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CASE REPORT

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A Novel Procedure of Regaining Aesthetics with Implants and Autogenous Dentin Graft -Two Year Follow Up

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Abstract

Generally, extracted teeth have been discarded as infective medical dusts in the world. While human bone autograft was done in 19th century, human dentin autograft for bone augmentation was reported in 2003. Dentin matrix like bone has the inborn chemical and physical properties to attract progenitor cells and induce them to generate new bone. Both decalcified bone and decalcified dentin are composed of predominantly type I collagen (95%) and the remaining as non-collagenous proteins including small amount of growth factors. The coagulation action of blood plasma by both decalcified bone and dentin are advantageous during surgical procedures.

This series of clinical cases describes a novel procedure of prosthodontics management of the fractured maxillary central incisors using two stage implants reinforced with autogenously dentin graft obtained by immediate transformation of extracted teeth. Results demonstrated that autogenously dentin could be recycled as an innovative biomaterial for local bone engineering.

Keywords: Atraumatic Extraction; Smart Dentin Grinder; Autogenously Particulate Dentin Graft; Osseointegration; Implants

Introduction

Bone grafts (autogenous, allogenic, xenogeneic and alloplastic materials) have been used for regeneration of dentoalveolar defects since ages. While human bone autograft was first done in the 19th century, human dentin autograft for bone augmentation was reported in 2003 [1]. In 2009, Korea Tooth Bank was established in Seoul for the processing of the tooth-derived materials, and an innovative medical service was begun for bone regeneration. Recently, the tooth-derived materials have become a realistic alternative to bone grafting and have been a huge success with the clinicians and patients owing to the excellent osteoconductive and osteoinductive properties of the graft and an almost nonexistent host tissue reaction. Dentin matrix, like bone, has the inborn chemical and physical properties to attract progenitor cells and induce them to generate new bone. At least 90% of organic content of dentin is type I collagen, which plays an important role in bone formation and mineralization [2,3]. The coagulation action of blood plasma by both decalcified bone and dentin are advantageous during surgical procedures [4-6].

This clinical case series describes a novel procedure of prosthodontics management of the fractured maxillary central incisors using two stage implants reinforced with autogenous dentin graft obtained by immediate transformation of extracted teeth. A smart dentin grinder was used to grind and sort the extracted teeth into specific sized dentin particulate. This was followed by subjecting the particulate matter to a chemical cleanser in order to obtain a bacterial free sterilized graft within minutes. Three patients were treated by similar procedures. The patients were re-evaluated for implant survival and prosthesis success after a period of one year.

Case 1

All the patients selected for treatment had fractured maxillary incisors which were not salvable and the patients were desirous of rehabilitation with implant prosthesis. Any medical history that would complicate the outcome of the treatment, such as uncontrolled diabetes mellitus, history of smoking, poor health or any other physical or psychological reason that might affect the treatment was considered as exclusion criteria for the cases.

A 21 year old patient reported to our Dental Centre with chief complaints of pain and mobility in upper front teeth since last ten months post trauma. Clinical examination revealed grade III mobile maxillary central incisors [Figure 1a]. Radiological examination showed a fracture of maxillary central incisors at the apical third of the roots [Figure 1b]. After consulting an endodontist, a treatment plan was formulated which included atraumatic extraction of maxillary central incisors, preparation of autogenous dentin graft for bone augmentation, two stage implant placement and functional rehabilitation with fixed prosthesis.

Figure 1: (a) Intraoral frontal view in occlusion **(b)** Introral periapical radiograph showing fractured maxillary central incisors at the apical third of root

Procedure

Maxillary and mandibular diagnostic impressions were made with irreversible hydrocolloid (Plastalgin, Septodont, France) and poured in dental stone (Kalstone, Kalabhai, India). The casts were articulated and diagnostic wax up was done to rehearse a proposed restorative plan and explain the intended procedure to the patient. Informed consent was taken from the patient and

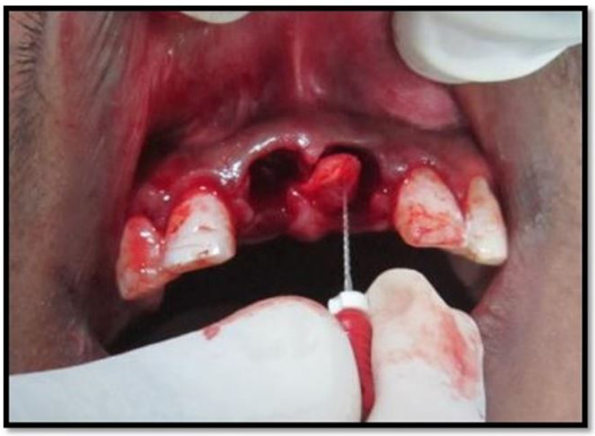

Figure 2: Atraumatic extraction of maxillary central incisors

Figure 3: (a) Smart Dentin Grinder **(b)** Milling of teeth **(c)** Drawer that collects particulate dentin after grinding and sorting **(d)** The particulate dentin graft

the maxillary central incisors were atraumatically extracted [Figure 2]. Immediately after extraction, the periodontal ligament, enamel and cementum of the extracted teeth were removed with a tungsten bur. The teeth were rinsed with distilled water and were subjected to milling in a smart dentin grinder (Kometa Bio) [Figure 3]. The grinder takes 3-4 seconds to grind the dentin. A vibrating movement of the grinding chamber for 20 seconds lets the particles of less than 1200 μm fall through a sieve to a

lower chamber. The particles less than 300 μm fall into a waste drawer as their dimensions are non-efficient for bone grafting. The particulate matter in the range of 300 to 1200 μm hence retrieved was treated with a dentin cleanser (0.5M of NaOH and 30% alcohol) for ten minutes in a sterile glass container which dissolves most of the organic debris, bacteria and toxins but does not harm the dentin collagen. The particulate matter was then rinsed for one minute in phosphate buffered saline which adds phosphates which is important for bio-activeness. The wet particulate was placed on a hot plate (140 °C) for five minutes and the dry bacteria free autologous dentin graft was obtained. The process from tooth extraction upto grafting takes approximately 15-20 minutes.

Two 3.8 mm x 13mm two stage immediate implants (Equinox, Myriad Plus) were placed in accordance with the standard implant surgical protocols in the extraction sockets of maxillary central incisors [Figure 4a], primary stability was achieved by wrenching the implant into the bone beyond the apex of the socket and the autogenous dentin graft was compacted in the space around the implants [Figure 4b]. Interrupted non resorbable 3-0 silk sutures were placed to achieve primary closure. Post-operative instructions were given to the patient and sutures were removed after one week. A second stage surgery was performed after four months. The angulated abutments were screwed and the implant stability was measured by using periotest (Ostell Mentor, Goteborg, Sweden). Pleasing smile was achieved by porcelain fused to metal crowns in relation to 11 and 21 [Figure 5]. The patient was functionally and aesthetically satisfied with the implant fixed prosthesis. A one year follows up showed good esthetics, osseointegration and maintenance of bone around the implants which was assessed by intraoral periapical radiograph [Figure 5 and 6].

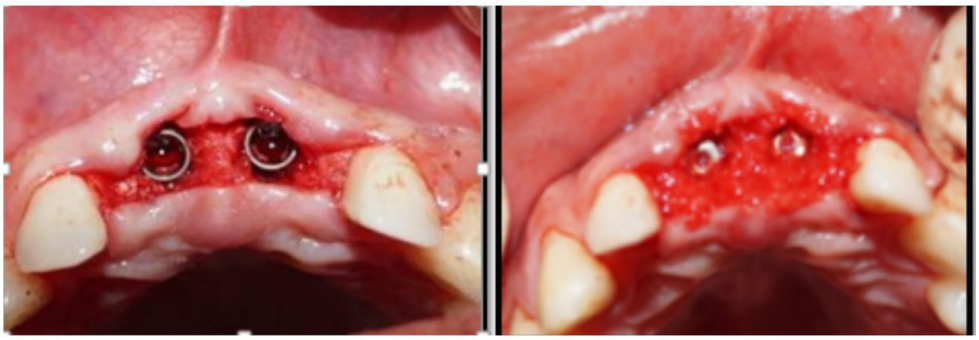

Figure 4: Placement of two 3.8mm x 13mm implants and autogenous dentin graft in fresh extraction sockets of maxillary central incisors

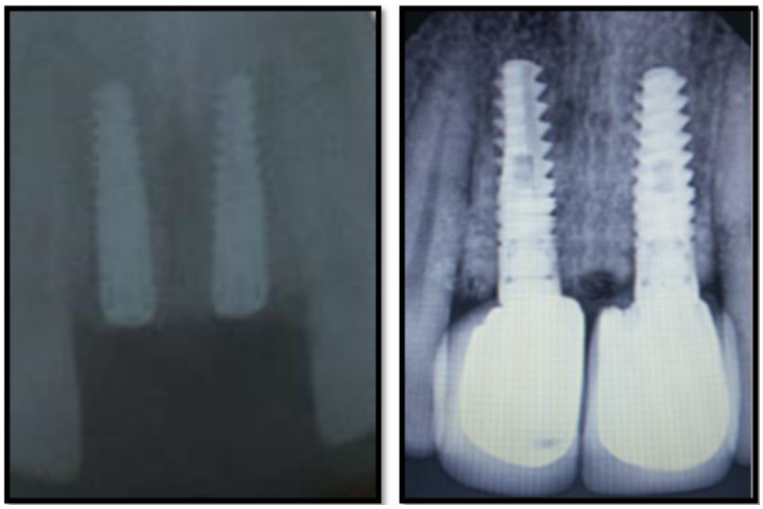

Figure 5: (a) Intraoral radiograph showing implants immediately after surgery **(b)** Intraoral radiograph after one year showing no bone loss around implants

Figure 6: Porcelain fused to metal crowns in situ

Case 2

A 25 year old male patient reported with chief complaints of missing front upper teeth since 06 months post trauma. Patient had good oral hygiene and no relevant medical history. Radiological examination revealed retained apical half roots segments of both the maxillary central incisors which were a traumatically extracted and used as a dentin graft [Figure 7]. The rest of the procedure followed was similar to that of case 1.

Figure 7: Rehabilitation of aesthetics in case 2

Case 3

A 30 year old patient reported with chief complaints of fractured upper front teeth since 06 months post trauma. Clinical examination revealed fractured maxillary central incisors below the level of cemento enamel junction. The maxillary right lateral incisor exhibited a class III Ellis fracture. The roots of 11 and 21 were a traumatically extracted and the routine procedures of dentin graft and implant placement were followed. Porcelain fused to metal crowns was fabricated for 11, 12 and 21 and composite restorations of 41 and 42 were carried out to achieve functional and aesthetic rehabilitation [Figure 8].

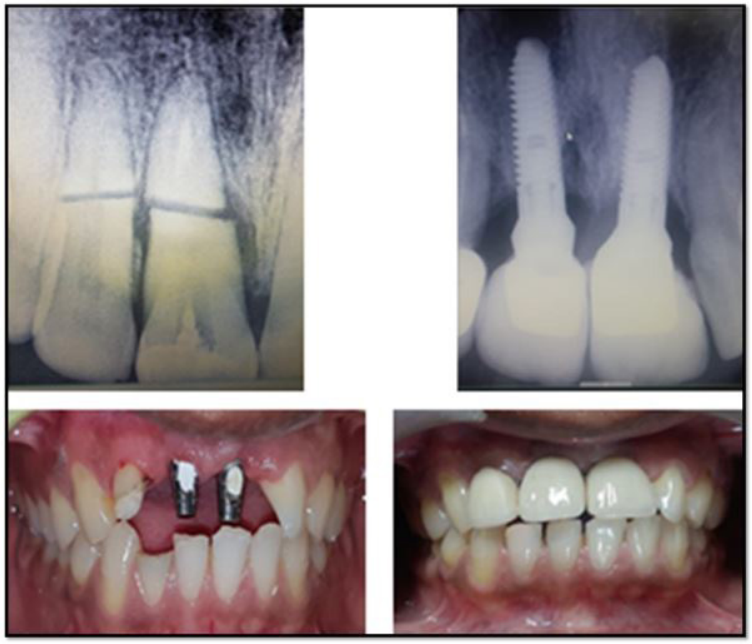

Figure 8: Rehabilitation of aesthetics in case

Discussion

Autogenous dentin graft is an innovative material owing to its very similar physical and chemical components when compared to bone. Both tooth and alveolar bone are derived from neural crest cells and are made up of the same Type I collagen. Furthermore, dentin contains BMPs, which induce bone formation and noncollagenous proteins such as osteocalcin, osteonectin, and

dentin phosphoprotein [7]. Autogenous bone graft is ideal for the reconstruction of hard tissue defects. It has osteoconductive, osteoinductive and osseointegrative capacities [8]. It does not trigger foreign body reaction and also ensures fast healing. However it is difficult to obtain a sufficient amount and secondary defect develops in the donor site [9]. On the other hand xenograft is not popular because of immune rejection response and high cost [10]. Kim, et al. [11] introduced a bone graft material using extracted auto tooth as a new bone graft material to overcome the disadvantages of other grafts[11]. Lee, et al. and Chang et al. [12,13] described potential of autogenous dentin bone graft with simultaneous implant placement with guided bone regeneration as a bone substitute in bone repair and regeneration.

Auto tooth bone graft materials are of block and granular types. The block type has osteoinduction capacity via blood wettability and has osteoconduction capacity via space maintaining and creeping substitution. It is remodeled by maintaining space during a specific period. The granular type is available in various sizes of particles, porosity between powders [14].

An immediate implant placement was planned in our cases to reduce the time and cost of therapy and surgical episodes and to preserve the bone and gingival tissues. The greatest rate of bone resorption occurs during the first six months following tooth extraction unless an implant is placed or a socket augmentation procedure performed. The early maintenance of gingival form greatly facilitates the peri-implant gingival tissue esthetics by maintaining support for the interdental papillae.

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Conclusion

There are various bone graft materials available in the market today. In particular, auto tooth bone graft material has been studied aggressively as a material to overcome the disadvantages of allograft, xenograft and synthetic graft without losing bone regeneration capacity like autogenous bone. In clinical applications, auto tooth bone graft material does not have genetic and infectious risks; it is as strong as other graft materials, providing good bone generation through osteoinduction and osteoconduction as well as excellent initial bone remodeling capacity. The bone formation and implant osseointegration described in the cases clearly indicates an increased efficiency of dentinal autograft in replacement of bone. Further researches including precise preparation methods and clinical application should be performed in order to ensure long term success in the avenues of developing new biomaterial in bone substitution.

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