Assessment of Different Orthodontic Treatment Need Indices

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ABSTRACT

Objective: To determine the orthodontic treatment need indices in the adolescents.

Study Design: Cross-sectional study.

Place and Duration of Study: Orthodontics Department, Armed Forces Institute of Dentistry, Rawalpindi Pakistan, from Dec 2019 to Feb 2020.

Methodology: A total of 144 subjects were selected. The orthodontic treatment need was determined using the Index of Orthodontics Treatment Needs (IOTN) and Dental Aesthetic Index (DAI). Dental casts were made for each subject and rated against DAI. Measurements against all ten components of DAI were undertaken based on the patient's occlusal morphology. Intraoral photographs and casts were used to determine the aesthetic and dental health components of IOTN.

Results: According to Index of Orthodontics Treatment Needs- Aesthetic Component, high severity and orthodontic treatment need were observed 18(12.5%). Index of Orthodontics Treatment Needs-Dental Health Component showed a high severity and treatment need 55(38.1%), while DAI revealed a high severity and treatment need 106(73.61%) subjects. Kappa analysis exhibited no significant association between IOTN-DHC Index and AC Index (κ=0.089, *p*=0.158) and only a slight agreement between IOTN-DHC and DAI (κ=0.18, *p*=0.005).

Conclusion: While using DAI and IOTN, the perception of orthodontic treatment needs is assessed differently. Indices exhibited low agreement for high treatment need cases and high agreement for low treatment need cases.

Keywords: Dental aesthetic index (DAI), Index of orthodontics treatment needs (IOTN), Orthodontic treatment need.

INTRODUCTION

Malocclusion is not a disease, but a developmental condition, a continuum representing biological diversity.[1] Management of malocclusion has been related with a great degree of subjectivity.[2] "Dental Aesthetic Index" (DAI) and "Index of Orthodontic Treatment Need" (IOTN) can be considered reliable and applicable indices for defining the prevalence and need for orthodontic treatment in the population.[3,4] They focus on individuals requiring orthodontic treatment and prioritize the needs of those individuals. The WHO has declared DAI as a "cross-cultural index" that can be applied to various ethnic groups.[5,6] IOTN's, on the other hand, uses two distinct apparatuses: a "Dental Health Component" (DHC) and an "Aesthetic Component" (AC) in which orthodontic treatment need is perceived based on pictures and both components are recorded separa-tely.[3] IOTN-DHC is a fast, easy and a reproducible method of determining the need for orthodontic treatment.[7]

Although both DAI and IOTN are internationally recognized occlusal indices for assessment of treatment needs, their results can vary considerably, suggesting significant discrepancies in the need for orthodontic treatment.[8] Although, literature acknowledges DAI and IOTN as most valid indices and DAI were recommended by WHO initially, however, none of the indices has been recommended by WHO for assessing orthodontic treatment need in its latest guide on conducting epidemiological studies.[9,10] This study, therefore, aimed to assess orthodontic treatment need perception by using both DAI and IOTN in adolescents in Pakistan to establish any concordance between these indices or a lack thereof. Therefore, the study will also help highlight the differences in assessing orthodontic treatment needs, if any, between the two selected indices.

METHODOLOGY

This cross-sectional study was conducted from December 2019 to February 2020 at Orthodontics Department, (AFID) Rawalpindi, Pakistan, after approval by the Ethical Committee of the Institute (Letter No: 905/trg-ABP1k2). The sample size was calculated using a sample size calculator, keeping minimum acceptable kappa (κ_0) at 0.45 and expected kappa (κ_1) at 0.2,[11] proportion of outcome (P) at 0.79,[12] significance level (α) at 0.05 and power of the study (β) at

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80%, a total sample size of 144 was calculated. Non-probability consecutive sampling was employed.

Inclusion Criteria: Subjects of either gender, aged 11-14 years, with no history of orthodontic treatment were included in the study.

Exclusion Criteria: Subjects who had undergone or were currently undergoing orthodontic treatment, physical or intellectual limitations that would prevent oral examination were excluded from the study.

The patients were examined in the OPD of the Orthodontics Department of AFID. Selected subjects were briefed about the study, and their demographic details were recorded. Clinical examinations were carried out by trained doctors according to WHO guidelines and based on DAI and IOTN. Dental casts for each subject were made and rated against DAI. Measurements against all ten components of DAI were recorded based on the patient's occlusal morphology. The value was multiplied by its related linear regression equation, and the final score of DAI was obtained by adding to a constant value of 13. The resulting score of DAI was classified into four groups, where each group explained the severity of malocclusion and the need for orthodontic treatment (Table-I).

determined by comparing it with the standard IOTN score chart, as shown in Table-II. Although evaluation of all deviations of occlusions was carried out, however individual's treatment need was based only on the most severe score. It was classified as: Grades 1 and 2 without/little need, Grade-3 moderate need and, Grades-4 and 5, definite orthodontic treatment need. For data analysis, Grades-1 and 2 individuals were classified as having low severity and treatment need, while Grades 3-5 individuals were classified as having high severity and treatment need. IOTN-AC has a 10-point scale of 10 coloured photographs (Figure) that present a declining and constant degree of attractiveness. Grade-1 represents maximum attractiveness, while Grade 10 depicts least attractive dentitions. Treatment need was judged based on three groups: Grades 1-4 no or little need, Grades 5–7 borderline need, and Grades 8–10 the clear need for treatment on aesthetic grounds.

Statistical Package for Social Sciences (SPSS) version 24.0 was used for the data analysis. Chi-squared test was used to evaluate the association between IOTN-DHC and gender. The agreement between the indices was analyzed using Cohen's Kappa

Table-I: The Standard Dental Aesthetic Index (DAI) Regression Equation (WHO 1997) and its Interpretation

Dai Components	Weight
Number of missing visible teeth (incisors, canines and premolars teeth in maxillary and mandibular arches).	6
Crowding in the incisal segment (0=no segment crowded; 1=1 segment crowded; 2=2 segments crowded).	1
Spacing in the incisal segment (0=no spacing; 1=1 segment spaced; 2=2 segment spaced).	1
Midline diastema in millimeters	1
Largest anterior irregularity on the maxilla in millimeters	1
Anterior maxillary overjet in millimeters	2
Anterior mandibular overjet in millimeters	4
Vertical anterior open bite in millimeters.	4
Anterior-posterior molar relation (largest deviation from normal either left or right): 0=normal; 1=1/2cusp either mesial or distal; 2=one full cusp or more either mesial or distal.	3
Constant	13
Total	Dai score

Dai Score Interpretation		
DAI Score	Severity of Malocclusion	Need for Treatment
<25	No or minor	No or slight
26 – 30	Definite	Elective
31 – 35	Severe	Desired
≥ 36	Very severe or handicapping	Mandatory

Intraoral photographs were taken to determine the AC and DHC of IOTN, and the same study casts were utilized. For IOTN-AC, intraoral photographs were compared to the standard pictures of the IOTN. Later, study casts were used to measure the DHC of the IOTN. This Dental Component score was

statistic. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

The study sample comprised 144 patients, including 80 males (55.5%) and 64 females (44.4%). No

Table-II: The Dental Health Component of the Index of Orthodontic Treatment Need

Grade-1: No Treatment Required

1. Extremely minor malocclusions, including displacements less than 1 mm

Grade-2: Little Need

2.a Increased Overjet > 3.5 mm but <= 6 mm (with competent lips)

2.b Reverse overjet greater than 0 mm but <= 1mm

2.c Anterior or posterior crossbite with <= 1mm discrepancy between retruded contact position and inter-cuspal position

2.d Displacement of teeth > 1mm but <= 2mm

2.e Anterior or posterior open bite > 1mm but <= 2mm

2.f Increased overbite >= 3.5mm (without gingival contact)

2.g Pre normal or post normal occlusions with no other anomalies. Includes up to half a unit discrepancy

Grade-3: Borderline Need

3.a Increased overjet > 3.5 mm but <= 6 mm (incompetent lips)

3.b Reverse overjet greater than 1 mm but <= 3.5mm

3.c Anterior or posterior crossbites with >1mm but <= 2mm discrepancy between the retruded contact position and inter-cuspal position

3.d Displacement of teeth >2mm but <=4mm

3.e Lateral or anterior open bite > 2mm but <= 4mm

3.f Increased and incomplete overbite without gingival or palatal injury

Grade-4: Treatment Required

4.a Increased overjet > 6mm but <= 9 mm

4.b Reverse overjet > 3.5 mm with no masticatory or speech difficulties

4.c Anterior or posterior crossbites with > 2 mm discrepancy between the retruded contact position and inter-cuspal position

4.d Severe displacements of teeth > 4

4.e Extreme lateral or anterior open bites > 4 mm

4.f Increased and complete overbite with gingival or palatal injury

4.g Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis

4.h Posterior lingual crossbite with no functional occlusal contact in one or more buccal segments

4.i Reverse overjet > 1 mm but < 3.5 mm with recorded masticatory and speech difficulties

4.j Partially erupted teeth, tipped and impacted against adjacent teeth

4.k Existing supernumerary teeth

Grade-5: Treatment Required

5.a Increased overjet > 9 mm

5.h Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant requiring pre-restorative orthodontics)

5.i Impeded eruption of teeth (apart from 3rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause

5.m Reverse overjet > 3.5 mm with reported masticatory and speech difficulties

5.p Defects of cleft lip and palate

5.s Submerged deciduous teeth

significant association was observed between gender and IOTN-DHC (p=0.447). IOTN-AC showed high severity and orthodontic treatment need in 18(12.5%) subjects. IOTN-DHC showed a high severity and treatment need in 55(38.1%), while DAI revealed a high severity and treatment need in 106(73.61%) subjects. Indices exhibited low agreement for high treatment need cases and high agreement for low treatment need cases.

Cohen's κ was run to determine if there was an agreement between the two indices regarding the orthodontic treatment needs of the selected study subjects. IOTN-DHC Grades 1-2 and IOTN-AC Grades 1-2 were assessed in 78(54%) cases with 90.7% agreement, while the agreement between IOTN-DHC Grades 3-5 and IOTN-AC Grades 3-5 was only 17.2% as observed in only 10 cases (6.9%). About 48 out of 58 (82.8%) adolescents with IOTN-DHC Grades 3-5 were classified with IOTN-AC 1-2. Kappa analysis exhibited no significant association between IOTN-DHC Index and AC Index (κ = 0.089, 95%CI, p = 0.158) (Table-III).

The agreement was seen in only 30 out of 86(34.9%) cases while comparing IOTN-DHC Grades 1-2 and DAI Grades 1-2, while the agreement between IOTN-DHC Grades 3-5 and DAI Grades 3-4 was seen in 50 out of 58 cases (86.2%). The agreement was observed in 08/58 (13.8%) cases with DAI Grades 1-2 and IOTN-DHC Grades 3-5. Agreement between

IOTN-DHC Grades 1-2 with DAI Grades 3-4 was seen in 50/86 cases (65.1%). After using Cohen's κ to evaluate the measure of agreement between IOTN-DHC and DAI, only a slight agreement was found between the two indices (κ=0.18, 95%CI, *p*=0.005), as depicted in Table-III.
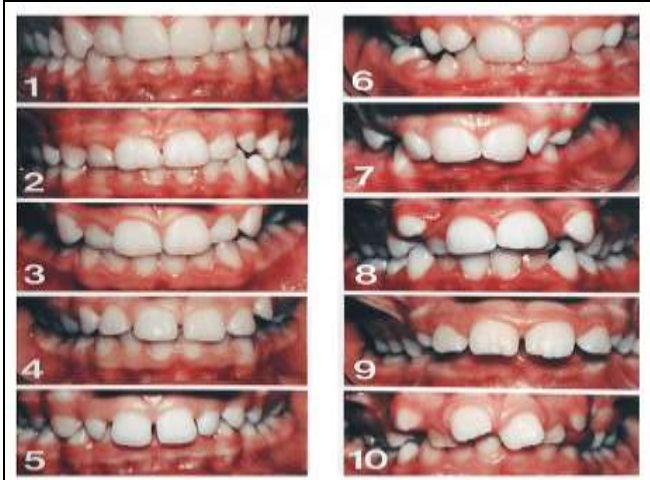

Figure: Aesthetic Component of Index of Orthodontic Treatment Need (IOTN–AC)

Table-III: Kappa analysis of agreement of Dental Health Component of Index of Orthodontic Treatment Need (IOTN–DHC) with Aesthetic Component (IOTN–AC) and Dental Aesthetic Index (DAI) (n=144)

Dental Aesthetic Index	IOTN–DHC		*p*-value
	Grade 1–2	Grade 3-5	
Grade 1–2	30(34.9%)	8(13.8%)	
Grade 3–5	56(65.1%)	50(86.2%)	0.005
Total	86	58	

IOTN-AC	IOTN–DHC		p-value
	Grade 1–2	Grade 3-5	
Grade 1–2	78(90.7%)	48(82.8%)	
Grade 3–5	8(9.3%)	10(17.2%)	0.158
Total	86	58	

DISCUSSION

Many indices have been developed to evaluate particular malocclusion and esthetics perceptions to assist orthodontists in assessing the overall need for orthodontic treatment. To "DAI and IOTN" are two such recognized epidemiological occlusal indices used to determine the prevalence of malocclusion and orthodontic treatment need in subjects.[11,12]

Literature acknowledges the importance of an inclusive valuation of orthodontic treatment needs from both an objective and a subjective perspective as being of value to public health authorities, health care providers and patients, especially in terms of their oral health-related quality of life.[13,14] Studies undertaken previously to assess orthodontic treatment need revealed varying rates of agreement between DAI, IOTN-DHC, & IOTN-AC. Kappa coefficient (Cohen's κ) in the range of 0.31–0.55 was found in all the studies, suggesting a mild to moderate agreement between these indices.[15,16]

However, no plausible theory was suggested for this concordance. In the present study, malocclusion prevalence was amplified when evaluated. As an outcome, more subjects can be expected to have orthodontic treatment need to be elucidated by distinctive DAI scores. Brazilian research reported similar results where a highly amplified orthodontic treatment need was observed when evaluated using DAI compared to IOTN.[11] Likewise, Iranzo-Cortés *et al.*[17] and Boronat-Catalá *et al.*[18] found an exaggerated need for orthodontic treatment when DAI was used in contrast to IOTN. In the present study, both indices exhibited low agreement for high treatment need cases and high agreement for low treatment need cases. This is also endorsed by the results of Vedovello *et al.*[11]

Clinical decisions must be evidence-based. Epidemiological statistics always provide the finest understanding of an illness and serve as the basis for understanding the clinical handling of disease. In this perspective, epidemiological studies assess the severity and distribution of a disease, such as malocclusion, in diverse populations and determine which population sets most need treatment. Using indices to quantify malocclusion in populations can help organizations and governments improve the clinical services in Orthodontics with a positive impact on the time of treatment and cost. However, further research is needed to improve the available orthodontic treatment need indices to devise a reliable and valid tool that may be applied universally without any differences in diagnostic accuracy.

CONCLUSION

While using DAI and IOTN, the perception of orthodontic treatment needs is assessed differently. Therefore, their agreement was different on different grades of treatment needs. There was a high agreement between DAI and IOTN-DHC for situations of low severity need. However, the agreement was very low for individuals with high severity of need for orthodontic treatment.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

MH & AJ: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

KK & NA: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

HA & AT: Critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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