

# Orthodontic Treatment Need from Eight to 12 Years of Age in an Early Treatment Oriented Public Health Care System: A Prospective Study

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**Abstract:** The aim of this study was to investigate the effects of an early treatment oriented orthodontic program on treatment need at age 12 years in a public health care system. The subjects consisted of one whole age cohort in a municipality in Finland, 87 children in total. All children were examined at ages eight, 10, and 12 years. Treatment need was assessed on casts using a modified Dental Health Component of the Index of Orthodontic Treatment Need and a 10-Grade Scale based on the Treatment Priority Index. Early treatment was started on children having definite treatment need according to both indices. The agreement between indices was good at ages eight and 12 years and moderate at age 10 years. Treatment need changed significantly from eight to 12 years. Of the 29 children with definite treatment need at age eight years, only two had treatment need at age 12 years. Of the 38 children with no treatment need at age eight years, 28 remained in this category and only two children had definite need for treatment at age 12 years. The duration of treatment ranged from one to 61 months, although 59% of the treatments lasted two years or less. We conclude that systematically planned early orthodontic treatment may have contributed to the significant reduction in treatment need from eight to 12 years of age. (*Angle Orthod* 2005;75: 344–349.)

**Key Words:** Orthodontic treatment need; Early treatment; Public dental health care

## INTRODUCTION

The resources for publicly funded dental care are seldom sufficient to accommodate unlimited orthodontic service demands. Therefore, selection of patients has been necessary to ensure that treatment is provided to subjects with the greatest need, those likely to derive most benefit from the treatment.

Occlusal indices aim to define orthodontic treatment need according to the severity of need from a dental professional's viewpoint. In Finland, the Finnish National Board of Health recommended a 10-grade index, adapted by Heikin-

heimo<sup>1</sup> from Grainger's<sup>2</sup> Treatment Priority Index (TPI), for selecting patients in health centers. A common index in international use has been the Index of Orthodontic Treatment Need (IOTN), which incorporates ranking of various occlusal traits in terms of their significance for an individual's dental health (Dental Health Component [DHC]) and esthetic impairment (Esthetic Component).<sup>3,4</sup> As with most indices, the IOTN is mainly designed for permanent teeth, and its application to the mixed dentition may require modifications.

In countries where orthodontic treatment is part of public oral health care, the increasing demand for orthodontic treatment has generated new interest in systematically planned early treatment because it is considered to be technically simpler, also involving less chair-side time per patient and less specialist resources than comprehensive treatment with fixed appliances.<sup>5–7</sup> Early treatment can typically be implemented by experienced general dentists.<sup>5–7</sup>

There is controversy concerning the best timing for orthodontic treatment, although the benefits of early/interceptive treatment regarding functional crossbite, maxillary canine eruption, and excessive overjet with a trauma risk have been accepted.<sup>8–11</sup> Regarding Class II malocclusion, studies have not shown early orthodontic treatment to be more ben-

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eficial than treatment started later in adolescence in the permanent dentition.<sup>12,13</sup> Early Class II treatment has, however, been considered effective in reducing the difficulty of and priority for phase 2 treatment.<sup>13</sup>

Reports on the applicability of interceptive orthodontics in the community are scarce.<sup>6,14</sup> A study from Northern Ireland reported that one-third of nine- and 11-year-old children benefited from interceptive orthodontics.<sup>6</sup> Interceptive measures were reported successful among those complying fully, and the need for further treatment was significantly reduced.<sup>6</sup> Similarly, a cost and productivity analysis of orthodontic care in Finnish municipal health centers suggested that savings might be obtained by starting treatments early,<sup>7</sup> although contrasting results have also been reported.<sup>15</sup>

In Finland, publicly funded dental treatment up to 18 years of age has been provided since 1972. With the decrease in caries prevalence, the frequency of orthodontic treatment has increased, and in 1992, every fourth dental visit by zero- to 18-year-olds involved orthodontics.<sup>16</sup> Functionally and esthetically acceptable occlusion has been the primary goal of the public dental health care in Finland.<sup>17</sup> Early treatment has been supported in many public health care units also because it has enabled involvement of general practitioners in carrying out the treatments, thus making free of cost treatment available for a higher number of children. Hence, the age of starting treatments in Finnish health centers has been low, 9.5 years on average, and considerable regional variation has been reported between health centers in the provision of orthodontic treatment.<sup>16</sup>

Early treatment has often been regarded only preliminary of the actual orthodontic treatment.<sup>12,18</sup> Yet, in countries where early treatment is regularly practiced, there is need for studies evaluating the benefits and limitations of early treatment per se in reducing malocclusions and orthodontic treatment need in children. Therefore, we decided to investigate results of an early treatment-oriented orthodontic program on a child population in Finland.

The specific aims were to study:

- eventual changes in orthodontic treatment need from eight to 12 years of age in one age cohort of children entitled to free of cost orthodontic care according to a systematic early-treatment plan;
- the effect of early orthodontic intervention on treatment need at the age of 12 years;
- the agreement between the two treatment need indices most commonly used in Finland.

## MATERIALS AND METHODS

### Subjects

This study was prospectively designed for screening and follow-up of one entire age cohort of children of a rural community, who were to be treated according to a pre-

planned protocol with an emphasis on early treatment. With the approval of the communal authorities, casts were obtained from the whole group throughout the study including the children with no treatment need. The subjects consisted of all children born in 1987 and living in the municipality of Kälviä, a rural district in western Finland. All the 89 children attended the first examination at age eight years. After the first examination, one subject moved out and another was excluded because of starting treatment without fulfilling the study criteria. The final number of total subjects was 87 (49 boys and 38 girls).

### Methods

Treatment need was evaluated with two indices, ie, the DHC component of the IOTN,<sup>19</sup> and the 10-Grade Scale based on the TPI.<sup>1</sup> The esthetic component of the IOTN was not applied because of the young age of the subjects.

DHC grades 1–2 and 10-Grade Scale scores 1–4 represented no/slight need, DHC grade 3 and 10-Grade Scale scores 5–6 moderate/borderline need, and DHC grades 4–5 and 10-Grade Scale scores 7–10 definite need for treatment.

All assessments were done on casts. As modifications of the DHC, a crossbite with any recorded lateral shift scored always for DHC grade 4, and crossbites of primary molars and canines were also recorded. Overjet and overbite were not recorded if the incisors were not fully erupted.

All subjects were examined at the ages of eight, 10, and 12 years. The subjects' mean age at the first examination was 8.3 years (SD 0.35) and in the following examinations 10.3 years (SD 0.29) and 12.4 years (SD 0.29). A consultant orthodontist (Dr Väkiparta) examined all subjects aged eight years. Two general dentists took alginate impressions at ages eight, 10, and 12 years. The bite was registered in centric relation, and the casts were trimmed accordingly. The consultant orthodontist assessed the treatment need of all subjects at ages eight, 10, and 12 years on the casts.

After the first examination at age eight years, orthodontic treatment was started in subjects diagnosed with both DHC grade 4–5 and scores 7–10 in the 10-Grade Scale, if the subject was considered to benefit from early treatment. The following malocclusions were included in that category:

1. Crossbite (anterior or lateral);
2. Increased overjet (greater than six mm);
3. Deep overbite with palatal contact;
4. Severe crowding.

Two subjects, who had their posterior crossbite treated with a quad helix (QH) before the first examination, were scored according to their initial casts before age eight years. The consultant orthodontist made all treatment plans based on casts and radiographs. Two experienced general practitioners carried out the orthodontic treatments according to the plan. A QH was preferred for correction of posterior

crossbite, and a headgear was usually the appliance of choice for the correction of sagittal relationships. No multibonded fixed appliances were used at this stage. Lingual/palatal arches were used for space maintenance and retention.

After the next examination at age 10 years, the same criteria for starting treatment (DHC 4–5 and 10-Grade Scale 7–10) were applied, and treatments were started accordingly. Treatment need was not assessed during the phase of active treatment, but occlusions in retention were assessed. Data on examinations, dental visits, orthodontic treatment, and the appliances used were carefully recorded.

**Data analysis**

The data were analyzed in SPSS for Windows 8.0 (SPSS Inc, Chicago, Ill). Cohen’s kappa<sup>20</sup> was used to test the agreement between the treatment need indices. Pearson’s chi-square test was used to test the differences between the sexes. Nonparametric related samples Wilcoxon signed ranks test was used to test the change in treatment need from eight to 12 years.

For intraexaminer reliability, the same examiner (Dr Väkiparta) reassessed after eight years the DHC scores of 38 randomly selected original casts. Intraexaminer agreement was substantial, a kappa value of 0.76.<sup>20</sup> In 32 of 38 cases, there was complete agreement, and in the remaining six cases the error did not exceed one category.

**RESULTS**

**Agreement between indices**

The agreement between the indices was good at ages eight and 12 years and moderate at age 10 years. At the age of eight years, the agreement between the indices was found in 76 of 87 subjects (87%) (Table 1). In the other cases, the 10-Grade Scale score was higher than the DHC score in seven subjects and lower in four subjects.

**Treatment need**

The distribution of treatment need did not significantly differ between boys and girls ( $P > .05$ ) at any age; therefore, the results of both sexes were combined. A highly significant change in treatment need occurred from eight to 12 years (Wilcoxon signed ranks test,  $P < .001$ ). The change of DHC category indicated diminished treatment need in 34 subjects, increased need in 15 subjects, and no change in 34 subjects. The majority of the no-change group consisted of subjects with no need for treatment at any age during the follow-up period (Figure 1).

At the age of eight years, 29 subjects (33%) had a definite treatment need according to both indices (Table 1). The number of subjects with a definite treatment need markedly decreased during the study period. Correspondingly, the number of subjects with no treatment need in-

**TABLE 1.** Distribution of Assessments of Treatment Need Using the 10-Grade Scale (10-GS) and the DHC Component of IOTN. DHC Scores 1–2 and 10-GS Scores 1–4 Represent No/Slight Need, DHC 3 and 10-GS Score 5–6, Moderate Need, DHC 4–5 and 10-GS 7–10, Definite Need<sup>a</sup>

10-GS at Age 8 y	DHC at Age 8 y			Total
	No Need	Moderate Need	Definite Need	
No need	33 <sup>ab</sup>	4	0	37
Moderate need	5	14*	0	19
Definite need	0	2	29*	31
Total	38	20	29	87

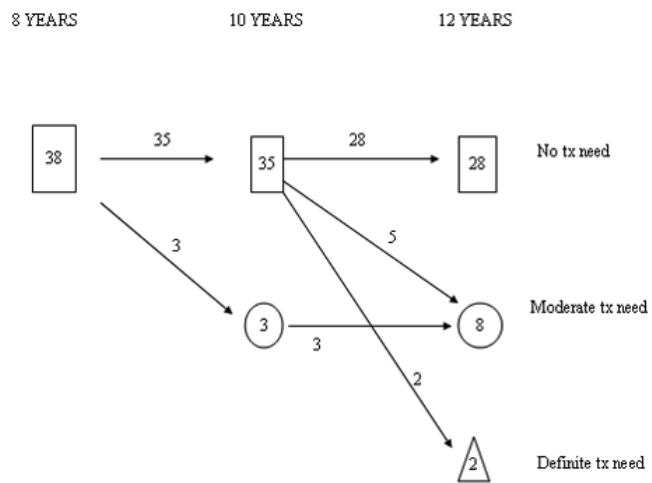
10-GS at Age 10 y	DHC at Age 10 y			Total
	No Need	Moderate Need	Definite Need	
No need	57*	6	0	63
Moderate need	4	7*	0	11
Definite need	1	2	3*	6
In treatment				7
Total	62	15	3	87

10-GS at Age 12 y	DHC at Age 12 y			Total
	No Need	Moderate Need	Definite Need	
No need	53*	10	0	63
Moderate need	3	8*	0	11
Definite need	0	0	9*	9
In treatment				4
Total	56	18	9	87

<sup>a</sup> DHC indicates Dental Health Component; IOTN, Index of Orthodontic Treatment Need.

<sup>b</sup> \* indicates agreement of assessments. Statistical evaluation by Kappa: at age 8 years,  $k = 0.80$  (substantial); at age 10 years,  $k = 0.55$  (moderate); at age 12 years,  $k = 0.65$  (substantial).

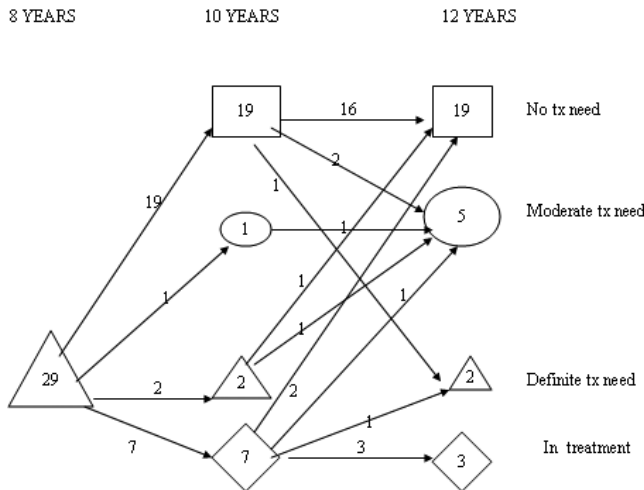


**FIGURE 1.** Development of orthodontic treatment need among subjects having no treatment need (Dental Health Component scores 1–2) at age eight years.

**TABLE 2.** Occlusal Traits Determining for Definite Treatment Need (DHC 4–5) at Age 8 Years<sup>a</sup>

Occlusal Trait	No of Subjects	%
Crossbite	12	42
Increased overjet	7	24
Contact point displacement	4	14
Impeded eruption	3	10
Deep overbite	2	7
Missing teeth	1	3

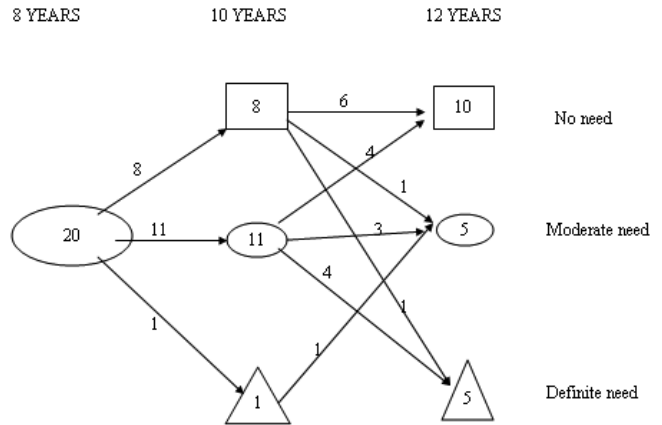
<sup>a</sup> DHC indicates Dental Health Component.



**FIGURE 2.** Development of orthodontic treatment need among subjects with definite need for treatment (Dental Health Component scores 4–5) at age eight years.

creased during the same period, whereas the number of subjects with moderate treatment need remained approximately the same (Table 1). The most common reasons for starting treatment at age eight years were crossbite (12 subjects) and increased overjet (seven subjects) (Table 2).

Of the children having no treatment need at age eight years (38%), only two subjects showed definite need for treatment at age 12 years (Figure 1). In the definite treatment need group, two of 29 subjects had the same treatment need at age 12 years despite the early treatment and three subjects were still in active treatment (Figure 2). The shift from one treatment need category to another during the follow-up period was least predictable among subjects with moderate/optional treatment need at age eight years. Half



**FIGURE 3.** Development of orthodontic treatment need among subjects with moderate/optional need for treatment (Dental Health Component score 3) at age eight years.

of them moved into the no-need category, whereas the other half either remained unchanged or developed definite need for treatment (Figure 3).

### Orthodontic treatment up to 12 years of age

One-third (31 subjects) of the 87 subjects received some orthodontic treatment during the follow-up period. One of them had only extractions, and three (3%) had only space maintainers as treatment. After the eight-year examination, active treatment was started on 26 of the 29 subjects with definite treatment need, and at the 10-year examination, seven of those started were still in treatment. Between the 10- and 12-year examinations, treatment was started on two subjects only. Five children (6%) discontinued their treatment, and three were still having treatment at age 12 years.

Apart from the screening visit, most of the subjects (77%) visited the consultant orthodontist twice or less during their treatment (mean 1.8, SD 1.6). During their treatment the subjects visited the general dentist 11 times in average, and only two subjects had more than 16 visits (Table 3). The mean duration of treatment was two years (24 months), not including the space maintainers. Treatment time ranged from one to 61 months, but 59% of treatments lasted for two years or less. QH and headgear were the most common treatment options, and no separate retention appliances were used (Table 3).

**TABLE 3.** Duration of Treatment and Number of Visits to the General Dentist Per Patient During Treatment With Different Orthodontic Appliances

Appliance	No of Subjects	Treatment Time (mo) (SD)	No of Visits (SD)
Quad helix	8	23 (14.4)	10.2 (1.7)
Head gear	8	20 (8.0)	10.0 (1.4)
Crosselastics/steeltcrown	2	1 (0.0)	2.0 (0.0)
Functional appliances	1	42	15
Two or more active appliances	8	32 (18.8)	14.5 (5.7)
Total	27	23.6 (15.7)	11.0 (4.6)

## DISCUSSION

Apart from occlusal factors, practitioners' country of origin and payment methods, as well as variation between indices of treatment need influence treatment decisions.<sup>21,22</sup> In this study, the agreement between the 10-Grade Scale and the DHC was good, particularly regarding definite treatment need at the ages of eight and 12 years, which supports the application of occlusal indices in public orthodontic care even at young ages.

The number and severity of malocclusions increase with age and the advancing transition of teeth. The benefits of screening of whole age cohorts for orthodontic treatment, especially before nine to 10 years of age have been questioned.<sup>23,24</sup> However, the malocclusions that benefit from early treatment should be detected in time, preferably in the early mixed dentition.<sup>8,9,11,25</sup> Screening for malocclusions in the early mixed dentitions enables optimal timing of treatments, provided specialist orthodontists are responsible for the timing and planning of treatments.<sup>26,27</sup>

### Treatment need

The clear reduction in treatment need from eight to 12 years reflects the favorable effect of early treatment on the target group. Marked improvement of malocclusion with early treatment has also been reported previously.<sup>6,27-29</sup> However, our study subjects were clearly younger compared with the subjects of most previous early-treatment studies.<sup>6,13,29</sup>

The no-treatment-need group showed least change during the dental development in our study and having no need at the age of eight years favored no treatment need at the age of 12 years. Among subjects who had moderate/optional treatment need in early mixed dentition, the pattern of moving from one category to another during the follow-up period was less predictable. A spontaneous decrease of treatment need was seen in one half of the cases, whereas in the other half, the need either increased or remained unchanged. This seems to support our policy of starting early treatment only in subjects with a definite need for treatment and to follow-up those with moderate/optional need to give time for eventual spontaneous correction and avoid over-treatment.

### Treatment

The average duration of treatment was two years, which can be considered reasonable, particularly regarding the subjects, who improved from definite need to no-need category by the age of 12 years and who may therefore not need any other treatment. In our study the average duration of treatments was only half of that reported recently for treatments in some Finnish health centers.<sup>15</sup> Both the duration of treatment and the number of dental visits varied significantly in our study, one probable reason being patient

compliance. The prolonged treatments often ended in discontinuation because of the lack of compliance. Treatments with one appliance only, generally either with headgear or QH, were generally noncomplicated and commonly lasted for less than two years.

Random clinical trials on early treatment have focused on Class II treatment and concluded that the benefit of early treatment is not in preventing phase 2 treatment but perhaps in reducing the time and difficulty of the second phase.<sup>12,13</sup> In our study, crossbite was the most common single reason for early treatment, and its treatment concept is different. Second-phase treatment with fixed appliances cannot be considered to follow automatically, particularly in subjects whose treatment need index after early treatment indicates only mild need.

If the resources are limited, as they usually are in public health care, elimination of definite treatment need from a population by correction of severe malocclusions could be regarded as the primary aim of free of cost orthodontic treatment. The second phase for alignment of mild dental irregularities may often have to be ruled out as less important. Our results suggest that, in a number of cases, there may be a good chance to reach functionally and esthetically acceptable occlusion with early treatment only.

## CONCLUSIONS

We conclude that systematically applied early orthodontic treatment may have contributed to the significant reduction in the treatment need from age eight to 12 years. If no treatment need existed at age eight years, the prognosis for no treatment need at age 12 years seemed good. The DHC of IOTN and the 10-Grade Scale, modified from the TPI, were in good agreement in selecting subjects for treatment at age eight years.

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