The aim of endodontic therapy is for complete debridement of pulpal tissues, thorough cleaning and shaping, and total obturation of the root canal space, which will subsequently provide an effective barrier to prevent passage of micro-organisms and their by-products into periodontal spaces and periapical tissues (Gutmann, 2002; Ingle and Bakland, 2002). Endodontic perforations interfere with this goal because of the presence of a communication with these tissues. Perforations may be caused by iatrogenic dentistry, resorptive processes, or caries and can be diagnosed through direct observation of bleeding, indirect bleeding assessment by means of a paper point, radiographs, and an apex locator (Alhadainy, 1994). Perforation defects may be repaired by non-surgical or surgical techniques. Surgical repair is indicated when access through the canal is impossible (Stock and NG, 2004).

Various materials have been utilized for perforation repairs, such as zinc oxide and eugenol-based cements (IRM and EBA), mineral trioxide aggregate (MTA), amalgam, glass ionomers, gutta percha, calcium hydroxide alone, and calcium hydroxide or Klorapercha N-O-covered with amalgam or gutta percha, hydroxyapatite and plaster of Paris (Alhadainy, 1994; Alhadainy and Himel 1994; Mittal et al, 1999).

The ideal material for treating endodontic perforations should be non-toxic, non-absorbable, radiopaque, bacteriostatic or bactericidal and easy to apply. The material should also provide a tight seal against microleakage at the perforation site.

Of the materials mentioned above, MTA is arguably the most suitable material for managing perforations (Pitt Ford, McKendry, 2002) as it has many favorable properties. However, one of the limitations of MTA is its extended setting time and difficulty in handling. The material is more suitable for box-like cavities where it can be lightly packed. This is a drawback not only for potential users but for experienced operators as well.

In clinical situations when this material is unavailable, clinicians are forced to resort to other materials when trying to save a perforated tooth. The material of choice must exhibit basic properties such as biocompatibility, ability to adhere to tooth structure for adequate sealing and ease of application.

In this case report, two cases of perforation repair are reported in which a light-cured glass ionomer was used. Post-operative evaluations were conducted after one and two years.
A 24-year-old female was referred to the Hospital University Sains Malaysia’s Specialist Dental Clinic for the treatment of pain and swelling associated with her maxillary right second premolar. The tooth had a six-month history of intermittent pain following placement of a composite resin restoration and was eventually endodontically treated by her previous dentist. However, the problem persisted following endodontic treatment.

Her previous medical history was unremarkable. Extra-oral examination revealed no abnormalities. Intra-oral examination showed that the tooth had a large disto-occlusal glass ionomer restoration extending subgingivally. The tooth was tender to vertical percussion and apical palpation and had class I mobility.

Periodontal probing showed a 6mm pocket at the distal of the tooth. A buccal fistula was present on the attached gingiva between the tooth and the first molar. Vitality testing was not performed as the tooth already had a history of root canal treatment.

Radiographic findings showed poor endodontic treatment with incomplete obturation of the canal, a periapical radiolucency, widening of the periodontal ligament, mesial loss of lamina dura and distal loss of alveolar bone crest (Figure 1a). A diagnosis of a failed root canal treatment and chronic periapical periodontitis with possible distal perforation was made. All possible treatment options were discussed and the patient expressed the preference to retain the tooth. Endodontic re-treatment with possible perforation repair by using light-cured glass ionomer (GC Fuji Lining...
LC, GC, Japan) was offered to the patient and she agreed to the treatment plan. She was informed that the more suitable material (MTA) for perforation repair was not available in the clinic.

At the next treatment visit, the tooth was isolated with rubber dam and subsequent treatment steps were performed under a 2.5x magnification using a microscope (Zeiss operating microscope; Carl Zeiss, Jena, Germany). After removal of the existing restoration, a distal perforation of 3mm in width through to the base of the pulp chamber was detected through probing and by observing the presence of blood (Figure 1b). Bleeding was arrested by rinsing with 1% sodium hypochlorite and pressure packing with gauze. The next step was the removal of debris and remaining caries from the perforation site. After rinsing the cavity with distilled water followed by drying, a dentin conditioner (GC Corporation, Tokyo, Japan) was applied to the dentin surrounding the perforation and left in place for 10 seconds, followed by rinsing with distilled water for five seconds and lightly drying with air and a sterile cotton pellet. The perforation defect was then repaired using a light-cured glass ionomer, GC Fuji Lining LC (GC, Japan) following the manufacturer’s instructions. The material was mixed to a slightly running consistency for ease of application and was carried into place by using a periodontal probe. The perforation site was gradually filled up from the base with the material covering about 2-3mm of the surrounding dentin (Figure 1c) and then light-cured (Bludent LED, Plovdiv, Bulgaria). Final thickness of the material was about 2mm. Care was taken not to occlude the orifices of the buccal and palatal canals. Subsequently, conventional endodontic re-treatment procedures were carried out. Remnants of the endodontic filling material were conventionally removed by using 32mm stainless steel #2 and #3 Gates Glidden drills (Premier Dental Co., Norristown, PA) and chloroform (Merck, Darmstadt, FRG). The canal was irrigated with 1% sodium hypochlorite and dried with paper points (Kerr Absorbent Points, USA). Calcium hydroxide (PD, Washington, USA) was placed as intra-canadal medication followed by a sterile cotton Caviton (GC, Japan) and a light-cured glass ionomer restoration (Fuji II, GC, Japan). The tooth was adjusted for minimal occlusal contact.

At three months review, the patient reported no signs and symptoms. There was no tenderness to percussion and palpation; the draining sinus had healed and the distal pocket depth was 3mm and the tooth had reduced mobility. Inspection of the perforation site was performed by removing the temporary restoration under rubber dam. It was noted that the repaired perforation was intact (visual and tactile examination) and clinically there were no signs of leakage.

Conventional root canal treatment was then continued with mechanical preparation of the canal with a step-back technique, followed by calcium hydroxide intracanal medication. Obturation was completed one month later with AH 26 (Dentsply De Trey GmbH, Konstanz, Germany) and cold lateral condensation technique of gutta percha (Dentsply Maillefer, Ballaigues, Switzerland). A year after the first visit, the tooth remained asymptomatic (Figure 1d). Regular recalls were continued at six-month intervals. The patient was advised of the necessity of a crown to restore the tooth.

**Case report two**

A 23-year-old male was referred to the Hospital University Sains Malaysia’s Specialist Dental Clinic for the management of an endodontic perforation of his lower left second molar. At the initial visit, he complained about swelling, mobility and moderate to severe pain. He stated that the endodontic treatment had not yet been completed. His medical history was unremarkable. Extra-oral examination revealed no abnormalities. Intra-oretally, tooth 37 presented with a large disto-occlusal glass ionomer restoration, distal caries, class I-II mobility, buccal and lingual swelling and an abscess. Periodontal probing showed 5mm pockets on the lingual opposite bifurcation area. The tooth was also tender to vertical percussion and apical palpation. Vitality testing was omitted as the tooth already had undergone initial endodontic treatment.

An intra-oral periapical radiograph revealed areas of radiolucencies associated with the furcation and distal root (Figure 2a). A diagnosis of acute periapical periodontitis and abscess formation with a possible lingual furcation perforation was made. All possible treatment options were presented to the patient and he was advised of the condition and poor prognosis of the tooth. However, he insisted that attempts be made to save the tooth and agreed to the perforation repair with a light-cured glass ionomer followed by definitive endodontic and restorative treatment. The patient was also informed about the unavailability of the more suitable material (MTA) for perforation repair in the clinic.

Treatment conditions were similar as described in case
Upon establishing access and removal of all existing restorative material and caries, a round perforation defect measuring about 2mm in diameter was detected on the pulpal floor towards the lingual aspect of the tooth (Figure 2b). Unlike the previous case, the perforation showed minor hemorrhaging and had no caries. One percent NaOCl irrigation followed by pressure packing with sterile gauze as described in case report one was used to achieve hemostasis. After rinsing with distilled water and drying, the perforation site was etched with a dentin conditioner (GC Corporation, Tokyo, Japan), which was applied to the surrounding dentin for 10 seconds, followed by rinsing with distilled water for five seconds and light air drying. Subsequently, the perforation site was repaired with a light-cured glass ionomer (GC, Tokyo, Japan). Mixing and application was similar to what has been described in case report one. The perforation site was gradually filled up with the material covering about 2-3mm of the surrounding dentin and then light-cured (Bludent LED, Plovdiv, Bulgaria). Final thickness of the material was about 2mm. Care was taken not to occlude the orifices of the root canals.

Subsequently, conventional endodontic treatment was performed consisting of cleaning and irrigating with 1% sodium hypochlorite and drying with paper points (Kerr Absorbent Points, USA). Calcium hydroxide (PD, Washington, USA) was placed as intra-canal medication followed by a sterile cotton pellet, Caviton (GC, Japan) and a light-cured glass ionomer restoration (Fuji II, GC, Japan). The tooth was adjusted for minimal occlusal contact.

At the three-month recall the patient was asymptomatic. Intra-oral examination showed that the tooth was no longer tender to percussion and palpation. Buccal and lingual swelling had subsided and tooth mobility was <1. Upon probing, the pocket depth in the lingual furcation area now measured 3mm. After removal of the restoration under rubber dam, examination of the perforation site (visual and tactile) showed an intact repaired perforation with no clinical signs of leakage (foul odor).

Conventional endodontic treatment was then continued with mechanical preparation of the canal using a rotary crown-down technique (ProTaper, Dentsply Mailfer). Canal preparation was completed with up to a F3 bur. Calcium hydroxide was used as...
intra-canalm edication. Obturation was comple ted one-
month later w ith AH 26 (Dentsply De Trey GmbH) and
cold lateral condensation of gutta percha (Dentsply
Maillefer, Ballaigues, Switzerland). The restorative
treatment consisted of an amalgam post and core and
complete metal crown. At a one-year post-operative
visit the patient presented with an asymptomatic tooth.
Regular recalls were carried out at six-month intervals.
Two years after treatment, the patient presented with a
normal functioning tooth (Figure 2c).

Discussion
Maintaining the integrity of the natural dentition is
essential for function and esthetics. Endodontic therapy
can play a vital role in achieving this goal. Occasionally
technical problems do occur during endodontic
treatment i.e. perforating a wall or floor of the pulp
chamber or root canal during caries removal, during
access cavity preparation, locating of canals and
mechanical debridement. This can significantly impair
the long-term prognosis of a tooth (Breault et al, 2000).

Different materials have been used for endodontic
perforation repair and the search for an ideal
perforation repair material is a challenge. A repair
material has to be placed in intimate contact with hard
tissues of the tooth and soft tissues of the
periodontium. These materials may pose a threat to
endodontic treatment outcome by causing local or
systemic adverse effects, either through direct contact
with or leaching of chemical components into the
periodontal tissues and alveolar bone (Breault et al, 2000).

In this case report, a light-cured glass ionomer was
chosen as an alternative to MTA. Light-cured glass
ionomer is a small particle, hydrophilic, non-aqueous
resin combined with a photo initiator and glass powder
formulation. The advantages of this material are its
insolubility in oral fluids, reasonable adhesion to tooth
structure, high strength, and dual cure properties. Light-
cured glass ionomers also offer the following attributes:
low cure shrinkage, low thermal expansion, and
extended fluoride release as found in traditional glass
ionomers (Scherer, Dragoo, 1995; Dragoo, 1997).

Traditional clinical applications for light-cured glass
ionomer include: erosive lesions in geriatric patients,
fixed prosthetics and resin bonded retainer
cementation, porcelain repair, bonded amalgam
restorations, core material, and pediatric restorations
(Scherer, Dragoo, 1995; Dragoo, 1997).

Dragoo (1997) demonstrated clinically and
histologically the biocompatibility of this restorative
material. The formation of an epithelial and connective
tissue adherence to light-cured glass ionomer represents
a significant advancement in the ability to restore
previously considered hopeless teeth (Dragoo, 1997;
Stock, NG, 2004). Dragoo’s (1997) clinical and
histological investigation of light-cured glass ionomer
demonstrates a biocompatibility to both soft and hard
tissues. As an additional benefit, fluoride release from
light-cured glass ionomer may positively affect bacterial
plaque biochemistry through an alteration of
carbohydrate metabolism (Scherer, Dragoo, 1995). As
the material polymerizes with visible light, its setting
is fast and controllable, thus improving performance and
reducing messy handling.

This is in contrast to MTA, which has an extended
setting time and requires careful handling. Based on the
above, even an inexperienced operator will appreciate
the handling of a light-cured glass ionomer as being less
demanding. In addition, sealing and resistance to
microleakage are predictable as the material through
chelation, chemically bonds to both enamel and dentin
(Mount, Hume, 1998), while the material has been
proven to be biocompatible (Human, Love, 2003). Glass
ionomer, as a restorative dental material, has been
successfully utilized for treatments of tooth abfractions,
external root resorption, and root perforation repair
(Shuman, 1999, Silveira, Sachez-Ayala, 2008). The
present case reports have demonstrated an additional
application. Based on its biologic compatibility, light-
cured glass ionomer material may be considered to be
part of the clinician’s armamentarium for the treatment
of endodontic perforations, especially when more
suitable materials such as MTA are unavailable.
Economically the glass ionomer material has a
significant advantage over MTA and it should,
therefore, be of interest to many practitioners. However,
much evidence from randomized controlled clinical trials
needs to be generated to assess whether a more
conclusive valid recommendation can be made about
the performance of light-cured glass ionomers for the
repair of endodontic perforations.
References


