Most root canals fail mainly due to micro leakage and bacterial infection. The purpose of this case report is to describe an endodontic retreatment and nonsurgical repair using Mineral Trioxide Aggregate (MTA)-Angelus. A 27-year-old female presented for further endodontic treatment of a maxillary right central incisor with a periapical radiolucency, a history of a failed root canal therapy and followed up with nonsurgical retreatment. The tooth remained asymptomatic. Radiograph showed evidence of osseous repair with resolution of periapical radiolucency, reparation of periradicular tissues, and deposition of cementum over MTA. This study concludes that immediate sealing of the perforation site is a critical factor for the prognosis of the perforation repair, and therefore the technique appears promising.

**Keywords:** Mineral trioxide aggregate; Endodontic retreatment; Periapical radiolucency; Iatrogenic root perforation; Nonsurgical repair

**Introduction**

Endodontic retreatment is a procedure performed on a tooth that diagnostically demonstrates incomplete treatment, yet the actual conditions require further endodontic treatment to achieve successful results [1]. Numerous factors associated with failing nonsurgical endodontic treatment are incomplete obturation, root perforation, external root resorption, coexistent periodontal-periradicular lesions, grossly overfilled or overextended canals, canals left unfilled, developing apical cysts, adjacent pulpless teeth, inadvertently removed silver points, broken instruments, unfilled accessory canals, constant trauma [2,3].

Perforations are cited as the 2nd greatest causes of treatment failure and have been reported to be a major factor in up to 9.6% of endodontic failures [4]. Root perforations can be pathological due to caries or root resorptive defects but most commonly occur iatrogenically due to the use of misaligned rotary burs during access preparation, inappropriate post space preparation, and while negotiating canals in the calcified tooth as well as in curved root [5,6].

Management of perforations will depend on a number of factors which includes time lapse since the creation of the perforation, diagnosis, etiology, location and size and shape of the perforation, access to the perforation site, visibility, adjacent anatomical structures (including adjacent roots), periodontal status, strategic importance of the tooth, and experience of the operator [7,8].

Immediate sealing of the perforation site with good biocompatible sealing material is a critical factor for the prognosis of the perforation repair [8]. A material with excellent sealing properties, Mineral Trioxide Aggregate (MTA) was introduced by Torabinejad et al. [9]. Gray or white powder...
consists of fine hydrophilic particles of tricalcium silicate, tricalcium aluminate, tricalcium oxide and other mineral oxides, which are responsible for its chemical and physical properties. Besides the retrograde filling application, it has also been regarded as an ideal material for perforation repair, pulp capping, pulpotomy and apexification [10,11]. Studies have shown that MTA present better features, such as: Alkaline pH (12.5) constant calcium release which inhibits bacterial activity [12]; efficient marginal adaptability and sealing ability [13,14], which avoid microbial infiltration [15]; and low toxicity to the periodontal tissues resulting in cementogenesis and osteogenesis [10,16], and gains the regeneration of periodontal attachment [17].

Majority of the data pertaining to MTA-Angelus are in-vitro animal studies. There are hardly any long term clinical studies; the purpose of this report was to present a case of contaminated one year old iatrogenic perforation with hopeless prognosis, managed successfully with MTA-Angelus. These cases illustrate the ease of use of MTA for management of perforations in retreated tooth with apical radiolucency.

Case Presentation

A 32 year old female patient reported to the department, with a chief complaint of discolored front tooth associated with mild pain on chewing/biting. The patient gave a history of trauma 5 years back and had undergone root canal treatment 3 years back. On intraoral examination, the tooth 11 and 21 was discolored and slight tender on percussion in 11 (Figure 1, 2). Intraoral periapical radiograph revealed that previous root canal treatment of 11 with incomplete obturation of the canal with periapical radiolucency (35 mm × 20 mm) at the apex of 11 extending to distal of 12, and coronal third perforation confirmed with file in place. Provisional diagnosis of failed root canal therapy with chronic periapical lesion and coronal third perforation in relation to 11 and necrotic pulp with 21 was arrived. Of the various treatment options explained to the patient, patient desired to retain the tooth. Treatment planning of retreatment of root canal combined with perforation repair with MTA-Angelus (Angelus, Londrina, PR, and Brazil) for 11 and RCT for 21 followed by all ceramic crowns was decided.

Standard isolation procedure with rubber dam was followed. Coronal access opening was refined and cleaned. Gutta-percha from the main canal was removed with H-file and solvent xylene (Figure 3). There was slight bleeding from the perforation site, which was controlled by irrigation with 1% sodium hypochlorite. Then the canal was prepared by step-back technique, accompanied by irrigation with 3% sodium hypochlorite and 3 mL of 15% trisodium EDTA along with manipulation of master apical file (#70) for 3 min, followed by irrigation with sodium hypochlorite, the root canal was filled with calcium hydroxide RC cal (Prime Dental) and introduced into the canal with a lentulo spiral. The calcium hydroxide dressing was changed twice at 3-week intervals and maintained for 2 months.

After 2 months, the dressing was removed by irrigation with 3% NaOCl and reaming motion with a K-type file, and then the root canals were obturated with seal apex sealer (Kerr manufactr Grp.) And gutta-percha (Hygenic, Akron, OH, USA) using a cold lateral condensation technique. At the same visit perforation site was packed using MTA-Angelus with pluggers, radiograph was taken to check for adequate condensation, and then the access was sealed with IRM (Figure 4). At the subsequent visit, 21 was cleaned, shaped and obturated with Gutta-percha points with AH-26 sealer (Figure 5). Then the access opening of both 11 and 21 was restored with composite resin. Acrylic crowns placed (Figure 6) until placement of final metal ceramic crowns (Figure 7).

Six months, one and 2 year follow-up appointments showed no signs of infection and tooth remained asymptomatic. Radiograph showed evidence of osseous repair with resolution of radiolucency, reparation of peri-radicular tissues, and deposition of cementum over MTA at the perforation site (Figures 8-10).

Discussion

Iatrogenic perforations impede proper endodontic therapy and
increase the risk of treatment failure; as a result, the prognosis is compromised, especially in non-vital teeth or teeth with periradicular lesions [18]. Perforations may lead to short-term or long-term complications such as infection, periapical cyst, or granuloma formation. Root perforation is followed by bacterial contamination, periradicular tissue injury, inflammation, bone resorption and further in furcation perforation there will be epithelial proliferation and periodontal pocket development [18,19].

As early as 1903, Peeso stated that successful management of root perforations is dependent on early diagnosis of the defect, choice of treatment, materials used, host response, and the experience of the practitioner [5]. These factors are valid even today. Ideally, to prevent bacterial contamination, perforations should be repaired as quickly as possible [17,18], for better post-treatment prognosis. In the cases presented, immediate repair of the perforation was not possible, because the patient presented to us one year after the defect.

In the present case, non-surgical approach was preferred due to accessibility and visibility of coronal third perforation. Major goals of nonsurgical retreatment of endodontically failed teeth with iatrogenic perforation include thorough debridement, disinfection and three dimensional obturation of previously treated canals to remove all etiological factors, without compromising on the root dentin [20]. Gaining access to prepare and seal the perforation with a biocompatible material and maintain an intact periodontal attachment apparatus [9].

Present case report showed failed root canal treatment with apical radiolucency, which could be due to incomplete obturation of the canal; the perforation was present in the mesio lateral midroot area of the upper right central incisor, which might have been caused during access preparation. To avoid such an occurrence, preparation of the access cavity should be carried out with regard to the anatomy of the tooth. Non surgical repair of perforation was considered in this case due to good visibility and accessibility to the cervical perforation. Matrix was not used while condensing MTA in the cervical third perforation; so there is slight extrusion of the material, which was later replaced by the cemental deposition (Figure 10). Previous studies by Pitt Ford et al. [10], Torabinejad et al. [9,16], Hashem and Hassanien [21] have shown that the superior sealing ability and biocompatibility of MTA causes cementum formation despite its extrusion into the periradicular tissues. In the present case white MTA-Angelus (Angelus, Londrina, PR, Brazil) was used which has good handling characteristics in addition to faster setting time [22]. Due to absence of calcium sulfate and lower percentage of bismuth oxide [23]. Setting time is 10 min since it does not contain calcium sulphate and it is cost
effective when compared to ProRoot MTA [23,24].

In addition MTA-Angelus has a high pH and greater calcium release in the first 24 h of activation possibly because of greater amount of Portland cement (80%) or other calcium releasing agents. MTA has demonstrated the ability to allow regeneration of these hard tissues [25]. The highly biocompatible nature of MTA and its tendency to induce osteogenesis and cementogenesis makes it a suitable candidate for root perforation repair and attains the regeneration of periodontal attachment [14,17,26]. It has been hypothesized that MTA may exhibit anti-recovery properties against the pathological lesions [26].

Resolution in apical and lateral radiolucity attributed to appropriate cleaning, shaping, antisepsis and filling of the root canal. Intermittent calcium hydroxide paste dressing for 2 months was appropriate as it removes remaining microorganisms from the root canal system [27]. This procedure may promote periapical repair, by: (i) Controlling the inflammatory reaction (by hygroscopic action; calcium potentiator bridge formation and phospholipid inhibition); (ii) neutralizing osteolace acid products (acid hydrolases and lactic acid); (iii) inducing cellular differentiation; (iv) inducing mineralization (alkaline phosphatase activation and calcium-dependent ATPases) and (v) neutralization of endotoxins [28].

Based on the outcome of the cases presented in this article, MTA seems to be an excellent material for the repair of perforations and there seems to be a marked improvement in the prognosis of teeth repaired with MTA. This may be due to superior sealing ability, cemento-conductor, osteoinductor properties [29,26], biocompatibility, high pH of MTA, and absence of microleakage and infection at the site of perforations.

Conclusion

In the presence of old and contaminated perforations, without important endodontic-periodontal complications, the technique presented in this paper may be one solution. The materials are easy to use and are relatively inexpensive. In the present case 2 year follow-up appointments showed no signs of infection and tooth remained asymptomatic. Radiograph showed evidence of osseous repair with resolution of periapical radiolucency, reparation of peri-radicular tissues, and deposition of cementum over MTA at the perforation site. Despite a perceived poor prognosis, present case report showed good clinical results, and therefore the technique appears promising. However, further long term studies are needed to further evaluate the prognosis of MTA in retreatment cases with perforations.

References
