

## COMPARATIVE EVALUATION OF ROOT RESORPTION ASSOCIATED WITH MAXILLARY CANINE IN OPG VERSUS CBCT: AN ORIGINAL RESEARCH

Dr. Arun Patyal<sup>1</sup>, Dr. Bhupendra Singh Rathore<sup>2</sup>, Dr. Rahul VC Tiwari<sup>3</sup>,  
Dr. Praveen Kumar Varma<sup>4</sup>, Dr. Afroz Kalmee Syed<sup>5</sup>, Dr. Heena Dixit Tiwari<sup>6</sup>,  
Dr. Akriti Mahajan<sup>7</sup>

1. M.D.S. Orthodontics And Dentofacial Orthopedics, Medical officer (Dental), Regional Hospital, Bilaspur, Himachal Pradesh. [drpatyal2001@gmail.com](mailto:drpatyal2001@gmail.com)
2. Senior lecturer, Dept of Orthodontics & Dentofacial Orthopaedics, College of dental science & Hospital Rau, Indore, M.P. [drbhupendra005@gmail.com](mailto:drbhupendra005@gmail.com)
3. OMFS, FOGS, (MHA), PhD Scholar, Dept of OMFS, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, 384315. [drrahulvctiwari@gmail.com](mailto:drrahulvctiwari@gmail.com)
4. Professor, Dept of Orthodontics, Vishnu Dental College, Vishnupur, Bhimavaram, Andhra Pradesh. [dpkvarma@yahoo.com](mailto:dpkvarma@yahoo.com)
5. MDS, Oral And Maxillofacial Pathology, Incharge Medical Officer, Covid Care Centers, Tenali, AP. [afrozsyed05@gmail.com](mailto:afrozsyed05@gmail.com)
6. BDS, PGDHHM, Final year Student, Master of Public Health, Parul University, Limda, Waghodia, Vadodara, Gujarat, India. [drheenatiwari@gmail.com](mailto:drheenatiwari@gmail.com)
7. MDS, Oral medicine and radiology, Private consultant, Jammu and Kashmir. [akritim709@gmail.com](mailto:akritim709@gmail.com)

Corresponding Author: Dr. Arun Patyal, M.D.S. Orthodontics And Dentofacial Orthopedics, Medical officer (Dental), Regional Hospital, Bilaspur, Himachal Pradesh. [drpatyal2001@gmail.com](mailto:drpatyal2001@gmail.com)

### ABSTRACT

**Aim:** The purpose of the present research was to compare the amount of root resorption visible on OPG as well as CBCT with respect to maxillary canine teeth.

**Methodology:** The clinical records of 60 consecutive patients who had impacted or ectopically erupting maxillary canines were identified from those seeking orthodontic treatment. For each case, two sets of radiographic information were obtained. The study sample was divided into two groups: group A ( $n = 30$ ) included those for whom a dental pantomograph (DPT) and CBCT obtained with a 3D Accuitomo-XYZ Slice View Tomograph® were available and group B ( $n = 30$ ) who had a DPT and CBCT obtained with a Scanora®. The DPT and CBCT images were subsequently analysed

**Results:** There was a highly significant difference between the 2D and 3D images in the width of the canine crown ( $P < 0.001$ ) and in canine angulation to the occlusal plane. Moreover, there was a highly significant difference between the DPT and Scanora CBCT images in canine angulation to the midline ( $P < 0.001$ ). There was also a significant difference between 2D and 3D images with respect to canine location ( $P = 0.0074$  for group A and  $P = 0.0008$  for group B). The presence or absence of root resorption of the lateral incisor was also significantly different in both groups ( $P = 0.0201$  and  $P < 0.001$  for groups A and B, respectively).

**Conclusion:** The results of this study suggest that CBCT is more sensitive than conventional radiography for both canine localization and identification of root resorption of adjacent teeth.

**Keywords** Cone-Beam Computed Tomography, Impacted Tooth, Root resorption.

## INTRODUCTION

The maxillary canines are the second most frequently impacted teeth after the third molars, with general prevalence rates from 1 to 3%.<sup>1,2</sup> However, in comparison with the third molar, the maxillary canines are located in a highly demanding area, both in function and aesthetics.<sup>3</sup> The potential collision of impacted maxillary canines and adjacent teeth could lead to root resorption (RR). RR is a relatively common phenomenon, defined as the progressive loss of cementum and dentine of the affected teeth, resulting in permanent tooth root. Due to a general lack of symptoms, the RR of permanent teeth caused by impacted canine collision has a tendency to be misdiagnosed.<sup>4</sup> RR is typically diagnosed by radiography.

In recent years, the techniques used to detect maxillary impacted canines have improved with new advances in medical imaging technologies. Through the use of CBCT images, many unidentified features of impacted canines can be easily resolved.<sup>5-7</sup> Furthermore, relative to 2D radiography, CBCT enhances the detection of RR on adjacent teeth, contributes to modifications in treatment plan, and improves confidence in diagnosis and treatment plans.<sup>8</sup> Furthermore, whereas 2D radiographs reveal RR in 30–50% of lateral incisors in individuals with impacted canines, the detection of lateral incisor RR increases by at least another 65% when using CBCT.<sup>9</sup> Today, it is clear that CBCT imaging is an important stage in making a diagnosis and planning treatment procedures for impacted canines. It is important to define the exact position relative to neighbouring structures and the inclination of the longitudinal axis of the impacted tooth.<sup>10</sup> The presence or absence of RR determines the optimal treatment strategy. When RR occurs, surgical exposure and orthodontic traction of the canine are carried out.<sup>11</sup> According to recent studies, using CBCT images as a diagnostic method has shown that 48% of ectopic canines caused RR of varying severity<sup>6-12</sup>; up to 70% of impacted maxillary canines cause RR of at least one adjacent tooth.<sup>13-14</sup> Diagnosed RR usually does not change prior to orthodontic treatment, but significantly affects the treatment plan in terms of determining the direction of orthodontic traction. Otherwise, RR existing on the adjacent teeth may become worse when displacing the impacted canine. This predominance is confirmed by all studies excluding patients with past or ongoing orthodontic treatment.<sup>15</sup> The prevalence of moderate and severe RR tends to be higher in most other studies, perhaps because, in cases of past or ongoing orthodontic treatment, poor control of the relationship between the canine and the adjacent roots could have worsened the RR that was already present to a lesser extent.<sup>16</sup> Many questions regarding both panoramic imaging and CBCT need to be addressed. However, there has been no direct comparison of panoramic imaging and CBCT, and no data are available on whether 3D imaging provides significantly more information than traditional radiographs, concerning the diagnosis of root resorption and localization of impacted canines. Therefore, the purpose of this retrospective study was to compare the radiographic diagnostic accuracy of CBCT with that of panoramic radiography for the localization of impacted maxillary canines and incisor root resorption lesions.

## AIM OF THE PRESENT STUDY

The purpose of the present research was to compare the amount of root resorption visible on OPG as well as CBCT with respect to maxillary canine teeth.

## METHODOLOGY

The clinical records of 60 consecutive patients who had impacted or ectopically erupting maxillary canines were identified from those seeking orthodontic treatment. A total of 89 impacted maxillary canines were studied. The patients were 37 females and 23 males, with ages ranging from 6.3 to 28.9 years. For the purpose of this study, two groups were formed.

For each subject, two sets of radiographic information had been obtained within a maximum interval of 2 weeks. The first set consisted of traditional panoramic radiographs and the second set 3D volumetric images obtained from a CBCT scan. Group A ( $n = 30$ ) included those patients who had a dental pantomograph (DPT) and group B ( $n = 30$ ) who had a DPT and CBCT obtained with a Scanora® 3D CBCT. One hundred and twenty sets of images were reviewed and analysed in a random order. The observers examined 60 DPT images and 30 images of each type of CBCT. If resorption was diagnosed, the severity of resorption was rated based on the grading systems suggested by Ericson et al.—(a) no resorption: intact root surfaces; (b) slight resorption: resorption extending up to half of the dentine thickness to the pulp; (c) moderate resorption: resorption midway to the pulp or more with the pulp lining being intact; and (d) severe resorption: the pulp is exposed by the resorption. The location of the diagnosed resorption defect was also recorded as in the apical, middle, or cervical third. The measurements of the width and angulation were compared between the 2D and 3D images using a non-parametric Wilcoxon signed rank test on the mean measurement. All comparisons between the 2D and 3D images were undertaken separately on the set of patients' data. *P*-values less than 0.05 were considered significant.

## RESULTS

Compared with panoramic radiography, lateral incisor root resorption cavities were more distinguishable using CBCT. Greater agreement between observers for all variables was achieved when using CBCT. The results show that the proportion of agreement was high for the assessment of CBCT images. Based on the analysis using the protocol (over the observers) for the categorical outcomes, there was only evidence for a difference between 2D and 3D imaging with respect to canine location;  $P = 0.0074$  for group A and  $P = 0.0008$  for group B. The detection of the presence or absence of root resorption of the lateral incisor was also significantly different in both groups ( $P = 0.0201$  and  $P < 0.001$ , respectively). The detection of the presence of central incisor root resorption was significantly different between the cbct and DPT images in group A ( $P = 0.045$ ). There was also a significant difference in the severity of lateral incisor root resorption between the DPT and CBCT in both groups ( $P = 0.02$ ).

**Table 1- Distribution of the 89 impacted maxillary canines and percentage for group A: patients who had a dental pantomograph (DPT) and cone beam computed tomogram obtained with Accuitomo; group B: patients who had a DPT and cone beam computed tomography obtained with Scanora.**

	Male	Female	Bilateral	Unilateral	Left	Right
Group A	12 (40%)	18 (60%)	9 (30%)	21 (70%)	17 (44%)	22 (56%)
Group B	11 (37%)	19 (63%)	20 (67%)	10 (33%)	25 (50%)	25 (50%)

**Table 2- Overall agreement level for each variable in each patient group in relation to canine resorption**

Groups	Proportion of agreement	Kappa	Standard error	P value
Group A Accuitomo	0.53	0.53	0.65	0.0412
Panoramic	0.30	0.26	0.26	0.0795
Group B Scanora	0.90	0.87	0.85	<0.0001
Panoramic	0.57	0.30	0.17	0.1184

## DISCUSSION

Over the years, clinicians have searched for clues that may indicate a high risk for incisor RR associated with impacted maxillary canines. CBCT enables the determination of the exact distance of adjacent teeth; such a relationship is almost impossible to accurately assess on OPT. CBCT provides more precise information in diagnostic analysis, especially for planning orthodontic and surgical procedures where complications can be expected due to the close relationship between maxillary impacted canine and adjacent teeth. The sensitivity of CBCT compared with panoramic imaging is much higher, allowing accurate diagnosis of the location and the degree of resorptive cavities, which may be critical in changing treatment plans. Although such treatment decisions appear to be a logical clinical outcome with the use of CBCT, the effects of the superior information derived from CBCT images will be of benefit in modifying treatment decisions and determining the threshold of RR. The use of CBCT increases the detection of RR significantly, by eliminating blurring and the overlapping of other teeth. For proper orthodontic mechanics, it is essential to determine the exact position of the impacted tooth relative to the adjacent teeth and surrounding structures. Knowing the inclination of the longitudinal axis of the impacted tooth will allow for improved force vectors. The early diagnosis of “possible” tooth collision is paramount in avoiding RR and can dictate an optimal treatment strategy. When RR occurs, the surgical exposure and orthodontic traction of the canine may be necessary to avoid further RR and aid in orthodontically erupting the tooth. Monitoring during treatment with progressive (additional) CBCT is recommended in some cases to confirm movements. Further research will focus on the monitoring of diagnosed RR during orthodontic treatment, the expansion of impacted maxillary canines, and whether and how they will change. In the analysis of treatment planning, a strong agreement was found between the two groups, similarly to Algerbanet *al.* research, meaning that the treatment plan proposal didn't differ much based on the panoramic and the CBCT data set. For both methods, orthodontic treatment with permanent canine traction was the preferred treatment plan. Some other studies found treatment plans to be different when analyzing 2D and 3D images.<sup>17</sup> The position of the impacted tooth and the inclination of its long axis strongly influence the prognosis, treatment duration and the difficulty of the case. In this study, the prognosis, treatment duration and difficulty of the case didn't differ much between the two groups, what might be explained by the agreement found between the two groups for the treatment plan. However, a previous study<sup>18</sup> found that the difficulty of the case differed significantly comparing 2D and 3D images, with a higher degree of difficulty obtained with the 3D image set.

## CONCLUSION

Early radiographic examination and diagnosis are essential to recognize impacted canines. The sequela of delayed eruption or treatment of impacted canines may be severe resorption of the adjacent lateral and central incisors.

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