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Original Research Article

Functional and aesthetic outcome with free fibula osteocutaneous flap in reconstruction of anterior mandibular defects in oral malignancies: our experience

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ABSTRACT

Background: For anterior mandibular defects, vascularized bone flap reconstructions are the best for providing a solid arch necessary to restore form and function, especially in patients receiving tumour excision surgery in head and neck region. Our aim was to study aesthetic and functional outcome of free fibula osteocutaneous flap (FFOCF) in anterior mandibular defects in case of anterior floor of the mouth malignancies with mandibular infiltration.
Methods: The clinical data of 15 oral cavity carcinoma patients with involvement of anterior floor of mouth with mandiblular infiltration that underwent FFOCF reconstruction at our institute, government medical college, Jammu, was prospectively collected from January 2018 till January 2020. In this study, the aesthetic and functional outcome of these patients was evaluated at 6 months and 1 year post surgery.
Results: The aesthetic result of reconstruction was excellent in most patients. Also, there was no long-term donor-site morbidity. There was no peri-operative death. Flaps survived in all patients. Functional outcomes including the ability to tolerate oral diet and speech outcome were good in all cases.
Conclusions: The FFOCF, in reconstruction surgery of advanced oral cavity carcinoma permits more radical resection of tumour with good functional as well aesthetic outcome.

Keywords: Reconstruction, Free flap, FFOCF, Oromandibular, Osteotomy

INTRODUCTION

Head and neck cancer is among the most prevalent type of cancer worldwide. The treatment methods include surgery, chemotherapy and/or radiotherapy, singly or in combination. Oromandibular defects following ablative surgery for malignant tumours of the head and neck region impact both form and function and require a multidisciplinary approach to optimize functional and cosmetic outcomes. The reconstruction of oromandibular defects has been challenging since early years. The procedures have evolved since the first use of autologous bone grafts, to the use of local and regional flaps and now to the era of free tissue transfer.

Mandible or the lower jaw forms a U-shaped bony foundation of the lower face, also serves as the attachment for tongue and muscles of the floor of the mouth. Functions of oromandibular region include mastication, deglutition, airway patency and speech which need complex units of tissue. In addition, such tissue is important to maintaining a socially acceptable aesthetic appearance.[1] Hence, ideally oromandibular defect reconstruction would need the replacement of structural bony foundation, restoration of the supporting muscle and soft tissue envelope and provide a platform for dental rehabilitation post reconstruction. For the majority of modern reconstructive surgeons who perform mandibular reconstruction, vascularized composite-free

tissue transfer and specifically the free fibula flap, represents the gold standard approach.[2,3]

The free oseocutaneous or osseous fibula flap was first described by Taylor for reconstruction of tibial pseudoarthrosis. This flap was popularized by Hidalgo et al for mandibular reconstruction and currently represents the benchmark for composite defects of the mandible and oral cavity.[4] The first transfer of autogenous bone for the mandible reconstruction was done by Sykoff in 1900.[5] In 1973, the fibula was discovered to be suitable transplant material for microsurgical transplantation independently by both Ueba et al in Japan and O'Brien et al in Melbourne, Germany.[6,7] Hidalgo was the first to describe the free fibula transplantation for reconstruction of mandible in 1989.[2]

Key issue in reconstruction of oromandibular defect is the length of bone required for secondary osseointegration, the morbidity associated with the donor site of bone flap and recreation of a functional joint for mouth opening and mastication. The FFOCF is based on the peroneal artery and vein. It is currently the flap of choice in most centres considering the quality of available skin island and the length of available bone with limited donor site morbidity. The cosmetic deformity and functional loss that occur after mandibular resection depends on the size and location of the segmental defect. The more anterior the defect, greater is the deformity and loss of function. Posterior defects are much better tolerated but a malocclusion may result in a dentate patient.[8]

According to Boyd et al anterior mandibular defects are more deforming and fail more frequently than defects that do not cross the midline. In patients with anterior mandibular defect, the use of fibula is always the best choice as the bone can be osteotomized into three segments to match the contour of the horseshoe-shaped mandible without destroying the vascularity of the segments.

Through this article, we were presenting experience of 15 FFOCF reconstructions done in our institute over a period of 2 years. Our aim was to study the aesthetic and functional outcome of using free fibula flap to reconstruct anterior mandibular defects in cases of anterior floor of mouth malignancies. FFOCF, though complex, but was still believed to be a reliable technique in mandibular reconstruction.

METHODS

The study was conducted from January 2018 to January 2020 through prospectively collected clinical data in the department of ENT of our institute on 15 histologically proven squamous cell carcinoma patients of oral cavity malignancies involving anterior floor of mouth with infiltration of mandible and were treated with wide local excision of tumour with neck dissection and reconstruction using FFOCF. Informed consent was taken from all the patients for their participation in the study and publishing their photographs.

The only eligible criterion was the possibility of using FFOCF for mandible reconstruction. Detailed clinical history, general physical examination and local examination were done including examination of neck nodes and flexible laryngoscopic examination. All patients were subjected to routine blood investigations, chest radiograph, electrocardiogram and fine needle aspiration cytology (FNAC) of suspicious lymphadenopathy. Orthomopantomogram, ultrasound abdomen and CECT neck (base of skull to T4) was also done. All patients were staged as per TNM Staging system. Data regarding site and extent of lesion, type of reconstruction was maintained. General morbidity, donor flap site morbidity, recurrence, post-operative complication (if any), post-operative functional outcome (deglutition and speech) and also facial/aesthetic appearance was assessed at 6 months and 1 year following surgery (by telephone conversation with the patient or guardian and/or direct examination using the proforma). Institutional ethical committee approval was also obtained.

Pre-operative preparation

All patients underwent surgical resection of the primary tumour enbloc along with neck dissection which was adequate to the stage of disease after preliminary work out. Evaluation of mandibular defect was also prior evaluated with the help of panoramic radiograph and CT mandible (Figure 1). Bone segment loss and soft tissue defect were measured. Left leg was preferably selected for flap harvest and perforators were detected and marked with a hand held Doppler (Figure 2). Right leg was chosen for any bone and soft tissue abnormality detected in left leg. Skin paddle was also marked. Inter maxillary fixation was done in normal occlusion with eyelets wires on the normal side. Bone defect was then measured. Length of the mandible defect ranged from 6 to 15 cm, being on average 9.5 cm.

Flap harvest

All flaps were harvested under tourniquet control by anterior approach. Anterior margin of the flap was elevated till perforators were identified and marked. Once the incision was made and carried to the fascia, a subfascial dissection was directed out towards the intermuscular septum. At this point, attention was directed at identifying perforators to be incorporated on the skin flap. If the skin island was not centered over the perforators, the skin paddle can be readjusted to incorporate the perforators in a more ideal fashion. The elevation was the same until the posterior dissection was reached. The posterior aspect of the skin island was incised with careful attention to incorporate the perforators. The remainder of the flap elevation was the same as previously described. Closure of the fibula donor

site was done by loose reapproximation of the muscles. The muscle closure was over a drain. The skin defect was grafted by harvesting a split-thickness skin graft from the thigh and transferring to the donor site. A bolster dressing may be placed followed by posterior splint. The leg was then elevated to decrease edema. The cast and bolster dressing were removed approximately 6 days later.

Figure 1: CT showing mandibular infiltration.

Figure 2: Designing of FFOCF.

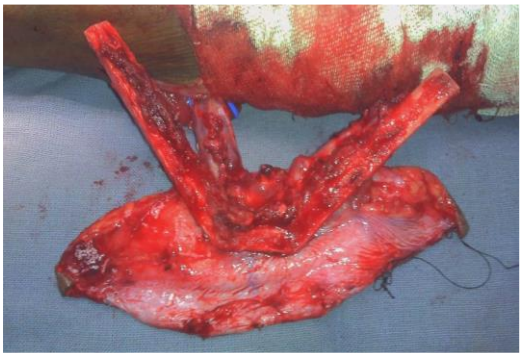

Figure 3: Harvesting of FFOCF.

Osteotomy of fibula

Flap was detached, vascular end were doubly ligated and flap was shifted to table. Atleast two osteotomies were made with micromotor drill and cutting burr to give fibula a proper shape to fix the anterior mandibular defect (Figure 3). Titanium miniplates and screws were used for fixation at sites of osteotomy. Flap was transferred to recipient site. Miniplates were used to fix transferred fibula with recipient bone. Few tagging sutures were placed to inset skin paddle and vascular paddle were delivered to neck. Donor artery and veins were separated and prepared for anastomoses which was performed under the microscope using 9-0 nylon sutures. Vascularity of flap was monitored and soft tissue transfer into the defect was completed.

Follow up

Patients were followed up on weekly basis after discharge from hospital. Nasogastric feeding was continued for 2 weeks and trial of oral feeding with liquids and semisolid diet started after that. The cast and dressing of donor site were removed after 14 days. The patient was then advised physiotherapy and walking. Patient were followed up monthly subsequently for a minimum six month period and then 6 monthly and after 1 year and on and off if required. All patients were given post-operative radiotherapy. Functional and aesthetic outcome, donor site healing and recurrence were noted.

RESULTS

Our study group included a total of 15 patients, among which 12 were males and 3 were females (Figure 4). Mean age of the patients was 49.17 (±11.25) years (Figure 5). Excision and reconstruction was done in same sitting in all the cases with FFOCF which were followed by post-operative radiotherapy without any delay.

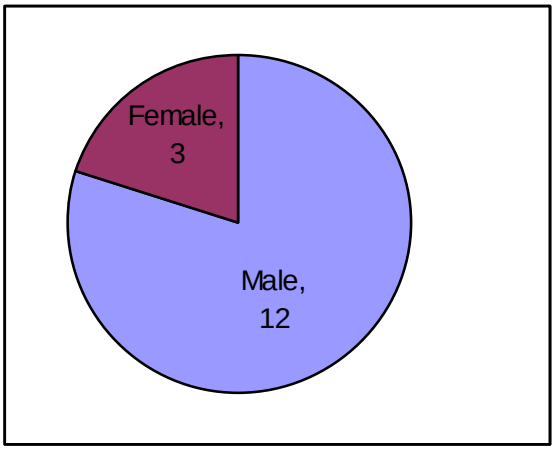

Figure 4: Sex distribution.

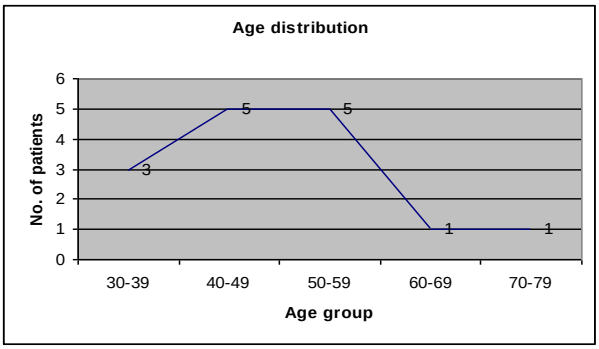

Figure 5: Age-wise distribution.

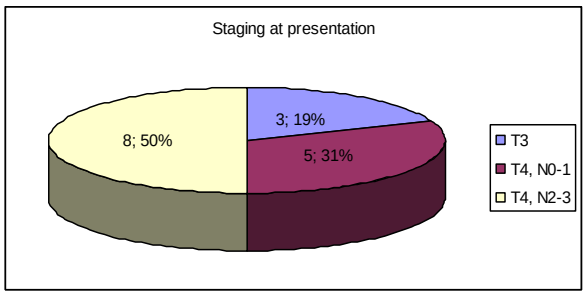

Figure 6: Staging at presentation.

Surgery

All patients were staged as per TNM staging (Figure 6) and surgical resection with suitable neck dissection was done. Combined bone and mucosal defect were noted in 9 cases and through and through bone, mucosa and skin defect were found in 6 cases.

Left leg was used for flap harvest in 12 cases. Right leg was used in 3 cases due to previous trauma or defect involving skin, soft tissue or bone in left leg. Single skin paddle was used in 7 cases where as double skin paddle was used in 12 cases. Length of bone segments used was 6-15 cm. Double and triple osteotomy were done in 13 and 2 cases respectively. Facial artery used as recipient in 11 cases where as superior thyroid artery in 4 cases. Double venous anastomosis was done in 13 cases with EJV and either IJV or facial vein or single to. Single end to side venous anastomoses with IJV was done in 2 cases. Pedicle length found were 6-10 cm. Vein graft for arterial or venous anastomoses were not required in any cases. All donor sites were grafted with split skin thickness grafting from thigh. Surgical outcome was good in most cases.

Follow up

Follow up period was 6 month to 1 year. Mean follow up period was 19 months. Post-operative radiotherapy was given in all cases. Two patients had partial loss of flaps after surgery and were treated with local tissue readjustment and local flaps. One patient developed orocutaneous fistula after surgery which healed in 2 months with oral care, food restriction and local flap coverage of intra oral fistula site. One patient died at 15 months follow up due to recurrence and distant metastasis. Two patients complained pain and tightness at donor site by 2 months of surgery and eventually improved when assessed on next follow up visit. Post-operative complications have been summarized (Table 1). The aesthetic result of reconstruction was excellent in most patients. There was no long-term donor-site morbidity. There was no peri-operative death. Flaps survived in all patients. Functional outcomes, including the ability to tolerate oral diet and speech outcome were good in all cases. Operative outcome in all patients receiving FFOCF is summarised (Table 2).

Table 1: Post-operative complications of FFOCF.

Post-operative complications	N
General complications (n=15)	
Pneumonia	1
UTI	1
DVT	0
Peri-operative death	0
Donor site morbidity (n=15)	
Pain/tightness	2
Skin graft loss	0
Motor weakness of great toe	0
Ankle instability/stiffness	0
Recipient site morbidity (n=15)	
Orocutaneous fistula	1
Partial dehiscence	2
Wound infection	1
Plate exposure	0
Recurrence	1

Table 2: Functional and aesthetic outcome of FFOCF.

Operative outcome (n=15)	At 6 months, N (%)	At 1 year, N (%)
Deglutition		
Normal	6 (40.0)	9 (60.0)
Soft diet	9 (60.0)	6 (40.0)
Gastric tube	0	0
Oral continence		
Normal/mild drooling	5 (33.3)	10 (6.7)
Decreased/moderate drooling	10 (6.7)	5 (33.3)
Disabling/severe drooling	0	0
Speech		
Normal/easily intelligible	4 (26.7)	8 (53.3)
Intelligible with effort	8 (53.3)	7 (46.7)
Unintelligible	3 (20)	0
Facial appearance		
Excellent/good	5 (33.3)	9 (60.0)
Acceptable	9 (60.0)	5 (33.3)
Poor	1 (6.7)	1 (6.7)

DISCUSSION

Iliac crest, scapula or radius were used in earlier days but fibula proved to be superior as it provided tubular bicortical bone of maximum length and reliable substantial perforator based skin paddle to reconstruct composite defect with minimal donor site morbidity.[9-12] Its blood supply coursed in parallel along the length, guaranteeing adequate vascularity to the osteotomized segments.13 Abnormalities of the lower leg vascular anatomy and patients with an enlarged peroneal artery (prevalence 0.2 to 8.3%) or impaired circulation to the leg was a valid contraindication for fibula transposition.[14] In our study, we preferred a through clinical examination of the dorsalis pedis and posterior tibial artery pulses pre-operatively and intra-operative vascular assessment through a hand held Doppler before flap harvesting.

The FFOCF had many features that make it excellent for most mandible and contiguous soft-tissue reconstructions. These were sturdy, straight, uniformly thick bone with triangular cross-section that has sufficient length (22 to 26 cm in adult) to fix angle to angle defects; bicorticocancellous structure that can support osseointegrated dental implants; sizable (2 to 3 mm diameter) and lengthy (up to 15 cm) pedicle; reliable, thin, pliable and sizeable (22 to 25 cm length; 10 to 14 cm width) skin paddle that can be handled easily to restore intraoral and/or extraoral soft-tissue defects of almost any configuration with respect to the bone; option to include muscle in the flap to fill dead space, which can be designed using the chimeric concept; option to use the distal vascular runoff for flowthrough to another free flap in sequence; proximity to the sural nerve, allowing its harvest through the same donor site if inferior alveolar nerve reconstruction was required; donor-site location, allowing two teams to work simultaneously at donor and recipient sites to save operative time; and acceptable donor-site morbidity.[16-22]

The fibula should always be raised with a skin paddle. In the present study, we have used double paddled skin in most cases. The clinical success of the skin paddle was above 90% when the musculocutaneous perforators of soleus muscle were incorporated in the flap, whereas the viability of the skin was only 33% when the flap was based on septal branches.[23] Hidalgo et al showed 90% success rate of the skin island in 60 patients.[15] Early concerns regarding the reliability of the overlying skin paddle, based on perforators from the peroneal system, have been abated by independent investigators.[15,21,24,25]

Figure 7: Post-operative radiograph showing position of fibula.

In the present study, we found that bone reconstruction and shaping was comprehensible with miniplates, screws and osteotomies (Figure 7). Almost all our patients had good aesthetic result. The main drawback of using the fibula for mandible reconstruction was its relatively small height of approximately 13 mm.[26] This produced a dilemma when dealing with anterior segment defects: choosing between restoring adequate alveolar height for dental implants and adequate facial height with an aesthetic inferior mandibular margin. Placement of the fibula at the inferior mandibular margin yielded excellent contour, but osseointegrated implants in this position required elongated prosthetic suprastructures to achieve occlusion, causing overloading from excessive lever arm forces that endangered their long-term success.[27] The double-barrelled fibula had been well described to restore mandibular height, especially at the anterior segment.[26,28]

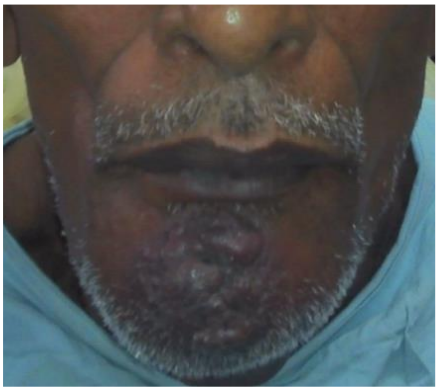

Figure 8: Pre-operative picture of patient with oromandibular malignancy.

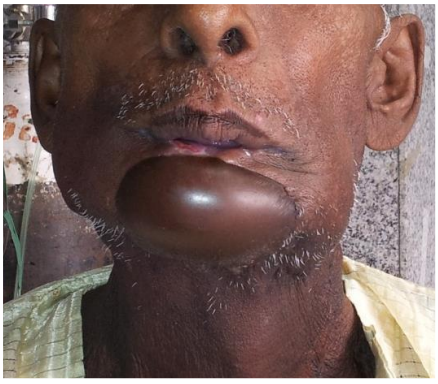

Figure 9: Post-operative picture after reconstruction.

In our study, the functional results were assessed as deglutition, oral competence and speech (Table 2). Regarding diet, 60% of patients resumed unrestricted diet and rest could took soft diet. None of the patients was gastric tube dependant at 6 month follow up. This showed that due to wide resection of oral cavity in malignancies, patient experienced difficulty resuming to the normal unrestricted diet. Solid food intolerance was due to decreased masticatory force. Use of double paddle in large tissue defect allowed good coverage and flap inset without tension to preserve oral competence. In all patients, intraoral skin paddle mucosalised mostly in 6 months. Speech was documented as normal in 53.3% and intelligible in 46.7% in our study group at 1 year followup. Abdel et al reported 56% normal diet, 44% soft diet, no liquid and tube feeding in 16 cases and Hidalgo et al reported 51% normal diet, 42% soft diet and 7% feeding tube dependent in 60 cases.[15,29] Abdel et al reported speech as normal in 46%, intelligible in 23% and intelligible (with effort) in 31% of the patients.[29] This study agreed that speech was markedly affected in patients with resection of the central segment of mandible resection.[29] Hidalgo et al reported normal speech in 39%, mildly impaired (intelligible) in 32% intelligible with effort in 19% and unintelligible in 10% of patients.[15] We assessed the aesthetic outcome in terms of symmetry, facial appearance and patient's perception (Figure 8 and 9). At 1 year follow up, facial appearance was quantified by patients themselves as excellent in 60% patients and good in 33.3% patients. One patient reported appearance as poor, also skin match was not satisfactory.

Fibula osteoseptocutaneous flap donor-site morbidity can be reduced by careful surgical technique and patient preparation. Early donor-site complications included skin graft loss, wound dehiscence and infection. More serious early complications include compartment syndrome caused by excessively tight primary closure of the donor site, lower extremity ischemia resulting from inadequate preoperative donor-site assessment and peroneal nerve palsies caused by poor surgical dissections.[30-34] The most common late complication was great-toe flexion weakness or contracture, which were amenable to preserving the flexor hallucis longus muscle motor nerve and minimal dissection to maintained its vascular supply.[30,35,36] But none of our patients developed great toe flexion weakness. Results show that pain was a minor symptom after FFOCF reconstruction and after 6 months; also, it may occur incidentally as very mild. DeGraff et al suggested that pain and speech improve with time, and such improvements are most pronounced in patients with cancer of the oral cavity and oropharynx.[37]

CONCLUSION

The treatment, rehabilitation and follow up care of patients with anterior floor of mouth malignancies must be carried out by an interdisciplinary team. The goals of mandibular reconstruction are restoration of both oral function and aesthetic contours. The free fibula flap is the flap of choice for anterior mandibular reconstructions due to its anatomic features, short-and long-term results as well as the relatively insignificant morbidity of the donor site. It results in satisfactory aesthetic and functional outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee

EFERENCES

1. McCarthy CM, Cordeiro PG. Microvascular reconstruction of oncologic defects of the midface. Plast Reconstr Surg. 2010;126(6):1947-59.
2. Hidalgo DA. Fibular free flap: a new method of mandible reconstruction. Plast Reconstr Surg. 1989;84(1):71-9.
3. Cordeiro PG, Disa JJ, Hidalgo DA, Hu QY. Reconstruction of the mandible with osseous free flaps: a 10-year experience with 150 consecutive patients. Plast Reconstr Surg. 1999;104(5):1314-20.
4. Gilbert RW. Free flaps in head and neck reconstruction. In: Gleeson M, eds. Scott Brown's otorhinolaryngology, head and neck surgery. 7th ed. Hodder Arnold publishers; 2008: 2867-90.
5. Peter WB, Stephen AS, Jarg-Erich H. Maxillofacial Surgery. 2nd ed. London: Churchill Living Stone Publication; 1999:527-8.
6. Fonceka RJ. Oral and Maxillofacial Surgery. 3rd ed. Philadelphia: Saunders Company; 2000: 364-5.
7. Wolff KD, Hözle F. Raising of microvascular flaps-a approach. 2nd ed. Berlin: Springer-Verlag Berlin Heidelberg; 2005: 107-37.
8. Parmar S. Defect based reconstruction: mandible and oral cavity. In: Watkinson JC, Gilbert RW, eds. Stell and Maran's Textbook of head and neck surgery and oncology. 5th ed. Hodder Arnold publishers; 2012: 956.
9. Cordeiro PG, Disa JJ, Hidalgo DA, Hu QY. Reconstruction of the mandible with osseous free flaps: a 10-year experience with 150 consecutive patients. Plast Reconstr Surg. 1999;104(5):1314-20.
10. Lin PY, Lin KC, Jeng SF. Oromandibular reconstruction: the history, operative options and strategies, and our experience. ISRN Surg. 2011;2011:824251.
11. Urken ML, Buchbinder D, Costantino PD, Sinha U, Okay D, Lawson W, et al. Oromandibular reconstruction using microvascular composite flaps. Arch Otolaryngol Head Neck Surg. 1998;124(1):46-55.
12. Reychler H, Ortabe JI. Mandibular reconstruction with the free fibula osteocutaneous flap. Int J Oral Maxillofac Surg. 1994;23(4):209-13.
13. Carr J, Macdonald DA,Waterhouse N. The blood supply of the osteocutaneous free fibular graft. J Bone Joint Surg Br. 1988;70(2):319-21.
14. Gedge DR, Singh NK. Devascularizing complications of free fibula harvest: peronea arteria magna. J Reconstr Microsurg. 2005;21(8):533-8.
15. Hidalgo DA, Rekow A. Review of 60 consecutive fibula free flap mandible reconstructions. Plast Reconstr Surg. 1995;96(3):585-96.
16. Wei FC, Seah CS, Tsai YC, Liu SJ, Tsai MS. Fibula osteoseptocutaneous flap for reconstruction of composite mandibular defects. Plast Reconstr Surg. 1994;93(2):294-304.
17. Frodel JL, Funk GF, Capper DT, Fridrich KL, Blumer JR, Haller JR, et al. Osseointegrated implants: a comparative study of bone thickness in four vascularized bone flaps. Plast Reconstr Surg. 1993;92:449-55.
18. Wei FC, Chuang SS, Yim KK. The sensate fibula osteoseptocutaneous flap: a preliminary report. Br J Plast Surg. 1994;47(8):544-57.
19. Wei FC, Santamaria E, Chang YM, Chen HC. Mandibular reconstruction with fibular osteoseptocutaneous free flap and simultaneous placement of osseointegrated dental implants. J Craniofac Surg. 1997;8(6):512-21.
20. Wei FC, Demirkan F, Chen HC, Chen IH. Double free flaps in reconstruction of extensive composite mandibular defects in head and neck cancer. Plast Reconstr Surg. 1999;103(1):39-47.
21. Wei FC, Yazar S, Lin CH, Cheng MH, Tsao CK, Chiang YC. Double free flaps in head and neck reconstruction. Clin Plast Surg. 2005;32(3):303-8.
22. Yazar S, Cheng MH, Wei FC, Hao SP, Chang KP. Osteomyocutaneous peroneal artery perforator flap for reconstruction of composite maxillary defects. Head Neck. 2006;28(4):297-304.
23. Michael M, Ghali GE, Larsen PE, Waite PD. Peterson's Principle of Oral and Maxillofacial Surgery. 2nd ed. London: BC Decker Inc; 2004: 811-2.
24. Carriquiry C, Aparecida CM, Vasconez LO. An anatomic study of the septocutaneous vessels of the leg. Plast Reconstr Surg. 1985;76(3):354-63.
25. Schusterman MA, Reece GP, Miller MJ, Harris S. The osteocutaneous free fibula flap: is the skin paddle reliable? Plast Reconstr Surg. 1992;90(5):787-93.
26. Jones NF, Swartz WM, Mears DC, Jupiter JB, Grossman A. The double barrel free vascularized fibular bone graft. Plast Reconstr Surg. 1988;81(3):378-85.
27. Bidez MW, Misch CE. Force transfer in implant dentistry: basic concepts and principles. J Oral Implantol. 1992;18(3):264-74.
28. Horiuchi K, Hattori A, Inada I, Kamibayashi T, Sugimura M, Yajima H, et al. Mandibular reconstruction using the double barrel fibular graft. Microsurgery. 1995;16(7):450-4.
29. Abdel WAA. Osteocutaneous free fibular flap for anatomical reconstruction of the mandible following tumor resection. J Egypt Nat Cancer Inst. 2003;15(3):243-51.
30. Schrag C, Chang YM, Tsai CY, Wei FC. Complete rehabilitation of the mandible following segmental resection. J Surg Oncol. 2006;94(6):538-45.
31. Wei FC, Celik N, Chen HC, Cheng MH, Huang WC. Combined anterolateral thigh flap and vascularized fibula osteoseptocutaneous flap in reconstruction of extensive composite mandibular defects. Plast Reconstr Surg. 2002;109(1):45-52.
32. Saleem M, Hashim F, Babu MM. Compartment syndrome in a free fibula osteocutaneous flap donor site. Br J Plast Surg. 1998;51(5):405-7.

33. Astarci P, Siciliano S, Verhelst R, Lacroix V, Noirhomme P, Rubay J, et al. Intra-operative acute leg ischaemia after free fibula flap harvest for mandible reconstruction. Acta Chirurgica Belgica. 2006;106(4):423-6.
34. Yazar S, Lin CH, Wei FC. One-stage reconstruction of composite bone and soft-tissue defects in traumatic lower extremities. Plast Reconstr Surg. 2004;114(6):1457-66.
35. Bodde EW, deVisser E, Duysens JE, Hartman EH. Donor-site morbidity after free vascularized autogenous fibular transfer: Subjective and quantitative analyses. Plast Reconstr Surg. 2003;111(7):2237-42.
36. Babovic S, Johnson CH, Finical SJ. Free fibula donor-site morbidity: the Mayo experience with 100 consecutive harvests. J Reconstr Microsurg. 2000;16(2):107-10.
37. DeGraff A, DeLaeuw RJ, Ros WJ, Hordijk GJ, Blijham GH, Winnubst JA. Long-term quality of life of patients with head and neck cancer. Laryngoscope. 2000;110(1):98-106.

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