

Study of the Internal Anatomy of the Mandibular Incisor Teeth

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Statement of Problem: Knowledge of internal anatomy of tooth plays an important role in a successful endodontics treatment. For a proper endodontic treatment, it is not only important to know the form of normal anatomy of tooth's interior but one must also be acquainted with the possible diverse forms.

Purpose: A thorough understanding of the internal anatomy of human mandibular incisors (central and lateral).

Materials and Methods: A total of 205 central and lateral mandibular incisors that had healthy roots were selected and put in 10% formalin solution. After cleaning the samples with the help of brushes and other devices, they were kept in 5% sodium hypochlorite solution. Finally the roots were cleaned and the samples were prepared for next stages. Three methods were used, coloring (fushin1%, radiography (buccolingual and proximal sides), and cross-sectioning (cervical- middle-apical).

Results: The result indicated that:

- 88% of the teeth had a single canal and one apical foramen;
- 8% of the teeth had a single canal and two apical foramena;
- 3.5% of the teeth had two canals and one apical foramen;
- 0.5% of the teeth had two canals and two apical foramena;

Conclusion: A thorough understanding of the pulp morphology is essential for successful treatment of root canal. Therefore, a dentist should always be on the watch for the existence of two canals or a two-branched canal while working on the mandibular incisor teeth. it is essential to have the necessary precision in finding the second canal.

Key Words: Internal anatomy ; Mandibular incisor teeth ; Teeth morphology

Journal of dentistry, Tehran University of Medical Sciences, Tehran, Iran (2004; Vol. 1, No.4)

Knowledge of internal anatomy of tooth plays an important role in successful endodontics treatment. One of the most common reasons for failures in such a treatment is insufficient knowledge of internal anatomy of teeth, which can cause errors in diagnosis and treatment plan.⁽¹⁾

For a successful endodontic treatment, it is not only important to know the normal anatomy of tooth's interior but one must also know the its possible different morphologic variation.⁽²⁾

It is evident that for cleaning, shaping, and filling a canal, it must first be found. For roots that may have two canals the general rule is to always assume that two canals do exist.

In the studies carried out on internal anatomy of mandibular incisor teeth, apart from statistical differences presented for prevalence of dual-canals, one realises the fact that dual-canal roots do exist in mandibular incisor teeth.⁽³⁾ Therefore, while beginning root treatment on a mandibular incisor tooth, a dentist should know

that he might encounter a dual-canal root and thus a thorough inspection is required. Subsequently, the presence of an unfilled canal may account for some of the unsuccessful endodontics treatment of the mandibular teeth.

Materials and Methods

To study the internal anatomy of the mandibular incisor teeth a total of 205 central and lateral mandibular teeth that had healthy roots without any root resorption were collected from various dental clinics, surgery department of college of dentistry and dental offices in Tehran. They were then put in 10% formalin solution. Age of the teeth, and reasons for their extractions were not registered.

These samples were cleaned using brushes and other devices. They were then put in 5% hypochlorate solution. Finally the remainder of germs was cleaned and the samples were prepared for next stages.

In present study, the three methods used, coloring, radiography, and cross-sectioning simultaneously. Methods of each procedure are described as follows:

Radiography: Researchers mainly used two methods in radiography.⁽⁴⁾

In this particular method in order to study the internal anatomy of mandibular incisor teeth, it was decided to take two radiographs of each tooth using periapical films from the buccolingual and proximal sides before cross sectioning.

Therefore, in each tooth sample, we first prepared an access cavity, then colored them and after coding each tooth we carried out the radiography as mentioned above.

All radiographs were taken under similar conditions and the selected films were all of the same type. All radiographs were obtained by the same radiography machine (Siemens 70kv 7mA).

After performing tests on different doses of rays and various distances of tube from film, the

most suitable time of radiation was 0.4 seconds and the distance of tube from film was selected as 2 cm. Films were developed under same possible conditions and placed in special periapical radiography cliché frames. Under each two films of one tooth (buccolingual and mesiodistal views), tooth number was attached.

Coloring: The optional materials included three types of colors, fushin 1%, van gisson, and methylen blue.

1- Fushin 1%

2- Van gisson → fushin + picric acid

3- Methylen blue → one pill in 50cc of water

In order to study the coloring properties of the above materials on the tooth tissue we had to perform the triple coloring once before taking cross sections and again coloring on teeth was done after taking cross section.

Finally, we selected coloring with fushin 1% for twenty minutes and the tooth was colored after preparing access cavity.

Cross Sectioning of Samples: After performing radiography on the teeth, crown of each tooth was cut off at the CEJ by hand piece and metal disk.

The roots were then cut in two areas so as to divide the root into three even sections of cervical, middle, and apical as much as possible. These three sections were glued to the film envelope pertaining to the same tooth and at the bottom of the envelopes number of the respective tooth was labeled.

All samples were accordingly prepared for study and examining the number and type of root canals of each tooth.

Two types of identifications have been completed, one for recording the study of radiographs and the other for recording the study of sections.

Radiographs and sections of each sample were studied independently by two endodontics post-graduates.

This was done using a magnifier with power of 3 and results of radiography study were

recorded in the respective form along with the tooth number, specifications, number and morphology of canals.

Also results of section study were recorded in its respective form, along with drawing of figure, canal specification and tooth number.

In the final stage after comparison of these studies, no.8 and no.10 files were used pursuing the path of the canal that passes through in the sections, number and form of canals were studied along with radiograph and final result was recorded.

The results of performed research on 205 mandibular incisor teeth were recorded in a table considering the figure of the existing canals.

Result

The following results were obtained from a total of 205 mandibular incisor teeth (Table I).

1- Out of 205 samples 181 had a single canal and one apical foramen, the relative frequency of which equals to 0.88 and the safety margin of 95% for this number equals 0.88 ± 0.06 .

2- Out of 205 samples, 7 of them had two canals and one apical foramen; the relative frequency

of which was 3.5% and the safety margin of 95% for this sample using Poisson distribution can be 7%.

3- Sixteen out of 205 samples, had a single canal and two apical foramina, the relative frequency of which was 0.08 and the safety margin of 95% for this sample was 0.08 ± 0.04 .

4- Out of 205 samples, one tooth had two canals and two apical foramina, the relative frequency of which was 0.05% and the maximum spread with safety margin of 95% for this sample can be 2% using Poisson distribution.

Table I- The result from total of 205 mandibular incisor teeth

Configuration Division	Type of canal	Case	Percent
Vertucci division	Type I	149	73
	Type II	7	3.5
	Type III	32	15
	Type IV	1	0.5
	Type V	16	8
Total		205	100
Black division	Type I	181	88
	Type II	7	3.5
	Type III	1	0.5
	Type IV	16	8
Total		205	100

Table II- Methods and results of studies about internal anatomy of mandibular incisors

Investigator	Teeth sample	Method	One canal (orifice) & one foramen	One canal (orifice) & two foramens	Two canals (orifice) & one foramen	One canal (orifice) & two foramens	Three canal (orifice) & three foramens
Green	200	Invitro section	80.0%	-	7.0%	13.0%	-
Rankine	111	Invitro	60.0%	-	35.0%	5.0%	-
Wilson and Henry		radiographs					
Green	500	Invitro section	79.0%	-	17.0%	4.0%	-
Madiera and Hetem	1330	Invitro clear and dyed	88.5%	-	11.0%	0.5%	-
Benjamin and Dowson	364	Invitro radiographs	59.0%	-	40.0%	1.0%	-
Vertucci	200	Invitro section	92.5	-	5.0%	2.5%	-
Caliskan	Central 100	Invitro clear and dyed	Central 82% Lateral 84%	2% 2%	14% 14%	-	2% -
	Lateral 100						
Present study	205	Invitro radiographs and dyed & section	88%	8%	3.5%	0.5%	-

Discussion

Understanding the pulp morphology is essential for successful treatment of root canal. Hence, dentists must always be on the watch for existence of two canals or a two-branch canal while working on the mandibular incisor.

Although there are certain naive dentists who consider mandibular incisors as relatively easy teeth for endodontic treatment, but Weine believes that after molars and multi-canal teeth,⁽⁵⁾ mandibular incisors are the most difficult ones. Hence, acquiring the necessary precision in finding accessory canals is mandatory.

While reviewing the results of studies carried out by various researchers, one notices a considerable difference in the presented statistics. It is observed that using similar methods has ended in closer results (at least regarding the number of single-canals) (Table II).

For example the number of single-canals in using the sectioning method carried out during 1956 and 1973, the percentages of spread are 79% and 80% consecutively.^(6,7)

In the radiography method the results were similar and for the single-canals they were 60% and 59% in 1965 and 1974, which differed greatly with other studies.^(8,9)

Seemingly in the radiography method the percentage of dual-canals reported, was mainly justified by visual examination of the radiography clichés, thereby the possibility of not being able to distinguish between wide canals that have calcifications in the middle and/or 8 shaped canals from the actual dual ones would still persist promoting higher risks of errors.⁽¹⁰⁾

In conclusion, it is essential to use different techniques such as coloring, radiography, and cross sectioning simultaneously, so as to derive comparatively more precise data and results.^(10,11)

In the study using Vertucci division the studied

teeth had 5 different types of canals, about 80% of the canals were V type. Meaning that at first it had one canal, which at the middle of the root or at the end it divides into two branches and form two separate apical foramina. This has not been reported by other researcher's. Considering the above statement even after careful examination and having a proper access cavity and checking to be certain of existence of a single canal entrance, we can never feel confident in the root treatment. Since we might have one canal with two apical foramina at the end, the oversight of which may cause failure in the treatment.

This makes the need for a better examination and also obtaining radiography clichés from different angles inevitable.

The next issue to be considered is about canals that have one entrance then divide into two canals and ultimately join to form one apical foramen (canal type III Vertucci).

The occurrence of type III canals in the performed study was a substantial 15%. The important point is that in these canals or in type II canals that also have a single apical foramen, would an apical seal from one canal suffice or both canals have to be cleaned and filled. On this case there are two different theories.

According to Weine, if one of the canals is prepared well, the apex be filled well, and the seal obtained completely, then the result would be satisfactory.⁽⁵⁾ But according to Benjamin and Dawson: When only one canal is treated, pulp tissue in the second canal can ultimately release harmful substances through a secondary canal to the interior space of the periodontium ligament.⁽¹⁰⁾ It was observed that the two canals often join at 1 to 2mm short of the root apex, which after the treatment of one canal, the second one has a direct connection with the periapical tissues through apical foramen. This condition certainly results in failure of endodontic treatment.

Considering the above statement we will have two groups in type III Vertucci canals. First

group consists of canals that join at 2 to 3 mm distance from the Apex and the second group are canals that unite almost at the area of apical foramen. In each of the mentioned groups the treatment may be different. The reason being that if we want to work in the type III Vertucci canals of the second group, in regards to the working length, we will practically have two canals and two separate apical foramina. Therefore, it is essential to divide type III of

Vertucci division in two separate groups and/or at least add a sub-group to it.

In dual-canal teeth one of the main reasons of overlooking the second canal is making an improper access cavity which leaves an ivory lingual over the second canal (which often is lingual canal) causes such a condition.⁽¹⁰⁾

Therefore, the access cavity should be extended toward the lingual making sure there is no lingual ledge.

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