Assessment of clinical outcomes of Roth and MBT bracket prescription using the American Board of Orthodontics Objective Grading System

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Abstract

Background: There is always a need to assess whether small changes in bracket prescription can lead to visually detectable differences in tooth positions. However, with little clinical evidence to show advantages of any of the popularly used bracket systems, orthodontists are forced to make clinical decisions with little scientific guidance. **Aim:** To compare the orthodontic cases finished with Roth and MBT prescription using American Board of Orthodontics-Objective Grading System (ABO-OGS). **Settings and Design:** Department of Orthodontics, Post-graduate dental college, retrospective cross-sectional study. **Materials and Methods:** Forty patients selected were divided into two groups of 20 patients each finished with straight wire appliance using Roth and MBT prescription, respectively. The examiner ability was assessed and calibrated by one of the ABO certified clinician to grade cases using the OGS. **Statistical Analysis:** Unpaired student *t*-test was used and $P < 0.05$ was accepted as significant. **Results and Conclusions:** MBT bracket group had a lower score of 2.60 points in buccolingual inclination and lower score of 1.10 points in occlusal contact category that was statistically significant when compared with Roth group. The difference in total ABO-OGS score was 2.65 points showing that the outcome for the MBT prescription was better than that of the Roth prescription, which is statistically significant, but with little or no clinical significance. It can be concluded that use of either one of the Roth and MBT bracket prescriptions have no impact to the overall clinical outcome and quality of treatment entirely depends on clinician judgment and experience.

Keywords: American Board of Orthodontics-Objective Grading System, MBT, Roth

Introduction

With the invention of pre-adjusted edgewise bracket prescription by Andrews in 1970, several modifications of Andrews's prescription was attempted to minimize wire bending during finishing and to attain a better finish. Modifications mostly involves alterations of a few degrees in tip and torque; but it is a known fact that expression of torque in particular is affected by many factors such as the slop between the archwire and the slot,[1] the method of ligation,[2,3] differences in the tolerance size of manufactured brackets and archwires,[4] initial inclination of the teeth,[1] and even variations in the shape of the labial surface of teeth.[5]

The MBT appliance was introduced by MacLaughlin, Bennet, and Trevisi in 1998. They claim that the increased palatal root torque in the upper incisors improves upon the under-torqued appearance produced by other prescriptions and the increased labial root torque in the lower incisor counteracts the forward tipping during leveling.[6] To date, there have been no scientific studies to support these claims.

Several studies have shown the variations in torque values of teeth achieved following treatment with pre-adjusted edgewise appliances.[7-9] Kattner and Schneider found no differences in the ideal tooth relationship index when they compared the study models of patients treated using a Roth prescription pre-adjusted edgewise appliance with those treated using a standard edgewise appliances.[10] Ugur and Yukay found no differences in the objectively measured torque values between cases treated using standard edgewise and a Roth prescription appliance.[9]

Although many aspects of orthodontics are not easily measured, several valid and reliable indices have been developed to evaluate the alignment of the teeth before and after orthodontic treatment. One of the most popular indices of dental alignment is the peer assessment rating (PAR) index. The advantage of using the PAR index is its ease of use, reliability, and validity.[11] It uses both pre and post treatment study casts to measure the relative alignment of the teeth. However, considering some of the inherent drawbacks in

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the PAR index such as it measures only one outcome of treatment, i.e., straight teeth; it requires both before and after study casts to generate a valid score and it does not capture all the fine details of dental alignment with no focus on occlusal stability. At the same time, American Board of Orthodontics-Objective Grading System (ABO-OGS) was designed specifically to critique final study models. It is one of the most detailed indices in use. It consists of seven distinct model-scoring criteria and one panoramic radiographic criterion.[12,13] The index focuses on post-treatment study models and is designed to overcome deficiencies in other indices. The American Board of Orthodontics Index (ABOI) is gaining increased recognition in the orthodontic profession as a valid measure of excellence in orthodontic finishing. Therefore, ABO-OGS was used to evaluate the treatment results in this study.

The aim of this study was to assess whether small changes in bracket prescription can lead to visually detectable differences in tooth positions as claimed by the bracket manufacturers. However, with little clinical evidence to show advantages of either of the bracket systems, orthodontists are forced to make clinical decisions with little scientific guidance. Hence, main objective of the present study was to assess the Clinical Outcomes of Roth and MBT bracket prescription using the ABO-OGS [Figure 1].

Materials and Methods

This retrospective study compared the clinical outcomes of orthodontic cases finished with Roth and MBT prescription with 022" inch bracket slot using ABO-OGS. Forty patients selected were divided into two groups of twenty patients each finished with straight wire appliance using Roth (Gemini; 3M, St Paul, Minnesota, USA) and MBT (versatile+; 3M, St Paul, Minnesota, USA) prescription, respectively. Confirmation of the bracket prescription used was obtained from the hospital notes, the departmental database, and by examination of clinical photographs taken during treatment. The study received institutional research board approval to review patient records. Pre-treatment and post-treatment orthodontic records including panoramic and cephalometric radiographs as well as dental casts were obtained from the archives of Department of Orthodontics, Manipal College of Dental Sciences, Mangalore, India.

These 40 cases were a subgroup selected from a larger sample that was collected without conscious bias as part of a concurrent outcomes study and fit the purposes of this study well. It was an equal representation of different types of finished cases because it was stratified by sex, pretreatment Angle Class, and extraction pattern.

The following inclusion criteria were used for selecting the case:
- Aged 20 years or under

- Treated with comprehensive orthodontic care using maxillary and mandibular fixed labial appliances
- Placement of a 0.019 × 0.025 inch stainless steel working archwire for at least one visit
- An ANB angle not <1° and not >5°.

Following exclusion criteria was used in the study:
- Broken dental casts
- Mixed dentition state
- Incomplete records
- A non-extraction approach
- Extractions other than premolars
- A functional appliance treatment
- Use of headgear
- Surgical cases.

Using the pretreatment records, a discrepancy index (DI) was determined for each case by one examiner. All the cases were evaluated by same examiner using the ABO-OGS [Figure 2] and cast/radiograph evaluation in all eight categories: Alignment/rotations, marginal ridges, buccolingual inclinations, overjet, occlusal contacts, occlusal relationships, interproximal contacts [Figures 3-7] and root angulations. The examiner ability was assessed and calibrated by one of the ABO certified clinician to grade cases using the OGS. ABO-OGS scores in each of the eight categories and total case scores measured in the cast/radiograph evaluation form were recorded. Treatment time was calculated using the dates of initial bonding and removal of fixed appliances. Patients debonded prior to estimate time of treatment were not recorded. The gender and initial age of the patient were also recorded.

Statistical methods

Unpaired student *t*-test was used to compare the age, treatment time, DI, and ABO-OGS score for Roth and MBT group. The adjusted mean difference between the two prescriptions along with an appropriate 95% confidence interval was estimated. *P* value less than or equal to 0.05 was accepted as significant. Similar analyses were performed on each of the eight subcategories of the ABO-OGS. The Statistical Package for the Social Sciences (SPSS, Chicago, III) was used for statistical analysis.

Results

The age, DI, and treatment time for the two groups are summarized in Table 1. On correlation of the DI and the treatment time, r value of 0.038 (*P* = 0.814) was obtained by Pearsons correlation test indicating no correlation between them. Results from the ABO-OGS scores are presented in Table 2. After adjusting for the covariates (DI, age, gender, and treatment time), we found that the MBT bracket group had a lower score of 2.60 points in buccolingual inclination (*P* < 0.001) and lower score of 1.10 points in occlusal contact category (*P* = 0.033) that was statistically
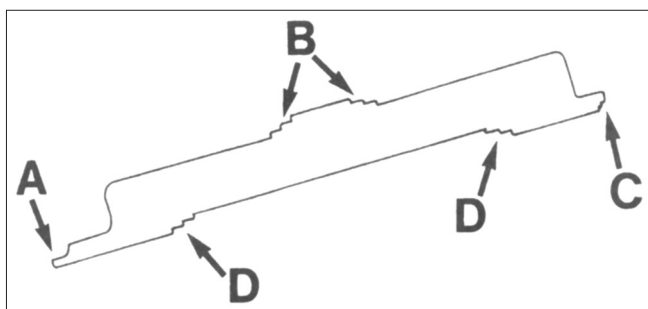
Figure 1: Parts of ABO gauge (a) This portion of the gauge is 1 mm in width and is used to measure discrepancies in alignment, overjet, occlusal contact, interproximal contact, and occlusal relationships. (b) This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in mandibular posterior buccolingual inclination. (c) This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in marginal ridges. (d) This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in maxillary posterior buccolingual inclination

Figure 3: Measuring alignment of molar using ABO gauge

Figure 5: Measuring buccolingual inclination of mandibular molars

significant when compared with Roth group but no statistically significant differences were found within any of the other

Figure 2: ABO gauge

Figure 4: Measuring buccolingual inclinations of maxillary molar using ABO gauge

Table 1: Comparison of age, treatment duration and discrepancy index between Roth and MBT prescription

	Roth		MBT		P value
	Mean	S.D	Mean	S.D.	
Age (years)	17.25	3.9	15.9	2.6	0.452
Treatment time (months)	19.75	1.6	20.35	2.2	0.343
Discrepancy index	16	6.9	12.2	3.1	0.035

categories. The total ABO-OGS score was 2.65 points lower in the MBT bracket group ($P = 0.002$). The alignment section was further divided into four components: Maxillary anterior (canine to canine) alignment, mandibular anterior alignment, maxillary posterior alignment (second premolar to second molar), and mandibular posterior alignment. When these four components were analyzed separately, mean maxillary and mandibular posterior alignment showed higher values; however, they are not statistically significant [Table 3]. As the data distribution was skewed the Mann Whitney U test was done for interproximal contact and root angulations. Between the two groups of Roth and MBT, no significant difference ($P < 0.05$) was elicited in the median values of interproximal contacts and root angulations with the Z values of −0.795 and −1.105, respectively [Table 4].

Discussion

The purpose of the study was to compare the orthodontic cases finished with Roth and MBT prescriptions using ABO-OGS and to determine whether any relationship exists between the DI and treatment duration. The DI developed by

the ABO[13] is an objective method to describe the complexity of the treatment for a patient based on observations and measurements taken from standard pretreatment orthodontic records. Hence, DI can be used for prediction of treatment duration, although various other factors also contribute to the length of orthodontic treatment.

Contrary to the findings of Schafer *et al.*,[14] and Laura *et al.*,[15] that showed that the DI score is correlated with increased treatment duration, with an average increase in treatment duration of about 11 days for each point increase in total DI score, the present study shows no correlation between DI and Treatment duration with r value of 0.038 ($P = 0.814$) as obtained by Pearsons correlation test [Table 1]. A possible explanation for this could be that this study included cases with bi-maxillary dento-alveolar protrusion treated with extraction of teeth, which is not considered in evaluating case complexity in DI in the other studies. Hence, not considering the axial inclinations of anterior teeth on basal bone as a parameter while evaluating the malocclusion could be considered a deficiency of the DI method in its current form.

It was found that the MBT bracket group had a statistically significant ($P < 0.001$) 2.60 point lower score in buccolingual inclinations when compared with Roth group [Table 2]. The reason for reduced score in buccolingual inclination in MBT group could be that the MBT prescription[6] has increased the negative torque of maxillary molars to −14°; thereby, preventing the overhanging of palatal cusp of maxillary molars that is sometimes seen with other prescriptions. Similarly, lingual crown tipping of lower molars (rolling-in) is prevented in MBT prescription by increasing premolar torque by 5°, first molar torque by 10°, and second molar torque by 25°.

The mean occlusal contact score obtained for MBT prescription is lower by 1.10 point as compared to Roth prescription, which was statistically significant ($P = 0.033$). This could be attributed to the absence of overhanging palatal cusps sometimes seen in cases treated with other prescription; therefore, we can assume that the MBT prescription helps in achieving better intercuspation.

After adjusting for the DI of the case and other covariates, the difference in total ABO-OGS was 2.65 points [Table 2],
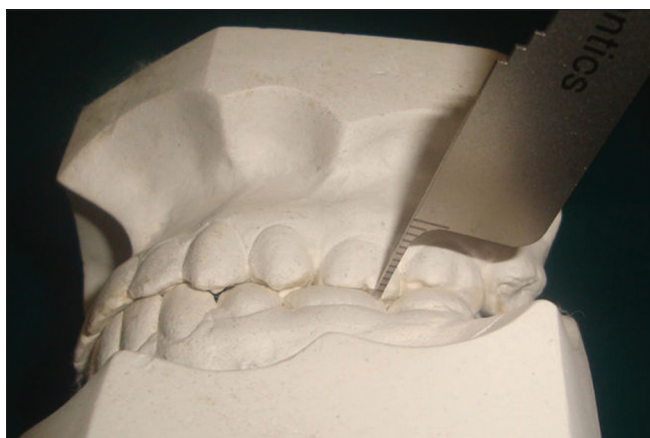

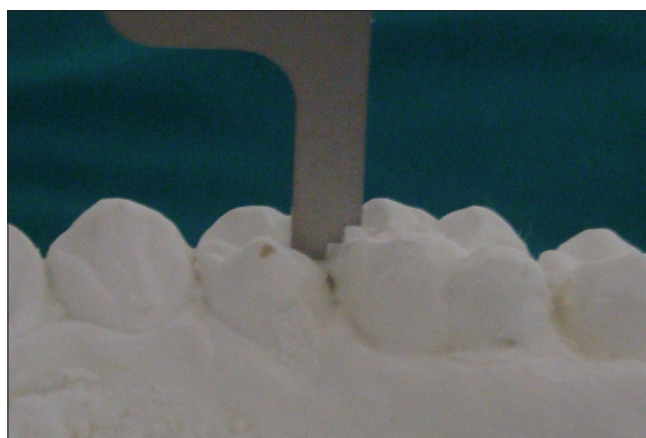
Figure 6: Measuring overjet in posterior segment

Figure 7: Measuring marginal ridge

Table 2: Comparison of ABO-OGS scores using unpaired student *t*-test

Categories	Roth				MBT				Difference			
	Mean	S.D.	95% CL		Mean	S.D.	95% CL		Mean	95%CL		P value
			Min	Max			Min	Max		Min	Max	
Alignment	3.80	1.32	1.15	6.44	3.15	1.18	0.78	5.51	0.65	−0.15	1.45	0.109
Marginal ridges	4.00	2.17	−0.35	8.35	3.85	1.53	0.78	6.91	0.15	−1.05	1.35	0.802
Bucco lingual inclinations	7.35	1.78	3.77	10.92	4.75	1.33	2.08	7.41	2.60	1.59	3.60	<0.001
Over jet	2.40	1.66	−0.93	5.73	2.00	1.21	−0.42	4.42	0.40	−0.53	1.33	0.391
Occlusal contacts	3.55	1.46	0.61	6.48	2.45	1.66	−0.88	5.78	1.10	−2.10	-0.09	0.033
Occlusal relationships	2.35	1.66	−0.97	5.67	2.50	1.31	−0.13	5.13	-0.15	−1.11	0.81	0.754
Interproximal contacts	0.20	0.523	−0.84	1.24	0.35	0.67	−0.99	1.69	-0.15	−0.535	0.23	0.435
Root angulations	1.55	1.27	−1.00	4.10	1.10	1.07	−1.04	3.24	0.45	−0.304	1.20	0.235
ABO total score	23.85	2.70	18.44	29.25	21.20	2.37	16.44	25.95	2.65	1.022	4.27	0.002

ABO-OGS: American board of orthodontics-Objective grading system; S.D.: Standard deviation; CL: Confidence level

showing that the outcome for the MBT prescription was better than that of the Roth prescription. However, only the buccolingual inclination and occlusal contact categories were shown to be statistically significant, but with little or no clinical significance. The largest discrepancy in any one category was only 0.6 points in the alignment/rotations, overjet, marginal ridges, and occlusal relationships categories.

The alignment section was further divided into four components: Maxillary anterior (canine to canine) alignment, mandibular anterior alignment, maxillary posterior alignment (second premolar to second molar), and mandibular posterior alignment. When these four components were analyzed separately, maxillary and mandibular posterior alignment sub-categories scored higher in both Roth and MBT group; however, they were not statistically significant [Table 3]. This may be attributed to the fact that second molar alignment was not given importance during treatment in both groups.

As the data distribution was skewed, the Mann Whitney U test was done for interproximal contact and root angulations. Between the two groups of Roth and MBT; they failed to show any significant difference ($P > 0.05$) in the median values of interproximal contacts and root angulations [Table 4].

The difference of 2.65 points between the groups observed in this study is unlikely to have a negative impact on an ABO candidate's case. A difference of five points in the total ABO-OGS score and a difference of 6 months in treatment time would be considered clinically significant. Similarly, the increased palatal root torque of maxillary central and

lateral incisors[6] present in MBT prescription does not have any apparent affect on clinical outcome. This might be because of the possibility that the clinician manipulated the working arch-wire to introduce more torque into the cases treated with the Roth prescription.[16] Another reason for the lack of difference might be due to inaccuracies in bracket placement, leading to inaccuracies in expression of tip and torque. Therefore, it can be stated that the overall clinical outcome will not be affected by the use of either one of the Roth or the MBT bracket prescriptions, and the quality of treatment result depends entirely on clinician judgment and experience.

Conclusions

- No correlation was found between DI and treatment duration
- MBT prescription group had a statistically significant 2.60 point lower score in buccolingual inclinations and 1.10 point lower score in occlusal contact when compared with Roth group
- The difference in total ABO-OGS score was 2.65 points, showing that the outcome for the MBT prescription was better than that of the Roth prescription; which is statistically significant. However, it can be concluded that use of either one of the Roth and MBT bracket prescriptions have no impact to the overall clinical outcome and quality of treatment entirely depends on clinician judgment and experience.

Limitations

It's a retrospective study where there is possibility of potential bias while selecting the samples; hence, a prospective randomized design would be appropriate to prevent any bias.

Although we used ABO-OGS to assess clinical outcome, which is a clear and objective method of measurement, other methods such as three dimensional laser scanning are more precise and may be able to detect differences between appliances. However, we would still state that orthodontics as a specialty always has a goal to produce the best esthetic result. Hence, a difference that is not appreciated by the human eye is of little importance.

Table 3: Breakdown of alignment

Alignment	Roth		MBT		P value
	Mean	S.D.	Mean	S.D.	
Maxillary anterior alignment	0.2	0.41	0.05	0.22	0.162
Maxillary posterior alignment	1.95	0.82	1.90	0.85	0.852
Mandibular anterior alignment	0.10	0.30	0.00	0.00	0.163
Mandibular posterior alignment	1.60	0.75	1.20	0.83	0.120

S.D.: Standard deviation

Table 4: Mann whitney test for interproximal contact and root angulation

	N	Min	Max	Percentiles			Mean rank	Z	P value
				25	Median	75			
Interproximal contacts									
Roth system	20	0	2	0	0	0	19.48	−0.795	0.583
MBT system	20	0	2	0	0	0.75	21.53		
Root angulations									
R system	20	0	5	1	1	2	22.45	−1.105	0.301
MBT system	20	0	4	0	1	2	18.55		

A further potential criticism of the study is that the patients were treated by different clinicians. Operator variability might, therefore, have masked the differences in bracket prescription. However, it could be argued that the main aim of pre-adjusted edgewise appliances was to reduce the amount of wire bending required when treating patients and, therefore, promote more consistent treatment outcomes both within- and between-individual operators;[16] hence, it can be assumed that operator variability may not have had much influence the outcome of the study.

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