



Assessment of Root Resorption and Root Shape by Periapical and Panoramic Radiographs: A Comparative Study

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ABSTRACT

Introduction: One of the common findings encountered by the clinician at the end of orthodontic treatment is the apical root resorption. Root resorption occurs to various degrees. A severe form of root resorption is characterized by shortening of root for more than 4 mm or more than one-third of the total tooth length. A low incidence rate of resorption is observed based on radiographic findings for the diagnosis of root resorption, panoramic radiography, and periapical radiography. Hence, we evaluated the accuracy of panoramic radiographic films for assessing the root resorption in comparison with the periapical films.

Materials and methods: This study included the assessment of all the cases in which pre- and post-treatment radiographs were available for analysis of the assessment of the amount of root resorption. Complete records of 80 patients were analyzed. Examination of a total of 900 teeth was done. Mean age of the patients in this study was 21 years ranging from 11 to 38 years. The majority of the patients in the present study were females. All the treatments were carried out by registered experienced

orthodontists having minimum experience of more than 10 years. All the cases were divided into two study groups. Group I comprised panoramic radiographic findings, while group II consisted of periapical radiographic findings. For the measurement of crown portion, root portion, and the complete root length, magnification loops of over 100 powers with parallax correction with inbuilt grids were used. Assessment of the tooth length and the crown length was done by the same observers. All the results were analyzed by Statistical Package for the Social Sciences software version 6.0.

Results: Maximum amount of root resorption was observed in case of maxillary central incisors and canines among group I and II cases respectively. However, nonsignificant difference was obtained while comparing the mean root resorption in relation to maxillary incisors and canines among the two study groups. While comparing the overall value of root resorption among the two study groups, a significant difference was obtained. The maximum value of tooth length in both the groups was observed in cases of maxillary canines. Significant differences were observed while comparing the tooth length of various teeth among the two study groups. Among the deviated forms of root shape, dilaceration was the most common form of root shape detected in both the study groups.

Conclusion: Periapical radiographs are more efficient in the assessment of the shape and resorption of the root.

Clinical significance: Thorough evaluation of periapical radiographs is necessary for detection of even minute levels of root resorption.

Keywords: Panoramic, Radiographs, Resorption.

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INTRODUCTION

In routine orthodontic treatment cases, one of the common findings encountered by the clinician at the

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end of treatment is apical root resorption. As quoted in the literature, more frequent severe root resorption is associated with orthodontic treatment.¹ Although it is not the only etiologic factor causing root resorption, it acts as a major triggering factor. Various degree of resorption occurs in relation to root portion. Shortening of root for more than 4 mm or more than one-third of the total tooth length is categorized as a severe form of root resorption. It is found to be associated with up to 5% of the teeth.^{2,3} Data of various histologic studies indicate that orthodontic forces are responsible for causing over 90% of the cases of root resorption. However, a low incidence rate of resorption is observed when diagnosed based on radiographic findings.⁴ Findings of Marques et al⁵ show an incidence rate of approximately 15% to be associated with orthodontic treatment. Panoramic radiography and periapical radiography are most commonly used for diagnosing root resorption. Hence, we evaluated the accuracy of panoramic radiographic films for assessing the root resorption in comparison with the periapical films.

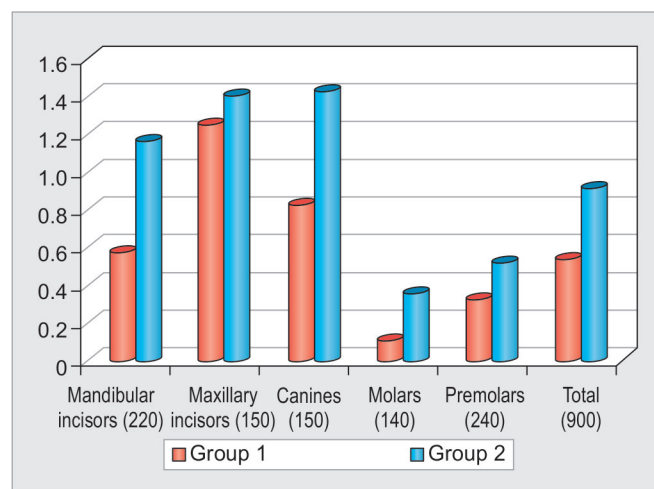
MATERIALS AND METHODS

This study was conducted in the Department of Oral Medicine and Radiodiagnosis of the dental institution and included assessment of all the cases in which pre- and posttreatment radiographs were available for analysis of estimating the amount of root resorption. Complete records of 80 patients were analyzed in which treatment has been completed and further, complete pre- and posttreatment details were available. Ethical approval was taken from the institutional ethical committee, and written consent was obtained after explaining in detail the entire research protocol. Examination of a total of 900 teeth was done. Only those patients in whom complete fixed orthodontic treatment has been completed in a single phase were included in the present study. Mean age of the patients in the present study was 21 years ranging from 11 to 38 years. The majority of the patients in the present study were females. All the treatments were carried out by registered experienced orthodontists having minimum experience of more than 10 years. All the cases were divided into two study groups. Group I comprised panoramic radiographic findings, while group II consisted of periapical radiographic findings. For the measurement of crown portion, root portion, and the complete root length, magnification loops of over 100 powers with parallax correction with inbuilt grids were used. Measurements were carried out on all the teeth from left first molars to the right first molars excluding the first premolars was done on a bright uniformly lit light set box. The difference between the total root length at the pretreatment time and posttreatment time was taken as the value of root resorption.⁶ Mesio Buccal root length

was measured in case of molars for assessing the amount of root resorption associated with the molars. Previously mentioned parameters were used in the present study for a measure of the deviation in the shape and form of the tooth.⁶ Assessment of the tooth length and the crown length was done by the same observers. All the results were analyzed by Statistical Package for the Social Sciences software version 6.0. Multivariate analysis and one-way analysis of variance were used for the assessment of the amount of root resorption. Student’s t-test was used for the assessment of tooth and crown length; $p < 0.05$ was considered statistically significant.

RESULTS

Among group I and II cases, maximum amount of root resorption was observed in case of maxillary central incisors and canines respectively (Graph 1). However, nonsignificant difference was obtained while comparing the mean root resorption in relation to maxillary incisors and canines among the two study groups. While comparing the mean root resorption in relation to various teeth among the study groups, significant difference was noticed only in case of mandibular incisors ($p < 0.05$) (Table 1). While comparing the overall value of root resorption among two study groups, significant difference

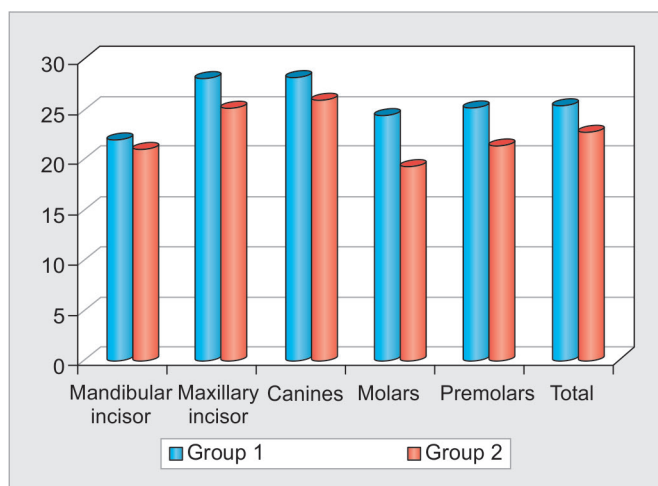


Graph 1: Mean quantity of root resorption (mm) in the apical area in different study groups

Table 1: p-value for mean quantity of root resorption (mm) in the apical area in different study groups

Anatomic location (No. of teeth)	Group I	Group II	p-value
Mandibular incisors (220)	0.57	1.16	0.02*
Maxillary incisors (150)	1.25	1.43	0.36
Canines (150)	0.82	1.42	0.84
Molars (140)	0.10	0.35	0.47
Premolars (240)	0.32	0.51	0.21
Total (900)	0.53	0.91	0.01*

*Significant

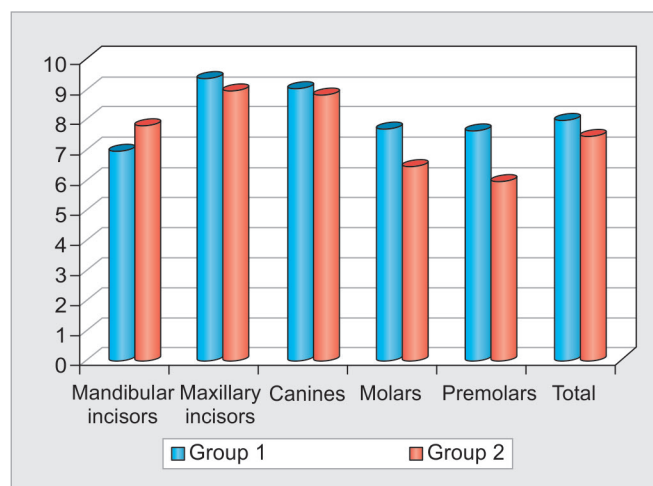


Graph 2: Total tooth length in groups I and II subjects (mm)

Table 2: p-value for comparison of tooth length in groups I and II subjects (mm)

Anatomic location	Group I	Group II	p-value
Mandibular incisors	21.9	20.9	0.02*
Maxillary incisors	28.0	25.1	0.02*
Canines	28.1	25.9	0.01*
Molars	24.3	19.2	0.03*
Premolars	25.1	21.2	0.02*
Total	25.3	22.6	0.01*

*Significant



Graph 3: Total crown length in groups I and II subjects (mm)

Table 3: p-value for comparison of crown length in groups I and II subjects (mm)

Anatomic location	Group I	Group II	p-value
Mandibular incisors	6.93	7.78	0.01*
Maxillary incisors	9.38	8.94	0.02*
Canines	9.01	8.81	0.25
Molars	7.68	6.48	0.03*
Premolars	7.62	5.94	0.02*
Total	7.95	7.43	0.03*

*Significant

Table 4: Frequency of root shape detection in both study groups

Shape	Group I (%)	Group II (%)
Dilacerated	11	16
Normal	83	76
Blunt	4	5
Pointed	1	3
Bottle shape	1	1

was obtained. The maximum value of tooth length in both groups was observed in cases of maxillary canines (Graph 2). Significant differences were observed while comparing the tooth length of various teeth among the two study groups ($p < 0.05$) (Table 2). While comparing the mean crown length in relation to various teeth among the two study groups, significant differences were observed (Graph 3 and Table 3). Among the deviated forms of root shape, dilaceration was the most common form of root shape detected in both study groups (Table 4).

DISCUSSION

One of the crucial steps in the early diagnosis of orthodontic treatment is assessment of radiographs. Radiographs offer numerous advantages, such as detection of key anatomical structures, radiographic detection of central pathologies, and evaluation of developing teeth at various stages of tooth development. The visualization of

radiographs helps in identification of all these features. In various dental treatment protocols, assessment of cephalic and panoramic films in the pretreatment phase is one of the routine procedures employed. These cephalometric and panoramic radiographs are recommended by most of the conducting educational programs.⁷ However, type of radiograph prescribed by the practitioner depends upon individual preferences. Whereas on one side some clinicians use full-mouth series of radiographs on adult patients, others prefer use of both panoramic and periapical radiographic films. Adult patients form the majority of group in which most of the dentists prefer using the periapical films.⁸ Time-saving features, less radiation dose, and more convenience for the patients are few of the advantages offered by the panoramic films. Of the common undesirable effect encountered while commencing orthodontic treatment is external root resorption. Clinicians are mostly dependent upon the radiographic findings for its diagnosis.⁹ Hence, we evaluate the accuracy of panoramic radiographic films for assessing the root resorption in comparison with the periapical films.

In this study, we observed that when comparison was made with periapical radiographic films, the overall quantity of root resorption in the apical region was found to be higher with panoramic radiographic films (Tables 1 and 2). The inherent difference in the magnification of the

two types of the radiographic films might be responsible for the observed difference in this study. Overall resorption when measured after adjusting the enlargement factor by one-fifth was found to be greater in cases with panoramic radiographs (Table 3). However, significant difference was observed only in case of incisors of mandibular region. Patients positing might be responsible for occurrence of such variations in the mandibular region. Dilacerations were the most common deviation of the shape of the roots observed in the present study (Table 4). Brusveen et al¹⁰ evaluated the occurrence of impacted maxillary canines as a risk factor for the development of root resorptions in the apical areas. They analyzed 66 patients who were treated with fixed orthodontic treatment. They divided the patients broadly into two study groups. The impacted group included patients with impacted maxillary canine unilaterally which was at sufficient distance from the maxillary incisors' roots in the initial stages of the treatments while the other group included patients without any impacted tooth. Pre- and posttreatment radiographs were used for the assessment of root shortening. They also evaluated the follicle to tooth ratio using periapical radiographs. They did not observe any significant difference in the apical resorption of the maxillary incisors in between the control group and the impaction group. Furthermore, no significant difference was observed by them in relation to the severity of root resorption in between the incisors of the impacted side alone and the control group incisor. Significant relation of follicle to tooth ratio was observed by the authors to the mesial inclination of the impacted canine. From the results, they concluded that in patients undergoing orthodontic treatment, impacted canine does not appear to be a risk factor for causing root resorption. Alqerban et al¹¹ compared the diagnostic accuracies of conventional two-dimensional (2D) panoramic radiographic techniques and three-dimensional (3D) cone-beam computed tomography (CBCT) techniques for the localization of the impacted canines and detection of root resorption induced by the impacted canines. They analyzed clinical records of the 60 patients who had impacted canine and reported seeking of orthodontic treatment. Two sets of radiographs were obtained for all the patients. All the subjects were divided into two study groups. First group comprised patients in whom 3D Accuitomo-XYZ Slice View Tomograph was performed, while second group included patients in which dental pantomograph and CBCT were obtained with a Scanora. They observed a statistically significant difference between the 2D and 3D images in the width of crown of canine. From the results, they concluded that in terms of sensitivity, CBCT is higher than conventional radiographs. Ho and Liao¹² evaluated the independent predictors of root resorption cases for surgical orthodontic treatment

of central incisors of maxilla that were impacted. They evaluated a total of 80 patients who received surgical-orthodontic treatment and had impacted unilateral maxillary central incisor. They retrospectively analyzed root resorption and its predictors from the patients' records and cephalometric and other radiographic details. They observed greater root resorption in subjects with impacted maxillary central incisors in comparison with physiological erupted contralateral incisors. From the results, they concluded that during surgical-orthodontic treatment, greater root resorption occurs in impacted maxillary central incisors in comparison with naturally erupted contralateral incisors. Sameshima and Sinclair¹³ evaluated the various treatment factors which could be used for the identification of external apical root resorption for detecting periapical radiographs at the end of orthodontic treatment. They examined the records of over 850 patients who underwent orthodontic treatment with fixed orthodontic appliances and measured the upper central incisor root apex's horizontal and vertical displacement on cephalometric radiographs. They observed significant association of duration of the orthodontic treatment and horizontal displacement of the apices of the incisors with root resorption. However, they did not observe any statistical difference in terms of slot wires, arch wire types, and types of expansions. From the results, they concluded that caution should be exercised by the clinicians in those patients in whom extraction therapies are planned for the correction of overjet. Sameshima and Asgarifar¹⁴ evaluated the accuracy of various types of radiographic films in the evaluation of root shapes at pretreatment and most treatment time for assessing the amount of root resorption. They evaluated a total of 42 patients and assessed their pre- and posttreatment radiographic details by periapical and panoramic radiographic films. They observed that for panoramic films, significantly higher apical root resorption was associated in comparison with periapical films. From the results, they concluded that periapical films should be preferred in cases where clinicians are expecting significant degrees of root resorption. As stated by the guidelines given by the British Orthodontic Society Radiography, for the supplementation of the panoramic radiography, standard occlusal radiograph might be necessary.^{15,16}

CONCLUSION

From the above results, the authors conclude that with panoramic radiographic films, more difficulty is encountered while assessing the shape of the root. Exaggeration also occurs in terms of quantity of root resorption with panoramic radiographs. However, further assessment studies are required for standardizing the fields of usage of various radiographic films.

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