

ORIGINAL RESEARCH

Correlation of the Bucco-lingual Width and the Incidence of Two Canals in Mandibular Incisors – An Observational Study

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ABSTRACT

Background information: Mandibular incisors are associated with high failure rate in endodontic therapy because of presence of two canals. There is no clinical diagnostic method to identify the number of canals in the mandibular incisors. **Aim:** To assess the correlation between incidence of two canals in mandibular incisors and its bucco-lingual width measured at the cervical third of crown. The secondary aims were to assess the percentage of different levels of canal bifurcation and the discrepancy in radiographic measurement of tooth width. **Methodology:** 70 extracted human mandibular incisors were included in the study. Using Vernier caliper, the bucco-lingual width at the cervical aspect of each mandibular incisor was measured. RVG image was taken through the mesiodistal plane to assess the number of canals, their level of bifurcation and also the buccolingual width of crown at cervical aspect. Canal configuration was categorised according to Vertucci's classification. **Result:** From the observations of this study, it is inferred that the incidence of Vertucci's type III canal configuration was 44.28%. Type III canal was found when the bucco-lingual width at the cervical third of crown was greater than 5.68 mm (from ROC curve) with 97% sensitivity and specificity. The bifurcation level of type III canals was 93% at middle – apical third, 3% at coronal, and 3 % at apical third. The spearman's correlation between radiographic measure of buccolingual width and its actual measure was 0.82. **Conclusion:** Within the limitations of this study, it can be concluded that if the bucco-lingual width at the cervical aspect of a mandibular incisor is greater than 5.68mm, then two canals (type III) can be found in 97% of the mandibular incisors among the South Indian population. The incidence of type III canals was 44.28%; the bifurcation level was mostly at middle third of root.

Key words: Root canal morphology, Dental pulp, Mandibular central incisors, Buccolingual width

The ultimate objective of root canal treatment is to locate and clean all the canals and complete obturation. Cleaning of canals eliminates all infection and removes the substrate (remaining pulp tissue) for microbial growth; Obturation acts as an inert material blocking or preventing

reinfection of canals. Thus, knowledge on anatomy of the root and canal configuration of

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each tooth is necessary to accomplish a successful root canal treatment. Often the second (lingual) canal which is under the cingulum in mandibular incisors is missed or left untreated due to lack of knowledge or experience. This result in leakage of canals, reinfection, persistence of microbes, and release of their noxious byproducts periapically causing symptoms and failure of root canal treatment. So, it is necessary to familiarize various root canal configurations in various racial groups since it may differ. At present there are no studies on mandibular incisor canal configuration among the South Indian population. Hence, this study was done to find if the buccolingual width of the mandibular incisors can be correlated and used to find the number of canals as a clinical predictable tool. Also, the level of canal bifurcation and the radiographic discrepancy of buccolingual width measure of tooth from original tooth dimension was assessed.

METHODOLOGY:

Seventy mandibular incisors with intact crown and fully developed apices were collected from practioners in and around Puducherry. No information was collected regarding the personal details of the patient and the reason for extraction. All the teeth were placed in 5.25% NaOCl

solution for 30 minutes. After this, remaining tissue and calculus were removed by scaling. The Buccolingual width of each tooth was measured at the CEJ (cementoenamel junction) using Vernier Caliper. Then, radiographic image of each tooth was made digitally by RVG. The RVG film is standardised with the help of double sided sticker fixed to a wooden block. For stabilising the tooth, a jig was prepared of modelling wax, which is a radiolucent material. The x-ray tube head was stabilised by a wooden box with a guiding hole so that the exposure is made through the mesiodistal plane (90° from the usual view). The object to source distance was also fixed and paralleling cone technique was used. The following observations were made: (i) number and type of root canals (ii) the level of canal bifurcation and (iii)the radiographic discrepancy on measurement of buccolingual width. The canal configurations were categorized according to Vertucci (2005).⁽¹⁾

RESULT:

Results are tabulated in tables 1 and 2. All the teeth had only one major apical foramen. According to the Vertucci’s classification (2005), first and third types of canals were found. Type I (figure 1) - A single canal is present from the pulp

| Bucco-lingual Width (in mm) | | Vernier caliper’s | | RVG | |
|----------------------------------|-------------|-------------------|----------|--------|----------|
| | | Type I | Type III | Type I | Type III |
| Mean | | 5.367 | 5.899 | 5.700 | 6.177 |
| 95% Confidence Interval for Mean | Lower Bound | 5.284 | 5.804 | 5.582 | 6.027 |
| | Upper Bound | 5.450 | 5.994 | 5.818 | 6.327 |
| Standard Deviation | | 0.257 | 0.258 | 0.3649 | 0.4088 |
| Minimum | | 4.740 | 5.030 | 5.0 | 5.5 |
| Maximum | | 5.700 | 6.520 | 6.0 | 7.0 |

Table 1: Mean and standard deviation of different types of canals by Vernier caliper and RVG

| Area Under the Curve | | | | |
|--|-------|----------------------------------|------------------|------------------|
| Test Result Variable(s) | Area | Cut off Value for type III canal | Specificity in % | Sensitivity in % |
| Bucco-lingual width with vernier caliper's | 0.971 | 1.34 | 4.26 | |

Table 2: Area under the ROC curve

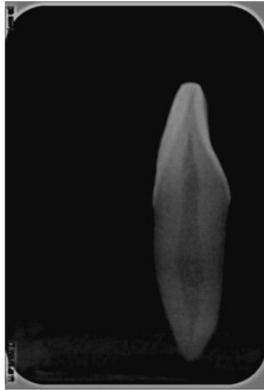


Figure 1: Vertucci's type I canal

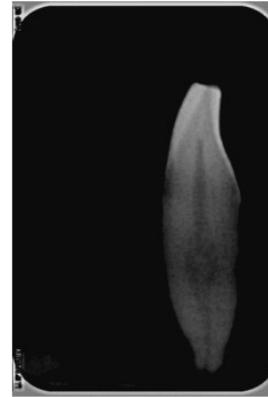


Figure 2: Vertucci's type III canal

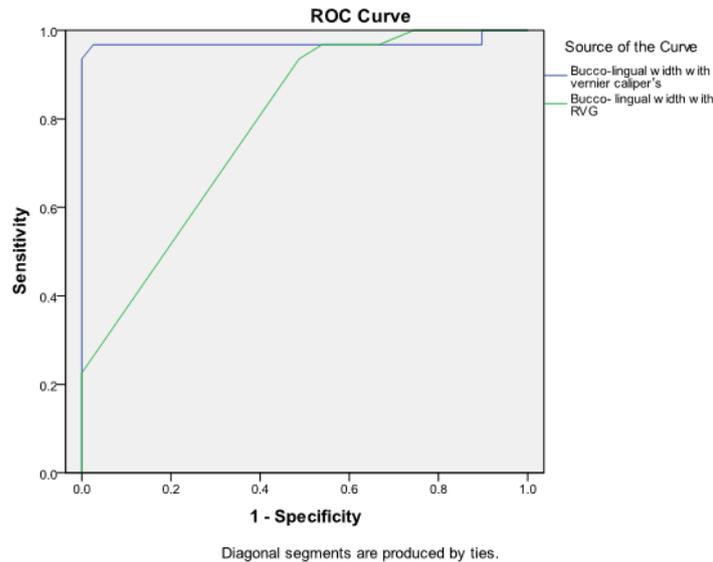


Figure 3: ROC curve

chamber to the apex. Type III (figure 2) - One canal leaves the pulp chamber, divides into two within the root, and then merges to exit in one canal. Of the analysed mandibular incisors, Type I canal was found in 39 teeth (55.72%) and type III in 31 teeth (44.28%). The ROC curve (figure 3) showed that type III canal occurred when the buccolingual width of the tooth at CEJ was more than 5.68 mm. The level of canal bifurcation was at middle third in 68 teeth (93%), at coronal third in 1 teeth (3%) and at apical third in 1 teeth (3%) . The Spearman's correlation between radiographic

measure of mandibular incisors' buccolingual width and the original measure shows an r-value of 0.822(p value <0.001).

DISCUSSION:

Root canal anatomy was studied using ex-vivo radiographic technique in this study. Other techniques used to study canal morphology are – (i) Cross sectioning of teeth; its limitation is canal cannot be viewed continuously. (ii) Longitudinal sectioning of teeth; its limitation is that limited amount of canal wall can be retained allowing to study the gross morphological details only. (iii)

Scanning electron microscopy (SEM) - it allows about 2,500 times magnification allowing detailed study but a very limited area is available for study. (iv) stereomicroscopy (v) Demineralisation-staining-clearing technique - allows the most detailed information providing 3D view of pulp cavity in relation to external anatomy of tooth. Also it is simple and fast. The *invivo* methods are (v) conventional intraoral radiography; it is not completely reliable due to distortion and superimposition in images (vi) Cone beam computed tomography (CBCT).⁽²⁾ It allows 3D visualization of canals with limited radiation and can be done *invivo*. (vii) the dental operating microscope provides enhanced visibility under adequate illumination - an important aid in locating the canals.⁽³⁾

The incidence of type III canal in mandibular incisors were 44.28% in this study. Rankine-Wilson & Henry (1965) reported two canals in 40.5% of mandibular incisors.⁽⁴⁾ Benjamin and Dowson reported 41.4%,⁽⁵⁾ Madiera and Hetem reported 11.5%,⁽⁶⁾ Vertucci reported 25.7%,⁽⁷⁾ Green reported 20%,⁽⁸⁾ Boruah and Bhuyan⁽⁹⁾ reported 36.25% in North East Indian population. Al-Qudah and Awawdeh⁽¹⁰⁾ reported 26.2% in Jordanian population. Walker reported that incidence of second canal to be infrequent in mandibular incisors in people of East Asian origin.⁽¹¹⁾ Occurrence of type IV vertucci canal configuration is very rare viz 3 % and 2 % in mandibular central incisors and lateral incisors respectively.⁽¹²⁾ The differences may be related to study design (in vivo versus ex vivo), technique of canal identification (radiographic examination, sectioning and clearing) or to racial divergence.

The knowledge on canal bifurcation level helps in expecting where the canal divides into two so that

search of the 2nd canal can be done precisely.

This pioneer study to clinically predict the number of canals based on the buccolingual width of mandibular incisors at CEJ is an novel concept and the results are promising. This has shown that when the measure was above 5.68mm, there is significantly higher incidence of 2 canals (type III). There are some more clues to detect additional canal. They are presence of continuous bleeding in teeth with pulpitis or normal pulps despite complete instrumentation, the presence of an apical rarefaction on the lateral side of root in necrotic pulps, eccentric location of an endodontic file on a radiograph at working length determination, inconsistent readings on apex locator, sinus tract tracing laterally away from main canal or a feeling of a "catch" on the canal wall during instrumentation of a wide and unobstructed canal, complete disappearance of the lumen in the coronal third of the root on periapical radiograph.

However, Nattress et al. assessed incidence of bifurcation in a root using the fast break guideline viz disappearance or narrowing of a canal infer that it divides. He investigated on 455 teeth and found that 17 teeth with a single canal when radiographed in BL direction were actually bifurcated canals when analysed in the MD direction. Thus, this fast break guideline resulted in failure to diagnose one third of divisions from a radiographic view.⁽¹³⁾ So, a careful evaluation of two or more radiographs is needed.

It is necessary to find if a type III canal configuration is present even though in type III canals, only a single apical foramen is present which is cleaned and obturated; Because, the second (missed) canal may become necrotic leading to the persistence of infection or

reinfection in case of poor apical or coronal seal. When two canals are present in mandibular incisor, one canal is labially located and the other lingually located; the labial canal being straighter. Rankie- wilson and Henry demonstrated that routine entry usually allows for instrumentation of labial canal only or the labial wall of the single canaled tooth.⁽⁴⁾ So, making appropriate incisogingival extension in access cavities facilitates the location of lingual canals.

Common reason for failure of lingual canal negotiation is the lingual shelf created due to inadequate access opening over the lingual canal. So, it is necessary to modify the conventional access preparation for better visualisation and instrumentation of extra canal even by compromising the crown structure.⁽¹⁴⁾

Biomechanical preparation should be done alternately in labial and lingual canals to prevent the hourglass preparation.⁽¹⁵⁾ Also, instrumenting the canals alone cannot clean the narrow ribbon shaped canals and the isthmus; hence cleaning

should be done with therapeutic agents like Sodium hypochloride and ultrasonics to clean the unreachable areas of the canal. Techniques of dynamic irrigation and different methods of obturation especially thermoplasticized techniques help overcome most of treatment difficulties.

The radiographic measure positively correlated with the original measure. This shows that radiographs cannot be used as sole aid to make measurements of tooth as described by studies earlier.⁽¹⁶⁾

CONCLUSION:

For a south Indian population, the buccolingual width of the mandibular incisors can be used as a reliable tool to predict the number of canals. Incidence of two canals in mandibular incisors was 44.28%. The level of canal bifurcation in mandibular incisors for type III canal was predominantly at the middle third of root. The measurement of buccolingual width of the tooth by RVG positively correlated with the original measure but not same.

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