Free Fibula Flap in Mandibular Reconstruction : A case report

Abstract:
The reconstruction of the mandible is a complex procedure and continues to be a challenge in reconstructive maxillofacial surgery. Indications for mandibular reconstruction are varied and include pathological resections, traumatic injuries and residual deformities amongst others. The mandible is an important anatomical unit of maxillofacial skeleton in terms of both aesthetics and function which necessitates its immediate reconstruction after resection.
A 16 years old female patient, diagnosed with ameloblastoma of left hemi -mandible underwent resection with immediate reconstruction using free fibula flap. Twenty two months follow up reveals excellent bony union and facial contours. The objective of the treatment is to resecting the mandibular defects and reconstruction with free fibular flap.
Our experience combined with positive literature references enhances the reliability of free fibular vascularized graft as a suitable and versatile reconstructive option for complex anatomical contours of the mandible.

Keywords: Ameloblastoma , Free Fibular flap , Immediate reconstruction

Introduction:

The first mandibular free fibula flap reconstruction, with osteotomies that mimic the structure of the mandible, was described in 1989. Since then, the application of the flap has become the mainstay in the head-neck reconstructive surgeries. Vascularized fibular osteomyocutaneous flap has been advocated in jaw reconstruction for large defects, which contributes to the restoration of the facial appearance and masticatory function of the patient [1].

Ameloblastoma, most common benign odontogenic tumour of the jaws, constitutes about 1% of all cysts and tumours of the jaws [2]. .t is slow growing, painless, locally aggressive tumour which may cause the expansion of the cortical bone and perforation of the buccal or lingual cortical plate along with the soft tissue infiltrations. The peak incidence of ameloblastoma occurs in third and fourth decade of life but can be found in any age group with equal gender predilection (1:1)[1,4]. In the mandible majority of ameloblastoma are found in the posterior molar ramus region[3].

Ameloblastoma may originates from developing enamel organ, epithelial cell rest of malassez and dental lamina, epithelial lining of odontogenic cysts and basal cells of oral epithelium[2]. According to the World Health Organization, classification of tumours(2005) there are four different categories of ameloblastoma: the conventional solid/multicystic ameloblastoma, and the unicystic ameloblastoma[5]. The other histopathological subtypes of ameloblastoma are follicular, plexiform, acanthomatous, desmoplastic, granular cell, and basal cell pattern.

There is a high prevalence of ameloblastoma in African and Asian populations, but minority in North American and European countries[6]. Even though the chances of recurrence of ameloblastoma has been established worldwide, histopathological data and demographic profile of ameloblastoma in different populations of the world is not adequate[6]. Surgical removal is considered the best option for patient with ameloblastoma and range from conservative surgical therapy to radical resection surgeries[7,8]. The

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management of mandibular continuity defect has changed exponentially in the last decade.

Reconstruction of extended defect by the transfer of free vascularized osteomyocutaneous graft is one of the frequently used techniques. The preferred donor-sites for reconstruction being fibula, scapula, rib and the iliac crest[9,10]. It is necessary to establish bone viability after revascularization of the flap. Vascular occlusion, Lack of because of vascular occlusion either arterial or venous can result in bone resorption, poor healing or even necrosis which may result in the failure of the flap.

The utmost goal of the surgery should include resection of the deceased mandible followed by the reconstruction immediately to maintain the function which includes speech, mastication & deglutition apart from facial contour and oral competence [11]. However, the best option to optimally reconstruct mandibular continuity defect has not yet been satisfactorily resolved and represents a challenge for oral and maxillofacial surgeons.

Case report:

A 16 years old female visited the OPD of Dept. of oral & maxillofacial surgery Babu BanarasiDas College of Dental sciences, BBD University with a 2 years history of slowly growing swelling at the left side of the lower face.

Extra oral examination revealed non-tender, firm, diffuse swelling over left side of the face extending from inferior border of the lower jaw till malar prominence and anteriorly from corner of the mouth till posterior border of ramus. The lesion was non-tender and there was no regional lymphadenopathy or presence of motor or sensory deficit. Intraorally marked cortical expansion was observed on the buccal side with mild lingual cortical expansion (Fig.1). The remaining part of the oral cavity was unremarkable apart from poor oral hygiene. Radiographic findings including Orthopantomogram (Fig.2) and CBCT (Fig.3) revealed a radiolucent multilocular lesion involving the coronoid, condyle, ramus & body of the mandible extending almost till the midline. Incisional biopsy confirmed follicular variety of ameloblastoma.

Patient was planned for surgery as a case of ameloblastoma and the treatment includes hemi- mandibulectomy followed by immediate reconstruction with free fibula flap. Two teams were engaged in the surgery. One team resected the tumor (Fig.4) and the other team harvested the fibular flap simultaneously. A submandibular approach was used on left side for exposure of the lesion. Layer wise dissection was done to expose the tumor which was resected along with 1 cm of healthy bone on distal side and disarticulation of the proximal end.

The facial artery and the vein at the resected site were secured with vascular clips for future vascular anastomosis. The donor site was exposed via lateral approach. A line was drawn from the fibular head to the lateral malleolus indicating the submuscular and subcutenous course of fibula(Fig.5). Two markings were made on the line, first was 7 cm distal from the fibular head which indicate approximate insertion of peroneal vessels within the intermuscular septum. The second marking was 6 centimeters away from the fibular head.

Then a curvilinear incision was made along the lateral border between the peroneal muscles and the fibular head. The peroneal muscle was separated from the soleus muscle through the posterior intermuscular septum. The septum was detached from the fibula along with its posterior border. After that, dissection was proceeded anteriorly toward the anterior intermuscular septum which separates the peroneal muscle from the extensor muscle. Dissection was done extraperiosteally with about 1cm cuff of flexor hallucis muscle was left attached to the fibula(Fig.6). The peroneal vessels were acknowledged at the distal osteotomy site and were ligated.

The peroneal vessel was acknowledged till their origin from posterior tibial artery. The first osteotomy cut was performed 4cm distal to nutrient vessel using Gigli's saw with 1 cm excess periosteum. Then the second osteotomy cut was perfomed 4cm proximal to the nutrient vessels with 1cm of excess periosteum. For balanced perfusion, the osseous tissue attached with vascular pedicle was observed after deflating the tourniquet(Fig.7). Then the proximal peroneal vessel was ligated, cut and harvested with part of overlying skin. Then the flap was trimmed and adapted as per morphology to the defect area, then stabilized using miniplate with screws.

The microvascular anastomosis was done end to end in between peroneal and facial artery with 9/0 prolene under aided vision of loop in a conventional way (Fig.8). The Patency of the anastomosed vessel was observed after releasing the clamps. Then the wound was sutured in layers with water tight seal in the oral cavity. Intra-operatively and post-operatively needle prick test was done to check the viability of the flap(Fig.9). Follow up: She received broad spectrum antibiotic, analgesics for 10 days and antiseptic mouth wash for 14 days following surgery.

The entire post operative period had no complications with good wound healing. The recovery of the patient was excellent both functionally & aesthetically. She was discharged after 10 days of surgery and recalled for follow-up after one month. Apparently, she was better with no complications both clinically and radiologically in the first follow-up. one year follow up revealed excellent functional and cosmetic result. Radiologically the bony union was complete and no resorption of the graft was observed.

Discussion:

The application of the fibula free flap was first described by Taylor and colleagues.

Ever since Hidalgo reported its first use in mandibular reconstruction in 1989, it has remained the method of choice for mandibular reconstruction after trauma and tumor ablation surgeries[12]. Free fibula flap primarily supplied by peroneal artery branch of posterior tibial artery and fibula bone by endosteal and periosteal vessel. Septocutaneous and musculocutaneous perforators supplies the skin attached to fibula by posterolateral intermuscular septum. The fibula can be transferred as a free osseous or free osteocutaneous flap.

An anatomic study by Schusterman and associates identified three types of perforators: 1.Septocutaneous, 2.Musculocutaneous, 3.Septomuscular (which did not pass within the structure of muscle but is adherent to it)[13]. Among these, musculo-cutaneous perforators were more than the proximal and septo-cutaneous perforators were less and distal according to them. To restore the sensation to skin component, the lateral sural cutaneous nerve can be harvested and anastomose to a recipient nerve.

Harvesting of the peroneal communicating branch as a vascularized nerve graft can be used to bridge the inferior alveolar and mental nerve to restore its sensation to the lower lip. For the placement of dental implant, fibula is suitable as it can withstand the masticatory forces due to its adequate thickness. Approximately 22 to 25 cm of bone can be harvested, leaving 6 to 7 cm proximally and distally to maintain adequate stability of the knee and ankle joints.

Because of the length of bone that can be harvested, the fibula is suitable for restoration of total and subtotal mandibular defects. Hidalgo has described obtaining vascular pedicles as long as 12 cm. Another advantage is the ability to reconstruct soft tissue defects using the skin paddle (potential for sensory innervation) of the free fibula flap. The width of the skin paddle is mainly limited only by the ability to achieve primary closure; however, a skin graft can be grafted to the donor site. Several osteotomies can be performed by contouring the fibula to mimic the structure of mandible.

These osteotomies are well tolerated if the osteotomized segments are at least 1 cm in length and the overlying periosteum is kept intact. Also, the donor site's distance from the head allows a two-team approach, if desired. Over the past decade, computer-aided virtual surgery is performed for reconstruction of craniofacial defects. A cutting jig guides precise bony resection of mandibular pathological defects and of the fibula segment. Virtual surgery provides more accuracy and eliminates much of the guesswork of mandibular and fibular osteotomies. With the advancement in the computer aided mandibular reconstruction technology, a drop in the surgical time has been demonstrated.

A success rate of 95% bony union using vascularised bone graft and 76% success rate using non-vascularized bone graft was reported by Pogrel et al for the primary reconstruction of mandibular defects. Foster and colleagues reported similar results, with a 96% success rate using vascularized bone grafts and a 69% success rate using nonvascularized bone grafts[14]. Pogrel and associates also found that the rate of failure for nonvascularized grafts increased for segmental mandibular defects longer than 6 cm and that extreme caution should be used in using nonvascularized grafts for reconstructing segmental mandibular defects longer than 9 cm. The rate of failure for non-vascularized grafts of 6 cm or shorter was 17%; this rate increased to 75% for the grafts over 12 cm in length [15].

This correlation of increase in failure rate with increased graft length was not seen with the use of vascularized bone grafts. In context with the remaining choices, fibula has been the most desirable choice, as it has the multitudinous proven advantages: the length and quality of bone that can be harvested, a segmental vascularity that allows multiple osteotomies for shaping and contouring of the fibula, adequate bone height and width to receive endosteal implants, an intermediate-thickness skin paddle, a reliable vascular pedicle that can reach 8 to 12 cm in length, low donor site morbidity, and an ideal location for the two-team approach. In our case 9 cm of fibular graft was used for reconstruction of the mandible and our experience has been in accordance with the published data. We recommend its use in continuity defects if the mandible to restore form and function. OPG should routinely be done at 3 months interval to assess bone response(Fig.10,11).

Figure 1:Intraoral swelling on right side with vestibular obliteration and cortical expansion

Figure 2 : OPG showing multilocular radiolucency on left side with impacted 38

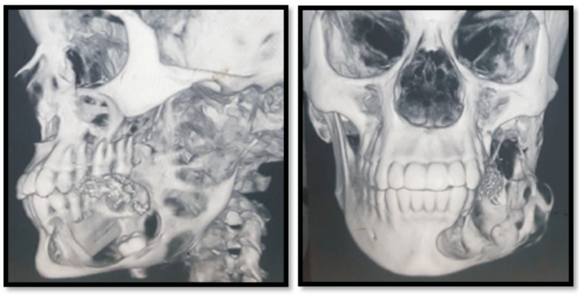

Figure 3: 3D CBCT showing bone resorption on affected side.

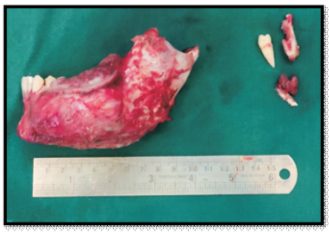

Figure 4 : Resected specimen

Figure 5 : Marking for harvesting free fibula

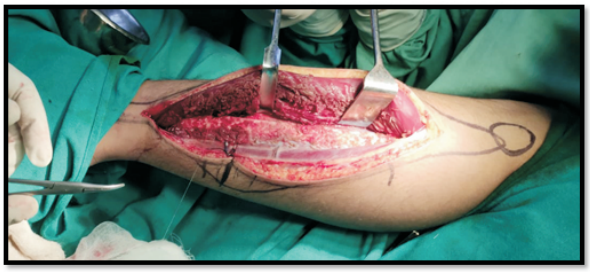

Figure 6: Exposure of fibular bone

Figure 7 : Vascular pedicle along with osseous attachement

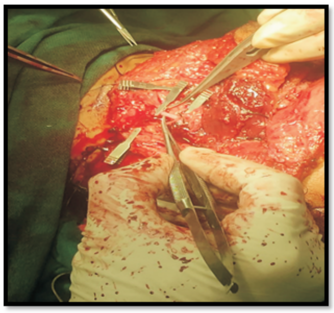

Figure 8 : Anastomosis between Peroneal artery and Facial artery

Figure 9 : Immediate post-op

Figure 10 : OPG 3 months post-op

Figure 11 : OPG six months post -op

Conclusion :

Oromandibular reconstruction is a complex procedure with various options. The surgeon's team should carefully deal to preserve adequate vessels if micro-vascular tissue transfer is planned. The soft tissue repair should provide sufficient bulk and ensure adequate tongue mobility. Also, the reconstruction must provide sufficient durability and strength to allow resumption of daily activities. A watertight closure should be achieved to avoid chances of infection or fistula.

Our results reveal that for reconstruction of mandibular defects, free fibular flap is a reliable method with a low morbidity rate. The application of the flap provides satisfactory reconstruction of composite mandibular defects.

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