ORIGINAL ARTICLE

ROOT RESORPTION 4 MONTHS AFTER INITIATION OF FIXED ORTHODONTIC APPLIANCE THERAPY

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ABSTRACT

Root resorption is an idiopathic and unpredictable adverse effect of orthodontic treatment, manifesting as apical root shortening or surface resorption, mostly not affecting functional efficiency. However extensive root resorption may compromise the otherwise successful orthodontic treatment outcome. The purpose of the study was to determine amount of apical root resorption of maxillary incisors four months after initiation of fixed orthodontic appliance therapy with the help of periapical radiographs. 60 patients (14 males and 46 females) with age ranging from 10-40 years were included. A proforma indicating bio data, group (experimental or control), root length at T1 (pre-treatment), root length at T2 (after 4 months) and their difference was filled for each patient. Results were considered statistically significant at p value of 0.05 . A total of 240 maxillary incisors were assessed and all of them showed some decrease in root length but was found to be statistically insignificant. Thus it is concluded that periapical root resorption cannot be detected 4 months after initiation of fixed orthodontic treatment by conventional periapical radiographs alone, however contemporary diagnostic tools may be of help in early detection.

Key Words: *Root resorption, Maxillary Incisors, Orthodontic treatment.*

INTRODUCTION

Tooth movement is enabled in orthodontic treatment due to tissue biological response which leads to inflammatory root resorption and bone remodeling adjacent to the root structure of the teeth.[1,2] Apical shortening is great area of concern for an orthodontist because it can proceed to non reversible consequences for the sustenance of teeth.[1,3] This has been present in almost all the teeth which are studied for histological examination after they are treated orthodontically. Rygh and co-workers have shown that cementum adjacent to hyalinized areas of the periodontal ligament is marked by this contact and that clast cells attack this marked cementum when the periodontal ligament area is repaired, especially in upper incisor region.[5,6]

Loss of cementum and dentine which are inevitable processes due to root resorption occur either physiologically or due to some pathological routes. Various aspects affecting resorption of roots have been described such as hereditary predisposition, individual vulnerability, anatomical features, severity of malocclusion, periapical infection, systemic disorders (diabetes mellitus, allergic conditions, hormonal abnormalities, and arthritis), mechanotherapy and different type of orthodontic procedures.[7-13] Prolonged forces other than mechanotherapy like nail-biting and mouth breathing also can produce root resorption.[14] The use of continuous forces cause excessive root resorption as compared to the intermittent forces and in such a situation the treatment should be stopped at least for one week, thus allowing the cementum to be repaired resulting in comparatively less root resorption thereafter.[15-17]

Moderate generalized root resorption is commonly seen in fixed orthodontic patients including all the teeth but somewhat greater in maxillary incisors. Severe root resorption fortunately is rare and some individuals experience root resorption with no history of orthodontic treatment. Severe root resorption fortunately is rare and some individuals experience root resorption with no history of orthodontic treatment. Prolong duration and excessive forces used during orthodontic treatment are the major risk factors for severe localized resorption[18] which is much greater for maxillary incisors.[19]

Root resorption starts 2 to 3 weeks after application of orthodontic forces which can be detected initially with the help of periapical radiographs.[20] Therefore the aim of this study was to determine root resorption four

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months after initiation of fixed orthodontic appliance treatment. The study will help the orthodontists to avoid excessive root resorption of maxillary incisors by detecting it as early as four months after initiation of orthodontic treatment with the help of periapical radiographs.

MATERIALS AND METHODS

This study was carried out after approval from the ethical review board of the institution. The total study duration was one year. Sampling was done through consecutive non probability sampling technique and sample size was calculated using WHO calculator for health studies, based on a previous study by *H*ooman et al[21] assuming 10 % of external apical root resorption in maxillary central incisors in patients with orthodontic treatment in which a sample of 240 maxillary incisors were the minimum for providing reliable results at 95%confidence level and *0.05* level of significance.

The study participants consisted 60 patients of both sexes (14 males and 46 females) who had reported to the orthodontic department for their treatment with age ranging from 11 to 40 years, as the risk factor is increased for root resorption when patient is older than 11 years[22] with higher susceptibility in males and adults.[23,24] For inclusion in the study, patients needed to present with Angle Class I, II or III malocclusion, while patients having endodontically treated teeth, morphologically malformed roots(concrescence, dilacerations, taurodontism and regional odontodysplasia), teeth that had undergone previous orthodontic treatment or trauma, those that already had resorption detected on orthopantomogram which is a pre requisite for fixed orthodontic treatment, syndromic patients or those with dentoskeletal deformation were excluded from the study.

Out of these 60 patients 30 were randomly allocated to experimental and control groups. Sampling was done under consecutive non probability technique using Quasi-Experimental study design. Patients allocated to experimental group underwent orthodontic treatment immediately while an informed consent from control group was taken in which they volunteered not to proceed towards orthodontic treatment for 4 months after the experimental group. Periapical radiographs of upper central and lateral incisors of both the groups were acquired using Care stream RVG 6200 digital dental x-ray sensor with a rectangular collimator. An attempt to reduce radiation exposure lead aprons and collars were used.

The periapical radiographs acquired before treatment were marked as T1, while radiographs acquired in both the groups after 4 months of beginning of treatment for experimental group were marked as T2. Only upper central and lateral incisors were studied on radiographs to observe any change in the root length. In order to study the difference between radiographs acquired at T1 and T2, Images of the exposure were printed and calibrated to the actual size of a periapical radiograph. The measurements were made using a digital vernier caliper with accuracy of 0.02/0.001 mm. The difference of length between T2 and T1 were measured from the most prominent coronal ridge to the root apex[25] (categorized as 0.01-0.05mm, 0.06-0.10mm, 0.11-0.15mm and 0.16-0.5mm). For data reproducibility and confirmation of calibration, a single investigator carried out all the analysis and after 3 weeks repeated the process to remove intraexaminer error which was assessed with the help of cohen's kappa test. Independent ***t***-test was used to compare the experimental and control groups. Chi-square test and proportions test were used for comparing gender composition in each group. Results were considered statistically significance at ($P < .05$). All tests were carried out with SPSS version 20.

RESULTS

A total of 240 maxillary incisors (120 incisors each in experimental and control group) showed a decrease in root lengths for both experimental and control group (Table-3). The difference between mean root lengths of maxillary right and left central and lateral incisor at T1 and T2 for both experimental (Table-4) and control group(Table-5).The mean difference (maxillary right C.I=0.0676, maxillary right L.I=0.979, maxillary left C.I=0.975 and maxillary left C.I=0.978) was found to be statistically insignificant(Table-6).

DISCUSSION

Periapical radiographs of maxillary incisors were

TABLE 1: AGE WISE DISTRIBUTION OF PATIENTS IN EXPERIMENTAL AND CONTROL GROUP

Group	No. of Patients	Mean Age	S.d
Control	30	16.20	4.71
Experimental	30	17.53	6.92
Total	60	16.87	5.91

TABLE 2: GENDER WISE DISTRIBUTION OF PATIENTS IN EXPERIMENTAL AND CONTROL GROUP

Gender	Frequency	Percentage
Males	14	24
Females	46	76
Total	60	100

TABLE 3: APICAL ROOT RESORPTION IN PATIENTS 4 MONTHS AFTER THE INITIATION OF ORTHODONTIC TREATMENT.

Tooth	Root resorption in millimeters								Total
	0.01-0.05mm		0.06-0.10mm		0.11-0.15mm		0.16-0.5mm		
	*Exp	†Cont	*Exp	†Cont	*Exp	†Con	*Exp	†Con	
Maxillary right central incisor	06	05	11	18	13	07	00	00	60
Maxillary right lateral incisor	09	08	08	19	13	03	00	00	60
Maxillary left central incisor	09	06	14	24	07	00	00	00	60
Maxillary left lateral incisor	08	07	14	21	07	02	00	00	60
Total	32	26	47	82	40	12`	01	00	240

(*Experimental Group)
(†Control Group)

TABLE 4: DIFFERENCE BETWEEN THE MEAN ROOT LENGTHS OF MAXILLARY INCISORS IN EXPERIMENTAL GROUP.

Tooth	Mean Root Length at T1	Mean Root Length at T2	*Difference	†S.d
Maxillary right central incisor	17.00mm	16.92mm	0.8mm	3.134
Maxillary right lateral incisor	15.70mm	15.61mm	0.09mm	3.415
Maxillary left central incisor	17.00mm	16.92mm	0.08mm	2.977
Maxillary left lateral incisor	15.68mm	15.60mm	0.08mm	3.338

(†Standard Deviation)
(*Difference between root lengths at T1 and T2)

TABLE 5: DIFFERENCE BETWEEN THE MEAN ROOT LENGTHS OF MAXILLARY INCISORS IN CONTROL GROUP.

Tooth	Mean Root Length at T1	Mean Root Length at T2	*Difference	†S.d
Maxillary right central incisor	16.77mm	16.66mm	0.11mm	2.670
Maxillary right lateral incisor	15.57mm	15.49mm	0.08mm	2.688
Maxillary left central incisor	16.78mm	16.71mm	0.07mm	1.940
Maxillary left lateral incisor	15.65mm	15.58mm	0.07mm	2.249

(†Standard Deviation)
(* Difference between root lengths at T1 and T2)

TABLE 6: COMPARISON OF MEANS BETWEEN EXPERIMENTAL AND CONTROL GROUP.

Tooth	Exp		Cont		P.value
	Mean.diff	S.d	Mean.diff	S.d	
Maxillary right central incisor	0.8	3.134	0.11	2.670	0.0676
Maxillary right lateral incisor	0.09	3.415	0.08	2.688	0.979
Maxillary left central incisor	0.08	2.977	0.07	1.940	0.975
Maxillary left lateral incisor	0.08	3.338	0.07	2.249	0.978

(*P.value significant at ≤ 0.05)

used in our study for the assessment of root resorption. 240 maxillary incisors of 60 patients, with 120 incisors each in the experimental and control group showed root resorption within the range of 0.06 to 0.10mm, while only 01 incisor in experimental group and none from control group had decrease in root length within the range of 0.16 to 0.5mm. The difference between both groups was found to be statistically insignificant. Hence the null hypothesis coined at the start of treatment which stated that "Apical root resorption of maxillary incisors four months after initiation of fixed orthodontic appliance therapy cannot be detected with the help of periapical radiographs" stood valid. Roots of maxillary incisors are most commonly affected by resorption, particularly during the course of orthodontic treatment.[26-28] Moreover, out of all four maxillary incisors, lateral incisor were reported to be more susceptible to root resorption.[29,30] Therefore in this study all four maxillary incisors were included, measured and evaluated separately. Time duration between T1 and T2 was selected to be four months as it was already found that patient in whom root resorption was detected early during treatment, suffered more root resorption as compared to others later on during treatment.[12] Therefore early detection has always been of great importance.[31,32]

Conflicting to our study which revealed an insignificant difference in root lengths on radiographs at T1 and T2, some studies suggested a significant difference in root length due to resorption during the orthodontic treatment. According to Jon Artun *et al*[16] root resorption was found significant both after 6 and 12 months of treatment, while the teeth in which root resorption was detected at 6 months exhibited relatively more root resorption at 12 months as compared to others, while in our study root resorption was only once measured at 4 months of treatment and was found to be not significant which shows that there is possibly less chances of root resorption in the advanced stages of the treatment.

Root resorption eight weeks after initiation of orthodontic treatment was found to be significant affecting all the teeth in both maxillary and mandibular arches.[26,7] For the assessment of orthodontically induced root resorption using cone beam computed tomography, an overall root loss of 0.8mm after orthodontic treatment was calculated.[33] For maxillary central incisor this is in accordance to our results for experimental group which was detected as early as 4 months after start of orthodontic treatment.

The degree of resorption can be highly variable, highlighting the importance of individual susceptibility. Currently, no patient is immune from the risk of some degree of root resorption. If and when resorption is recognized during the course of intervention, lighter forces must be used, root length monitored 6-monthly with radiographs because it can not be detected as early as 4 months and the treatment aims should be reconsidered to maximize longevity of the dentition.

CONCLUSION

It is concluded that although there was a decrease in the root lengths of maxillary central and lateral incisors four months after initiation of orthodontic treatment, the results showed that the difference at T1 and T2 for both experimental and control group was statistically insignificant. The study was conducted purely on conventional periapical radiographs. More extensive studies in different centers on a larger scale with the help of modern imaging technologies such as CBCT can be used for assessment of orthodontically induced root resorption as it is as far the best method for the detection of external root resorption.[34]

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2 Kawish Syed:	Analysis and interpretation of data.
3 Amir Mehmood:	Title, abstract, Data analysis and recording.
4 Syed Riaz Shah Gilani:	Discussion and methodology.