

Clinical

Use of ophthalmic dyes in root canal location

Sashi Nallapati BDS and Gary Glassman DDS, FRCD(C) illustrate the significance and use of ophthalmic dyes in the location of root canal orifices

The relationship between uninstrumented root canals and endodontic treatment failure has been studied extensively. Locating all the canals, then shaping and cleaning them in their entirety has been shown to be essential for predictable clinical and biological success (Hoen M, Pink F, 2002; Siqueira JF Jr, 2001; Crump S, 1979; Cheung GS, 1996).

High visual magnification and fiber-optic illumination incorporated in the surgical operating microscope (SOM) has revolutionized endodontic therapy. The use of the SOM has facilitated the ease with which root canals are found in their typical, as well as aberrant, positions during orthograde endodontic treatment (Carr GB, 1998; Ruddle CJ, 1997).

Although the SOM is an indispensable aid in visualizing the detailed anatomy of the pulp chamber, it is essential to develop the visual acuity to appreciate the subtle differences that aid in the location of the root canals. The inherent color differences between the axial dentin and pulpal floor dentin, the coronal dentin and radicular dentin, as well as the differences in color and consistency between soft tissue and hard tissue, will assist in locating the root canal orifices (Niemczyk S, 1976).

This is of even greater significance in teeth with full coverage where the orientation markers of the natural tooth cannot be seen, such as cusp tips, grooves and the external contours of the root outlines. Other situations where the 'pulpal road map' has been altered are teeth that have been previously endodontically treated where canals have been missed, where prior occlusal access has been made, altering the chamber floor anatomy, and teeth with pulp chamber obliterations and canal calcifications.

Any help in terms of 'marking' the pulp tissue in canal orifices will facilitate the location of canals in both conventional and retreatment cases.

It is the purpose of this article to illustrate the significance and use of ophthalmic dyes in the location of root canal orifices (Niemczyk S).

Ophthalmic dyes

Ophthalmic dyes (e.g. fluorescein sodium, rose bengal) are currently being used in ophthalmological diagnostic procedures and for locating damaged areas of the cornea due to injury or disease.

Other uses for these dyes in ophthalmology include detection of epithelial defects, evaluation of the nasolacrimal system, determination of tear breakup time, angiography, location of non-epithelialized foreign bodies and contact lens pressure points (Newell FW, 1986).

Fluorescein sodium is available in pharmacies as a clear, orange-red solution as sterile, single-dose disposable eye drops in cartons of 10 units. Each unit contains approximately 0.5 ml. It is also available as individual strips. When the strips are used, the agents can be reconstituted by immersion in a dappen dish that contains sterile water or 90% alcohol (Figures 1 and 2). There are no serious contraindications reported for its use topically, except possible hypersensitivity. No serious side effects have been reported except for nausea (Newell FW, 1986).

There are few references for the use of ophthalmic dyes and fluorescence in dentistry. Those that are of significance have studied the use of ultra-violet induced fluorescence spectroscopy in diagnosis, pulp and root canal location, as well as using fluorescent spectroscopy to measure the relative sealing efficiency of root canal sealers (Foreman PC, 1983; Pini R et al, 1989; Taher M et al, 1973).

How they work

When these dyes come into contact with vital or non-vital pulp tissue they are readily absorbed by the connective tissue elements of the pulp in the chamber and root canal system. When exposed to blue light, these dyes dramatically fluoresce, showing scattered tissue segments that contrast with the surrounding monochromatic dentin. It is this quality that makes them useful in the location of pulp tissue in root canals,



Figure 1: Fluorescein sodium strips



Figure 2: Dye can be reconstituted by placing the strip in sterile water

Clinical

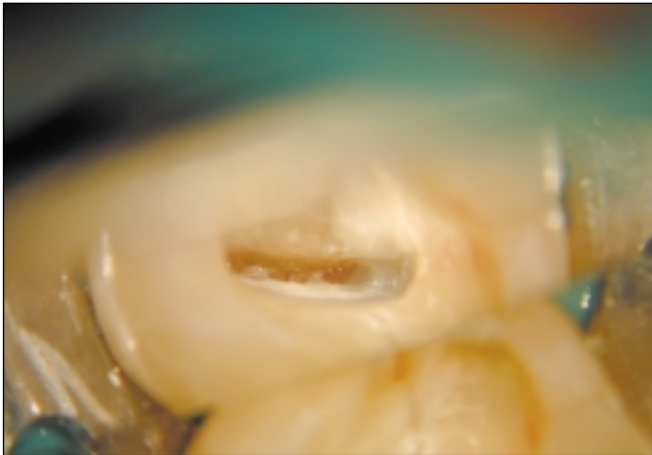


Figure 3: High magnification image showing the isthmus between distobuccal and disto lingual canal in a lower first molar

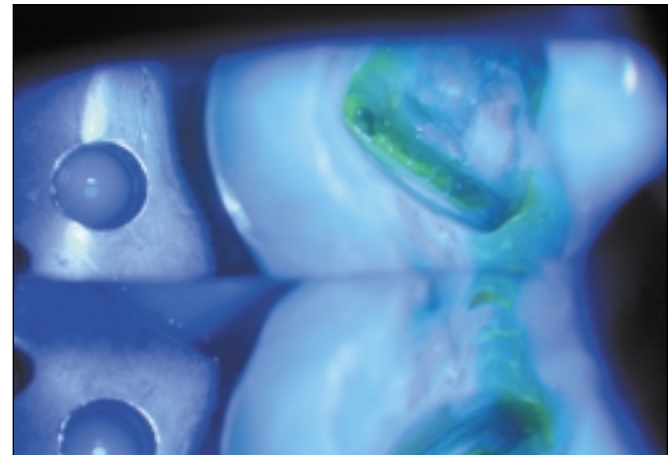


Figure 4: Pulp tissue in the isthmus takes up the dye, and on exposure to blue curing light fluoresces bright green

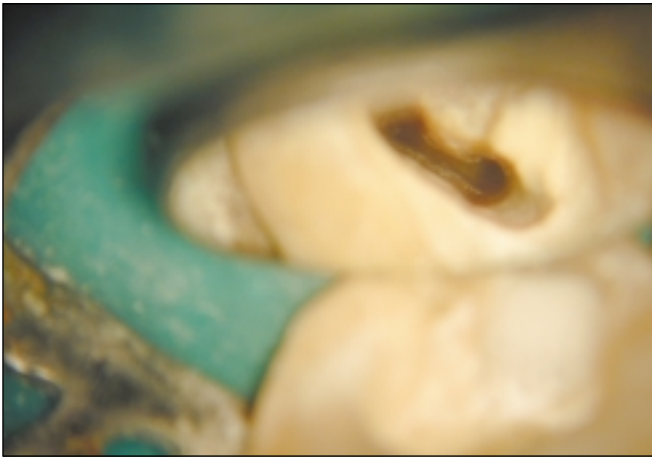


Figure 5: Canal orifices are enlarged and the isthmus troughed between both of the distal canals



Figure 6: High magnification image showing a clean isthmus, devoid of any pulp tissue

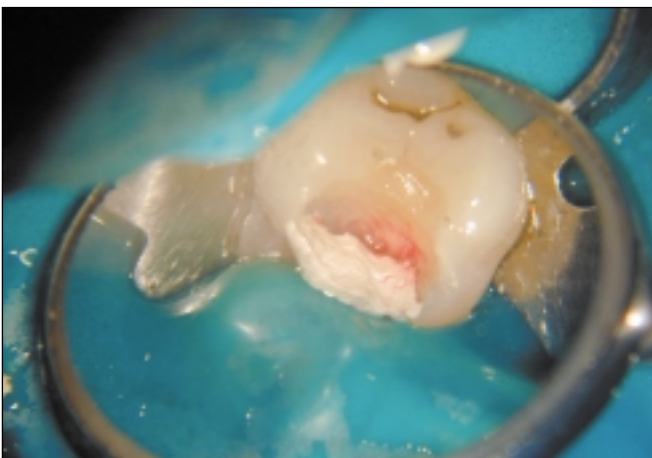


Figure 7: Initial access into the pulp chamber of a maxillary first molar

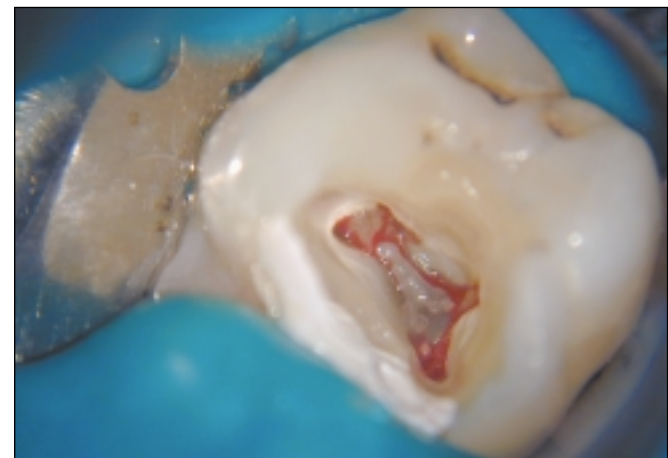


Figure 8: Straight line access achieved to MB, DB and palatal canal. Notice the hemorrhagic pulp and the pulp stone obliterating entry into the canal orifices

especially in those that are calcified and have tissue remnants within (Niemczyk S, 1976).

Technique

Once straight-line access is achieved, the pulp chamber is flooded with fluorescein sodium and allowed in contact with all the walls for a couple of minutes. The excess is then suctioned away. With the

incident light from the SOM turned off, blue light (dental curing light) is used to illuminate the chamber. With the aid of SOM, the operator can now visualize the bright green fluorescence emitted by the pulp tissue that has absorbed the dye (Figures 3, 4, 5 and 6).

Case report 1

A 25-year-old healthy female patient reported at the primary author's

Clinical

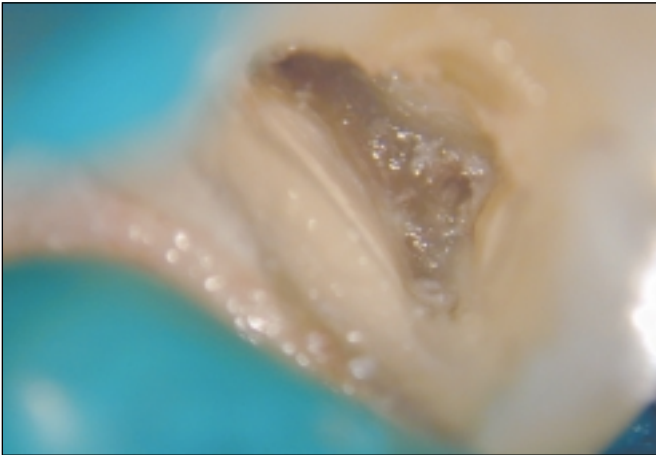


Figure 9: Pulp stone is removed, exposing the floor of the chamber

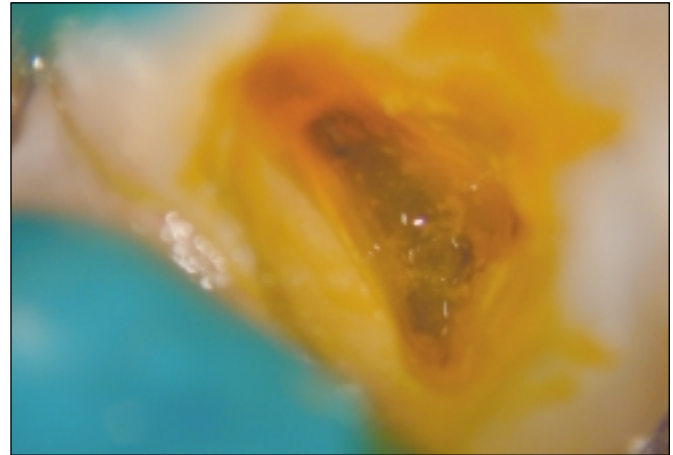


Figure 10: Pulp chamber flooded with fluorescein sodium dye

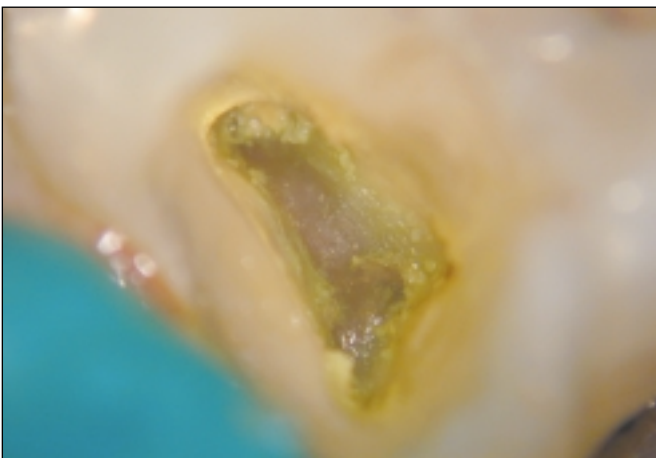


Figure 11: Excess dye is vacuumed. Stained pulp tissue can be seen as light green under the incident light in the microscope

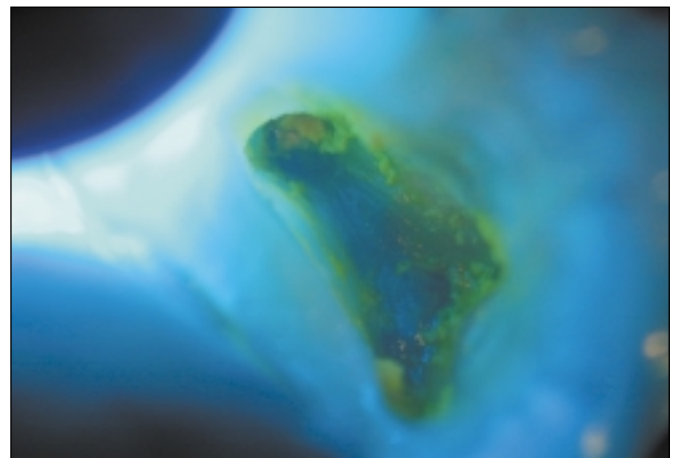


Figure 12: Pulp tissue fluoresces bright green under blue curing light with the microscope light turned off

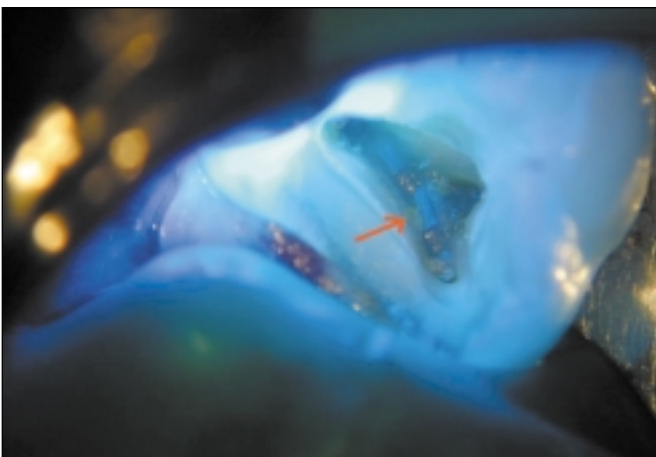


Figure 13: Red arrow points to the stained and fluorescing pulp tissue, marking the orifice of MB2 canal

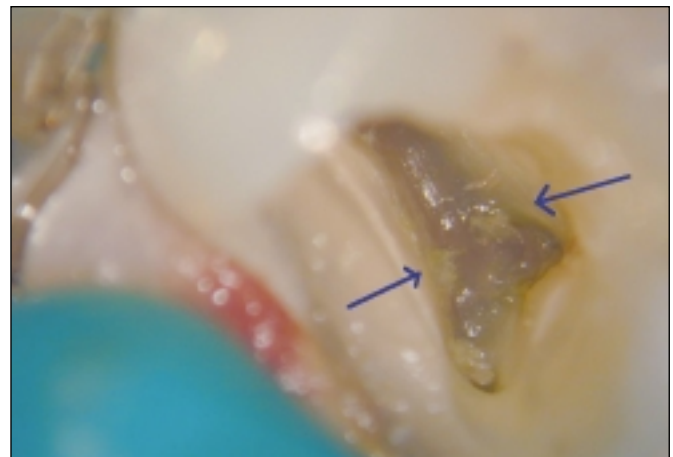


Figure 14: Blue arrows point to stained pulp tissue in the isthmus between MB, MB2 canal and DB and palatal canal

private practice with the chief complaint of ‘toothache’ in the upper left first molar. After the clinical and radiographic examination had been completed, a diagnosis of irreversible pulpitis subsequent to dental caries was made and endodontic treatment advised.

Access into the pulp chamber revealed a hemorrhagic pulp. Three canals (mesiobuccal (MB), distobuccal (DB) and palatal (P)) were readily detected and straight-line access was directed to these canals.

In order to locate the mesiolingual (MB2) canal, the pulp chamber was flooded with fluorescein sodium. After suctioning the excess, a blue curing light was used to fluoresce the pulp tissue in the chamber, including the isthmus between the MB and MB2 canal. The MB2 canal was readily located by the uptake of the dye that emitted bright green fluorescence. All four canals were then cleaned, shaped and obturated and the access subsequently restored (Figures 7 to 19).

Clinical

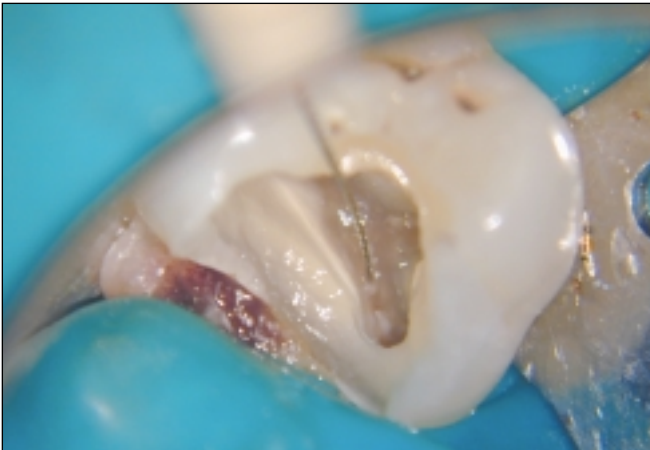


Figure 15: MB2 canal located with a .10 stainless steel hand file

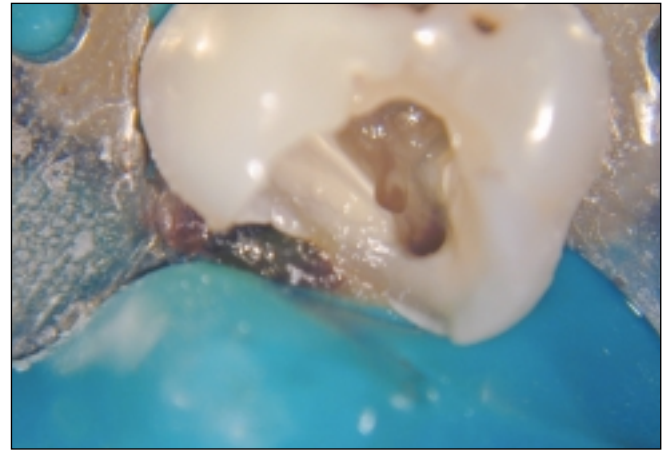


Figure 16: Both the mesiobuccal canals prepared



Figure 17: All canals obturated with gutta percha. palatal canal not in the view. Matrix band with wedge in place for the core placement

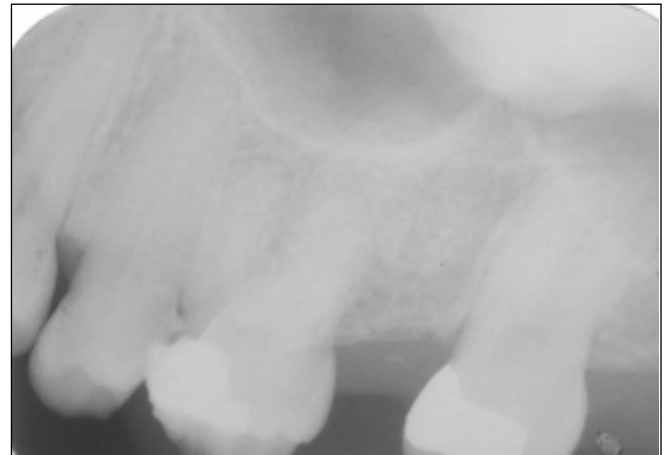


Figure 18: Pre-operative radiograph of a maxillary left first molar

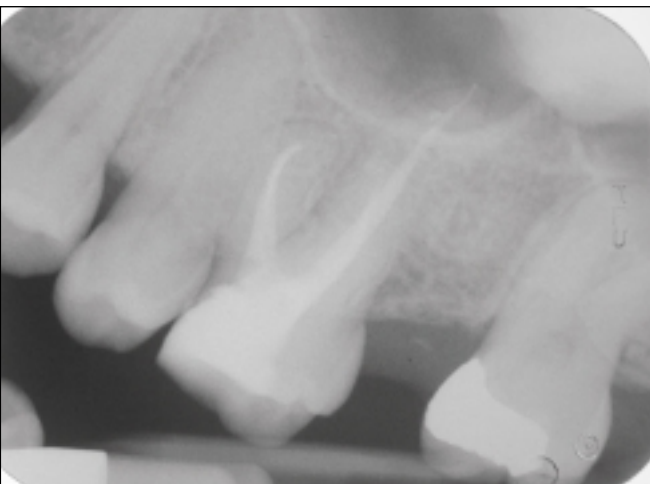


Figure 19: Immediate postoperative radiograph of the maxillary left first molar



Figure 20: Preoperative radiograph of a maxillary right first molar with prior access. Referring dentist could not locate any of the buccal canals

Case report 2

A 42-year-old male patient was referred to the primary author's private practice after the referring dentist could not locate any of the buccal canals in a maxillary right first molar.

Radiographic examination revealed the canals appeared to be calcified in the coronal 2mm. Once access was achieved, the pulp chamber was cleaned thoroughly with 5.25% sodium hypochlorite,

rinsed with 100% ethyl alcohol, and then dried to visualize the anatomy of the chamber floor. There were no hints of the 'pulpal road map' leading to the buccal canals. The access was then extended to below the cusp tips to facilitate straight-line access and the pulp chamber was flooded with fluorescein sodium. After suctioning the excess, the chamber floor was examined through the SOM with a blue curing light (with the SOM light turned off). There was

Clinical

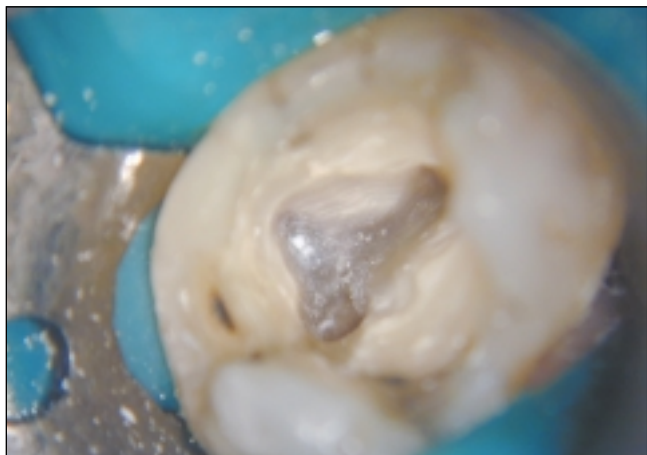


Figure 21: Pulp chamber cleaned and dried with 200% alcohol. No obvious signs of any of the buccal canals

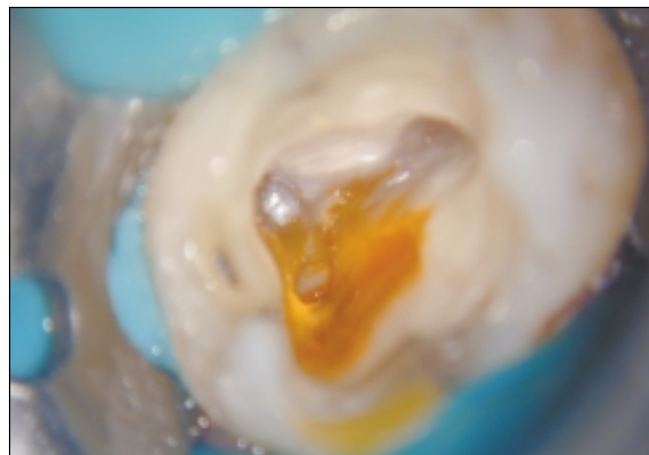


Figure 23: Pulp chamber flooded with fluorescein dye



Figure 22: Access extended to below the mesiobuccal cusp tip. There is still no sign of any of the buccal canals

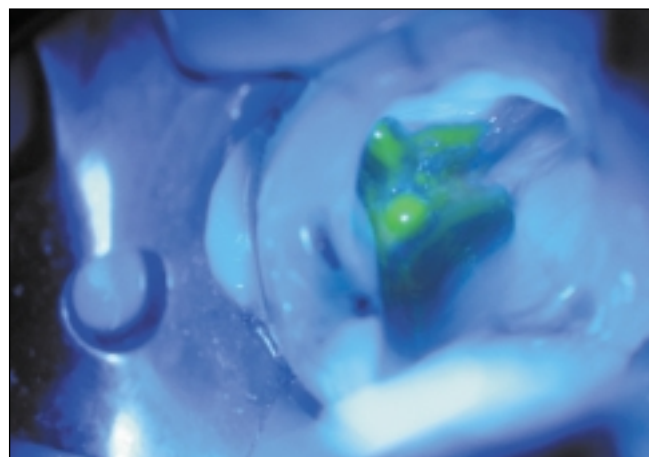


Figure 24: Pulpal tissue remnants fluorescing under blue curing light, marking the presence of the canal orifices

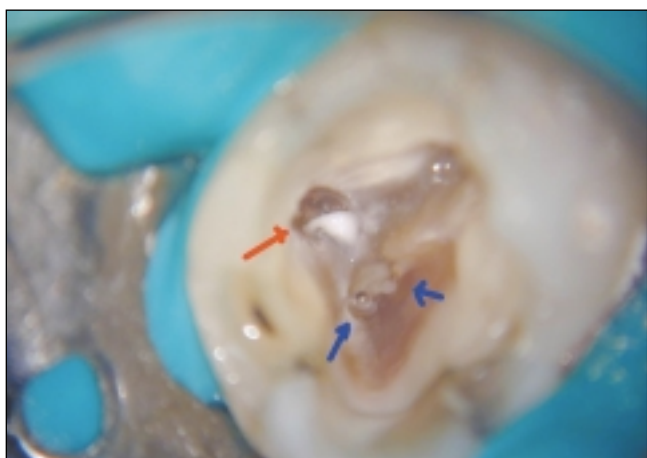


Figure 25: Further troughing with ultrasonics in the marked areas reveal the DB (red arrow) and mesiobuccal (blue arrows) canals



Figure 27: Immediate postoperative radiograph. MB and MB2 join in the coronal third to exit as one canal


a dramatic bright green fluorescence where the remnants of pulp tissue were. On troughing further with ultrasonic tips (Endotips.com, San Diego, California) and exploration with DG-16 endodontic explorers (Hu-Freidy, Chicago, Illinois), MB, MB2, and DB canals were located. All canals were cleaned, shaped and obturated and the access cavity subsequently restored (Figures 20 to 27).

Conclusion

There is no one single technique that will allow all canals to be found predictably 100% of the time. Keeping an open mind to new ways of thinking and accumulating the knowledge from different sources will allow new methods to emerge. The use of ophthalmic dyes in finding hidden and calcified canals is another



Figure 26: All canals prepared. Red arrow pointing to the unsuccessful attempt made by the referring dentist to locate the DB canal. Notice its actual location

useful tool to be included in the endodontic armamentarium to guide our pathway to predictable clinical and biological success. 

References

- Carr GB (1998) Retreatment, *Pathways of the Pulp*. 7th edition, pp 810, 832
- Cheung G S (1996) Endodontic failures – changing the approach. *Int Dent J* **46**(3): 131-8
- Crump S (1979) Differential diagnosis in endodontic failure. *Dental Clinics of North America* **23**(4): 617-35
- Foreman PC (1983) Ultra-violet light as an aid to diagnosis. *Int Endod J* **16**(3): 121-6
- Hoen M, Pink F (2002) Contemporary endodontic retreatments: An analysis based on clinical treatment findings. *JOE* **28**(12): 834-836
- Newell FW (1986) *Ophthalmology: Principles and Concepts*. 6th Ed St. Louis, MO, CV Mosby Co, p.124
- Niemczyk S (1976) Intrinsic and extrinsic aids in root canal location. *Endo Therapy* **2**(1): 7
- Pini R, Salinbeni R, Vannini M, Cavalieri S, Barone R, Clauser C (1989) Lasers: Root canal diagnostic technique based on ultra-violet induced fluorescence spectroscopy. *Surg Med* **9**(4): 358-61
- Ruddle CJ (1997) Microendodontic non-surgical retreatment. *CCNA* **41**(3): 429
- Siqueira JF Jr (2001) Etiology of root canal treatment failure: why well-treated teeth can fail. *Int Endod J* **34**(1): 1-10
- Taher M, Sidky E et al (1973) The use of fluorescent dye for detecting the relative sealing efficiency of various root canal sealers. II. Qualitative assessment for the effect of aging. *Egyptian Dental Journal* **19**(2): 197-210

The authors would like to thank Dr Gary Carr (PERF) and members of 'Roots', the internet-based endodontic discussion forum, for their invaluable support.