

ROOT CANAL MORPHOLOGY OF MANDIBULAR INCISORS IN PAKISTANI POPULATION USING CBCT

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ABSTRACT

Objective: To find the incidence of two canals, and root canal morphology of mandibular incisors in Pakistani population thus preventing missed canals during endodontic procedures.

Materials and Methods: 100 CBCT scans taken in Armed Forces Institute of Dentistry, Rawalpindi, Pakistan were studied to determine the presence of second canal as well as determining the root canal morphology according to Vertucci's classification, in mandibular incisors. The data was analyzed using SPSS 20.0.

Results: Images of 400 mandibular incisors were observed. 73.8% of the incisors had one canal (Vertucci's Type I) and 26.2% had two canals (Vertucci's Type II 4%, Type III 20.4% and Type IV 1.7%).

Conclusion: Overall, 26.2% incisors had two canals, so the dentists performing root canal treatment of mandibular incisors must be aware of this fact to avoid missed canal. CBCT can be used successfully to determine root canal configurations.

Keywords: Cone beam CT, Mandibular incisors, Root canal morphology

INTRODUCTION

Success of root canal system is based on shaping and cleaning of root canal space and obturating the root canals to obliterate the space. Research has shown the root canal system to be complex and with multiple variations.¹ The operator must have knowledge of pulp chamber anatomy and intricate root canal system. Missed canal is one of the most common causes of root canal failure.² This may occur due to operator inexperience or lack of knowledge of root canal anatomy. This applies to mandibular incisors and many dentists fail to appreciate the

presence of a second canal.

Present knowledge of root canal anatomy is based on clinical experience, case reports and research findings. Studies have been conducted to determine root canal morphologies of teeth including the morphology of mandibular incisors. Rankine-wilson and Henry³ reported 40.5% incidence of two canals in mandibular incisors. After examination of 300 extracted incisors, Vertucci⁴ determined the frequency of two canals to be 30% in mandibular central incisors and 25% in mandibular lateral incisors.

Al-Quadah et al⁵ reported incidence of two canals to be 26.2%, de Oliveira et al,⁶ 20% and Al-Fouzan SK,⁷ 30%. These researches show a considerable variance in the frequency of presence of second canal. This may be related to study design i.e. in vivo versus ex vivo, technique of canal

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identification or to racial divergence. In addition to the presence of two canals, the shape, branching and rejoining of the canals is also presene.⁸

Cone beam CT has revolutionized dental treatment by providing three dimensional images with great detail at low radiation dose. Radiographic views in planes not available before, has allowed us to view root canal anatomy in great detail in vivo which was only possible before by sectioning and staining extracted teeth.⁹ This study aims at finding the incidence of two canals as well as the morphology of the root canals in Pakistani population. This will help the dentists treating Pakistani origin patients, to avoid endodontic treatment failure due to missed second mandibular incisor canal and also help them choose the correct root canal procedure according to the root canal morphology.

MATERIALS AND METHODS

About 100 CBCT images were studied in this retrospective study. All images were taken with a NewTom VGi CBCT machine (QR s.r.l, Italy) in Armed Forces Institute of Dentistry, Rawalpindi, Pakistan. Image parameters were set to 110kV and 10 mA, and an exposure time of 18s. Field of view was 15x15 cm and 250µm voxel size.

Although the CBCT scan was not done for the purpose of this study, however the scan included the required field i.e. the mandibular incisors. The teeth selected had closed apices and were free from any kind of restoration. Teeth with any peri apical radiolucency, proximity or in the line of fracture and history of orthodontic treatment were no included.

400 incisors of 100 patients were analyzed using the in-built software, NNTTM with free viewer and sharing application (QR s.r.l, Italy). Two-dimensional axial, sagittal and coronal sections were observed on a 21 inch LCD.

Vertucci's¹ classification was used for canal characterization:

1. Type I: A single canal present from the pulp chamber to the apex.
2. Type II: Two separate canals leave the pulp chamber, but join to form one canal to the site of exiting.
3. Type III: One canal leaves the pulp chamber, divides into two within the root, and then merges to exit in one canal.
4. Type IV: Two separate and distinct canals are present from the pulp chamber to the apex.

The data was analyzed using SPSS 20.0. chi-square test was used.

RESULTS

100 CBCT scans were studied which make a total of 400 incisors of which there were 50% (n=200) central incisors and 50% (n=200) lateral incisors.

Table 1 shows the overall frequency of different type of root canal morphology according to Vertucci's type I to IV.

The frequency of Vertucci's Type I to IV in mandibular central and lateral incisors separately, is shown in Table 2.

Table: 1 Frequency of various canal configurations in mandibular incisors

Mandibular incisors	Vertucci's classification			
	Type I	Type II	Type III	Type IV
n=400	73.8% (n=295)	4% (n=16)	20.5%(n=82)	1.7% (n=7)

Table: 2 Frequency of various canal configurations in mandibular central and lateral incisors

Mandibular incisors	Vertucci's classification			
	Type I	Type II	Type III	Type IV
Central	76.5%	3.5%	17%	3%
(n=200)	(n=153)	(n=7)	(n=34)	(n=6)
Lateral	71%	4.5%	2.4%	0.5%
(n=200)	(n=142)	(n=9)	(n=48)	(n=1)

DISCUSSION

There are a number of methods to determine the morphology of root canal system. The methods may be in vivo or in vitro. The methods commonly used are direct observation, plane periapical radiographs, sectioning followed by microscopic observation or using dyes to visualize root canal morphology, and CBCT.³⁻⁸ Only the first two are used in the clinics to determine the number of canals during endodontic treatment.

A lot of variation has been observed in the root canal morphology of the mandibular incisors. Genoglu N¹⁰ reported an incidence of 29% second canal in 2000. In Jordanian population, a 26.2% presence of second root canal is reported,⁵ where as 30% is reported in Saudi Arabian population.⁷ Boruah LC¹¹ showed that North-East Indian population had 36.25% prevalence of two canals (canal clearing and staining technique) while Jaju SP⁸ reported it to be 46.6% (using CBCT), in the same population showing variability in the same country. Perlia P¹² examined 575 mandibular incisors in Romanian population and found that 19% had two canals.

This study used CBCT images to determine the frequency of presence of mandibular incisor second canal and found it to be 26.2%. This falls within the range reported in the literature. Incidence was also calculated separately for central and lateral incisors (23.5% and 29% respectively). This is different from that reported by another study conducted in Pakistan by Sheikh MA.¹³ A total of 100 extracted lateral incisors were examined using plain radiography and reported that 39% had two canals. The difference within the same population is possible due to ethnic differences, as previously mentioned. Secondly, the technique used by Sheikh MA is less accurate than CBCT resulting in a dissimilar result.¹⁴ The mandibular root canal morphology classified according to Vertucci was Type I 4%, Type II 20.5% and Type 4 1.7% (two separate foramina). Al Qudah⁵ reported presence of two foramina in 8.7% and Boruah and Bhuyan¹¹ reported it to be 6.25%.

Failure of identification of second canal leads to failure of root canal treatment. It is important that dentists know signs that suggest the presence of second canal. Clinically, continuous bleeding in teeth with pulpitis or normal pulps despite complete removal of pulp can suggest the presence of such

canals.¹⁵ Inconsistent apex locator readings, buccal or lingual position of canal orifice, feeling of a catch during instrumentation and eccentric position of endodontic file in radiograph are some other indications of presence of second canal.¹⁶ A common reason for not locating a second canal in mandibular incisors is an inadequate access opening into the tooth which leaves a lingual shelf of dentine over the second (usually the lingual) canal.¹⁷

Use of CBCT to locate canal configuration has a very low error rate.¹⁴ Application of CBCT to provide diagnosis without any invasive procedure damaging tooth structure or discomfort to the patient, is well suited for endodontic procedures. According to Matherne *et al*,¹⁸ CBCT images can be used to identify a greater number of root canals than by evaluations of phosphor-stimulated plate or charge-coupled device images. This makes its use in endodontic treatment very useful. However, high cost and radiation dose limit its use.

CONCLUSION

Overall, 26.2% mandibular incisors had two canals. The clinicians must be knowledgeable of the fact and be careful when performing endodontic treatment of these teeth. Secondly, CBCT is a viable tool for endodontics and can be used in complex cases.

REFERENCES

1. Vertucci FJ. Root canal morphology and its relationship to endodontic procedures. *Endod Top* 2005;10:3 29.
2. Witherspoon DE, Small JC, Regan JD. Missed canal systems are the most likely basis for endodontic retreatment of molars. *Tex Dent J* 2013; 130(2):127-39
3. Rankine Wilson RW, Henry P. The bifurcated root canal in lower anterior teeth. *J Am Dent Assoc* 1965;70:1162 5.
4. Vertucci FJ. Root canal anatomy of the mandibular anterior teeth. *J Am Dent Assoc* 1974;89:369-71
5. Al Qudah AA, Awawdeh LA. Root canal morphology of mandibular incisors in a Jordanian population. *Int Endod J* 2006;39:873 7.
6. de Oliveira SH, de Moraes LC, Faig Leite H, Camargo SE, Camargo CH. In vitro incidence of root canal bifurcation in mandibular incisors by radiovisiography. *J Appl Oral Sci* 2009;17:234 9.
7. Al-Fouzan KS, AlManee A, Jan J, Al-Rejaie M. Incidence of two canals in extracted mandibular incisors teeth of Saudi Arabian samples. *Saudi Endod J*

- 2012;2:65-9.
8. Jaju SP, Jaju PP, Garcha V. Root canal assessment of mandibular incisors in an Indian population using cone beam CT. *ENDO (Lond Engl)* 2013; 7(2):105-11
 9. Scarfe WC, Levin MD, Gane D, Farman AG. Use of cone beam computed tomography in endodontics. *Int J Dent* 2009;634567:1-20
 10. Gencoglu N. Incidence of furcated canals in mandibular incisors and efficacy of thermafil obturator. *Saudi Dent J* 2000;12:72 6.
 11. Boruah LC, Bhuyan AC. Morphological characteristics of root canal of mandibular incisors in North-East Indian population: An in vitro study. *J Conserv Dent* 2011;14:346-50
 12. Perlia P, Nistor CC, Toma C, Dimitriu B. Endodontic configuration of the lower incisors in a Romanian population. *Rom J Morphol Embryol* 2013;54(3 Suppl):775-8
 13. Shaikh MA, Kalhor FA, Sangi L. Frequency of second canal in mandibular lateral incisors (in-vitro). *Pak Oral Dent J* 2014;34(1):147-9
 14. Neelakantan P, Subbarao C, Subbarao CV. Comparative evaluation of modified canal staining and clearing technique, cone-beam computed tomography, peripheral quantitative computed tomography, spiral computed tomography, and plain and contrast medium-enhanced digital radiography in studying root canal morphology. *J Endod* 2010;36(9):1547-51.
 15. Iqbal MK, Gartenberg J, Kratchman SI, Karabucak B, Bui B. The clinical significance and management of apical accessory canals in maxillary central incisors. *J Am Dent Assoc* 2005; 136: 331–5.
 16. Kabak YS, Abbott PV. Endodontic treatment of mandibular incisors with two root canals: Report of two cases. *Aust Endod J* 2007; 33: 27–31
 17. Benjamin KA, Dowson J. Incidence of two root canals in human mandibular incisor teeth. *Oral Surg* 1974; 38: 122–6.
 18. Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems in vitro. *J Endod* 2008;34:87-89