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ORIGINAL RESEARCH

Root Canal Morphology of Mandibular Canine among people of Kodagu , a south Indian Population study using orthopantomograph

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Abstract

Introduction: A retrospective study was conducted to assess the morphology of mandibular canines using Orthopantomograph (OPG) in kodava population of south India.

Materials and Methods: For the morphological assessment of mandibular canines 1000 images of opg's which were taken for different reasons by the patients were examined. The canal pattern, number of canals, the root length were evaluated and the effect of gender and bilateral symmetry were assessed. Collected data were analyzed by applying the non parametric tests and student's t-tests.

Results: As per the radiological classification stated, the most common pattern was type I morphology (96.5 % on right, 97.2 % on left), followed by type II (2.8% on right , 2.6% on left), type IV (0.6% on right , 0.1% on left) , type III and V (0.1% on both right and left). No significant differences were observed between the male and female patients in terms of canal type,root length and root canal pattern (P>0.05).No significant statistical difference was observed for mentioned parameters on right and left half of the jaw.

Conclusion: Due to the diverse morphology and the potential presence of extra canal in mandibular canine among Indians, greater care is required in performing endodontic treatments. OPG can also be used as a pre diagnostic tool in the clinical practice as it is very economical .Careful examination of OPG can aid in accurate diagnosis and good prognosis .

Keywords: Root Canal,Morphology,canine teeth,Mandibular,orthopantomogram

Introduction

The orthopantomograph also known as orthopantomogram**(**OPG or OPT**)** is a panoramic single image radiograph of the mandible, maxilla and teeth. Theyare used in evaluation of caries and its sequlae and also in complexities of all the diseases of maxillary sinus and other jaw bones . It is used as a convenient, inexpensive and rapid way to evaluate not only the gross anatomy of the jaws and related pathologies but can also be used in evaluating minute details such as morphology of root canal. [1]

The main goal in endodontics includes the biomechanical preparation of the pulp chamber and root canals for perfect obturation, obtaining complete hermetic sealing apically and coronally without jeopardizing the treatment which otherwise would result in any flare ups

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or complications. Having proper knowledge about dental morphology and being able to make an accurate interpretation of it and having adequate access to its sources are prerequisites of a successful root canal treatment and determination of the treatment outcome [2, 3] This can be achieved by proper diagnostic imaging techniques like panoramic radiographs, full-mouth periapical radiographs and cone-beam computed tomography (CBCT), which provides information about the teeth and their surrounding structures.[4]

The morphology of the root canal systems of canines may vary according to ethnic differences, origin, age, gender, and study design. The knowledge of morphological characteristics and variations of the root canal plays an important role in the success of endodontic diagnosis and treatment.[4]

Canines are not only having aesthetic value for providing natural shape to face as cornerstone of dental arch but also functions in occlusal guidance.[5] The mandibular canine is usually single-rooted and according to numerous studies 1.7 to 6.2% of these teeth are double-rooted and 10.6% have two or more canals.The ideal technique for evaluation is the one that is accurate, simple, non-invasive and capable of in vivo application. Cone-beam computed tomography (CBCT) has become a successful tool to explore the root canal anatomy.[6,7] Shah N[4] had concluded that CBCT is as accurate as modified canal staining and clearing technique which is a gold standard in identifying root canal anatomy.[1] The objective of this study is to evaluate the morphological changes in the root canal anatomy of mandibular canine using OPG in different ethnic groups which can be further used in routine dental practices .

Materials and Methods

The present study evaluated the OPG (panoramic) images of 1000 completely erupted mandibular canines belonging to 1000 patients who presented to a private radiology clinic in Kodagu district in southern India over one-year period from January 2021 to December 2021. The study was approved by institutional ethical committee(KoIMS/IEC/05/2018-19)Mandibular canines with no endodontic treatments were included in the study and digital panoramic images that fulfilled the following criteria were selected for the study. High-quality images that showed mandibular canines with completely erupted roots, untreated root canals, absence of coronal or post-coronal restorations, absence of periapical lesions and root resorptions and bilateral presence of mandibular canines were included. Incomplete root formation, root canal treated tooth, tooth with coronal and post coronal restorations and periapical lesions, tooth with root resorption were excluded from the study.

All the panoramic images were taken with Genoray (Papaya plus) at 70kvp ,10mA, 14.0sec exposure time. The canines were categorized on the basis of patient's gender, tooth quadrant (left or right), number of canals and the root canal morphology. The Triana software (integrated with Genoray dental software , South Korea) was used to analyse the images and do the measurements.

The anatomic length of the root was measured on the OPG from the CEJ to the apex and width measured at the CEJ mesio distally. The prevalence of each type was determined through evaluating the OPGby the radiological classification mentioned below. The following information was recorded and analyzed a) The number of canals for each canine b)The root canal pattern c) The possibility of morphological bilateral symmetry and d) The anatomical length from the CEJ to the apex and width measured at the CEJ mesio distally.

Radiographic classification for the pulpal morphology of lower mandibular canines

Type I: 1-1: A single root canal from the crown / CEJ to root apex.

Type II: 1-2-1: A single canal splits into two canals separated by a small dentinal island between 2 canals along the middle 3rd of root joined again at the root apex.

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Type III: 2-2: 2 pulphorns from the crown / CEJ to root apex extending down as two separate canals till apex.
Type IV: 1-2: 1 single canal from the crown / CEJ splinting into 2 at the apex.
TypeV: 1- 3: Single root canal from the crown / CEJ splits into 3 canals with dentinal island separation between each canal.
The data were analyzed in STATA (16.1), StataCorp,College Station,Texas USAusing the Chi-squared test and the t test. The level of statistical significance was set at 0.05.

Results

There were 587 females and 413 males in the sample totally. Table 1 presents the canal configurations according to the radiological classification criteria. The most common pattern was type I morphology (96.5 % on right, 97.2 % on left), followed by types II (2.8% on right, 2.6% on left), type IV (0.6% on right , 0.1% on left) , type III and Type V (0.1% on both right and left). No significant differences were observed between the male and female patients regarding this prevalence (P>0.05)

Table 1: Pulpal morphology of lower mandibular canines

Type	Right	Right	left	left
	Frequency	Percentage	Frequency	Percentage
Type I	965	96.5%	972	97.2%
Type II	28	2.8%	26	2.6%
Type III	6	0.6%	1	0.1%
Type IV	1	0.1%	1	0.1%
Type V	1	0.1%	1	0.1%

The mean anatomical length of the roots was 14.77 mm in male and 14.71 mm in female. The mean anatomical width at the CEJ of the roots mesio-distally was 5.31mm in male and 5.35 mm in female No significant changes were noted in root length and width with respect to gender(P=0.00) (Table 2).No significant differences were observed between the right and left canines regarding any of the parameters evaluated in the study (P>0.05). The probability of morphological bilateral symmetry for the type of root canal of mandibular canine was 98.6 %.

Table 2: Anatomic length and width of mandibular canine.

Gender	Root length of mandibular canine from CEJ to root apex on right side(in mm)	Root length of mandibular canine from CEJ to root apex on left side (in mm)	Width of mandibular canine at CEJ on right(in mm)	Width of mandibular canine at CEJ on left(in mm)	Mean root length of mandibular canine from CEJ to root apex (in mm)	Mean width of mandibular canine at CEJ (in mm)
Females	14.68	14.58	5.22	5.32	14.71	5.31
Males	14.35	15.18	5.44	5.54	14.77	5.35

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Figure 1: OPG/Panoramic radiograph showing type II morphology of canine on right side and Type I morphology of canine on left side.

Figure 2: OPG/Panoramic radiograph showing type II morphology of canine on right and Type III on left side.

Figure 3: OPG/Panoramic radiograph showing the type V morphology of canine on right side and type IV on left side.

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Discussion

The present study reported the most common root canal morphology for mandibular canines to be type I (96.5 % on right, 97.2 % on left) as consistent with the results obtained by Pineda and Kuttler[8](81.5%), Rahimi et al[9] (91.6%) .Of all the studies conducted on mandibular canines, Pecora et alreported the highest prevalence of type I morphology (92.2%).[10]

The second most common morphology detected in the present study was type II (2.8% on right , 2.6% on left), followed by type IV (0.6% on right , 0.1% on left) ,type III and Type V(0.1% on both right and left). In the study by Vertucci[11]reported that the second and third most common morphologies detected were two separate canals which leaves the pulp chamber but join to form one canal to the apex. (14%) and one canal leaves the pulp chamber and divides into two smaller canals which later merge again to exit through one canal (2%) respectively.

The prevalence of two separate as well as completely distinct canals run from the pulp chamber to the root apex morphology for mandibular canines was reported to be 6% by Vertucci[11]5% by Pineda et al[8]and 1.2% by Pecora et al.[10] However, the present study detected no cases such astwo separate canals that leave the pulp camber but join to form one canal to the apex, two separate as well as completely distinct canals run from the pulp chamber to the root apex ,the canal starts as a single until the middle third of the root then divides into two separate canals that rejoin after some distance and then, near the apex, divides into two again in mandibular canine in Kodagu population of South India. This disparity could be due to factors such as differences in the classification used sample size and the racial differences.

The present study found that 2.8% of the cases on right side and 2.6% of cases on left side had a second canal, which is consistent with the numbers obtained by Bellizzi and Hartwel[12] (4.11%), and 6% by Ingle et al[13]but lower than Vaziri et al[14] (12%), and other studies [7,11,12,15].The disparity in the results of morphological studies may be due to the differences in the used classification systems, the sample size and the racial differences. Sufficient care should therefore be taken in determining the duration of functioning, clearing and shaping of mandibular canines during root canal treatment.

Sert and Bayirli[15]consider gender as an important factor for assessing root canal morphology before treatment. In our study, gender did not affectroot length and also the number of mandibular canine canals. In the present study, the average length of mandibular canine root was 14.73mm from CEJ to root apex and studies by Versiani et al[16]and Amardep et al[17]reported similar findings.

There was no significant changes in the canal morphology with respect to gender while studies showed the prevalence of two canals more in men than in women in Sert and Bayirli[15] and Altunsoy et al[18]. But, Kayaglu et al.[19]reported that canines with two canals are often more in women than in men.

Our findings about the variations of canal in mandibular canine are rather different from the results of previous results in other populations of Iran and other races.[6,9,14]

The results of our study about the type of tooth are different from the studies of Pecora et al[10], Pineda and Kuttle[8]and Vertucci[11]and about the number of canals and the differences can be attributed to race as an important factor. In our study and other studies in the past, no statistically significant differences was observed between right and left half of the jaw and canine root canal morphology.

In clinical terms, morphological bilateral symmetry is crucial in the treatment of patients with contra lateral teeth[20]. The present study found the probability of morphological bilateral symmetry in mandibular canines to be 98.6% this finding helps dentists better predict the morphology of mandibular canines in complex cases.

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Furthermore, the results obtained in the present study regarding mandibular canine canal diversity are somewhat different from those obtained in previous studies on other races. These differences can be explained by ethnical differences as well as the differences in other parameters (such as the study methods, classification system and sample size).[18,19,]
Prior to this study, no studies had addressed the anatomic diversity of mandibular canines using panoramic radiographs in Indian population but the results of this study cannot be generalized to the whole population of India as the sampling was conducted in a specific center in Kodagu ,Karnataka in southern India thus it is suggested that further studies be conducted in different parts of India to obtain more accurate results.

Conclusion

In our study we reported 2.8% and 2.6% on right and left side of mandibular canine had double canals respectively. These findings emphasize the importance of clinician's knowledge of morphological diversity of root canals. Since leaving a canal untreated is one of the main causes of root canal treatment failure, the presence of a second canal must always be considered by the dentist in mandibular canine root canal treatments.
Conventional radiographic images such as OPG can also be used in endodontic treatments to assess root canal anatomies in rural set ups where the use of three-dimensional (3D) imaging techniques such as CBCT cannot be accessed. This study shows how OPG can be used as a sensitive tool in the detection of supplemental canals.

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