Original Article

Revisiting Myocutaneous Flaps as a Reliable Option for Reconstruction of the Oromandibular Region: An Algorithmic Approach

Güvenilir Bir Seçenek Olarak Miyokütan Fleplerin Oromandibuler Bölge Rekonstrüksiyonu için Yeniden Değerlendirilmesi: Algoritmik Yaklaşım

Kemalettin YILDIZ[1], İsmail Melih KUZU[2], Reşit Burak KAYAN[2], Osman KELAHMETOĞLU[3],
Mehmet Veli KARAALTIN[2], Ahmet KİRAZOĞLU[1], Kemal UĞURLU[2], Ethem GÜNEREN[1]

[1]Bezmialem Vakıf University Faculty of Medicine, Department of Plastic, Reconstructive and Aesthetic Surgery, İstanbul, Turkey
[2]Plastic, Reconstructive and Aesthetic Surgery, İstanbul, Turkey
[3]Yeditepe University Faculty of Medicine, Department of Plastic, Reconstructive and Aesthetic Surgery, İstanbul, Turkey

ABSTRACT

Objective: Reconstruction of extensive, composite oromandibular defects using osteocutaneous free flaps has become the gold standard procedure over the past two decades, although such reconstruction is associated with severe morbidity in certain patients. In such patients, soft-tissue flaps may be a better option, being associated with less donor-site morbidity but acceptable functional results.

Methods: Seventeen patients were followed up for at least two years. Patients with mid-anterior segmental mandibular and posterior mandibular defects, who underwent reconstruction using boneless, pedicled or free myocutaneous flaps were evaluated in terms of flap failure and overall morbidity.

Results: Five of 7 patients in the pedicled flap group and six of 10 in the free flap group had comorbid diseases that were both severe and more numerous in the pedicled flap group. Four of 17 patients lacked a significant clinical sign affecting the surgical choice. In seven patients, primary reconstructions using pedicled or free flaps were performed. In 10 cases, the reconstructions were salvage procedures. Tumor recurrence or osteoradionecrosis developed in six of the 17 cases. The complication rates were 5/7 in the pedicled flap group and 3/10 in the free flap group.

ÖZ

Amaç: Osteokutanöz serbest flepler kullanılarak kapsamlı, kompozit oromandibuler defektlerin rekonstrüksiyonu son yirmi yılda altın standart prosedür haline gelmiştir, ancak bu rekonstrüksiyon bazı hastalarda ciddi morbidite ile ilişkilidir. Bu gibi hastalarda, yumuşak doku flepleri daha az donör bölge morbiditesi ve kabul edilebilir fonksiyonel sonuçlar ile daha iyi bir seçenek olabilir.

Yöntemler: On yedi hasta en az iki yıl takip edildi. Kemiksiz, pediküllü veya serbest miyokütan flep kullanılarak rekonstrüksiyon yapılan orta-ön segmenter mandibuler ve posterior mandibuler defekti olan hastalar flep sağkalımı ve genel morbidite açısından değerlendirildi.

Bulgular: Pediküllü flep grubunda 7 hastanın beşinde ve serbest flep grubunda 10 hastanın altısında komorbid hastalık bulunmaktaydı. On yedi hastanın dördünde cerrahi yöntemi etkileyen önemli bir klinik bulgu yoktu. Yedi hastada pediküllü veya serbest flep kullanan primer rekonstrüksiyonlar yapıldı. On olguda rekonstrüksiyonlar kurtarma prosedürleriydi. On yedi olgunun altısında tümör nüksü veya osteoradionekroz gelişti. Komplikasyon oranları pediküllü flep grubunda 5/7 ve serbest flep grubunda 3/10 idi.

Conclusion: Soft tissue flaps are a suitable option that can be used in posterior and/or posterolateral defects in primary reconstruction or secondary salvage procedures.

Keywords: Boneless, myocutaneous flap, musculocutaneous flap, oromandibular, reconstruction

Sonuç: Yumuşak doku flepleri primer rekonstrüksiyon veya sekonder kurtarma prosedürlerinde posterior ve/veya posterolateral defektlerde kullanılabilecek uygun bir seçenektir.

Anahtar Sözcükler: Kemiksiz, miyokütan flep, muskulokütan flep, oromandibuler, rekonstrüksiyon

Introduction

Reconstruction of oromandibular defects using osteocutaneous free flaps has been the gold standard procedure for the past two decades (1). Many modifications of fibular flaps have been described. Today, virtual surgical planning and computer-aided design and manufacture are valuable innovations (2,3). When treating patients with advanced cancer who require postoperative radiotherapy, in whom bony reconstructions have failed, or patients in poor general health with short life expectancies, complex reconstruction procedures such as placement of free, vascularized bony flaps are best avoided. In such patients, techniques that allow rapid recovery, oral competence, and minimal donor-site morbidity are preferred (4). Soft-tissue-only flaps are also useful for patients with large defects secondary to temporomandibular joint (TMJ) resection (5). Some other indications for the use of soft-tissue-only flaps may include the lack of suitable bone donor sites, or prior vanishing bone disease (6-9). There are vascularized bone reconstruction examples in the literature after giant ameloblastoma resections (10). In this study, we also suggest that posterolateral defects with a history of giant ameloblastoma resection can be an indication for soft tissue only flaps.

Although anterior oromandibular defects should be reconstructed with osseous flaps to maintain rigidity; to obviate the development of an Andy Gump deformity; and to prevent airway collapse, facial distortion, and leakage of liquid through the oral commissure; the functional morbidity in patients with composite segmental mandibular defects is attributable to the loss of the soft-tissue lining rather than the bone defect per se. Therefore, reconstruction of such defects using soft-tissue flaps, such as a pedicled latissimus dorsi or free rectus abdominis flap, rather than osteocutaneous flaps, is a form of boneless reconstruction. Such procedures are commonly termed salvage procedures, and are easier, safer, and quicker than bony reconstruction, imposing less stress on the patient. Compared with the placement of bony flaps, these procedures require less surgical time, better obliterate dead space, form a better lining, and prevent orocutaneous fistula formation more reliably. Boneless flaps are also thought to be more resistant to radiotherapy than bony flaps (5,11-16).

The literature does not describe the boneless reconstruction of extensive oromandibular defects using only soft-tissue flaps in any detail. Pedicled latissimus dorsi myocutaneous (LDMC) flaps and trapezius myocutaneous flaps have been placed during salvage procedures in patients requiring head-and-neck reconstructions (6,17). We discuss the advantages of such procedures not only in terms of salvage, but also (in selected cases) as a form of primary reconstruction.

Methods

Seventeen patients with oromandibular defects reconstructed using soft-tissue flaps between 2011 and 2016 have been retrospectively evaluated. Patients with traumatic mandibular defects were excluded. In addition, two patients exhibiting prior osteocutaneous free flap failure were not shown in the free flap group, but rather in the pedicled flap group. Therefore, none of the patients were mentioned in both groups. All defects were attributable to tumor resection or radionecrosis. Both free and pedicled musculocutaneous flaps were used for primary reconstruction or salvage.

Table 1 lists patient demographic features, including age and gender, etiological factors, the locations of the defects, preoperative status, comorbidities, surgical preferences, duration of operations and hospitalization, complications, and secondary surgical procedures.

Defects were located in the posterior mandible in 6 patients (pedicled LDMC flaps were placed in 4 patients and free vertical rectus abdominis myocutaneous [VRAM] flaps in 2); the posterolateral mandible in 6 patients (pedicled LDMC flaps were placed in 3 patients and free VRAM flaps in 3); the anterior segmental mandible in 1 patient (reconstructed using a free VRAM); and the anterolateral mandible in 4 patients (free VRAMs were placed in all patients).

The choice of a soft-tissue rather than a vascularized bone flap was made after a detailed evaluation of all patients. The subcutaneous transfer technique was used when placing all pedicled LDMC flaps (17). All free soft-tissue flaps were VRAM flaps. Patients with segmental defects (i.e., the condyle and part of the ramus were intact) or posterior defects that included the condyle were usually reconstructed using soft-tissue flaps unless the cosmetic outcome was the overriding consideration.

Patients were followed up for at least 2 years (range: 24-40 months) because of oncological issues or the need for post-irradiation assessment. The success of soft-tissue flap placement in terms of mandibular reconstruction was evaluated by scoring flap failure, overall morbidity, and cosmetic outcomes.

Since the study was a retrospective observational analysis, no comparative statistics were done at this point. However, descriptive statistical analysis was performed.

This study was approved by Kemalettin Yıldız and all participants signed an informed consent agreement.

Results

The mean patient age was 59.17 years (range 25-76 years). The mean age of patients receiving LDMC flaps was 57.5 years, and that of patients receiving free flaps was 60.3 years. Although the means of ages were similar in the two groups, both of the patients aged <40 years were in the pedicled flap group. Five of 7 patients in the pedicled flap group had comorbidities, and 6 of 10 in the free flap group. The comorbidities were more severe and more numerous in the pedicled flap group.

Preoperatively, only 4 of the 17 patients (2 in either group) lacked a clinical sign that influenced the choice of surgery. Three patients had edentulous mandibles. Seven patients underwent primary reconstructions using pedicled or free flaps. In 10 patients, the reconstructions were salvage procedures. Among 3 patients with the failure of free flaps, 2 underwent pedicled flap reconstruction and 1 underwent free flap surgery. Tumor recurrence or osteoradionecrosis developed in 6 of the 17 patients (2/7 in the pedicled group and 4/10 in the free flap group).

The complication rates were 5/7 in the pedicled flap group and 3/10 in the free flap group. In the pedicled flap group, neck wound dehiscence secondary to radiotherapy was observed in 2 patients. The flap-associated complications were partial necrosis in 1 patient who died in the early postoperative period, and seromas at the LDMC flap donor sites of 3 patients. In the free flap group, neck wound dehiscence (n=2) and skin necrosis (n=1) secondary to radiotherapy were observed. Wound dehiscence was also evident at one free flap donor site.

Flaps used in ultimate reconstruction survived; partial loss of the externally oriented part of the skin island of a pedicled latissimus dorsi flap was observed in only 1 patient, and the flap healed after careful debridement. The mean operative time (combined resection and reconstruction) was 7.1 h.

The etiologies of the defects were radionecrosis developing after treatment of nasopharyngeal carcinoma in 1 patient, ameloblastoma in 2 patients, mesenchymal sarcoma in 4 and squamous cell carcinoma in 10 patients. The mean age was 57 years (range: 25-78 years). Five patients were aged >60 years, and 2 patients were young. In a 25-year-old patient with radionecrosis, the skin paddle of the pedicled latissimus dorsi flap was attached both intra- and extra-orally via de-epithelialization of the intermediate region (Figure 1). In the other young patient, a free VRAM flap was preferred (Figure 2). A late postoperative assessment is shown in Figure 3.

The mean hospitalization time was 16.8 days. The mean hospitalization time of patients receiving LDMC flaps was 17.5 days, and that of patients receiving free flaps was16.3 days. Detailed data of the patients are listed in Table 1.

The cosmetic and dental occlusion outcomes varied. The mandibular angle was usually blunted, and 4 patients required secondary procedures to reduce flap or pedicle bulk. In most of thepatients, revision surgery was performed under local anesthesia in an out-patient setting. When teeth were present, some malocclusion was always in play as one condyle was missing. However, this was well-tolerated by all patients. Malocclusion is not a priority compared with the other possible morbidities.

Discussion

Boneless mandibular reconstruction of posterior defects has been reported previously (4,5,11,12,14,16,18). Cordeiro and Disa (18) developed an algorithm that considered the number of zones adjacent to the mandibular defect. Intraoral defect reconstruction was assigned the highest priority; soft-tissue flaps afforded favorable results (18). Although malocclusion was not evaluated in the cited work, we were also of the view that the priority was the reconstruction and that occlusion problems were less important. We propose that free VRAM flaps and pedicled LDMC flaps should be placed in selected patients with oromandibular defects.

The immediate reconstruction of mandibular defects using vascularized bone has become widely accepted as the gold standard procedure over the past two decades. With the accumulation of surgical experience, the failure rate, and complications and morbidity associated with reconstruction have decreased (1,19). However, the risk of failure after reconstruction using vascularized bone remains significantly higher than that associated with the use of soft-tissue flaps because flap orientation is determined by alignment of the bone rather than optimal positioning of the pedicle (4). Further, patients who are reconstructed using soft-tissue alone experience less postoperative pain and recover more quickly. Such considerations are important when treating patients with head-and-neck cancer, many of whom require subsequent adjuvant therapy or have short life expectancies (6). Although, in theory, it is preferable to replace absent mandibular tissue with "like" (vascularized bone), we are of the view that this is not mandatory if the defects are entirely posterior.

Patients with head-and-neck cancer in poor general health who require several resections of oral soft tissue and the mandible have low long-term survival rates. In many cases, surgery is not appropriate because of systemic disease and/or a history of heavy tobacco, alcohol, or drug use. Their nutritional status may also be impaired, either because of alcoholism or because the tumor interferes with alimentation. Thus, the extent and complexity of surgical procedures should be minimized in such patients. We prefer to place soft tissue-only flaps in such patients because many patients with advanced cancer require postoperative radiotherapy. In such patients, it may be critical to minimize the time that elapses between surgery and adjuvant therapy to ensure long-term treatment success. Less complex reconstructions are thus appropriate, being associated with minimal peri- and post-operative complications.

Prior bony flap reconstructions failed in some of our patients who were in poor general health and had short life expectancies. Under such circumstances, salvage procedures should be used to cover vital organs and to deal with complications caused by post-surgery defects and radiotherapy.

Table 1. The data of the patients including age and gender, etiological factors, the locations of the defects, preoperative status, comorbidities, surgical preferences, durations of operation and hospitalization, complications, and secondary surgical procedures are shown

Patient number	Age (years) gender	Etiology	Defect location	Preoperative status	Co-morbidity	Surgery	Op time (hours)	Complication	Secondary surgery	Hospitalization (days)
1	39 y/M	Ameloblastoma	Posterior		Bipolar disorder	Pedicled LD	3 h			12
2	25 y/M	Nasopharengeal Ca (ORN)	Posterior	RT (ORN)*		Pedicled LD	4 h	Wound dehissence (neck region)	None (secondary healing)	18
3	60 y/M	Mesenchymal sarcoma	Posterior-lateral	Post fibula flap (RT &TR)	HT	Pedicled LD	6 h	Wound dehissence (neck region)	None (secondary healing)	28
4	61 y/FM	Ameloblastoma	Posterior	FFF	CRF, HT, DM	Pedicled LD	6 h	Partial flap necrosis, seroma	Debridement	14 (exitus)
5	69 y/M	Mesenchymal sarcoma	Posterior-lateral	FFF	DM, HT	Pedicled LD	3 h	Seroma, hematoma		22
6	76 y/FM	SCC	Posterior-lateral	Edentulous	COP, HT	Pedicled LD	6 h	Seroma	Flap debulking	17
7	73 y/M	SCC	Posterior		COPD, DM, HT	Pedicled LD	5 h			12
8	64 y/M	SCC	Anterior	Post fibula flap (RT & TR) anterior fistula		Free VRAM	7 h			14
9	68 y/FM	SCC	Posterior		HT	Free VRAM	6,5 h		Flap debulking	10
10	62 y/M	SCC	Antero-lateral	ORN (post fibula flap RT)	HT	Free VRAM	7 h	Wound dehissence (neck region)	Debridement	25
11	66 y/FM	Mesenchymal sarcoma	Posterior-lateral	Edentulous		Free VRAM	6 h			12
12	63 y/M	SCC	Posterior		HT	Free VRAM	6 h		Flap debulking	14
13	59 y/M	Mesenchymal sarcoma	Antero-lateral	Post fibula flap (RT & TR)		Free VRAM	8 h	Partial skin necrosis and Wound dehissence (neck region)	Debridement and STSG	28

Table 1. Continued

Patient number	Age (years) gender	Etiology	Defect location	Preoperative status	Co-morbidity	Surgery	Op time (hours)	Complication	Secondary surgery	Hospitalization (days)
14	62 y/FM	SCC	Posterior-lateral	Edentulous	DM	Free VRAM	6 h	Wound dehissence (donör area)	None (secondary healing)	11
15	58 y/M	SCC	Antero-lateral	ORN (post fibula flap RT)	HT	Free VRAM	7,5 h		Flap debulking	16
16	56 y/FM	SCC	Antero-lateral	FFF, anterior fistula	DM, HT	Free VRAM	6 h			19
17	45 y/FM	SCC	Posterior-lateral			Free VRAM	6,5 h			14

SCC: Squamous cell carcinoma, RT: Radiotherapy, ORN: Osteoradionecrosis, TR: Tumor recurrence, FFF: Free Flap failure, HT: Hypertension, DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, CRF: Chronic renal failure

Anterior mandible defects require placement of rigid osseous flaps to prevent the development of the Andy Gump deformity, airway collapse, drooling, and facial distortion. However, if the defects are lateral or posterior, it is not essential to reconstruct the bony mandible; soft-tissue flaps alone are useful in certain scenarios (4,5,11,12,14,18). Thus, we propose the use of an algorithmic approach when evaluating anterior mandibular defects. In the absence of prior free flap failure, osteoradionecrosis, a need for radiotherapy, and tumor recurrence, we use a free fibular osteocutaneous flap. If one or more of these conditions is present, we prefer to use a free rectus myocutaneous flap. Finally, if any one (or more) of these conditions is combined with a medical comorbidity, we choose a pedicled pectoralis myocutaneous flap for reconstruction of the anterior defect (Figure 4).

In terms of posterior mandibular defects, we prefer to use a free VRAM flap in the absence of prior free flap failure, osteoradionecrosis, a need for radiotherapy and tumor recurrence. If one (or more) of these conditions is present, we place a pedicled LD flap. We propose that osteocutaneous free flaps should be placed in patients with postero-lateral defects if all of the conditions mentioned above are absent, and the patients are dentulous. However, if one (or more) of the conditions is present and the patient is edentulous, we choose a free VRAM flap. Finally, if one (or more) of the conditions is present together with a comorbidity, we prefer to use a pedicled LD flap (Figure 4).

An anterolateral thigh flap may serve as a second flap during double-flap reconstruction or as a single bulky flap when some of the vastus lateralis muscle is also harvested. Donor site deformities and morbidities are higher when the flaps include muscle and large skin islands.

In patients with comorbid disease, those who have undergone prior irradiation, those for whom recipient vessels are not available, and those with recurrent disease who will not survive for long, we propose that a pedicled latissimus dorsi flap should be used to obliterate the defect and close the floor of the mouth and crucial neck tissues such as the carotid artery and the jugular veins. This is a salvage procedure.

In patients who are more stable oncologically and medically, we propose the placement of a VRAM flap. This affords many advantages. The long pedicle can cover posterior defects. The versatility of the flap allows reconstruction of multiple areas, and the bulky tissue obliterates large composite defects while providing stable soft tissue tolerant of adjuvant irradiation and possible later revision.

Patients who lack a posterior mandible are usually of near-normal appearance and have acceptable oral function provided that the anterior mandible is located in the correct anatomical position, and the oral lining is adequate (16). Problems arise only when the angle of the jaw loses definition or the TMJ is non-functional. Such prostheses are associated with high long-term complication rates and do not restore the mixed gliding and hinge functions of the original TMJ. However, if the defect

Figure 1. The use of pedicled latissimus dorsi myocutaneous flap in osteoradionecrosis
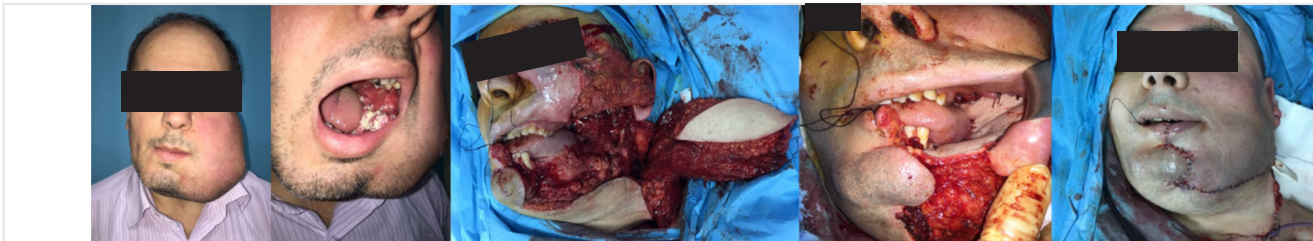(Case 2 in Table 1)

Figure 2. The use of free VRAM flap in the reconstruction
(Case 17 in Table 1)
VRAM: Vertical rectus abdominis myocutaneous

is segmental in nature, and the original condyle can be preserved, vascularized bone reconstruction may restore normal mandibular function and is usually the first option considered. As explained above, this may be associated with unacceptable morbidity in certain patients who are in poor general health or have a poor oncological prognosis. In such patients, the use of soft-tissue flaps to reconstruct segmental mandibular defects may be useful.

Oncological resection of a head-and-neck cancer is often followed by adjuvant radiotherapy of the surgical area. This compromises flap survival, increasing fibrosis and the risk of osteoradionecrosis of the mandible or flap. Blood flow to the target area is reduced, causing exposure of the bone or implant. Osteocutaneous flaps are particularly susceptible to radionecrosis, infection, and exposure of fixation material. Bulky myocutaneous flaps feature a robust blood supply to the muscle, covering bone with well-vascularized tissue that may be less susceptible to radionecrosis. After flap irradiation, bulky soft tissue usually shrinks but remains cosmetically acceptable. Foreign materials used for fixation also interfere with radiological imaging, creating artifacts on scans used to screen for tumor recurrence, associated with a risk of misdiagnosis.

Study Limitations

Other soft-tissue flaps, such as anterolateral thigh fasciocutaneous or pectoralis major myocutaneous flaps, are also available. Radial forearm free flaps could perhaps be used to repair some small

Figure 3. The postoperative view of the case 17 reconstructed with free VRAM flap
VRAM: Vertical rectus abdominis myocutaneous

defects, but most defects created by oncological resection are quite large and require bulky flaps such as the flaps that we have used (i.e., latissimus dorsi or rectus abdominis myocutaneous flaps).

Conclusion

In conclusion, soft tissue flaps are a feasible option that can be used in posterior and/or posterolateral defects in primary reconstruction or secondary salvage procedures.

Anterior Mandible Defects

Free Flap Failure
Osteoradionecrosis
Radiotherapy
Tumor Recurrence

No

Yes

Yes
++ Comorbid diseases

Osteocutaneous Free Fibula Flap
Myocutaneous Flap

Free Rectus Flap

Pedicled Pectoralis Flap

Posterior Mandible Defects

Free Flap Failure
Osteoradionecrosis
Radiotherapy
Tumor Recurrence

No

Yes

Free VRAM Flap

Pedicled Latissimus Dorsi Flap

Posterolateral Mandible Defects

Free Flap Failure
Osteoradionecrosis
Radiotherapy
Tumor Recurrence

No / Dentulous
Patient

Yes / Edentulous
Patient

Yes
++ Comorbid diseases

Osteocutaneous Free Fibula Flap
(or Iliac Crest Bone Flap)

Free VRAM Flap

Pedicled Latissimus Dorsi Flap

Figure 4. An algorithmic approach in mandible reconstruction. Free flap failure, osteoradionecrosis and tumor recurrence in mandibula reconstructions can be subject to the reconstruction stage with soft tissue flaps. Soft tissue flaps for the composite mandible reconstructions can also be used in selected cases with posterior and/or posterolateral mandible defects in whom radiotherapy is planned and/or who have any comorbidities

VRAM: Vertical rectus abdominis myocutaneous

Ethics

Ethics Committee Approval: Bezmialem Vakıf University Clinical Research Ethics Committee (number: E.21697/date: 208.06.2021).

Informed Consent: Obtained.

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Concept: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Design: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Data Collection or Processing: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Analysis or Interpretation: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Literature Search: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G., Writing: K.Y., İ.M.K., R.B.K., O.K., M.V.K., A.K., K.U., E.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Wei FC, Seah CS, Tsai YC, Liu SJ, Tsai MS. Fibula osteoseptocutaneous flap for reconstruction of composite mandibular defects. Plast Reconst Surg 1994;93:294-304.

2. Deek NFAL, Wei FC. Computer-assisted surgery for segmental mandibular reconstruction with the osteoseptocutaneous fibula flap: Can we instigate ideological and technological reforms? Plast Reconst Surg 2016;137:963-70.

3. Berrone M, Crosetti E, Tos PL, Pentenero M, Succo G. Fibular osteofasciocutaneous flap in computer-assisted mandibular reconstruction: Technical aspects in oral malignancies. Acta Otorhinolaryngol Ital 2016;36:469-78.

4. Mosahebi A, Chaudhry A, McCarthy CM, Disa JJ, Mehrara BJ, Pusic AL, et al. Reconstruction of extensive composite posterolateral mandibular defects using nonosseous free tissue transfer. Plast Reconst Surg 2009;124:1571-7.

5. Kroll SS, Robb GL, Miller MJ, Reese GP, Evans GR. Reconstruction of posterior mandibular defects with soft tissue using the rectus abdominis free flap. Br J Plast Surg 1998;51:503-7.

6. Uğurlu K, Ozçelik D, Hüthüt I, Yildiz K, Kilinç L, Baş L. Extended vertical trapezius myocutaneous flap in head and neck reconstruction as a salvage procedure. Plast Reconstr Surg 2004;114:339-50.

7. Schiel H, Prein J. Seven-year follow-up of vanishing bone disease in a 14-year-old girl. Head Neck 1993;15:352-6.

8. Duraisamy D, Veerasamy JS, Rajiah D, Mani B. Vanishing mandible: A rare case report with accent to recent concepts on aetio-pathogenesis. J Clin Diagn Res 2015;9:25-7.

9. Gulati U, Mohanty S, Dabas J, Chandra N. "Vanishing bone disease" in maxillofacial region: A review and our experience. J Maxillofac Oral Surg 2015;14:548-57.

10. Singh M, Shah A, Bhattacharya A, Raman R, Ranganatha N, Prakash P. Treatment algorithm for ameloblastoma. Case Rep Dent 2014;2014:121032

11. Blackwell KE, Buchbinder D, Urken ML. Lateral mandibular reconstruction using soft-tissue free flaps and plates. Arch Otolaryngol Head Neck Surg 1996;122:672-8.

12. King TW, Gallas MT, Robb GL, Lalani Z, Miller MJ. Aesthetic and functional outcomes using osseous or soft-tissue free flaps. J Reconstr Microsurg 2002;18:365-71.

13. 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;109:45-52.

14. Butler CE, Lewin JS. Reconstruction of large composite oromandibulomaxillary defects with free vertical rectus abdominis myocutaneous flaps. Plast Reconstr Surg 2004;113:499-507.

15. Chim H, Salgado CJ, Mardini S, Chen HC. Reconstruction of mandibular defects. Semin Plast Surg 2010;24:188-97.

16. Hanasono MM, Zevallos JP, Skoracki RJ, Yu P. A prospective analysis of bony versus soft tissue reconstruction for posterior mandibular defects. Plast Reconstr Surg 2010;125:1413-21.

17. Yıldız K, Kayan RB, Güneren E. Pedicled latissimus dorsi myocutaneous flap in the reconstruction of the head and neck region: Experience with 17 patients. Bezmialem Science 2017;5:101-6.

18. Cordeiro PG, Disa JJ. Challenges in midface reconstruction. Semin Surg Oncol 2000;19:218-25.

19. Kim JW, Hwang JH, Ahn KM. Fibular flap for mandible reconstruction in osteoradionecrosis of the jaw: selection criteria of fibula flap. Maxillofac Plast Reconstr Surg 2016;38:46.