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Endodontic treatment of a continuous C-shaped maxillary first molar with independent four canals identified by using cone-beam computed tomography

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ABSTRACT

Endodontic treatment of a continuous C-shaped maxillary first molar with independent four canals identified by using cone-beam computed tomography

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본 연구의 목적은 특이한 C형 치근과 근관을 가지고 있는 상악 제 1대구치의 근관치료 증례를 콘빔단층촬영을 사용하여 진단 및 치료하였음을 보고하는 것이다.

본 증례에서는 특이적인 해부학적 근관 형태가 콘빔단층촬영을 사용하여 확인되었으며 비외과적 근관치료가 시행되었다. 촬영한 영상에서 모든 치근이 C 형태로 융합되어 있으며 독립적인 4개의 근관을 포함하고 있음이 관찰되었다.

C형 근관계의 복잡성을 고려할 때 콘빔단층촬영이 적절한 근관계의 확인과 의원성 손상을 예방하기 위해 유용한 보조적 방법인 것으로 보여진다.

Key words : Maxillary first molar, C-shaped canal, Canal morphology

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Ⅰ. Introduction

The presence of untreated canals is a well-known cause of endodontic failure after treatment[1]. Hence, for a successful endodontic treatment, a thorough understanding of the root canal morphology is very important. During the clinical procedure, however, unexpected

anatomic variations can be encountered, one of which is a C-shaped root canal usually found in the mandibular second molars[2, 3]. This morphological variation also has been reported to be in the maxillary first molars[4], with the reported incidence of this rare anatomy being as low as 0.09%[5].

With developing armamentarium such as cone-beam computed tomography (CBCT) and dental operative microscope (DOM), they became a valuable tool for canal identification, especially in complex canal morphology[6].

This report describes a rare C-shaped variation in a maxillary first molar which was identified by CBCT and treated by non-surgical root canal treatment.

Ⅱ. Case report

A 29-year-old man visited the Conservative Department of Wonkwang University Daejeon Dental Hospital for pain and discomfort of upper left first molar. The patient had a medical history of chronic thrombocytopenia. History taking revealed the presence of occasional spontaneous pain and sensitivity on cold stimuli for past several days. Clinical and radiographic examination revealed a large temporary restoration near to pulp chamber, a palatal cusp fracture, and a slight apical ligamental space widening of the tooth(Fig.1). On the basis of the examination, a diagnosis as symptomatic irreversible pulpitis with symptomatic apical periodontitis was made. The clinical condition was explained to the patient and endodontic treatment was proposed and accepted.

After getting a written consultation about his medical condition from the patient's physician, the treatment was started. The tooth was anesthetized and isolated with a rubber dam. The temporary restoration and remaining caries were removed. Access opening was made and the evaluation of pulpal chamber floor using endodontic explorer revealed common 3 canal

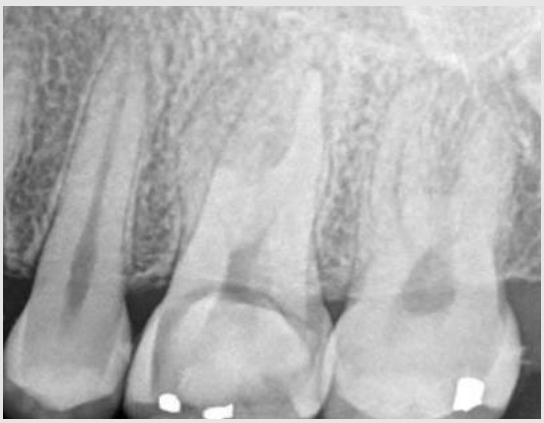

Fig. 1. Pro-operative periapical radiograph. A large temporary restoration near to pulp chamber, and a slight apical ligamental space widening of #26 tooth were observed.

orifices: mesiobuccal, distobuccal, palatal. After canal negotiation, for tentative working length measurement of the three canals, an electronic apex locator(Root ZX, Morita, Tokyo, Japan) was used. For the confirmation of determined working lengths, a periapical radiograph was taken, which revealed a possibility of the presence of another canal in mesiobuccal root(Fig. 2). To see the presence of any additional root canals, and if so, to grasp the complex canal morphology, a CBCT scan was obtained(Alphard VEGA, Asahi Roentgen Ind. Co., LTD, Kyoto, Japan) using tube voltage of 60~110 kV and tube current of 2~15 mA. The D scan mode of the CBCT was chosen for the detailed scan of canal morphology. Axial view showed the continuous C-shaped root connected 4 independent root canals from second mesiobuccal canal to palatal canal(Fig. 3).

At the next appointment, for the detection of

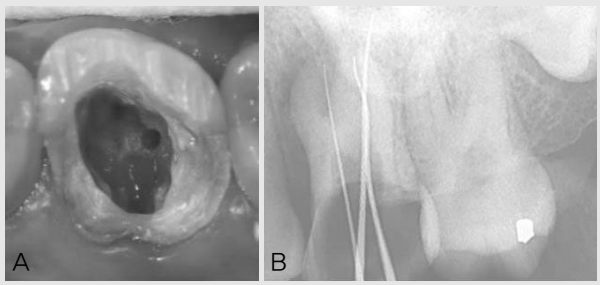

Fig. 2. (A) Clinical view after access opening and coronal flaring showed three canal orifices. (B) Periapical radiograph revealed a possibility of the presence of another canal in mesiobuccal root.

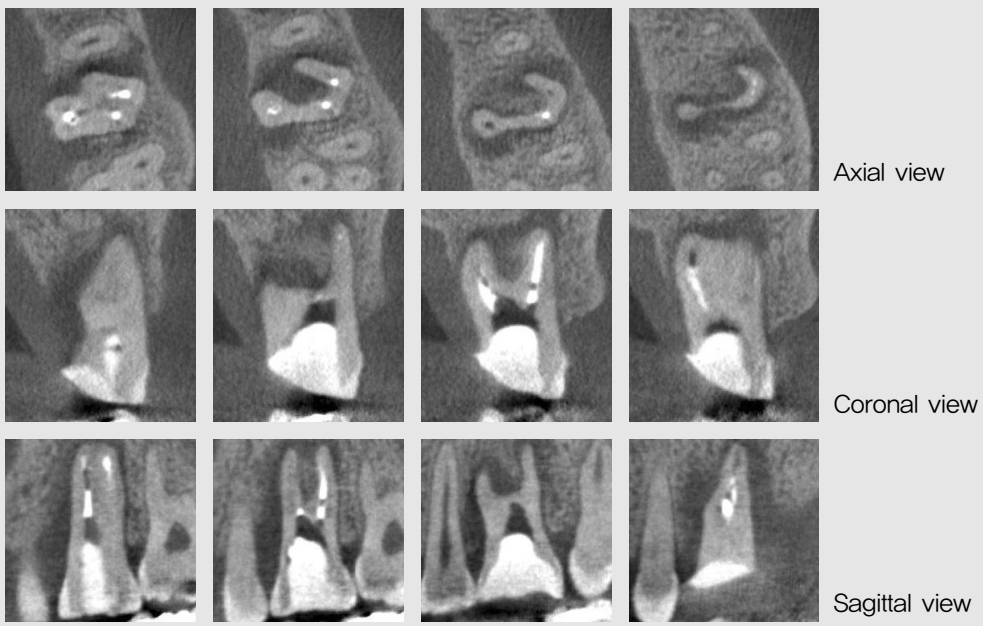

Fig. 3. CBCT D mode shows the continuous C-shaped root connected 4 independent root canals from second mesiobuccal canal to palatal canal.

the fourth canal, a high magnification of a microscope(OPMI pico Dental microscope, Carl Zeiss Surgical GmbH, Germany) was utilized. The hidden canal was located at more mesial portion of the floor than expected location. After determination of working lengths of all four canals by electronic apex locator and a radiograph(Fig. 4), mechanical instrumentation was performed with ProTaper nickel-titanium rotary files(ProTaper Universal, Dentsply-Maillefer, Ballaigues, Switzerland). 2.5% sodium hypochlorate(NaOCl) solution was used for the irrigation of canals. In the area of long isthmus area connecting four canals, an ultrasonic instrument and sonic irrigation system(EndoActivator, Dentsply-Maillefer, Ballaigues, Switzerland) was also applied.

At the third appointment, after the confirmation of symptom and sign free state, the root canal obturation was performed. After irrigation using 17% ethylenediamine tetra acetic acid(EDTA) solution for 1 minute and soaking using 2.5% NaOCl solution for 10 minutes, the canals were dried with paper points. Gutta-percha master points were fit at lengths and confirmed with a radiograph. Continuous wave of condensation technique with AH Plus sealer(Dentsply DeTrey GmbH, Konstanz, Germany) was applied. The final radiograph showed connected four canals filled with radiopaque material(Fig. 5). After canal filling, permanent restoration including post and core

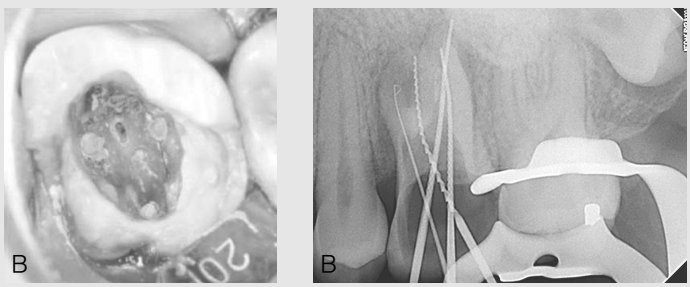

Fig. 4. (A) Clinical view after canal filling showed four canal orifices.
(B) Periapical radiograph shows the files in four canals including secondary mesiobuccal canal.

Fig. 5. Periapical radiograph shows the connected four canals files filling with radiopaque materials.

was delivered to the patient(Fig. 6). The patient was recalled after 6 months for checking the healing state of periapex and the treated tooth was seemed to be in the state of healing procedure.

Ⅲ. Discussion

During root development, when the extension of epithelium for independent roots on multi-rooted teeth is inadequate to allow the complete split of roots, leaving a large fused root. This becomes C-shaped root canal[7]. Although mostly found in mandibular second molar, since the first case report in 1984 by Newton and Mc Donanlds[4], there has been some reports about this anatomic variation in maxillary first molar. According to the case report and literature review of Jorge et. al.[7], there are three types of pulp chamber anatomy found on the reported cases; fusion between palatal and distobuccal canals, fusion between mesiobuccal and distobuccal canals, and fusion between two palatal canals. Of the three types, the fusion of distobuccal and palatal root is the most common type. In other studies about root and canal morphology of maxillary molars, only 2 out of 83 teeth showed to have fused roots in Irish population[8], no four fused roots were observed in Burmese people[9], no C-shaped one root was observed in Thai population[10], and only 1 out of 221 teeth had all roots fused in Ugandan population[11]. These results show that C-shaped canal with all roots fused and with continuous canals is extremely rare in frequency. In another case report of Karanxha et al.[12], the case of C-shaped maxillary first molar with three independent buccal root canals was also described as a very rare variation.

About the primary medical history of this patient, chronic thrombocytopenia is a state of imbalance of blood platelet level for certain reason[13]. There has been no study revealing any relationship of this bleeding disorder and root canal anatomy until now.

The three-dimensional examination using CBCT images provided sufficient information about complex root canal morphology compared

Fig. 6. Permanent restoration including post and core was delivered to the treated tooth.

to the conventional radiographs. In this case, the CBCT showed the presence of C-shaped canal connecting four individual canals. In the radiograph taken for the working length determination at the first visit, the file in mesiobuccal canal was shown as if there were a perforation in focal area in spite of the sign of electronic apex locator was normal. After CBCT taking, with the grasp of the complex canal morphology, the presence of perforation was ruled out and also could be prevented the iatrogenic perforation from isthmus area. Considering the field of view(FOV) of D mode, which is the smallest(51 x 51mm) of the other modes, the usefulness of CBCT can be accepted within clinical decision[12]. Hence, the use of accessory tool like CBCT might be able to provide valuable information during clinical procedures[14, 15].

Ⅳ. Conclusion

Although the C-shaped canal configuration in the maxillary first molar has been reported, the continuous C-shaped root involving four independent canals(mesiobuccal, second mesiob uccal, distobuccal, and palatal) in this study seems to be very rare. The utilization of CBCT and DOM is helpful for accurate diagnosis and management of this unusual canal morphology.

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