Treatment of dental perforation during endodontic retreatment using a novel MTA-based reparing material.Case series

Mario Zuolo[1]

DDS, MSc, practices at Endodontic Specialists in Sao Paulo, Brazil. He has a Masters in Molecular Biology from UNIFESPPaulista School of Medicine, Sao Paulo, Brazil, and is a Professor in the graduate department of Endodontics, Professor in the Endodontics Programming at EAP-APCD, Sao Paulo, Brazil. Dr. Zuolo lectures globally on endodontics. The author of numerous publications since 1998, most recently co-wrote Reinterventionin Endodontics, published by Quintessence in 2014.

Root perforation is defined as a mechanical or pathological communication between the periodontal apparatus of the tooth and the root canal system (1). They are caused by iatrogenic events in most cases, but can also be causedby caries or internal resorption. The occurence of iatrogenic perforations during root canal treatment ranges from 2,3to 12% and are often associated with many risk factors such as anatomy , tooth position and operators experience (2,3).According to the site affected by iatrogenic event, the location of perforation may vary. Coronal perforations can be associated to crown-root angulations, calcification of the pulp chambre and,orificies and excessive removal of coronal dentin. Excessive instrumentation and flaring to the initial thirds of the canal may also result in coronal or midroot perforations As to perforations in the apical third, they might be the consequence of failure in maintaining the original path of the canal due to inappropiate cleaning and shaping, or can be initiated by blocked canals (3). Perforations can also be related to postand core restaurations. Kivinnssland et al (1989) when analyzing 55 cases over a 11-year period, concluded that 53% of the perforations were related to the prosthodontic treatment (4).

Bacterial infecction emanatingeither from the root canal or the periodontal tissues, or both, would prevent healing andresult ininflamatory sequels including pain, swelling, suppuration, and bone resorption. It may leadto extraction of the involved tooth (2,3).In a clinical trial, de Chevingny et al (2008) concluded thatthe healed rate in teeth with a preoperative perforation was 31% lower than in teeth without the perforation (absent 87%; present 56%) even when repaired using appropiate materials (5). Further, another study accessing the reasons for extration of endodontically treated teeth suggested that 4,2% of the teeth in the sample were extracted because of iatrogenic perforations and stripping (2).

The potencial for a favorable periodontal tissue response after perforation is influenced by a variety of factors such as immediacy, location, size and bacterial contamination.Sucessful treatment also depends on accurate diagnosis and visualization of perforation as well as the use the biocompatible materials effective in sealing the perforation and preventing bacterial penetration. The use of magnification and ilumination allows detection of the perforation situated in the pulp chamber and in the straight portion of canals (6). Modern endodontic practice using electronic apical locators and dental operating microscopes enhances dentists to diagnose and treat root perforations andachieving better outcomes.

Many fold dental materials (gutta-percha, amalgam, glass ionomer cement, zincethoxybenzoic acid cement) have been proposed in the related literature for nonsurgical perforation repair with varying degrees of success (7-9). An ideal endodontic repair material should seal the pathways of communication between the root canal system and its surrounding tissues. In addition, it should be nontoxic, noncarcinogenic, nongenetoxic, biocompatible, insoluble in tissue fluids, and dimensionally stable. According to the literature , it appears that mineral trioxide aggregate (MTA) is a suitable repair material with various endodontic uses (10,11).

There has not been any available evidence-based guidelines for the most effective way to manage this form of iatrogenic complication (12). According to Siew et al 2015, a favorable prognosis may be obtained by reparing the perforated root nonsurgically, with an overall chance of success of about 80,9%,when using MTA based material. MTA has been thoroughly investigated bothin vitro and in vivo, and the positive biological response has been well documented (20). A case series, in which 9 out of 10 teeth were reported healed after 5 years, investigated the prognosis of teeth with perforation in the furcation or within the cervical third of root repaired with MTA (13).

However, MTA also has some disadvantages. Because of its consistency, its manipulation and placement in the site of repair can be challenging (13). Additionally, its use can cause discoloration of the tooth, and it should be used with caution when in esthetic zones (5). Felman and Parashos (2013) showed in their study that white MTA (wMTA) can discolor ex vivo teeth, and the presence of blood within the canal adjacentto the settingwMTAmayincrease this discoloration. (14). Although wMTA contains only 9% of the iron oxide of gray MTA (15), this quantity may be enough to result in the observed discoloration. A new material MTA REPAIR HP – "High Plasticity" MTA (Angelus®, Londrina, PR, Brazil) has recently been introduced with the intent to improve some of those characteristics (16).This new formula maintains all the chemical and biological properties of the original MTA. Nevertheless, it changes its physical properties of manipulation, resulting in a greater plasticity, facilitating manipulation and insertion. Additionally, its formula uses a different radiopacier calcium tungstate (CaW04) instead of bismuth oxide, that according to the manufacturer, does not cause staining of the root or dental crown.

The purpose of this report was to present the results of8dental perforation cases treated during endodontic retreatment using a new MTA-based repairing material.

Materials and Methods

The experimental study was conducted on 8 teeth of 7 adult patients aged between 33 a 75 years who were referred to our private practice, São Paulo, Brasil, from December 2014 to August 2015for endodontic retreatment. During the first visit, ethical approval was requested and granted, and consent was obtained from all patients. The patients who were included were not known to be pregnant or medically compromised.

Diagnosis of Perforations

The diagnosis of perforation was confirmed by clinical visualization using DOM during retreatment of the teeth. All the teeth showed aradiolucent lesionassociated to the defect.Location of each perforation was determined and recorded using a calibrated periodontal probe.

Retreatment Protocol

All retreatments were performed using a dental operating microscope, local anesthesia, and rubber dam isolation. The removal of the portion of the filling material of the gutta-percha below level canal orifice and correct coronal access was performed using Gates-Glidden burs (Dentsply, USA)and ultrasonic diamond tips E7D and E6D (Helse, Brazil). As irrigation protocol was used2% Chlorhexidine solution (CHX-Formula&Ação, Sao Paulo, Brazil) and 5 ml de sterile saline solution every file exchangethorough the whole retreatment. After alternated irrigation as described above, canal was filled with CHX and the solution was activated ultrasonically with a E1 irrisonic tip (Helse, Brasil) , promoting the removal the debris and cleansing of canal. The filling material, till 2/3 of the canal, was removed using a Reciproc file #25 (VDW, Munich, Germany). The apical foramen was located with the aid of an apex locater (Raypex, VDW, Munich, Germany) using K-type file #10 or #15. The working length (WL) was established at the "0.0" and confirmed with anx-ray. Instrumentation proceeded using R#25 reciprocating file in a crown-down technique until reaching the WL. Apical enlargement was done with ReciprocR40 or R50 depending of root canal anatomy. After instrumentation was completed, the canal was irrigated with 5 ml de EDTA 17% (Formula &Ação, São Paulo, Brazil) for 3 minutes and a final rinse with 5 ml of saline solution. A gutta-percha cone was fit at 1mm short from WL and another x-ray was taken for confirmation. The canal was dried with paper points R40/R50 and then filled using gutta-percha cones R40/R50 and AH Plus Sealer (Dentsply, USA) and lateral condensation technique.

Perforation Repair Protocol

The treatment approach used represents the standard technique inall cases (17):

i) endodontic reinterventioncan be completed before or after repairing the defect, in all cases in this study perforation was filled prior to obturation of the canals so as to prevent filling material from being forced into the region of the defect;

ii) heat cautery was used to removal of granulation tissue if necessary ;

iii)decontamination of the perforation with an ultrasonic tipE3D (Helse, Brasil) and irrigation using chlorhexidine and physiological saline solutionwasdone in all cases;

iv) Preparation of MTA Repair HP was done according to the manufacturer's recommendations The material was gently guided into the defect using an endodontic explorer andcondensed with an appropriately sized endodontic condenser;

v)hardening of the MTA Repair occurred in all cases after 10-15 minute

vi)a small amount of glass ionomer was used to cover and protect the material after the curing of the MTA Repair.

Restoration After Endodontic Reintervention

The teeth were restored with composite restorations and/or esthetics posts, when it was possible, immediately after the retreatment.In cases where immediate restoration was not possible, such as teeth with post and provisorial crowns, the prosthetic space was filled with chlorhexidine (18). The provisional restoration was performed in such a manner that it was well adapted to canal walls and with adequate proximal contacts, preventing dislodging between operative sessions. Thefinal restorations were performed in a period of 7-14 days later. A final x-ray was taken immediately after the endodontic procedure.

Follow-up Examination

The findings of clinical controls were performed by the two authorsat different time intervals, rangingfrom 12 – 14monthsafter retreatment in order to check the absence of periodontal defect in the area of perforation, of pain, of swelling, of sinus tract . The type and quality of restoration were also verified. The quality of the coronal restoration was assessed clinically by visual and tactile inspection by DOM as well as byx-ray.Signs of restoration breakdown or caries were also inspected. Radiographs were coded, stored and subsequently assessed by designated examiners. Preoperative, post-treatment, and follow-up radiographs were examined independently in a random sequence. Clinical and radiographic criteria to categorize each tooth was done using the following criteria: healing- grouped in into two types, i) complete (absence of periapical radiolucency and absence of signs/symptoms), ii) incomplete(advanced reduction of periapical radiolucency size and absence of signs/symptoms), or treatment failure (presence of pain, swelling, a sinus tract, periodontal pocket, and unchanged periapical radiolucency) (17).

RESULTS

Table 1 shows theoutcome results. Amongthe8clinical cases included in this study, no patients reported episodes of pain or swelling at follow up. At the 12 to 14 month recallradiographic evaluation showed that 5 cases exhibited complete healing (Fig 1) with intact PDL space and 2 cases showed regression of the lesion and were classified as incomplete healing (Fig 2). One case was classified as failed since there was a periodontal pocket present at follow up and no radiographing sings of healing.

DISCUSSION

Perforations are frustrating procedural complications that may adversely affect the prognosis of the injured tooth. A growing body of literature (19) demonstrates favorable healing outcomes using contemporary bioactive materials, although long-term reports (< 10 years) are fairly rare. With appropriate case selection and careful techniques, repair may be a viable treatment option for perforated teeth. These cases report show that perforations can be repaired successfully with MTA Repair HP.At the 12 at14 month recall radiographic showed sign of healingin 7 cases. One failed since there was a periodontal pocket present at follow up and no radiographing sings of healing.

The aim of repairing a root perforation is to maintain a health periodontium that is in juxtaposition with the perforation. Success of perforation repair depends on a good sealing of the perforated local with biocompatible material that contributes to the well being of the periodontal ligament (19). MTA material, initially introduced as a retrograde root filling material, has also evolved to become the most often recommended material for perforation repair because of its excellent biocompatibility (19). It is bioactive and provides other favorable properties that support its use for such purpose (20). Studies involving successful nonsurgical root canal retreatment associated with root perforation (21,22) range from 50% to 90%. Siew et al 2015(12), in a meta-analysis, showeda success rate of 80,9% after a total 188 repaired perforations when MTA was employed. MTA material allows the growth of cementoblasts with deposition of cementum over its surface because of its excellent biocompatibility and osteoconduction property (19,23).

In theseclinical report, precise identification of the location of a perforation with the use of DOM can help to enhance disinfection and the achievement of a good sealing at the defect region . The use of a modified MTA (MTA-BIOCERAMICS-based high- plasticity reparative cement) has shown positiveclinical results considering the short follow-up period observed. From a clinical point of view, the handling and placement of the MTA REPAIR HP was easier than the conventional MTA. According to the manufacturer, the replacement of distilled water (from the conventional Angelus MTA) by a liquid that contains water and another organic plasticizer resulted in a new product with high plasticity(16) .(Fig 3)

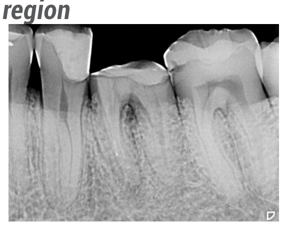
Adequate restoration of the tooth after endodontic reintervention is fundamental in the healing process of periradicular tissues. The concept of restoration encompasses restoring esthetics and function, protecting the remaining tooth structure, and preventing future bacterial recontamination. Doyle et al (2006) and Doyle et al 2007 assessing factors linked to the prognosis of endodontically treated teeth found that prosthetic failures accounted for 59.4% of unsuccessful endodontic outcomes(24,25). Based on the foregoing evidence, immediate restoration of teeth submitted to endodontic reintervention is of the utmost importance and should always be performed whenever possible (26,27). In all cases of this study a final restauration was in place in the follow up with no clinical/radiography signs of leakage.

The importance of clinical cases is to showthat it is possible to repair perforations defects using scientific-based clinical protocols of treatment. Reports from dentists have played important roles in the field of dentistry but should be validated using adequate laboratory and clinical research studies. In conclusion, the clinical protocol using the new MTA REPAIR HP described in these case reports was effective to repair for root perforations, suggesting it is a worthwhile attempt to save the affected teeth.

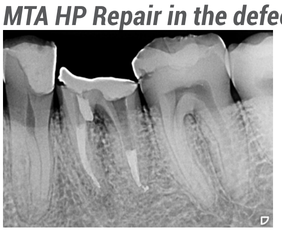
LEGENDS OF THE FIGURE

Fig. 1: Case 7 – Healed Complete / Repair of a lateral root perforation (coronal-strip perforation) caused by bur

a)Initial radiograph showing tooth # 19 after gutta-percha removal and strip perfotation associated with the mesio lingual canal. Note lesion at the furcal region



b) Radiograph after retreatment and placement of MTA HP Repair in the defect



c) Radiograph at 12 month follow up showing a final post and core restauration and intact PDL in the furcal aspect of the root

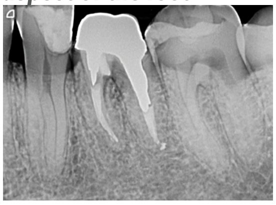


Fig. 2: case 5 – Healed incomplete / Repair of a lateral perforation in the cervical third caused by internal reabsorption

a) Initial Rx showing failed endodontic treatment and internal resorption. Please note crestal bone defect in the mesial aspect of the root ,with a probing defect of 5 mm in this point.

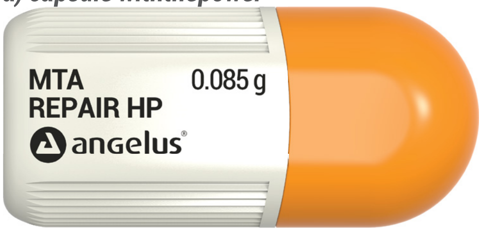
b) Clinical view with x 8 magnification of the defect treated with the MTA HP Repair, just after the final cure of the material

c) Radiograph after MTA placement

d) Radiograph at 13 month follow up. Bone defect is still visible but reduced in size and there was no probing defect at this time

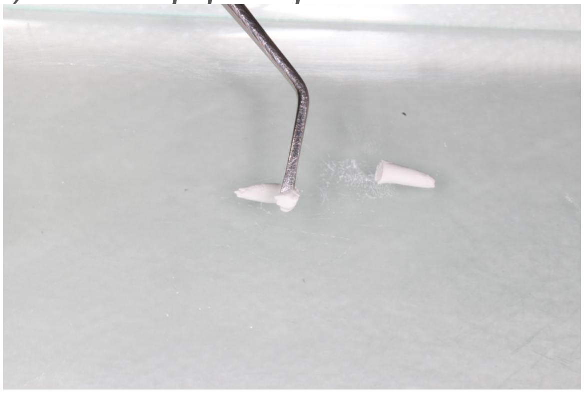
Fig3 : MTA Repair HP

a) capsule withthepower



b) liquid

c) material afterpropermanipulation



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