CASE REPORT

Management of Traumatic Dens Invaginatus Using Regenerative Endodontics in an Adult Patient

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ABSTRACT

This study details a case report of a 26-year-old patient with a discoloured immature maxillary lateral incisor, linked to type II Dens Invaginatus (DI). The development of the root and apex were affected by pulp necrosis due to trauma. Despite the patient's age, a regenerative endodontic procedure (REP) was selected. The treatment was completed over two visits: the first involved chemomechanical debridement and applying Triple Antibiotic Paste, followed by pulpal regeneration on the second visit. After one year, the follow-up revealed incomplete healing, with no apical closure, root canal wall thickening, or increased root length. However, the periapical radiolucency had significantly decreased in size. Within the study's limitations, the result demonstrates that REP in immature adult teeth can successfully achieve the primary goal of resolving signs and symptoms along with periapical radiolucency.
Malaysian Journal of Medicine and Health Sciences (2025) 21(4): 387-389. doi:10.47836/mjmhs.21.4.46

Keywords: Dens invaginatus, Immature teeth, Open apex, Pulp necrosis, Regenerative

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INTRODUCTION

Immature teeth are susceptible to pulpal necrosis due to trauma, caries, and anatomical abnormalities such as dens evaginatus and dens invaginatus (1). Dens invaginatus (DI) is a developmental anomaly caused by the folding of the enamel organ into the dental papilla during the early soft tissue formation stage. The exact cause of DI is not well understood, and it can affect any tooth, though it is most commonly seen in maxillary lateral incisors. DI is classified into three types based on the extent of invagination observed on radiographs: Type I, II, III(a), and III(b) (1). This invagination allows irritants to penetrate the pulp space through a thin layer of hypo-mineralized enamel and dentin, leading to early pulp necrosis before root development is complete.

Early identification of teeth with DI and thorough examination of their internal anatomy are crucial for successful management. When these teeth present with pulp necrosis and an immature root, the conventional treatment for open apex teeth has been apexification, either through long-term calcium hydroxide therapy or the immediate placement of a mineral trioxide aggregate (MTA) apical plug (2). While these treatments often alleviate disease symptoms, they do little to restore normal pulpal defenses, nociception, or encourage continued root development. As a result, the teeth are left with thin and fragile dentinal walls, making them more prone to fractures and reducing their long-term survival rate (2). In response, regenerative endodontic procedures (REP) offer an alternative approach aimed at enhancing tooth survival and function in teeth that were previously considered untreatable (2).

CASE REPORT

A 25-year-old healthy Malay gentleman was referred to the Endodontic Postgraduate clinic, Universiti Teknologi MARA (UiTM), for the management of tooth 22 , requiring root canal treatment due to an open apex associated with DI. History of alleged fall and hit his front teeth when he was nine years old. During examination, the tooth was asymptomatic but exhibited greyish discolouration. Investigation showed negative results for percussion, electric pulp testing, and cold testing (Endo Ice; Coltene/Whaledent Inc, Cuyahoga Falls, OH). Periodontal probing with a CP-12 probe (Hu-Friedy, Chicago, IL) revealed pocket depths within normal limits and grade 1 mobility. A periapical radiograph using the paralleling technique revealed incomplete root development, with thin dentinal walls and an open apex larger than 2.0 mm, with a radiolucent periapical lesion measuring approximately (3.0 x 3.0) mm (Figure 1). Based on the clinical and radiographic findings, a

diagnosis of pulp necrosis with asymptomatic apical periodontitis was made.
Regenerative endodontic procedure (REP) was selected

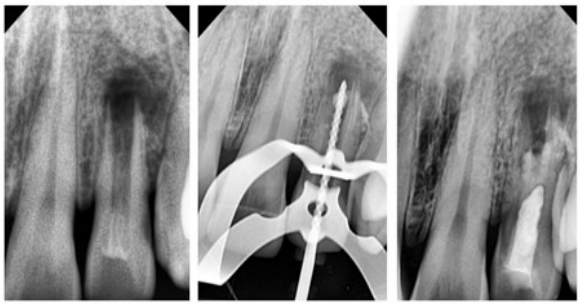

Figure 1: (a) Pre-op radiograph (b) Working length determination (c) Biodentine lining

despite the patient's older age . The patient consented, and written informed consent was obtained. The treatment was successfully completed over two visits, following AAE, (2021) clinical consideration procedure. During the first visit, 2% mepivacaine with 1:100,000 epinephrine was administered via the infiltration technique. All procedures were performed under a direct operating microscope (DOM) (AM-5000, Alltion, Guangxi Province, China). After isolating the tooth with a rubber dam, access to the pulp cavity through the dens invaginatus was achieved. The root canal was irrigated with 10 mL of 2.5% sodium hypochlorite (NaOCl) (Coltene, Alt, Switzerland) using an EndoVac negative pressure irrigation system (Sybron Endo, Orange, CA, USA) and the canal was dried with sterile paper points. The working length was measured with an apex locator (Root ZX; Morita, Tokyo, Japan) using a #40 K-file (Dentsply Maillefer, Ballaigues, Switzerland), and confirmed with a periapical radiograph. Minimal mechanical instrumentation was performed with small files in gentle circumferential motions to displace necrotic pulp tissue without enlarging the canal. The canal was again irrigated with 10 mL of 2.5% NaOCl and dried with sterile paper points. A triple antibiotic paste (TAP) in a 1:1:1 ratio (100 mg of metronidazole, 100 mg of minocycline, and 100 mg of ciprofloxacin) was placed up to the working length using capillary tips (Ultradent Products, Inc., South Jordan, UT, USA) attached to a 3 mL syringe. The access cavity was sealed with CavitTM (3M ESPE, Seefeld, Germany) and Intermediate Restorative Material (IRM) (Dentsply Caulk, Milford, USA).

At the second appointment, three weeks later, the patient remained symptom-free. Anesthesia was administered using 3% mepivacaine without epinephrine via the infiltration technique, and the tooth was isolated with a rubber dam before accessing the canal. The triple antibiotic paste was removed, and the canal was irrigated with 20 mL of 1.5% NaOCl (Coltene, Alt, Switzerland), followed by irrigation with 20 mL of 17% Ethylenediamine tetraacetic acid (EDTA) (Pulpdent, MA, USA) and a final rinse with 20 mL of saline (Ain Medicare, Malaysia). All irrigation procedures were carried out using the EndoVac system (Sybron Endo, Orange, CA, USA). The canal was dried with paper points, and a pre-curved #20 H-file (Dentsply Maillefer, Ballaigues, Switzerland) was introduced 2 mm beyond the apex to induce bleeding from the periapical tissues into the pulp chamber. The blood clot was formed 4-5 mm below the cementoenamel junction (CEJ). A 3-4 mm layer of Biodentine (Septodont, USA) was placed on top of the clot. An SDR Smart Dentine Replacement lining (Dentsply DeTrey GmbH, Konstanz, Germany) was applied over the Biodentine, followed by IRM (Dentsply Caulk, Milford, USA) to seal the access cavity (Figure 2). A postoperative radiograph was then taken.
After 3 weeks, the tooth was asymptomatic and treatment

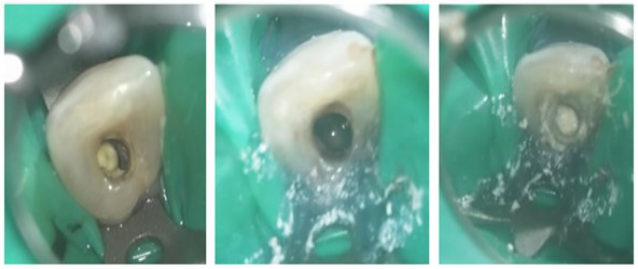

Figure 2: (a) TAP placement on 1st visit (b) Blood clot formation (c) Biodentine placement

then proceeded with non-vital bleaching (Opalescence Endo, Ultradent, Jordan), followed by composite restoration (3M, ESPE, Filtek, USA). A notable and acceptable change in shade was observed after three cycles of bleaching (Figure 3). After one year of follow-up, incomplete resolution of the pre-existing apical radiolucency was noted, with no signs of apical closure or thickening of the root canal walls and no increase in root length. However, a notable reduction of apical radiolucency was observed (Figure 4).

DISCUSSION

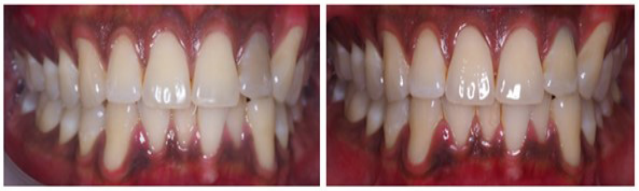

Figure 3: (a) Pre-treatment intraoral photograph (b) Post-treatment intraoral photograph

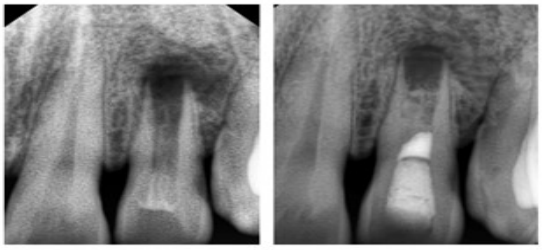

Figure 4: (a) Pre-op radiograph (b) Post-op radiograph after 1 year follow up

Type II DI with pulp necrosis and an open apex presents one of the most challenging clinical scenarios, as the invagination often blocks the optimal access to the canal system, making thorough chemomechanical instrumentation and three-dimensional filling difficult. To address this, the DI is carefully removed under a DOM, while the EndoVac negative pressure irrigation system is utilized to help minimize the risk of irrigant extrusion in cases with an open apex.

Teeth with open apices and thin root canal walls pose challenges for conventional endodontic treatment due to their unfavorable crown-to-root ratio and fragile dentinal walls, which are prone to fractures (2). Given these limitations, regenerative endodontic procedures (REPs) have emerged as an alternative approach for managing immature teeth (2) with dens invaginatus (DI) and necrotic pulps. Regenerative endodontic therapy involves "biologically based procedures aimed at replacing damaged tissues, including dentin, root structures, and cells of the pulp-dentin complex". Successful regenerative endodontics requires three key components: stem cells, scaffolds, and growth factors (2). Despite the patient's older age in this case, a regenerative endodontic procedure (REP) was chosen due to its potential benefits in restoring functional tissue rather than relying solely on conventional root canal treatment .

A combination of metronidazole, minocycline, and ciprofloxacin (TAP) (2), was utilized in this case due to its proven efficacy. Irrigating dentin with EDTA has been shown to promote stem cell apical papilla (SCAP) migration. Interestingly, the AAE, (2021) clinical guidelines did not recommend rinsing the canal with saline after EDTA application. However, a study suggest that when using a blood clot as a scaffold, a final flush with 20 mL of saline after EDTA is beneficial for REP protocols, as EDTA can impact clot formation (3).
Calcium silicate cement is the preferred biomaterial in regenerative endodontic procedures (REP) for sealing the pulp space. In this case, Biodentine was chosen due to the patient's aesthetic concerns regarding discolouration. Studies have shown that both MTA and Biodentine offer similar clinical and radiographic success in pulpotomy treatments for traumatized immature anterior permanent teeth. However, MTA has a higher likelihood of causing discolouration compared to Biodentine (4). To minimize the risk of discolouration, Biodentine was selected.

Regenerative endodontic procedures (REP) have three primary goals: the elimination of symptoms and evidence of bony healing, increased root wall thickness and length (secondary goal), and a positive response to vitality testing (tertiary goal) (2). Although younger patients tend to be better candidates for REP due to their enhanced healing capacity or stem cell regenerative potential (2), Arslan et al. (2019) found that age did not significantly impact the healing of radiographic lesions in REP cases (5). Our case report aligns with Arslan et al.'s findings.

This case report describes an acceptable REP intervention in a traumatized immature maxillary permanent lateral incisor associated with dens invaginatus in an adult patient, which presented with greyish discolouration. The outcome was currently too early to be established, with both success and failure being possibilities. Although it appeared to be successful after one year's review, a more prolonged review would be more beneficial in order to reach for conclusion and stable longevity.

CONCLUSION

Within the study's limitations, our findings demonstrate that selecting REP in immature adult teeth proved to be successful in achieving the primary goal of resolving signs and symptoms along with periapical radiolucency. Clinicians may consider this option before proceeding to root canal treatment.

ACKNOWLEDGEMENT

We would like to thank the Faculty of Dentistry, University Teknologi MARA for their support.

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