Masterclass in Clinical Practice

Endodontics

with

Prof Peet J. van der Vyver[1]
Dr Martin Vorster[2]

Microscope magnification in endodontics

[1] Peet J. van der Vyver,
BChD (Pret); Dip. Odont (Aest Dent);
Dip.Odont (Endo); MSc Odont (Endo), PhD (Endo)

[2] Martin Vorster,
BChD (Pret); PGDipDent (Endo); MSc (Dent)

Introduction

The Dental Operating Microscope (DOM) increases the field of vision and detail observed, essentially allowing the dentist to see things that they would not be able to distinguish with the naked eye. This enables the clinician to operate with a higher level of precision, developing refined motor movements over time. The use of DOM in endodontics provides the clinician with five distinct advantages: magnification, illumination, documentation, patient communication and ergonomics. The DOM provides magnification with a stereoscopic view with the ability to control your level of magnification, either by turning of a dial (Fig. 1a) or automatically by the push of a button on the control handle (Figure 1b).[1]

Magnification

Unaided vision and even Galilean loupes with an integrated light source do not provide any measurable visual benefits inside the root canal. Most of the time clinicians can only see up to the level of the canal orifice.[1] Natural vision also begin to deteriorate at the age of 40[2] and the lack of awareness of this problem is common amongst dental professionals.[3] According to Eichenberger et al,[4] and Perrin et al,[5] this age related disability can be minimised by the use of loupes or being compensated for by the use of the DOM.

Dentistry and especially endodontics, requires precise motor skills along with a high level of visual acuity. High-powered magnification, such as 4-6 or more times magnification, provides enhanced visual information of the pulp chamber for identification of canal orifices (Fig. 2) compared to either the unaided vision or an entry level 2.5x magnification loupes.[6]

In various areas of general dentistry, the increased visual information provided by higher magnification eliminates confusion in diagnosis and treatment planning and enhances

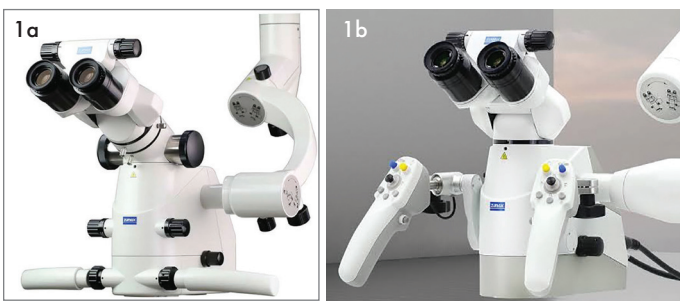

Figure 1.(a) Zumax OMS 2360 microscope with manual magnification dial; (b) Zumax OMS 3200 with automatic focus

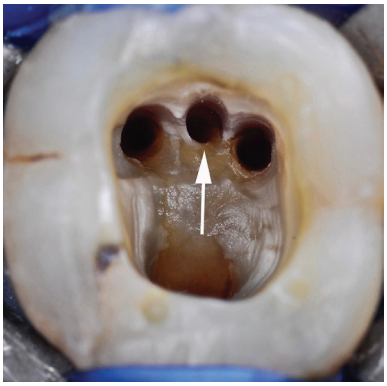

Figure 2. A magnified view (6X) of the pulp chamber floor of a mandibular first molar after root canal preparation. Note the mid-mesial canal (arrow) that was located under magnification before the canal preparation

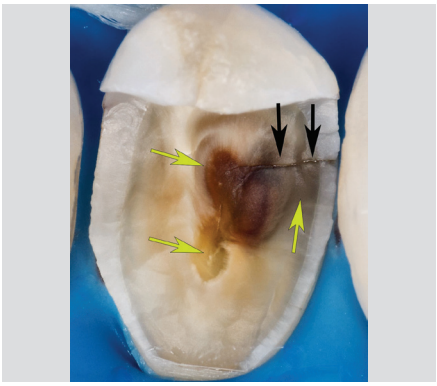

Figure 3. High magnification view (10X) of left maxillary second premolar. Note the different colours on the pulp floor (decay and sclerotic canal orifices)(yellow arrows) and a structural dentine crack originating from distal gingival margin and extending into the direction of the pulp chamber (black arrows)

Figure 4. Zumax microscope showing the co-axial light direction projected in the line of vision

clinical outcomes compared to the clinical work performed with unaided vision (for example increased longevity of dental restorations). Efficient magnification improves the dentist's capability to identify caries by inspecting the micro texture and colour of tooth surface. Magnification also aids with the identification and assessment of crack formation in teeth (Fig. 3).[7]

Illumination

When magnifying any field of view, the image observed becomes darker because of a decrease in the amount of available light. The DOM can easily be positioned on the operative field with precise focus, utilising the built-in LED coaxial light source directly into the line of vision (Fig. 4). This light source provides excellent illumination and eliminates the formation of shadows resulting in more detail to be observed. It also avoids multiple adjustments unlike the traditional overhead dental operating light or headlamps on loupe systems.

Documentation

A built in camera or digital single-lens-reflex (DSLR) camera can be attached to the microscope to enable the clinician to take high quality photos or video in order to document cases or procedures in a step-by step fashion. The DOM allows clinicians to perform this task during the procedure without the need to stop (Fig. 5), move away from the operatory field and pick up a digital camera in order to take photos. Documentation of procedures can be used for patient education, risk management, medico-legal cases and communication with third party funders.

Patient Communication

A picture is worth 1000 words. The live video or captured images from the camera allow patients to observe detail in their mouths giving them a better understanding of their dental problems (Fig. 6). It is further used to explain to patients the complexity of the case with better understanding of the treatment proposed and to demonstrate the final outcome of treatment.

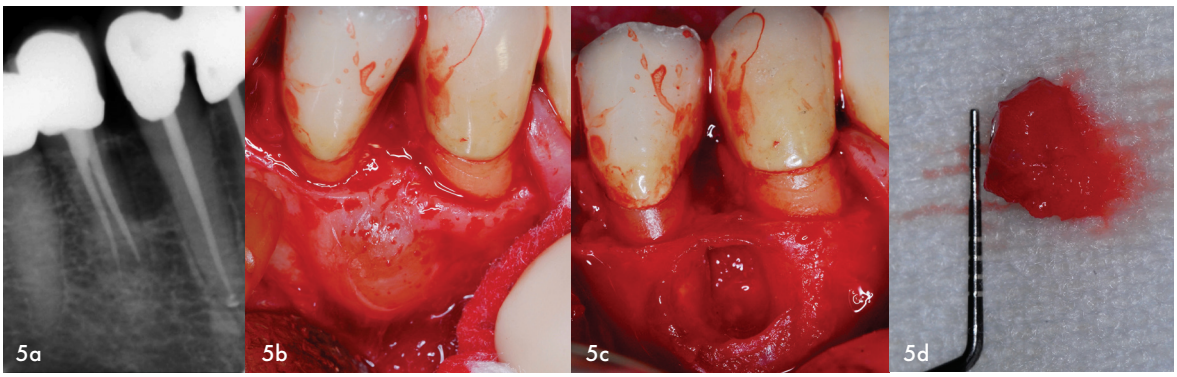

Figure 5.(a)Periapical radiograph of a 45 year old patient that presented with a lateral periodontal cyst between roots of the right mandibular canine and first premolar; (b) mucoperiosteal flap was raised; (c) access into the cortical bone plate to expose the cyst; (d) cyst removal and measurement. All the clinical photos were taken during the procedure without the need to stop, move away from the operatory field and pick up a digital camera to record the steps

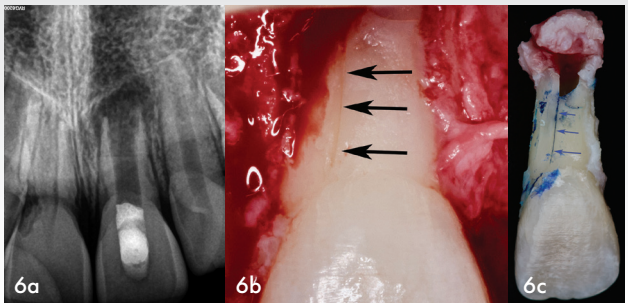

Figure 6. (a) Periapical radiograph showing failure of a revascularization procedure after 6 months on the maxillary left central incisor of a 9 year old patient; (b) photo captured during a surgical procedure that was used to communicate the poor prognosis of a vertical root fracture (black arrows) of the immature root and that the tooth will have to be extracted (c) image of extracted tooth after the fracture line (blue arrows) was stained with methylene blue dye

Ergonomics

The use of loupes and microscopes has been shown to improve clinicians working posture and reduced repetitive stress injuries related to poor posture.[8] The DOM forces the clinician to work in an upright neutral position. Brown et al,[9] reported in a survey performed amongst general practitioners that the most frequent reason to retire prematurely was musculoskeletal disorders. Studies indicate that more than 50% of those who practice dentistry experience work-related pain that usually starts during dental school.[10]

The Use of the DOM in Endodontics

The enhanced vision and illumination of the DOM directly influence the clinician's field of information in order to make critical decisions during endodontic treatment. This has a direct effect on outcome and prognosis of the treatment.

The following points outlines the importance of magnification during endodontic treatment:

- Identification of structural dentine cracks (Fig.7)
- Diagnosis of secondary caries and leaking restoration margins that can compromise the coronal seal during and after endodontic treatment (Fig.8)
- Preparing more retracted endodontic access cavities (Fig.9)
- Outlining and removing pulp calcifications (Fig.10)
- Identification of missed or additional canal orifices (Fig.11)
- Confirming canal cleanliness after irrigation (Fig.12)
- Managing perforations and tooth resorption lesions (Fig.13)
- Removal of fractured instruments (Fig.14)
- Preparing more conservative osteotomy sites and retro-canal-preparation with ultrasonic instruments for periapical surgery (Fig.15)

Clinical application of different levels of magnification

According to Low, Dom and Baharin,[11] magnification in endodontics can be categorised into three levels:

Low Level Magnification (3-8 times)

This level is appropriate for clinical examination of the tooth, positioning of a bur for access cavity preparation or an ultrasonic tip to remove a dentine ledge or pulp calcification and for general root canal instrumentation procedures. The low magnification level with wide field of view, allows the operator the ability for comparison of adjacent anatomic landmarks.

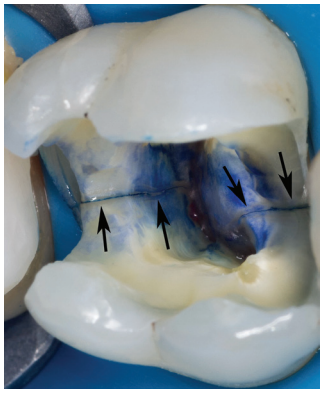

Figure 7. Maxillary left first molar of a 54 year old male patient that presented with irreversible pulpitis. After removal of the previous restoration, two structural dentine cracks (black arrows) were noted and stained with methylene blue to follow the extent and depth into the pulp chamber

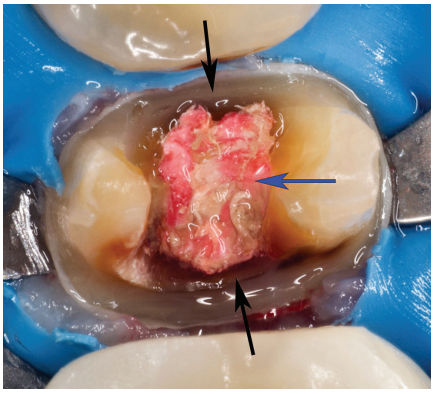

Figure 8. Mandibular left second premolar after removal of a previously placed crown. Note the secondary caries on the mesial and distal margins (black arrows) and gutta percha (blue arrow) that was exposed to coronal leakage

Figure 9. Retracted, conservative access cavity preparation prepared under magnification on a maxillary right first premolar

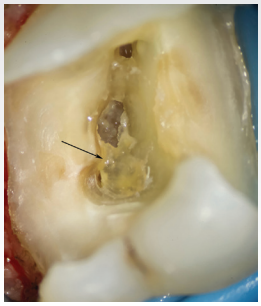

Figure 10. Maxillary right first molar after removal of decay and exposure of the pulp. Note the pulp calcifications (black arrow) in the pulp chamber

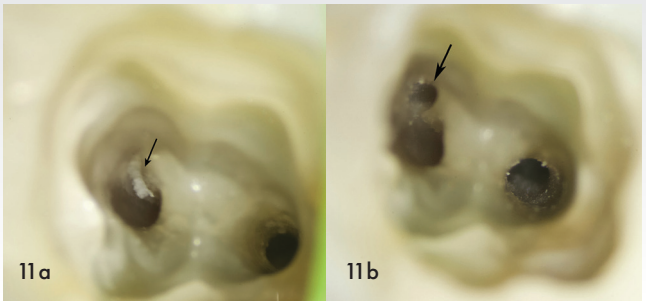

Figure 11. (a) Debris (black arrow) was noted under magnification on the buccal aspect of the mesial canal orifice after canal preparation on a mandibular right second molar with a C-shape configuration; (b) after exploring the debris in the groove another canal (black arrow) was located on the lingual aspect of the tooth

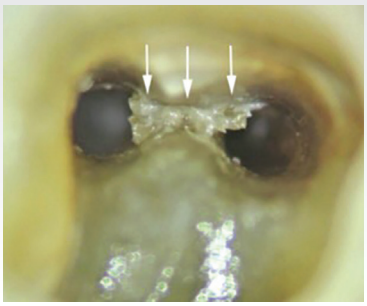

Figure 12. Remaining necrotic pulp tissue in an isthmus area (white arrows) after an irrigation protocol was noted under magnification between two distal canals in mandibular right first molar

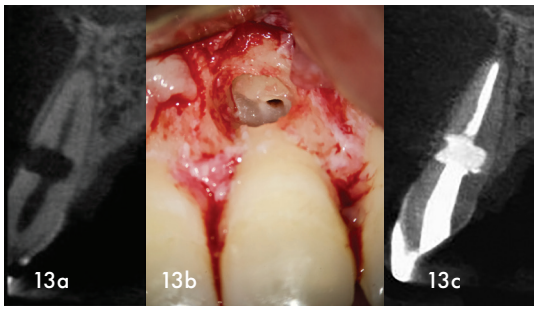

Figure 13. (a) Coronal view of CBCT of a maxillary left central incisor with internal resorption communicating towards the external root surface; (b) lesion was debrided under magnification (15X); (c) Coronal view of CBCT one year after treatment with MTA.

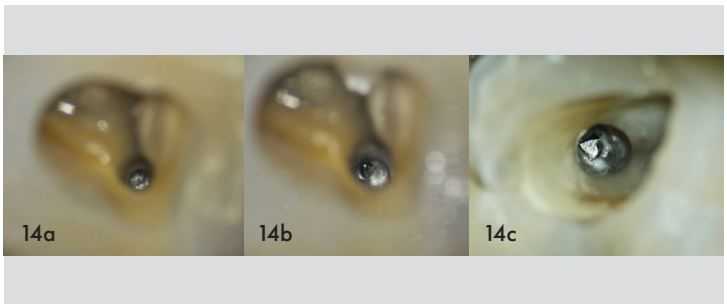

Figure 14. Magnified view of a fractured root canal instrument in the mesiobuccal canal of mandibular left first molar at the beginning of the apical third of the root canal level: (a) Microscope magnification 3X; (b) Microscope magnification 8X; (c) Microscope magnification 19X. Note the excellent detail visible at 19X that will make it easier to plan the management.

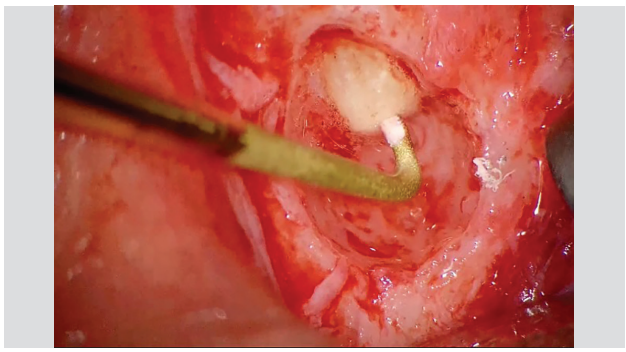

Figure 15. Conservative osteotomy site and retro-canal-preparation with ProUltra ultrasonic instrument (Dentsply Sirona).

Medium Level Magnification (8-16 times)

Medium level magnification is commonly used for non-surgical and surgical endodontic procedures as it provides still an acceptable field of view with adequate depth of field. It is mainly used for perforation repair, closing an open apex with MTA, removal of fractured instruments from canals coronal or midroot levels, identification of canal bifurcations in coronal third of the root and for performing apical micro-surgery. A meta-analysis of endodontic microsurgery showed that the rate of success is higher when done under the DOM.[12]

High Level of Magnification (16-30 times)

This high level of magnification diminishes the field of view with very narrow depth of field where even minor movements can lead to loss of focus. It is mainly used for identification and following the extend of cracks, identification of canal bifurcations in midroot to apical level and to identify subtle colour variances between secondary and tertiary dentin for canal identification in teeth that present with calcific metamorphoses.

Conclusion

The Dental Operating Microscope has gained popularity over recent years and has become the standard of care for endodontics performed by general practitioners and specialists. In this masterclass on magnification, the authors highlights and gives a summary of all the advantages of using magnification in dentistry and more specifically endodontics.

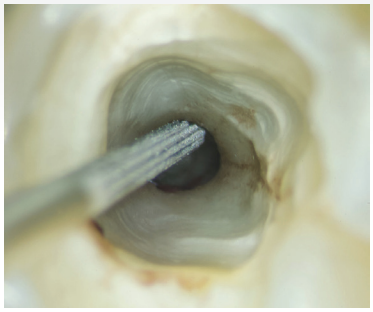

Figure 16: Low level magnification (8X): Removing restrictive dentine in the canal orifice of a mandibular second molar with a C-Shaped canal configuration.

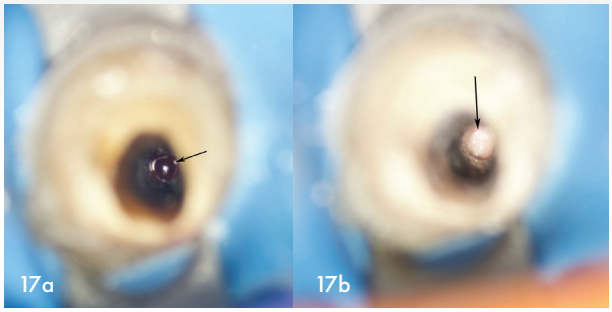

Figure 17. (a) Magnified view (15X) of a maxillary left central incisor presenting with an open root apex (black arrow); (b) Magnified view (15X) after packing MTA (black arrow) to close the open root apex

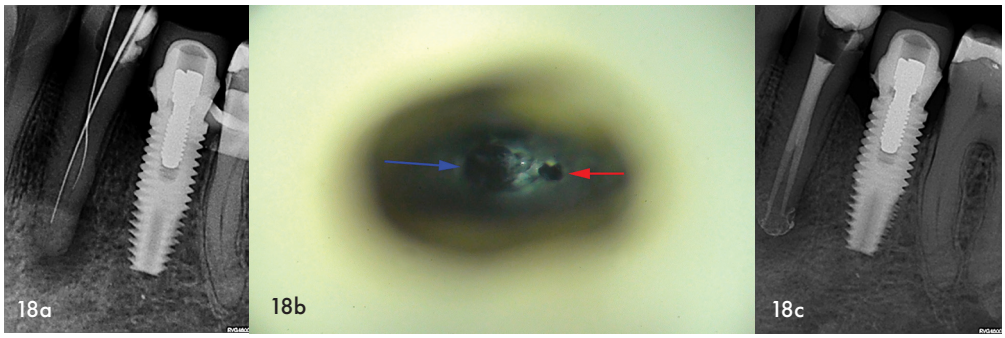

Figure 18. (a) Periapical radiograph showing the lingual canal detection in the midroot level of a mandibular left first premolar; (b) the orifice of the second canal was located under magnification (19X) after a dentine ledge was removed with an ultrasonic tip. Note the main buccal canal (blue arrow) and the located orifice of the lingual canal (red arrow); (c) postoperative obturation result

References

1. Perrin P, Neuhaus K, Lussi A. The impact of loupes and microscopes on vision in endodontics. Int. Endod. J. 2014;47(5):425-429.

2. Burton J, Bridgman G. Presbyopia and the dentist: the effect of age on clinical vision. Int. Dent. J. 1990;40(5):303-312.

3. Eichenberger M, Perrin P, Ramseyer S, Lussi A. Visual acuity and experience with magnification devices in Swiss dental practices. Oper. Dent. 2015;40(4):E142-E149.

4. Eichenberger M, Perrin P, Neuhaus KW, Bringolf U, Lussi A. Visual acuity of dentists under simulated clinical conditions. Clin. Oral Investig. 2013;17(3):725-729.

5. Perrin P, Ramseyer ST, Eichenberger M, Lussi A. Visual acuity of dentists in their respective clinical conditions. Clin. Oral Investig. 2014;18(9):2055-2058.

6. Doppalapudi N, Burugapalli RK. Benefits of utilization of magnification in dentistry: a review. Dental Research and Oral Health. 2020;3(3):121-128.

7. Mamoun JS. A rationale for the use of high-powered magnification or microscopes in general dentistry. Gen. Dent. 2009;57(1):18-26; quiz 27.

8. Del Fabbro M, Taschieri S, Lodi G, Banfi G, Weinstein RL. Magnification devices for endodontic therapy. Cochrane Database of Systematic Reviews. 2009(3).

9. Brown J, Burke F, Macdonald E, et al. Dental practitioners and ill health retirement: causes, outcomes and re-employment. Br. Dent. J. 2010;209(5):E7-E7.

10. Valachi B. Practice Dentistry Pain-Free: Evidence-based Strategies to Prevent Pain & Extend Your Career. 2008.

11. Low JF, Dom TNM, Baharin SA. Magnification in endodontics: A review of its application and acceptance among dental practitioners. Eur. J. Dent. 2018;12(04):610-616.

12. Setzer FC, Kohli MR, Shah SB, Karabucak B, Kim S. Outcome of endodontic surgery: a meta-analysis of the literature—part 2: comparison of endodontic microsurgical techniques with and without the use of higher magnification. J. Endod. 2012;38(1):1-10.