Research Article

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Evaluation of Root and Root Canal Morphology of Mandibular Premolars among Jodhpur Population Using CBCT

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ABSTRACT

Aim: To evaluate morphological variations, number of roots and root canals in mandibular premolars with the help of cone beam computed tomography (CBCT) among Jodhpur population.

Materials and Method: 113 extracted mandibular first premolars and 132 mandibular second premolars in Rajasthan population were collected from the dental hospitals in Jodhpur.The teeth were mounted on a modelling wax in an arch form (ten teeth in one arch) &the apices of the roots of each row in a single plane. All images were taken using a Kodak 9000 3D CBCT machine. The tooth position, number of roots and canals, and canal configuration according to Vertucci's and Melton's classification were recorded.

Result: The results showed that 99.1% of mandibular first premolars had one root and 0.9% had two roots and third root was not found; 84.9% had one canal, 15 % had two canals and third root canal was not found. The prevalence of C shaped canal was 2.6%. All mandibular second premolars had one root; 78.7% had one canal and 18.1% had two canals. The prevalence of C shaped canal was 1.6%.

Conclusion: Mandibular second premolar had a more canal variation as compared to mandibular 1st premolar. The prevalence of C shaped canal was mostly type 1. CBCT has potential as an auxiliary tool in the evaluation of mandibular premolars with complex canal morphology to improve the quality of root canal therapy.

Keywords: Cone-beam computed tomography, Mandibular premolar, Morphology, Root canal configuration.

INTRODUCTION

A clear understanding of the anatomy of tooth is very necessary in endodontics because it deals with the internal anatomy management.[1]Variations in canal anatomy, incomplete canal instrumentation and obturation are the most substantial causes of endodontics failure. Ingle states that mandibular premolars are the most complex and a challenge to endodontically treat them.[2] Thus endodontic flare-ups, re-treatment and failures are most likely seen due to variants in root canal morphology.[3] A distinctive statement of mandibular premolars is a 'single-rooted' tooth depicting a 'single' root canal, wider bucco-lingually than mesio-distally having two pulp horns; large pointed buccal and small rounded lingual. The canal is oval shaped cervicallyand as it approaches the middle, it becomes round.

Vertucci and Melton has classified canal morphology into various types. Vertucci has

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Fig 1: Mandibular 1st premolars arranged in arch.

Fig 2: Mandibular 2nd premolars arranged in arch.

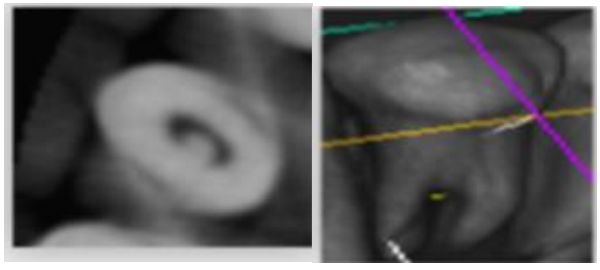


Fig 3a and 3b: Mandibular 1st premolar showing two roots and two canals, C shaped type 1 root canal.

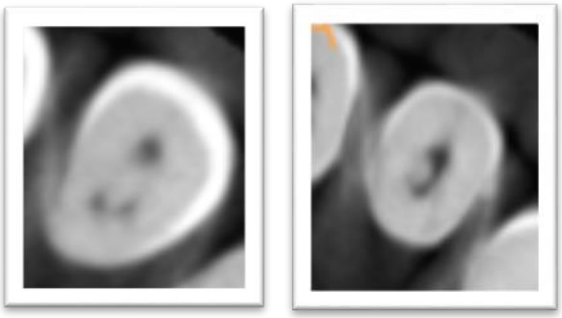
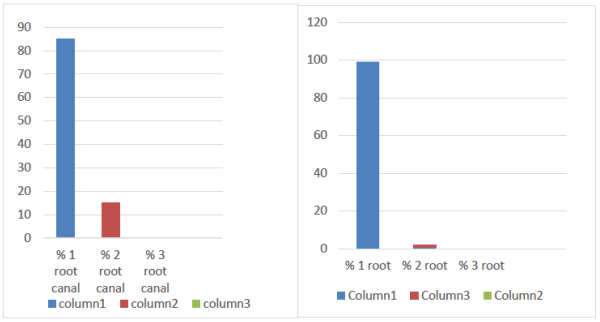
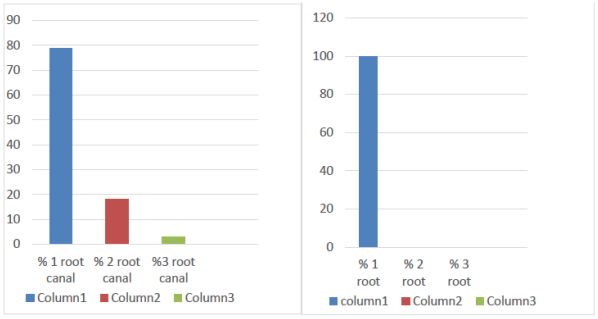


Fig 4a and 4b: Mandibular 2ndpremolar showing three root canals and C shaped type 1 root canal.



Graph 1: Showing percentage of root and root canal in mandibular 1st premolar.



Graph 2: Showing percentage of root and root canal in mandibular 2ndpremolar.

reported that 97.5% mandibular second premolars and 74% mandibular first premolars have one canal at the apex. It may also have three roots with three canals or one root with four canals. C-shaped canal anatomy cannot be overlooked in mandibular first premolars.[4]Canal configurations in mandibular premolars may vary significantly with respect to

1. Ethnicity
2. Race
3. Gender

Researchers have authenticated studies on number of canals, incidence of multiple roots,

complex canal morphology by using different study types like root canal clearing technique, radiographs of root canal treated teeth, in-vitro radiography and sectioningand analysis of extracted teeth and several studies have reported a large variation.[5]According to Micheti *et al.*CBCT is a very interesting, reliable, noninvasive measuring technique that can be used in all spatial planes to study dental anatomy. This study is aimed to evaluate morphological variations, number of roots and root canals in mandibular premolars with the help of cone beam computed tomography (CBCT) among Jodhpur population.

MATERIALS AND METHOD

This cross-sectional double blind in-vitro study was conducted in Jodhpur Dental College General Hospital, Jodhpur Rajasthan, after being approved by the Institutional Ethical Commitee. The teeth samples used in this study were those indicated for orthodontic extraction. The inclusion criteria was single rooted fully erupted teeth with closed apices. Teeth with deep caries, metallic restorations, fractures, teeth with incompletely formed roots, and those which were endodontically treated were not included. All attached soft tissue and calculus were removed using an ultrasonic scaler.Teeth were sterilized in 5.25% sodium hypochlorite for 15min. The teeth were mounted on a modelling wax in an arch form (ten teeth in one arch) (Figure 1 and 2).

Teeth were so arranged as to maintain the apices of the roots of each row in a single plane. All images were taken using a Kodak 9000 3D CBCT machine with exposure parameter of 66kV and 8 mA along with an exposure time of 10.8 sec.Software used to view the scanned teeth was the CS 3D imaging – DICOM CD Viewer.Scan reports included cross-sections, buccolingual longitudinal sections, and mesiodistal longitudinal sections. Canal patterns were observed in the cross-sectional and longitudinal section and were tabulated based on the canal morphologies. The radiographic analysis was done by two independent Endodontists and in cases of doubt; an oral radiologist was consulted to reach a confirmative decision.

RESULT

The canal morphology of 113 mandibular first and 132 mandibular second premolars was assessed according to Vertucci's classification and Melton's classification.

Mandibular first premolars -Type 1- 96 teeth (had one canal) 84.9%,

Type 2-17 teeth (had 2 canals) 15 % (Fig- 3a)
1 root - 112 teeth - 99.8%
2 root – 1 tooth - 0.9%
Type 1- C shaped canals - 3 teeth - 2.6% (Fig - 3b)

Mandibular second premolars- Type 1- 104 teeth (had one canal) 78.7%,

Type 2- 24teeth (had 2 canal) 18.1%
Type 7- 4 teeth (had 3 canal) 3% (Fig- 4a)
1 root - 132 teeth - 100%
Type 1- C shaped canals - 3 teeth - 1.6% (Fig - 4b)

DISCUSSION

If a root canal is not adequately cleaned then it reduces the success rate of the treatment. To overcome this issue it is necessary to know the complex anatomy of the teeth. Complex Root canal anatomy is very challenging step in endodontics. As it is mentioned in several studies that premolars are having variations in anatomy like number of roots, number of root canals, C shaped canals etc. These findings can be confirmed with the help of CBCT. In the current study CBCT was used to analyze the canal morphology of the mandibular first premolars and second premolar among Rajasthan population.CBCT is successful advancement to obtain the knowledge of morphology and canal configuration of the tooth due to its 3D imaging feature.[5]

C-shaped canals are predominantly found in mandibular second molars but their presence has been documented in mandibular premolars. 1991, Melton et al. [6]

Type 1- continuous C shaped canal
Type 2- Semicolon C shaped canal
Type 3- two discrete and separate canals

Subdivision 1- C shaped orifice in the coronal third that divides into 2 or more discrete and separate canals that join apically.

Subdivision 2- C shaped orifice in the coronal third that divides into 2 or more discrete and separate canals into mid root to the apex.

Subdivision 3- C shaped orifice in the coronal third that divides into 2 or more discrete and separate canals in the coronal third to apex.

Determine of the root canal pattern can be done on the basis of Vertucci's classification[4]:

Type I: A single canal extends from the pulp chamber to the apex (1).

Type II: Two separate canals leave the pulp chamber and join, short of the apex, to form one canal (2-1).

Type III: One canal leaves the pulp chamber and divides into the root; the two then merge to exit as one canal (1-2-1).

Type IV: Two separate, distinct canals extend from the pulp chamber to the apex (2).

Type V: One canal leaves the pulp chamber and divides short of the apex into two separate, distinct canals, with separate apical foramina (1-2).

Type VI: Two separate canals leave the pulp chamber, merge in the body of the root, and redivide short of the apex to exit as two distinct canals (2-1-2).

Type VII: One canal leaves the pulp chamber, divides and then rejoins in the body of the root, and finally redivides into two distinct canals short of the apex (1-2-1-2).

Type VIII: Three separate, distinct canals extend from the pulp chamber to the apex (3).

In this study we used these classifications to determine the root canal morphology and C shaped canal pattern.

Root canal morphology of mandibular premolars has been reported based on various population including Chinese[7], Turkish[8], American[9, 10], Mexican.[11]

A study done on Chinese population by Lu et al., and Yang et al., showed only 54% and 86.8% of mandibular first premolars with a single canal respectively whereas only 22% and 97.2% in mandibular second premolars, 93.48% in South Indian population.[2]

A similar CBCT study done by Salar Pour et al., and Kim et al, on Iranian population prevalence is (88.5% 1 canal or 11.5% 2 canals[12] and in Korean population prevalence of one root is 99.9% in mandibular 1st premolar and 99.4% in mandibular 2nd premolar respectively. They also portrayed highest occurrence of single canal morphology in mandibular first and second pre-molars.[13] In Spanish population, the prevalence of single canal was 83.3 %.[14] In Indian populations, 80% - single canal. 11% - two canals[14] and C shaped canal is a challenging variation.[4] Vertucci reported the occurrence of a C-shaped canal in 0.5% of the mandibular first premolars.[15] In Jordanian population- 58.2% single canal in first premolar and in second premolar 72%.[16] Lu et al. reported the incidence of C-shaped canals in the Chinese population to be 18% and Baisden et al. indicated the existence of a C-shaped canal in 14% of the mandibular first premolars.

Sikri et al reported that the prevalence of a C-shaped canal in mandibular premolars in Indian population was 10.7%, whereas, in our study, among the Jodhpur population the prevalence of c shaped canal is 2.6% in mandibular 1st premolars and 1.6% in mandibular 2nd premolar. The prevalence is shown in result as well as in graph. (Graph 1 and 2)

CONCLUSION

Mandibular premolars in Rajasthan population exhibited high variability and complexity in their canal systems. These variations included extra canals, C-shaped canal and 3 canals.This study reveals the higher ratio of three canals in mandibular premolars in Rajasthan population.Significantly, a CBCT scanner was able to detect these complex variations. This suggests that CBCT has potential as an auxiliary tool in the evaluation of mandibular premolars with complex canal morphology to improve the quality of root canal therapy.CBCT scanning is of great value in detecting anomalous canal morphology when diagnosis by conventional radiography is inconclusive.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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