Incidence of furcated canals in mandibular incisors and efficacy of thermafil obturator

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تم بحث إمكانية حدوث تشعب في أقنية القواطع السفلية وقدرة حشوات الكاتابيركا الملينة بالحرارة (ثيرما فيل) على حشي هذه الأقنية .أخذ (٧٠) قاطعة سفلية مقـــلوعة وتم علاج جذورها وحشيها بمادة الثيرمافيل وإسمنت غروسمان . تم وضع هذه القواطع بعد حشيها في مادة أزرق الميثيلين ومن ثم جففت الأسنان وجعلت شفافة . وبالفحص المجهري تبـــين أن ٧١ % من الأسنان أظهرت قناة رئيسية ، و ٢٩ % أظهرت قناة متشعبة ٦٠% منها من نوع ٢ و ٣٥ % أظهرت نوع ٣ و ٥% أظهرت نوع ٤ . وأظهرت حشـــوات الثيرمافيل فعالية في حشي القناة الرئيسية والقنوات الجانبية والمتشعبة ماعدا قاطعين ذات أقنية متشعبة من نوع ٢.

The prevalence of furcated canals in mandibular incisors and efficacy of Thermafil in filling these canals was investigated. Seventy extracted mandibular incisors were instrumented and filled with Thermafil and Grossman's sealer. The teeth were placed in methylene blue then dehydrated and cleared. Under a stereomicroscope, 71% of the teeth showed main canals and 29% furcated canals. Sixty percent of furcated canals were Type 2, 35% were Type 3 and 5% were Type 4. Thermafil obturator was found to be effective in filling not only all main and lateral canals, but also furcated canals except in 2 teeth with Type 2 canal configuration.

Introduction

Obturation of the root canal is the final and most important step in root canal treatment. Nowadays, it is easy to achieve satisfactory obturation of the main canals in most clinical cases. However, the existence of lateral and accessory canals often complicates the disease process and the treatment.

Mandibular incisors often have furcated root canals. These furcated canals may not appear on radiographs and therefore need different angled radiographs for better information. Where they exist, an apicoectomy may cause complications because a single apical foramen may ultimately become two separate foramina. Results are likely to be poor when using the retrograde root filling technique, because the lingual foramen of a furcated canal is unlikely to be located accurately at the time of surgery.[1] To avoid complications and failure, proper instrumentation and filling must be done.

Recently, Thermafil (Tulsa Dental Products, Tulsa, OK) obturator has been introduced. It is reported to have better adaptation and sealing ability than lateral condensation technique.[2,3] It has been demonstrated that the warm gutta-percha flows and seals the irregularities of the root canal to produce a good seal.

The purpose of this study was to evaluate frequency of furcated root canals in a small series study of extracted mandibular incisors and the efficacy of Thermafil technique in filling these canals.

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Materials and Methods

Seventy extracted mandibular incisors were used in this study. The teeth were stored in 10% formalin solution, immersed in 5.25% sodium hypochloride to remove soft tissue from root surfaces and then rinsed under tap water. Access cavity was opened and pulp tissue remnants were removed with a barbed broach. Canal patency was determined by passing a size 15 file through the apical foramen and 1mm was subtracted from these measurements to establish the working lengths. The teeth were instrumented using the step-back' technique and irrigated with 5.25% NaOCl before and after recapitulation with a size 40 master apical file. The root canals were obturated with number 40 metal carrier Thermafil obturator and with Grossman's sealer. Thermafil oven was used to warm the obturator according to the manufacturer's instructions. Zinc oxide eugenol cement was used to seal the coronal orifice. The roots were stored in 100% humidity for 24 hours and coated with two layers of nail polish, except the apical foramen which was marked before obturation and then placed into aqueous 1% methylene blue at 37^{C}C for two weeks. After removal from the ink, the teeth were rinsed, dried and the nail polish was removed. The experimental teeth were demineralized in 5% nitric acid then

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dehydrated in ascending grades of alcohol and cleared in methyl salicylate.[4]

Under stereozoom photomicroscope (Olympus) presence of main canal, furcated canal, lateral canals was evaluated and classified according to Vertucci.[5]

Type 1. A single canal extends from the pulp chamber to the apex.

Type 2. Two separate canals leave the pulp chamber and join short of the apex to form one canal.

Type 3. One canal leaves the pulp chamber, divides into two within the root and then, merges to exist as one canal.

Type 4. Two separate and distinct canals extend from the pulp chamber to the apex.

The presence of the filling within the root canal was also recorded.

Results

The type of the root canal and lateral canal identified in experimental groups are summarized in Table 1. Of the 70 teeth, 50 teeth (71%) showed single main canals (Type 1), while 20 teeth exhibited furcated canals (29%). Of the 20 teeth, 12 had Type 2(60%),7 Type 3(35%), 1 Type 4 (5%) root canal configuration. Also, 3 teeth with main canal showed lateral canals in apical area.

Table 1. Classification and number of mandibular incisors with various types of canal configurations.

No. of teeth	Canal Configuration				
	Type 1	Type 2	Type 3	Type 4	Canals with lateral canal
	(Main canal)	(Furcated canal)			
70	50 (71.4%)	12 (17%)	7 (10%)	1 (1.4%)	3 (in apical area)

Table 2 shows the presence of filling within the root canals of the mandibular incisors. In Type 1, the main and the lateral canals of all teeth were obturated (Fig. 1). Ten of 12 teeth in Type 2 (Fig. 2), all teeth in Type 3 (Figs. 3 & 4) and 1 tooth in Type 4 were filled by thermoplasticized gutta-percha. On the other hand, although the labial canals of 2 teeth of Type 2 were filled totally, the lingual canal was not filled completely to the point where it joined the labial canal (Fig. 5). In this study, the extent of dye penetration was not measured but any tooth showing leakage was recorded and the trail of ink was evaluated. Ten teeth showed limited leakage only in main canal. Penetration of dye into any of the lateral or furcated canals was not observed.

Table 2. Filling efficacy of Thermafil obturator according to the canal configuration in mandibular incisors.

NO. Of teeth	Canal Configuration									
	Type 1		Type 2		Type 3		Type 4		Internal Canal	
	Pres	Abs	Pres	Abse	Pres	Abs	Pres	Abs	Pres	Abs
70	50 (100%)		10 (83.3%)	2 (16%)	7 (100%)		1 (100%)		3 (100%)	

Pres = Present; Abs = Absent

Fig. 1. Photograph of a main canal with lateral canal filled with Thermafil obturator at magnification x12.

Discussion

An understanding of the morphology of the pulp cavity is necessary for successful root canal therapy. In this study, 71% of the mandibular incisors had only main canals and 29% showed furcated canals. Investigators have demonstrated the frequency of furcated canals in mandibular incisor as ranging from 11.1 to 40.5%.[6-9] This wide variation may be due to the population or the patient's age during the time of extraction. It is

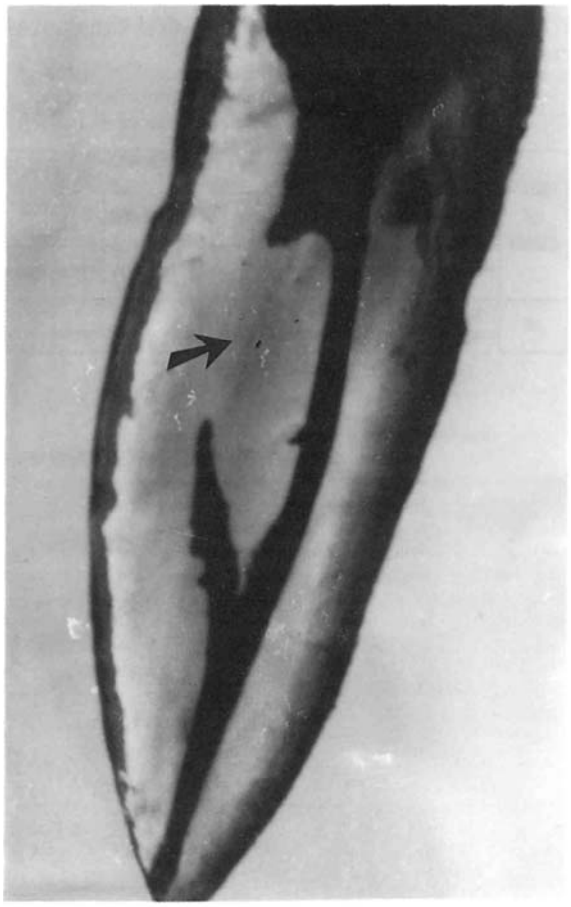

Fig. 2. Photograph of a furcated canal in a mandibular incisor at magnification x85. Furcated canal is perfectly filled with gutta-percha although calcification was seen in the middle of this canal. Calcified area is marked with the arrow.

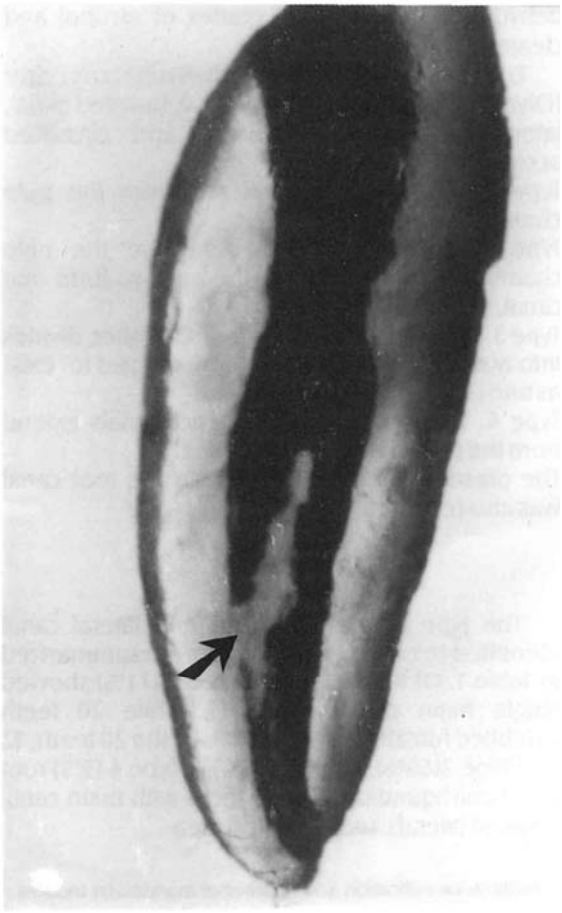

Fig. 3. Photograph of the furcated canal (Type 2) in mandibular incisor at magnification x12. Furcated canal is perfectly filled with gutta percha. Calcified area is marked with an arrow.

known that because of the deposition of cement or dentin, some root canals would be obliterated by age. More ramifications have been detected in patients between 35 to 45 years of age than patients over 55 years of age.[7]

In this study also, some of the furcated canals found to be calcified may be due to the age (Figs. 2-3). Clearing technique is used in this study to enable the investigator to view more clearly all of the ramifications of the root canal system three dimensionally. Also methylene blue dye shows more detail of unfilled areas entering through main canal to the branches. The result of this study showed that Thermafil technique is effective to fill all main and lateral canals with gutta-percha as reported in a previous study.[3] Also, 18 of 20 furcated canals were filled perfectly with gutta-percha. Teeth with canal furcations in the middle or apical third may present problems in treatment.

Of the two canals, the one most continuous with the large main canal, is usually amenable to adequate enlarging and filling procedures while the preparation and filling of the other canal is often extremely difficult.[8] Mauger et al[10] investigated 275 mandibular incisors and reported that when a lingual access is made, a predominant bulge of dentin is present in the cingulum area, which makes detection and debridement of the lingual canal more difficult. They reported that making straight-line access in the incisal or facial edge of mandibular incisor will allow better access to the lingual canal. In this study, lingual access was made and lingual canals of 2 of 20 teeth with furcated canals were not filled completely to the point where it joins the labial main canals.

Strindberg[11] showed that the success rate of endodontically treated teeth is lower in single rooted teeth than teeth with two or three roots.

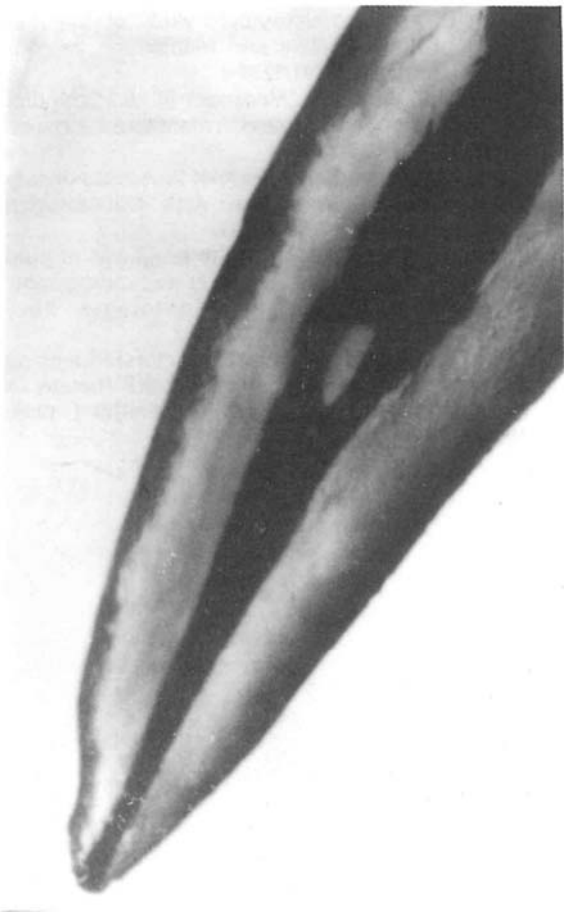

Fig. 4. Photograph of a bifurcated canal in Type 3 (with an island) in a mandibular incisor at magnification x12.

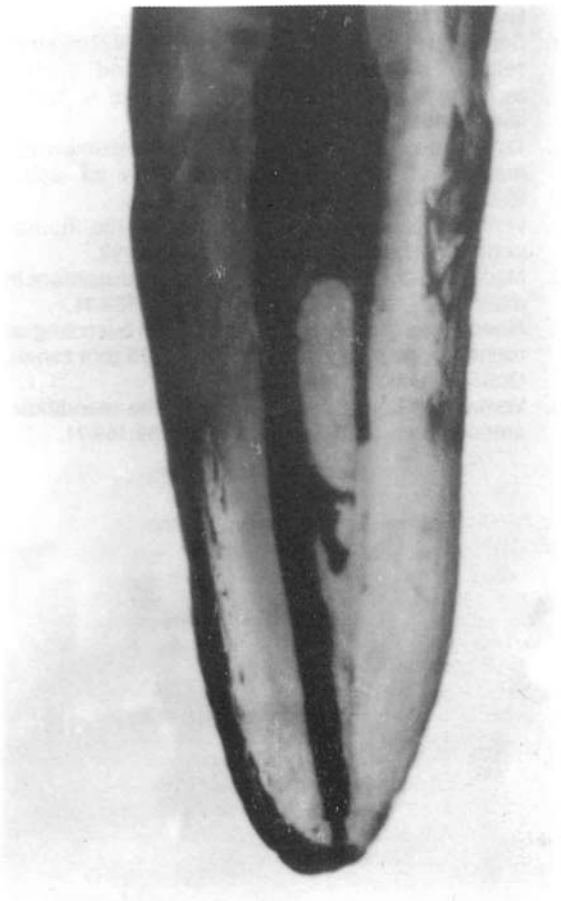

Fig. 5. Photograph of a furcated canal in a mandibular incisor at magnification x12. Incomplete obturation can be seen in lingual canal.

Similar observation of increased endodontic failure in anterior teeth was reported by Grahnen and Hannson.[12] Although it is easy to obturate the main canal in single roots, the presence of an unfilled lateral branches may explain some failures of endodontic treatment in these teeth, even if radiographically the canal seems to have been obturated.

Smith et al[13] found the success rate of lateral condensation technique to be 86.66% in all teeth. In previous studies,[23] lateral canals were filled with sealer in lateral condensation technique, but Thermafil and Ultrafil techniques were effective to fill the lateral canals with gutta-percha. In this study, lateral condensation technique was not evaluated. Practically, it is not possible to fill furcated canal with cold gutta-percha. So only thermoplasticized gutta-percha technique was used to detect the effect of warmed gutta-percha on furcated or lateral canals. All sealers may resorb with time and this may lead to the failure of the root canal treatment.

Although favorable results were obtained from in vitro studies with Thermafil technique, further work should include a clinical study to correlate with this in vitro study. Facial or lingual access cavity may be performed to determine whether it is more effective than lingual access cavity to locate, instrument and obturate the lingual canal in mandibular incisors.

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