Original Article

Comparing Dental Aesthetic Index (DAI) and IOTN in Determining the Orthodontic Treatment Needs of Qazvin Students

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Abstract

Background: Different indices have been used to determine orthodontic treatment needs such as the Dental Aesthetic Index (DAI) and the index of orthodontic treatment needs (IOTN).

Objectives: The present study was carried on to compare the dental aesthetic index (DAI) and the IOTN's dental health component (DHC) in assessment of orthodontic treatment needs of 11 - 14 year old schoolchildren in Qazvin.

Methods: In a cross-sectional descriptive study, 250 of 11 - 14 year old schoolchildren from two school districts of Qazvin were selected by a two-stage stratified cluster sampling method and their AC scores were determined according to the orthodontist and child's own idea. Also the subjects' DHC and DAI scores were determined according to the existing standards. The patients' demographic data were recorded by means of a questionnaire and correlations between AC's as determined by the subject and by the orthodontist, as well as scores of the DHC and the DAI, were analyzed using Spearman correlation ratio.

Results: The mean of AC score as determined by the subject was 2.556, while the scores by the orthodontist were 4.308; while DHC score was 2.60 and DAI score was 26.86. The coefficient of correlation between students and specialist AC, students AC and DAI, specialist AC and DHC, specialist AC and the DAI, DHC and the DAI, students AC and DHC was respectively 0.269, 0.262, 0.549, 0.506, 0.794 (In all cases $P < 0.0001$) and 0.202 ($P < 0.001$).

Conclusions: Existence of a positive and significant relationship between the AC, the DHC and the DAI indicates their potential for determining the need for orthodontic treatment. The highest need for orthodontic treatment was determined by the AC of the specialist and the lowest need by that of the patient. Only gender of the student had a significant effect on the values of the DHC and the DAI as determined by the specialist.

Keywords: DAI, Aesthetic Component of the IOTN, Dental Health Component of the IOTN

1. Background

The Dental Aesthetic Index (DAI) links the clinical and esthetic components mathematically to produce a single score that combines the physical and esthetic aspects of occlusion as well as reflecting malocclusion severity and the need for orthodontic treatment (1), while other indices require separate assessments of aesthetic, physical and anatomical components of malocclusion. Compared to other indices, DAI is more popular, easier to use and time-saving (2). However, it has also limitations such as not taking some parameters into account in absence of molar teeth, hidden teeth, posterior cross-bites, midline disorders resulting in lack of ability to determine aesthetic needs comprehensively (3-5).

The "Index of Orthodontic Treatment Need" (IOTN), as a well-known index in orthodontics, includes an Aesthetic component (AC) with 10 severity levels and a dental health component (DHC) with five severity levels. The two components are analyzed separately and although they cannot be united into a single score, they can be combined to classify the patient as orthodontic treatment need (3). Its easiness of use as well as the very high level of agreement between IOTN ratings determined by clinicians, children and their parents are the most significant advantages of this index (6). Both DAI and IOTN are designed to improve the patient's beauty and psycho-social status and both aim at identifying those children who need orthodontic treatment and prioritizing their needs. However, not all aesthetics related issues are included in these two indices, and from a specialist's point of view not all successful orthodontic treatments result in improved facial beauty. These indices are similar in that both use features of mal-

occlusion, identify treatment priorities and use aesthetical and anatomical components in determining a patient's need for orthodontic treatment. However, there are differences between them, so that in the IOTN the AC and the DHC are calculated separately, while in the DAI the aesthetic component and anatomical assessments are integrated and a single score. In a study by Jenny and Cons (1996) [7], it was revealed that, despite some similarities, the two indices have differences in sensitivity, reliability, validity and determining treatment priorities. In another study, a significant relationship was revealed between the AC of the IOTN and DAI and also between the DHC of the IOTN and DAI [8].

2. Objectives

The present study was carried out to compare DHC of IOTN and DAI in determining orthodontic treatment needs of 11 - 14 year-old students in Qazvin, Iran in 2008.

3. Methods

This descriptive cross-sectional study was carried out in 2014, on 250 students between 11 and 14 years old, with equal gender distribution (125 each) using a two-stage stratified cluster sampling method, in schools of Qazvin, Iran. The mean age of patients was 12.47 years. From among 130 schools of Qazvin, 30 schools were randomly selected and considering of classes in each school, an equal number of students from each class were chosen for the study. The subjects were included in the study if consenting and the protocol of the study was approved by the school of dentistry of Qazvin University of Medical Sciences. Students who had a history of orthodontic treatment were excluded. A briefing session about the objectives of the study was held for the students and then the questionnaires were completed during individual interviews. The questionnaire included demographic questions (sex, age, school district and type of school [public or private]) clinical examinations were performed by a trained dental student in the final year of studies, according to W.H.O. guidelines and on the basis of DAI. The examinations were performed under natural daylight, using disposable gloves, tongue-depressors and mirrors.

Williams Periodontal Probe was used to measure distances in millimeters. A dental cast was taken from each subject and rated on the basis of DAI.

All of the 10 criteria or components of DAI were measured on the basis of patient's occlusal morphology (as in W.H.O. guidelines) and multiplied by its related linear regression added together to a constant value of 13 gives the final score of DAI. The resulting numerical values of DAI were classified in 4 groups, in terms of need for orthodontic treatment:

1- Normal or mild malocclusion, with no or little need for orthodontic treatment (DAI $\leq$ 25),

2- Definite malocclusion with optional need for treatment (DAI = 26 - 30),

3- Severe malocclusion with high need for treatment (DAI = 31 - 35),

4- Very severe or handicapping malocclusion (DAI $\geq$ 36).

In order to determine the AC and DHC of the IOTN, intraoral photographs were taken from all subjects to obtain study casts. Intraoral photographs were used to determine the AC of the IOTN to be compared to standard pictures of the IOTN and study casts; with appropriate carving, were used to determine the DHC of the IOTN. Referring to the table of the DHC, the score of this component was determined by the specialist of orthodontics. In the next step, ten color pictures for classifying the appearance of teeth into ten degrees were given to the children for comparing with their own teeth. Before seeing the pictures, it was explained for the individual that these pictures are categorized from the best and most beautiful condition of the teeth [1] to the worst condition [9]. They were asked to compare these pictures with their own teeth and give a score to themselves. Their AC was also determined by the students of dentistry and the specialist of orthodontics. DHC of IOTN has 5 degrees and scores equal to 2 and 1 indicate little or no need, a score equal to 3 a borderline need and scores equal to 5 and 4 a serious need for orthodontic treatment. The AC of IOTN included ten color pictures on the basis of which scores of 1, 2, 3 and 4 indicated little or no need, scores of 5, 6 and 7 a borderline need and scores of 8, 9 and 10 a definite need for orthodontic treatment. Also, to ensure reliability of the examiner in this field of research, he participated in a workshop in this regard prior to the start of the study and his reliability in assessing 25 patients' dental cast in terms of need for orthodontic treatment was approved (Kappa = 0.697). The relation between variables was obtained through using Spearman's correlation coefficient. Linear regression analysis was used to evaluate the effect of different variables (e.g. age, gender, school district and type school) on the scores of the AC, the DHC and the DAI.

4. Results

The mean age of the students ($\pm$ standard deviation) was 12.47($\pm$ 1.11) years old. Sixty-four (25.6%) of them were 11 years old, 62 (24.8%) were 12 years old, 66 (26.4%) were 13 years old and 58 (24.8%) were 14 years old. Of these students
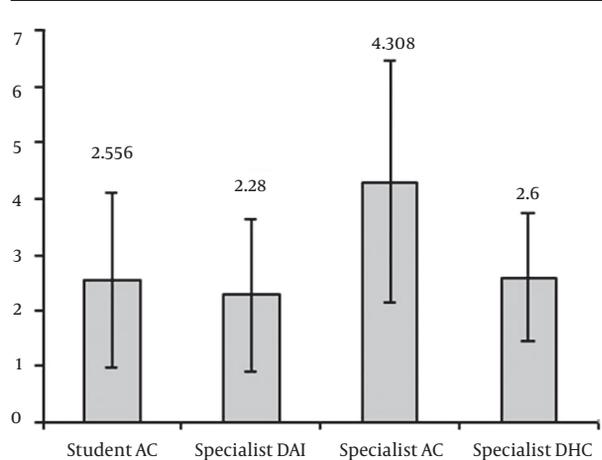
115 (46%) were selected from School District One and 135 (54%) from school district Two, 166 (66.4%) studied in private schools and 84 (33.6) in public schools. One hundred and ninety nine (79.6%) of them had class-I malocclusion, 42 (16.8%) of them had class-II malocclusion and 9 (3.6%) of them had class-III malocclusion. The scores of the DAI (given by the specialist) were as follows: 21 (23 children, 9.2%), 19 (18 children, 7.2%), 22 and 11 (17 children, 6.8%), 23 (16 children, 6.4%) and 20 (13 children, 5.2%). The highest observed DAI score was 55 (2 children, 0.8%) and the lowest was 15 (1 child, 0.4%). The mean DAI score (given by the specialist) was 26.86 in the studied population, with a standard deviation (SD) of 7.76 and a range of 15 - 55. The results of the AC scores (given by the patient, and the specialist) and the DHC (given by the specialist) are presented in Table 1, the mean and SD of different variables in Figure 1.

Figure 1. Distribution of the 11 to 14 year old School Children, Based on the Mean and Standard Deviation of the Components of IOTN by Students and Specialist

Table 1. Distribution of Index Scores which Determined by Students and Specialist[a]

Index Scores	Specialist DHC	Specialist AC	School Children AC
1	48 (19.2)	12 (4.8)	63 (25.2)
2	77 (30.8)	46 (18.4)	85 (34)
3	66 (26.4)	49 (19.6)	59 (23.6)
4	45 (18)	31 (12.4)	15 (6)
5	14 (5.6)	44 (17.6)	15 (6)
6	-	36 (14.4)	6 (2.4)
7	-	9 (3.6)	-
8	-	12 (4.8)	5 (2)
9	-	3 (1.2)	2 (0.8)
10	-	8 (3.2)	-
Total	250 (100)	250 (100)	250 (100)

[a]Values are expressed as No. (%).

The relation between AC, DHC and DAI was evaluated using Spearman's correlation coefficient (Table 2). Based on this, there were statistically significant relations between various components of the index compared to each other. The correlation coefficient of the AC of patient with that of the specialist was 0.269 (P < 0.0001), and the AC of patient with the DHC of the specialist had a correlation coefficient of 0.202 (P < 0.001) and the AC of patient with the DAI of the specialist had a correlation coefficient of 0.262 (P < 0.0001). Also, the correlation coefficient of the AC of the specialist with the DHC of the specialist was 0.549 (P < 0.0001), the AC of the specialist with the DAI of the specialist had a correlation coefficient of 0.506 (P < 0.0001) and the DHC of the specialist with the DAI of the specialist had a correlation coefficient of 0.794 (P < 0.0001). The highest correlation coefficient was seen between the DHC

of the specialist and the DAI of the specialist and the lowest between the DHC of the specialist with the AC of patient.

According to the DAI, 135 patients (54%) had no or little need for orthodontic treatment, 49 (19.6%) had definite malocclusion with optional need for treatment, 33 (13.2%) had severe malocclusion with high need for treatment and 33 (13.2%) had very severe or handicapping malocclusion.

Also, based on the AC of patient, 222 patients (88.8%) had no or little need for orthodontic treatment, 21 (8.4%) had optional need for treatment and 7 (2.8%) had definite need for treatment. based on the AC of the specialist, they were 138 (55.2%), 89 (35.6%) and 23 (9.2%), respectively.

Evaluation of the DHC of the IOTN revealed that 125 patients (50%) had no or little need for orthodontic treatment, 66 (26.4%) had optional need for treatment and 59 (23.6%) had definite need for treatment.

The linear regression analysis was used to assess the effect of variables such as gender, age, school district and type of school on the values of AC and DHC, as well as DAI. The results showed that only the gender of students affected the values of the DHC and the DAI of the specialist (P < 0.0001 and P < 0.03. respectively) and other variables had no significant effect.

5. Discussion

Attention to the views of the patient seeking orthodontic treatments, while in some cases may be diverse and even contradicting, plays a major role in attaining successful treatment. So that, when the patient's willingness for receiving treatment matches the scientific principles and expert opinions, the treatment will be inevitable (10). The

Table 2. Evaluation of the Relation Between the AC, DHC and DAI

Index Scores	Specialist DAI	Specialist DHC	Specialist AC	Student AC
Student AC				
r	0.262	0.202	0.269	-
P	< 0.0001	< 0.0001	< 0.0001	-
Specialist AC				
r	0.506	0.549	-	0.269
P	< 0.0001	< 0.0001	-	< 0.0001
Specialist DHC				
r	0.749	-	0.549	0.202
P	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Specialist DAI				
r	-	0.794	0.506	0.262
P	-	< 0.0001	< 0.0001	< 0.0001

results of the present study showed that specialists had determined more treatment needs for these patients. On this basis, if orthodontic treatment was to be performed solely according to the opinion of the specialists, 6.4% of would receive the treatment that they do not feel as needed. Determining the patient's treatment needs by the specialists may establish the patient's percept based need or predicts his/her demand. Evidently, expert opinion in this regard includes consideration of various aspects of a patient's satisfaction with the appearance of his/her teeth. On the other hand, this method of determining treatment needs may cause bias in selection of patients in favor of the treatment provider. Previous knowledge of the patient, his/her information about dental arrangement through past experience with orthodontic treatment and relationship with an orthodontist or a dentist in the family can all influence the patient's perception of his/her need for orthodontic treatment, too.

The results of assessing the relationship between the AC and DHC of IOTN and DAI showed significant relationship between various components. The high level of correlation of the studied indices in the present study indicates their ability to assess the condition of occlusion of patients and determining their needs for orthodontic treatment, so that it can be said that all of them had been valid and credible in this regard. The highest correlation existed between the DHC and the DAI and the lowest between the DHC and the AC of the patients. In other words, the DHC of the IOTN and the DAI, both determined by specialists of orthodontics had a high level of agreement; however, since the DHC was determined by the specialists and the AC by the patients, their agreement was not similar to those

of other studies. This shows that despite the high level of importance of patients' opinions in determining their need for orthodontic treatment, there may be cases where they do not agree with specialists' opinions, which may be due to inadequate education for patients, failure to identify marked occlusal abnormalities, failure to provide a correct evaluation of the condition of their teeth in cases such as open-bite or anterio-posterior components of malocclusion, because of their complexity.

Shue-Te Yeh et al. (2000) (8), assessing the relationship between the DAI and the IOTN and the patient's perception of aestheticity, function and speech or treatment need, showed that there has been a significant relation between the two components of the IOTN, the AC and the DAI and between the DHC and the DAI, which is consistent with our study, although the level of significance in the present study was somewhat higher than theirs. Minor differences may be due to different study groups (patients requiring orthodontic treatment in their study and 11 - 14 year old schoolchildren in the present study) or different sample size. Borzabadi et al. (2012) (9) comparing the DAI and the DHC of the IOTN in determining orthodontic treatment needs of 728 subjects and showed that the IOTN and DAI had a strong association which was statistically significant. These results are also consistent with the findings of the present study. Manzanera et al. (2009) (11) had shown that there was only moderate agreement between the two indices. This means that, when one of these indices is used to measure or prioritize orthodontic treatment in a determined population, the individuals selected with an obvious treatment need are going to be different in 17 percent of the cases depending on which index is used, DAI or IOTN.

Cardoso et al. (2011) (12) had shown that the accuracy of the indices, was 61% for the DAI (95% CI to 70; P = 0.037) and 67% for the DHC-IOTN (95% CI = 58 to 77; P = 0.001). Both indices presented good reproducibility and validity.

The DAI and the IOTN have certain similarities; both have an aesthetic (anatomic) component, both evaluate occlusal abnormalities according to the opinion of specialists of orthodontics and both try to identify those patients who are more in need for orthodontic treatment. However, they have differences in evaluating the missing teeth. In the IOTN, one missing tooth (if judged to be a bad abnormality) will be graded as grade 3 that will require definite treatment. While according to the DAI, one missing tooth, if not accompanied by other abnormalities, will be given a score of 6, which will be multiplied by 1 and added to 13 to give the final score of 19 that suggests little or no need for orthodontic treatment. Also, in the IOTN, the AC will be assessed independently from the DHC, both by the clinician and the patient. Orthodontic treatment needs are rated non-existing, borderline and definite, and hence patients in better or worse occlusal conditions cannot be identified, while the DAI has the potential of rating the severity of malocclusion and can differentiate the patients in terms of severity of malocclusion.

The DAI, in spite of its ease of use and simplicity, does not assess such abnormalities as buccal cross-bites, midline deviations and deep over-bites (13-16). Also, Class-I molar relation and distal or mesial deviation are not highlighted in the DAI, so that this index can only be used in patients normal bony structures without such abnormalities as palatal and labial clefts, mandibular and maxillary abnormalities, deep-bite and cross-bite. Measurements are performed in millimeters and minor errors may change the scores of the index (8).

However, some studies have shown reliability of the DAI and it has been shown that there has been a significant correlation between the scores of the DAI and perception of students and parents of their need for orthodontic treatment (17, 18). In comparison, the IOTN is more precise assessing the patients' perception of treatment and aesthetic needs (8). Although this index was designed to meet children's treatment needs in Britain, where nearly all orthodontic treatment are funded by insurance companies (19), which is not possible in many other countries, it is possible that expert opinions given by orthodontists in these communities will be different from what the IOTN is based on. However, there is need for further research using larger samples and on different populations.

5.1. Conclusion

The results of the present study on comparing the dental aesthetic index (DAI) and the IOTN's dental health

component (DHC) in assessment of orthodontic treatment needs of 11 - 14 year old schoolchildren in Qazvin, showed that there was a statistically significant, positive relation between the two indices. Also, the paired relations between the AC of IOTN based on the patients' and specialists' views; the DHC of IOTN and the DAI were statistically significant in all cases, which reveals the potential of these indices to be used to determine the occlusal status of subjects and their need for orthodontic treatment. The highest correlation was seen between the DHC and the DAI and the lowest between the DHC and the AC of the patient. The highest need for orthodontic treatment was determined on the basis of the AC by the specialists. From among the variables of gender, age, type of school and school district of the studied school children, only their gender and in relation with the scores of the DHC and the DAI had a significant effect.

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