Finland.

The consequences of early treatment of Class II malocclusion have been discussed in several earlier studies. O'Brien *et al.* (2003) found that early treatment of a Class II malocclusion increased the patient's self-concept and reduced negative social experiences. According to Kiyak (2006), children and parents have high expectations concerning the psychosocial benefits of orthodontic treatment. That author stressed the importance of good communication during the initiation period of treatment in order to identify children whose psychological well-being can be improved by early treatment.

In the present study, a Class II division 1 malocclusion was mentioned in connection with both an early and late starting age. Orthodontists with a longer work history tended to favour early treatment of Class II division 1 malocclusions more often than those who had graduated more recently.

This difference might be explained by the longer clinical experience of the first group or by changes in specialist training during the past two decades. However, attempts to identify a common profile for those Finnish orthodontists who preferred early treatment were not successful. It seems that factors other than the institution of graduation, the length of experience, or working sector, guide orthodontists' decisions on timing of Class II division 1 treatment.

Conclusion

Although most Finnish orthodontists prefer early treatment, e.g. for crossbites and Class II malocclusions, there was a wide variation in the preferred age for treatment of other types of malocclusions. This wide variation was also seen in the choice of appliances. This highlights the need for further studies to determine the factors connected with the selection of treatment modalities and practices.

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