COMPARISON OF ROOT RESORPTION WITH ROTH & MBT SYSTEM USING CBCT

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Abstract

Objective: To compare the magnitude of external apical root resorption (EARR) of incisors in patients undergoing the initial phase of orthodontic treatment with two sets of brackets.
Materials and Methods: 18 Angle Class I patients (anterior crowding: 3 to 5 mm; mean age: 17.2 years) were included in the study and randomly divided into two groups: group I (n 9, MBT BRACKET) and group II (n 9, ROTH BRACKETS). The degree of EARR was detected in 144 upper and lower incisors by using cone-beam computed tomography (CBCT) scanned and measured. The scans were obtained before (T1) and 6 months after initiation of treatment (T2). Differences between the groups were analyzed by nonpaired and paired t-test, respectively, with 5% significance level.
Results: Significant differences were found for both groups between T1 and T2. No differences in the degree of EARR was detected.
Conclusions: Although EARR has occurred in all teeth evaluated, the bracket design (MBT AND ROTH BRACKETS) did not demonstrate any influence on the results observed.

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1. INTRODUCTION

Root resorption is the most common undesirable effect following Orthodontic treatment. External apical root resorption (EARR) can be defined as blunting or shortening of the root apex, a condition often associated with orthodontic treatment. Bates [1856] was the first to discuss root resorption of permanent teeth.[1] Identification and management of EARR is very important during Orthodontic treatment.

As we deliver the force for any Orthodontic movement, the force is concentrated at the apical region of the tooth leading to wear and tear of that portion leading to root resorption. Histologically, root resorption (RR) is presented as regions of resorption lacunae on the surfaces of the roots. 75% of the areas show complete repair with secondary cementum. Orthodontic force applied to teeth for a short amount of time can produce resorption lacuna in the absence of radiographically visible EARR.[2,3] In cases of increased magnitude of force and increased treatment duration, PDL is injured resulting in hyalinized tissue formation and the exposure of root dentin.

The teeth more susceptible to EARR are maxillary and mandibular incisors. The degree of root resorption associated with Orthodontic treatment is influenced by a number of individual and general factors.[4, 5, 6, 7] EARR is also influenced by genetic and biochemical factors that have been accounted to be responsible for at least 50% of EARR variations[8].

The straight wire appliance was introduced in 1970 by Charles Andrew and Roth in 1979 introduced a bracket set up containing modification of tip, torque, rotation and in-out movement of Andrew's standard set up bracket system.[9] Roth devised a single prescription that would be applicable to most of the cases to finish to an "end of appliance therapy goal", in which all teeth were slightly in overcorrected position.[9] McLaughlin, Bennett and Trevisi [MBT] in 2001 redesigned the entire straight wire bracket system and is the most popular bracket prescription today.[10] The base of the bracket was designed with incorporation of tip and torque in the base itself for each individual tooth. This minimized the number of bends needed in the arch wires. Use of light and continuous force, with lacebacks and bendbacks in sliding mechanics posed the basis of MBT technique.

Irrespective of type of Orthodontic technique and bracket system, teeth subjected to orthodontic forces can undergo detectable root resorption during the first 6 months of active treatment. Root resorption mainly leads to sensitivity & mobility. Therefore, patients who are under the risk of root resorption should be identified early and radiographic examinations after 6 months of corrective treatment is advisable[12].
Previously, two-dimensional radiographs (2D) like periapical, panoramic, and occlusal radiographs, or a combination had been used for diagnosis[13, 14]. Recently, Computed tomography scans have been regarded as the most precise tool in detecting root resorption[15]. Therefore; cone beam computed tomography (CBCT) images showing root resorption may influence Orthodontists in either continuing or modifying the treatment plan.[15]

Though both systems (Roth and MBT) have their individual preferences and variations in their brackets, the type of movement produced by them on individual tooth can influence the amount of resorption. Comparison of root resorption in these two bracket systems with the use of CBCT, frames the basis of this study.

This study was designed to compare the percentage of root resorption in maxillary and mandibular incisors after alignment and leveling during Orthodontic treatment using Roth brackets (0.022 X 0.025 inch slot), and the straight-wire appliance (MBT) technique (0.022 X 0.025 inch slot).

2. MATERIALS AND METHODS

Inclusion Criteria

1] Age group 18-25
2] Angle Class I malocclusion with anterior crowding ranging from 3 to 5 mm
3] Average growth pattern
4] No missing teeth

Exclusion Criteria
1]Previous Orthodontic treatment
2]Periodontal trauma
3]Evidence of previous trauma
4]Teeth with anomalies
5]Presence of pathological conditions
6]Presence of transverse and vertical discrepancies.

The current study was ethically approved by Bharati Vidyapeeth Deemed University, Pune [ref no.- BVDU/DCH/SANGLI/1426/2015-16]
In this prospective study, 18 patients [mean age 17yrs 2 month, minimum 12 years 7 months, maximum 24 years 11 months] were randomly divided into two groups:- 1] Group I : Subjects with MBT bracket system and 0.022 X 0.025 – inch slot [American Orthodontics] [n=9; 7 female and 2 male] 2] Group II: Subjects with Roth bracket system and 0.022 X 0.025 – inch slot [American Orthodontics] n=9; 5 female and 4 male].

CBCT scans were assessed prior to the beginning of the treatment and after levelling and alignment to evaluate the root resorption of upper and lower incisors.

The patients were treated until the initial leveling and alignment stage for duration of 6 months. Same wire sequence was followed in both the groups ; 0.014 NiTi, 0.016 NiTi, 16 X 22 NiTi and 17 X 25 NiTi wires. The arch wire was ligated to the brackets using a metallic ligature [Libral Traders]. The difference by measuring the total length of the root from incisal edge to the apical aspect of the root indicated the EARR between T1 and T2 (T1-T2), in millimeters. All the 18 cases were evaluated for EARR. [Figure 1]

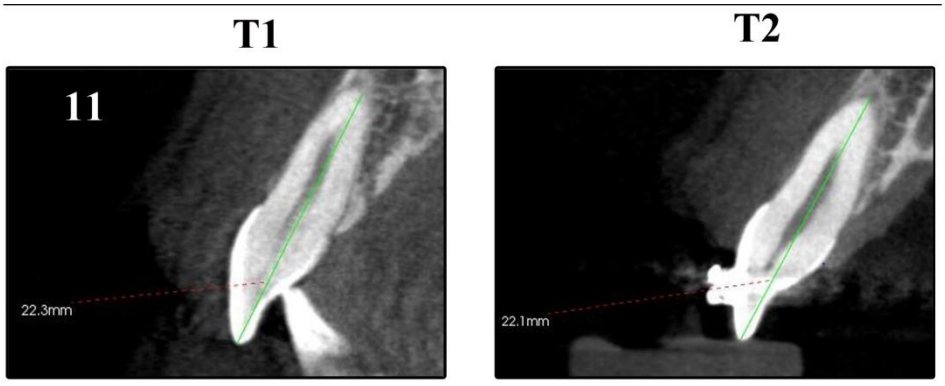

Figure-1: EARR was calculated by assessing the difference in the total tooth length, measured from the incisal border to the root apex, between T1 and T2 (T1-T2), in millimeters.

3. STATISTICAL ANALYSIS

Power analysis showed that a sample size of at least 18 patients would give an 80% probability of detecting root resorption comparison using CBCT a real difference of 0.4 mm between the groups. To assess the intra-examiner errors, the measurements were recalculated by using paired t-test. Mean and standard deviation for both the groups were calculated and the resulted were evaluated. A paired t-test was conducted for comparing the amount of root resorption in each group between T1 and T2. Comparison between both the groups was carried out by nonpaired t-test. The significance level was set at 5% for all the statistical tests.

4. RESULT

The results were statistically significant for all the teeth when compared between T1 and T2 for group I (Table 1). Group II also showed sililar results wherein statistically significant root resorption was seen in all the teeth (Table 2). On comparing the amount of root resorption between the 2 groups, no significant difference was found (Table 3).

Table 1: Comparison Of The Degree Of Root Resorption [Mm] Between T1 And T2 For The Patient In Group 1 [MBT Brackets]

Measurements	**T1**			**T2**			**T1-T2**	**P**
	Mean	**SD**	**Std.error**	**Mean**	**SD**	**Std.error**		
Maxillary Central Incisors	23.52	1.53	0.36	23.21	1.50	0.35	0.32	0.001*
Maxillary lateral incisor	22.61	1.67	0.40	22.01	1.60	0.38	0.59	0.001*
Mandibular Central incisor	21.23	1.42	0.33	20.81	1.43	0.34	0.42	0.001*
Mandibular Lateral Incisors	22.02	1.53	0.36	21.61	1.58	0.37	0.41	0.001*

Paired t test; * - indicates significant at $p \leq 0.05$

Table 2: Comparison Of The Degree Of Root Resorption [Mm] Between T1 And T2 For The Patient In Group 2 [Roth Brackets]

Measurements	**T1**			**T2**			**T1-T2**	**P**
	Mean	**SD**	**Std.error**	**Mean**	**SD**	**Std.error**		
Maxillary Central Incisors	23.56	1.21	0.29	23.25	1.16	0.27	0.31	0.001*
Maxillary lateral incisor	22.48	0.95	0.22	21.84	1.34	0.32	0.64	0.001*
Mandibular Central incisor	21.37	1.19	0.28	21.09	1.14	0.27	0.28	0.001*
Mandibular Lateral Incisors	22.29	0.87	0.20	21.99	0.96	0.30	0.30	0.001*

Paired t test; * - indicates significant at $p \leq 0.05$

Table 3: Comparison Of The Degree Of Root Resorption [MM] Between Group 1 [MBT Brackets] And Group 2 [Roth Brackets]

Measurements	Group 1			Group 2			Difference [Group 1-Group 2]	p
	Mean	SD	Std.error	Mean	SD	Std.error		
Maxillary Central Incisors	0.32	0.26	0.06	0.31	0.23	0.05	0.01	0.892
Maxillary lateral incisor	0.59	0.42	0.10	0.64	0.69	0.16	-0.05	0.817
Mandibular Central incisor	0.42	0.44	0.10	0.28	0.17	0.04	0.14	0.216
Mandibular Lateral Incisors	0.41	0.28	0.07	0.31	0.27	0.06	0.10	0.254

Unpaired t test.

5. DISCUSSION

Root resorption is an undesirable effect of Orthodontic treatment. The type of malocclusion, appliance used, wire sequence, force application, type of tooth movement, treatment mechanics, duration of treatment, root morphology were the factors found to be responsible for root resorption.[4,5,16,17,18,19]. To avoid these probable errors, our case selection was limited to Class I malocclusion cases with minimal crowding of 3-

5 mm, overjet not more than 2mm without any dilacerations present with the teeth. The cases were subjected with the same sequence of NiTi wires until 6 months.

The subjects were assessed for EARR by taking pre and post treatment CBCT records. To avoid intra-observer error, same person carried out the measurements. To avoid fatigue associated errors, observer assesses one CBCT at a time at different time intervals. The measurements were taken from mid of the incisal border to the tip of the root apex which were automatically calibrated by the software of CBCT machine in millimeter. During stage I, sequential use of round and rectangular NiTi wire were subjected for complete expression of tip and torque value in both the groups. At the end of stage I, CBCT post-treatment records [T2] were compared with CBCT pretreatment records [T1] and these results were subjected to statistical analysis for assessment of EARR.

The result of our study revealed EARR ranging from 0.28 mm to 0.64 mm with an average of 0.40mm. It was found that our values were less and significant as compared to an average 0.53mm to 0.076mm shown in various other studies. One of the major reasons for higher EARR values in other studies could be attributed to error associated with radiographs as image lenghthing, amplification, shortening and processing error.[3,12] Numerous researches have shown maxillary central incisors with highest root resorption rate followed by maxillary lateral incisor, mandibular central incisor, mandibular lateral incisor.[7,12] However our results varied than these studies.

In this study, the result of group I -MBT brackets showed highest EARR of 0.59 mm with maxillary lateral incisors followed by mandibular central incisor= 0.42 mm, mandibular lateral incisors =0.41 mm and maxillary central incisors with 0.32mm.

The results of group II-ROTH brackets showed highest EARR of 0.64mm with Maxillary lateral incisors followed by maxillary central incisors = 0.31mm, mandibular lateral incisors =0.30 mm and mandibular central incisors with 0.28 mm. Few studies stated that ROTH bracket system could not bring about the desired orthodontic treatment outcome.[2,9,11] MBT bracket prescription tried to overcome this by reducing tip and increasing the torque in the brackets. More torque expression in brackets leads to more root movements in the bone which can lead to more root resorption. Considering this, we could find more EARR values associated with the MBT brackets prescription compared to the ROTH in our study.

In this study the maxillary anteriors presented with more amount of EARR compared to mandibular anteriors. The shape of roots of maxillary anteriors being more conical, higher stresses could be highly distributed over the smaller root apex.

Among all the anterior teeth, maxillary lateral incisors showed highest percentage of root anomalies.[21] The lateral incisors have long and narrow root, hence more force might be distributed along the root surface.[5,7,12,21] In our study, EARR with lateral incisors in group I was 0.59mm, and 0.64mm in group II. These results showed highest root resorption compared to other anterior teeth in both the groups. This hypothesis of EARR with lateral incisors was also supported by studies done by Vennessa leite et al, Kamonporn et al and Hooman et al.[21,22,23]

In ROTH brackets, mandibular central incisor and mandibular lateral incisors both tip and torque values were 0, but in MBT torque was replaced with -6 degrees. Hence, we could assume that the roots of mandibular incisors have to travel a longer distance in group I than in group II. This could lead to obvious root resorption tendency.

Studies have been done on ROTH and MBT prescriptions to evaluate the EARR. The results when compared amongst these individual studies did not conclude significant amount of EARR. To assess the same, we have compared these two systems in a single study. The result of our study presented with significant amount of root resorption in their individual prescriptions.

However, on comparison there was no statistical significant difference associated with them.

Risk of EARR increased 20 times when root of incisors were close to lingual and labial cortical plate.[5] However one drawback that could be associated with our study was that we have not assessed the close proximity of root to the cortical bone.

Technological innovations like CBCT made it possible to evaluate the degree of root resorption in a three-dimensional way, due to its precision in measuring root shortening[15]. An average of 0.40 mm of root resorption was found in our study. This value is closer to that in the literature of 0.25 mm in the leveling and alignment phase.[24] It was suggested that patients submitted to a supposedly faster dental movement may have a greater level of root resorption, since orthodontic mechanics could be regarded as an etiologic factor for root shortening.[7]

6. CONCLUSION

Based on the similarity of the amount of root shortening in the studied groups during the first 6 months of orthodontic treatment, the design of the brackets (MBT & ROTH) did not influence the degree and amount of EARR.

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