Management of severely curved canals; case report and a review

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ABSTRACT
The successful execution of endodontic treatment hinges on precise instrumentation and irrigation techniques. The presence of severe root canal curvatures can significantly impact treatment outcomes. To ensure optimal treatment, it is imperative to accurately assess the degree of curvature, enabling the selection of appropriate instruments and techniques. Various iatrogenic errors, including ledge formation, instrument separation, perforation, and apical transportation, can arise from diverse levels of curvature, potentially compromising treatment success. Therefore, effective management of root canal curvature is a critical component of treatment planning.
This review delves into the strategies for effective management of curved canals with illustration of a case report.

Introduction:

Endodontic therapy enables the preservation of natural teeth, maintaining both function and aesthetics, in cases of both vital and necrotic dental pulp.[1] The endodontic procedure encompasses several stages—access cavity preparation, instrumentation, irrigation, and root canal obturation—all of which are susceptible to the influence of root canal curvature.[2] While successful therapy relies on various factors, canal preparation remains a crucial step, as it directly impacts debridement, space creation, and the establishment of appropriate canal geometry for adequate obturation. However, teeth with perfectly straight roots or canals are exceedingly rare. In fact, even seemingly straight roots often exhibit severe curvatures or multiple planes of curvature along their length. Tomes, in 1848, referred to these curvatures as "dilacerations." Dilaceration refers to an angulation or sharp bend in the root or crown of a formed tooth or a deviation in the linear relationship between a tooth's crown and its root.[3] A tooth is considered dilacerated if it exhibits a 90-degree or greater angle along its axis or root. Alternatively, a deviation of 20 degrees or more in the apical portion of the root can also be indicative of dilaceration. [4]
The presence of curvature can complicate root canal instrumentation. Several factors, including the flexibility and diameter of endodontic instruments, instrumentation techniques, the location of the foraminal opening, and the hardness of dentin, can influence the final outcome of curved canal instrumentation.[5]
This case report presents a unique instance of a mandibular third molar with dilacerated root canals, underscoring the importance of on-going research and clinical observation. The primary objective of this report is to discuss the management of this unusual dilacerated root canals, emphasizing the evaluation of conventional intra-oral periapical radiographs.

Case History:

A female patient of 44-years old reported to the dental clinic in Kozhikode, Kerala, India, in the month of July 2024 with a chief complaint of pain in her right lower jaw. She gave a history of spontaneous pain which was intermittent in right mandibular third molar region for about 6 months. As per the patient`s description, pain

increased in intensity 4-5 days before she reported to the clinic and specified that pain used to aggravate while consuming cold food. There was no contributory medical/dental history. On clinical examination a large occlusal restoration with defective margins in relation to mandibular third molar tooth (Tooth no-48) was noted which was non-responsive to percussion was noted. Vitality test was conducted with dry ice on tooth no-48 which resulted in intense pain while an electric pulp test initiated an exaggerated response. Preoperative periapical radiograph was obtained which showed secondary caries involving pulp with the tooth no 48 (tooth of interest) and there was uniform periodontal widening for all the roots. And adjacent tooth (tooth no -47) was having a tooth coloured crown and radiograph revealed that it was root canal treated but having a peri apical lesion. Since tooth number 47 was asymptomatic and patient was not ready for the intervention of asymptomatic tooth, it was not treated during that visit. But explained about the prognosis. Additionally Preoperative radiographic evaluations raised concerns about the morphological variation of the tooth no-48 as we could trace the root canal outlines of distal & mesial root as dilacerated. [Figure 1] After the diagnosis of symptomatic irreversible pulpitis with asymptomatic apical periodontitis in relation to tooth no 48 was arrived, a non-surgical endodontic treatment was initiated after obtaining informed consent from the patient.

Firstly, local anesthesia was administered followed by caries excavation. A modified rectangular shaped endodontic access cavity was prepared and found three distinct orifices. Since the canals were severely curved and narrow, we anticipated procedural errors. So we used high quality controlled memory NITI files which are heat treated. The apical portion of the tooth was dilacerated. It was crucial to avoid attempts to straighten the canal, as such actions can lead to treatment failures, including direct perforation, ledge formation, and the creation of teardrop foramina or foraminal rips. Cleaning and shaping was done using RCS Blue and RCS magic path rotary files, upto size 25 (Suzhou Ramo Medical Instrument co.,Ltd,China) for all the canals since they have high fatigue resistance to fracture.

It was found that Magic path files could easily reach the working length with least resistance and enlarged glide path. With enlarged glide path RCS Blue files were able to prepare the severely curved canals with no damage to the flutes of the files.

Normal saline, 5.25% sodium hypochlorite solution, and 17% EDTA were used for irrigation protocol and the final flushing of the canals was done with normal saline. Subsequently, obturation was successfully performed using the cold lateral compaction technique after checking the cone fit in master cone radiograph. [Figure 2] The access cavity was restored using restorative composite resin and the treatment was completed in a single visit. Post obturation radiograph was taken; [Figure 3] patient is currently under follow up for both tooth no 48 and tooth no 47.

Discussion:

Dilaceration is believed to result from trauma during tooth development. This trauma displaces the calcified portion of the tooth, causing the remaining tooth structure to form at an angle. To effectively manage root canal curvatures, a comprehensive understanding of the tooth's internal anatomy, coupled with a detailed analysis of preoperative radiographs, is essential. A phased approach, beginning with hand files to negotiate the bends followed by rotary files, is crucial. The implementation of appropriate instrumentation techniques and customized treatment plans can facilitate effective management, prevent complications, and enhance overall treatment quality.[6]

Preparing curved canals presents a significant challenge in endodontics due to the potential for complications. While radiographs effectively depict mesio-distal curvatures, they often fail to reveal curvatures in the bucco-lingual plane, which are also frequently present. Consequently, procedural errors such as ledge formation, instrument fracture, canal blockage, and the creation of zips and elbows are the primary causes of treatment failure in these cases.[7]

The ideal canal shape is a progressive taper, with the widest diameter at the coronal end and the narrowest at the apical constriction. The crown-down instrumentation sequence has largely replaced the outdated step-back method. Advantages of this coronal-to-apical approach with early coronal flaring include:

- Reduced coronal binding of instruments
- Less likelihood of working length measurement changes during preparation
- Lower risk of periradicular tissue inoculation with endodontic pathogens
- Enhanced irrigant penetration into the root canal system
- Decreased risk of irrigant and debris extrusion [8]

Methods for Identifying Root Canal Curvatures

1. Periapical Radiograph
- Pros: Convenient and cost-effective.

• Cons: 2D representation of a 3D structure, making it difficult to accurately assess bucco-lingual curvatures.
2. Cone Beam Computed Tomography (CBCT)
• Pros: Provides detailed 3D imaging, allowing for precise measurement of root curvature using software like Planimp.
• Cons: Higher radiation exposure compared to traditional radiographs and higher cost.
3. Schneider's Method
• Involves marking key points on a radiograph and measuring the angle formed by the lines connecting these points.
• Classification:
o Straight canal: Angle < 5°
o Moderately curved canal: Angle 5-20°
o Severely curved canal: Angle > 20°
4. Lutein Method
• A modification of Schneider's method, using four geometric points to calculate the angle of curvature.
5. Weine's Method
• Similar to Schneider's method, but involves measuring the angle formed by lines drawn from the canal orifice to the point of curvature and from the apex to the point of curvature.[9]
While these methods offer valuable insights into root canal curvature, a combination of techniques, including clinical examination, radiographic analysis, and advanced imaging modalities like CBCT, is often necessary for accurate assessment and effective treatment planning.[10]
The case presented was treated using a combination of hand instrumentation with K files and NiTi rotary instruments. It is crucial to ensure proper treatment of teeth with complex root canal morphology on the initial attempt, as subsequent endodontic treatment of such teeth is more likely to fail if not executed carefully.

Conclusion:
Diligent attention should be paid to radiographic assessment, access cavity preparation, and exploration to effectively negotiate curved canals. Modern NiTi instruments, particularly those with greater or variable taper, offer significant advantages over traditional 0.02 tapered stainless steel files, especially in curved root canals. These newer instruments enable the creation of superior canal shapes, requiring fewer instruments and less time.

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Figure legends:

Figure 1: Pre-operative radiograph

Figure 2: Master cone Radiograph

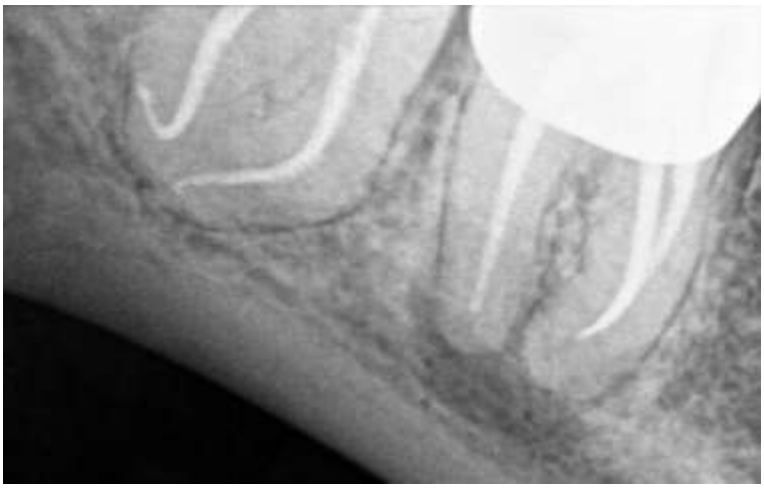

Figure 3: Post obturation radiograph