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WORD COUNT 1857
TIME SUBMITTED 27-FEB-2022 08:10PM
PAPER ID 83052740

Name of Journal: *World Journal of Clinical Cases*

Manuscript NO: 73020

Manuscript Type: CASE REPORT

A successful individual endodontic treatment of severely curved root canals in mandibular second molars: A case report

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Abstract

BACKGROUND

The incidence rate of severely curved root canals in mandibular molars is low, and the root canal treatment of mandibular molars with this aberrant canal anatomy may be visibly and technically challenging.

CASE SUMMARY

A 26-year-old Chinese female patient presented with intermittent and occlusal pain in the left mandibular second molar. The patient had undergone caries for filling restoration before endodontic consultation. With the aid of cone beam computed tomography (CBCT), a large periapical radiolucency was observed, and curved root canals in a mandibular second molar were confirmed, depicting a severe and curved distolingual root. Nonsurgical treatments, including novel individual preparation skills and techniques and the use of bioceramic materials as an apical barrier, were performed, and complete healing of the periapical lesion and a satisfactory effect was achieved.

CONCLUSION

A case of a severely curved root canal in a mandibular second molar was successfully treated and reported herein. The complex anatomy of the tooth and the postoperative effect were also evaluated *via* the three-dimensional reconstruction of CBCT images, which accurately identified the aberrant canal morphology. Furthermore, new devices and biomaterial applications combined with novel synthesis techniques can increase the success rate of intractable endodontic treatment.

Key Words: Cone beam computed tomography; Canal curvature; Mandibular second molar; Root canal therapy; Case report

Xu LJ, Zhang JY, Huang ZH, Wang XZ. A successful individual endodontic treatment of severely curved root canals in mandibular second molars: A case report. *World J Clin Cases* 2021; In press

Core Tip: The treatment of patients with severely curved root canals is problematic. Herein, with the guidance of cone beam computed tomography, individual preparation skills and techniques and the use of bioceramic materials as an apical barrier may aid in the treatment of such severely curved teeth.

INTRODUCTION

To date, root canal therapy (RCT) is a preferred treatment for pulpitis and periapical disease, and its success rate is closely associated with the anatomical morphology of the root canal system[1]. Being familiar with internal canal morphology is crucial for endodontists. The anatomical variations existing in the root canal system, such as curvature, may result in severe complications, such as ledge formation, apical transportation and perforation during root canal preparation, which increases the failure rates of the treatment[2]. To reduce the occurrence of these complications, a comprehensive understanding of root canal curvature models, including the degree of

curvature and radius, is important. Mandibular permanent molars are the most vulnerable to dental disease, but the anatomical structure of the root canal is usually complex and substantially varied, which is considerably challenging for clinicians. According to reports, the anatomical configuration of molar roots and canals varies by nation. For example, the proportions of Spanish, Iranian and Indian people with permanent second mandibular molars that have two roots are 83%, 81.6%, 79.35%, respectively[3-5]. Most mandibular second molars have a small degree of bifurcation or have conical roots that are fused on the buccal surface and separated on the lingual surface. This fused root was coined in a C-shaped root, which is an important feature of mandibular second molars. Kim *et al*[6] reported that the proportion of patients with a double root canal system in their mandibular second molars totaled 58% in Korea, while the proportion with the C-shaped type accounted for 40%, as analysed by cone beam computed tomography (CBCT) data.

CBCT was introduced as a high-resolution imaging massage in oral and maxillofacial radiology[7]. Analysing and displaying the curved root canal system in the sagittal, coronal and axial planes can allow for three-dimensional reconstruction of CBCT scans, providing high-resolution images of the root canal system to gain a better understanding of the direction of curvature. Thus, visualization of the canal anatomy can enable precise canal preparation and provide clinical guidance for the diagnosis and treatment of complex and curved canals. This clinical report describes three severely curved canals in the left mandibular second molar that were successfully healed with individual RCTs under dental microscope and CBCT guidance. Herein, we propose preparation techniques with ultrasound systems and dental lasers, and we find evidence that filling with bioceramic materials as an apical barrier may aid in the treatment of severely curved teeth.

CASE PRESENTATION

Chief complaints

She was referred for evaluation of the left mandibular second molar with the chief complaint of intermittent pain and occlusal pain in this tooth.

History of present illness

She was referred for evaluation of the left mandibular second molar with the chief complaint of intermittent pain and occlusal pain in this tooth.

History of past illness

The patient denied having a remarkable medical history or drug allergies, and she reported caries for which her dentist filled as restoration.

Personal and family history

There is no personal or family history.

Physical examination

Upon extraoral examination, no significant signs were noted. The intraoral examination revealed that the left mandibular second molar (#37) had been restored with white material (Figure 1A) and showed no signs of swelling, no response to the pulp test, and no pathological mobility. Periodontal probing around the tooth showed a pocket within physiological limits without an intraoral sinus. However, there was severe pain from percussion and palpation. The first mandibular molar had a crown and no response to the cold test or percussion and was asymptomatic.

Laboratory examinations

There are no personal or laboratory examinations.

Imaging examinations

Radiographic examination showed that tooth #37 had a large periapical radiolucency encompassing both the mesial and distal regions with a size of 11 mm^2 × 6 mm^2 × 6 mm^2 (Figure 1B).

FINAL DIAGNOSIS

Chronic apical periodontitis.

TREATMENT

Endodontic treatment.

OUTCOME AND FOLLOW-UP

Three-month and one-year.

DISCUSSION

Endodontic treatment failure in mandibular molars is mostly due to the complexity and diversity of root canal configurations. In this case, three mandibular molar canals, namely, the mesiobuccal, mesiolingual and distal canals, were separate and independent from each other. Interestingly, the CBCT images revealed that these canals were severely curved, showing highly rare degrees of curvature, illustrating the challenges that must be faced when dealing with the anatomical variations in canals. As studies have reported, most mandibular second molars have two roots or a fused root, with 55% having three canals[10]. Precisely understanding the positions, directions and angles of these curvature canals is important for treatment. However, diagnostic X-ray is a two-dimensional image that does not reflect the buccal and lingual curvature. Unlike radiograph images, CBCT images can sufficiently depict the original morphology such that file separation is prevented and the healing effect after treatment can be evaluated. In this study, visible three-dimensional canal models based on CBCT datasets were found to facilitate the shaping and cleaning efficiency of root canal systems. Friedland *et al*[11] reported the use of three-dimensional reconstructions of

CBCT to efficiently and accurately observe and analyse anatomically curved canals. Hence, the precise assessment of root canal curvature is essential for guiding endodontic operations.

In this case, all the root canals were severely curved, especially the apical tip of the distal root canals (Figure 1), which was intractable to preparation and fillings. However, the small taper and flexibility of Ni-Ti files allow the original apical shape and position to be maintained[12]. In addition, files that are pre-bent into the root canal may retain more pericervical dentine and reduce dentin stress, instrument separation and other complications[13]. The crown-down technique, which can be used to access canals, recommends a wide pathway to facilitate irrigation (Figure 2A-B). High concentrations of sodium hypochlorite with ultrasonic activation as a mechanochemical preparation can further eliminate infections of the lateral canals and curved apex. The use of lasers in dentistry fields confers many advantages, such as removing carious enamel and dentine and facilitating endodontic treatment and prosthetic procedures, including crown lengthening and sulcus uncovering[14]. Erbium laser-assisted working techniques in endodontic therapy can accelerate the healing processes *via* endodontic space decontamination and the removal of pathological tissues[15] and carious dental tissues, as well as through debridement and disinfection of periodontal tissue[16]. Photon-Induced Photoacoustic Streaming (PIPS) is a new technique that requires the use of an Er: YAG laser to activate the water molecules in irrigants to remove dentin debris and smear layers due to the positive radial effect[17,18]. For these curved canals, PIPS can be used to clean the apical region as well as the narrow area of irregular canals (traffic and the gorge area) that the files cannot reach, which is a minimally invasive method to disinfect the tooth[19]. Great importance is attached to the ability to fill the apex of curvature since conventional canal fillings cannot seal the irregular apex. iRoot BP Plus can be used for repairs such as pulpotomy, pulp floor perforation repair, and root perforation repair[20]. Interestingly, we filled the curved apex with iRoot BP Plus (Figure 2C-F) due to its good sealing ability and its capacity to absorb water from the dentinal tubules and to prevent oral fluid contamination[21]. The apical barrier using bioceramic

materials in the apical regions showed good biocompatibility, was chemically bonded to the dentin, and reduced the number of microcracks generated by pressurized filling[20]. Finally, crown restoration was performed to protect the remaining tooth tissue (Figure 2G-I) and the natural occlusion was checked (Figure 3A). After three months (Figure 3B) and one year (Figure 3C-I) of follow-ups, the treated mandibular molar showed complete healing of the periapical lesion and a satisfactory effect In conclusion, a thorough understanding of tooth and root canal morphology by CBCT during preoperative assessment is highly important in complicated cases. Exploring the root canals under magnification, making preparations with individual sequential techniques combined with new instruments such as ultrasonic activation and PIPS, and using fillings with bioceramics as an apical barrier are essential prerequisites to increase the success rate of this difficult endodontic treatment. Although the endodontic treatment of teeth with large periapical bone destruction and aberrant curved canals was difficult and intractable, nonsurgical root canal therapy was performed with novel devices and introduced skills in this case, resulting in a good prognosis in which the periapical radiolucency disappeared without any symptoms. This report also provides meaningful guidance and serves as a reference for other similar cases.

CONCLUSION

In conclusion, a thorough understanding of tooth and root canal morphology by CBCT during a preoperative assessment is highly important in complicated cases. Exploring the root canals under magnification, making preparations with individual sequential techniques combined with new instruments such as ultrasonic activation and PIPS, and using fillings with bioceramics as an apical barrier are essential prerequisites to increase the success rate of this difficult endodontic treatment. Although the endodontic treatment of teeth with large periapical bone destruction and aberrant curved canals was difficult and intractable, nonsurgical root canal therapy was performed with novel devices and introduced skills in this case, resulting in a good prognosis in which the

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