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Revitalization of Open Apex Teeth with Apical Periodontitis Using a Collagen Scaffold

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Abstract

The present case discusses a regenerative endodontic technique with an artificial scaffold in a tooth with open apex and apical periodontitis. Collagen was used as scaffold for regeneration of the tissue in the present case. After disinfecting the canal, blood clot was stimulated and then it was filled with collagen scaffold. The tooth showed healing of periapical radiolucency with increase in root length and dentinal thickness in the apical portion of the root. Collagen as an artificial scaffold for regenerative endodontic procedure showed good result with significant hard tissue repair and it was comparable to the results with natural scaffold that have been used earlier.

Keywords: *Root development, Revascularization, Tissue regeneration, collagen scaffold*

1. Introduction

Trauma or injury to the pulp tissue of a young tooth if leads to irreversible pulpitis with pulpal necrosis, can cause compromised root development necessitating endodontic therapy. Traditional treatment modalities that have been in practice are removal of diseased pulp tissue with placement of calcium hydroxide or MTA to allow formation of a hard tissue barrier for closure of apical portion of root canal. These techniques have been used with variable treatment outcomes. These techniques have limitations of being time consuming with lack of predictability because of difficult disinfection of root canal. The main reason behind carrying these procedures is to make it possible to fill the root canal. Lack of further root development makes the root susceptible to fracture with very thin dentinal wall. Retreatment of fully developed teeth with enlarged apical foramen may be difficult to obturate without overobturating the filling material beyond the apex.

There has been a gradual shift in treatment protocol of teeth with open apex. The virtue of tissue to grow into the pulp space of a tooth with open apex is called revascularization (1). Disinfection with minimum instrumentation has been used resulting in high incidence (84%) of negative cultures (2). A triple antibiotic paste of ciprofloxacin, metronidazole and minocycline (3, 4) for 3-4 weeks adds to produce a pulp space free of bacteria and promoting of tissue repair. An intentional periapical instrumentation with a large hand file produces blood clot to act as a scaffold promoting in growth of tissue from periapical area. A significant accumulation of undifferentiated mesenchymal cells occurs into the canal space by induction of periapical bleeding (5). These mesenchymal cells play a major role in tissue regeneration in these immature teeth having open apex.

The aim of present case was to evaluate the role of type 1 collagen scaffold in tissue repair of necrosed tooth with open apex in contrast to natural scaffolds that have been previously used with good results.

2. Materials and Methods

A 22 year old female reported to the outpatient department with chief complaint of broken and discolored upper front tooth with a history of trauma 12-13 years back. Clinical examination revealed the tooth to be mild sensitive to percussion. Periodontal probing was within normal limits with absence of tooth mobility. [Figure1] IOPA radiograph showed periapical radiolucency in association to tooth no.11. [Figure2] The pulpal diagnosis was necrotic pulp and periapical diagnosis was chronic apical periodontitis. Regenerative endodontic therapy was selected by the patient after considering all the available treatment options. Informed consent included following options:

- No treatment
- Apexification using MTA as a barrier followed by standard root canal filling
- Regenerative endodontic procedure as outlined on the American Association of Endodontists website updated February 4,2013
- Addition of collagen scaffold
- Extraction of the tooth

An endodontic access opening was made using rubber dam isolation under local anesthesia that consisted of inferior alveolar nerve block and buccal infiltration by 2% lignocaine with 1:2,00,000 epinephrine. After determining the working length, the canal was instrumented , irrigated with 5% sodium hypochlorite and 17% EDTA 10ml and dried with paper points. A triple antibiotic dressing was placed into the canal and the access opening was filled with cavit. After 4 weeks, the patient revisited and was completely asymptomatic. He was given a buccal infiltration with 2 ml of lignocaine without adrenaline. The tooth was reopened, irrigated with 2% chlorhexidine and dried with paper points and then bleeding was induced into the canal using a no.50 k file. Collagen granules were soaked into the normal saline solution and placed into the canal with the help of endodontic plugger up to the CEJ and access cavity was sealed with glass ionomer cement.
Recall visits were scheduled at 6 month and 12 month interval. At 6 months recall, patient was asymptomatic showing partial healing of periapical radiolucency. [figure3] At 12 months recall, patient was asymptomatic with continuation of periapical healing. [figure4]

3. Results and Discussion

The periapical lesion in the present case showed healing within 6 months of treatment. Formation of dentin in the apical region resulting in the increase of dentinal thickness in this case is clinically significant as it reduces the risk of root fracture. The study of Yamauchi et al on animals that included placement of cross linked collagen scaffold in combination with blood clot resulted in increased deposition of mineralized tissue on the root canal walls. They concluded that increase in vital support structure resulted due to the thickening of root structure with cementum like tissue. The tissue formed in the lumen of the canal was said to be more like bone because it had marrow and vasculature. Similar to the results of their previously established findings, this case report suggests formation of new cementum and bone like tissue within the canal spaces. Although tissue formed newly is bone and cementum, in place of pulp with dentin, it will result in better maintaining of function of teeth making it compatible with clinical requirements. A similar kind of bone formation inside the canal was seen in reimplanted and avulsed immature teeth which were explained to occur because of devascularized pulp remnants rich in collagen that served as scaffold (6, 7). An early study on immature teeth of rhesus monkey by Nevins et al by implanting collagen-calcium phosphate gel scaffold(calfskin collagen at 10 mg/ml) showed reorganization and differentiation of tissue inside the canal as bone and cementum (8, 9). A case report was published using a higher concentration (20 mg/ml) of same preparation in immature necrotic pulpectomized maxillary lateral incisor of a child with 6 months follow up (10). Our study suggests that collagen has better predictability compared to calcium hydroxide, MTA placement or blood clot method of revascularization to promote formation of hard tissue inside the root canal of necrotic immature permanent teeth. The possibility of successful tissue repair appears not to be precluded by restraints of failed conventional treatment, narrow canal & foramen size.

5. Figures

Fig.1: Preoperative Photograph Fig.2: Preoperative Radiograph

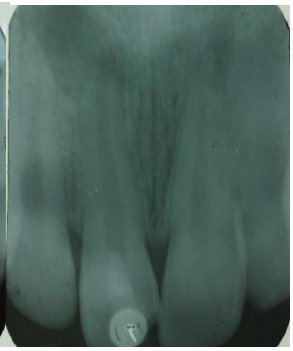

Fig.3: 6 Months Follow up Fig.4: 12 Months Follow up

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