Assessment of clinical cases using ABO discrepancy index

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ABSTRACT

Introduction: The American Board of Orthodontics objectively quantifies the complexity of malocclusion before orthodontic treatment. This study aims to assess the complexity of cases as measured by ABO discrepancy index (DI) in the patients under treatment by the orthodontics residents of Kantipur Dental College (KDC). Additional objectives were to 1) Ascertain DI relative to sex, age and race/ethnicity, and 2) Differential analysis of the components of the DI.

Materials & Method: DI was determined for 220 consecutive cases started by orthodontic residents of KDC in a three-year graduate orthodontics program from 2014-2018. The DI was scored and compared with the patient's sex and age.

Result: The DI is not statistically significant to age, sex and race/ ethnicity. The mean DI score (± SD) was 18.65 (±10.521). Differential analysis of the components of the DI showed that the highest scores were for cephalometric measures, followed by overjet, crowding, occlusion, and the lowest scores were for lingual posterior crossbite.

Conclusion: The DI was a relatively reliable index for measuring malocclusion severity. It is independent of patient's age and race/ethnicity but is dependent on sex. Area of possible future improvements includes malocclusion sub-categories (Class II div. 1 and 2), and scores for bony and soft tissue impactions.

Keywords: Discrepancy index, Case complexity, Cephalometrics, Malocclusion, Orthodontic patients

INTRODUCTION

The success of the case depends upon the precise case history, diagnosis and treatment planning. Assessment of the complexity of the case is the gold standard for the optimized results. Case difficulty should be assessed which can often be subjective; however, it is related to case complexity, which can be quantifiable. Discrepancy Index (DI) has been designed by American Board of Orthodontics (ABO) to provide an objective evaluation of the complexity of a malocclusion. This might lead to a better understanding of difficulty before starting the orthodontic treatment, which improves the compliance of the patient.

The DI is an objective method which is based on the observations and measurements taken from standard pretreatment orthodontic records i.e. study model, lateral cephalogram and panoramic radiographs.[1] It includes the evaluations of overjet, overbite, anterior open bite, lateral open bite, crowding, occlusion, lingual posterior crossbite, buccal posterior crossbite, and cephalometric angles i.e. Maxillo-mandibular relationship (ANB), Mandibular plane angle in relation to cranial base (SN-GoGn) and Lower incisor to Mandibular plane angle (IMPA).[2] The greater the number of these conditions in a patient, the greater severity of the malocclusion and the greater the clinical effort required to achieve optimal treatment.[1, 3]

To the researcher's knowledge, no studies in Nepal have quantified the overall DI score of the patients who were treated or are being treated by the orthodontic residents. The purpose of this study was to assess the complexity of cases as measured by ABO discrepancy index (DI) in the patients under treatment by the orthodontic residents of Kantipur Dental College (KDC). Additional objectives were to 1) Ascertain DI relative to sex, age and race/ethnicity, and 2) Differential analysis of the components of the DI.

MATERIALS AND METHOD

Institutional review committee approval was obtained from IRC-Kantipur Dental College. This is a retrospective study conducted in Kantipur Dental College from 2014-2018. 220 consecutive cases were taken as a sample from the patient records that were started by orthodontic

residents of KDC in a three-year graduate orthodontics program. Data were collected and analyzed between October and November 2018.

The criteria for inclusion were:

i. Orthodontic patients treated by the residents in the Department of Orthodontics, KDC.

ii. Natural born ethnic Nepalese. The two ethnic groups (Aryans and Mongoloids) in this study were defined as per the study of Sharma *et al*.[4]

Cases were excluded if the records were incomplete, casts were broken/damaged or the radiographs were unclear. A total of 158 cases were analyzed. Sample size of 156 was calculated using data from the study of Schafer *et al*[3] using formula

$$n = \frac{Z_a^2 s^2}{d^2}$$

Where,
n = required sample size
Z_a = z deviate corresponding to desired reliability level (at 95%, 1.96)
s= variance (s = standard deviation)
d = Maximum tolerance error

Discrepancy Index scores were collected by the investigators. Casts were analyzed for overjet, overbite, anterior open bite, lateral open bite, crowding, occlusion, lingual posterior crossbite, buccal posterior crossbite, and others. Pretreatment lateral cephalometric tracings were done for ANB, SN-GoGn, and IMPA angles, Panoramic radiographs were assessed for impactions, supernumerary teeth, axial inclinations, etcand extraoral and intraoral photographs were used to collect the DI score. Scores were recorded as per the guidelines of ABO Discrepancy Index scoring system and worksheet.[5,6] Pre-treatment age, sex and race/ethnicity were also recorded from the case records of the orthodontic residents. 30 cases were scored twice, 2 weeks apart to determine the inter-examiner repeatability (k = 0.89).

Statistical analysis

A Spearman correlation coefficient was calculated to evaluate the association between the patient's pre-treatment age with the DI scores. Mann-Whitney tests were used to evaluate the associations of the patient's sex and race/ethnicity with the DI scores. Kruskal-Wallis Test was used to evaluate the relation between malocclusion classes and DI scores.

RESULT

An outlier, a score of 117 (next highest score, 57) was identified in the DI scores. No investigator recalled any other patient having a DI exceeding 100, so the outlier was excluded from further analysis or presentation in this report. The mean DI score (± SD) was 18.65 (±10.521). Differential analysis of the components of the DI showed that the highest scores were for cephalometric measures, followed by overjet, crowding, occlusion, and the lowest scores were for lingual posterior crossbite. All variables are listed in Table I.

Of the 158 patients, 95 (60.1%) were female. Average DI scores were 17.04± 9.955 for female patients and 21.06 ±10.962 for male patients; these were statistically significant (P = 0.011). Patients were aged 18.737 ± 5.9608 years (range, 8-39 years) at the start of treatment. Age at the start of treatment was not

Table 1: DI Variables

Variables	n	Mean± SD	Std. Error of Mean	Minimum	Maximum
Overjet	158	2.95± 3.140	0.250	0	24
Overbite	158	1.35± 1.489	0.118	0	6
Anterior open bite	158	0.80± 3.195	0.254	0	24
Lateral open bite	158	0.27± 1.614	0.128	0	14
Crowding	158	2.61± 2.573	0.205	0	7
Occlusion	158	2.50± 3.186	0.253	0	12
Lingual posterior crossbite	158	0.15± 0.551	0.044	0	4
Buccal posterior crossbite	158	0.19± 0.741	0.059	0	4
Cephalometric angles	158	6.01± 7.079	0.563	0	43
ANB	158	1.71± 2.594	0.206	0	10
SN-MP	158	1.72± 3.293	0.262	0	16
LI-MP	158	2.58± 5.059	0.402	0	34
Others	158	1.82± 3.125	0.249	0	22
DI Total	158	18.65± 10.521	0.837	1	57

Table 2: Demographics

Variables	n (%)	Mean ± SD	Std. Error Mean	Minimum	Maximum	P value
Age	158 (100%)	18.737 ± 5.9608	0.4742	8	39	0.908
<14	41 (25.9%)					
15-25	98 (62%)					
26+	19 (12%)					
Sex						0.011
Male	63 (39.9%)	21.06 ± 10.962	1.381			
Female	95 (60.1%)	17.04 ± 9.955	1.021			
Race/Ethnicity						0.117
Aryan	111 (70.3%)	19.14 ± 10.085	0.957			
Mongolian	47 (29.7%)	17.49 ± 11.517	1.680			
Malocclusions						>0.001
Class I	71 (44.9%)	15.41 ± 9.597				
Class II	65 (41.1%)	19.86 ± 9.359				
Class III	22 (13.9%)	25.50 ± 12.820				
Extraction	60 (38%)	19.20± 7.517				0.106
4 premolars	40 (25.3%)					
2 maxillary premolars	11 (7%)					
Others	9 (5.7%)					
Non-extraction	98 (62%)	18.31± 12.020				

significantly associated with the DI. Patients were also categorized on the basis of eruption of permanent teeth (Table 2).[7,8]

The population had 111 Aryans (70.3%) and 47 Mongolians (29.7%). Average DI scores were 19.14 ± 10.085 and 17.49 ± 11.517 for Aryans and Mongolians respectively. These scores were not statistically significant (P = 0.117).

Of the total sample, most had Angle's Class I malocclusion (44.9%), followed by Class II (41.1%) and Class III (13.9%). The mean DI scores were 15.41 ± 9.597, 19.86 ± 9.359 and 25.50 ± 12.820 for patients with Angle's Class I, Class II and Class III malocclusions respectively. These scores were statistically significant. (P = >0.001)

Among 158 patients, 98 were treated without undergoing extractions, while 60 had undergone extraction/s of tooth/teeth (Table 3). Patients undergoing extraction/s had mean DI score of 19.20 ± 7.517, and the patients treated without extractions had mean DI score of 18.31 ± 12.020. The association between extractions/non-extractions with the DI score was statistically insignificant (P = 0.106). Among the extraction cases, majority had undergone extractions of both maxillary and mandibular premolars (25.3%),

Table 3: DI Other Variables

Others	N	Mean± SD	Std. Error of Mean	Minimum	Maximum
Supernumerary teeth	158	0.04± 0.306	0.024	0	3
Ankylosis of permanent teeth	158	0± 0	0	0	0
Anomalous morphology	158	0.09± 0.569	0.045	0	6
Impaction (except 3rd molars)	158	0.29± 1.191	0.095	0	10
Midline discrepancy (≥3 mm)	158	0.14± 0.511	0.041	0	2
Missing teeth (except 3rd molars)	158	0.35± 1.666	0.133	0	16
Missing teeth, congenital	158	0.14± 1.197	0.095	0	14
Spacing (4 or more, per arch)	158	0.37± 0.926	0.074	0	4
Spacing (max. central diastema ≥ 2 mm)	158	0.10± 0.494	0.039	0	2
Tooth transposition	158	0.03± 0.224	0.018	0	2
Skeletal asymmetry (nonsurgical tx)	158	0± 0	0	0	0
Additional treatment complexities	158	0.28± 0.859	0.068	0	4

followed by maxillary premolars only (7%) and others (5.7%).

DISCUSSION

We assessed the relationship of the DI to the patient's age, sex and race/ethnicity at the beginning of treatment. Statistically, there was no effect of age and race/ethnicity on the overall DI when the patients were sampled over 5 years (2014-2018). However, there was a significant difference between the DI scores of male and female patients.

In comparison, Schafer *et al*[3] reported an insignificant differences in DI scores for male and female patients. Male (n = 291) had a similar DI sore of 15.8 ± 9.7, compared with 15.6 ± 11.1 for females (n = 425). As expected, female patients comprised 60.1% of our sample, demonstrating that they are more likely to seek orthodontic treatment.

Urtane *et al*[9] reported that the severity of malocclusion and the subsequent need of orthodontic treatment increased with age. Statistically significant difference between the mean The Index of Complexity, Outcome and Need (ICON) values in all age groups (12-13, 18 and 35-44 years old) was observed. Similarly, ICON scores were determined to be higher in the age group of 18-year-olds. Further, the ICON weighs heavily on esthetics, which is highly subjective rather than objective.[10] Koochek *et al*[11] reported that even though the ICON showed good sensitivity for identifying treatment need, its specificity was poor. In this study, the mean pre-treatment age was about 19 years. There was no statistically significant correlation between the DI and pre-treatment age, indicating that malocclusion complexity, as measured by the DI, does not depend on age. Pre-treatment age in this study was also significantly greater than other similar studies that evaluated graduate orthodontic programs. The mean pretreatment age at the University of Tennessee, Louisiana State University, and the University of Alabama was reported 12.92 years.[12] Similarly, Yang-Powers *et al*[13] reported a mean pre-treatment age of 14.3 years at the University of Illinois at Chicago.

An important result of this study was the finding that the DI is independent of two major Nepalese ethnic groups,[4] documented by a mean DI for Aryan patients of 19.14 compared with 17.49 for Mongolian patients; this was not significantly different (p = 0.117).

DI score seemed to be statistically insignificant (p = 0.106) when compared to the cases treated with or without extractions. The mean DI scores of the patients treated with or without extraction/s were 19.20 and 18.31 respectively. This implies that the initial DI score does not necessarily dictate whether the patient is going to be treated with or without extraction.

Further, the mean DI score increased with the increase in the class of malocclusion. Angle's Class I, Class II and Class III had the DI scores of 15.41, 19.86 and 25.50 respectively. This means that the severity of malocclusion as measured by the discrepancy index is highest for Class III, followed by Class II and Class I. Among the samples, 44.9% had Class I, 41.1% had Class II and 13.9% had Class III malocclusion. The number of patients having Angle Class I and Class II malocclusions were similar. In contrast, in the similar set of samples, Shrestha *et al*[14] reported that the majority of the patients had Class I (54.70%), followed by Class II (36.90%) and Class III (8.40%) which were in accordance with the results of this study.

Some of the patients having multiple bony impactions, who were treated with great difficulties for a longer period of time, had lower overall DI scores. This could mislead the case as an easy one, which pointed towards its inconsistency in assessing the complexity of the certain cases.

CONCLUSION

DI was found to be independent of age and Nepalese race/ethnicity but was dependent on sex. Males were found to have mean DI scores significantly higher than females.

DI was found to be relatively reliable index compared to previous indices to access the severity of malocclusion. But the areas of possible future improvement in the current ABO DI could be the addition of malocclusion sub-categories (e.g. Class II Division 1 and Division 2), bony and soft tissue impactions scores modification.

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