

## ERGONOMICS OF FREE FIBULA FLAP IN MANDIBLE RECONSTRUCTION

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### Abstract

Primary Objectives: To do cadaveric dissections with the objectives of, • To find the location of perforator with good size, diameter and length to serve as the single best perforator for chimeric free fibula osseocutaneous/ osseomyocutaneous flap for reconstruction of mandible • To find the safe site for osteotomy and application of contoured plates and screws **MATERIALS AND METHOD:** We applied the knowledge obtained through the cadaveric studies to our clinical cases. 20 cases requiring oro-mandibular reconstruction were taken up for the study. The general etiologies of the cases were: Trauma, Dental Cysts and malignancy. In all the cases the free fibula flap was harvested with the single best perforator to the skin paddle placed eccentric in location. **DISCUSSION:** Mandible is an important structure which not only forms the lower jaw but also gives character to the face. • If the eccentric location of the pedicle of the skin paddle affect the survival of the flap. **CONCLUSION:** when positioned inferiorly and posteriorly in mandible reconstruction site, gives better manoeuverability during anastomosis of the flap pedicle to the recipient vessels and also does not cause kinking of the vessel. From of cadaveric and clinical studies we have tried to answer some of the burning questions of the free fibula osteomyocutaneous flap procedure.

**Keywords:** Osseocutaneous, Ergonomics, Manoeuverability, Vascularaised

### INTRODUCTION

Composite defects in the oro-mandibular region commonly resulting from trauma and cancer surgeries pose a great challenge for the reconstructive surgeon. It envisages the surgeon's planning abilities and abstractive thinking about the defect that has to be reconstructed. Seeing that Mandibular defects occur more commonly secondary to wide local excision for carcinoma in the oro-mandibular region, they produce significant morbidity by affecting both the function and aesthetics of the face. Also most carcinoma patients may already have had a course of radiotherapy or might need radiotherapy post-surgically. This imposes further burden on any of the flaps designed to cover the cancer post-excisional defect. Having decided on the use of vascularaised free fibula osteomyocutaneous flap for the reconstruction, the surgeon has to plan the flap taking into accounts multitudes of factors like positioning of the skin paddle, the site to harvest the flap, the muscles to include in the flap to obliterate the dead space, length of the pedicle needed for a tensionless anastomosis, length of the bone needed to replace the mandible lost in surgery, the number and sites of osteotomies needed to get the desired curvature and the positioning of the pedicle in the graft for anastomosis without kinks in the vessels.

Previous radiotherapy and post-radiational vascular diseases impose further challenges in choosing a healthy recipient vessel in the neck for anastomosis. Reconstruction of the mandible not only brings back the contour of the chin, it also

acts as base for fixing prosthetic dentition and thus aids in various functions like chewing, deglutition, breathing and speech.

### **Primary Objectives:**

To do cadaveric dissections with the objectives of,

- To find the location of perforator with good size, diameter and length to serve as the single best perforator for chimeric free fibula osseocutaneous/osseomyocutaneous flap for reconstruction of mandible
- To find the safe site for osteotomy and application of contoured plates and screws

### **Clinical Studies:**

We applied the knowledge obtained through the cadaveric studies to our clinical cases. 20 cases requiring oro-mandibular reconstruction were taken up for the study. The general etiologies of the cases were: Trauma, Dental Cysts and malignancy. Sex distribution: Males 18, females 2. Of the 20 clinical cases, 2 cases of ameloblastoma and 2 cases of road traffic accidents did not require skin cover. They involved only mandibular reconstruction with lining. The rest of the 16 cases were malignant conditions, necessitating wide local resection. All the 16 cases required reconstruction of the mandible with both mucosal lining and skin cover.

In cases of post-excisional defects in the floor of the mouth, during harvesting of the free fibula flap, a segment of the soleus muscle was taken as part of vascularised free fibula chimeric osteomyocutaneous flap. The soleus muscle was used to give padding to the floor of the mouth and to fill the cavity created by the excision procedure. In cases where there is composite deficit in the peri-commissural and lip area, skin paddle was harvested in adequate dimensions as part of the vascularized free fibula chimeric osteocutaneous flap and folded to provide both the lining and the cover. In all malignant condition modified radical neck dissection was performed as protocol by the surgical oncologists and ENT surgeons. The maximum size of skin paddle that was harvested with the pedicle in eccentric location was 15x8 cm. (120 cm<sup>2</sup> ). In all the cases the free fibula flap was harvested with the single best perforator to the skin paddle placed eccentric in location.

If the composite defect envisages distance apart from lining and cover, we harvest skin paddle of adequate size in eccentric location from the middle third of the leg (where we can get good length of perforator). Thereby we use the biogeometry of properllar flap due to the eccentric location of the perforator in relation to the paddle. On the other hand, if the composite oro-pharyngeal defect does not require cover but only a long bone stock, then the free flap is harvested from the lower third. The average operating time ranged from 3½ to 6 hours. In our study, safe skin paddle with a maximum dimension 120 cm<sup>2</sup> was safely harvested in chimeric configuration with eccentric location of perforator to the skin paddle which allowed us to better manipulate the skin paddle three dimensionally during positioning of flap in composite reconstructions. We found that it was advantageous to harvest from middle third as it contains the lengthy perforators. If there is need for long pedicle and robust perforator with good length next best choice is to choose from lower third of fibula The next aspect studied is optimal positioning of peroneal vessel in relation to graft during fixation of osteotomies. The posteromedial surface of the fibula which contain peroneal

vessel, when positioned inferiorly and posteriorly in mandible reconstruction site, is the optimal position without causing any kinking on vessel

## DISCUSSION

Mandible is an important structure which not only forms the lower jaw but also gives character to the face. Loss of the mandible and the soft tissue of the oro-mandibular region, either due to trauma or post-surgical, cause great distress to the patients – both functionally and aesthetically. Hence it needs to be reconstructed to provide optimal functional and aesthetic outcome to the patient. With many regional, loco-regional and distant flap options available, the vascularized free fibula chimeric osseomyocutaneous flaps have become the gold standard for reconstruction of the oro-mandibular defects. With the increasing importance to the vascularized free fibula flaps, there arises a need to standardize as much as possible the marking, dissection of the soft tissue, osteotomy sites of the fibula and its positioning in the recipient site. With this in mind, we conducted anatomical study of the peroneal perforator system in cadavers with dye injection and studied various parameters with the objectives of,

- Location of the single best peroneal perforator in the leg,
- Location of the best site surface and site for osteotomy of the fibula These cadaveric dissection findings were then applied to live surgeries and the outcomes observed. In addition two more parameters studied in the clinical cases
- Best position of the flap in the recipient site that does not cause strain in the pedicle.
- If the eccentric location of the pedicle of the skin paddle affect the survival of the flap.

## CONCLUSION

Vascularized free fibula osteocutaneous flap is an established procedure for reconstruction of the oro-mandibular defects but several questions arises like; what is the location of the single best perforator for the skin paddle? What is the safe skin paddle dimension that can be harvested on a single eccentrically located pedicle? Where are the safe windows for osteotomy located on the harvested free fibula? What is the best position of the skin paddle in the recipient site which does not cause kinking of the vessel? etc., We have done cadaver studies and clinical studies to answer some of these questions. It was found from our studies that the perforators of good length and calibre are best found in the middle third of the leg, and most of the perforators were musculocutaneous travelling through the flexor hallucis longus muscle.

Hence if a larger skin paddle is needed, it can reliably be harvested from the middle third of the leg with the pedicle placed eccentrically. But if the defect requires a longer bone stock and a smaller pedicle, it is better to harvest from the lower third of the leg.

We also found from our clinical studies that designing the skin paddle with the pedicle eccentrically located allows for better three dimensional manipulation of the skin paddle in the recipient site, allowing it to cover wider area in the facial region like, cheeks, chin, upper neck, upper and lower lips etc., Also from our clinical studies we found that a single eccentrically located perforator of good length and calibre can support a skin paddle of 120 cm<sup>2</sup>.

We also found from our studies that the safe window for osteotomies can be found in the peroneal surface of the fibula as the musculoperiosteal vessels runs in the anteromedial and posteromedial surface of fibula. Hence osteotomies can be performed with the apex of the wedge located at the peroneal surface and base at the interosseus border. We found from our studies that the posteromedial surface of the fibula which contains the peroneal vessel, when positioned inferiorly and posteriorly in mandible reconstruction site, gives better manoeuvrability during anastomosis of the flap pedicle to the recipient vessels and also does not cause kinking of the vessel. From of cadaveric and clinical studies we have tried to answer some of the burning questions of the free fibula osteomyocutaneous flap procedure.

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