

Assessment of Periapical Root Resorption after Six Months of Fixed Orthodontic Treatment

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Abstract

Objective: The objective of the study was to compare the frequency and amount of root resorption after 6 months of fixed orthodontic treatment in crowding and non-crowding orthodontic patients.

Methods: This cross sectional study conducted at the Department of Orthodontics, Alvi Dental Hospital, Karachi. The six month study was conducted from June - December 2008. Sample consists of 60 patients of two groups. Group A comprises of 30 patients of crowding in maxillary anterior teeth and Group B consisted of 30 patients of non crowding cases of maxillary anterior teeth. The data was collected through non probability purposive sampling. In preorthodontic phase (stage I), the apical root resorption was measured as a difference between length of tooth at pretreatment (T1) as compare to stage II (Postorthodontic stage) i.e. length of root six months after the orthodontic treatment (T2). Subjective scoring of resorption was done from 0-4 with the help of apical root resorption index. Finally the root resorption was compared in between two groups i.e. crowding and non-crowding and data was recorded in a predesigned questionnaire.

Results: In crowding group we found 27 (90%) cases with apical root resorption of less than 2mm as compared to non-crowding group, which had 21 (70%) cases. When compared the length of the tooth in stage II the average length was significantly higher in non-crowding group as compared to crowding ($p < 0.05$). In crowding group we found statistically significant difference in mean decrease length of tooth (mm) at T2 i.e after 6 months compared to mean tooth length (mm) ($p < 0.05$) at T1. We estimated mean decrease of difference in length of T1 and T2 in crowding group compared with non-crowding group ($p < 0.05$).

Conclusion: There is significant difference ($p < 0.05$) in mean length of tooth root in crowding and non-crowding patients after six months of orthodontic treatment.

Keywords: Crowding, root resorption, orthodontics, periapical.

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Introduction

Apical root resorption is an undesirable sequelae of orthodontic therapy in some patients that results in permanent loss of tooth structure from the root apex. Experimental studies done have shown that all human teeth develop resorption lacunae on the pressure side of root surface shortly after the application of orthodontic forces, and they are re-

paired by cementum once the forces are discontinued¹. Such studies concluded that maxillary anterior teeth, especially the lateral incisor are most severely affected². The study conducted by Marques et al, revealed that the extent of apical root resorption of incisors was 14.5% after orthodontic treatment evident radiographically³. It has been stated that mean resorption of all six anterior teeth is less than 1.5mm. However 4% of patients experienced generalized resorption of more than 3mm and 5% of adults and 2% of adolescents are likely to have at least one tooth that resorbs more than 5mm post orthodontically^{4,5}. Although the resorption process stops when the active appliances are removed. Many mechanical and biological factors plays significant role in it and may lead to root resorption^{6,7}. Identification of these factors may help the clini-

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cians and Orthodontist to decrease the incidence of root resorption. The ability to identify the small proportion of patients at risk of severe apical root resorption before or early in the treatment might therefore be of clinical significance in such a way that we can minimize the mechanics and reduce the duration of treatment, which results in resorption. The resorptive changes in the roots are commonly observed by periapical radiographs and tomographs⁸. Due to the dearth of local data on the subject the current study was planned and conducted with the rationale to evaluate the frequency and amount of root resorption after orthodontic treatment. The objective of the study was to compare the frequency and amount of root resorption after 6 months of fixed orthodontic therapy in crowding and non-crowding cases.

Patients and Methods

This study was conducted at Department of Orthodontics, Alvi Dental Hospital, Karachi in the year 2008. The total duration of study was six months, from January 2008 - June 2008. The sampling technique was Non probability, purposive sampling technique. Sample size of 60 (30 in each group) was calculated through Raosoft software with the confidence level of 95%, margin of error 5%, population size of 70 and considering the response distribution of 50%. The inclusion criteria were patients age 11 years and above, both genders, requiring fixed orthodontic treatment. The exclusion criteria were patients with any dental anomaly, previous history of trauma, previous orthodontic treatment, use of elastics during treatment and heavy arch wire mechanics.

Patients requiring orthodontic treatment meeting the inclusion and exclusion criteria were selected. Procedure was explained to the patients and verbal informed consent was taken. Patients were diagnosed on the basis of thorough clinical and radiological examination. The 60 patients were divided into two groups (Group A: 30 patients with crowding and Group B: 30 patients without crowding). The division of patients on the basis of crowding and non crowding groups was due to the fact that crowded

teeth needs more duration to align and has to move more distance than non crowded teeth so there are greater chances of root resorption in patients having crowded teeth. All patients were treated with multibonded, preadjusted 22x25 bracket slot fixed orthodontic appliance.

Periapical radiographs were taken according to a standardized paralleling technique at predetermined stages of treatment. Three radiographic projections were made at each stage: with the central ray between the 2 central incisors and with the ray centered on each lateral incisor. Radiographs were taken and developed by the principal investigator and all patients through standardized paralleling technique at pretreatment stages: before treatment (stage I) and approximately 6 months later (stage II) for the evaluation of root resorption. The principal investigator assessed all the radiographs. Radiographs were traced on acetate tracing paper with a sharp 3HB drawing pencil. Two landmarks were located : midpoint of the incisal edge and the root apex and root length was measured using millimetric standard ruler as a distance from midpoint of the incisal edge to the root apex of both maxillary central incisors in all three radiographs at each stage and average measurement was taken as a final measurement. In preorthodontic phase (stage I), the apical root resorption was measured as a difference between length of tooth at pretreatment (T1) as compare to stage II (Postorthodontic stage) i.e. length of root six months after the orthodontic treatment (T2). Apical root resorption was measured as a difference between length of root at T1 and length of root at T2 in millimeters. Subjective scoring of resorption was done from 0-4 with the help of apical root resorption index, Fig.1. Finally the root resorption was compared in between two groups;crowding and non-crowding.

Data analysis was done on software SPSS version 17.00. Mean and standard deviation were computed for quantitative variables like age, length of tooth in stage I and stage II and percentages were calculated for apical resorption index score between the two groups. Frequency and percentages were computed for qualitative variables like gender in

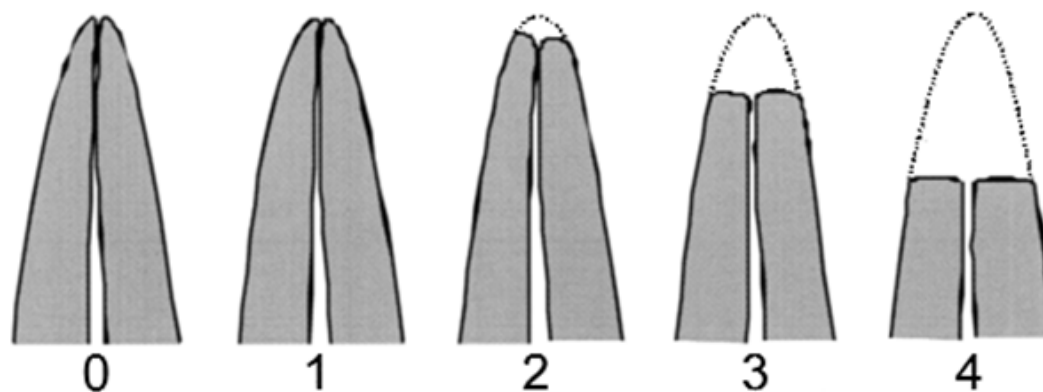
both groups. Independent t test was used to determine the mean difference in length of tooth between the two groups and paired t test was applied to estimate the mean length of tooth T1 and T2 (after 6 months) in both groups at 5% level of significance.

Results

This study comprised of 60 patients requiring orthodontic treatment fulfilling the inclusion criteria. Their mean age was 14.12 ± 4.29 years and age range was between 10-37 years. There were 37 (61.7%) females while 23 (38.3%) males Fig. 2. Age and gender matched 60 patients were divided into two groups (Group A of 30 patients with crowding and Group B of 30 patients without crowding). In Group A there were 22 (73.3%) cases between age group 11-17 years as compared to Group B which had 25 (83.3%). In group A average age was 14.80 ± 5.69 years as compared to Group B 13.43 ± 2.06 years as shown in (Table 1). In Group B female

proportion was 23 (76.7%) as compared to males, while in Group A, 16 (53.3%) were males as compared to 14 females (46.7%) Fig. 2.

In crowding group we found 27 (90%) cases with apical root resorption but less than 2mm as compared to non crowding group which had 21 (70%) cases. When compared, the length of the tooth in stage II the average length was significantly higher in non crowding group as compared to crowding ($p < 0.05$) (Table 2,3). In crowding group we found statistically significant difference in mean length of tooth (mm) at T2 compared to mean T1 tooth length (mm) ($p < 0.05$) We estimated mean decrease of difference in length of T1 and T2 in crowding group compared with non-crowding group ($p < 0.05$).



- 0-no resorption.
- 1-irregular root contour.
- 2-apical root resorption less than 2 mm of original root length.
- 3-apical root resorption from 2 mm to 1/3 of original root length.
- 4-apical root resorption exceeding 1/3 of original root length.

Fig. 1. Criteria for subjective scoring of root resorption.

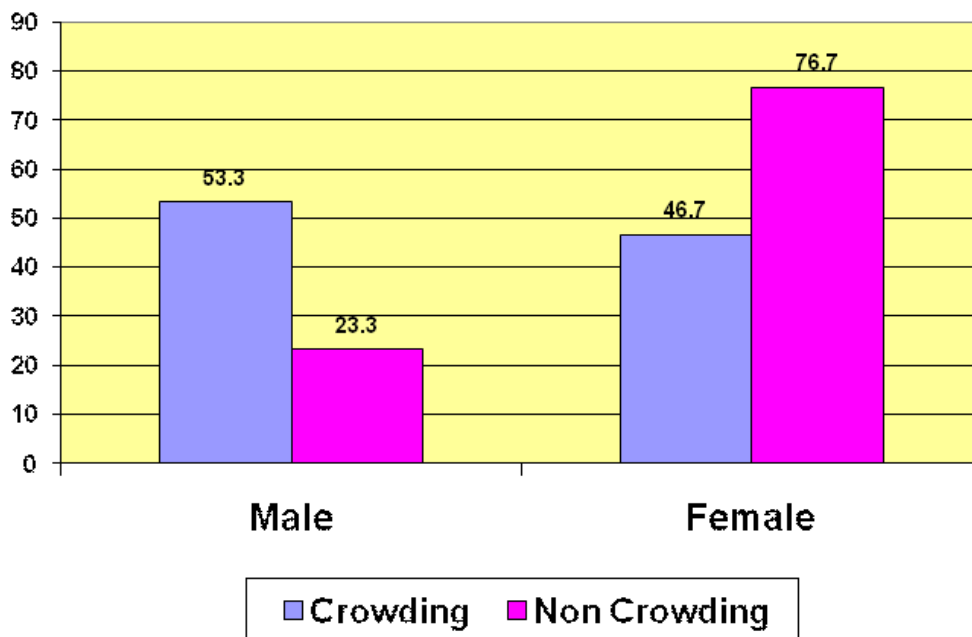


Fig. 2. Comparison of gender percentage distribution between group A(Crowding n=30) and group B(Non Crowding, n=30).

Table 1. Age Distribution of the Subjects

Age groups (years)	Crowding n =30 (%)	Non Crowding n =30 (%)
≤ 10	3 (10)	1 (3.3)
11 - 17	22 (73.3)	25 (83.3)
18 - 24	2 (6.7)	4 (13.3)
25 - 30	2 (6.7)	-
31 +	1 (3.3)	-
Over all Mean ± S.D.	14.12 ± 4.39	
Mean ± S.D.	14.80 ± 5.69	13.43 ± 2.06

S.D.=Standard Deviation

Table 2. Comparison of apical root resorption through ARI in Crowding (n=30) and non crowding (n=30) groups

Apical Root resorption (ARI)	Crowding n=30 (%)	Non crowding n=30 (%)
No resorption	0	5 (16.7)
Irregular root contour	1 (3.3)	3 (10.0)
Root resorption apically < 2mm	27 (90.0)	21 (70)
Root resorption apically from 2mm to one-third of the original root length	2 (6.7)	1 (3.3)
Root resorption exceeding one-third of the original root length	0	0

Table 3. Comparison of mean difference (after 6 months) between crowding (n=30) and Non crowding (n=30) groups

Group	Mean \pm SEM	Df	t-value	p-value
crowding	0.966 \pm 0.116	58	4.017	0.000
Non crowding	0.385 \pm 0.086			

Discussion

Root resorption after orthodontic treatment is a common finding⁹. Many factors have been studied to evaluate their role and they can be age, gender, systemic conditions, morphology of dentition, history of trauma, orthodontic mechanics, type of tooth movement and the magnitude of orthodontic force¹⁰⁻¹².

The results of our study revealed that mean age of the study population was 14.12 + 4.29. This is not inconsistent with the study conducted in Karachi which had a mean age of 18.76 + 3.66 years¹³. The reason for this might be that teeth with complete root formation have undergone more root resorption as compare to teeth with incomplete root formation^{14,15}. In teenagers the root formation of all the incisors had been completed and therefore these teeth demonstrate more root resorption as compare to other teeth which were still in the phase of apexogenesis. However, another study conducted in 2013 revealed that age has no significant influence on the rate of root resorption after orthodontic treatment¹⁶.

Major study population was non- crowding group and in males crowding group. A study conducted at Brazil stated that males are more prone to root resorption as compared to females and the possible reason that males have more dilacerated and pipette shaped root apices in maxillary central incisors which are more prone to resorption¹⁷. Although various studies demonstrate female predisposition in root resorption as a consequence of orthodontic treatment^{18,19}.

The role of tooth crowding in root resorption can never be overlooked. Our study demonstrates higher frequency of root resorption in crowding as compare to non-crowding group. However, in a retrospective systematic review it has been concluded that tooth morphology, crowding status and previous trauma are unlikely to cause root resorption after orthodontic treatment¹¹.

Assessment of pretreatment and post treatment lengths of roots can be used to the amount of root resorbed during and after orthodontic therapy. It has been evident from the study that crowding causes more apical root resorption as compare to non crowding cases. It may be due to abnormal root shape and alignment which leads to excessive and abnormal immunopathological inflammatory response responsible for root resorption^{20,21}.

Small sample size and short duration of study are the limitation of study. A longitudinal study with larger sample size should be planned so that the results can be more generalized.

It is also recommended that further studies should be planned considering more variables affecting root resorption so that they can help the orthodontist in treatment planning.

It has been recommended that patients prone to root resorption should be evaluated and diagnosed before treatment using modern diagnostic techniques like cone beam computed tomography which gives precise idea about the root lengths and morphology.

Conclusion

The frequency and amount of root resorption occurs more commonly in crowding patients and there is a significant difference ($p < 0.05$) in mean length of tooth root in crowding and non crowding patients after six months of orthodontic treatment. Orthodontist should identify the risk factors responsible for root resorption and should strive to curtail them.

Conflict of Interest

Authors have no conflict of interest and no grant/funding from any organization.

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