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Orginal Article

Root canal treatment of the three-canalled maxillary second premolar: a case report

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Abstract

This article is a case report of conventional endodontic therapy for a left maxillary second premolar with three root canals. The incidence of three canals at the apex of the maxillary second premolar has been reported to be 0.3-1.0%. This anatomical variation of root canal system can be challenging in endodontic treatment. The patient was 44 year-old female that needed the root canal treatment on tooth # 25 with three canals. Therefore, thorough knowledge of the root canal anatomy and its variation, careful interpretation of the preoperative radiographs and access cavity modification are essential for enhancing intracanal preparation, disinfection and obturation. Only then, a predictable endodontic therapy of the three-canalled maxillary second premolar can be accomplished. In two years recall demonstrated success both clinically and radiographically.

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***Key words**: anatomical variation; maxillary second premolar; three root canals*

Introduction

The success in endodontic therapy mostly depends on the removal of all pulp tissue or necrotic debris and bacteria within the root canal system. Cleaning and shaping the entry root canal system makes it more predictable endodontic treatment. Therefore, a thorough knowledge of root canal morphology is essential to locate all root canals and increase the success rate[1].

There are many variations of root canal system in each tooth especially maxillary premolar. Many researchers[1-13] have investigated the root canal configuration of the maxillary first and second premolars. In most instances the maxillary second premolar had one canal but teeth with two or more canals have also been reported. Barette[8] found 65.6% of 22 maxillary second premolars, possess more than one canal. The incidence of three-canalled maxillary premolars has been reported as 0.5-6% for first premolars[1,3,9] and 0.3-1% for second premolars[1,6,11]. Caliskan *et al*[10] reported two canals at 44.3% and three canals at 0.7%, while another[11] reported two canals at 32.4% and three canals at 0.3%. Vertucci[1] studied 200 maxillary second premolars and found 24% with two canals and 1% with three canals. The most variable root canal anatomy was found in the maxillary second premolar[1]. The root canal configuration presented within the roots of human permanent teeth can be classified according to Vertucci[1] into eight types:

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

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

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

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

Type V. One canal leaves the pulp chamber and divides short of the apex into two separate and distinct canals with separate apical foramina.

Type VI. Two separate canals leave the pulp chamber, merge in the body of the root, and redivide short of the apex to exit as two distinct canals.

Type VII. One canal leaves the pulp chamber, divides and then rejoins within the body of the root, and finally redivides into two distinct canals short of the apex.

Type VIII. Three separate and distinct canals extend from the pulp chamber to the apex.

These variations can be predicted by radiographs. Then the clinicians should detect the presence of extra root canals by observing multiple preoperative radiographs, taken from different angulations. Martinez-Lozano *et al*[15] reported that varying the horizontal angle 20-40 degrees can improve visualization of additional canals in maxillary premolars. The most common root canal configuration of three-canalled maxillary premolars is three separate roots, each containing a single canal. The less frequent three-canalled configuration with one or two roots is more difficult to envision on preoperative radiographs, but usually have all canal orifices located on the pulp chamber floor. The three canals are classified as the mesiobuccal, distobuccal, and palatal canals, which are similar to those of the maxillary molar[14]. A general guideline for the identification of a three-rooted maxillary premolar on a straight-on preoperative radiograph is if the mesial-distal width of the mid-root image appears equal to or greater than the mesial-distal width of the crown image, then the tooth most likely has three canals. This guideline acts as a good visual clue, but is not absolute[14].

Successful root canal therapy can be compromised if one fails to recognize the existence of the extra root canals and leave it untreated. Consequently, awareness of the possible existence of these anatomical variations and careful interpretation of the preoperative radiographs is important for endodontic treatment of the maxillary second premolar. This report discusses the endodontic treatment of a maxillary second premolar with three root canals.

Case report

A 44-year-old Thai female came to the dental office for the chief complaint of tooth cavity and food impaction in the area of the maxillary left molar. The patient's medical history revealed no allergies or systemic diseases and was noncontributory.

Intra-oral examination revealed the pulp was exposed by a large carious lesion in tooth # 25 (left maxillary second premolar). The tooth was asymptomatic except the patient felt discomfort because of food impaction. No intra-oral swelling or mobility presented. Periodontal pocket probing and palpation test were within normal limits. Tooth # 25 responded with discomfort to percussion. Electric pulp testing was performed using a Vitality Scanner (Analytic Technology, Redmond, WA, USA); the tooth had no response while all other controlled teeth responded normally.

A preoperative periapical radiograph demonstrated the presence of a large carious lesion on the distal portion of the tooth. The lesion involved the pulp chamber and the periodontal ligament space appeared radiographically normal with intact lamina dura. Tooth # 25 was diagnosed with a necrotic pulp with normal periapical tissue.

The preoperative radiograph also revealed the information that tooth # 25 had an unusual root canal configuration. The mesial-distal width of the mid-root portion was found to be greater than normal. The visualization of the root canal was difficult because of an abrupt loss of a radiolucent canal in the pulp cavity (Fig. 1A). The variation of the canal morphology was recognized and the clinician prepared to locate all three root canals.

First visit, local anesthesia was administered. An interim building on the distal wall of tooth # 25 with bonded resin composite was made to facilitate the rubber dam isolation and aseptic technique. The pulp chamber was exposed after rubber dam placement. The modified coronal access was made in a more triangular shape rather than the usual oval access of the maxillary second premolar to locate all the root canals. Only two canals: distobuccal and palatal canal were found. Then access outline was extended more toward the mesio-buccal aspect of the crown (Fig. 2). Under the magnification loupe at 2.6 X, the mesoibuccal canal was found. The canal length of mesiobuccal, distobuccal and palatal canals were determined by using an electronic apex locator (Root ZX, J. Morita, Kyoto, Japan) and confirmed by radiograph. The working lengths of these three canals were 17.5 mm., 15.0 mm. and 14.0 mm., respectively. According to Vertucci's canal configuration classification, this tooth was Type VIII. All three root canals were cleaned and shaped with a step back instrumentation technique using K files # 10-80 and Gates-Glidden burs # 1-4. Sodium hypochlorite 2.5% and calcium hydroxide were used as an intracanal irrigating solution and medication, respectively, to disinfect the root canal system. The tooth was temporary sealed with IRM (Dentsply International, Milford DE, USA).

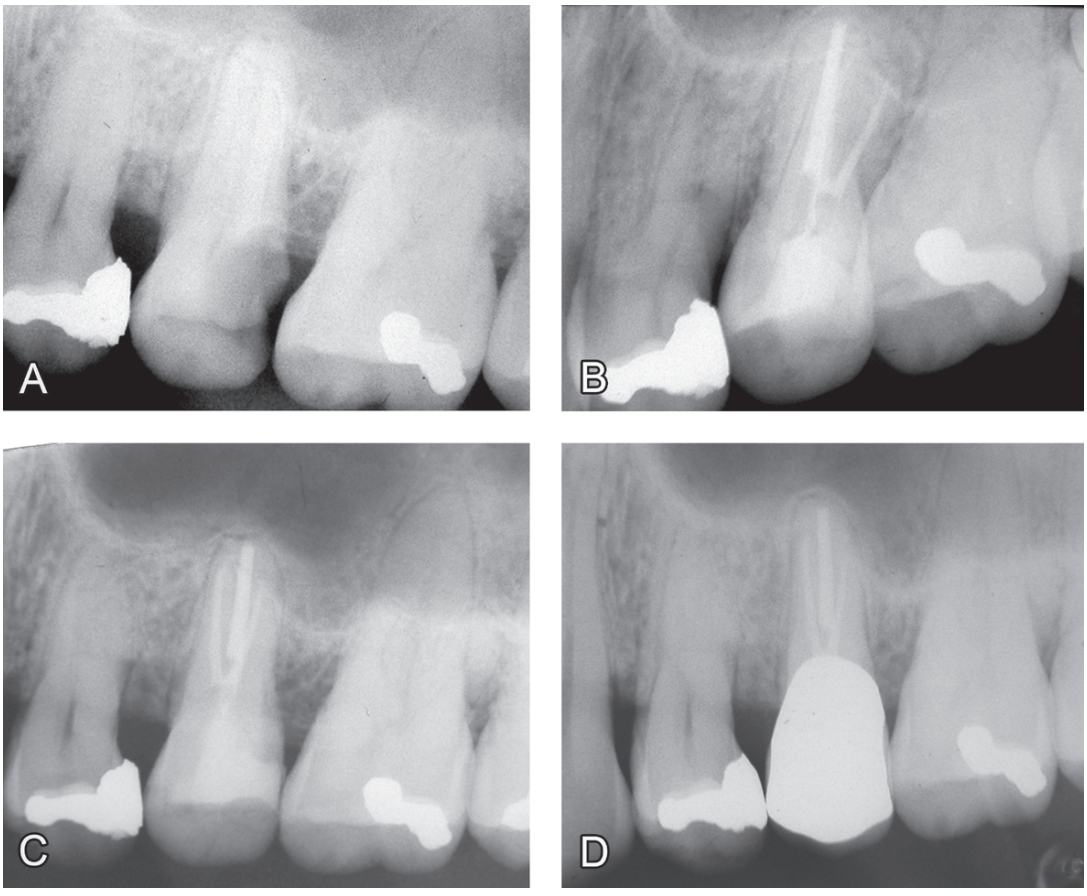

Fig. 1 A) Preoperative radiograph revealed a deep carious lesion, a great mesial distal width and an abrupt loss of a radiolucent canal, suggesting the existence of three root canals. B) Immediate postobturation radiograph: mesial angulation, demonstrated the two buccal canals and the large one palatal canal. C) Immediate postobturation radiograph: straight-on, showed the three canals: mesiobuccal, distobuccal and palatal canal. D) Twenty three-month postoperative radiograph revealed success radiographically.

Second visit, one week later the three root canals were obturated with lateral condensation technique using gutta-percha cones and CU Root Canal Sealer (Grossman's Formula, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand). Temporary restoration with IRM was made and two postoperative radiographs, straight-on and mesial angulation, were taken (Figs. 1B and 1C).

Third visit, two weeks later the patient reported no discomfort. Clinically, no mobility or intra-oral swelling or periodontal pocket greater than three millimeters presented. Periodontal palpation and percussion responses were within normal limits. The coronal-radicular core build up was made with resin modified glass ionomer (Vitremer, 3M ESPE, St Paul, MN, USA). One month later, a full-coverage, porcelain-fused-to-metal crown was placed to prevent both cuspal and crown root fracture. In two years recall, no mobility or intra-oral swelling or periodontal pocket greater than three millimeters presented. Palpation and percussion responses were within normal limits. The periodontal ligament space appeared radiographically normal with intact lamina dura (Fig. 1D). Re-evaluation demonstrated success both clinically and radiographically.

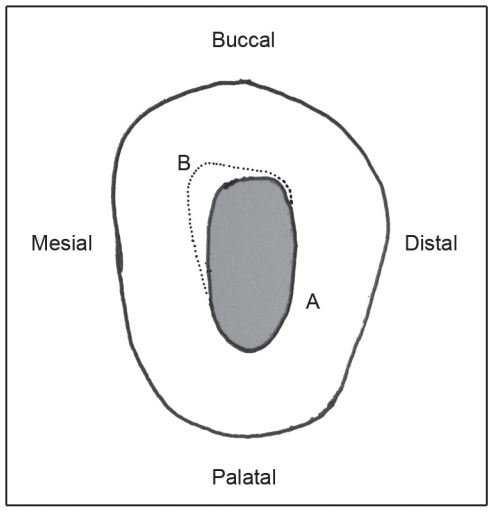

Fig. 2 A diagram represented the modification of the access preparation in the three canalled maxillary premolar. (A) regular access preparation (B) modified access preparation

Discussion

Conventional endodontic treatment of the maxillary second premolar is occasionally a very difficult procedure particularly in the presence of extra roots or root canals. The recognition of atypical anatomy is important even though it is not usually encountered. Many investigators[1-13] have reported on the anatomical variations associated with the maxillary second premolar which may have one, two, three or four roots and canals. Visualization of three-canalled maxillary premolars on preoperative radiographs can often be difficult, because the radiographs only provide a two-dimensional image of the three-dimensional root canal system. Therefore, it is prudent to have more than one preoperative radiograph used to identify the atypical morphology of extra roots or canals of the premolars. Vertucci *et al*[16] stated that careful evaluation of two or more periapical radiograghs before starting the endodontic treatment is mandatory. These radiographs should be taken with the varied angulation of the x-ray cone, horizontally and vertically, to provide enough needed information about root canal morphology. Any attempt to develop techniques that require fewer radiographs runs the risk of missing information, which may be significant for the success of therapy[17]. Whenever there was an abrupt loss of a radiolucent canal in the pulp cavity, an extra canal should be suspected that could be in the same root or in another independent root[13]. The earlier this complex root canal morphology is anticipated, the more likely one can properly manage intracanal preparation and obturation. Thorough knowledge of root canal morphology and its variation together with careful interpretation of the preoperative radiographs is essential to identify these extra roots or root canals.

When three canals are present, the coronal access outline form must be modified from an oval shape to become more triangular with its base on the buccal aspect and has a greater buccal-lingual extension to permit straight line access to those canals[16]. Enhancing the visualization inside the pulp chamber by using magnification such as loupe or dental operating microscope may be helpful, because it improves the thorough exploration of the pulp chamber's floor and the visualization of the canal orifices, especially where root canals divide below the floor of the pulp

chamber. When one can recognize the presence of extra roots or root canals, one can prepare to locate all of the root canals which can lead to a complete root canal debridement, disinfection and tight seal obturation[16].

Conclusion

The successful outcome of endodontic therapy for this case depended on early identification of extra root canals existing within the root. Evaluation of preoperative radiograph revealed the variation of root canal morphology. The clinician prepared to locate extra root canals by modifying the access cavity outline toward the mesio-buccal aspect of the crown and using magnification loupe. This important information and techniques were helpful in locating all three canals. Consequently, predictable endodontic treatment was accomplished.

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การรักษาคลองรากฟันกรามน้อยบนซี่ที่สองที่มีสามคลองรากฟัน : รายงานผู้ป่วย 1 ราย

ปาริชาติ ตั้งกฤษณขจร ท.บ., ป. บัณฑิต (วิทยาเอ็นโดดอนต์), อ.ท. (วิทยาเอ็นโดดอนต์)

กลุ่มงานทันตกรรม สถาบันสุขภาพเด็กแห่งชาติมหาราชินี กระทรวงสาธารณสุข

บทคัดย่อ

รายงานผู้ป่วยนี้บรรยายการตรวจวินิจฉัยและการรักษาคลองรากฟันกรามน้อยซี่ที่สองที่มีสามคลองรากฟัน ความชุกของฟันกรามน้อยบนซี่ที่สองที่มีสามคลองรากฟันมีเพียงร้อยละ 0.3-1.0 ความหลากหลายทางกายวิภาคของคลองรากฟันเป็นงานที่ท้าทายสำหรับการรักษาคลองรากฟัน ผู้ป่วยหญิงอายุ 44 ปี ต้องการรักษาคลองรากฟันซี่ที่ 25 ซึ่งมีสามคลองรากฟัน ดังนั้นการศึกษาลักษณะทางกายวิภาคของฟันเหล่านี้ให้เข้าใจและตระหนักถึงความหลากหลายที่เกิดขึ้นได้ ร่วมกับการศึกษาภาพรังสีก่อนการรักษาอย่างละเอียด และการปรับเปลี่ยนรูเปิดบนตัวฟันให้กว้างขึ้น เป็นสิ่งจำเป็นสำหรับการเตรียมคลองรากฟัน การกำจัดเชื้อโรคในคลองรากฟัน ตลอดจนการอุดคลองรากฟันได้อย่างสมบูรณ์ ทำให้สามารถคาดหวังความสำเร็จของการรักษาคลองรากฟันกรามน้อยบนซี่ที่สองที่มีสามคลองรากฟันได้สูงขึ้น จากการติดตามผลภายหลังการรักษาเป็นเวลา 2 ปีพบว่าประสพความสำเร็จทั้งจากการประเมินผลทางคลินิกและจากภาพรังสี

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คำสำคัญ: *ความหลากหลายทางกายวิภาค; ฟันกรามน้อยบนซี่ที่สอง; สามคลองรากฟัน*