Rips, Strips and Broken Tips: Handling the Endodontic Mishap

PART II: The Perforation

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In the *Glossary of Endodontic Terms* (7th edition, 2003) published by the American Association of Endodontists, the term "perforation" is defined as: "the mechanical or pathologic communication between the root canal system and the external tooth surface".[1] Within this explanation there is an almost endless list of clinical situations where this aberrant "communication" can lead to root canal treatment, retreatment, corrective surgery and/ or extraction. Considering the technical advances in dentistry over the past 20 years, and specifically in the discipline of endodontics, dissembling complex restorations, creating barriers, and sealing these communications is now a treatment option with some degree of predictability.

Pathologic situations (such as root resorption) aside, the mechanical or iatrogenic perforation is a procedural mishap that can wreak havoc on any dentist who performs endodontic treatment. From the inexperienced, recently-graduated dentist who simply encounters a calcified pulp cham-

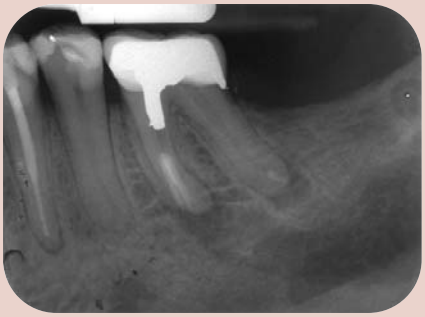


FIGURE 1—Retention or Extraction and Implant replacement. At consultation, pain was identified from tooth 3.6. Noted on this tooth were a full crown, cast metal core and post in the mesial root very close to, if not perforating, the inner root wall; carbon fiber post very far down the distal root to where the apical seal has been compromised; lesion at the distal root apex; canals were "zipped" or transported from the true mesial canal apices. Extraction was advised for this tooth, with implant suggested for replacement.

FIGURE 2—NeoCote™, NeoPlug™, and NeoTape™ synthetic wound barrier (Citagenix Inc., Laval, QC) are absorbable collagen wound dressings used to provide a matrix to control the placement of MTA at the perforation site. It controls bleeding, stabilizes blood clots, fully absorbs in 10-14 days and accelerates the wound healing process.

FIGURE 3—MTA ProRoot™ material. ProRoot MTA is compositionally formulated to have the physical properties, setting requirements and characteristics necessary for a clinically effective root repair material. Each pack of ProRoot MTA powder comes with a premeasured unit dose of water for convenience in mixing — simply pour the powder onto a pad, add the water and mix. Upon mixing, ProRoot MTA reaches a working consistency rapidly and is ready to be applied to the prepared site. Because ProRoot MTA creates a good seal, allows less leakage, is biocompatible and sets in the presence of moisture, root repairs performed with this material result in more predictable results.

ber and has no traditional textbook "landmarks" to guide him/her to canal orifices, to the well seasoned endodontist who may perforate the canal wall in the apical third in the course of freeing up a separated rotary file, the more difficult that a case may be, the higher the incidence that problems may occur.

Tackling the problem is easier if it is broken down into component parts: the patient, the canal system, and the perforation. Patient management includes informed consent about what happened and advising about the treatment options. Perhaps referral to a specialist would be in the best interest of the patient. Perhaps the patient may prefer to have the tooth extracted, and plan for a prosthetic replacement (Fig. 1).

In the most general terms, the more rapidly a perforation can be sealed, the better. Ideally, if treatment is performed under a surgical microscope and a rubber dam, and all of the needed repair materials are available, it has value to correct the defect at the same appointment. Alternatively, if this is not the case as outlined below, the overriding key value to the patient and clinician to promote healing is to keep bacteria from contaminating the perforation to the greatest extent possible from the time of occurrence to the time of the repair. Coronal seal between visits is critical.

The canal system, the inflamed or necrotic pulp which was the reason why the tooth was entered, still needs to be addressed. Depending on the case, it may be more efficient to wall off the perforation with a barrier material, and then finish the endodontic therapy... leaving the handling of the perforation as the final step in that one appointment. In other cases, it may be best to complete the pulpectomy, place a dressing of calcium hydroxide in the canal system, and then deal with the perforation as the priority. At a second visit, the endodontic therapy can be completed.

The advent of recent materials has facilitated treatment of perforations to a significant degree. Synthetic collagen wound dressing, such as Neocote™ (Citagenix Inc. Lava, QC) (Fig. 2), allow walling off the perforation site, and provide a matrix to pack the final restorative material against. The root repair material,

FIGURE 4—MTA ProRoot™ is available in grey or white as shown in this photo (DENTSPLY Tulsa Dental).

FIGURE 5—Dovgan MTA Carriers (Quality Aspirators, Duncanville, Texas). Available in 3 diameter sizes, with one size being "bendable" to adapt to a particular clinical situation. Available from Obtura Spartan Canada.

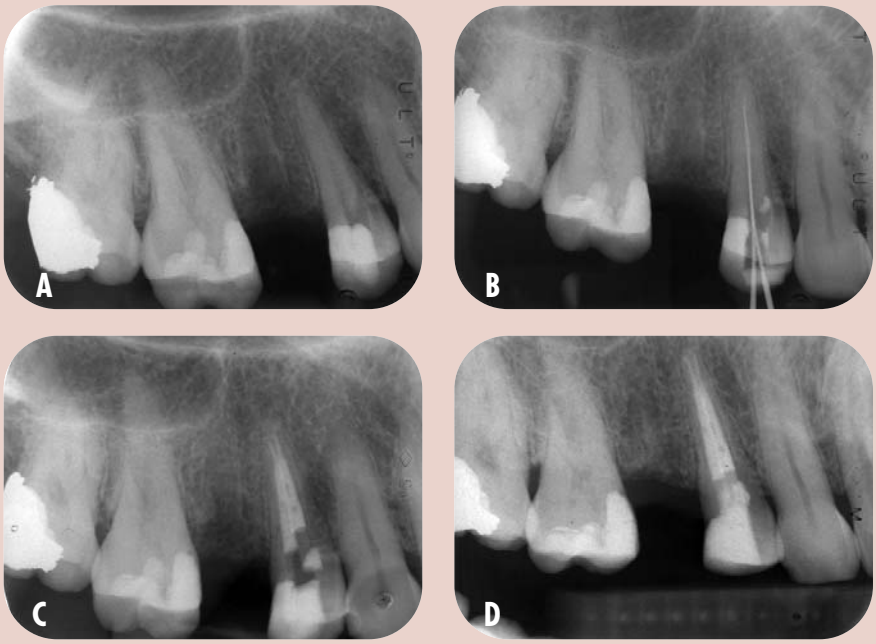
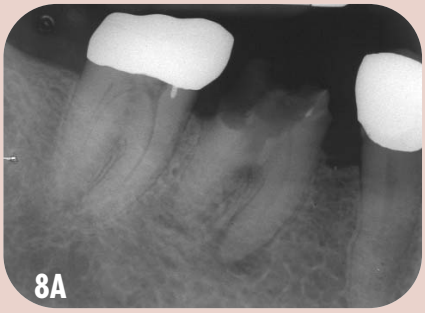
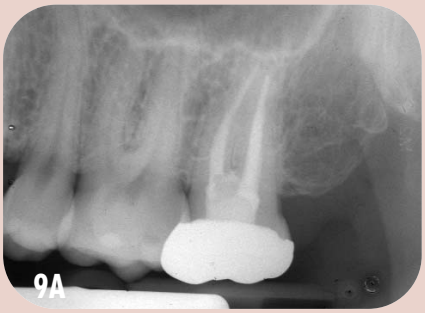
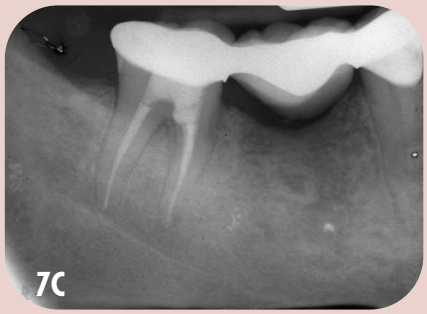
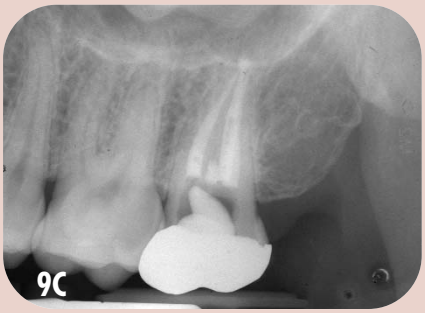


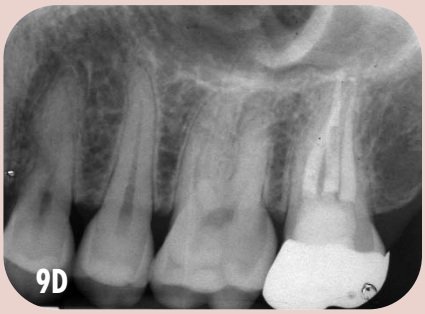
FIGURE 6A-D—Perforation during access. **6A)** Initial access into tooth 1.4 displays bur penetration through the mesial wall. **6B)** Walling off the perforation, and negotiating the true canal spaces. **6C)** Obturation of the canals, followed by sealing of the perforation with MTA. **6D)** Five month recall; no symptoms; no abnormal periodontal probing depths.









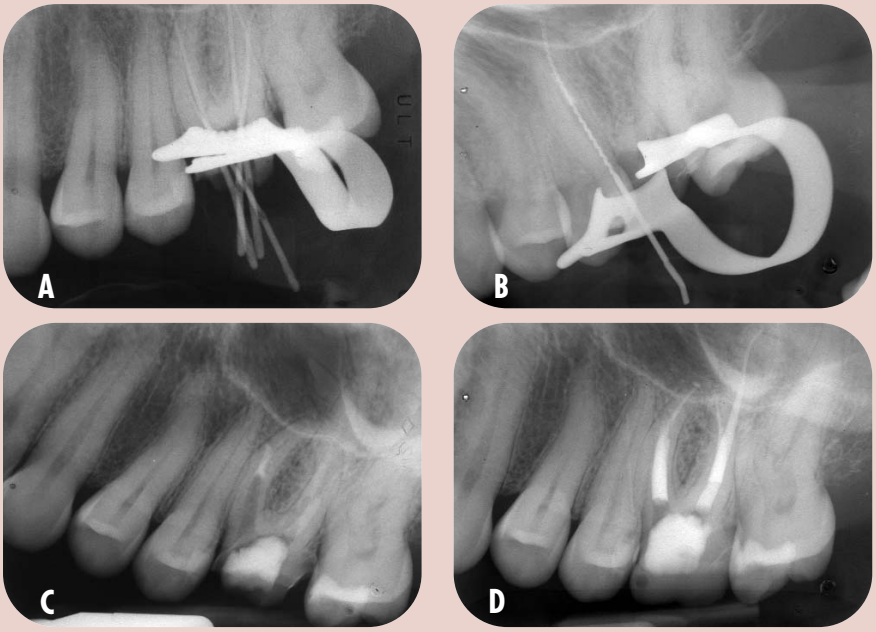


FIGURES 7ABC & 8ABC—Two cases of perforation into the furcation. **7A) & 8A)** Pre-operative film, as patient was referred. **7B) & 8B)** Conventional root canal treatment followed by MTA repair at the perforation site. **7C)** Three month recall and **8C)** One year recall. Apical and furcation lesions resolving, and teeth have been permanently restored.

FIGURES 9A–D—Furcation perforation repair in two appointments on tooth #27. **9A)** Pre-operative film. Patient indicating chronic pain in this tooth since the completion of endodontic therapy. Furcation floor looks suspect. **9B)** Removal of all canal and chamber material. Perforation discovered on furcation floor. Calcium hydroxide placed into canals, and perforation treated with Neocote™ and MTA. **9C)** At second appointment, patient reported symptoms had resolved. Canal retreatment was completed. **9D)** Three month recall, with chamber permanently restored. No symptoms reported.

Mineral Trioxide Aggregate (ProRoot™) (Fig. 3) has been shown in numerous studies to allow significantly less leakage, better adaptation to root canal walls, less bacterial migration[2-5] and formation of new cementum over the restored root interface.[6] First developed as a grey cement material, a white, tooth coloured MTA has been developed for use in anterior teeth where aesthetics may be a concern (Fig. 4). The powder component mixes with sterile water, and there is an initial set at approximately five minutes. Complete setting is reported to be over a four to eight hour period. Placement of the MTA into a specific site has been made easier with the development of Dovgan MTA carriers (Quality Aspirators, Duncanville, TX) (Fig. 5), available in three different diameters, and one being "bendable" to adapt to fit into the furcation or down a canal space.

The most common locations where perforations occur are through the exterior root wall during access, the furcation floor in molars when searching for a canal orifice, progressing straight through a curved root once in the canal, and enlarging the canal to



FIGURES 10A-D—Speeding through a curve. **10A)** Trial cone film sent with patient on referral. Straight path of cone noted in curved MB root, and perforation. **10B)** Perforation closed off with MTA, and a trial file negotiating true MB canal space on check film. **10C)** Second check film displaying perforation repair, and calcium hydroxide in the palatal and DB canal spaces. **10D)** Three month recall. Canals sealed, no apparent disruption of the PDL space along the MB root, and temporary crown in place. No symptoms reported. Patient advised to proceed with permanent core and crown.

create a post space resulting in a "strip"perforation.

ACCESS

During access into a tooth with a narrow mesial-to-distal direction, the bur can be directed slightly off line and though the exterior root wall (Fig. 6). In a case like this, the perforation can be walled off with a barrier, and access can be corrected. The canal system can then be treated in the usual manner, with placement of Neocote™ into the perforation site and sealing with MTA at the end of treatment. The MTA will set by the time the patient returns for the permanent restorative appointment.

FURCATION

Looking for a canal orifice on the chamber floor of molars can lead to perforations into the furcation area. Once the canal systems have been treated, the final step is placing the barrier for a matrix, and sealing with root repair material (Figs. 7 & 8). In some particular cases, it may be better to locate the canals and place calcium hydroxide to get the endodontic component under control. The perforation site can then be cleaned, packed with Neocote™ to form a matrix, and then sealed off with MTA (Fig. 9). At the next appointment, the MTA is permanently set, and the endodontic therapy can be completed without risk of washing out of the MTA.

MISSING THE CURVE

With the advent of engine driven files, more rapidly completed treatment can be a positive. However, with speed comes an increase risk of problems. An instrument progressing straight where the canal curves can result in contact with the root wall, the ligament and the apical or radicular bone (Fig. 10). The use of the Dovgan carrier is most advantageous in a case like this, where access half way up the root requires very narrow diameter instruments and precision placement. Because the MTA material is easily washed out until it has set, sealing the perforation would be the priority in the first appointment. Endodontic therapy would be completed at the second appointment.

STRIPPING THE WALLS

Overzealous coronal shaping or post space preparation can lead to what is called a "strip" perforation. Recalling root anatomy, in cross sectional view there is often a subtle concavity to the distal root on the mesial (furcation) side. Coronal flaring can encroach upon this concave surface. Widening the space for a post space can cause the same result. Suddenly, hemorrhage can be found in the canal space! Using the same strategic approach, under medium to high power magnification, a soft compressible barrier can be placed into the defect (Neocote™). The canal treatment can be carried out, with obturation finishing just apical to the defect. After replacing the barrier with fresh Neocote™, the MTA can be placed to obturated the coronal third of the canal — including the perforation site — right up to the chamber floor. In Figures 11 & 12, four different cases are shown with this kind of repair and healing.

Utilizing a repair material with greater clinical and histological success than ever before, coupled with magnification, fibre optic illumination, and the use of precision instruments for placement, the bar has been raised on what can be treated and restored to full function in a patient's natural dentition. **OH**

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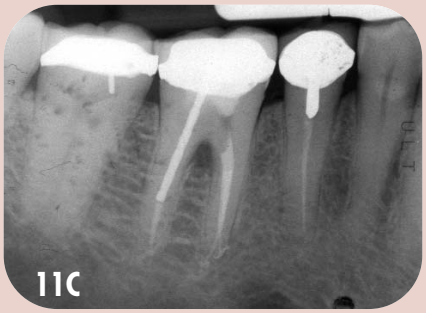
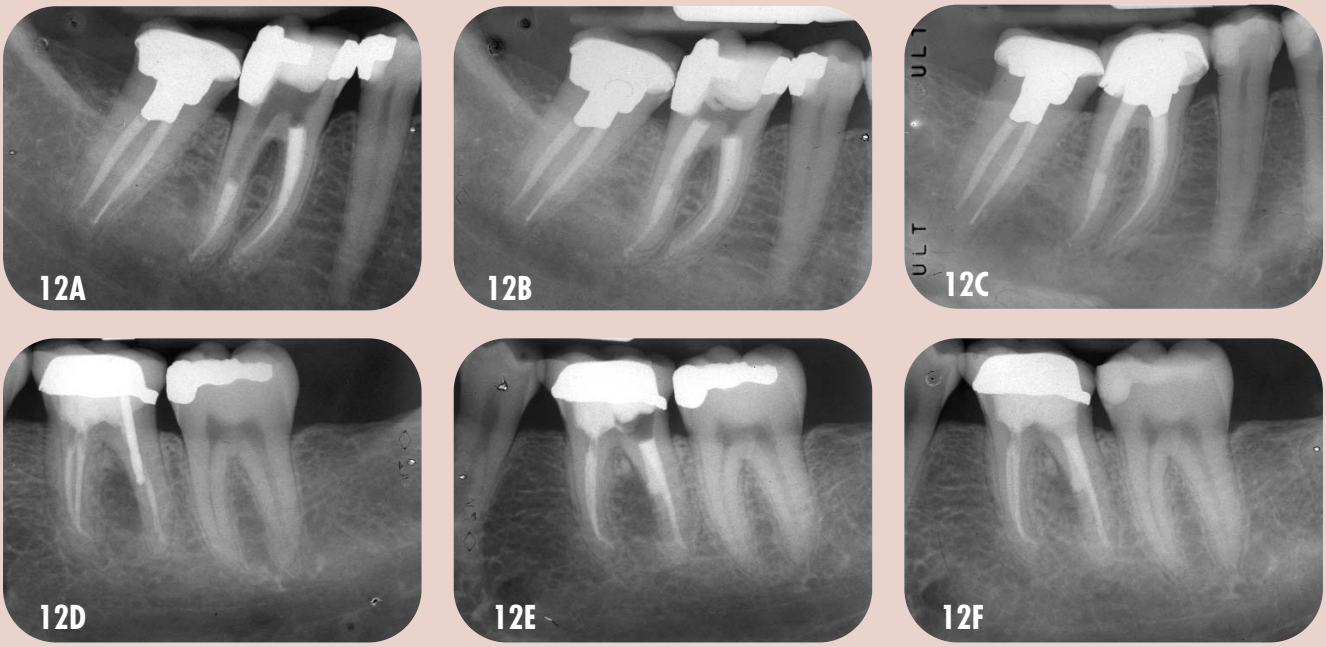


FIGURES 11A-H—Two cases of mesial root "stripping" and treatment. **11A, B)** Canal treatments, with post space allowances, and teeth ready to restore. **11C, D)** Inadvertent post space creation in the mesial canals, resulting in furcation perforations. **11E, F)** Clearing of chamber and post, sealing the mesial wall defects with MTA. **11G, H)** Six month and twelve month recalls, with osseous healing noted.



FIGURES 12A-F—Two cases of Distal root "stripping" and treatment. **12A)** Overzealous flaring of the distal root. **12B)** Sealing of the coronal third of the distal canal with MTA. **12C)** Twelve month recall; lesion resolved; tooth permanently restored. **12D)** Post placement in the distal root with resultant furcation lesion developing; no apical lesion apparent. **12E)** Decision made to only retrieve post, and seal perforation with MTA. **12F)** Three month recall, no symptoms, and furcation lesion reduced in size.

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Oral Health welcomes this original article.

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