Rehabilitation of Avulsed Teeth in Fractured Jaws via Bone Grafting and Implant Placement: Report of Two Cases

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Abstract
The maxillofacial region is one of the most injury-prone areas during road traffic accidents, personal violence, falls and sports. Maxillofacial trauma can lead to breakage or avulsion of upper anterior teeth, which may cause significant aesthetic and functional problems. There are many treatment options available for rehabilitation including removable partial dentures, fixed partial dentures, crown and bridges and implant-supported prostheses.

Herein, two cases are presented where implant placement was done for upper anterior teeth, which were traumatized or avulsed following maxillofacial trauma. Both patients demonstrated a history of maxillofacial trauma and had undergone open reduction and internal fixation. The first patient had a severe maxillary alveolar defect treated via autogenous bone grafting and a six-month period was given for proper integration of the bone graft. The second patient was a smoker with very poor oral hygiene and a deep bite. Thus, implant placement was not initially justified.

Keywords: Maxillofacial injuries; Dental implants; Tooth avulsion; Dental prosthesis

INTRODUCTION
The maxillofacial region is commonly injured during road traffic accidents, personal violence, falls and sports; which may lead to anatomical deficiencies in both soft and hard tissues of facial structures.

These defects often result in the loss of neural sensation, attached mucosa, bone, teeth and alveolar processes, which might require rehabilitation. Dental injuries are common in maxillofacial regions [1,2] and may or may not be associated with fractures of the temporomandibular joint, maxilla, mandible, teeth and supporting structures [1,3].

Maxillofacial trauma can lead to loss of upper anterior teeth, which are most likely to break or get avulsed along with alveolar bone, leading to significant aesthetic and functional problems [4-6].

Facial fractures are usually treated by reduction, fixation and immobilization of the fractured segments, followed by occlusal adjustments and restoration of missing teeth and soft tissues where necessary [7]. There are several treatment options available for rehabilitation including removable partial dentures, fixed partial dentures, crown and bridges and implant-supported prostheses [8].
Herein, two cases are presented where implant placement was done for the upper anterior teeth, which were traumatized or avulsed following maxillofacial trauma.

**Case one:**
A 20 year-old male patient presented with missing upper anterior teeth needing to be replaced. The patient had a history of facial trauma four months prior to referral and avulsion of the right central incisor, lateral incisor, canine and first premolar teeth along with a LeFort I fracture for which he was operated.

The treatment plan included bone grafting of the defect in the maxillary alveolar region (Fig. 1) with two-stage implant placement.

The surgical procedure started with a crevicular incision (Fig. 2) in the mandible extending from the premolar of one side to the premolar of the opposite side for better visualization and accessibility of the symphysis. Then, by elevation of a full mucoperiosteal flap the mandibular symphysis region was exposed. Marking was done extending approximately 1.5 cm on either side from the mid-symphysis and two blocks of 1.5×1.0 cm monocortical bone were harvested (Fig. 3) using a rotary instrument and chisel; the incised wound was primarily sutured in layers and compression dressing was placed to prevent hematoma; the harvested bone was grafted in the region of the maxillary alveolar ridge defect (Fig. 4).
To attain desired alveolar height and thickness, the bone graft was secured with the help of stabilizing screws. Before securing the graft, decortication of the recipient site was done by drilling holes with the help of bur. This aids in regional acceleratory phenomenon. These holes provide access for trabecular bone blood vessels to the graft site, expedite revascularization and bring growth factors to the graft site. Periosteal undermining was done at the recipient site to acquire abundant tissue for closure. Watertight closure was achieved by horizontal mattress suturing using polyglactin suture material.

After six months, screws were removed and bone morphology was evaluated at the recipient site (Fig. 5).

There was satisfactory healing both at the recipient site and at the donor site (Fig. 6). Four implants were inserted into the grafted bone to replace each missing tooth depending upon the height and width of the bone. First, with the help of diagnostic casts, a surgical stent was prepared and under local anesthesia with adrenaline, a crestal incision was made extending from the right central incisor to the right first premolar region. The site was exposed, desired marking was done with the help of the pilot drill, bony expansion was done with the help of bone taps to attain desired width so that the density of bone around the implant would increase; then implants were placed in the desired position and primary suturing of the mucosa was done.
A waiting period of six months was necessary for proper osseointegration of implants in the grafted bone (Fig. 7). After six months, all the implants were exposed and loaded (Fig. 8). There were no signs of inflammation with well-keratinized gingival tissue.

**Case two:**
A 30 year-old male patient presented with missing upper anterior teeth (Figs. 9 and 10) requiring to be replaced. The patient had a history of facial trauma nine months back with avulsion of both maxillary central and lateral incisors along with LeFort I fracture for which he was operated; the patient had undergone a second surgery for removal of miniplates after a gap of six months after the first surgery. The patient had a history of smoking and poor oral hygiene. He was referred to the department of periodontics for oral prophylaxis and was asked to quit smoking and advised to extract the maxillary right canine and first premolar teeth due to poor prognoses.

An impression was taken and a diagnostic cast was prepared to evaluate the occlusion and to prepare the surgical splint (Fig. 11). It was noticed that the lower anterior teeth were overerupted and to maintain the proper overbite and occlusion the mandibular anterior teeth (mandibular left lateral incisor was congenitally missing) had to undergo intentional root canal treatment, crown height reduction and crown lengthening to achieve proper occlusion and esthetics. Six teeth were missing; therefore, four implants were placed according to the available height and width of bone for better anchorage and prosthetic stability. With the help of diagnostic casts, a surgical stent was prepared and under local anesthesia with adrenaline, a crestal incision was made extending from the right first premolar region to the left lateral incisor for exposure. The site was marked with the pilot drill; bone taps were used instead of drills to attain desired width (to increase the bone density of the fixture site).
The implants were placed in position (Fig. 12) and suturing of the mucosa was done. After waiting for a period of six months, all the implants were exposed and loaded (Fig. 13). There were no signs of inflammation with well-keratinized gingival tissue.

DISCUSSION
Maxillofacial trauma may lead to defects, which may create functional and esthetic problems [5]. The loss of maxillary anterior teeth leads to resorption and remodeling of the alveolar bone. Eventually an atrophic alveolar ridge develops [9]. Various treatment options are available for patients having maxillary defects [1,3,5,9-11]. Prosthetic rehabilitation by dental implants aims to restore the anatomy, function and esthetics.

Autogenous bone is highly efficient for reconstructing the jaw anatomy [12,13], restoring esthetics [14,15] and providing biomechanical support for the placement of dental implants [16]. Autogenous bone can be harvested from the calvarium [17,18], iliac crest [19-22], tibia [23,24], fibula [25], scapula [26], symphysis [16,27-33] and buccal shelf of the ramus [16,34-45]. Every donor site varies in the quality and quantity of available bone that can be harvested [46]. Graft resorption and donor site morbidity are the main drawbacks associated with autogenous bone grafting. It is documented that membranous grafts show less resorption than endochondral bone grafts [47,48]. Intraoral donor sites are best for harvesting bone.
An average increase in bone width of 4 or 5 mm (maximum of 6 or 7 mm) [48] and 2 mm (maximum of 3 mm) increase of vertical ridge height [49] is desired in intraoral block grafting procedures. Complications of harvesting block autografts from the chin include the risk of inferior alveolar nerve paresthesia, infection, loss of tooth vitality and the postoperative sagging of the chin. Careful incision design and proper osteotomy location can prevent these complications [14,50].

Use of implant-supported or implant-retained prosthesis in severely resorbed ridges usually requires bone grafting to provide adequate support and restoration of oral functions [51]. Proper planning, modifications and different treatment plans are required to determine conditions for rehabilitation of function and esthetics in maxillofacial defects. This includes provision of health of both soft and hard tissues [52].

As was seen in the radiological and clinical examinations of both patients, the desired result in the anterior maxilla was obtained. Difficulty of prosthetic rehabilitation in maxillary defects can be minimized by proper pre-surgical planning and evaluation of every case individually. It is emphasized that prosthodontists and oral and maxillofacial surgeons should work in tandem when planning treatment of patients with maxillofacial trauma.

CONCLUSION
In alveolar ridge defects, careful pre-surgical planning and evaluation should be carried out for proper prosthetic rehabilitation. The involvement of various disciplines is required in rehabilitation of maxillofacial trauma patients.

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