

Masterclass in Clinical Practice Endodontics

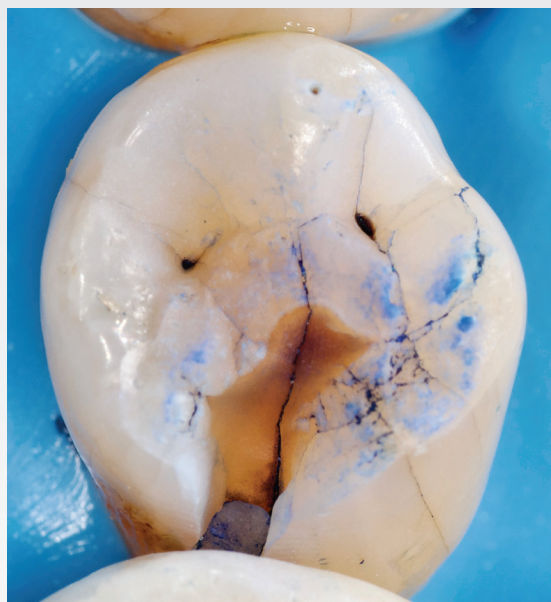
with

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The use of magnification, transillumination and methylene blue dye to determine the extent of structural cracks in teeth



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The prevalence of cracked teeth is approximately 80% in patients over 40 years of age (Cameron, 1964). According to Endodontics - colleagues for excellence (2008), a cracked tooth is defined as an incomplete fracture initiating from the crown and extending subgingivally, usually directed in a mesio-distal direction. The fracture may extend through either the mesial or distal or both marginal ridges and the proximal surfaces.

The fracture can be limited to the crown of the tooth only or it might extend from the crown into the proximal root surface. Fracture extending below the cervical gingival margin and across the tooth, ultimately results in a split tooth and the fragments on either side of the fracture become separable. These cracks often cause pulpal inflammation initially, but ultimately periapical pathosis as it extends in an apical direction.

Cracked teeth are the third most common cause of tooth loss in industrialised countries, primarily affecting maxillary molars and premolars and mandibular molars. (Guertsen et al., 1992). According to a study by Mariona and Anthony, 2018, the inability to visualise the extent of the crack through clinical examination with the naked eye alone, is a limitation in accurate determination of the endodontic diagnosis and treatment options.

Examination and diagnostic tools

Examination under magnification is crucial to aid in tooth fracture identification, diagnosis, and the endodontic management of these teeth (Bhandari, 2021). According to Clark et al, 2003, the use of a Dental Operating Microscope (DOM) at magnification levels of 14-18X can significantly improve a clinician's ability to diagnose the extent of cracks in teeth.

Transillumination by aiming an LED light source perpendicular to the fracture plane at the cervical level of the tooth, is another important aid for identification of cracks. A crack that propagates into the dentine will cause a disruption in the light transmission.

Drawbacks of transillumination include the dramatisation of all cracks to the point that craze lines can appear as structural cracks and that subtle colour changes are rendered invisible (Sebeena et al, 2012). Lubisich et al, 2010, recommend that



Figure 1. (a and b) The SmartLite Pro Transillumination Tip (Dentsply Sirona) is a diagnostic aid for the SmartLite Pro Curing Light (Dentsply Sirona) that helps visualize interproximal caries, evaluate cracked teeth and to illuminate endodontic access cavities when looking for missed canal systems.

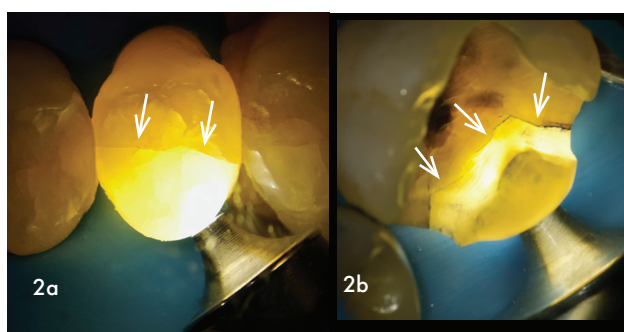


Figure 2.(a) Transillumination of a maxillary premolar with a suspected crack using the SmartLite Pro Transillumination Tip (Dentsply Sirona). Illumination from the palatal cusp showed evidence of mesial-distal crack in the tooth (arrows). Note that the crack blocked the light from adequately illuminating the buccal cusp; (b) Transillumination of the mesio-buccal cusp of a maxillary first molar outlining a cusp fracture (arrows) that was visible after removal of a previous amalgam restoration.



Figure 3.(a) Vista-Blue methylene blue dye (Vista Dental); (b) High magnification view through the DOM (X15) of the pulp chamber of a non-vital mandibular right first molar. After access cavity preparation a crack was noted on the distal marginal ridge. After staining the surface with methylene blue dye for 10 seconds it was rinsed with water and air-dried. Note the extent of the crack up to the pulp chamber floor (arrows).

transillumination with a fibre-optic light must be used in conjunction with magnification for identification of structural cracks.

Methylene blue dye is another option that can be used for identification of cracks in teeth (Figure 3). It helps to further determine the extent of the crack which is vital information to select the ideal treatment. Staining cracks with this dye often makes the difference between deciding to preserve the tooth or to extract. Methylene blue dye is superior to caries-indicator dyes as it pools much better and its dark blue colour optimises visibility. This allows for better documentation using photography as well as patient communication when discussing treatment options and long-term prognosis. Some negative aspects of using this dye is that it will stain plaque profusely as well as dentine surfaces previously exposed to sodium hypochlorite.

The authors therefore recommend cleaning tooth surfaces

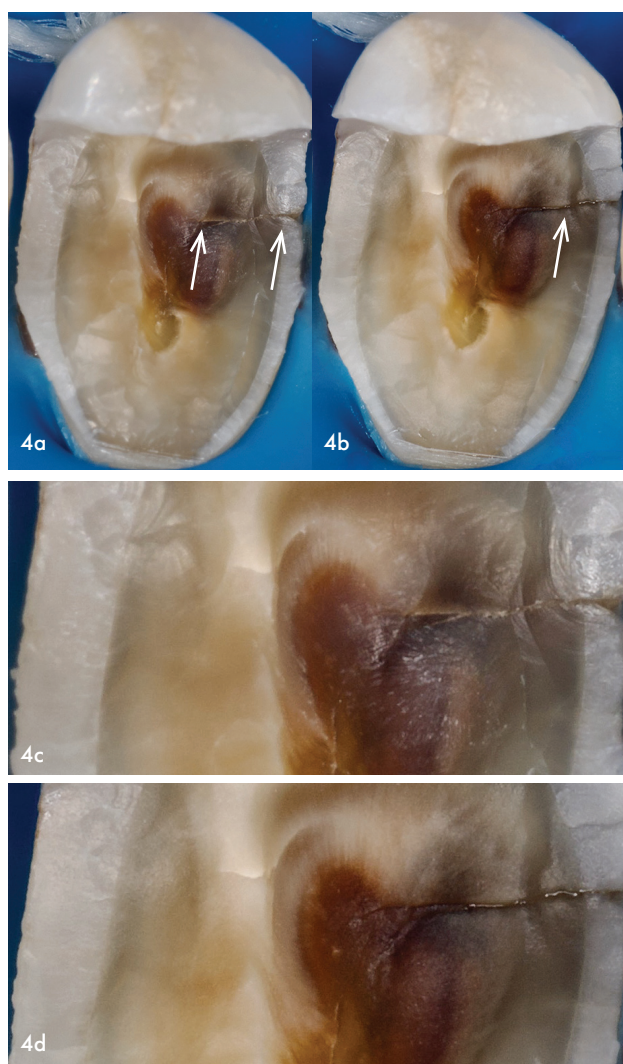


Figure 4.(a) High magnification view under the DOM (X12.5) of a right maxillary second premolar tooth after removal of a previous amalgam restoration that caused a buccal cusp fracture. There was evidence of a crack extending from the distal gingival margin up to an island of secondary dentine covering the roof of the pulp (arrows); (b) After sandblasting the surface with 29 micron aluminium oxide the biofilm was removed from the crack and crevicular fluid (arrow) was visible inside the crack indicating a structural crack; (c) 19X magnification view of the crack before sandblasting; (d) 19X magnification view of the crack after sandblasting.

with a rubber cup in conjunction with coarse pumice slurry or air polishing of the tooth surface with bicarbonate of soda or glycine powder in order to remove the biofilm prior to staining and examination under the DOM. Air polishing also has the ability to remove the biofilm in the cracks and this greatly improves the visualisation of the cracks especially with regards to depth, extent and fluid movement through the dentine crack.

Prognosis

The prognosis of cracked teeth can be summarised as follows according to Bhandari, 2021:

1. Teeth with cracks extending up to the cervical dentine



Figure 5 . Preoperative view of a 54-year-old male patient that reported with signs symptoms of irreversible pulpitis in his maxillary left first molar previously restored with a MO amalgam restoration.

could provide the patient with a 90-92% survival rate over a five year period (Sim et al., 2016; Davis and Shariff, 2019);

2. Cracks extending into the canal orifices without any periodontal involvement could provide the patient with a 82% survival rate over a five year period (Davis and Shariff, 2019);
3. Cases with cracks extending into the canal orifices with periodontal pocketing is lower than 74% over a 2 year period (Kang et al., 2016; Oliveri et al, 2020);
4. Cracks extending down canal orifices for a distance of 5-7mm have a very poor prognosis and should definitely be extracted.

Case Report

A 54-year-old male reported with symptoms of irreversible pulpitis of his maxillary first left molar previously restored with a MO amalgam restoration (Figure 5). After air polishing the occlusal surface of the tooth with bicarbonate of soda, the occlusal surface was stained with methylene blue dye for 5 seconds and rinsed off with water and dried. Examination under magnification revealed two cracks on the distal marginal ridge and on the disto-palatal aspect of the tooth (Figure 6).

The amalgam restoration was removed and the cavity preparation surface cleaned with 29 micron aluminium oxide particle abrasion before staining the exposed dentine with methylene blue dye. A structural mesio-distal crack was visible extending from the mesial gingival margin, across the pulpal floor and ending over the distal marginal ridge. A second crack from the disto-palatal aspect joining at an oblique angle with the mesio-distal crack was also evident (Figure 7). The pulp chamber was opened, inflamed tissue removed, surfaces air abraded and the methylene blue dye reapplied. A high magnification view of the pulp chamber

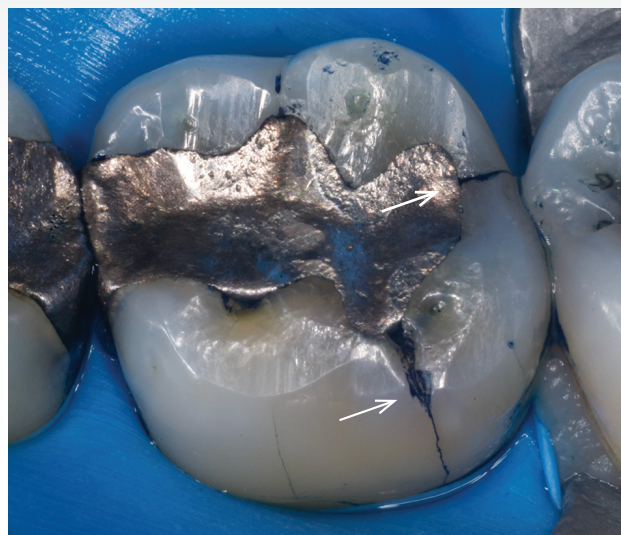


Figure 6. After air polishing the occlusal surface of the tooth with bicarbonate soda the occlusal surface was stained with methylene blue dye. Two cracks were confirmed. One on the distal marginal ridge and on the disto-palatal aspect of the tooth.

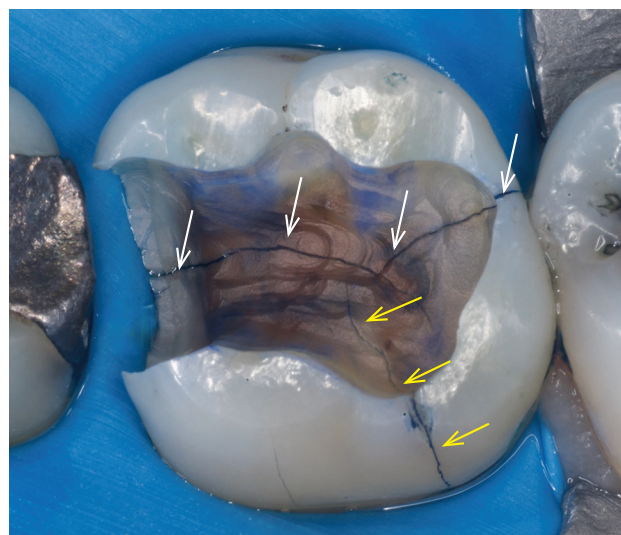


Figure 7. Occlusal view after removal of the amalgam restoration, air particle abrasion with 29 micron aluminium oxide and staining exposed dentine with methylene blue dye. Note the mesio-distal crack was visible extending from the mesial gingival margin, across the pulpal floor and ending over the distal marginal ridge (white arrows). A second crack from the disto-palatal aspect joining at an oblique angle with the mesio-distal crack was also evident (yellow arrows).

revealed that the distal crack extends past the pulp floor into the distal root canal system (Figure 8) and the mesial crack extended into the pulp floor right up to the MB2 canal orifice (Figure 9). Due to the nature and extend of these cracks it was decided to extract the tooth.

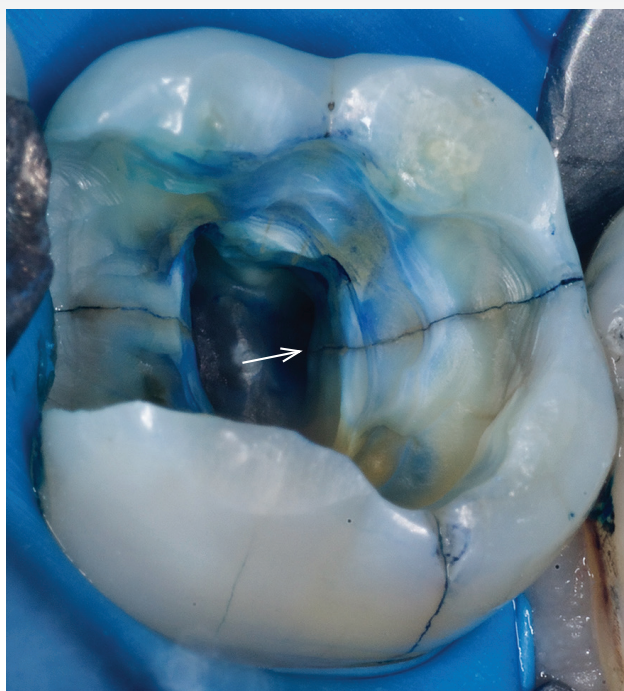


Figure 8. High magnification view of the distal aspect of the pulp chamber and reapplication of the methylene blue dye. Note the distal crack extends into the distal root canal system (arrow).

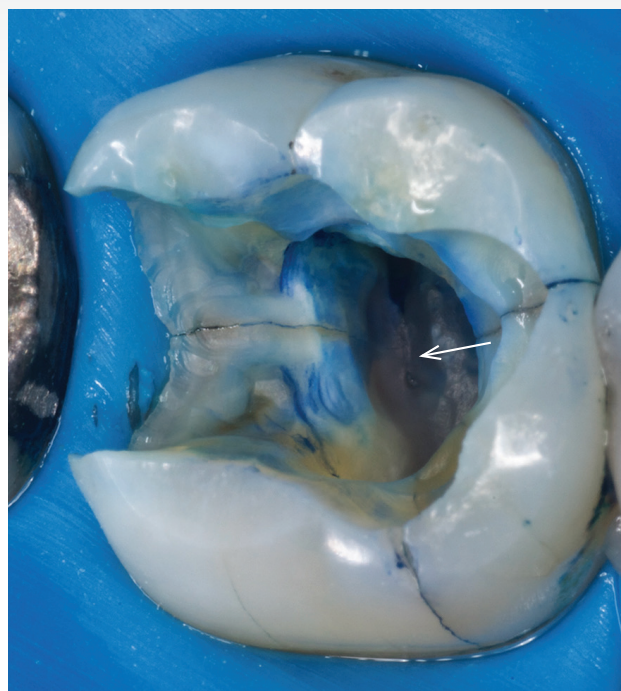


Figure 9. High magnification view of the mesial aspect of the pulp chamber. Note the distal crack extends into the pulp floor right up to the MB2 canal orifice.

Conclusion

In this Masterclass on the use of magnification, transillumination and methylene blue dye in the determination and extent of structural cracks in teeth, the authors demonstrate the different diagnostic tools and highlights the criteria for prognosis determination. Accurate diagnosis and subsequent treatment planning are paramount factors determining the ultimate fate of these teeth.

References

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