Original article

An analysis of residual orthodontic treatment need in municipal health centres

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Summary

Objective: The aim of this study was to analyse residual orthodontic treatment need in Finnish municipal health centres.

Subjects and methods: A random sample of two age groups, 16- and 18-year-olds (n = 2212), from seven municipalities was invited for a clinical examination, and 1041 adolescents participated. Two calibrated orthodontists blindly examined the participants for residual treatment need, applying the Dental Health Component (DHC) and Aesthetic Component (AC) of the Index of Orthodontic Treatment Need. Self-perceived treatment need, satisfaction with occlusal function, and dental appearance were evaluated with a questionnaire. Differences between objective and self-perceived treatment need and between treated and untreated adolescents were analysed using the chi-square test.

Results: A total of 18.8 per cent of all adolescents had DHC grade 4 or 5 and/or AC category 8–10, indicating a definite need for treatment. In the analysis between treated and untreated adolescents, orthodontic treatment history or gender had no statistically significant association with the objectively defined need (P > 0.05). Self-perceived treatment need was reported by 9.6 per cent of adolescents. This need was more common among treated (13.9 per cent) than untreated (4.6 per cent) adolescents (P < 0.001). Among all adolescents, satisfaction with occlusal function was high, 91.3 per cent; 78.9 per cent of adolescents were satisfied with their dental appearance. The main reasons for dissatisfaction and self-perceived need were visible contact point displacements.

Conclusions: The observed proportion of residual orthodontic treatment need is in line with earlier findings. The high satisfaction with occlusal function reflects the applied selection criteria; orthodontic treatment of displacements causing only aesthetic concern is not prioritized.

Introduction

In Finland, publicly funded health centres provide orthodontic care, free-of-charge, to adolescents up to the age of 18 years. Approximately 24 000 new treatments are started every year (1). In most health centres, access to care is determined using a standardized treatment need scale or its local modification (1, 2). The 10-grade scale is a Finnish version of Grainger’s Treatment Priority Index and has been recommended by the Finnish National Board of Health in the assessment of malocclusion severity (3, 4). Priority is given especially to functionally disturbing malocclusions. However, access to orthodontic treatment has been found to vary from a threshold value of 2 (mild malocclusion) to the value of 8 (severe malocclusion) (5).

Because of a lack of specialist orthodontists and variability in their distribution, the availability of specialists differs regionally. Therefore, orthodontic treatment planning, consultation, and difficult treatments are performed by specialists while simple treatments are often carried out by trained general practitioners under supervision (6, 7). Several tasks such as taking impressions and removal...
of fixed appliances have commonly been delegated to trained auxiliaries. Among 0- to 18-year-olds, the percentage of children and adolescents wearing orthodontic appliances has been found to vary from 2.4 per cent to 43 per cent (6).

An evaluation of treatment outcomes should reveal how well the available resources have been directed to the children and adolescents in need of treatment, and whether all treated adolescents have benefited from their treatment. This study is part of a comprehensive investigation elucidating orthodontic treatment outcomes in Finnish health centres with different personnel, treatment modalities, and timing of treatment (8). The specific aim of the current study was to analyse residual orthodontic treatment need.

**Subjects and methods**

**Subjects**

The seven municipalities included in the study were selected on the basis of an earlier study to represent different treatment practices, i.e. differences in staffing, scope, and timing of orthodontic treatment (9). A random sample of 16- and 18-year-old adolescents from these seven municipalities was invited to participate. A description of the randomization protocol is presented in Table 1. An invitation letter was sent via the school to the pupils and via mail to the home addresses of other adolescents in the older age group. The total number of invited adolescents was 2212. For practical and economic reasons, only a single examination period could be carried out in each municipality. A total of 1041 adolescents (47 per cent) participated. The attendance rate in the included municipalities varied from 39 per cent to 57 per cent (Table 2).

The data concerning orthodontic treatment history were collected from the patient records. The group with no previous treatment history consisted of 495 adolescents (47.6 per cent of all participants). Orthodontic treatment was ongoing for 35 adolescents (3.4 per cent) and 41 adolescents (3.9 per cent) had discontinued treatment. A total of 424 adolescents (40.7 per cent) had completed their treatment. Those treated in other health centres or in private practices (4.4 per cent, n = 46) were excluded from the study. The final sample consisted of 995 adolescents.

**Methods**

Two calibrated orthodontists examined the adolescents clinically using the Dental Health Component (DHC) and the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN) (10). The examiners did not know which of the adolescents had had orthodontic treatment.

All participants were asked to score her/his own dental appearance on a visual analogue 10-grade scale (VAS). The scale was anchored at both ends with a colour photograph of the AC of the IOTN, with 1 = good, attractive occlusion and 10 = definite treatment need based on aesthetics. The score had to be given as a whole number.

The study protocol was approved by the Ethics Review Committee of the Hospital District of South-West Finland and the local Ethics Review Committees of the health centres. Informed consent was obtained from all participating adolescents.

**Statistical methods**

For the analyses, the AC scores and their respective VAS scores were categorized into three treatment need categories: no need (scores 1–4), moderate need (scores 5–7), and definite treatment need (scores 8–10). Agreement between these assessments was analysed using Cohen’s Kappa and Kendall’s tau-b. The DHC grades were analysed using three treatment need categories: no need (grades 1 and 2), moderate need (grade 3), and definite treatment need (grades 4 and 5). Differences between objectively assessed and self-perceived treatment need and between treated and untreated adolescents were

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**Table 1. Randomization of subjects in the study.**

<table>
<thead>
<tr>
<th>Status</th>
<th>Group</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-year-olds</td>
<td>Ninth grade, primary school*</td>
<td>Every third class***</td>
</tr>
<tr>
<td>18-year-olds</td>
<td>Second grade, secondary school*</td>
<td>Every third class***</td>
</tr>
<tr>
<td>18-year-olds</td>
<td>Others*** (vocational schools, working, etc.)</td>
<td>Every third name in an alphabetical list***</td>
</tr>
</tbody>
</table>

Adolescents were invited from three different groups: primary school pupils, secondary school pupils, and ‘others’.

*The names of schools and the names and addresses of the 18-year-olds were received from the registers of local health authorities.

**The names of pupils in secondary schools were extracted from the lists.

***The starting numbers in all groups were allotted.

**Table 2. The number of children and adolescents under 17 years in the seven selected municipalities, accompanied by the number of invited and participating adolescents, their distribution between age groups and orthodontic treatment rate.**

<table>
<thead>
<tr>
<th>Health centre</th>
<th>Number of 0- to 17-year-olds</th>
<th>Number of invited adolescents</th>
<th>Number of participating adolescents (% of invited)</th>
<th>16-year-olds%</th>
<th>18-year-olds%</th>
<th>Orthodontic treatment rate%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre 1</td>
<td>6800</td>
<td>300</td>
<td>144 (48)</td>
<td>44</td>
<td>56</td>
<td>51</td>
</tr>
<tr>
<td>Centre 2</td>
<td>7000</td>
<td>306</td>
<td>130 (43)</td>
<td>35</td>
<td>65</td>
<td>68</td>
</tr>
<tr>
<td>Centre 3</td>
<td>7800</td>
<td>310</td>
<td>133 (43)</td>
<td>19</td>
<td>81</td>
<td>65</td>
</tr>
<tr>
<td>Centre 4</td>
<td>9700</td>
<td>312</td>
<td>156 (50)</td>
<td>55</td>
<td>45</td>
<td>47</td>
</tr>
<tr>
<td>Centre 5</td>
<td>11500</td>
<td>310</td>
<td>160 (52)</td>
<td>42</td>
<td>58</td>
<td>51</td>
</tr>
<tr>
<td>Centre 6</td>
<td>14200</td>
<td>300</td>
<td>172 (57)</td>
<td>51</td>
<td>49</td>
<td>33</td>
</tr>
<tr>
<td>Centre 7</td>
<td>17000</td>
<td>374</td>
<td>146 (39)</td>
<td>40</td>
<td>60</td>
<td>27</td>
</tr>
<tr>
<td>Mean</td>
<td>10 571</td>
<td>316</td>
<td>149 (47)</td>
<td>41</td>
<td>59</td>
<td>49</td>
</tr>
</tbody>
</table>
analysed using the chi-square test (IBM SPSS Statistics for Windows, Version 20.0; IBM Corp., Armonk, New York, USA). P values < 0.05 were interpreted as statistically significant.

Results

Objectively assessed treatment need

DHC/IOTN

A total of 181 adolescents (18.2 per cent of all included adolescents, 76 treated, 6 with ongoing treatment, 16 with discontinued treatment, and 83 untreated adolescents) had DHC grade 4 or 5, indicating a definite need for treatment. The distribution of diagnosis codes is presented in Table 3. In all, 266 adolescents (26.7 per cent) were categorized into DHC grade 3, indicating a borderline need for treatment. Among them, the most frequent single trait causing treatment need was contact point displacement (3d), registered in 237 adolescents (23.8 per cent). In comparisons between treated and untreated adolescents, orthodontic treatment history or gender had no significant association with objectively defined treatment need (P > 0.05).

AC/IOTN

Of all participants, 1.8 per cent (7 treated, 1 with ongoing treatment, 3 discontinued, and 7 untreated adolescents) were categorized into AC grades 8–10, indicating definite residual treatment need based on aesthetics; 12 of them were categorized as having definite treatment need also according to the DHC. AC grades 5–7 (moderate treatment need) were registered in 10.9 per cent of all adolescents (47 treated, 4 with ongoing treatment, 13 discontinued, 44 untreated).

According to both DHC and AC categories, objectively defined residual treatment need was found in 18.8 per cent (n = 187) of all adolescents.

Subjective opinions

Questionnaire

While 91.3 per cent (n = 908) of adolescents were satisfied or very satisfied with their occlusal function, 2.1 per cent of adolescents (12 treated, 1 with ongoing treatment, and 8 untreated adolescents) reported dissatisfaction. Of all adolescents, 78.9 per cent (n = 785) were satisfied or very satisfied with their dental appearance, and 4.4 per cent (6 male, 38 female, P = 0.045) expressed clear dissatisfaction. Self-perceived orthodontic treatment need was reported by 9.6 per cent (n = 96) of adolescents; of them one male and three females indicated functional reasons. No treatment need was reported by 57.5 per cent (n = 572), and 22.5 per cent (n = 224) could not say whether or not there was a need. Of the adolescents who reported treatment need, 24.0 per cent (n = 23) mentioned crowding or displacements in their upper front teeth as the main reason for dissatisfaction. Self-perceived treatment need was expressed by 11.9 per cent (n = 73) of females and 6.1 per cent (n = 23) of males (P < 0.001). The share among treated adolescents was 13.9 per cent (n = 59), among those with ongoing treatment 14.2 per cent (n = 5), among adolescents with discontinued treatment 22.0 per cent (n = 9), and among untreated adolescents 4.6 per cent (n = 23). The difference between treated and untreated adolescents was statistically significant (P < 0.001). When adolescents were categorized according to both gender and previous orthodontic history, and comparisons were made between untreated adolescents and those who had completed treatment, a statistically significant difference was found between treated 25.7 per cent (n = 48) and untreated females 6.6 per cent (n = 14) (P < 0.001), but not between treated 10.7 per cent (n = 11) and untreated males 5.9 per cent (n = 9) (P = 0.165).
Table 4. Orthodontists’ assessment of dental appearance with the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN), compared to adolescents’ own assessment with a visual analogue scale (VAS) anchored with photographs 1 and 10 of the AC.

<table>
<thead>
<tr>
<th>VAS/AC category</th>
<th>Scores 1–4, n (%)</th>
<th>Scores 5–7, n (%)</th>
<th>Scores 8–10, n (%)</th>
<th>Total n</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 1–4</td>
<td>849 (85.3)</td>
<td>20 (2)</td>
<td>0 (0)</td>
<td>869 (87.3)</td>
</tr>
<tr>
<td>AC 5–7</td>
<td>92 (9.2)</td>
<td>15 (1.5)</td>
<td>1 (0.1)</td>
<td>108 (10.9)</td>
</tr>
<tr>
<td>AC 8–10</td>
<td>14 (1.4)</td>
<td>3 (0.3)</td>
<td>2 (0.2)</td>
<td>18 (1.8)</td>
</tr>
<tr>
<td>Total</td>
<td>955 (96)</td>
<td>38 (3.8)</td>
<td>2 (0.2)</td>
<td>995 (100)</td>
</tr>
</tbody>
</table>

The number of cases where both assessments agreed is shown in bold. (n = number of adolescents).

Agreement between objective and subjective assessments

Of the adolescents with no objective treatment need (n = 548), 7.3 per cent expressed self-perceived need (33 treated, 3 with ongoing treatment, and 4 untreated adolescents). Of these, none of the untreated, five of the treated, and two with ongoing treatment were dissatisfied with their dental appearance; two adolescents with ongoing treatment and one treated adolescent were dissatisfied with function, and one treated adolescent with both function and dental appearance.

Of adolescents with definite treatment need (n = 187), 53.5 per cent (42 treated, 1 under treatment, 7 discontinued, and 50 untreated) had no self-perceived treatment need. Of them, the adolescent with ongoing treatment had overjet of more than 9 mm (5a), of adolescents with discontinued treatment, one had impeded eruption (5i), three had overjet of 6–9 mm (4a), one had crossbite (4c), and two had contact point displacement in excess of 4 mm (4d). One treated and one untreated adolescent had increased overjet over 9 mm (5a), one treated and one untreated had hypodontia (4h), 11 treated and 12 untreated adolescents had contact point displacements in excess of 4 mm (4d), and partially erupted teeth (4t) were found in 29 treated and 31 untreated adolescents. Moreover, one untreated adolescent was categorized as having treatment need based on aesthetics.

Agreement between adolescents’ own (VAS) and dental professionals’ opinion regarding dental appearance (AC) was obtained in 86.9 per cent of cases (Table 4). Orthodontists were more critical than the adolescents themselves (Cohen’s kappa = 0.154, Kendall’s tau-b = 0.208).

Discussion

The focus of this study was on residual orthodontic treatment need among 16- and 18-year-old adolescents in publicly funded orthodontic care. There were two reasons for inclusion of 16-year-olds in this study. First, we assumed that most orthodontic treatments had been completed in this age cohort. Secondly, because of the Finnish school system, they were easily available. Surprisingly, attendance by 16-year-olds was not as active as by the older age group (19–55 versus 45–65 per cent). It is possible that they were not interested; however, it is also possible that they for other reasons, such as exams, requisite practical training, or long distance could not participate. Nevertheless, it cannot be dismissed that less than 50 per cent of all invited adolescents participated in this study. The contribution of only one single examination period per health centre may possibly have cut the numbers.

The proportion of residual orthodontic treatment need, 18.8 per cent, can be considered reasonable; in Eastern Finland, residual need has earlier been reported in 16 per cent of treated and 18 per cent of untreated 15- to 16-year-old adolescents (11). However, both higher and lower percentages have been registered (7, 12–14). Nevertheless, it should be kept in mind that residual treatment need also depends on availability of orthodontic care (15). In the referred studies the treatment rate among 16-year-olds was 42 per cent, while among 18- to 20-year-olds the rates were higher, 46–54 per cent. The average treatment rate in our study was 49 per cent.

The main reasons for objective treatment need, partially erupted teeth and contact point displacements, can both be seen as expressions of lack of space. Moreover, less severe contact point displacements were found in additional 24 per cent of adolescents. These findings reflect the applied selection criteria, suggesting that displacements causing functional disturbances should be treated, not malpositions as such. Although crowding in our sample was common, its effect on objectively defined dental appearance was minor, as only a handful of adolescents were categorized as having aesthetically based treatment need.

In accordance with earlier studies, subjective assessments of dental appearance were less critical than those made by professionals (14, 16, 17): less than 2 per cent of adolescents categorized themselves as having borderline and only one adolescent as having definite treatment need based on aesthetics. The share of satisfied adolescents was comparable with earlier studies (11, 13, 14). Given that crowding only seldom entitles to subsidized orthodontic care, it is hardly surprising that it is often mentioned as one of the main reasons for self-perceived treatment need (13, 14, 18). In our study, females were more often dissatisfied with their own dental appearance than males, and also more likely to express self-perceived treatment need. The same tendencies have been reported among 18- to 19-year-olds and 16- to 25-year-olds (18–20). The share of self-perceived need, less than 10 per cent, was lower than that found by Bjerklin et al. (21) but higher than that reported by Hirvinen et al. (13). Interestingly, almost half of this need was expressed by adolescents with no objective treatment need.

Conclusions

The observed proportion of residual orthodontic treatment need is in line with earlier findings. The high satisfaction with occlusal function reflects the applied selection criteria; orthodontic treatment of displacements causing only aesthetic concern is not prioritized. Thus, subjectively disturbing deviations may remain untreated.

Supplementary material

Supplementary material is available at European Journal of Orthodontics online.

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References