



Journal Homepage: - www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/5432
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/5432>



RESEARCH ARTICLE

MANDIBULAR RECONSTRUCTION WITH VASCULARISED FREE FIBULA FLAP.

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Manuscript Info

Manuscript History

Received: 15 July 2017
 Final Accepted: 17 August 2017
 Published: September 2017

Key words:-

Fibula, Microvascular, Reconstruction, Mandible, Osteocutaneous flap.

Abstract

Objective: To study etiology of mandibular defects, the versatility of vascularised free fibula flap, the functional and cosmetic outcome in patients undergoing mandibular reconstruction and complications associated with microvascular free fibula flap.

Methodology: The study was conducted in the department of Burns, Plastic, Reconstructive and Microvascular surgery SKIMS Srinagar from DEC- 2012 to AUG- 2014. The patients undergoing mandibular reconstruction during this period were the subjects of study.

Results: The study included 20 patients; there were 14 males and 6 females. The etiology of mandibular defect in 17 patients (85%) was post tumor excision, in 2 patients (10%) mandibular defect was secondary to fire arm injury and there was 1 patient (5%) of post bear maul mandibular defect. Primary reconstruction was done in 18 patients (90%) and reconstruction was secondary in 2 patients (10%). Osteocutaneous flap was harvested in majority of patients (90%), bone only flap was used in two patients (10%) The average length of bone flap was 10 cm (range 6cm to 14cm), skin paddle measuring an average of 12x6cm (range 8x6cm to 16x9cm) was transferred with bone flap in osteocutaneous flap. In majority of cases (18 patients) donor site was covered by split thickness graft, and in two cases donor site could be closed primarily. Functional result was good in sixteen patients (80%), fair in three patients (15%), and poor in one patient (5%). Cosmetic result was good in fifteen patients (75%), fair in four patients (20%), and poor in one patient (5%). Complications developed in three patients (15%). There was complete flap loss in one patient (5%) due to venous thrombosis. Skin paddle was lost in one patient (5%) but the bone flap survived. orocutaneous fistula developed in one patient (5%). Donor site morbidity was recorded in five patients (25%). Calf paresthesias developed in two patients (10%), pain in lower leg developed in two patients (10%), and there was partial graft loss at donor site in one patient (5%).

Conclusion: The fibula osteocutaneous free flap allows the reconstruction of complex mandibular defects. It allows harvest of a long segment of bone, to reconstruct any length and part of mandible. Multiple osteotomies may be performed to achieve normal mandibular contour. The skin of the lower lateral leg is thin and pliable, with large

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amounts of skin available, allowing reconstruction of soft tissue defects in oromandibular region.

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Introduction:-

Mandible contributes to airway stability, is important in speech, deglutition, and mastication, and determines the shape of the lower face. Consequently, functional and aesthetic goals are important considerations in mandible reconstruction. The vast majority of segmental mandible defects are caused by tumors. Fire arm injuries are the most common traumatic cause, but their number is very small as compared to tumors. Segmental loss due to infection is rare. Mandible defects requiring reconstruction sometimes have segmental bone loss alone. However, the majority usually include adjacent intraoral soft tissue as well as soft tissue in submandibular region. Some bone defects include external skin loss only and the most complex include bone, mucosa, and skin.

Two classifications have been used for mandible defects. The more commonly used one describes the bone loss in terms of central segment (designated C and defined as lying between the two canine teeth), lateral segments (L), and hemimandible segments (H).⁽¹⁾ Hemimandible and lateral segments are similar except that the former includes the condyle, whereas lateral segments do not. A defect commonly is a combination of more than one segment, for example, LC, HC, or LCL.

Osteocutaneous free-flap reconstruction is the most effective method of mandible repair. These flaps have both soft tissue and bony components for reconstructing complex tissue defects. Free flap survival rates of up to 95% have been achieved.⁽²⁾ Since the development of free-flap for mandible reconstruction there have been multiple donor sites from which to choose. Rib, metatarsal, and ilium were among the first flaps developed.⁽³⁾ The ilium was the most popular of the three due to its abundant bone stock. The ilium was the workhorse free flap during the first decade of free flap mandible reconstruction⁽⁴⁾. Further evolution in microvascular surgery led to the development of the radius, scapula, and fibula as other donor sites⁽⁵⁾. These additional options have increased the flexibility and precision of the technique in reconstruction of complex oromandibular defects.

Recent studies have shown that the fibula is currently the donor site of choice for most patients⁽⁶⁾. The free fibula flap is the most versatile and reliable option for the reconstruction of large mandibular defects.⁽⁷⁾ The free fibula flap was introduced in 1975 by Taylor⁽⁸⁾, and Hidalgo confirmed in 1989 that it could withstand multiple osteotomies and successfully recreated the subtle mandibular contour⁽⁵⁾. However, it was Chen et al. who described the fibula osteocutaneous free flap in 1983⁽⁹⁾. The inclusion of a skin paddle enhanced the reconstructive potential of the fibula flap which allowed simultaneous reconstruction of composite mandibular defects. Fibula flap provides up to 25 cm of bone and a skin paddle as large as 10cm x 20cm can be harvested with bone.⁽⁵⁾ The bone stock of the fibula flap along with its bicortical and cancellous structure makes it excellent for the placement of osseointegrated implants.

Methods:-

The study was conducted in the department of Plastic, Reconstructive and Microvascular surgery SKIMS Srinagar. The patients undergoing mandibular reconstruction by free fibula were subjects of the study.

Results:-

The study included 20 patients; there were 14 males (70 %) and 6 (30 %) females, male to female ratio was 2.33:1. In 85% of cases (17 patients) mandibular reconstruction was done for defects following excision of tumor, which included 12 cases of squamous cell carcinoma, 3 cases of mucoepidermoid carcinoma and 2 cases of ameloblastoma. In 2 patients mandibular defect was secondary to fire arm injury and there was one case of post bear maul mandibular defect.

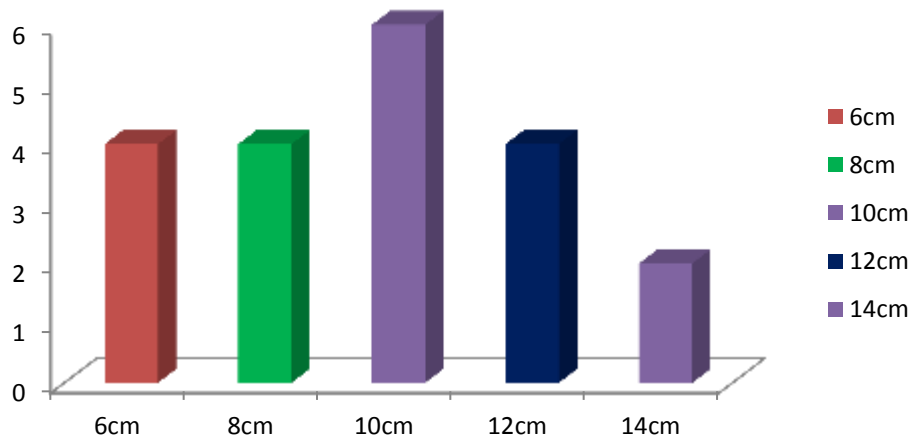
Table 1:- Etiology of mandibular defects

Diagnosis	Number of patients	Frequency
Squamous cell carcinoma	12	60%
Mucoepidermoid carcinoma	3	15%
Ameloblastoma	2	10%
Fire arm injury	2	10%

Bear maul	1	5%
Total	20	100%

Reconstruction was primary in eighteen patients (90%), and secondary in two patients (10%). Osteocutaneous flap was harvested in majority of patients (90%) and bone only flap was used in two patients (10%). In case of osteocutaneous flap, single skin paddle was used in seventeen patients (85%), and double skin paddle was used in one patient (5%) for lining as well as cover. In case of osteocutaneous flap, the skin paddle was used as intra oral lining in 14 patients. It was used as cover in 3 patients. In one of our patients the double paddle osteocutaneous flap was used for lining as well as cover. The average length of bone flap was 10 cm (range, 6cm to 14cm). The average size of skin paddle transferred with the bone flap was 12cm x 6cm (range, 8x6cm to 16x9cm).

Table 2:- Length of bone flap used



Two osteotomies of bone flap had to be done in five patients (25%) for central segment reconstruction, single osteotomy was done in seven patients (35%) to reconstruct lateral segment of mandible. 1.5 mm to 2 mm titanium miniplates were used for fixation. A minimum of two plates were used to stabilize each osteotomy site. The number of miniplates used ranged from 4 to 8 in each patient. In majority of cases (18 patients) donor site was covered by split thickness graft, and in two cases donor site could be closed primarily. Functional result was good in sixteen patients (80%), fair in three patients (15%), and poor in one patient (5%). Cosmetic result was good in fifteen patients (75%), fair in four patients (20%), and poor in one patient (5%). Post operative complications developed in three patients (15%). There was complete flap loss in one patient (5%) due to venous thrombosis. Skin paddle (used as cover) was lost in one patient (5%) but the bone flap survived, which was subsequently covered by another flap. Orocutaneous fistula developed in one patient (5%), which healed spontaneously.

Table 3:- Post operative complications

Complication	Number of patients	Frequency
Complete flap loss	1	5%
Skin paddle loss	1	5%
Fistula formation	1	5%
Total	3	15%

Donor site complications were recorded in five patients (25%). Calf paresthesias developed in two patients (10%), which improved with time. Pain in lower leg developed in two patients (10%), it was managed by analgesics and graft loss in one patient. No patient developed peroneal nerve injury or ankle instability.

Discussion:-

Reconstruction of complex mandibular defects is a challenge to any reconstructive surgeon. Any interruption in mandibular continuity results in both cosmetic and functional deformities. When reconstructing mandibular defects, the restoration of bony continuity alone should not be considered; the functions of chewing, swallowing,

articulation, and oral competence must also be taken into account. ⁽⁶⁾ The present study was carried out on 20 patients who underwent reconstruction with free fibula flap for mandibular defects. Among these, 14 patients were males and 6 were females. The age of patients ranged between 12-70 years with the mean age of 45 years. In majority of our patients two teams operated at the same time, as the fibular flap harvest allows the ablative and reconstructive surgeons to work simultaneously. The duration of surgery was reduced but still the duration of surgical procedure was longer than conventional procedures. The range of operation time was 8-12 hours with average time of 10 hours. The range of hospital stay was 14-28 days and average stay was 18.4 + 4.5 days. The donor site in majority of patients (90%) was covered by split thickness skin graft and in two patients (10%) the donor site was closed primarily as bone only was harvested. Most reconstructions had one to two osteotomies within the bone flap in addition to requiring fixation at each end. Therefore, each patient had at least four sites requiring stabilization. There were no osteotomy site fractures or nonunions in any patient. Thus it can be concluded that multiply osteotomized bone grafts have adequate blood supply and these flaps heal like normal bone. It has been demonstrated that the multiple screws and plates necessary at each site of fixation do not compromise graft blood supply ⁽¹⁰⁾. Osteocutaneous flap was harvested in majority of patients (90%) and bone only flap was used in two patients (10%). The fibula can be harvested as a pure bone flap or together with muscle and skin, permitting greater flexibility in the reconstruction of complex oromandibular defects. The skin paddle can also be harvested as a neurosensory flap, and a vascularized nerve graft can be harvested with the fibula flap ⁽¹¹⁾. Multiple skin paddles can be harvested with the fibula flap, based on the septocutaneous and the musculocutaneous perforators ⁽¹²⁾. Functional result was assessed in terms of speech, ability to manipulate food bolus, swallowing and oral competence. Functional result was good in sixteen patients (80%), fair in three patients (15%), and poor in one patient (5%). Our findings were similar to other published series. Adam Maciejewski ⁽¹³⁾ reported that the functional results are good-to-excellent for a majority of patients. Bong Chul Kim et al ⁽¹⁴⁾ reported that vascularized free-tissue transfers have become the most feasible option for the reconstruction of maxillofacial defects. Free flaps can provide superior functional results in the maxillofacial region. Cosmetic result was assessed in terms of facial symmetry, contour of midface, and any deviation of mouth. Cosmetic result was good in fifteen patients (75%), fair in four patients (20%), and cosmetic result was poor in one patient (5%). Hidalgo and Andrea ⁽¹²⁾ reported a series of 20 patients who underwent fibula free flap reconstruction of mandibular defects. Aesthetic outcome was judged to be excellent in 55 percent of patients, good in 20 percent, fair in 15 percent, and poor in 10 percent. Dragos et al ⁽¹⁵⁾ reviewed their experience with free fibula osteofasciocutaneous flaps in a series of seven patients. The aesthetic outcome was reported to be satisfactory in all patients. In our study there was one complete graft failure, due to venous thrombosis. There was an overall success rate of 95%. None of the patients had plate exposure or extrusion. The success rate of 100% was reported by Cheung et al ⁽¹⁶⁾ in their series of 12 fibula flaps used to reconstruct anterior mandibular defects. W Fu-Chan et al ⁽¹⁸⁾ reported a success rate of 96.3 percent in their series. The use of free bone flaps for mandibular reconstruction has the obvious advantage of being a well-vascularized tissue that can withstand the hostile environment of the oral cavity. The vascularized bone flaps maintain bone stock, resist resorption and can withstand radiotherapy with little risk of radionecrosis ⁽¹⁸⁾. Postoperative complications developed in three patients (15%). There was complete flap loss in one patient (5%). Skin paddle was lost in one patient (5%) but the bone flap survived, and was covered by another flap. Orocutaneous fistula developed in one patient (5%), which healed spontaneously. Lopez-Arcas et al ⁽²¹⁾ in their series of 117 patients reported that thirty-one patients (26.5%) developed postoperative complications, including hardware failure or intolerance in 16 patients (13.7%), total or partial flap failure in 10 patients (8.5%) and wound infection in 3 patients (2.6%). Nabeela and Warraich ⁽¹⁹⁾ reported recipient site complications included wound infection in 6 patients (35.2%), dehiscence of the wound in 3 patients (17.6%) and one patient with fire arm injury had fistula formation (5.8%). Complication rate in our study was similar to other published series. More than 75% of patients had normal leg function. Donor site morbidity included calf paresthesias in 2 patients (10 %), 2 patients complained of leg pain and claw-toe deformity in one patient (5%). There was no case of peroneal nerve injury and ankle instability. Our study revealed that majority of the patients had normal leg function and results were in concordance with the literature. Hidalgo ⁽²⁰⁾ reported that donor site morbidity was usually mild and transient. The most significant problem reported was delayed healing of donor sites closed with a skin graft. Postoperatively all patients ambulated normally. By selectively dissecting the perforators of skin paddle using hand held Doppler in the posterior crural septum, no muscular cuff is needed to ensure the vascularity of the skin paddle in most of the cases, resulting in less morbidity at the donor site. Also the flexor hallucis longus and tibialis posterior are sutured to the interosseous membrane after flap harvest, as described by Wei et al ⁽²¹⁾, to provide a new insertion to the muscle. Early mobilisation is recommended in all patients to avoid scar contracture and muscle atrophy.

Conclusion:-

The fibula osteocutaneous free flap allows the reconstruction of complex mandibular defects. It allows harvest of a long segment of bone, to reconstruct any mandibular defect. Multiple osteotomies may be performed to achieve normal mandibular contour. The skin of the lower lateral leg raised with bone flap is thin and pliable, with large amounts of available skin, allowing reconstruction of soft tissue defects in oromandibular region. The fibula flap harvest can easily be performed simultaneously with the head and neck procedure. Preoperative mapping of the cutaneous perforators improves the versatility of the flap design and decreases the donor site morbidity. Primary reconstruction of mandibular defects following excision of tumors provides good functional and cosmetic outcome. Given the reconstructive potential for restoration of form and function, the fibula flap will remain a workhorse in complex mandibular reconstruction for years to come.

Compliance with ethical standards:-

1. The authors declare that there is no conflict of interest.
2. A written informed consent was taken from every patient included in study.
3. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.
4. The authors declare that they received no grant for the study.