Amalgamation of allogenic bone graft, platelet-rich fibrin gel, and PRF membrane in auto-transplantation of an impacted central incisor

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Abstract

"Social six" teeth refers to the maxillary incisors and canines that play a vital role in the appearance of an individual and absence of any one of them has a significant psycho-social impact. Hence, early treatment and rehabilitation of the same are extremely important. A multitude of treatment options ranging from orthodontic extrusion, extraction followed by implant placement, fixed partial denture, and auto-transplantation have been advocated. This case report discusses the unique amalgamation of platelet-rich fibrin (PRF), demineralized freeze-dried bone graft with use of PRF membrane during auto-transplantation of an impacted central incisor. The authors have focused on maximum usage of autogenous materials in the most economic and least invasive manner. Furthermore, this amalgamation has been used to provide rehabilitation in the least span of time.

Keywords: Allogenic bone graft, auto-transplantation, platelet-rich fibrin

Introduction

"Maxillary anterior teeth have a predominant role in the appearance of any individual and further influence the psychological impact in public. Missing and unerupted maxillary incisors were considered to be the most unattractive deviant occlusal trait."[1] "Very few reports have been published regarding the functional problems associated with missing anterior teeth, although some speech difficulties have been reported, particularly with "s" sound."[2] A multitude of treatment options is available for a missing incisor depending on the age of the patient, angulation of the tooth, adjoining structures, and most importantly patient compliance. These options range from "orthodontic alignment of the tooth, removal followed by implant placement, prosthetic rehabilitation, and auto-transplantation. Of the above, auto-transplantation offers the fastest and most economical means of replacing missing teeth.[3]"

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"Auto-transplantation is the removal of embedded, impacted, or erupted teeth from one site to the same socket or a different site in the same individual. The recipient site may be either an extraction site or surgically prepared alveolus.[4]"

In the current case report, we describe one of the few cases using a successful combination of economical resources in terms of grafts available to expedite bone regeneration and provide a favorable environment for a transplanted maxillary central incisor.

Case Report

A 22-year-old male reported to the Department of Oral and Maxillofacial surgery with the primary concern of a missing front tooth. This missing tooth resulted in an obvious unaesthetic appearance and psychological compromise to the young male. There was no history of tooth loss or trauma. General examination and lab investigations revealed no evidence of any systemic disease. Oral hygiene was fairly good, and occlusion was normal. Successively, local examination of the concerned site revealed normal contour of the alveolus and angulation of adjacent teeth were normal, without any encroachment in the space of the missing central incisor. Following the clinical examination, radiographs were taken to further investigate the concerned site. The intra-oral peri-apical film revealed a horizontally impacted left central incisor just below the nasal floor, with the crown facing labially along-with radio-opaque tooth like masses. The morphology of these masses could not be confirmed with the radiographs.

The patient was provided with various treatment options including orthodontic repositioning of the incisor, auto-transplantation or extraction followed by implant placement. Based on the time required and treatment cost,

auto-transplantation of the tooth was decided as the final treatment plan.

The patient was taken up for surgery, wherein a trapezoidal flap was raised to expose the impacted central incisor under local anesthesia. On exposure, the incisal edge of the incisor was visible on the labial surface of the alveolus; along with three small tooth-like masses with a peculiar "S" shape adjacent to it [Figure 1]. The malformed tooth-like masses were extracted, and the central incisor removed carefully from its socket without sectioning and with minimal bone removal. The residual bony defect, being large, was prepared to form a bed for the incisor. To prepare platelet-rich fibrin (PRF), 20 ml of blood was withdrawn from the patient's antecubital vein and centrifuged (REMI centrifuge machine Model R-8c with 12 × 15 ml swing out head) for 10 min at 3000 rpm (approximately 400 g) per minute. Demineralised freeze-dried bone allograft (DFDBA) was mixed with PRF clot and was placed in the defect. Following this, the incisor was carefully replanted in the prepared socket [Figure 2]. In addition to the graft and PRF gel, a PRF membrane was used as an autologous barrier membrane to cover the defect from edge to edge [Figure 3]. Splinting was done using periodontal wiring. Flap stabilization was achieved with primary closure of the wound using 3-0 Mersilk. Patient was put on antibiotic and analgesic coverage and was also instructed to use 0.2% chlorhexidine gluconate solution as mouth rinse for 5 days. Suture removal was done after 1-week following which the healing occurred uneventfully. The splinting was reinforced on the 7th postoperative day with Erich's arch bar. Histopathological examination of the tooth like masses confirmed the specimen to be odontomes. On the 10th postoperative day, endodontic treatment of the incisor was performed. Splinting was removed 4 weeks postoperatively, and the patient was advised against biting on the reimplanted tooth. A follow-up radiograph was taken at this time period [Figure 4] after which regular follow-up was done till 1-year.

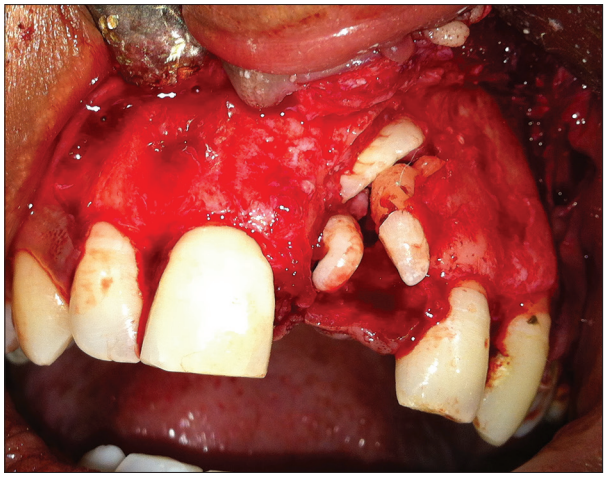

Figure 1: Exposed incisal edge of confidence interval and "s" shaped odontomes

Discussion

The central incisor is the second most commonly impacted anterior tooth, with a frequency of 0.06–0.2%.[5] The principal factors involved in impaction are supernumerary teeth, odontomes, and trauma. In our case, the central incisor impaction appeared to be a result of the presence of three odontomes located inferior to it which might have prevented its eruption. The esthetic and functional importance of anterior maxillary incisors renders early intervention necessary to enable appropriate treatment and prevent subsequent complications. "Treatment alternatives for an impacted central incisor include (1) orthodontically induced eruption of the impacted central incisor into its proper position, (2) extraction and space closure by replacing the lateral incisor by the central incisor with subsequent prosthetic restoration; (3) extraction of the impacted tooth and surgical repositioning of the impacted central incisor; and (4) extraction and restoration with an implant or a bridge later when growth has ceased.[6]" In our case, auto-transplantation was performed. In addition to being the fastest and most economical treatment option, it also holds the advantage of using patient's own tooth and providing a highly esthetic outcome. A recently published long-term review of cases involving auto-transplantation with a follow-up range of 17–41 years showed the success rate to be over 90%,[7] which is similar to that of dental implant-supported restorations.

Auto-transplantation was first tried by Widman in 1915 in impacted canines.[8] It offers several advantages over extraction of the tooth and rehabilitation with prosthesis. Apart from being inexpensive and fast, transplantation prevents loss of alveolar bone height. Furthermore, due to the intact proprioceptive impulses, the patient gets the feel of a natural tooth. The maintenance of gingival contour around the tooth is superior to that around the prosthesis. "The success rate of auto-transplantation is influenced by a number of preoperative and postoperative factors like age of the patient, trauma to the alveolar bone and/or periodontal cells,

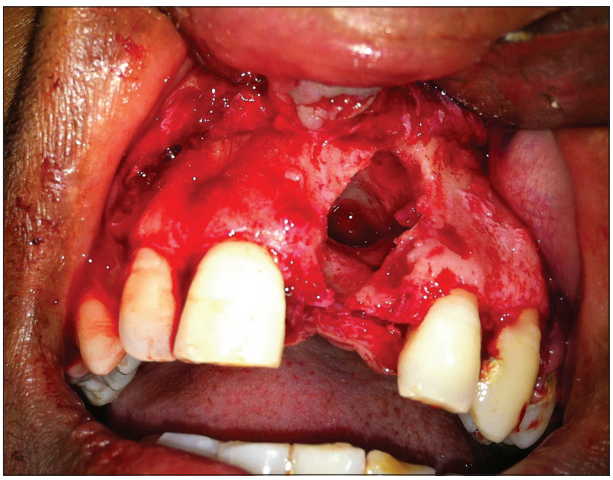

Figure 2: Recipient site showing extraction socket

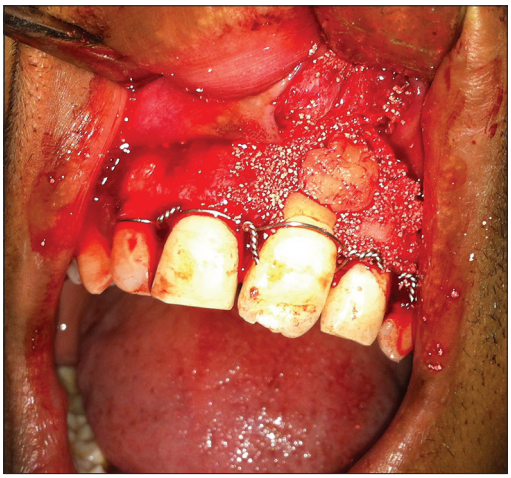

Figure 3: Auto-transplanted confidence interval with platelet-rich fibrin (PRF) gel, demineralized freeze-dried bone allograft, and PRF membrane

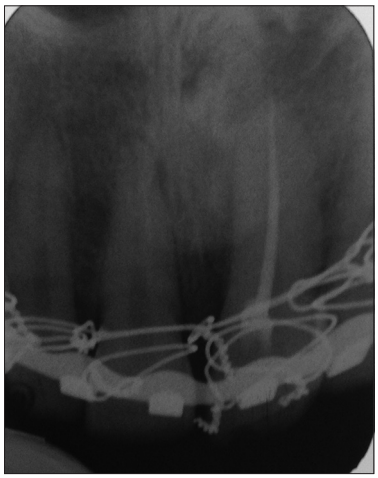

Figure 4: Intra-oral peri-apical radiograph at 4 weeks

the type of tooth transplanted, recipient site contamination, timing of the endodontic treatment and duration and method of splinting after transplantation."[9] When harvesting a tooth for transplantation, injury occurs primarily to two tissues, the dental pulp and periodontal ligament. Compromised healing of these tissues leads to 2 main complications: Replacement root resorption and inflammatory root resorption.[8] Inflammatory root resorption is caused by pulpal necrosis and subsequent migration of these tissue disintegration by-products, through dentinal tubules to the root surface. This can be resolved by endodontic therapy. "Replacement root resorption/ankylosis develop from a damaged periodontal ligament that fails to heal."[10] These complications are seen within 6 months to 1-year from the treatment.

Furthermore, the success of any procedure depends on the regeneration of tissues. Regeneration is defined as the reproduction or reconstitution of a lost or injured part of the body in such a way that the architecture and function are completely restored. Regeneration of tissue after surgery requires (a) recruitment of progenitor/stem cells to differentiate into committed cells, (b) growth/differentiation factors as necessary signals for attachment, migration, proliferation and differentiation of cells, and (c) local-micro environmental cues like adhesion molecules, extracellular matrix, associated noncollagenous protein molecules, and so forth. Lack of any of these elements would result in repair rather than regeneration. Perhaps the most commonly used technique for regeneration is the use of bone replacement grafts. These grafts can promote tissue or bone regeneration through a variety of mechanisms. Out of various graft materials available, DFDBA has been commonly used to fill the intrabony surgical defects as it possesses excellent osseo-inductive and conductive properties.

In addition, to augment tissue regeneration and healing, local application of growth factors and host modulating agents is being used to maximize the body's healing potential, promote healing of soft tissue and bone through stimulation of collagen production to improve wound strength and initiation of callus formation. Studies have demonstrated that specialized secretory granules of platelets, such as alpha-granules, contain these growth factors. Growth factors are known to attract stem cells present in apical tissues.

Platelet-rich fibrin, introduced by Choukroun *et al*. in the year 2001, is a second-generation platelet concentrate enriched with platelets and growth factors like platelet-derived growth factor, transforming growth factor 1, insulin-like growth factor etc., which promote tissue regeneration and healing. PRF not only has a workable three dimensional architecture but exhibits varied potent local properties such as cell migration, cell attachment, cell proliferation, and cell differentiation. It has been shown as an ideal biomaterial.

In vitro studies have proved that PRF releases autologous growth factors gradually for at least 1-week and up to 28 days. PRF used in conjunction with bone grafts offers several advantages including better wound healing, bone growth and maturation, graft stabilization, wound sealing and hemostasis, and improving the handling properties of graft materials. Clinical trials suggest that the combination of bone grafts and growth factors contained in PRF may be suitable to enhance bone density. PRF can also be obtained in the form of a membrane by squeezing out the fluids in the fibrin clot; thus, it is both, healing and an interpositional biomaterial. As a healing material, it accelerates wound closure and mucosal healing due to fibrin bandage and growth factor release. As interpositional material, it avoids the early invagination of undesired cells, thereby behaves as a competitive barrier between desired and undesired cells.

Several factors favored the success of transplantation in our case. The patient was young and healthy, had good oral hygiene and no evidence of periodontal disease; there was minimal trauma to the surgical site and tooth root during the

procedure; endodontic treatment was prompt and adequate; strict immobilization was maintained for a sufficient period of 4 weeks. Placement of DFDBA in the extraction socket provided a scaffold for bone remodeling around the tooth. PRF clot mixed with the DFDBA allowed rapid healing. The graft was covered with a PRF membrane, which permitted recolonization of the periodontal cells into the extraction site and optimized the periodontal healing, based on the concept of guided tissue regeneration. A 1-year of follow-up revealed no signs of bone loss, root resorption, or ankylosis which confirmed the promising results of the amalgamation of DFDBA and PRF products.

Auto-transplantation has been used since time immemorial and is a documented treatment alternative for an impacted tooth. This is one of the very few cases to use DFDBA, PRF gel, and PRF membrane as a combination to provide synergistic benefits from each other. Going by this case, the authors are of the opinion that the use of allogenic bone graft and PRF products can be tried in other bony defects as well.

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