Original Article

# AN EARLY EXPERIENCE OF MANDIBLE RECONSTRUCTION USING FREE FIBULA: OSSEOUS AND OSTEOCUTANEOUS FLAPS

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## ABSTRACT

***Objective:*** *To evaluate the outcomes of using the free fibula, osseous and osteocutaneous flaps for reconstruction of mandibular defects resulting from trauma and after tumour resection.*

***Material and Methods:*** *This descriptive study was conducted at the Plastic Surgery Unit, Hayatabad Medical Complex Peshawar and Plastic Surgery and Burn Unit, Khyber Teaching Hospital, Peshawar from January 2009 to July 2013. A total of 11 patients underwent reconstruction of mandible for defects either caused by trauma or after excision of malignant tumors. Fibula osseous or osteocutaneous flaps were used for the reconstruction of mandibular defects.*

***Results:*** *There were 11 patients including 8 males and 3 females. The age of the patients ranged from 26-54 years and the mean age was 37 years. Indication for mandibular resection were squamous cell carcinoma of the floor of the mouth and alveolar ridge in 4 cases and central giant cell granuloma of the mandible in one case. All the 6 cases of trauma sustained firearm injuries that resulted in shattered mandible. Primary reconstruction of the mandibular defects was performed in all the patients. Nine of the flaps survived out of the total 11. Venous thrombosis was the cause of failure in the two flaps. In one patient partial necrosis of the skin paddle occurred. Partial wound dehiscence and delayed wound healing was observed in 4 patients. Apart from scarring at the dondor site, we observed ankle instability in 1 patient and residual pain in 3 patients and a temporay foot drop in one patient. The patients started oral feeding in the fourth week after operation and they were completely mobilised in 10 weeks' time.*

***Conclusions:*** *Fibula Free Flap is a reliable and adaptable choice for mandible reconstruction with relatively low donor site morbidity and good long-term outcomes.*

***Key words:*** *Free fibula, mandible reconstruction, microsurgery*

## INTRODUCTION

Reconstruction of the defects in the craniofacial region is indicated in cases of trauma, infections and after cancer ablation. The nature of the individual defects varies and may either require restoration of soft tissues or bony defects alone or may necessitate the reconstruction of composite tissue loss. Reconstruction of such defects poses a challenge because of the prominence of the region and the concerns for adequate function and cosmesis[1,2].

The soft tissue defects of the facial region may be reconstructed with simple procedures like skin grafts, fasciocutaneous or musculocutaneous flaps. Defects resulting from missile injuries or tumor excision are usually difficult to restore. The full thickness defects with composite tissue loss needs to be restored with composite tissues that include bone and should be

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managed with a flap that contains vascularized bone[3].

Mutilation of the facial region not only spoils the beauty of the face but also sets an untoward effect on patient's psychology. The restoration of the anatomy in such defects is a dilemma for the reconstructive surgeon. Segmental mandible defect reconstruction used to be one of the most difficult tasks in maxillo-facial surgery. Due to particularities of each patient and despite a large variety of surgical techniques available for such cases, the choice of the most suitable method remains an important issue. In the past few years microvascular surgery has nmade the reconstruction of challenging defects possible[2,4]. One of the best advances in this area is represented by the free fibula transfer.

Prior to the advent of free tissue transfer, reconstruction of the defects of mandible and midface was suboptimal[5]. The mandibular defects used to be reconstructed with metallic plates, free bone grafts or combination of both. Several studies have reported on the various complications associated with the use of reconstruction plates such as wound dehiscence with plate exposure, infection from loosening and breakage of screws, plate fracture and unsatisfactory facial contour[6]. Plating across the defects with non-vascularized bone grafts also results in plate exposure, particularly in irradiated patients. For coverage of the plates certain bulkier flaps were used with varying degrees of success[7,8]. Certain microvscular free flaps like free scapular flap, free radial forearm flap and iliac crest have been used for the reconstruction of mandible. The radial forearm flap was developed in China[9]. The advantage of radial forearm flap is that approximately 10-12 of bone can be harvested but the fracture of radius at donor site remains a complication and moreover the thin radius does not allow for multiple osteotomies[2]. Gilbert and Teot described the use of free subscapular flap along with 14 cm of bone[10]. The disadvantage is the location of the donor site which forbids simultaneous harvest of the flap at the time of tumor resection. The iliac crest was the main free flap used for mandibular reconstruction in 1980s however the short vascular pedicle and the lack of segmental perforating vessels limits its use for osteotomies[11].

Taylor DI developed the free fibula flap in 1975 and five years later, in 1983, Chen and Yan described the reconstruction of composite defects by a free fibular osteocutaneous flap[9,12]. In 1984 Yoshimura found that the bone viability may be assessed by skin inspection due to the availability of the septocutaneous branches of the peroneal artery[13]. Hidalgo in 1989 used the free fibula for reconstruction of mandible defects associated with lesions of the floor of the mouth[14]. Since then the fibula was adopted by various authors and some of them were able to standardize its use[15]. Nowadays, the free osteofaciocutaneous fibula flap is considered suitable for short segments of bone defects, associated or not with external skin replacement, floor of mouth defects or buccal mucosa defects or for hemi mandible reconstruction. Its use is limited only in large through and through defects, where the defect concerns more the soft tissue than the bone[16].

The current study was considered to determine the results of using the free fibula osseous and osteocutanous flaps for reconstruction of wide range of mandibular defects. The combined teams of Maxillofacial Surgery and Plastic Surgery Departments performed more complex surgeries in order to improve our oncological and functional outcomes.

## METHODS AND MATERIALS

This descriptive study was conducted over a period of 4 ½ years from January 2009 to July 2013 at the Plastic Surgery Unit, Hayatabad Medical Complex Peshawar and Plastic Surgery and Burn Unit, Khyber Teaching Hospital Peshawar. A total of 11 adult patients were included in the study. The patients having mandibular defects due to trauma and those requiring mandibular resection were included in the study. Malnourished patients and those with abnormalities like impaired circulation of the leg, extensive leg trauma, diabetics with significant venous stasis or peripheral edema were excluded from the study. The patients, planned for reconstruction were admitted to the hospital. Detailed history, complete clinical examination and necessary investigations were performed. Patients were counseled pre-operatively about the procedure, its purpose with risks and benefits. Informed consent was taken from all the selected patients.

The surgeries were performed under general anesthesia. Hand held Doppler was used for identification of the perforating vessels. These were marked and the skin flap was then designed to incorporate at least one vessel. Teams of maxillofacial surgeons and plastic surgeons conjointly performed all the surgeries.

A tourniquet inflated to 300 mm Hg was used during harvesting. Incisions were placed over the skin markings. The peroneus longus was reflected anteriorly, and the fibular bone was identified. While harvesting the fibula, a 6 cm of bone was preserved proximally to avoid injury to the peroneal nerve. Similarly 8 cm of bone was left at the distal end to to support the ankle. Bone cuts were made with an oscillating saw and the bone was pulled laterally as the interosseous membrane was transected. The tibialis posterior was dissected and the pedicle underneath was identified and ligated. Dissection was carried upto the posterior tibial bifurcation. The anterior and posterior tibial pulses were palpated prior to transecting the poreneal vessels. The length of bone needed for reconstruction was measured. Multiple osteotomies were performed for contouring of the bone. A split thickness skin graft was used for coverage of skin defect that could not be closed primarily. After aseptic dressing of the wound a posterior splint was applied. The bone was plated and inset into the defect. The pedicle was positioned along the lingual aspect of the flap. The anastomosis was then performed with standard microvascular techniques. Intermaxillary fixation done and at the end of surgery a nasogastric tube was inserted for feeding purposes.

Postoperatively all the patients were started on intravenous antibiotics, analgesia and fluids. Heparin was given for three days and later replaced with oral aspirin 75mg twice daily. Flap monitoring was performed clinically. The patients were mobilised in a non-weight bearing fashion on the second postoperative day. The splints were removed and the skin graft was assessed on the fifth postoperative day. The patients were then allowed to bear weight using walker or any other assistive device. The patients remained hospitalized for 3-4 weeks. For the first two weeks feeding was allowed with soft diet through naso-gastric tube. Lower limb was immobilized with a cast for the same period. Patients were counseled regarding jaw opening exercises to minimize the impact of this complication.

The data was analyzed by SPSS version 17. The variables under study were age, sex, operative time, donor site morbidity, flap survival, duration of NG tube feeding and postoperative complications (infection, dehiscence, skin necrosis, delayed wound healing or fistula formation). Simple descriptive statistics were used.

## RESULTS

A total of 11 patients 8 (72.72%) males, 3(27.27%) females; mean age 37 years, range 26 years to 54years were included in this study. Mandibular defects resulted from trauma or tumor resection. The details of etiology of mandibular defects are given in table 1.

The mandibular defects were described according to the Jewer classification. There were 6 central (C) defects, 2 lateral (L) defects and three combined central- lateral (LC) defects. The lateral segment defects were reconstructed with a straight piece of vascularised free fibula whereas osteomities were performed for the central and combined LC defects.

The average operating time was 6.5 hours. Primary mandibular reconstruction was implemented in all the patients. Free fibula osseous flap was performed in 4 cases and osteocutaneous flap was performed in 8 patients. The range of hospital stay was 3-4 weeks the range of duration of NG tube was 14-22 days. Postoperative radiotherapy was given to 4 patients.

Out of the 11 flap transfers, 9 (81.81%) were

**Table: 1 Etiology**

| Diagnosis | n | % |
|---|---|---|
| Squamous cell carcinoma | 04 | 36.36 |
| Central giant cell granuloma | 01 | 9.09 |
| Firearm injury | 06 | 54.54 |
| **Total** | **11** | **100** |

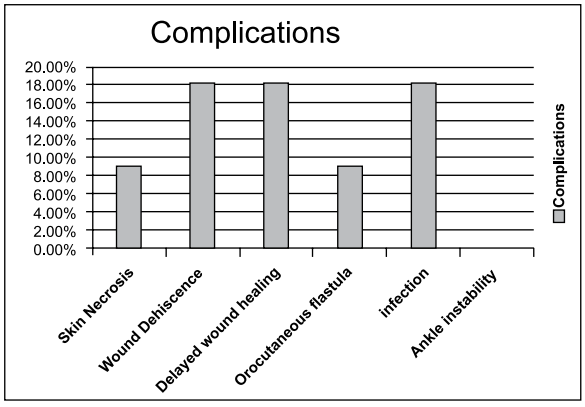
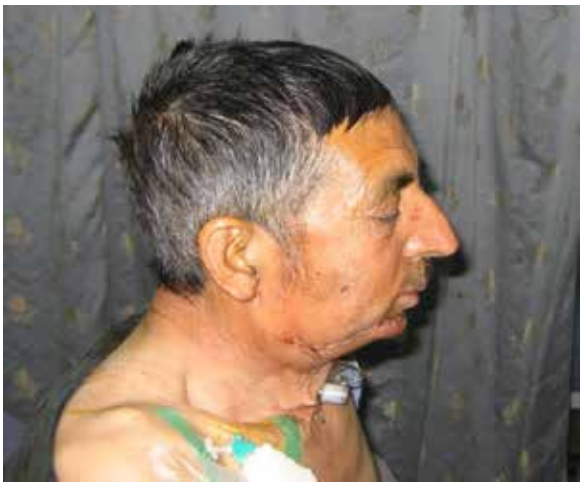



**Figure - 1:**

**a) Traumatic mandibular defect**

**b) fibula with fiaxation plate**

**c) Preop lateral view**



**d) Post op lateral view**

successful and 2 (18.18%) completely failed. Venous thrombosis was the cause of failure in the two osseous flaps. Despite re-exploration and thrombectomy the two flaps could not survive. Partial necrosis of the skin paddle was observed in one patient. Debridement of the necrosed portion and proper wound care resulted in a satisfactory outcome. Partial wound dehiscence occurred in 2 patients and secondary sutures were applied in both these flaps. Delayed wound healing was observed in 2 patients. Wound infections at the recipient site occurred in two patients which were managed by local antiseptic measures. Orocutaneous fistula developed in one patient and revisional surgery was performed for its closure. Apart from scarring at the dondor site, we observed ankle instability in 1 patient and residual pain in 3 patients and a temporary foot drop in one patient. The patients started oral feeding in the fourth week after operation and they were completely mobilised in 10 weeks' time. Details of complications are given in Figure 1.

We did not notice any significant difficulty in both feeding and speech in any case. None of the patient received implants for dental rehabilitation.

## DISCUSSION

Restoration of mandibular defect poses a challenge to the reconstructive surgeon. Optimal aesthetic and functional outcomes are desired due to the prominence and social importance of the region. Mandibular defects at certain anatomic sites have distinctive complications and they should be reconstructed with the most appropriate reconstructive option to meet the essential needs of the patient. The goal of treatment is to restore the continuity of missing bone segment, provide foundation for dental restoration, provide soft tissues for internal lining and the external cover and

restore sensate and functioning lower lip with adequate buccal sulcus.

Mandible reconstruction is indicated in cases of mandibular defects caused by ailments like congenital, pathologic, and iatrogenic; as a result of tumour excision, infections or post-radiation necrosis; motor vehicle injuries, diverse injuries like gunshot injuries, interpersonal assaults, burns, electrical flashes and splashes[1,17,18]. In present study we found traumatic mandibular defects due to firearm injuries to be the common indication followed by the oncological resection. While studying the indications for mandible reconstruction, Sajid MAH and Szpindor E reported the the most common indication for reconstruction of the mandibular defects as oncological resection, followed by resections secondary to osteodystrophy, osteoradionecrosis and facial trauma[18,19]. Firearm inflicted injuries are common in our region due to the social and cultural system and secondly due to the unending terrorist activities.

Although the free fibula was described by Taylor GI in 1975 but Hidalgo performed the first mandible reconstruction using a free fibula transfer in 1989[12,14]. In 1991 he also realized that this technique could be applied for most of the mandible reconstructions[15]. Fibula has a double vascularization, both endosteal and periostal. This aspect is of particular importance, since it makes possible to perform multiple segmental osteotomies without jeopardizing bone viability. The periosteal vascularization provides the freedom for mandible shape reconstruction[20]. There is no length restriction and the 25 cm available exceeds the span of any mandible defect to be reconstructed. The flap has a long vascular pedicle (up to 8 cm) and vessels have a large caliber (2-3 mm the artery and 3-4 mm the vein). Their caliber allows the loupes only magnification in free transfers in adults[21,22,23].

Mandibular defects can be reconstructed with nonvascularized bone grafts, titanium reconstructive plates or microsurgical techniques that allow the use of vascularized bone[5]. In the present study mandible reconstruction was performed using the free fibula osseous and osteocutaneous flaps. We found that two of the eleven flaps could not survive but still the success rate was 81.8%. Although the success rate is lower than the international studies however this figure can be compared with the success rate of 82.6%, concluded by Riaz N in a similar study[24]. The cause of failure in both the patients was venous thrombosis same as reported by Riaz N in one of their case[24]. Peiptu D reported that all the flaps were successful in the seven operated patients[20]. Peled reconstructed 13 patients of discontinuity defects of the mandible with free fibular flap and two flaps were lost with the success rate of 84%3. In another study 21 cases of mandibular reconstruction with fibula free flap were evaluated[5]. They performed 7 free osseous fibula flaps and 14 osteocutaneous fibula flaps. All flaps except one survived and they confirmed the viability by scintigraphy[5].

Primary reconstruction of the mandible has an edge over the secondary reconstruction. We performed primary reconstruction of the mandible in all the cases. The benefits of an immediate or primary reconstruction are; the constraint of size, contour and bone orientation to the opposing maxilla can be evaluated and achieved more precisely, surgery is performed in a fresh and scarless bed and the distortion produced by forces of wound contraction on the remaining soft tissues and the mandibular fragments after resection is lessened. Early patient rehabilitation is possible in primary reconstruction and the number of operations is reduced minimizing the hospital stay and the morbidity[20,22,23].

Patient with advance tumor usually present with co morbid conditions and reducing surgical morbidity and operating time should be a major concern in their treatment[24,25]. In the present study we were able to finish the whole surgery including tumor resection and flap harvest and inset in six and half hours on average. This is consistent with the studies performed by Riaz N and Rosenthal E[17,26]. The various postoperative complications that we observed in our study were similar to those reported by contemporary authors of our country. Riaz N and Sajid MAH in their studies have also described venous thrombosis as the cause of flap failure[18,26]. Skin necrosis, delayed wound healing and orocutaneous fistula have all been described as the complications related to the procedure. We did not apply dental implants in any of the reconstructed mandible, however, Tosoco et al in their study have reported with better functional and aesthetic results after they had prosthodentically rehabilitated the patients via implants[27].

In the current study two teams of plastic surgeons and maxillofacial surgeons accomplished the

procedures together. While the maxillofacial surgeons performed the head and neck dissection and tumor resection, the plastic surgery team performed the flap dissection, and vascular anastomosis. Both teams participated in osteotomies and bone fixation[5].

## CONCLUSIONS

Mandibular defects arising either from tumor resection or commuinuted fractures are common in our region. Fibula Free Flap is a reliable and adaptable choice for mandible reconstruction with relatively low donor site morbidity and good long-term outcomes. Majority of our poor patients have no access to avail the modern facilities and there is an urgent need to upgrade the facilities in our tertiary care hospitals.

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