ORIGINAL RESEARCH

Effectiveness of the American Board of Orthodontics Discrepancy Index in predicting Treatment Time

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ABSTRACT

Aim: This study was aimed to explore the effect of pretreatment severity of malocclusion on the duration of the treatment using The American Board of Orthodontics discrepancy index (ABO-DI).

Materials and methods: This clinical retrospective study consisted of orthodontics records of 37 patients who were treated with comprehensive fixed orthodontic appliance from 2011 to 2013. The sample of the study was collected so as to exclude, to the maximum possible, the patient cooperation variability by reviewing all patient chart entries. The DI measurements were used to gather the information of the pretreatment and relate it to the time duration of the treatment. Statistical analyses were performed using the chi-square test and Pearson correlation coefficient.

Results: The average treatment time was 24.5 months. The DI scores mean for class I and II was 14.30 and 20.15 respectively. Age and sex did not significantly influence the treatment duration ($p > 0.05$).

Conclusion: The results of this study showed that the ABO-DI could be a useful tool to predict orthodontic treatment time.

Clinical significance: The ABO-DI can significantly aid in orthodontic treatment time planning.

Keywords: American Board of Orthodontics, Discrepancy index, Orthodontic treatment time.

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INTRODUCTION

Considerable efforts have been made to develop reliable and standardized measurement tools in orthodontics to assess treatment outcome. Quantitative indices like the peer assessment rating (PAR) and the objective grading system (OGS) have been successfully used so far, but these are limited to occlusal aspects only.[1,2] The ABO's main goal is clinical excellence, as it aims to deliver high-quality orthodontics. The DI is an objective way of describing the complexity or difficulty of a treatment plan for an orthodontic patient based on clinical findings and measurements recorded from cephalometric and panoramic radiographs and casts.[1]

A common question for patient undergoing orthodontic treatment is "How long will my orthodontic treatment take?" Consequently, it is essential for the orthodontist to understand the factors that influence the treatment time.[2] The treatment time of comprehensive orthodontic treatment was reported to range between 23.4 and 33.4 months with an average treatment duration of 28.6 months.[1-3] There are many factors affecting treatment time including sex, degree of crowding, pretreatment ANB angle, Angle's definitions, second molars banding, extraction/ without extraction, oral hygiene, intraoral elastic wear, total number of treatment appointments, failed appointments, number of treatment phases, number of replaced brackets and bands, need of wearing headgear, PAR score, type of appliances, missing teeth, impacted teeth, cephalometric measurements, total number of office visits, number of broken appliances, overjet and overbite before initiating treatment, time between appointments, presence of deciduous dentition, facial height, needing for extractions, or surgical cases, and case difficulty.[2-9]

Besides, the orthodontist's skill to correctly predict the duration of treatment time is an essential clinical practice-management skill.[3] Factors affecting the orthodontic treatment duration were assessed with the use of ABO's DI to assess the severity of the pretreatment malocclusion. The treatment complexity index (TCI) was used to assess complexity based on treatment modalities. The Indiana University School of Dentistry comprehensive clinical assessment and the ABO OGS were used to assess the clinical outcomes for the patients undergoing the orthodontic treatment.[10] Deguchi et al[11] showed that the PAR and a modified DI are also useful indexes for evaluating the case complexity, but the reliable use of the DI requires the introduction of race-specific cephalometric standards or the development of a weighting system. Campbell et al[12] found that the DI scores were significantly higher than average for cases of posterior crossbite, anteroposterior discrepancy, and class II, division I malocclusion. Early treatment has longer times and they had the lowest DI average scores. However, Parrish et al,[13] when studying the relationship between the ABO-DI and treatment duration in a graduate orthodontic clinic, concluded that there was no relationship between DI and treatment time.

The DI, which was developed by the ABO, is an index for assessing case selection to be presented for board certification. The use of this index was to evaluate treatment complexity rather than the treatment need.

Therefore, the objective of this study was to evaluate the effect of pretreatment severity of malocclusion on the duration of the treatment using ABO-DI.

MATERIALS AND METHODS

In this study, the sample consisted of completed orthodontic patients, selected from the files of Jacksonville University School of Orthodontics from 2011 to 2013. Orthodontic records comprised pretreatment study models, pretreatment cephalometric radiographs, and treatment plans, and treatment daily notes were examined for patients who fulfilled the following inclusion criteria: (1) availability of patients' complete records, (2) patients who completed comprehensive orthodontic treatment with orthodontic multibracket fixed appliance therapy, (3) treatment outcome including class I canine, 2 mm overbite and 2 mm overjet, no crowding or spacing, (4) compliant patients with no more than 3 missing appointments, (5) 3 or less visits with broken brackets, and (6) compliance with instructions, such as wearing rubber bands. Exclusion criteria were: (1) phase I treatment (e.g., headgear, functional appliances), (2) limited treatment, (3) craniofacial anomalies, (4) transfers from another orthodontic office, (5) treatment prematurely terminated, and (6) incomplete patient records.

All examination measurements for both lateral cephalometric radiographs and study models were accomplished by one examiner. The study models were analyzed by using the OrthoCAD software (Cadent, Carlstadt, New Jersey, USA). The DI scores were calculated using the formula outlined by Cangiolosi et al[1] and established by the ABO guidelines in November 2006.

The OrthoCAD's ABO-DI module was used to locate the points and compute the total scores for the variables of overbite and overjet measurements, occlusal relationships, buccal and lingual crossbites, crowding, anterior openbite, lateral openbite, and other variables. The cephalometric analysis of the radiographs was recorded manually using transparent paper with sharp pencil. The records taken involved ANB, SN-GoGn, and IMP angles.

Statistical Analysis

The data were analyzed by descriptive statistics using parametric and nonparametric statistics which investigated the correlations between variables. The relationship between categorical and continuous variables was explained using a Pearson correlation coefficient method. The DI score in the predictive model as the independent variables and the different categories of malocclusions used as the dependent variable were analyzed using a one-way analysis of variance (ANOVA).

RESULTS

A total of 217 records were screened and only 37 patients' records fulfilled the inclusion/exclusion criteria; 24.5 months was the average treatment time for the 37 patients in this study, while 17.7 points were the total average DI score (Table 1); 21.5 months was the average treatment time for class I patients with an average DI score of 14.30 points. On the contrary, in patients with class II, the average treatment time was 29.6 months and the DI score was 20.15 points, which showed a high value (Table 2). The average age for patients in the study at the beginning of treatment was 15.7 years. There was no statistically significant difference found between age and gender.

The ANOVA showed that there were differences among molar classifications. There is a statistically significant difference between class I and II patients as shown in Table 3 ($p < 0.05$).

Table 1: The average (mean) DI score for males and females in the sample

Gender	Mean	n	Standard deviation
Male	17.38	13	10.532
Female	17.83	24	12.193
Total	17.68	37	11.489

Table 2: The average (mean) DI score for different molar classification in the sample

Molar classification	Mean	n	Standard deviation
Class I	14.30	20	9.303
Class II	20.15	13	13.874
Class III	26.50	4	7.724
Total	17.68	37	11.489

Table 3: The analysis of variance comparison of DI score by molar classification

	Sum of squares	Degree of freedom	Mean square	f-value	Significance
Between groups	619.216	2	309.608	2.547	0.093
Within groups	4132.892	34	121.556		
Total	4752.108	36			

Table 4: The mean of DI score for those with extraction *vs* nonextraction

	Extraction	n	Mean	Standard deviation	Standard error mean
Months of treatment	No	18	23.83	6.364	1.500
	Yes	19	25.16	6.466	1.483

The correlation coefficient of 0.294 demonstrated a weak correlation, indicating that an increase in DI score corresponds to an increase in the months of treatment. When comparing the mean DI scores for those with extraction (15.39) *vs* without extraction (19.84), there was no statistically significant difference (p > 0.05), even though those with an extraction had higher DI scores. The mean treatment time for class I growing without extraction with DI ≤ 15 was 21.5 months; however, for class I growing without extraction with DI > 15 was 29 months. For class I growing with extraction, the treatment time was 22 months, while class II growing without extraction with DI ≤ 15, the treatment time was 21.4 months. For class II growing without extraction with DI > 15, the treatment time was 32 months. For class II growing with extraction with DI ≤ 15, the treatment time was 26 months. For class II growing with extraction with DI > 15, the treatment time was 31.5 months (Table 4).

Table 4 shows only ex *vs* non-ex for the total sample and it appears that there were no significant differences in treatment time.

DISCUSSION

The objective of this investigation was to evaluate the effect of pretreatment severity of malocclusion on the duration of the treatment. While several factors attribute to the length of orthodontic treatment, the DI is one procedure that can be used for prediction.[13] The DI is a dependable index for measuring complexity of malocclusion.[14] It has been reported that the DI score correlates with increased treatment period.[10]

The design of the present study was to exclude, to the maximum possible, the patient cooperation variability that could influence the duration of the treatment time. It was found that there was a small-to-moderate correlation, indicating that an increase in DI score corresponds to an increase in the months of treatment. The same result is found in the study of Vu et al,[10] when they concluded that the DI and the TCI month sent complexity index (TCIy concluded that the) are sensitive potential indicators of treatment duration.[10]

The average treatment time was 24.5 months in this study. The treatment time averaged for class I patients was 21.5 months and for class II, it was 29.6 months. The patients with mean treatment duration of 30 months and a DI score > 15 points were significantly longer than those with a DI score ≤ 15 (22 months). This is almost consistent with the study reported by Vu et al[10] who reported that patients with mean treatment duration of 32.9 months with a DI score > 20 points being significantly longer than patients with a DI score between 10 and 19 (28.5 months) or less than 10 (26.3 months).

In some studies, for patients with class II that involved a two-phase treatment, the treatment times were 28.61[3] and 31.2 months.[15] On the contrary, when the two-phase treatment was excepted, the times of treatment were 22.18, 23.12, and 23.53 months.[16-18]

When comparing the demographic data with DI and treatment duration, the result was not statistically significant (p > 0.05). This is consistent with Parrish et al.[13] Also, it is in agreement with Vu et al[10] who reported that the treatment time average for females was 1.3 months shorter than for males. However, this difference was not statistically significant (p = 0.22). Previous studies have noted that females take shorter time than males.[2,18] Starnbach and Kaplan[19] attributed this finding to poor cooperation of males. Our study attempted to exclude the patient compliance variable, and therefore, it could be the reason that no difference in treatment time between gender was observed (p > 0.05). Some other studies have stated that the age factor has no influence on treatment time,[3,17,20] and the present study showed similar findings.

The present study showed that there was a positive weak correlation between DI and treatment time. The Salzmann[21] Index was used and a correlation was found in the study by Fink and Smith,[17] while other studies that used the PAR index reported mixed findings.[4-6] A DI score of >15 points would expect longer treatment time than 22.1 months in almost 85% of the time as reported by Simister et al.[22] In comparison of the mean DI scores

for those with extraction (15.39) *vs* those without extraction (19.84), no significant difference was observed. This finding is in contrast with a previous study that reported that the treatment time duration for patients with extraction stayed 7.8 months longer than patients who had no extractions.[10] Based on the number and pattern of extractions, no significant difference was found in treatment duration.[10]

CONCLUSION

Based on the findings of this study, the following conclusions could be drawn:
- ABO-DI is a useful tool to predict treatment time in addition to other factor, such as appointment timing, type of appliance, compliance, and treatment modality.
- The treatment time averaged in class II patients is 7 months longer than class I.
- There is no influence on the treatment duration by age and gender.

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