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ANALYSIS OF APICAL ROOT RESOPRTION DURING ORTHODONTIC TREATMENT USING CBCT

Orthodontology

Dr Tanushree	Post Graduate Student, Department Of Orthodontics and Dentofacial Orthopedics Inderprastha Dental College and Hospital
Dr. Rahul Paul	Principal, HOD and Professor, Department Of Orthodontics and Dentofacial Orthopedics Inderprastha Dental College and Hospital
Dr. Vineet Golchha*	Professor, Department Of Orthodontics and Dentofacial Orthopedics, Inderprastha Dental College and Hospital*Corresponding Author
Dr. Deepti Yadav	Reader, Department Of Orthodontics and Dentofacial Orthopedics, Inderprastha Dental College and Hospital
Dr. Mudita Gupta	Lecturer, Department Of Orthodontics and Dentofacial Orthopedics, Inderprastha Dental College and Hospital

ABSTRACT

Irreversible root resorption is one of the risks involved with orthodontic tooth movement. The purpose of this study was to compare the apical root resorption of maxillary and mandibular central and lateral incisors after fixed orthodontic treatment using CBCT/RVG/OPG. A sample size of 20 patients were considered for the study. Pre-treatment CBCT/OPG/RVG was recorded and after that the patient underwent routine fixed orthodontic treatment in the department and after 6 months of treatment, patient were re-evaluated. The initial root length using pre-treatment records were tabulated and final root length using post treatment records were tabulated. The difference between the two was the apical root resorption seen using OPG, RVG and CBCT. The apical root resorption in Group II[OPG] was greatest followed by Group I[RVG] and lowest in group III[CBCT]. When all the eight teeth were compared for apical root resorption the greatest amount of root resorption was seen in the maxillary right lateral incisor and least was seen in mandibular right lateral incisor.

KEYWORDS

Root Resoprtion , CBCT , Lateral Incisor , RVG

INTRODUCTION

Apical root resorption is a multifactorial biological process that can be defined as the physiologic and pathologic dissolution of the mineralized tissues, including dentin, cementum and adjacent alveolar bone, mainly because of osteoclastic cell activity.[1]Orthodontics is one of the most common causes of external apical root resorption

Methods commonly used to evaluate root resorption are histological analysis and radiographic examination. Histological studies have found a high incidence of root resorption caused by orthodontic treatment but this procedure can be used usually in animal studies or in extracted premolars. On the other hand, radiographic examination can be applied to in vivo studies and it includes the use of two dimensional techniques eg periapical films, panoramic films, or three dimensional techniques ie cone-beam CT (CBCT).

Levander and Malmgren [1988][2] presented a widely accepted classification system based on intraoral radiographs for apical root resorption. This index grade the severity of apical root resorption from Grade I (presence of irregular root contour) to Grade 4 (root resorption is greater than 1/3 of the original root length).

Cone beam CT (CBCT) was introduced in dentistry in the late 1990s, and provides an excellent measure to study apical root resorption due to its ability to produce a distortion-free and reproducible image of any single root. Numerous studies have been done to find the effect of orthodontic treatment on root length but there are contradictory results in the literature regarding the extent of root resorption of maxillary and mandibular incisors caused due to orthodontic treatment. Hence, this study is undertaken to evaluate and compare apical root resorption of maxillary and mandibular central and lateral incisors after fixed orthodontic treatment using CBCT/RVG/OPG.

METHODOLOGY

15 patients reporting to the Department of Orthodontics and Dentofacial Orthopedics, Inderprastha Dental College and Hospital, Ghaziabad were considered for the study.

Inclusion criteria

- Aged 16 years and above
- No previous orthodontic treatment
- No developmental anomaly of teeth

Exclusion criteria for the study was:

- History of trauma
- Prior root resorption
- Endodontically treated teeth
- Periapical inflammation of cysts/tumors.
- Restorations [crowns, bridges, implants] in anterior teeth.

After patient selection, the patients were informed about the study and consent form was signed by the patient. Pre-treatment OPG using Kodak 8000C, RVG using Vatech sensor and CBCT using Carestream CS9500 [Figure 1]was done in Inderprastha Dental College and Hospital. OPG was evaluated using the mechanical method, RVG was evaluated using EZ Dent-i software while CBCT was evaluated using CS 3D imaging software.

Figure 1–Radiographic machines for OPG,CBCT and RVG

Patients were re-evaluated after 6months and both pre-treatment and post 6 months treatment radiographs were examined for apical root resorption of maxillary and mandibular incisors. The difference between the initial and final root length was tabulated as apical root resorption and subjected to statistical analysis.

RESULTS

The data was subjected Mann Whitney U Test showed that there is no statistically significant difference in the amount of root resorption among all the teeth using OPG,RVG and CBCT .Comparison of apical root resorption in the individual teeth was done using Kruskal Wallis test. The analysis showed that the highest apical root resorption was seen in Group III(CBCT) in maxillary and mandibular right and left central incisors and mandibular right lateral incisors. Although, for maxillary lateral incisors and mandibular left lateral incisor, highest amount of apical root resorption was seen in Group II(OPG).Multivariate analysis of variance among the three groups was assessed for all the eight teeth examined and it was found that there was statistically significant difference among the three groups with respect to maxillary right lateral incisor (p=0.027)[Table 1].

Table 1: Multivariate Analysis of Variance among the Three Groups

Variable	Type III sum of squares	df	Mean square	F	P-Value
Max. Right CI	0.440	2	0.220	0.927	0.404
Max. Left CI	1.338	2	0.669	1.863	0.168
Max. Right LI	0.909	2	0.454	3.959	**0.027***
Max. Left LI	0.156	2	0.078	0.385	0.683
Mand. Right CI	0.633	2	0.316	1.079	0.349
Mand. Left CI	0.954	2	0.477	1.689	0.197
Mand. Right LI	0.081	2	0.040	0.173	0.841
Mand. Left LI	0.163	2	0.081	0.624	0.541

Intergroup comparison with respect to maxillary right lateral incisor among the three groups was done which showed a statistically significant difference between Group II(OPG) and group III(CBCT) (p=0.040)and no statistically significant difference among other groups. [Table 2].

Table 2 : Intergroup Comparison with Respect to Maxillary Right Lateral Incisor among the Three Groups

Group	Group	Mean difference	Std. error	Significance
I (RVG)	**II (OPG)**	-0.279	0.124	0.089
	III (CBCT)	0.041	0.124	1.00
II (OPG)	**III (CBCT)**	0.320	0.124	**0.040***

DISCUSSION

The radiographic diagnosis of apical root resorption is done by three-dimensional method (CBCT) which is considered more accurate, and hence more effective than two-dimensional methods (panoramic and periapical radiographs).[3] It was seen that panoramic radiography underestimated apical root resorption after orthodontic tooth movement.[4]

In the present study CBCT was found to be more effective in relation to all the anteriors except for maxillary lateral incisors and left mandibular lateral incisor in which OPG was more effective. Dudic et al[4] found CBCT to be more effective than OPG where 275 teeth were assessed for root resorption. Yi et al[1] compared the diagnostic accuracy of cone-beam computed tomography (CBCT) and periapical radiographs (PR) where it was found that CBCT has a higher diagnostic efficacy than periapical radiographs.

In the present study, OPG showed the highest apical root resorption in maxillary lateral incisors and mandibular left lateral incisor which can be because both RVG and OPG overestimated the root resorption due to magnification errors and also, the evaluation done for OPG was done manually.

One of the factors to be considered for apical root resorption is the root morphology; with teeth with blunt roots or pipette shape roots like maxillary lateral being most prone. In the present study also, when the central and lateral incisors were compared it was found maxillary right lateral incisor showed greatest amount of root resorption and least by mandibular right lateral incisor. The present study is in accordance with the study done by Deng Y et al[5] , Jian Hong Yu et al[6] and Smale et al[7].On the contrary, according to Janson et al[8], Neuman WG et al[9] the most resorbed teeth were the upper central incisors and lastly the lower lateral incisors.

There are certain limitations of the present study, one of them being the time duartion. The importance of the treatment time has been demonstrated by Harry etal [10] and Segal etal [11] where they demonstrated a strong correlation between root resorption and duration. Tooth extraction has also been shown to be a risk factor for ARR, another factor not considered in the present study.On the one hand, Baumrind et al[12] and Kaley et al[13] in their study found no association between tooth extraction and root resorption however, Sameshima et al[14] found that removal of four first premolar teeth resulted in more root resorption. McNab et al[15]also found that the amount of root resorption is 3.72 times greater for extraction than non-extraction patients.

CONCLUSION

The following conclusions can be drawn from the present study –

1. There was no statistically significant apical root resorption seen after 6 months of fixed orthodontic treatment except for maxillary right lateral incisor.
2. CBCT was found to be more effective in determining the apical root resorption of maxillary and mandibular teeth as compared to OPG and RVG.
3. When all the eight teeth were compared for apical root resorption the greatest amount of root resorption was seen in the maxillary right lateral incisor and least was seen in mandibular right lateral incisor.

Apical root resorption is multifactorial and its extent influences the prognosis of orthodontic treatment. But there is enough scope for further study to assess the effect of treatment time, effect of retraction mechanics in extraction cases and effect of labial versus lingual technique .

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