Orthodontic treatment needs in an urban Iranian population, an epidemiological study of 11-14 year old children

A. BORZABADI-FARAHANI*, A. BORZABADI-FARAHANI**, F. ESLAMIPOUR***

ABSTRACT. Objectives A preliminary study to investigate the orthodontic treatment need and its gender distribution in urban Iranian schoolchildren. Study design A cross-sectional study was carried out at the school premises. Subjects and methods For this survey, 502 subjects attending 6 different schools in the city of Isfahan, Iran (253 females and 249 males, aged 11-14 years) were randomly selected and examined, including those who were wearing an orthodontic appliance at the time of the survey (1 female and 5 males). IOTN (DHC and AC) scores were recorded for those who were not undergoing orthodontic treatment. One examiner, who had been formally calibrated in the use of occlusal indices, screened all schoolchildren. IOTN scores was calculated from direct examination. Gender dimorphism was evaluated by the Chi-square test (AC and DHC components of IOTN index). The prevalence of most severe occlusal traits in those who scored DHC 4 and 5 was calculated. Results At the time of the survey, 1.1% of subjects were wearing an orthodontic appliance, 36.1% had definite need (DHC 4 or 5) for orthodontic treatment, 20.2% borderline need (DHC 3) and 43.8% showed slight or no need for treatment (DHC 1 or 2). Reviewing the AC scores, 17.9% of the studied subjects showed definite need (AC 8-10) for orthodontic treatment, 36.1% borderline need (AC 5-7) and 46% showed slight or no need for treatment (AC 1-4). The prevalence of the four most severe occlusal traits in those with definite orthodontic treatment need were: severe maxillary crowding (43.6%), increased overbite (39.1%), increased overjet (35.8%) and severe mandibular crowding (27.4%). No gender differences were found for AC (P>0.05) and DHC (P>0.05) of IOTN index. Conclusion Approximately one-third of Iranian school children were in need of orthodontic treatment, as determined by the index of orthodontic treatment need.

Key words: 11-14-year-olds; Orthodontic treatment need; IOTN; Iran.

Introduction

Measuring and recording the treatment need in a population is useful for the planning of orthodontic services. Without a satisfactory estimate of the need and demand for treatment it is difficult to develop and organise a meaningful orthodontic service. Oral health-related benefits of orthodontic treatment such as reduced susceptibility to dental caries, periodontal disease, temporomandibular disorder, and traumatic dental injury have been reported in the literature [Burden, 2007]. The oral health benefits of orthodontic intervention are quite limited and previous studies state that the main ill-effect of malocclusion is psychosocial and related to the aesthetic impairment, rather than functional [Addy et al., 1988; Helm and Petersen, 1989; Howat, 1993; Burden, 2007], although this has been disputed recently [Shaw et al., 2007].

From the patient’s perspective the most important motivation for orthodontic treatment is an improvement in appearance [Tulloch, 1984]. In this context, meaningful evaluation of the need for orthodontic treatment must include an assessment of the aesthetic impairment of a malocclusion.

Several indices that attempt to categorise malocclusion into groups according to the level of treatment need have been developed. Occlusal indices such as the Occlusal Index of Summers [1971] and the Handicapping Malocclusion Assessment Record of Salzmann [1968] apply a score to each occlusal trait, which is then weighted to give an overall score. Index of Orthodontic Treatment Need (IOTN); Peer Assessment Rating (PAR); Norwegian Orthodontic Treatment Index (NOTI) have been developed and have provided useful information on treatment need and provision of orthodontic services [Evans and Shaw, 1987; Brook and Shaw, 1989; Espeland et al., 1992; Richmond,
Occlusal indices have enabled quantification of orthodontic needs; although they are not always comparable. Orthodontic treatment needs estimates ranged between 27.5 and 76.7 percent; however, the demand for treatment is reported to be much lower and ranging from 2 to 47 percent [Richmond, 2000].

Brook and Shaw [1989] described the Index of Orthodontic Treatment Priority; later named the Index of Orthodontic Treatment Need (IOTN). The IOTN is one of the most commonly used indices to assess the orthodontic treatment needs among children and adults. The IOTN has two separate components, a clinical component called the Dental Health Component and an Aesthetic Component. No attempt has been made to combine these two components into an overall assessment of treatment need [Brook and Shaw, 1989]. The Dental Health Component of the IOTN is a modification of the index previously used by the Swedish Dental Board. It has five grades ranging from grade one, ‘no need for treatment’, to grade five, ‘very great need’. A grade is allocated according to the severity of the worst single trait and describes the priority for treatment. The Aesthetic component consists of a 10-point scale illustrated by a series of photographs that were rated for attractiveness by a panel of lay judges and selected as being equidistantly spaced through the range of grades [Evans and Shaw, 1987]. The use of occlusal indices in Iranian population is relatively new.

The aim of the present study was to determine the need for orthodontic treatment and its gender distribution in urban Iranian school children.

**Study Design**

Permission to undertake the survey was obtained from the Ministries of Health and Education. The ethical approval was given by the Research Ethics Committee and Faculty of Community Dentistry, School of Dentistry, Isfahan University of Medical Sciences.

Present cross-sectional study was initially carried out to provide preliminary information on prevalence of malocclusions in Iranian population [Borzabadi-Farahani et al., 2008]. The target population for the present study consisted of urban Iranian schoolchildren aged 11-14 years in the city of Isfahan, Iran. This age group represents the period of eruption of the permanent canines and premolars when the majority of potential orthodontic problems become evident. Isfahan is the capital city of Isfahan province and Iran’s third largest city. The city of Isfahan is located in the central part of Iran and houses 3% of the whole population. The city had a population of 1,986,542 and the Isfahan metropolitan area had a population of 3,430,353 in the 2006 census, the second most populous metropolitan area in Iran after the capital.

Exclusion criteria for this study were: subjects with craniofacial anomalies (clefts and syndromes) and non-Iranian nationals. To ensure random selection from the schools, using a stratified selection technique, six public schools were selected from different geographic locations in the city of Isfahan. A total of 502 subjects (253 females and 249 males, aged 11-14 years) were selected for this study; however, 6 subjects (1 female and 5 male

<table>
<thead>
<tr>
<th>Component</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>DHC 1 &amp; 2</td>
<td>No or little need</td>
<td>106 (43.4)</td>
<td>111 (44)</td>
</tr>
<tr>
<td>3</td>
<td>Borderline need</td>
<td>47 (19.3)</td>
<td>53 (21)</td>
</tr>
<tr>
<td>4 &amp; 5</td>
<td>Definite need</td>
<td>91 (37.3)</td>
<td>88 (34.9)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>244</td>
<td>252</td>
</tr>
</tbody>
</table>

Chi-Square = 0.397, n = 496, df=2, P>0.05, Values in brackets are percentages

![Distribution of the Dental Health Component of the IOTN Index in the study sample (n=496), including the 95% confidence intervals for each component.](image-url)
ORTHODONTIC TREATMENT NEEDS IN IRANIAN CHILDREN

subjects) were wearing orthodontic appliances at the time of the survey. An orthodontist (Ali Farahani), who had received extensive training and was calibrated to use the IOTN index, visited the schools and conducted the clinical examinations. A mouth mirror and a ruler were used. After the examination, the schoolchildren and the school authorities were notified whether orthodontic treatment was necessary.

The Index of Orthodontic Treatment Need (IOTN) ranks malocclusion in terms of the significance of various occlusal traits for an individual’s dental health and perceived aesthetic impairment, with the intention of identifying those individuals who would most likely benefit from orthodontic treatment. The index has an Aesthetic and Dental Health Component. The Aesthetic Component (AC) consists of a scale of 10 color photographs showing different levels of dental attractiveness, grade 1 representing the most attractive and grade 10 the least attractive dentitions. The Dental Health Component (DHC) incorporates the various occlusal traits considered to increase the morbidity of the dentition. There are five grades within the DHC which have been grouped following validation into grades 1 and 2 representing 'no need for treatment', grade 3 representing 'borderline' cases, and grades 4 and 5 representing those "in need of orthodontic treatment".

**Statistical analysis**

All data were collected and entered into the SPSS 16 program for statistical analysis (Statistical Package for Social Sciences, SPSS Inc., Chicago, Ill, USA). Gender dimorphism was evaluated by the $\chi^2$ test (Aesthetic and Dental Health Components of the IOTN index). We calculated the prevalence of most severe occlusal traits in those who scored DHC 4 and 5. Any P value less than 0.05 was interpreted as statistically significant.

**Results**

At the time of the survey, 1.1% of the participants were wearing an orthodontic appliance. According to the Dental Health Component of IOTN index, 36.1% of the subjects presented definite need for orthodontic treatment, 20.2% borderline need and 43.8% showed slight or no need for treatment (Table 1; Fig. 1). There was no statistically significant difference between genders with regard to the Dental Health Component of the IOTN index (P>0.05). Reviewing the Aesthetic component of IOTN index revealed that 17.9% of the subjects showed definite need for orthodontic treatment, 36.1% borderline need and 46% showed slight or no need for treatment (Table 2; Fig. 2). There was no statistically significant difference between genders with regard to the Aesthetic Component of the IOTN index (P>0.05).

In the present study, the children in need of treatment could be divided into two separate groups according to their dental health and/or aesthetic need for treatment. The first group comprised 18.2 percent of children with an occlusal trait judged to represent a risk to dental health, DHC grades 4 and 5, but with acceptable or borderline aesthetics. The second group was composed of children with both

<table>
<thead>
<tr>
<th>AC</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>111 (45.5)</td>
<td>117 (46.4)</td>
<td>228 (46)</td>
</tr>
<tr>
<td>5-7</td>
<td>89 (36.5)</td>
<td>90 (35.7)</td>
<td>179 (36.1)</td>
</tr>
<tr>
<td>8-10</td>
<td>44 (18)</td>
<td>45 (17.9)</td>
<td>89 (17.9)</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>252</td>
<td>496</td>
</tr>
</tbody>
</table>

Chi-Square = 0.046, n = 496, df=2, P>0.05, Values in brackets are percentages

**FIG. 2 - Distribution of the Aesthetic Component of the IOTN Index in the study sample (n=496).**
a dental health and aesthetic need for orthodontic treatment; this group comprised 17.9\% of our study sample. Table 3 summarises the distribution of occlusal traits according to the dental health component (DHC) of the IOTN index. The Dental Health Component of the IOTN identifies and records only the most severe occlusal trait of a malocclusion. The prevalence of the four most severe occlusal traits in those with definite treatment need were as follows: severe maxillary crowding (43.6\%), increased overbite (39.1\%), increased overjet (35.8\%) and severe mandibular crowding (27.4\%).

**Discussion**

Findings of the present study provide some preliminary information on orthodontic treatment need of a representative sample of Iranian 11-14 year olds in 2008, using the IOTN index. At age interval of 11-14 year, a good number of children will not as yet have commenced orthodontic therapy. In the present surveys children examined were at a sufficiently advanced age (11-14 years) for the permanent dentition to be established, thus allowing an accurate occlusal assessment to be made.

Validity and reliability of the IOTN index has been verified previously [Richmond et al., 1993; Burden and Holmes, 1994; Burden et al., 1994]. To assess the validity of the Aesthetic component of the IOTN a validation exercise involving 74 dentists (44 orthodontist and 30 non-orthodontist) was carried out [Richmond, 1990]. It was aimed to determine the cut-off points representing the different level of orthodontic treatment need. A scale of 10 color photographs showing different levels of dental attractiveness was used, grade 1 representing the most attractive and grade 10 the least attractive dentitions. The validation panel judged grades 1-4 to represent ‘no or little need’, grades 5, 6, and 7 ‘borderline need’, and grades 8, 9, and 10 to represent a clear need for treatment on aesthetic grounds. Lunn et al. [1993] suggested a major change in the Aesthetic and dental health components of the IOTN. They found that the IOTN would have improved reliability if both the dental health component and the Aesthetic component were reduced to three grades. For the Aesthetic component, the suggestion was to collapse the 10-point scale mentioned before to a 3-point scale. For the dental health component, three grades were suggested instead of five. These suggestions were accepted by the IOTN specialist team in Manchester and are being used as reflecting current British standards for orthodontic treatment. In the present study to compare our findings with previous reports we used the Aesthetic component of the IOTN index in its original form (a scale of 10 color photographs).

According to the Dental Health Component of the IOTN index, approximately one-third of the surveyed population (36.1\%) was in definite need of orthodontic treatment. Previous reports in the United Kingdom indicate that approximately eight out of ten children already wearing an orthodontic appliance fall into the ‘need for treatment’ category of IOTN [Richmond et al., 1993]. At the present

<table>
<thead>
<tr>
<th>Occlusal traits DHC</th>
<th>% DHC (4&amp;5)</th>
<th>Total</th>
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<tbody>
<tr>
<td>Increased overjet</td>
<td>38.5</td>
<td>140</td>
</tr>
<tr>
<td>Reverse overjet</td>
<td>9.5</td>
<td>20</td>
</tr>
<tr>
<td>Maxillary crowding &gt;5 mm</td>
<td>43.6</td>
<td>81</td>
</tr>
<tr>
<td>Mandibular crowding &gt;5 mm</td>
<td>27.4</td>
<td>52</td>
</tr>
<tr>
<td>Increased overbite</td>
<td>39.1</td>
<td>170</td>
</tr>
<tr>
<td>Anterior open bite</td>
<td>3.9</td>
<td>8</td>
</tr>
<tr>
<td>Anterior crossbite</td>
<td>14.5</td>
<td>40</td>
</tr>
<tr>
<td>Unilateral posterior crossbite</td>
<td>18.9</td>
<td>50</td>
</tr>
<tr>
<td>Bilateral posterior crossbite</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Impeded eruption of teeth</td>
<td>24</td>
<td>44</td>
</tr>
</tbody>
</table>

**Table 3 - Distribution of occlusal traits according to the DHC grades of the Index of Orthodontic Treatment Need.**
time there is no report of treatment need in children undergoing orthodontic treatment in Iran. However, considering that orthodontic treatment in Iran is mainly provided in private practices and the fact that orthodontic treatment is rather costly for most families, we can assume that the population undergoing orthodontic treatment represented the most severe orthodontic problems. In this context we assume that the 1.1 percent of 11-14-year-olds already wearing orthodontic appliances at the time of the survey were in need of treatment and couple that with the 36.1 percent not undergoing treatment but judged as in need, then the overall treatment need at age 11-14 would be 37.2%.

Comparing the present findings with other studies in Jordan [Hamdan, 2001] (28%), Kuwait [Kerosuo et al., 2004] (28%), United kingdom [Holmes, 1992] (32%) and New Zealand [Crowther et al., 1997] (31.3%), they have reported a lower prevalence of subjects with definite orthodontic treatment need. Our estimate of orthodontic treatment need as assessed by the DHC of the IOTN (36.1%) is comparable to those reported in north Jordan [Abu Alhaija et al., 2004] (34%), Turkey [Ucuncu and Ertugay, 2001] (38.8%), Ireland [Burden, 1995] (36%) and Sweden [Josefsson et al., 2007] (37%). However our findings were below those reported in Malaysia [Abdullah and Rock, 2001] (47.9%) and China [So and Tang, 1993] (52%).

Contrary to our findings, some African studies, with a wider age range, reported a much lower estimate for Nigerian [Otuyemi et al., 1997] (13%) and Tanzanian children [Mugonzibwa et al., 2004] (22%). In the present study, no gender differences were found for the AC and the DHC of the IOTN index, which is in line with the work of Ucuncu and Ertugay [2001]; however, Burden et al. [1994] reported that significantly more males than females were in need of orthodontic treatment. The high discrepancy between treatment needs, as indicated by the AC (17.9%) of the IOTN on the one hand and the DHC (36.1%) of the IOTN on the other hand, may be due to the fact that many occlusal traits such as ectopic teeth, hypodontia, deep traumatic overbites or crossbites have dental health implications, but do not attract a high Aesthetic Component score. In our study we did not record any children with only aesthetic need for orthodontic treatment. The Aesthetic Component of the IOTN index is constructed and verified for Caucasians. Some authors [Dawjee et al., 2002] suggested that the 10 photographs should be complemented with photographs of subjects from other ethnic backgrounds; however, in the present study we did not encounter any ethnic related issue using the Aesthetic component of the IOTN index.

The IOTN was originally designed to meet standards of need for orthodontic treatment in the United Kingdom, where almost all orthodontic treatment is publicly funded [Shaw, 1983]. Approximately one-third of British schoolchildren would be found eligible for treatment in public programs using the IOTN, however, providing publicly funded orthodontic care for as many as a third of Iranian schoolchildren would not be feasible in the near future. The decision to provide orthodontic treatment is based on many factors including severity of malocclusion, patient cooperation, cost, risks and can not be made solely on the basis of indices. However the results of the present study are useful for public health planning and for the generation of hypotheses for future studies.

Conclusion

According to our findings, 36.1% of Iranian schoolchildren were in need of orthodontic treatment. The prevalence of the four most severe occlusal traits in those with definite treatment need were: severe maxillary crowding (43.6%), increased overbite (39.1%), increased overjet (35.8%) and severe mandibular crowding (27.4%).

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