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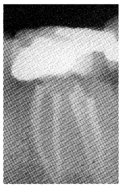

CASE REPORT

Endodontic management of badly broken down teeth using the canal projection system: two case reports

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Abstract

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Aim Teeth that have been weakened by caries and require root canal treatment to maintain their functional integrity may present with minimal coronal tooth structure and are a challenge for isolation and restoration. The aim of this clinical report is to demonstrate the management of badly broken down teeth using the Projector Endodontic Instrument Guidance System (PEIGS).

Summary The PEIGS is an adjunct to root canal treatment designed to enhance the ease of treatment delivery. Use of this system facilitates projection of canal orifices from the floor of the pulp chamber to the cavosurface, providing direct visualization of and physical access to the projected canals. This report demonstrates the use of this novel device for the management of two badly broken down teeth.

Key learning points

Use of the endodontic projection system has the following advantages:

- 'Projects' the canal orifice from the floor of the pulp chamber to the cavosurface, thereby enhancing visualization and access to the canals.
- The bonded coronal build up reduces the risk of interappointment crack initiation and coronal-radicular fracture of weakened tooth structure.
- Permits individualization of canals especially when they lie in close proximity to each other on the chamber floor.
- Isolation may be facilitated by ease of clamp retention, rendering many structurally debilitated teeth endodontically treatable.

Keywords: broken down teeth, endodontic canal projection, isolation, pre-endodontic build-up, projector.

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Introduction

Technical and scientific advances in endodontics have resulted in retention of teeth, which were earlier deemed untreatable (Johns *et al.* 2006). It is universally accepted that preservation of a natural tooth with a good prognosis is superior to tooth loss and replacement (Roda & Gettleman 2006).

The current techniques employed to manage severely broken down teeth include the use of special clamps with specific designs, surgical exposure of the cervical tooth structure to facilitate clamp placement, use of orthodontic bands, preformed copper bands, pin or adhesive retained amalgam, composite and glass ionomer buildups. However, these have inherent disadvantages (Madison *et al.* 1986, Jeffrey & Woolford 1989). Presence of minimal coronal structure can risk further damage to the crown during rubber dam clamp placement thereby compromising isolation and causing subsequent coronal leakage (Jeffrey & Woolford 1989, Zerr *et al.* 1996). Pre-endodontic build-up of the coronal tooth structure following caries removal and identification of the canal orifices can facilitate the endodontic process by providing a strong core and coronal seal (Kurtzman 2004).

The canal projection technique using the Projector Endodontic Instrument Guidance System (PEIGS) (CJM Engineering, Santa Barbara, CA, USA) provides pre-endodontic reconstruction of debilitated coronal and radicular tooth structure whilst preserving individualized access to canals (Kurtzman 2004, http://www.cjmengineering.com). This case report introduces the innovative concept of using the 'Projector' which 'projects' the canal orifices from the chamber floor to the cavosurface providing better visibility and access (Weathers 2004), and also ensures optimum isolation and reinforcement of the tooth structure.

Case reports

Case report 1

A 36-year-old female reported to the Department of Conservative Dentistry and Endodontics, S.D.M. College of Dental Sciences, Dharwad, India, complaining of a dull, mild intermittent pain in the right maxillary posterior region for 2 months. Intra-oral examination revealed the presence of a grossly decayed tooth, 16 (FDI), with three walls missing (Fig. 1a). Pulp sensibility testing elicited a negative response. The preoperative radiograph (Fig. 1b) revealed deep occlusal caries involving the pulp and widening of the periodontal ligament space in relation to the palatal root. A diagnosis of pulpal necrosis and chronic periradicular periodontitis was made.

Root canal treatment was then planned using the PEIGS as rubber dam isolation was challenging. The Projector is a small, black, cone-shaped plastic device, which slides onto an endodontic file (Fig. 1d). It has a central lumen, an apical bevel and is made of a specially formulated plastic (linear low-density polyethylene) which is nonadherent to dental restorative materials. It is available in two sizes; 'regular' which is used in cases where the size of the access cavity is adequate to accommodate the medium-sized device, and 'skinny' which is used in cases where the size of the access cavity is not adequate to accommodate the medium-sized device (Table 1).

After securing adequate anaesthesia and application of rubber dam with a clamp with apically inclined beaks, caries was excavated. Access cavity preparation was performed and four canal orifices were identified (Fig. 1c). The canals were enlarged to a size 20 file using the standardized method of cleaning and shaping. Canal orifices were dimpled with a slow speed round bur (Mani Inc., Tochigi-Ken, Japan) of diameter 1 mm, to facilitate placement of the projectors and to prevent flow of adhesive into the canals.

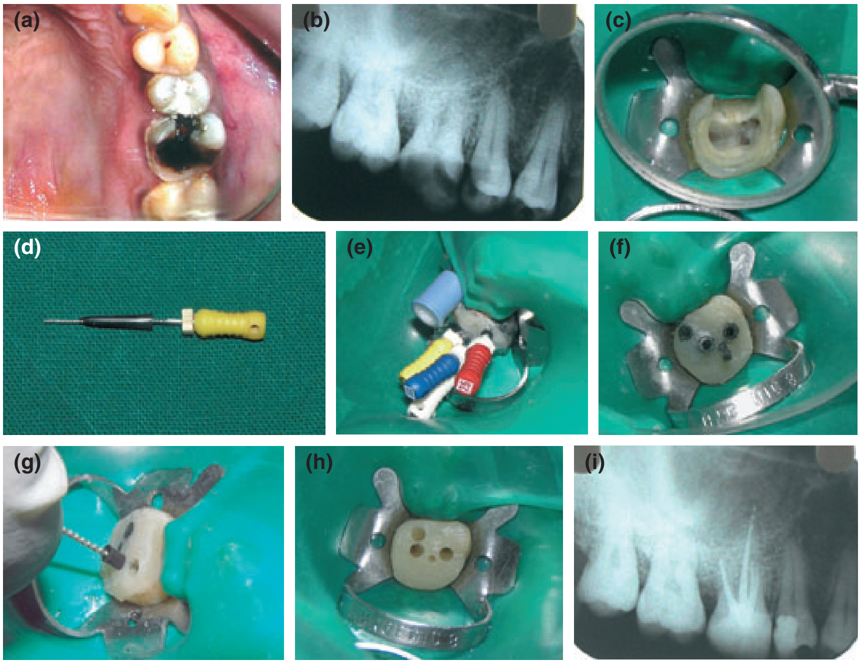

Figure 1 (a) Preoperative photograph: severely broken down tooth 16 (mirror view). (b) Preoperative radiograph: deep occlusal caries and chronic periradicular periodontitis, tooth 16. (c) Access opening completed under rubber dam, four orifices detected. (d) Files are prepared with projectors. (e) Composite built up around projectors to occlusal surface. (f) Files removed leaving projectors in place. (g) Projectors are removed using H-file. (h) Final result: orifices projected to occlusal surface. (i) Postobturation radiograph.

A stainless steel automatrix band (Hawe Supermat®; KerrHawe, Lugano, Switzerland) was placed followed by the application of phosphoric acid gel (Scotchbond Etchant gel; 3M ESPE, St Paul, MN, USA) to etch the exposed dentine and enamel. Rinsing and drying was accomplished after 30 s. The Projectors were placed on four endodontic files and slid up toward the file handles, so that 5–8 mm of each file tip protruded beyond the tip of the Projector. Different sizes of files were used to aid in identification of the projected orifices. Size 20 was used for the mesiobuccal canal, size 15 for the second mesiobuccal canal, size 25 for the distobuccal canal and size 30 for the palatal canal. Each file with a Projector was then inserted into its respective orifice and the Projector was pressed into place with cotton pliers until it seated precisely and snugly into the dimple created at the orifice. A dentine bonding agent (Adper Single Bond, 3M ESPE) was then applied and light-cured.

Table 1 Details of the dimensions of the PEIGS

Regular	
Overall length	*c.* 10.00 mm
Diameter 1 mm from apical end	*c.* 1.20 mm
Large diameter	*c.* 2.00 mm
Tapered lumen full length	
Skinny	
Overall length	*c.* 13.00 mm
Diameter 1 mm from apical end	*c.* 0.80 mm
Large diameter	*c.* 1.14 mm
Tapered lumen full length	

PEIGS, Projector Endodontic Instrument Guidance System.

The build-up was placed in increments using a hybrid composite (Filtek Z100, 3M ESPE) and light-cured (Fig. 1e).

Following curing, the files were removed by counter-rotation, leaving the Projectors in place (Fig. 1f). A high speed, bull-nosed diamond (Mani, Inc) was used to level the occlusal surface providing ideal endodontic reference points. The final result was a stable coronal structure with straight-line access into each canal with maximum structural reinforcement. A size 60 Hedstrom hand file was then used to remove the Projectors from the core, by rotating it clockwise, to engage the flutes in the lumen of each Projector and withdrawing (Fig. 1g). Thus, a pre-endodontic build-up with individualized access to each canal was achieved successfully (Fig. 1h).

The original hand file was introduced into each projected orifice and a working length radiograph was taken. Standard instrumentation was performed to clean and shape the canals. Interim coronal seal of the canals was simplified by snipping 3 mm from the large diameter end of each Projector, reinserting them into their respective projected orifices and then sealing each with Cavit (3M ESPE). At the subsequent visit, the small Cavit seals were removed with a round bur, and the submerged Projectors were easily removed by engaging them with a Hedstrom file and withdrawing. Following canal preparation and filling to the level of the chamber floor (Fig. 1i), the composite in the projected canals was freshened with a diamond bur (Mani, Inc.) and additional composite resin was bonded directly over gutta percha to the level of the cavosurface. The pre-endodontic build-up itself was used as a core and full crown preparation was performed followed by crown cementation at a subsequent appointment.

Application of this technique created a conical projected orifice which was easily visualized and accessed and consistently delivered the tip of the endodontic file to the respective canal whilst maintaining independence of canals from each other. This technique, once mastered, takes minimal time and greatly enhances treatment of badly broken down teeth.

Case report 2

A 21-year-old female attended with the complaint of a mildly painful tooth in the mandibular right posterior region for the past 4 months. Intra-oral examination revealed a grossly decayed tooth, 46 (FDI). Pulp sensibility tests elicited a negative response. The preoperative radiograph showed deep occlusal caries involving the pulp space and slight widening of the periodontal ligament space. The pulp was diagnosed as necrotic, associated with chronic periradicular periodontitis. Root canal treatment was initiated using the PEIGS. The procedure for management of this badly broken down tooth was similar to that described above. Figure 2a–e demonstrates the steps undertaken.

Discussion

The dentist may often be confronted with severely compromised teeth. High quality root canal treatment and reconstructive procedures are prerequisites to ensure long-term maintenance of such teeth (Ricucci & Grosso 2006). In such difficult cases, canal Projectors can facilitate adequate access and preparation of root canals during root canal treatment. This technique enhances management of complexities including severe coronal breakdown, tipped/rotated teeth, limited mouth opening and near proximity of orifices on the chamber floor (Weathers 2004).

In cases of severe coronal breakdown, various methods of isolation have been suggested, including the use of clamps with apically inclined beaks, the Silker-Glickman clamp (The Smile Center, Deerwood, MN, USA), or the split-dam technique (Kurtzman

Figure 2 (a): Preoperative photograph: severely broken down tooth 46. (b) Preoperative radiograph: deep occlusal caries and periradicular periodontitis. (c) Access opening completed under rubber dam, three orifices detected, matrix band placed. (d) Final result: orifices projected to occlusal surface. (e) Postobturation radiograph.

2004). However, multiple tooth isolation can be less effective than single tooth isolation and often requires the use of other aids such as floss ligation and/or sealants (Scott 2002).

Occasionally, periodontal or restorative procedures may be necessary to simplify placement of the rubber dam (Ingle *et al.* 2002). These procedures include clamping of anaesthetized attached gingiva, surgical crown lengthening procedure such as gingivoplasty or alveoloplasty (Gutmann & Lovdahl 1997) and the composite 'donut' technique (Heydrich 2005). Restorative methods may also be considered to build up the tooth so that a retainer can be placed properly (Lovdahl & Gutmann 1980, Lovdahl & Wade 1997). A preformed copper or orthodontic band or a temporary crown may be cemented over the remaining natural crown. However, the disadvantages include inferior sealing ability, blockage of canal systems by cement during access opening or instrumentation and periodontal inflammation if improperly placed/contoured.

Occasionally, so little tooth structure remains that even band or crown placement is not possible. In such cases, it becomes necessary to replace missing tooth structure to facilitate placement of the rubber dam clamp to prevent contamination of the working field (Lovdahl & Gutmann 1980, Lovdahl & Wade 1997, Scott 2002). The tooth can be built up with hard, fast-setting temporary cement (e.g. Ketac-Fil, ESPE, Seefeld, Germany; TERM, LD Caulk, Milford, DE, USA), pin-retained amalgam or composites (Ingle *et al*. 2002, Scott 2002). However, these restorative methods are time consuming; they can impede endodontic access and may require replacement when they are weakened by endodontic access procedures.

To overcome these challenges, the canal projection technique was developed and offers the following advantages: (i) it 'projects' the canal orifice from the floor of the pulp chamber to the cavosurface, thereby enhancing visualization and access to the canals, (ii) permits individualization of canals and therefore can simplify management of canals that lie in close proximity to each other on the chamber floor, (iii) can allow for ease of isolation as canal projection essentially replaces missing tooth structure thereby facilitating clamp retention and thus rendering many structurally debilitated teeth treatable and (iv) allows files to be inserted easily, particularly nickel–titanium files which are sometimes difficult to insert into mesial canals as they are unable to retain a bend, as the canals are no longer obscured by prominent marginal ridges and other visual obstructions.

The bonded composite coronal build-up decreases coronal leakage (Uranga *et al.* 1999, Heling *et al*. 2002, Schwartz & Fransman 2005) and also reduces the risk of coronal-radicular fracture during endodontic therapy thereby reinforcing the tooth (Hurmuzlu *et al*. 2003, Daneshkazemi 2004). Furthermore, the bonded core seals the accessory canals that exit the chamber floor (Niemann *et al*.1993, Luglie & Sergente 2001, Haznedaroglu *et al*. 2003), providing a degree of protection to the chamber floor in cases where extensive decay has left an area of the floor thin. This prevents leakage of contaminants to the furcation through what would otherwise be a temporary seal between treatment visits. The technique can also reinforce perforation repairs by overlaying mineral trioxide aggregate (MTA) with a bonded resin prior to root canal treatment, preventing re-aggravation of the perforation site during subsequent procedures (Ford *et al.* 1995).

Canal projection allows correction of misdirected access cavities by essentially reconstructing the walls and floors around Projectors which act as 'internal matrix barriers'. It insulates files from metallic coronal restorations to facilitate accurate electronic length determination (Carrotte 2004, Kim & Lee 2004) and also prevents ingrowth of tissues in cases where cervical tooth structure has been destroyed. The canal projection process elongates the 'hydraulic chamber' of each canal, offering advantages during the hydraulic condensation of obturating materials, especially whilst using warm vertical condensation techniques (Glickman & Pettiette 2006).

It should be noted that, as with many useful techniques, canal projection is a technique-sensitive procedure and may have its limitations; in fact, the obturation may not be limited to the canal orifices and initially it may be time consuming. However, once mastered, the technique can be performed with speed and precision, and it can significantly enhance the balance of treatment, particularly in cases of severe coronal break down.

Conclusion

Management of teeth with minimal coronal structure can be a challenging task when root canal treatment is required as a part of oral rehabilitation. Coronal leakage, isolation complexities and risk of interappointment coronal-radicular fracture may be major contributors to endodontic failure. This case report demonstrates the use of an innovative technique, canal projection, as an efficient method for managing these complex cases.

Conflict of interest

The authors affirm that they have no commercial interest in the materials used or their method of use as discussed in this manuscript.

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