Research Article

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Assessment of the Prevalence of the Different Types of Vertucci's Root Canal Configurations in Mandibular Anterior Teeth

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ABSTRACT

Background: Effective root canal treatment and endodontic surgery require a thorough knowledge of tooth anatomy and root canal morphology so that micro-organisms and pulp tissue can be accessed and removed, and root-ends managed properly. The present study was conducted to assess the prevalence of the different types of Vertucci's root canal configurations in mandibular anterior teeth.

Materials & Methods: 540 subjects of both genders were subjected to CBCT scan for mandibular central incisor, lateral incisor and canine. Root canal configurations were classified into 8 types according to Vertucci.

Results: Type I root canal configuration was seen in 720 central incisor, 725 lateral incisor and 710 canine, type II in 130 central incisor, 135 lateral incisor and 102 canine, type III in 150 central incisor, 176 lateral incisor and 114 canine, type IV in 10 central incisor, 24 lateral incisor and 12 canine, type V in 8 central incisor, 14 lateral incisor and 8 canine, type VII in 2 central incisor, 6 lateral incisor and 4 canine. All central incisors and lateral incisors had 1 root and canine had 1 root in 98.4% and 2 roots in 1.6% teeth. 1 canal 1 foramen was seen in 81% central incisor, 80% lateral incisor and 87% canine, 2 canals 1 foramen in 15% central incisor, 17% lateral incisors and 9% canines and 2 canals 2 foramina in 4%, 3% and 4% central incisor, lateral incisors and canines respectively.

Conclusion: Authors found that the occurrence of two canals and two foramens were seen in 4% in central incisors, 3% in lateral incisors and 4% in canine.

Keywords: Central incisors, Endodontic surgery, Root canal configuration.

INTRODUCTION

Effective root canal treatment and endodontic surgery require a thorough knowledge of tooth anatomy and root canal morphology so that micro-organisms and pulp tissue can be accessed and removed, and root-ends managed properly.[1] In the human dentition, a wide range of anatomical variations in each tooth type has been reported in terms of the number and shape of roots and root canals.[2] For many decades, this topic has been the subject of numerous experimental and clinical reports, and it is clear that root and canal morphology vary greatly between populations, within populations and even within the same individual.[3] Endodontic treatment ensures effective infection control and 3-dimensional (3D) filling of root canals to maintain or restore the health of peri-

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radicular tissues. A missed root canal significantly increases the risk of unsuccessful treatment. Therefore, knowledge of the canal anatomy is essential. Considering that ethnicity influences root canal configuration, studies are necessary in different populations worldwide.[4]

Weine et al[5] were the first to categorize root canal configurations within a single root into three types depending on the pattern of division of the main root canal along its course from the pulp chamber to the root apex. Later, Vertucci et al[6] developed a classification system based on the evaluation of 200 cleared maxillary second premolars in which the pulp cavities were stained with dye; they found canal systems that were more complex than described by Weine and co-workers, and identified a total of 8 configurations. The present study was conducted to assess the prevalence of the different types of Vertucci's root canal configurations in mandibular anterior teeth.

MATERIALS & METHODS

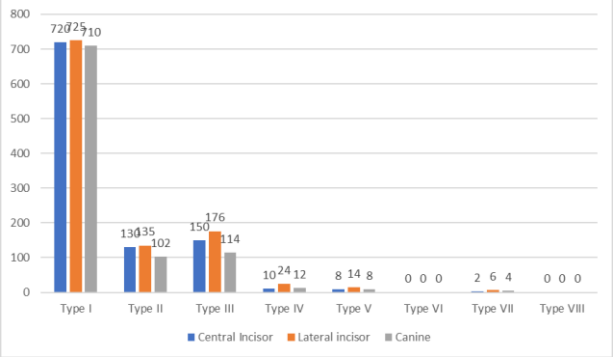
The present study was conducted among 540subjects of both genders. Institutional ethical clearance was obtained before starting the study. A CBCT scan was taken with Kodak machine using following parameters a 0.14-mm voxel size, 90 kV, 4 mA, and 19 seconds with a field of view limited to 70 X 80 mm. Mandibular central incisor, lateral incisor and canine were covered in all scans. The images were analyzed using NNT software. The evaluation was performed by a specialist in endodontics. The axial sections were analyzed from the coronal to apical direction. The images were carefully examined in the coronal and sagittal planes. Teeth with root resorption, pulp nodules, root canal calcification, extensive restorations, coronary prostheses, intra-radicular posts, or previous endodontic treatments were excluded. Root canal configurations were classified into 8 types according to Vertucci. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I and Graph 1 shows that type I root canal configuration was seen in 720 central incisor, 725 lateral incisor and 710 canine, type II in 130 central incisor, 135 lateral incisor and 102 canine, type III in 150 central incisor, 176 lateral incisor and 114 canine, type IV in 10 central incisor, 24 lateral incisor and 12 canine, type V in 8 central incisor, 14 lateral incisor and 8 canine, type VII in 2 central incisor, 6 lateral incisor and 4 canine. The difference was significant (P< 0.05). Table II shows that all central incisors and lateral incisors had 1 root and canine had 1 root in 98.4% and 2 roots in 1.6% teeth. 1 canal 1 foramen was seen in 81% central incisor, 80% lateral incisor and 87% canine, 2 canals 1 foramen in 15% central incisor, 17% lateral incisors and 9% canines and 2 canals 2 foramina in 4%, 3% and 4% central incisor, lateral incisors and canines respectively. Table III shows that symmetric root canal configuration between the contralateral teeth of central incisor, lateral incisor and canine with type I was seen in 78%, 75%, and 84%, in type II was 2%, 1.6% and 0.25%, type III was 16%, 18% and 10%, type IV was 2.5%, 3.1% and 3.5%, type V was 1.30%, 0.40% and 1.2% and type VII had 0.20%, 1.9% and 0.05% respectively. The difference was significant (P< 0.05).

Table I: Vertucci's classification in teeth.

Vertucci's classification	Central Incisor	Lateral incisor	Canine	P value
Type I	720	725	710	0.02
Type II	130	135	102	
Type III	150	176	114	
Type IV	10	24	12	
Type V	8	14	8	
Type VI	0	0	0	
Type VII	2	6	4	
Type VIII	0	0	0	
Total	1020	1080	950	



Graph I: Vertucci's classification in teeth.

Table II: Distribution of mandibular anterior teeth regarding the number of roots, canals, and foramina.

Tooth	Number of roots		1 canal 1 foramen	2 canals 1 foramen	2 canals 2 foramina
	1	2			
Central incisor	100%	0	81%	15%	4%
Lateral incisor	100%	0	80%	17%	3%
Canine	98.4%	1.6%	87%	9%	4%

Table III: Frequencies of Individuals with Symmetric Root Canal Configuration Between the Contralateral Teeth.

Vertucci's classification	Central Incisor	Lateral incisor	Canine	P value
Type I	78%	75%	84%	0.01
Type II	2%	1.6%	0.25%	
Type III	16%	18%	10%	
Type IV	2.5%	3.1%	3.5%	
Type V	1.30%	0.4%	1.2%	
Type VI	0	0	0	
Type VII	0.20%	1.9%	0.05%	
Type VIII	0	0	0	

DISCUSSION

Cone-beam computed tomographic (CBCT) imaging has been used in endodontics for different purposes, including the diagnosis of periapical pathologies, fractures, root resorption, and the study of root canal anatomy.[7] With CBCT imaging, 3D anatomic tracking of the root canal system can be performed with minimal distortion. In addition, it is non-invasive, painless, fast, and easy to perform.[8] CBCT imaging is considered an excellent method for epidemiologic anatomic studies in endodontics because of its in vivo approach; the prevalence per individual can be determined, with easy accessibility of a large sample size.[9] The present study was conducted to assess the prevalence of the different types of Vertucci's root canal configurations in mandibular anterior teeth.

In present study, type I was seen in 720 central incisor, 725 lateral incisor and 710 canine, type II in 130 central incisor, 135 lateral incisor and 102 canine, type III in 150 central incisor, 176 lateral incisor and 114 canine, type IV in 10 central incisor, 24 lateral incisor and 12 canine, type V in 8 central incisor, 14 lateral incisor and 8 canine, type VII in 2 central incisor, 6 lateral incisor and 4 canine. Candeiro et al[10] in their study overall, 2543 CBCT scans, including those of 4773 lower central incisors (LCIs), 4835 lower lateral incisors (LLIs), and 4805 lower canines (LCs), were analyzed. The scans were obtained from a private radiologic clinic using the PreXion 3D device with a 0.14-mm voxel size; exposure parameters of 90 kV, 4 mA, and 19 seconds; and a field of view of 80 X 80 mm. Root canal anatomy was analyzed according to the Vertucci classification. All LCIs and LLIs had 1 root, whereas 2.4% of LCs had 2 roots. Two root canals were observed in approximately 20% of LCIs and LLIs and in approximately 11% of LCs. The most common configuration was type I followed by type III. Bilateral symmetry occurred in a majority of the individuals (ie, 91% in LCIs, 87% in LLIs, and 87% in LCs). No sex influence was noted with LLIs and LCs ($P < 0.05$). However, LCIs showed a higher prevalence of 2 canals in men ($P< 0.05$).

In present study, all central incisors and lateral incisors had 1 root and canine had 1 root in 98.4% and 2 roots in 1.6% teeth. 1 canal 1 foramen was seen in 81% central incisor, 80% lateral incisor and 87% canine, 2 canals 1 foramen in 15% central incisor, 17% lateral incisors and 9% canines and 2 canals 2 foramina in 4%, 3% and 4% central incisor, lateral incisors and canines respectively. Kayaoglu et al[11] evaluated the number of roots/root canals in the mandibular anterior teeth of a Turkish population, to assess the relationship between gender or age and the frequency of two canals in a single root, and to determine the symmetry in root/root canal numbers between contralateral sides among patients. Most teeth had a single root and single root canal. Roots with two canals were more frequent in the incisors (14.9%, 17.2%, and 6.1% of the central incisors, lateral incisors, and canines, respectively). Teeth with two roots were more frequent in the canines (3.1%*vs.* 0% or 0.1%). Females more often had canines with double root canals ($p < 0.001$). When at least one tooth had two root canals, bilateral symmetry between contralateral teeth was found in 45.0%, 29.0%, and 28.0% of cases for central incisors, lateral incisors, and canines, respectively. Patients older than 56 years had fewer teeth with double root canals ($p \leq 0.001$). A small proportion of the mandibular anterior teeth had two roots or root canals. Double

root canals were mostly unilateral. Age and gender were associated with the number of root canals.We found that symmetric root canal configuration between the contralateral teeth of central incisor, lateral incisor and canine with type I was seen in 78%, 75%, and 84%, in type II was 2%, 1.6% and 0.25%, type III was 16%, 18% and 10%, type IV was 2.5%, 3.1% and 3.5%, type V was 1.30%, 0.40% and 1.2% and type VII had 0.20%, 1.9% and 0.05% respectively. A previous Midwest Brazilian study showed 22% of LCs with 2 canals.[12, 13]

CONCLUSION

Authors found that the occurrence of two canals and two foramens were seen in 4% in central incisors, 3% in lateral incisors and 4% in canine.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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