



## Study of the apices of human Mandibular premolar teeth with the use of cone beam computed tomography

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### ABSTRACT

**Aim:** The aim of this study was to determine the distance of the apical constriction from the apical foramen and size of the apical Foramen in human Mandibular premolars using Cone beam computed tomography [CBCT].

**Methodology:** Forty freshly extracted Mandibular premolars were collected. 10 premolars were arranged on a wax occlusal rim with a base, 4 sets were prepared for exposure. Each set was exposed to CBCT, at 60kv voltage, 2mA current and an exposure time of 12 sec. Each tooth was analysed by inbuilt software (Planmeca Romexis viewer 3.5.1.R) which was utilised to perform multi-threshold segmentation for analysis.

**Results:** The mean distance from the Apical Constriction (AC) to the Apical Foramen is 0.72mm with a standard deviation (SD) of 0.43mm and a Mean diameter of the Apical foramen (AF) of Mandibular premolars being 0.69 mm with a standard deviation of 0.37mm.

**Conclusion:** This study demonstrated that the mean distance of the apical constriction from the apical foramen was 0.72mm; therefore, the Biomechanical preparation and obturation should end at this point and the mean size of apical foramen was 0.69mm. The study focuses on the importance of Cone beam computed tomography in finding the accurate location of the apical constriction and the Apical foramen.

### KEYWORDS

Apical constriction, Apical foramen, Mandibular Premolars

### INTRODUCTION:

Proper sealing of the root canal is very important in preventing the passage of bacteria and their toxins into the periapical area thereby preventing infection.<sup>1</sup> The main anatomic and histological references for determining ideal apical limit for root canal therapy are Cemento Dentine junction (CDJ), apical constriction (AC) and apical foramen (AF).<sup>2</sup> Apical limit of root canal instrumentation and obturation was always been a controversy. Researchers have concluded that best prognosis of root canal therapy will be achieved when the apical limit terminates at the CDJ. As it is difficult to determine the position of the CDJ by radiography apical constriction serves as the termination point of root canal therapy.<sup>3</sup>

Mandibular Premolars exhibit high degree of variation in their root canal anatomy. <sup>4</sup>This variation is highest seen in Mandibular first Premolars so, often mandibular first premolars have been considered as **Endodontist's enigma**.<sup>5</sup>

CBCT allows the clinician to view the tooth and pulpal struc-

tures in thin slices in all three anatomic planes: Axial, Sagittal and Coronal. This capability allows visualization of periapical pathology and root morphology with higher resolution and accuracy. CBCT imaging has been helpful in providing important information in endodontic problems where conventional radiography has failed.<sup>6</sup>

Hence the Aim of the present study was to evaluate the distance of the apical constriction from the apical foramen and size of the apical foramen in human Mandibular premolars using CBCT.

### MATERIALS AND METHODS:

Forty patients were randomly selected with an age group of 18 to 25 years which were referred to department of oral and maxillofacial surgery for extraction of Mandibular premolars for orthodontic purposes. After obtaining patient consent according to Declaration of Helsinki, All the extractions were carried out.

**Inclusion Criteria:**

- A] Premolars with no or minimal caries
- B] Premolars with mature apices
- C] Premolars with vertucci's Type 1 configuration
- D] Premolars with single constriction<sup>7</sup>

**Exclusion criteria:**

- 1] Premolars with resorption
- 2] Premolars with multiple canals

All teeth were disinfected according to OSHA regulations, in jars containing 10% formalin (Emplura formaldehyde solution) until the initiation of laboratory studies. Samples were stored in 5.25% sodium hypochlorite solution (Reachem, Reachem Laboratory chemicals) for 48 hours at room temperature to dissolve debris. All samples were then rinsed and soaked in running water to remove debris. The teeth were cleaned by scaling and polishing. Soft tissue debris, bone chips and calculus were removed.

Premolars were arranged in sets of 10 on wax occlusal rims mounted on a stone cast. Four such sets were prepared for exposure. All images were taken in PlanmecaPro Max 3D Max with image capturing parameters at 60kv voltage, 2mA current and an exposure time of 12 sec.Each tooth was analysed by inbuilt software (Planmeca Romexis viewer 3.5.1.R) which was utilised to perform multi-threshold segmentation for analysis. Axial, coronal and sagittal two-dimensional sectional images were displayed on a 32-inch Dell LCD screen with a resolution of 1280x1024 pixels in a dark room. The criteria to characterize the major foramen as opposed to other minor foramina in this investigation was the opening of the largest diameter found at the apical level<sup>9</sup> and The smallest cross sectional area of the canal was defined to be the "APICALCON-STRICTION". All the measurements were done by two experienced examiners, in case of any discrepancy the mean of both values were considered. The data was statistically analysed using SPSS 3.0(statistical package of social science).

**RESULTS:**

The results of the study showed that the mean distance from the apical constriction to the apical foramen is 0.72mm with a standard deviation of 0.43mm. The mean size of the apical foramen is 0.69mm with a standard deviation of 0.37mm. The 95% confidence interval for the distance from the apical constriction to the Apical Foramen is 0.58-0.86mm and the size of the apical Foramen is 0.57- 0.81mm. [Table 1]

**TABLE 1- Showing the mean distance from apical constriction to apical foramen and size of apical foramen of Mandibular premolars in mm**

	Total Sample size	MEAN	Standard deviation	Standard error	95% confidence interval	
					LOWER	UPPER
Distance from AC-AF	40	0.72	0.43	0.068	0.58	0.86
Size of AF	40	0.69	0.37	0.058	0.57	0.81

AC- Apical constriction      AF- Apical Foramen

**DISCUSSION:**

In recent years several studies have been conducted to establish the exact location of the apical constriction and the position of the apical foramen. There is little literature reported on the distance of the apical constriction to apical foramen. The present study utilized CBCT which provides an accurate three dimensional view of the canals there by eliminating the need to section teeth and measure the distance by traditional radiography or stereomicroscope which are not highly reliable. CBCT accurately measured the smallest diameter of 0.28mm thus providing highly accurate measurements.

The present study showed the mean size of the apical foramen in Mandibular premolars is to be 0.69mm differed with Morfis et al study which demonstrated the mean size of the

apical foramen to be 0.36mm.<sup>10</sup>The difference might be due to the use of SEM in their study and the population observed in the study. The apical limit for the BMP and obturation is the apical constriction.

The most commonly followed apical limit for biomechanical preparation and obturation is the apical constriction. Cemento Dential junction coincides with the apical constriction in majority of cases. Ponce et al <sup>2</sup>in their study concluded that CDJ is the point at which two histological tissues meet. The present study was done on patients under age group 18-25 years as the CDJ continuously undergoes modification. <sup>2</sup>

Naseri et al <sup>8</sup> in their study concluded that determining the location of the CDJ is not possible radiographically so apical constriction serves as a safe apical limit for pulp space therapy. According to Martos et al<sup>9</sup> the major foramen was in a central location on the root apex in 40% of specimens and deviated from the anatomical apex in 61%.According to Morfis et al<sup>10</sup>only 37.64% of Mandibular premolars had the location of foramen at the apex. Available literature suggests majority of the measurements to date were done from the foramen to the anatomic apex of the tooth. There is little available literature measuring the distance from the apical foramen to apical constriction studies have suggested that the obturation should end at the apical constriction.<sup>8</sup>Based on these conclusions in our present study it is more accurate to measure the distance from apical constriction to apical foramen than from the apex to apical constriction.

The present study showed that the mean distance of apical constriction to apical foramen is 0.72mm. Dummer et al<sup>6</sup> concluded that the mean distance from apical constriction to apical foramen is 0.99±0.57mm which differed from this study, probably due to the difference in the teeth and the technique used in both the studies. So the root canal preparation and obturation should end at 0.72±0.43mm short of apex in Mandibular premolars this is closely in accordance with 1mm short of radiographic apex which is popularly followed in routine pulp space therapy of any tooth.

**CONCLUSION:**

To conclude, CBCT could be used as an important diagnostic tool for accurate measurement of the size of the apical foramen and distance of the apical constriction. In cases of adjacent RCTs it is recommended to opt for a CBCT evaluation which allows the clinician to accurately determine the location of the apical constriction, number of canals and the foramina at the same time. This could reduce the overall radiation exposure.

The mean size of apical foramen was found to be 0.69mm. The mean distance from the apical constriction to the apical foramen is 0.72mm in Mandibular premolars. Hence the Biomechanical preparation and obturation could be limited to0.72±0.43mm short of the apex.

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