Exploring the perception of orthodontic treatment need using the Dental Aesthetic Index and Index of Orthodontic Treatment Need

Silvia A. S. Vedovello,[a] Patrícia R. dos Santos,[a] Ana Letícia Mello de Carvalho,[a] Mario Vedovello Filho,[a] Glaucia M. B. Ambrosano,[b] Antonio C. Pereira,[b] and Marcelo de C. Meneghim[b]
São Paulo, Brazil

Introduction: This study aimed to explore the perception of orthodontic treatment need by using the Dental Aesthetic Index (DAI) and the Index of Orthodontic Treatment Need (IOTN). **Methods:** A cross-sectional study was conducted on a representative random sample (N = 248) of adolescents aged 12 years. The DAI and both components of IOTN were used to evaluate malocclusion. The association between the Dental Health Component of the IOTN with gender and ethnic group were analyzed by chi-square test. The concordances between the indexes were analyzed by the kappa statistic, with 95% confidence intervals (CIs). **Results:** The prevalence of adolescents with high severity and orthodontic treatment need was 10.5% (95% CI, 6.7-14.3), 36.5% (95% CI, 32.3-44.3), and 73.4% (95% CI, 67.9-78.9) for the Aesthetic Component of the IOTN, Dental Health Component of the IOTN, and DAI, respectively. The indexes showed high agreement for the cases with low treatment need, whereas low concordance was observed for the cases with high treatment need. **Conclusions:** The perception of orthodontic treatment need was assessed differently using DAI and IOTN. (Am J Orthod Dentofacial Orthop 2019;156:818-22)

For investigators to determine the prevalence and orthodontic treatment need in malocclusion epidemiological studies, it is necessary to use specific indexes that ensure a reduced level of subjectivity and the possibility of comparison between different populations.[1-13]

The Dental Aesthetic Index (DAI)[1] and the Index of Orthodontic Treatment Need (IOTN)[2] can be considered reliable and valid indexes for determining the prevalence and orthodontic treatment need in the permanent dentition.[11,14-16] The World Health Organization[17] has adopted DAI as a cross-cultural index that has been applied in diverse ethnic groups.[11,18-22] IOTN measures only the worst features of the malocclusion and has 2 separate components, which evaluate the normative (Dental Health Component) and perceived (Aesthetic Component) orthodontic treatment need.[2] Previous population studies have also used this index.[23-27]

DAI and IOTN are internationally established occlusal indexes; however, there are important differences between them. DAI is a cumulative index that prioritizes the esthetic aspects of occlusion, whereas the dental component of IOTN takes into consideration certain conditions and aspects of the dentition, which are often not esthetically detrimental, but could be clinically or functionally negative. Thus, these indexes may induce a clear divergence in orthodontic treatment need.[4,5,7,8,12,28]

Although previous studies have measured the same conditions (prevalence, severity, and orthodontic treatment need), they did not do this the same way. DAI may overestimate orthodontic treatment need with prioritization of the esthetic aspects, and when considering only the most severe occlusal condition, IOTN may ignore some features of malocclusion.[7,8] In this context, the literature is weak because it does not show how indexes are associated with the severity and

[a]Department of Orthodontics, Araras Dental School, University Center of Hermínio Ometto Foundation FHO, Araras, São Paulo, Brazil.
[b]Department of Community Dentistry, Piracicaba Dental School, University of Campinas, Piracicaba, São Paulo, Brazil.
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Address correspondence to: Silvia A.S. Vedovello, Av. Dr. Maximiliano Baruto, 500, Jardim Universitário, CEP: 13607-339, Araras, SP, Brazil; e-mail, silviavedovello@gmail.com.
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need for orthodontic treatment. Although the DAI and IOTN have been accepted as valid by the literature and international associations, neither of them have been recognized as the most suitable for assessing orthodontic treatment need.[4,5,7,8,12,28]

This study aimed to explore the perception of orthodontic treatment need by using the DAI and IOTN in Brazilian adolescents.

MATERIAL AND METHODS

The Brazilian National Research Ethics Committee approved the study (protocol 759.321/2014). This cross-sectional study was conducted in municipal schools in the city of Araras (São Paulo, Brazil), with 12-year-old school children. The minimum sample calculated was 240 individuals, considering a test power higher than 80% for a significance level of 5% and prevalence of 50% (exposure/nonexposure ratio of 1:1; Epi Info software, Centers for Disease Control and Prevention, Atlanta, Ga). Excluded from the sample were adolescents who had previously undergone, or were at present undergoing orthodontic treatment; physical or intellectual limitations that would prevent the examination from being performed; or those whose parents did not authorize their participation. Thus, a sample of 248 school children was obtained.

This study was conducted between August and November 2016, in 2 parts: training calibration and data collection. Participants were examined in the courtyard of the school where they were enrolled. Demographic data provided information on gender and ethnic group. The children's ethnic group was classified as white (children of European descent), nonwhite (black children of African descent), and multiracial.

The outcome variable was the normative need for orthodontic treatment, determined by the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN-DHC). IOTN-DHC evaluates the need; absence of teeth (including congenital absence and impacted teeth); overjet (positive or negative); anterior or posterior crossbite; crowding; overbite; and an anterior or posterior open bite, using a scale of 5 grades, in ascending order. Although all the deviations of the occlusion were evaluated, only the most severe findings were used as a basis for determining an individual's treatment needs, which were classified as without/little need (Grades 1 and 2), moderate need (Grade 3), or definite orthodontic treatment need (Grades 4 and 5).[2] The individuals were classified as low severity and treatment need (Grades 1 and 2) and high severity and treatment need (Grades 3-5) for data analysis.[11,12,27]

The Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN-AC) determined the perceived need for orthodontic treatment. The IOTN-AC was used to evaluate individuals' psychosocial needs using a dental attractiveness scale illustrated by 10 colored photographs that present a decreasing and continuous degree of attractiveness. In this scale, Grade 1 represents the most attractive dental arrangement and Grade 10 the least attractive. The individuals themselves made the evaluations by identifying the degree of esthetic compromise in the photographs of the scale, considered similar to that of their smile. Photographs 1-4 were of individuals without or little need for orthodontic treatment (Grades 1 and 2); photographs 5-7 were of individuals with moderate need of orthodontic treatment (Grade 3), and photographs 8-10 were of individuals with severe need for orthodontic treatment (Grades 4 and 5).[2] The IOTN-AC was dichotomized into low perception of orthodontic treatment need (Grades 1 and 2) and high perception of orthodontic treatment need (Grades 3-5).

The DAI considers the esthetic aspects of occlusion. The DAI links clinical and esthetic components mathematically to produce a single score. This score reflects the severity of the malocclusion. The esthetic component of the DAI includes 10 parameters of dentofacial anomalies related to both clinical and esthetic aspects of the anterior teeth. Four grades of malocclusion are given, with priorities and orthodontic treatment recommendations assigned to each grade. Grade 1 indicates normal or minor malocclusion with no treatment need or slight need (DAI $\leq$ 25). Grade 2 indicates malocclusion with elective treatment need (DAI = 26-30). Grade 3 indicates severe malocclusion with highly desirable treatment need (DAI = 31-35). Grade 4 indicates very severe malocclusion with mandatory treatment need (DAI $\geq$ 36).[1] DAI was classified as low severity with no or slight treatment need (Grades 1 and 2) and high severity with highly desirable or mandatory treatment need (Grades 3 and 4).

Theoretical and clinical training and calibration exercises were arranged for a total of 36 hours under the supervision of 1 benchmark intraexaminer.[29] The mean weighted kappa value was 0.90 for DAI and 0.93 for IOTN-DHC. DAI and IOTN-DHC were used to determine the normative orthodontic treatment need.

Statistical analysis

The association between the IOTN-DHC with gender and ethnic group were analyzed by chi-square test. The concordances between the indexes were analyzed by the kappa statistic, with 95% confidence intervals (CIs).[30] All

Table I. Individual analysis of the association between gender and ethnic group with IOTN-DHC Index

Variable		Total	IOTN-DHC* Grades 1 and 2	IOTN-DHC* Grades 3-5	P value
Gender	Male	112 (45.2)	68 (60.7)	44 (39.3)	0.7733
	Female	136 (54.8)	85 (62.5)	51 (37.5)	
Ethnićgroup	White	135 (54.4)	89 (65.5)	46 (34.1)	
	Nonwhite	57 (23.0)	34 (59.6)	23 (40.4)	0.9729
	Multiracial	56 (22.6)	30 (53.6)	26 (46.4)	0.2226

Note: All data are expressed as n (%).
*Low (Grades 1 and 2) and high (Grades 3-5) severity and treatment need.

analyses were performed with the SAS software version 9.2 (SAS Institute Inc, Cary, NC) with a significant level of 5%.

RESULTS

The studied population comprised 248 school children. There were 136 girls (54.8%) and 112 boys (45.2%). Gender and ethnicity did not have a statistically significant association with IOTN-DHC ($P < 0.05$; Table I).

The concordance between IOTN-DHC, IOTN-AC, and DAI is presented in Table II. The prevalence of adolescents with high severity and orthodontic treatment need was 10.5% (95% CI, 6.7-14.3), 36.5% (95% CI, 32.3-44.3) and 73.4% (95% CI, 67.9-78.9) for IOTN-AC, IOTN-DHC, and DAI, respectively. The indexes showed high agreement for the cases with low treatment need, and for the high treatment need, there was low concordance.

When we assessed the IOTN-DHC 1-2 and IOTN-AC 1-2, the agreement was 92.2%. Adolescents with IOTN-DHC 3-5 showed a concordance of 14.7% with IOTN-AC 3-5. However, according to IOTN-DHC 1-2, 7.8% of adolescents were classified with IOTN-AC 3-5, and 85.3% of the adolescents with IOTN-DHC 3-5 were classified with IOTN-AC 1-2, as shown in Table II.

In assessing the IOTN-DHC 1-2 and DAI 1-2, the agreement was 35.9%; between IOTN-DHC 3-5 and DAI 3-4, it was 88.4%. Adolescents with IOTN-DHC 3-5 showed a concordance of 11.6% with DAI 1-2. The concordance between IOTN-DHC 1-2 with DAI 3-4 was 64.0% (Table II).

DISCUSSION

The DAI and IOTN are established epidemiological occlusal indexes that have previously been used in different populations to determine the prevalence and orthodontic treatment need. Although several studies have objectively compared orthodontic treatment need indexes, different levels of agreement between DAI and IOTN have been reported,[2,4,12,18-28,31-33] which continue to raise doubts about the degree of association between them.

Previous studies have found different rates of agreement between indexes, specifically between DAI, IOTN-DHC, and IOTN-AC. Kappa data in the range of 0.41-0.55 were observed, with all the studies attesting to moderate agreement between the indexes.[4,5,7,8,11,27] Although the studies pointed toward a moderate agreement, they did not present explanatory hypotheses for this fact (ie, moderate agreement). In the present study, the instruments reached a high agreement for low severity diagnoses and orthodontic treatment need (83.3%), although, for high severity and treatment need, a low agreement was shown (46.2%).

According to our results, the prevalence of malocclusion increased when assessed with DAI, and consequently, more individuals were perceived to have an orthodontic treatment need, which can be explained by the characteristic of the instrument. DAI links clinical and esthetic components mathematically to arrive at a single score, which combines the physical and esthetic aspects of the occlusion. However, the IOTN-DHC classifies the individual under certain conditions that are often not esthetically damaging.

The difference between DAI and IOTN-DHC should be considered when measuring and comparing the results of different studies. The choice of instrument should be based on the type of study proposed. The option for DAI presupposes that no functional considerations or potential risks to the dentition have been included, whereas in some ways, the IOTN ignores some of the characteristics of malocclusion, and only the most severe condition is considered. For prevalence studies, IOTN will probably ignore some important conditions because it is an "all or nothing" index.[5] In studies that evaluate the influence of contextual factors (eg, quality of life), when it is important to identify individuals' perceptions about orthodontic treatment need,[26] IOTN can be used in association with IOTN-AC.

The clinical decision-making process should be based on scientific evidence. In this context, epidemiological studies evaluate the distribution (severity) of the disease (malocclusion) in different populations and determine which population groups present the greatest need for treatment. Thus, epidemiological data provide an important basis for clinical expertise and the best understanding of disease in the individual. Furthermore, as this study evaluated the occlusal indexes most used in the

Table II. Kappa analysis of the association between IOTN-DHC Index and IOTN-AC Index and DAI

			IOTN-DHC*		
Variable		*Total*	*Grades 1 and 2*	*Grades 3-5*	P *value*
IOTN-AC†	Grades 1 and 2	222 (89.5)	141 (92.2-63.5)	81 (85.3-36.5)	
	Grades 3-5	26 (10.5)	12 (7.8-46.2)	14 (14.7-53.8)	
Kappa			0.0799 (95% CI, −0.0160 to 0.1759)		0.0490
DAI‡	Grades 1 and 2	66 (26.6)	55 (35.9-83.3)	11 (11.6-16.7)	
	Grades 3 and 4	182 (73.4)	98 (64.0-53.8)	84 (88.4-46.2)	
Kappa			0.2076 (95% CI, 0.1182-0.2970)		0.0456

Note: All data are expressed as n (%) unless otherwise stated.
*Low (Grades 1 and 2) and high (Grades 3-5) severity and treatment need; †Low (Grades 1 and 2) and high (Grades 3-5) severity and treatment need; ‡Low (Grades 1 and 2) and high (Grades 3 and 4) severity and treatment need.

literature, it may play an important role in understanding the extent of malocclusion in the population and also contribute to the organization of clinical services in Orthodontics, with a positive impact on costs and time of treatment. In conclusion, DAI diagnosed more individuals with high severity and orthodontic treatment need. There was a high agreement between DAI and IOTN-DHC for situations of low severity and need, although a low agreement was found for individuals with high severity and orthodontic treatment need.

CONCLUSIONS

The perception of orthodontic treatment need was assessed differently when using DAI and IOTN. In addition, self-perception of orthodontic treatment need using IOTN-AC was the same as the clinicians' assessment using IOTN-DHC.

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