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# Impedance-based Access Cavity Navigation for Micro-invasive Endodontic Treatment of Dilaceration

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## Objectives:

Tooth dilaceration describes an abnormal curvature of the tooth root, often resulting from traumatic dislocation of deciduous teeth into the developing permanent tooth germ or from other developmental anomalies. Such curvatures significantly complicate endodontic treatment due to sharp angulations, obliteration of the root canal, and dentine dysplasia.
Guided endodontic approaches were introduced (Lang et al. 2017, 2018), using CBCT imaging and drill guide technologies to facilitate canal localization and access. While effective in many situations, these guidance methods have clinical limitations, particularly in narrow or highly curved root segments with limited working space. In the presented case, a maxillary lateral incisor (tooth 12) with a 45° dilaceration in the coronal third of the root, resulting from trauma at age 6, was successfully treated after 30 years of asymptomatic function. The tooth exhibited advanced obliteration of the canal lumen and chronic periapical inflammation.

## Material and Methods:

Preoperative assessment and access cavity planning were performed using Cone-Beam Computed Tomography (CBCT) in combination with **SicatEndo software** (SICAT GmbH, Bonn, Germany).
A lateral, micro-invasive access cavity was prepared, guided by a novel **impedance-based navigation system** (Schlumbohm GmbH, Brokstedt, Germany), which allowed real-time monitoring of dentin wall thickness to avoid iatrogenic perforations.
Initial root canal negotiation was performed with stainless steel hand files, followed by rotary NiTi instrumentation under continuous irrigation with 5% sodium hypochlorite (NaOCl). Final disinfection included sonic activation of EDTA and NaOCl solutions. The canal system was obturated using a thermoplasticized gutta-percha technique. To reinforce the weakened root structure, a fiber post was placed, followed by a coronal composite restoration.

## Results:

Impedance-guided navigation enabled precise canal localization and access through the dilacerated portion without dentin perforation. Hard tissue loss was minimized, preserving enamel at the occlusal surface as well as coronal, peri-cervical, and radicular dentine.

Finally, postoperative radiographs and a 6-month clinical follow-up demonstrated complete resolution of periapical periodontitis, with full bone regeneration, absence of fistula formation, and no pain or discomfort. The conservative access design maintained both functional and esthetic integrity of the tooth.

## Conclusions:

This case highlights the potential of preoperative CBCT-based planning combined with impedance-guided navigation for managing complex root canal anatomies. The micro-invasive access technique effectively reduces iatrogenic risks while preserving tooth structure, thereby enhancing the long-term prognosis of endodontically treated teeth.
The use of real-time impedance measurements allowed accurate assessment of remaining dentin thickness during access preparation, minimizing the risk of perforation particularly in the highly curved and obliterated coronal third of the root. This technique enabled a conservative, tissue-preserving approach while maintaining full control over the entry path, even in the presence of a severe 45° dilaceration.
Moreover, the lateral micro-invasive access design contributed to the preservation of enamel and peri-cervical dentin, which are known to play a critical role in maintaining the mechanical integrity of the tooth under functional load. The combination of minimal dentin removal, effective disinfection, and subsequent fiber post reinforcement provided stable conditions for long-term retention and restoration.

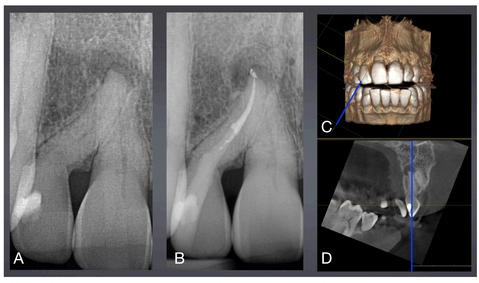


**Fig. 1: A:** Upper lateral incisor (12) with 45° dilaceration. **B:** successful obturation of the root canal system avoiding root perforation. **C+D:** Access entry and cavity preplanning using CBCT imaging and SicatEndo software approach.

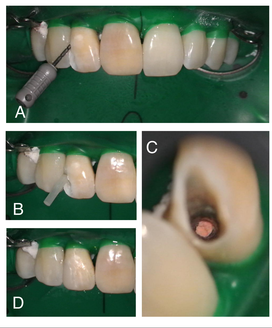


**Fig. 2:**

**A:** Anterior view with initial 08 C-Pilot K-file at working length at the exact position and angle of preplanning.

**B:** Fiber post placed beyond dilaceration to reinforce the root at the critical zone (see also Fig. 1B)

**C:** Intraoperative mirror view at 15x magnification with gutta-percha adjacent to fiber post length.
**D:** Final composite restoration.


**Fig. 3:**
Schlumbohm EndoPilot with prototype software to measure dentine impedance during access preparation and automatic reduction of bur speed in thin dentine zones to avoid perforation.

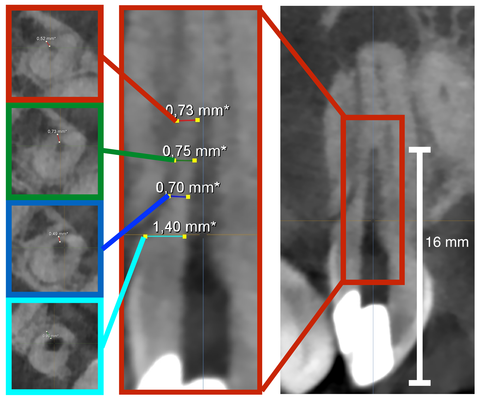


**Fig. 4:** Control CBCT of access cavity (16 mm) before reaching the root canal lumen after additional preparation of 1 mm.


**Fig. 5: A:** Baseline periapical radiograph showing radiolucency at the apex. **B:** Six-month follow-up radiograph showing complete periapical healing and intact periodontal ligament.

## References:

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