Abstract
Failure to recognise and treat aberrant canal anatomy can affect the prognosis of endodontic therapy. This case report shows a variation in conventional anatomy in mandibular first molars. A third mesial canal may be present between the Mesio-lingual and Mesio-buccal canal in Mandibular molars. A clinician should be aware of the possibility of this extra anatomy when treating mandibular molars.

Introduction
A comprehensive knowledge of canal anatomy and its variations is essential to ensure consistency in endodontic therapy. Variations from conventional anatomy are encountered occasionally in all teeth. Inability to recognise, detect and treat this additional anatomy can lead to failure of endodontic therapy.

In mandibular first molars, the normal anatomical pattern consists of two mesial canals and one or two distal canals. However, a third mesial canal may be occasionally present between the mesio-buccal and the mesio-lingual canals. Recognising and treating this variation is crucial to improve the prognosis of endodontic therapy.

Table 1: Prevalence of a third canal in the mesial root of Mandibular Molars according to different authors (Compiled by Siju Jacob)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>No. of teeth</th>
<th>Method</th>
<th>Three Canals (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skidmore and Bjorndal</td>
<td>1971</td>
<td>45</td>
<td>Vitro</td>
<td>0</td>
</tr>
<tr>
<td>Pineda and Kottler</td>
<td>1972</td>
<td>500</td>
<td>Vitro</td>
<td>0</td>
</tr>
<tr>
<td>Vertucci</td>
<td>1974</td>
<td>100</td>
<td>Vitro</td>
<td>1</td>
</tr>
<tr>
<td>Pomeranz</td>
<td>1981</td>
<td>100</td>
<td>Vivo</td>
<td>12</td>
</tr>
<tr>
<td>Martinez-Berna and Badanelli</td>
<td>1985</td>
<td>1418</td>
<td>Vivo</td>
<td>1.5</td>
</tr>
<tr>
<td>Fabra-Campos</td>
<td>1985</td>
<td>145</td>
<td>Vivo</td>
<td>2.1</td>
</tr>
<tr>
<td>Fabra-Campos</td>
<td>1989</td>
<td>760</td>
<td>Vivo</td>
<td>2.6</td>
</tr>
<tr>
<td>Goel</td>
<td>1991</td>
<td>60</td>
<td>Vivo</td>
<td>15</td>
</tr>
</tbody>
</table>

Case report: Middle mesial canal
Siju Jacob shows why it pays to be aware of the possibility of a third mesial canal when treating mandibular molars
mesio-lingual canal. This is referred to as the middle mesial canal. The middle mesial canal maybe confluent or may have a separate portal of exit. The incidence of middle mesial canals varies from 1 to 15 per cent 3.

After local anesthesia and rubber dam application, an access cavity was prepared. Initial access revealed two mesial canals and one distal canal (see Fig. 5). On closer examination with a surgical microscope (Zeiss Germany) a ledge of dentin was found between the mesio-buccal and mesio-lingual canals (see Fig. 7). Troughing of this isthmus with ultrasonics under magnification revealed a middle mesial canal (see Fig. 7).

All canals were cleaned and shaped (see Fig. 8) using Pro taper (DentsplyMailfefer, Switzerland) and hand files. The middle mesial canal was confluent with the Mesio-buccal canal. Canals were irrigated with sodium hypochlorite, 17 per cent EDTA and two per cent Chlorhexidine. Canals were dried using paper points and a calcium hydroxide paste (Apexit, Ivoclar Vivadent, Switzerland) was placed in the canals (see Figs. 9 a and 9b). The access cavity was sealed with a layer of Cavit (5M ESPE, Germany) followed by glass ionomer cement (Fuji VII, GC, Japan).

The patient was recalled two weeks later. The calcium hydroxide was removed (see Fig. 10). The canals were obturated using gutta percha and AH plus sealer (Dentsply Detrey, Germany) in warm vertical condensation. The access cavity was sealed and the core buildup done using a dual cured resin (Luxacore, DMG, Germany) (see Figs. 11 to 15).

Discussion

The biologic objectives of endodontic therapy include removal of all potential irritants from the root canal space and the control of infection and periapical inflammation. Complex root canal anatomy can prevent achievement of endodontic goals. It is important to identify, debride, disinfect and obturate as much anatomy as possible. A missed canal can lead to failure of Endodontic therapy 1. Therefore every effort must be made to locate additional canals if any.

An extra mesial canal known as the middle-mesial canal has been documented by numerous researchers 15. The percentage varies from one to 15 per cent. The majority of middle mesial canals will merge with either the mesio-buccal or mesio-lingual canals. Rarely, they may have a separate apical portal of exit.

Numerous techniques enable the clinician to look for the middle mesial canal. It is important to have an adequately flared access cavity to visualise the anatomy of the chamber. Constricted access can lead to missed anatomy 16.

The use of the surgical operating microscope has vastly enhanced the quality of Endodontic therapy 11,12. Magnification coupled with coaxial lighting greatly enhances visualisation and the potential to discover additional anatomy.

The use of ultrasonic tips for precise cutting has gained favour among clinicians in the last decade. Ultrasonics in conjunction with the surgical microscope (Microsonics) greatly enhances the clinician’s ability to locate extra canals 5.

Conclusion

Variations in conventional root canal anatomy can occur in any tooth. The middle mesial canal in Mandibular molars is one such variation. Knowledge of anatomical variations and the techniques to discover and manage these variations will significantly enhance the prognosis of endodontic therapy. References available on request.

About the author

Dr Siju Jacob BDS MDS maintains a private practice limited to Endodontics in Bangalore, India. In addition, he conducts hands-on courses in Endodontics and Microscopes for general practitioners and Endodontists at his center at Bangalore. He can be reached at drsiju@gmail.com or through his website www.rootcanalclinik.com.

Fig. 9a

Fig. 9b

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 15
Evidence shows that the number of sessions used to perform a successful root canal treatment does not differ between one or multiple sessions. The only possible post-operative complications with single session root canal treatments are:

1. Post-operative pain.
2. Flare up.

For a better understanding of successful single visit endodontic therapy the following factors are key:

1. Adequate working length control (using electric measurement devices and if necessary x-ray).
2. Mechanical root canal preparation (best results will combine the use of hand and rotary files).
4. An optical root canal obturation to avoid apical leakage.
5. Coronal sealing to prevent coronal leakage.

Each one of these key factors are determined by other factors.

Determinant factors for an adequate working length control:
1. Straight line access.
2. Establishing glide path.
3. Use of adequate file to correctly bind.

Determinant factors for adequate mechanical root canal preparation:
1. Straight line access.
2. Establishing glide path.
3. Hand-file reshaping to size 25 or 20.
4. Determination of the “first file to bind” – “Master apically file”.
5. Shaping of the so-called “apical capture zone”
6. Adequate use of sequential files protocol either hand or rotary.
7. Adequate irrigation and smear layer removal protocol while mechanical shaping.

Determinant factors for adequate chemical root canal disinfection:
1. Coronal isolation (rubber dam).
2. Adequate coronal access.
3. Adequate shaping protocol.
4. Use of irrigation solutions in optimised sequences.
5. Optimized irrigant delivery.
6. Adequate energising of the irrigants.
7. Satisfactory irrigant evacuation.

Determinant factors for inadequate root canal obturation (either under filling or incomplete filling):
1. Canals not dry prior to obturation.
2. Inadequate straight-line access.
3. Inadequate irrigation protocol.
4. Excessive enlargement of a curved canal.
5. Packing of debris in the apical portion of the canal.
6. Skipping of sequential file sizes.
7. Inadequate tug back.
8. Inadequate master cone selection.
9. Inadequate condensation procedure.
10. Coronal seal.

Conclusion
A trained and experienced operator who follows a strict treatment protocol can manage to perform root canal treatments in one visit alone having in mind the management of postoperative complications. The author needs to acknowledge that not all root canal treatments can be executed as single session.

Useful reading

About the author
Dr. med. dent. Liviu Steier is a visiting professor at the School of Dental Medicine in Florence, visiting professor at Talia School of Dental Medicine in its endodontic postgraduate programme; and an honorary clinical associate professor at Warwick Medical School. He is also a registered specialist in endodontics (GDC) and Specialist fuer Prothetik (www.dgep.de).

www.suntechdental.com
www.sundentallabs.com
Case report: Failure evaluation in endodontics

Dr Hank Willis and Dr Craig Barrington discuss how we can use failed treatments to help us learn from our mistakes

The patient was a 44-year-old female with non-concordant medical history. No known drug allergies and no current medications. She reported a dental phobia and was tearful during the exam. She hadn’t seen a dentist in three to four years and reported that her last dental visits have made her lose hope for her teeth.

The Rootmaster was once just as familiar a sight on London’s streets as Ledermix is now on dentists’ shelves. And the word, reliable, trusted, indispensable, can justifiably be applied to both. The Rootmaster was unquestionably a leader. So we’re rather tempted to rename our product Ledermix.

Ledermix Dental Paste
Ledermix Dental Paste is particularly useful in the emergency management of patients with irreversible pulpitis. Pain is reliably relieved until definitive root canal treatment can be performed. Ledermix Dental Paste contains one third more steroid than Ledermix Dental Cement. Consequently the paste is usually preferred in pulp exposure cases.

In endodontic therapy Ledermix Dental Paste can be used when periapical periodontitis is present.

After pulp extraration and during endodontic therapy, the canals may be filled with Ledermix Dental Paste (or a mix of Ledermix and calcium hydroxide). The cavity is closed with a cotton wool pledge and a temporary filling.

Ledermix Dental Cement
Ledermix Dental Cement may be used as a temporary sublining for deep cavities where no exposure has occurred if the dentine is hypersensitive. For small pulp exposures, Ledermix Dental Paste may be used as a pulp capping agent.

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Prolonged use may result in reduced healing capacity of the periodontal ligament. Drainage should be effective before starting treatment with Ledermix. Hypersensitive. For small pulp exposures, Ledermix Dental Paste may be used as a pulp capping agent.

The cavity is then closed with a temporary filling. Approx 3-6 days later the vitality of the tooth is determined, the cavity re-opened and the cotton pledget removed. The dentine close to the pulp of the wound in the pulp is covered with Ledermix Dental Paste. The cavity is then closed with a temporary filling.

Pulpitis in all instances of exposed pulp and acute pulpitis (except total purulent pulpitis) Ledermix Dental Paste is applied with a small cotton pledget to the dentine. The cavity is then closed with a temporary filling.

The cavity is closed with a cotton wool pledget and a temporary filling.

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