Reconstruction of mandibular continuity defect with double-barrel vascularised free-fibula flap – A Case Report

***Amarjeet Gambhir, ** Gita Rani**
*Department of Oral & Maxillofacial Surgery, S.K.S. Sarabha Dental College & Hospital, Ludhiana,Punjab,India
**Department of Prosthodontics, Christian Dental College, Ludhiana, Punjab, India.
Correspondence: Amarjeet Gambhir
E mail: amarjeetgambhir@yahoo.com

Abstract

Free vascularized fibula flap is presently considered to be the treatment of choice in mandibular reconstruction for extensive bone defects. Although the fibula flap presents many advantages over other donor sites, it does not offer sufficient bone height to restore the alveolar arch when reconstruction involves a dentate mandible, making prosthetic rehabilitation difficult. This patient report describes the "double-barrel" technique for secondary reconstruction of mandibular continuity defect in a young female following tumor resection. A fibula graft corresponding to at least twice the length of the mandibular defect was harvested, halved perpendicular to its length, and the resulting struts were folded on top of each other to form a "double barrel". The struts were then fixed to each other with plates & screws and stabilized in the defect using a reconstruction plate. Assessment of the patient at one year follow up showed successful reconstruction with no height discrepancy between the native mandible and the grafted fibula. In conclusion, vascularized double-barrel free fibula flap is a safe & reliable technique for comprehensive reconstruction of segmental mandibular defects. It creates better conditions for definitive prosthetic rehabilitation, obviating the need for secondary procedures such as distraction osteogenesis or onlay bone graft.

Key words : Bone defects, free-fibula flap, mandibular reconstruction, prosthetic rehabilitation

Introduction

Reconstruction of the maxillofacial region has been a challenge owing to the complexity of function and esthetics. The reconstruction of segmental mandibulectomy defects with free vascularized bone flaps is the current standard of care. A variety of donor sites, such as the iliac crest, radius, scapula, and fibula, have been used for this purpose with predictable long-term results[1]. Each technique has its own advantages and disadvantages. The radius and iliac crest have limited length while the scapula has limited width.

Free vascularized fibula flap was first used by Hidalgo[2] in 1989 for reconstruction of mandibular continuity defects and has indeed become the most popular reconstruction method nowadays. The fibula flap presents many distinct advantages, such as consistent shape, ample length & volume of bone, segmental blood supply, long vascular pedicle, low donor site morbidity and proper dimension for implant placement[3]. The only limitation is that its height is insufficient to restore the alveolar arch when reconstruction involves a dentate mandible. In these cases, despite a successful reconstruction, there is a height discrepancy between the native mandible and the grafted fibula, resulting in subsequent difficulty in wearing conventional dentures or osseointegrated implants[4] .

The present case report describes the secondary reconstruction of mandible with free vascularised fibula flap in a young female following tumor resection. A double-barrel technique was used to restore the full height of the mandible with regard to the final prosthetic rehabilitation.

Case presentation

A 27 year old female reported to the maxillo-facial surgery OPD with the chief complaint of facial asymmetry and difficulty in mastication since last 9 months. She gave history of resection for giant cell lesion of left mandible 1 year back. Subsequently, she complained of deviation on mouth opening to left side as well as difficulty in mastication.

Clinical examination revealed an asymmetrical face with obvious deviation on mouth opening to left side **(Figure 1)**. Intraorally, there was a continuity defect extending from right parasymphysis till left angle region of mandible. Teeth from right mandibular lateral incisor to left third molar were missing, and occlusion was deranged with lingual cross-bite on dentulous side **(Figure 2)**.

Radiographic examination (OPG) revealed a mandibular L defect extending from right lateral incisor to left angle region **(Figure 3)**.

Secondary reconstruction with a microvascular free-fibula flap was planned using the double-barrel technique. Under general anesthesia, a left submandibular incision

Figure1. Preoperative extraoral view showing obvious facial asymmetry.

Figure 2. Preoperative intraoral view showing mandibular deviation to left side with deranged occlusion.

Figure 3. Preoperative panoramic radiograph shows mandibular continuity defect extending from right lateral incisor region to left angle region

Figure 4. Double-barrel fibular graft osteotomized & fixed to native mandible reconstruction plate & screws using

Figure 5. Postoperative intraoral view showing correction of mandibular deviation & stable occlusion

was made to expose the mandibular ends. The exact length of the defect was measured to be 9 cm. Right facial artery and vein were isolated and prepared for microvascular anastomoses. 21 cm of right fibular bone was harvested under the tourniquet using Gilbert's lateral approach. Excess bone was taken to increase the pedicle length & was discarded. The graft was osteotomized at its midpoint, and the two segments were folded onto each other to form a double barrel. Two additional osteotomies were done, one in each strut, to simulate the mandibular contour. Temporary intermaxillary fixation was done and the graft was inset. The graft and the precontoured reconstruction plate were fixed to the native mandible with screws and transosseous wires **(Figure 4)**.

A 4 hole plate was used to fix the superior strut with the mandible in left angle region. Microvascular anastomoses were performed between the facial and peroneal vessels. Intermaxillary fixation was released and wound was closed in layers using suction drain.

Postoperatively, the patient was closely monitored for flap vascularity. Antibiotics were continued for 10 days, and patient was kept on nasogastric tube feeds for 8 days. Intermaxillary fixation was applied on 3rd postoperative day, and maintained for 2 weeks. Bone scan performed on

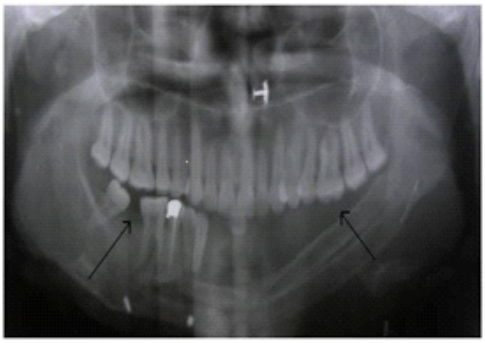

Figure 6. One year postoperative panoramic radiograph showing excellent mandibular contour with definite union between the graft & the mandible (arrows indicate height of graft comparable to native mandible)

the 10th postoperative day showed viable graft. Ambulation was started on 10th day and patient was kept on monthly follow up.

At 1 year follow up, mandibular contour was judged to be good with no deviation on opening the mouth **(Figure 5).** No donor site complication was seen. OPG showed definite union of the graft with the mandible with remodeling of the reconstructed portion. Importantly, no vertical discrepancy was seen between the reconstructed mandible and the dentate mandible on the unaffected site, creating an ideal situation for definitive prosthetic rehabilitation **(Figure 6).**

Discussion

Microsurgical techniques are now considered to be safe and reliable in reconstruction of the jaws after tumor resection. Among the different free flaps used for mandibular reconstruction, the fibula flap represents the most versatile & reliable option and has undoubtedly emerged as the favoured method in centers across the world.

The clinical and anatomic advantages of the free vascularized fibula flap are[5] :

- straight form and high mechanical resistance to pressure and torsion;
- rapid incorporation and healing of the highly vital flap, due to the excellent perfusion;
- composition, with a high content of cortical bone;
- great length, which allows the bridging of large defects;
- possibility of osteotomizing it at various points allowing adaptation;
- can be elevated with skin and muscle as an osteomyocutaneous flap;
- relatively simple harvesting of the flap with convenient sized blood vessels for anastomoses;
- low morbidity of the donor region.

The main disadvantage of this flap is the insufficient bone height (15 mm) for reconstruction of both the mandibular skeletal base and the alveolar ridge. This is especially evident in cases of partial loss of dentate mandibles. In these cases, a relevant vertical discrepancy between the reconstructed side and unaffected dentate mandible can create functional and aesthetic problems[6]. Several options can be considered to resolve this discrepancy. The fibula flap can be placed in an ideal position from a prosthetic viewpoint but this has a negative influence on the facial profile. The other treatment option to increase the height of the fibula flap is using a new revascularized flap or autogenous onlay bone graft on top of the first one. However, this solution is rarely accepted by patients because of further major surgery and morbidity. Vertical elongation of the revascularized fibula flap by distraction osteogenesis has also been described by certain authors[4,7]. However, this technique again requires additional surgical procedures and considerably increases the total treatment time & cost.

The double-barrel technique is a plausible way of restoring the full height of the mandible in the nonatrophic cases. This technique was first used by Jones et al[8] in 1988 in 3 patients with segmental bone defects of the distal femur and in 1 patient with adjacent bony defects of the radius and ulna. In 1995, Horiuchi et al[9] first used the double-barrel fibula graft for mandibular reconstruction in 5 patients and provided an alveolar height greater than 4 cm. Bahr et al[6] used the double-barrel technique for mandibular reconstruction in 8 patients. He et al[10] described use of double-barrel vascularised free fibula flap for mandibular reconstruction in 7 patients with satisfactory results.

Use of the fibula as a "double-barrel" graft is made possible by its peculiar blood supply. Dividing the graft and folding the struts onto each other does not affect the blood flow through the supplying vessels and the medullary cavity. This has been shown on cadaver fibula through injection of india ink[8]. The implant-bearing bone of the double-barrel graft shows a more suitable distance to the occlusal plane of the adjacent dentate mandible compared with the bone of the conventional single-strut fibula. This reduces the height of the prosthetic superstructure and diminishes unfavourable lever arm forces on the implants or the supporting teeth. A decisive advantage of the "double-barrel" technique is that the superior strut can be placed more lingually to mimic mandibular anatomy and avoid a cross-bite. A precondition for the use of "double-barrel" graft is that the height of the mandible should be at least twice the diameter of the fibula; otherwise, the reconstructed segment would be too high. The dimensional requirements limit the indication of the graft mostly to young patients.

Conclusion

Segmental defects of the mandible can be esthetically and functionally reconstructed by a vascularised double-barrel free fibula flap. It not only provides sufficient length of bone for reconstruction of large defects but also matches the height of the native mandible creating better conditions for definitive prosthetic rehabilitation in appropriately selected patients.

Acknowledgements

We would like to express our sincere thanks to Dr Amresh Baliarsingh and Dr Neelima Malik for their constant support and guidance throughout the preparation of this article.

References

1. Foster RD, Anthony JP, Sharma A, Pogrel MA. Vascularized bone flaps versus nonvascularized bone grafts for mandibular reconstruction: an outcome analysis of primary bony union and endosseous implant success. Head Neck 1999; 21:66-71.
2. Hidalgo DA. Fibula free flap: a new method of mandible reconstruction. Plast Reconstr Surg 1989; 84:71-9.
3. Moscoso JF, Keller J, Genden E, Weinberg H, Biller HF, Buchbinder B, et al. Vascularized bone flaps in oro mandibular reconstruction. A comparative anatomic study of bone stock from various donor sites to assess suitability for endosseous dental implants. Arch Otolaryngol Head Neck Surg 1994;120:36-43.
4. Chiapasco M, Brusati R, Galioto S. Distraction osteogenesis of a fibular revascularized flap for improvement of oral implant positioning in a tumor patient: a case report. J Oral Maxillofac Surg 2000; 58:1434-1440.
5. Taylor GI, Miller GDH, Ham FJ: The free vascularized bone graft. A clinical extension of microvascular techniques. Plast Reconstr Surg 55:533, 1975
6. Bahr W, Stoll P, Wachter R: Use of the double barrel free vascularized fibula in mandibular reconstruction. J Oral Maxillofac Surg 1998; 56:38-44.
7. Eski M, Turegun M, Deveci M, et al: Vertical distraction osteogenesis of fibular bone flap in reconstructed mandible. Ann Plast Surg 57:631, 2006
8. Jones NF, Swartz WM, Mears DC, et al: The "double barrel" free vascularized fibular bone graft. Plast Reconstr Surg 81:378, 1988
9. Horiuchi K, Hattori A, Inada I, et al: Mandibular reconstruction using the double barrel fibular graft. Microsurgery 46:450, 1995
10. He Y, Zhang ZY, Zhu HG, Wu YQ, Fu HH: Double-barrel fibula vascularized free flap with dental rehabilitation for mandibular reconstruction. J Oral Maxillofac Surg 69:2663-2669, 2011