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# Managing Curved Canals- Case Report.

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## ABSTRACT

**Dilaceration is characterised as a developmental anomaly involving a sudden positional change between the crown and the root axis of a tooth. This condition may occur in both primary and permanent dentitions, with a higher prevalence in posterior teeth and within the maxillary arch. Diagnosis is best achieved through periapical radiographic imaging, which provides a clear view of root morphology and curvature.**

**Among the most demanding aspects of endodontic management is the preparation of roots with severe curvature. Successful treatment relies on careful, methodical, and controlled canal shaping, aimed at achieving adequate enlargement while preserving structural integrity and preventing procedural errors.**

## INTRODUCTION

Contrary distinctions well known in endodontics, a tooth with a completely straight root and root canal is uncommon. Most teeth exhibit a degree of root canal curvature, often involving multiple planes along the canal's length.[1] The term dilaceration was introduced by Tomes in 1848 to describe a pronounced angular deviation or sharp curvature between the crown and root of a fully formed tooth, or a departure in the typical linear relationship between them.[2] Dilaceration is typically identified when a mesial or distal bend of at least 90° occurs in the root or when the apical portion of the root demonstrates a deviation of 20° or more from the long axis of the tooth [1]

Alternatively, dilaceration may be classified based on the direction and degree of root curvature. Root canals, particularly in posterior teeth, often present with complex anatomy, making endodontic treatment challenging.

**Preparing and Managing Curved Canals**

The etiology of dilaceration is commonly linked to trauma during tooth development. When disruption occurs in the earlier phases of calcification, the hardened portion of the tooth becomes displaced, and the remaining structure forms at an abnormal angle.[1]

Treating curved root canals requires careful planning and execution, as complications such as ledge formation, blockages, apical transportation, and root perforation are more likely in these situations.[3] The success of endodontic treatment in such anatomically complex scenarios is influenced by several key factors:

- Flexibility and diameter of endodontic instruments
- Choice of instrumentation technique
- Dentin hardness
- Position of the apical foramen

Curved canals can be classified into several types based on their morphology:[3]

- Gradual apical curvature (commonly seen in mesial roots)
- Localized acute curvature in the apical third
- Continuous curvature throughout the canal
- Pronounced curvature due to dilaceration
- Dual or "S-shaped" curves

**Determining and Managing Root Canal Curvature**

**Assessing Canal Curvature**

Before initiating endodontic treatment, it is essential to evaluate the degree of root canal curvature using radiographic imaging. One commonly used method involves measuring the interior angle formed by two lines: one extending from the canal orifice along the coronal portion of the root and the other extending from the apex along the apical portion of the canal.[4] This helps in planning an appropriate instrumentation strategy and anticipating potential difficulties.

**Traditional Instrumentation Challenges**

Conventional root canal shaping has historically relied on ISO-standardized, 0.02-taper stainless steel files. However, files larger than size #15 or #20 lack flexibility and tend to straighten within curved canals. This tendency often results in procedural errors such as ledges, elbows, or zipping, particularly in the apical third of the canal.[5] Conversely, consistent and controlled dentin removal along the curved path of the canal is difficult to achieve with straight, rigid files.

**Strategies to Minimize Iatrogenic Damage**

Reducing procedural errors involves:

- Minimizing the restoring force that causes files to straighten
- Limiting the length of the cutting area on the file to prevent uncontrolled dentin removal[6]

**Key Techniques Include:**

1. **Pre-Composing the File:**
   - **Gradual curvature** along the entire file length for smoother navigation.
   - **Sharp apical curve** (approximately 45°) to better negotiate steep bends.

2. **Use of Small and Intermediate File Sizes:**
   - Smaller files (due to their flexibility) should be used extensively before progressing to larger sizes.
   - Custom intermediate sizes can be created (e.g., shortening a #15 file cuts the tip to produce a #17 size).

3. **Employing Flexible Files:**
   - These maintain canal anatomy more effectively, reducing the risks of apical transport or perforation.

4. **Reducing Active Cutting Length of Files:**
   - **Anti-curvature filing** ensures safe dentin removal away from furcation areas.
   - **Dulling cutting edges** on select portions of the file, accomplished using abrasive tools.
   - **Crown-down technique**, which flares the canal from coronal to apical, improving irrigation flow and minimizing apical debris extrusion.

**Balanced Force Technique**

A major breakthrough in manual canal preparation was the **balanced force technique**, which allows effective shaping while preserving canal curvature.[5] The sequence includes:

- **Clockwise Rotation (60°):** Engages the file into the dentin.
- **Counterclockwise Rotation (120°) with apical pressure:** Shaves and breaks dentin from canal walls.
- **Clockwise Rotation (60°) without advancement:** Retrieves debris in the file flutes.

**Advantages:**

- Enhances shaping efficiency with less risk of transportation or perforation
- Centralizes instruments within the canal, maintaining original anatomy
- Reduces apical extrusion of debris, thus minimizing postoperative discomfort

**File Motion in Root Canal Instrumentation**

Instrumentation of straight root canals is generally straightforward and can be accomplished using simple inward and outward file motions, with or without rotation. However, curved canals present significant challenges. Deviation from conventional techniques, such as the balanced force method, may result in canal wall curvature errors—especially in cases with buccolingual curvature not visible on radiographs. Therefore, the balanced force technique is recommended as a universal approach for reduced risk in varied canal anatomies.[7]

**Nickel-Titanium (NiTi) Instruments in Curved Canals**

The introduction of highly flexible nickel-titanium (NiTi) files, with tapers 2–6 times greater than traditional 0.02 stainless steel files, has transformed root canal preparation. NiTi files such as **GT** and **Protaper** (Dentsply) offer enhanced curvature navigation, minimized canal transportation, and compatibility with both hand and rotary systems.[5]

NiTi hand instruments are especially useful in anatomically complex scenarios—such as severe apical curvature or restricted access—where rotary instrumentation is contraindicated.

**Crown-Down Technique**

Modern endodontics favors the **crown-down preparation** method, which has replaced the outdated step-back technique due to several advantages:[5]

- Reduced coronal binding of instruments
- More stable working length during preparation
- Less chance of pushing microorganisms apically
- Superior irrigant penetration
- Decreased risk of irrigant extrusion

**Clinical Sequence for Managing Curved Canals**

The following describes a step-by-step clinical approach for instrumentation of curved root canals:[3]

1. **Anesthesia and Access:** Administer local anesthesia; achieve straight-line access to the pulp chamber.
2. **Initial Irrigation:** Flush the chamber with sodium hypochlorite (NaOCl).
3. **Canal Scouting:** Establish patency using a #10 K-file to reproduce natural canal curvature.
4. **Custom File Creation:** Shorten the #10 file by 1mm and precurve it to match the canal anatomy—this becomes a #12 file.
5. **Initial Exploration:** Insert file #12 up to the apical third.
6. **Irrigation:** Maintain patency by frequent NaOCl and saline irrigation to prevent blockages.
7. **Coronal Flaring:** Initiate reverse flaring in the coronal third using a #40 K-file.
8. **Recapitulation:** Return with file #12 to remove debris and confirm patency.
9. **Crown-Down Shaping:** Continue sequential flaring with #35 and #30 K-files.
10. **Glide Path Enlargement:** Use Gates-Glidden (GG) drills (#1, #2, #3) in step-back sequence to improve coronal access and tactile control.
11. **Irrigation and Patency Check:** Recapitulate with file #12, followed by EDTA solution for lubrication.
12. **Working Length Determination:** Take a radiograph using a #10 file.
13. **Apical Enlargement:** Instrument to full working length sequentially with #15–#25 K-files according to flexibility.
14. **Finishing Shaping:** Place a #30 file up to 1 mm short of working length; confirm preparation using larger passive files (#35, #40, #45).
15. **Final Irrigation and Drying:** Irrigate with saline and dry using paper points.
16. **Straight Canal Prep:** Employ the step-back method for any straight canals present.
17. **Obturation:** Seal the canals using the lateral condensation technique.

**Case Report**

A 24-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain in the upper left back tooth region.

• Clinical examination revealed deep caries on the occlusal surface of the maxillary left second premolar (tooth #25), which was tender on percussion.

• Radiographic examination showed an occlusal carious lesion with pulpal involvement and a pronounced curvature in the apical third of the root canal [Figure 1].

• After administration of local anesthesia and rubber dam isolation, an access cavity was prepared. The canal orifice was located and negotiated using a precurved #10 K-file to follow the curvature as observed in the radiograph.

• The glide path was established till the radiographic working length using #10 and #15 K-files. Coronal flaring was carried out using orifice shapers to facilitate straight-line access.

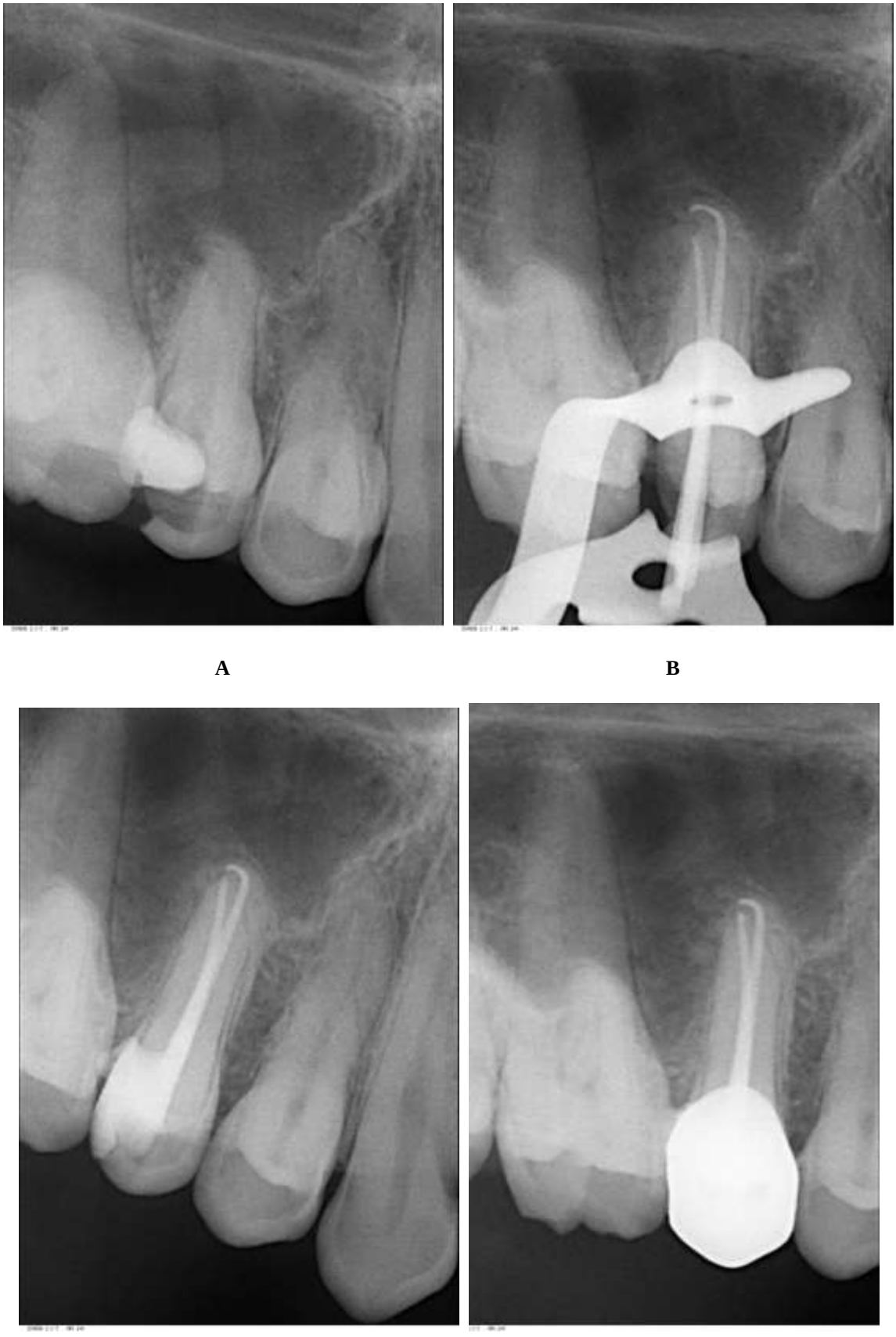
• Working length was then confirmed using an electronic apex locator. A slight reduction in working length was noted after coronal flaring due to canal straightening. The length was re-established using a precurved #10 K-file to maintain canal curvature.

• Cleaning and shaping were performed with rotary ProTaper files. The S1 and S2 instruments were used in a gentle brushing motion to the working length, followed by F1 for final shaping.

• Throughout the procedure, all files were precurved to adapt to the canal anatomy and prevent transportation or ledge formation.

• After thorough irrigation with 3% sodium hypochlorite and saline, the canals were dried with paper points, and a master cone was selected and confirmed radiographically.

• Obturation was performed using the cold lateral compaction technique, and the access cavity was sealed with a temporary restorative material.



**A** **B**

**C** **D**

**Figure 1a-Preoperative Xray , 1b-Biomechanical Preparation , 1c-Obturation , 1d-1year Follow Up**

## DISCUSSION

Effective cleaning and shaping of the root canal system is essential for achieving a successful endodontic outcome. The objective is to create a continuously tapering preparation that narrows from the coronal portion toward the apical constriction, ensuring thorough debridement and disinfection of the entire canal space. Such a taper facilitates the efficient action of irrigants and instruments, improving removal of necrotic tissue, microorganisms, and debris.

In the present case, the maxillary second premolar exhibited a pronounced curvature in the apical third, which posed considerable difficulty during instrumentation. Curved root canals often present a greater risk of procedural complications such as ledge formation, apical transportation, canal blockage, or instrument separation. These errors commonly arise when the canal curvature is not adequately respected or when improper instrumentation techniques are used.

Radiographically, only the mesiodistal curvature of the canal can be appreciated; the buccolingual curvature remains hidden, further increasing the clinical challenge. Therefore, preoperative radiographic evaluation combined with careful tactile sense during canal negotiation is crucial.

In this case, the use of precurved stainless-steel K-files for initial negotiation followed by nickel-titanium (NiTi) rotary instrumentation allowed for effective cleaning and shaping while maintaining the original canal curvature. NiTi rotary files, due to their superior flexibility and shape memory, significantly reduce the risk of canal aberrations and instrument fatigue in curved canals.

Meticulous coronal flaring, frequent recapitulation, and copious irrigation with sodium hypochlorite were essential to prevent blockage and ensure effective debridement. Preservation of the natural canal curvature throughout the procedure is vital to prevent apical zipping and to maintain the integrity of the apical constriction.

Proper understanding of root canal anatomy, careful use of precurved hand files, and the integration of NiTi rotary systems contribute greatly to the successful management of anatomically challenging teeth such as the maxillary second premolar with a curved canal.

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