

Root Canal Morphology of Mandibular second Premolars in North Indian SubPopulation

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Abstract- Introduction: The main goal of root canal treatment is to prevent or heal formation of apical periodontitis. Complexity of root canal anatomy presents clinical challenges related to treatment outcome. The aim of this study was to investigate the morphology of the root canal system of mandibular 2nd premolar in north Indian subpopulation using periapical radiographs and CT Dentascan. No such study on Indian subpopulation is present till date. **Methods:** A total of 310 mandibular second premolar teeth were examined with the help of periapical radiographs and CT Dentascan in 158 patients, aged between 15 to 60. Number of roots and root canals were evaluated. **Results:** Among the teeth examined 6.4% (n=20) had more than one root. Regarding canal morphology, 3.8% (n=12) of the teeth had two canals, whereas 1.9 % (n= 6) had three canals and 1% had more than 3 canals. **Conclusion:** Most of the mandibular 2nd premolar had 1 root and 1 root canal. Less than 1 of 10 mandibular 2nd premolar had complex root canal system(2 or more canals).This study provides supplemental information about root canals of mandibular 2nd premolar in north Indian subpopulation.

Index Terms- dentascan, mandibular 2nd premolar, root canal

I. INTRODUCTION

The main objectives of endodontic therapy are proper cleaning and shaping of all pulp spaces and complete obturation of these spaces with an inert filling material. Slowey (1) stated that the root canal anatomy of each tooth has certain commonly occurring characteristics as well as numerous atypical ones that can be roadmaps to successful endodontics. So the clinician must have an understanding of the complexity of the root canal system and its possible variations in order to achieve a successful outcome.

As a group, the mandibular premolars are among the most difficult teeth to treat endodontically. A possible explanation for this difficulty may be the extreme variations in root canal morphology that occur in these teeth. Furthermore, the incidence, location, and morphology of root canal systems may vary in different ethnic or regional populations. The mandibular second premolar is typically described in textbooks as a single rooted tooth with a single root canal system (2, 3). But, there are numerous case reports and anatomic studies that have reported variations in this tooth (5-10).

Traditional radiograph is limited in its ability to give reliable information on the number and morphology of root canals (12). The application of further analytic diagnostic tools such as dental CT for the assessment of unusual root canal

morphology has been highlighted, aiding the correct endodontic management of complicated and challenging cases (13).

There are no published reports on the root canal anatomy of mandibular 2nd premolars in Indian population. Therefore, the purpose of this study was to evaluate root and canal morphology in mandibular second premolars in north Indian subpopulation.

II. MATERIAL AND METHODS

Case selection:

Patients having fully erupted permanent mandibular second premolars with completely developed apices lacking root canal fillings and coronal restorations were selected. Most of these patients required pre-operative CT Dentascan assessment for implant placement, orthodontic treatment and other treatment needs. A total of 310 mandibular second premolar form 158 patients were evaluated. Informed consent was obtained from the patient.

Image acquisition:

A minimum of two radiographs were taken for each tooth-first was taken at an angle of 90 degrees in the horizontal plane and second was taken at 30 – 40 degrees mesial to the horizontal plane as suggested by Martinez-Lozano et al(13).CT Dentascan images were obtained for all the patients. Two independent Endodontists assessed the number of roots and canals, the position where canal bifurcation occurred and the canal configuration to reach consensus on the interpretation of radiographic findings. The types of canal configuration was categorised based on Vertucci's classification (14).

III. RESULTS

Among the 310 mandibular second premolars studied, 19 teeth exhibited 2 roots and 1 tooth had 3 roots. No significant difference was found between the number of root / root canals and tooth position.

Number of roots:

The majority of the teeth 93.5% had a single root. Two roots were found in 6.1% of the cases whereas three-rooted (0.3%) teeth were extremely rare. Two rooted premolar were bilaterally present in 5 patients. Results were tabulated (table 1) along with major anatomical studies on mandibular second premolar.

Reference (Country)	No. of teeth studied	Type of study	1 Root%	2 Roots%	3Roots%
Visser (1948) (16)	2,089 (Germany)	Analysis of extracted teeth	99.85% (2,086)	0.05% (1)	0.1% (2)
Vertucci (1978) (17)	400 (USA)	Clearing	100 % (400)	—	—
Geider et al. (1989) (18)	328 (France)	In vitro radiography & sectioning	97.6% (320)	0.4% (8)	—
Zaatar et al. (1997) (19)	64 (Kuwait)	Radiographs of RCT teeth	95.6% (61)	4.7% (3)	—
Present study	310(India) CT analysis in vivo	Radiographic and	93.5 % (290)	6.1 % (19)	0.3 % (1)

Number of canals:

Of all the teeth studied, single canal was present in 93.2% of the cases. Two separate canals were present in 3.8% of cases whereas three canals were found in 1.9% of the cases. CT images confirmed the presence of 4 canals in 0.6%.

Reference studied	No. of teeth (Country)	Type of study canals%	1 canal%	2 or more
Barrett (1925) (20)	32 (USA)	Sectioning	65.6% (21)	34.4% (11)
Pineda and Kuttler (1972) (21)	250 (Mexico)	Radiographic In vitro	98.8% (247)	1.2% (3)
Zillich and Dowson (1973) (22)	906 (USA)	Radiographic in vitro and Probing	87.5% (793)	12.5% (113)
Vertucci (1978) (17)	400 (USA)	Clearing	97.5% (390)	2.5% (10)
Geider et al. (1989) (18)	328 (France)	In vitro radiography and sectioning	86.6% (284)	13.4% (44)
Zaatar et al. (1997) (19)	64 (Kuwait)	Radiographs of RCT teeth	95.3% (61)	4.7% (3)
Hasheminia and Hashemi (2005) (25)	80 (Iran)	Clearing and sectioning	88.8% (71)	11.2% (9)
Present study	310 (India)	Radiographic and CT analysis in vivo	93.2 % (289)	6.8 % (21)

Table – 1

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IV. DISCUSSION

Anatomical studies render invaluable knowledge about the normal and unusual canal morphology. Various techniques have been used in studies evaluating canal morphology. The aim of this study was to investigate the morphology of the root canal system of mandibular 2nd premolar in north Indian subpopulation using periapical radiographs and CT Dentascan. Compared to other technique, Dentascan and periapical radiographs are non-invasive method and can be used directly to evaluate living samples. Matherne et al (15) suggested that computed tomography imaging has been successfully used in endodontics for better understanding of the root canal anatomy. Yoshioka et al (16) have indicated that sudden narrowing of the canal system on a periapical radiograph suggests canal system multiplicity. However, it has its inherent limitation to assess the root canal system completely.

Our study shows that the incidence of more than one root in mandibular 2nd premolar is about 6.4 % which is very much higher than the previous anatomical studies (7-11). Only one study by Serman and Hasselgren(17) got results similar to the present study. With respect to the number of canals, the findings were quite similar to the findings of Hasheminia and Hashemi(18). One of the possible reasons could be the different ethnic population(19) in our study and secondly 2 rooted mandibular 2nd premolar may occur bilaterally. In our study, almost 5 patients had two rooted mandibular 2nd premolar bilaterally. In addition, mandibular 2nd premolar with 3 or more root canals were reported occasionally and their incidence in this study was also minor(19).

Matherne et al (20) reported the superiority of computed tomography over other diagnostic methods in locating the additional canals. In the present study, axial images of CT were used to confirm the additional roots or canals. Thus CT imaging is not only non-invasive but also highly sensitive method for morphological studies in living samples(21). In clinical practice, 2 or more root canals may be overlapped in perapical radiographs and the information provided by dentascan in this study was useful to probe root canal orifices(21).

The human mandibular 1st premolar tooth, in comparison had a higher incidence of more than 1 canal system(24.2%) and more than 1 apical foramina(21.1%) in weighted studies(22). No literature is available on incidence of multiple canals in mandibular 2nd premolar using dentascan and periapical radiographs in Indian subpopulation. This study provides supplemental information about mandibular 2nd premolar in north Indian subpopulation.

V. CONCLUSION

The present in vivo study has revealed that the mandibular 2nd premolar can have an extremely complex root and root canal morphology.

- (i) Most of the mandibular 2nd premolars have a single root i.e 93.5 % and 6.4% had more than

- (ii) one root, which is much higher in north Indian subpopulation than other ethnic group studies.
- (iii) In 5 patients, two rooted mandibular 2nd premolar is bilaterally present, increasing the overall percentage.
- (iv) The incidence of single canal in mandibular second premolars is 93.2%, two canals is 3.8%, 3 canals is 1.9%, 4 canals is 0.6%.
- (v) While doing root canal therapy of mandibular 2nd premolar, one should be cautious and find extra canals, which otherwise may lead to higher failure rate.
- (vi) The use of 3-dimensional imaging methods in future large anatomic studies would be of value in assessing the occurrence and the frequency of anomalous canal morphology.

REFERENCES

- [1] Slowey RR. Root canal anatomy. Road map to successful endodontics. Dent Clin North Am 1979; 23:555-73.
- [2] England MC Jr, Hartwell GR, Lance JR. Detection and treatment of multiple canals in mandibular premolars. J Endod 1991; 17:174-8.
- [3] Ash M, Nelson S. Wheeler's dental anatomy, physiology and occlusion. 8th ed. Philadelphia: Saunders, 2003.
- [4] Woelfel J, Scheid R. Dental anatomy: its relevance to dentistry. Philadelphia: Lippincott Williams & Wilkins, 2002.
- [5] Geider P, Perrin C, Fontaine M. Endodontic anatomy of lower premolars: apropos of 669 cases. J Odontol Conserv 1989;11-5.
- [6] Sert S, Aslanalp V, Tanalp J. Investigation of the root canal configurations of mandibular permanent teeth in the Turkish population. Int Endod J 2004; 37:494-9.
- [7] Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol 1984; 58:589-99.
- [8] Green D. Double canals in single roots. Oral Surg 1973; 35:689-96.
- [9] Miyoshi S, Fujiwara J, Tsuji YT, Yamamoto K. Bifurcated root canals and crown diameter. J Dent Res 1977; 56:1425.
- [10] Vertucci FJ. Root canal morphology of mandibular premolars. J Am Dent Assoc 1978; 97:47-50.
- [11] C.F. Hildebolt, M.W. Vannier and T.K. Pilgram, et al. Quantitative evaluation of digital dental radiograph imaging systems. Oral Surg Oral Med Oral Pathol, 70 (1990), pp. 661-668.
- [12] Martínez-Lozano, Forner-Navarro, and Sánchez-Cortés Analysis of radiologic factors in determining premolar root canal systems Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;88:719-22
- [13] Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med
- [14] Oral Pathol Oral Radiol Endod 1984;58:589-99.
- [15] Andre Gahleitner, G. Watzek, H. Imhof, and Dental CT: imaging technique, anatomy, and pathologic conditions of the jaws Eur Radiol (2003) 13:366-376.
- [16] Yoshioka T, Villegas JC, Kobayashi C, Suda H. Radiographic evaluation of root canal
- [17] multiplicity in mandibular first premolars. J Endod 2004;30:73- 4.
- [18] Serman NJ, Hasselgren G. The radiographic incidence of multiple roots and canals
- [19] in human mandibular premolars. Int Endod J 1992;25:234-7
- [20] Hasheminia M, Hashemi A. Frequency of canal configuration in maxillary first premolars and mandibular second premolars. J Isfahan Dent School 2005; 1:59-64.

- [21] Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems in vitro. J Endod 2008;34:87-9.
- [22] Cleghorn Blaine M, Christie William H, Dong Cecilia C.S: The root and root canal morphology of human mandibular 2nd premolar: A literature review. J Endod 2007;33:1031-37
- [23] Trope M, Elfenbein L, Tronstad L. Mandibular premolars with more than one root canal in different race groups. J Endod 1986; 12:343-5.
- [24] Yang Haibing, Tian Cheng, Li Guoju, Yang Lin, Han Xuan, Wang Yan. A cone beam computed tomography study of root canal morphology of mandibular 1st premolars and the location of root canal orifices and apical foramina in a Chinese subpopulation. J Endod 2013;39:435-38.
- [25] Cleghorn Blaine M, Christie William H, Dong Cecilia C.S: The root and root canal morphology of human mandibular 1st premolar: A literature review. J Endod 2007;33:509-16.

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