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Original Research Article

American board of orthodontics- discrepancy index (ABO-DI) as prognostic factor for the duration of orthodontic treatment: A cross-sectional retrospective study

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ABSTRACT

Objective: To evaluate American Board of Orthodontics-Discrepancy Index (ABO-DI) as a prognostic factor in predicting the duration of orthodontic treatment.

Materials and Methods: This cross-sectional retrospective study was conducted on the pre-treatment and post-treatment records of 151 consecutively de-bonded cases, who were treated between January 2016 and September 2013 with comprehensive orthodontic therapy. The ABO-DI was used to assess the pretreatment severity of malocclusion. The sample was divided into three groups based upon the discrepancy score calculated from pretreatment study model and lateral cephalogram; Group-1 (DI score <16; n= 65), Group-2 (DI score 16-25; n= 49) and Group-3 (DI score> 25; n=37). The duration of orthodontic treatment was calculated as total treatment time (in months) from the date of placement of initial brackets and archwires to the date when orthodontic appliances were removed. Spearman's correlation test and One way ANOVA analysis followed by Post-Hoc tests for multiple comparisons were used to assess the association between the ABO-DI scores and duration of orthodontic treatment.

Results: The mean duration of treatment for Group-1, Group-2 and Group-3 was found to be 25.83±8.42, 28.16±10.55 and 28.84±9.61 months respectively, but there was no statistically significant relationship between the severity of malocclusion on the duration of comprehensive orthodontic treatment (P>0.05). An insignificant correlation (P=0.102, r= -0.134) between different groups of severity of DI scores and treatment duration was revealed with Spearman test.

Conclusion: The duration of orthodontic treatment increased with increase in severity of malocclusion, however, it is not a reliable tool for predicting the treatment duration.

1. Introduction

Before starting any orthodontic treatment, the very first questions asked often by the patients seeking orthodontic treatment is that "How long will I have to wear orthodontic braces ?" or "When do I get my orthodontic braces removed ?".[1] So every potential orthodontic patient is keen to know the duration of the orthodontic treatment as it involves patient's commitment, compliance and financial and logistic implications.[2] Shia GJ[3](1986) listed 18-factors that has been associated with the increased orthodontic treatment duration in his own practice, but he failed to provide any of his data. Mavreas D and Athanasiou AE[4] (2008) in their systematic review mentioned that orthodontic treatment duration depends on various factors such as age, early v/s late treatment, type of malocclusion, skill and number of operators involved, the compliance of the patients, types of ligation, impacted teeth and the severity of the initial malocclusion. He mentioned that new studies are required with robust research techniques to give the precise answers

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about duration of orthodontic treatment.

Numerous studies and systematic reviews[5–9] have been conducted to determine the various factors effecting the duration of orthodontic treatment. They mentioned that factors like poor patient compliance, number of times appliances are broken, missed appointments, poor oral hygiene can result into increased orthodontic treatment duration.

Cangialosi TJ et al. (2004) introduced an 11-characteristics of ABO-DI to assess the complexity of pretreatment malocclusion for the Phase III of American Board of Orthodontics certification exam.[10] This index has become a reliable and accepted tool for quantifying the severity of pre-treatment malocclusion based on pre-treatment study model and lateral cephalogram.[11]

Very few studies[12,13] have been conducted to evaluate the relationship between ABO-DI score and orthodontic treatment duration. Parris et al. (2011) conducted a retrospective study on 732 patient's records to investigate the association between orthodontic treatment duration and different components of ABO discrepancy index.[12] The findings showed a positive association between various components of the ABO-DI and total DI score with treatment duration. However, the sample included in this investigation was from different race and ethnicity and Asians constituted only 2% (n=18) of the total sample. Another study by Aljehani D and Baeshen HA (2018) reported that the ABO-DI can be useful guide in predicting the orthodontic treatment duration.[13] However, the sample size selected for that retrospective was too small (n=37) and hence the finding the study should be considered with caution. To the best of our knowledge, there is paucity in the literature assessing the impact of ABO-DI score on the duration of orthodontic treatment on a large sample of Asian ethnicity generally and North Indians particularly.

Therefore, the objective of this investigation was to evaluate the pre-treatment ABO-DI score as potential prognostic tool for predicting orthodontic treatment duration on patients of North Indian ethnicity.

2. Materials and Methods

This cross-sectional retrospective study was conducted on pre- and post-treatment records of 151-consecutively debonded cases that were treated with comprehensive fixed orthodontic treatment between January 2016 and September 2013. This study was approved from the institute ethical review board with reference No.15/4Trg/MDS/16057-59.

The Final sample was screened from a total of 612 de-bonded orthodontics cases based on set inclusion and exclusion criteria. Case with fixed orthodontic treatment done in both arches, pre-and post-treatment study model, lateral Cephalogram with complete entries in the record file were included. Cases with craniofacial syndromes, cleft lip and palate, who left orthodontic treatment before the finishing-stage, multiple missing teeth, mixed dentition, maxillo-facial trauma and orthognathic surgery were excluded.

The severity of pre-treatment malocclusion was assessed by ABO discrepancy index[12] and based on total DI Score all the cases in the study were divided into three groups: Group1- Discrepancy Index score less than 16; Group 2- Discrepancy Index score between 16-25 and Group 3- Discrepancy Index score more than 25.

All the linear variables from the pre-treatment study models were measured using ABO scale[12], a metallic scale and a sliding calliper with 0.50 mm precision. The lateral cephalograms were manually traced using 3H pencil on matted acetate sheet (50 micron thickness). The cephalometric landmarks were identified, marked and tabulated for Angles ANB, SN to Go-Gn and IMPA. The duration of orthodontic treatment was calculated as total treatment time (in months) from the date of placement of initial brackets and archwires to the date when orthodontic appliances were removed.

2.1. Intraobserver reliability

The assessment of intra-observer reliability and reproducibility of anatomic landmark location and measurements errors were analysed by retracing the 10% randomly selected lateral cephalograms after 3-weeks interval using Cohen Kappa statistics. A value of 0.68–0.94 showed substantial agreement between the two points observation made by the same examiner.

2.2. Statistical analysis

Statistical analysis was performed using statistical package for social sciences (SPSS Inc., Chicago, IL, version 26.0 for Windows). Discrete categorical data were presented as n (%); continuous data were analysed by mean and standard deviation. The treatment duration was checked for normality by measures of Kolmogorov Smirnov test. Since, the data was normally distributed, One way ANOVA followed by Post Hoc tests of multiple comparisons to determine significant differences between the group were used. Spearman's ranked test was used to find out the correlation between different severity group of DI and treatment duration. The level of significance was set at $P < 0.05$.

3. Results

Table 1 describes the demographic details of the sample. The sample comprised of 62.9% of the females and 37.08% of males. The maximumpercentage of the sample i.e. 49.66% was in the age range of less than 15 years followed by 15-20 years (35.09%) and more than 20 years (15.23%). Table 2 shows the descriptive statistics for the age range, gender and ABO-DI and treatment duration. The mean

duration of orthodontic treatment was 27.32±9.47 months and was statistically non-significant for the age range and gender.

The mean duration of treatment was 25.83±8.42, 28.16±9.61 and 28.84±9.61 months for Discrepancy index score for <16, 16-25, and >25 respectively and the mean differences were found to be statistically insignificant (P>0.05). However, mean duration of orthodontic treatment was found to be increased with increase in ABO-DI scores. The Spearman's Correlation test also showed an insignificant (P; 0.102, r; -0.134) association between different severity groups of DI scores and treatment duration.

4. Discussion

The present study was conducted on a sufficiently large sample to draw generalized conclusions on Asian ethnic group. In this study, no attempt was made to segregate patients based on the type of malocclusion and extraction plan and diagnosis. Various indices[14–19] have been used in the literature to assess the severity of malocclusion, viz. Handicapping Malocclusion Assessment Record,[14] the Occlusal Index,[14] Treatment Priority Index,[14,15] Malocclusion characteristics,[16] Salzmann Index,[5] Dental Health Component of IOTN index,[17] angle ANB[5,18] and ABO Discrepancy Index,[12,13,19]

In the present study, ABO Discrepancy Index was used to assess the severity of malocclusion at the beginning of orthodontic treatment. This index has also been used in the earlier studies to predict the duration of orthodontic treatment.[12,13,19]

The average duration of treatment in present study was 27.32±9.47 months. However, the mean duration of treatment was varied for the different severity groups 1,2, and 3 with the values of 25.83±8.42, 28.16±9.61 and 28.84±9.61 months, respectively. Though, we found increased duration of orthodontic treatment with increase in ABO-DI score but the relationship between the severity of malocclusion on the duration of orthodontic treatment was statistically not significant. The probable reason for this finding can be attributed to the unequal distribution of the sample in each groups (Group 1=65; Group 2= 49; Group 3= 37).

The findings of present study were in agreement with retrospective study conducted by Grewe and Hermanson[14] who quantified the severity of malocclusion using the Handicapping Malocclusion Assessment Record, the Occlusal Index and the Treatment Priority Index and found no significant correlation between orthodontics treatment duration and the severity of malocclusion. Wenger et al[16] observed that duration of orthodontic treatment was lesser for Class I malocclusions cases than Class II or Class III malocclusions. They also mentioned that various other factors such as high pre-treatment ANB angle and low mandibular plane angle, large overjet, and buccal occlusion have been reported to influence the orthodontic treatment duration but increased in the duration of orthodontic treatment with increased in severity of malocclusion was not statistically significant. Janson et al.[15] evaluated the severity of malocclusion using Treatment Priority Index (overjet, overbite or open-bite, molar relationship, tooth displacement and posterior cross-bite) and found no statistically significant association between orthodontic treatment duration and severity of malocclusion.

The result of this study was in contradiction to the finding by Fink DF and Smith RJ,[5] who used the Salzmann Index, ANB angle and mandibular plane angle to assess the severity of malocclusion and found that increase in ANB angle and increase in Salzmann Index increased the duration of orthodontic treatment. Turbill et al.[17] used Dental Health Component of the Index of Orthodontic Treatment Need (DHC) to assess the severity of malocclusion and concluded that treatment of more complex malocclusion (DHC grade 5) took longer treatment time. Popowich et al.[18] found overjet and pre-treatment ANB angle had a significant association with duration of orthodontic treatment. Class II div 1 malocclusion which are often associated with a larger overjet and ANB angle were found to have a longer treatment duration than Class I malocclusions. Parrish et al.[12] found that increased treatment time was associated with increased ABO-Discrepancy Index (DI) score. The mean treatment time was 24.5 months as reported by Aljehani D and Baeshen HA.[13] The sample included was Class I and II malocclusion treated either with extraction or non-extraction treatment.[13] Vu et al.[19] found that increased treatment time was associated with increased ABO-DI and Treatment Complexity Index score.

The systematic review[4] have enlisted several factors that influences the treatment duration viz. extraction treatment lasts for longer duration than non-extraction therapy, In the permanent phase of dentition, age has no effect, early treatment in Class II/1 takes longer treatment time, more variable and operator sensitive ortho-surgical treatment, within public health systems treatment duration are conflicting. Miscellaneous factors viz. such as impacted maxillary canines, the orthodontic technic employed, skill and number of operators involved, the compliance of the patients, and the severity of the initial malocclusion have a profound effect on the duration of orthodontic treatment.[4]

The findingsfrom this study suggests that the ABO-DI score, which was developed to measure the "complexity of case" for ABO certification examination, its additional use for predicting the treatment duration as claimed by some authors appears to be tenuous.

5. Limitations of the study

1. The effectiveness and duration of orthodontic treatment is considered to depend largely on patient

Table 1: Demographic details of the sample (n=151)

Variables		Number	% Age
Gender	Male	56	37.08%
	Female	95	62.91%
Age Range (Years)	<15	75	49.66%
	15-20	53	35.09%
	>20	23	15.23%

Table 2: Descriptive statistics for Gender, Age Range (years) , ABO-DI score and Treatment duration (months)

		N	Treatment Duration (months)Mean ± SD	Significance (P value)
Age range	<15	75	27.29±9.87	0.298
	15-20	53	28.47±9.99	
	>20	23	24.78±6.23	
	Total	151	27.32±9.47	
Gender	Male	56	26.84±10.51	0.631
	Female	95	27.61±8.86	
DI score	<16	65	25.83±8.42	0.23
	16-25	49	28.16±9.61	
	>25	37	28.84±9.61	
	Total	151	27.32±9.47	

NS = Not Significant (P>0.05), *= Significant (P<0.05), **=Highly significant (P<0.01), ***=Very high significant (P<0.001).
Group-1: DI score <16; Group-2: DI score 16-25; and Group-3: DI score> 25

cooperation which was not evaluated in the present study.

2. In the present study no attempt was made to analyse either the appropriateness of the initial diagnosis and treatment plan or the quality of the finished result.

5.1. Future recommendation

Further studies with longitudinal design are needed for evaluating the impact of ABO-DI score and individual components of the Discrepancy index on treatment duration.

6. Conclusion

Within the limitation of this retrospective study, it can be concluded that ABO-DI is not a reliable prognostic tool to predict the duration of orthodontic treatment and should be cautious for predicting the treatment duration.

7. Source of Funding

None.

8. Conflict of Interest

None.

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