Journal of
Medical Case Reports

CASE REPORT

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Incidental mishaps and learning curves during free fibula reconstruction of mandible: a case report

Dharnappa Poojary[1], K. M. Sandeep[1*], K. P. Shetty[2], Sameep Shetty[1], Premalatha Shetty[1], Joanna Baptist[1] and Ritesh Singh[1]

Abstract

Background Free fibula reconstruction of the mandible has been the gold standard for reconstruction of mandible owing to its rich periosteal and peroneal blood vessel supply. This demands a multidisciplinary approach of maxillofacial and plastic surgeons. Meticulous presurgical planning of harvesting fibula, resection of diseased bone, contouring the fibula to the created defect to restore the anatomy and function, microvascular anastomosis, and postoperative medical care are vital for the survival of the flap.

Case series We report a series of cases in four Indian patients. Case 1 involves a 23-year-old male individual, Case 2 involves a 47-year-old male individual, Case 3 involves a 23-year-old male individual, and Case 4 involves a 56-year-old female individual. All patients underwent fibula reconstruction of the mandible post-odontogenic and malignant tumor resections with incidental intraoperative mishaps and management with successful outcomes with a follow-up of 12 months.

Results All the above cases were done with a multidisciplinary approach, including plastic and maxillofacial surgeons. Despite the incidental mishaps, it was a learning experience for the betterment of the planning of future cases.

Conclusion Although the free fibula flap is a conventional method for reconstruction, there is a risk of error hidden in each of its subtle steps that can contribute to flap failure. Therefore, meticulous surgical planning is mandatory for execution of the treatment plan. Although complications are inevitable, they should not overshadow the learning opportunities from each respective case.

Keywords Free fibula flap, Reconstruction, Ameloblastoma, Lingual plating, Quality of life

Introduction

Resection and reconstruction of the mandible and maxilla have long been used to treat benign and malignant tumors of the oral cavity. Several reconstructive methods have been documented for treating mandibular defects. For almost a century, nonvascularized bone grafting has been employed for reconstruction following tumor resection.

Walter originally described the use of a fibula transplant in 1911, as mentioned by Lucas *et al.* [1]. Hidalgo reported use of the free fibula flap in 1989

*Correspondence:
K. M. Sandeep
sandeep.km@manipal.edu
[1] Department of Oral and Maxillofacial Surgery, Manipal College of Dental Sciences Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka 576104, India
[2] Department of Plastic Surgery, Kasturba Medical College Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka 576104, India

to restore mandibular tissue loss [2]. The free fibula flap is currently considered the gold standard in mandibular reconstructive surgery [3, 4]. Because of the functional and aesthetic implications of mandibular bone loss, reconstructing the mandible to replicate the intricate anatomy is very challenging. A successful reconstruction must meet several requirements, including the restoration of face aesthetics and functions (chewing, breathing, and speech) [4].

The free fibula flap has several advantages, including a long pedicle, a flexible skin island, a good stock of dense cortical bone, consistent bone shape, minimal donor site morbidity, a superior union rate, multiple osteotomy, anti-collapse effectiveness, segmental blood supply, the potential for two skin paddles, and ease of harvest, with a flap survival rate of up to 95% [4].

There are two major factors to be considered when it comes to mandible reconstruction: The first is the anatomical variation in the region. Second, mandibular movements are difficult and complex [5]. Mandible repair is necessary to restore bone integrity following ablative surgery, infection, massive jaw cysts, or trauma. Mandible reconstruction involves a variety of procedures, including pedicle flaps, titanium reconstruction plates, and bone transplants [5]. However, the best procedure described for mandible rebuilding is the free fibula osteocutaneous flap, which is secured with a titanium plate and screws. The choice of treatment approach is determined by a variety of criteria, including patient factors, surgical team competence, the patient's tolerance to treatment, the need for occlusal rehabilitation, and the extent of the mandibular defect [5].

Here we report a series of four cases of free fibula reconstruction; three cases experienced incidental mishaps, one case had postoperative complications, and all were managed successfully.

Case series

Case 1

A 23-year-old Indian male patient reported to the department of plastic and reconstructive surgery on 23 August 2023 with swelling on left jaw for the previous 8 months and paraesthesia in the left lower lip in the previous 2 months.

He was histopathologically diagnosed with ameloblastoma, and resection and reconstruction with free fibular flap were planned. Resection with left hemimandibulectomy and condylar disarticulation were done; a free fibula flap 15×3×3 cm in size was harvested, with a pedicle and skin paddle for flap monitoring. The periosteum was stripped on one side (buccal) with the intact periosteum with a pedicle on the lingual side aiming to reconstruct the mandible (Fig. 1A–E).

Owing to ignorance or poor meticulous planning, the orientation of the flap graft had to be changed. The periosteum and pedicle flap were placed on the buccal side, while intact bone was stripped off of the periosteum on the lingual side to fit the defect. The pedicle was detached prior to the main peroneal vessel; hence, reconstruction had to be done within 2 hours

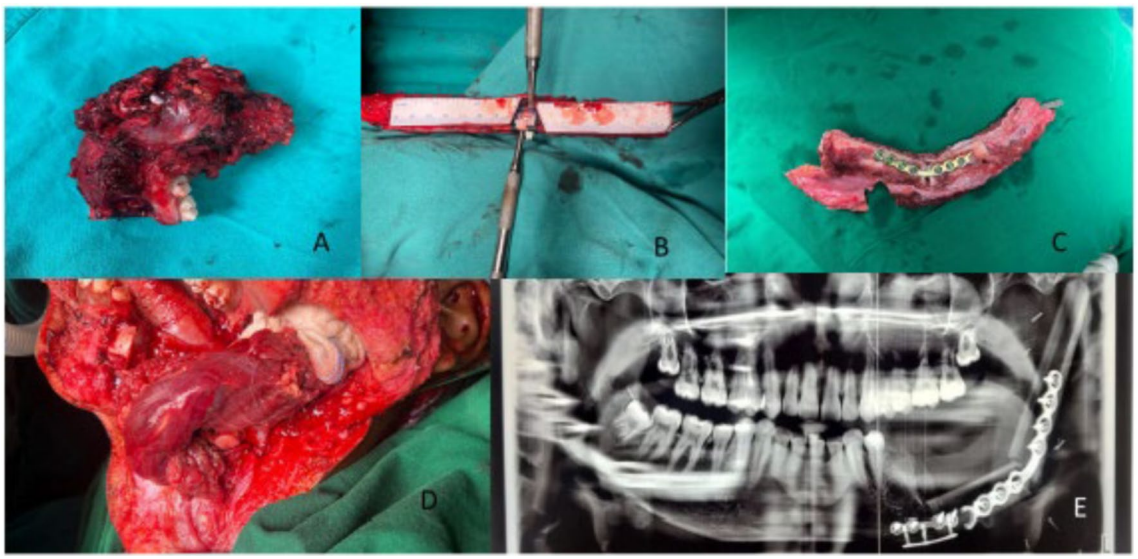

Fig. 1 **A** Resected tumor with clear margin; **B** free fibula 10×3×1.5 cm in size was harvested; **C** lingual plating of fibula with reconstruction plates and screws, with the proximal part shaped to the neocondyle and skin paddle; **D** reconstruction done with the bulk of the flap pedicle on the buccal side; and **E** postoperative orthopantomogram showing neohemimandible, neocondyle, and lingual plating

to prevent flap failure. Therefore, we proceeded with the lingual plating of the fibula with 2.5 mm-diameter reconstruction plates and bicortical screws.

We positioned the flap graft to fit the defect and, with a colored pencil, marked the site for holes on the lingual side. The proximal part of the fibula was recontoured into the condyle. Osteotomy was performed on the fibula to form angle and body; the mandible was reconstructed and fixed with an eight-hole 2.5 mm reconstruction plate and 2.5×10 mm screws. Moreover, the distant end of the fibula was secured to normal mandible with two miniplates on the buccal side (Fig. 1B–E).

A skin paddle was interposed as the articulating disc; a neocondyle was positioned in the glenoid fossa, and periosteum was advanced and sutured to temporalis and pterygoid muscles, creating a pseudo-temporomandibular joint (TMJ) complex. The approximate duration of reconstruction was 100 minutes, followed by microvascular anastomosis.

Postoperatively, the patient was on low-molecular-weight heparin to prevent thrombosis, and Doppler was done to monitor the flap vitality. Severe swelling was observed during the postoperative period because the flap pedicle was engaged on the buccal side. A skin paddle could not be utilized to check the flap vitality, as it was de-epithelized and placed as an articulating disc for the neocondyle pseudo-TMJ complex.

Swelling completely subsided, and facial symmetry was achieved in 3 months postoperatively with normal mouth opening and occlusion.

Case 2

A 47-year-old Indian male patient reported to the department of oral and maxillofacial surgery at Kasturba Medical College (KMC), Mangalore in December 2022 with a complaint of swelling of the lower jaw on the left side and paraesthesia in the previous 6 months.

He was histopathologically diagnosed with Acanthomata's ameloblastoma, and resection and secondary reconstruction with free fibula flap was scheduled. Immediate reconstruction was not done, since the patient could not afford the cost. Hence, a reconstruction plate was placed. The size of the defect was 10×3×3 cm, extending from region 43 to region 38 (Fig. 2A).

Problems associated with the reconstruction included changes in the position of reconstruction plate, ramus, and body of the mandible to a more superior position owing to the unopposed pull of the temporalis and masseter muscles on the left side, resulting in a shortened face and the shift of the face on the left side (Fig. 2A).

The surgical site was exposed by the midline lip-split approach. The fibula was harvested (10×3×3 cm in size) and completely detached from the main pedicle. The proximal segment was fixed below the lower

Fig. 2 **A** Three-dimensional computed tomography showing loss of height on left side due to the pull of the temporalis muscle; **B** free fibula 10×3×3 cm in size was harvested; **C** fibula flap detached from pedicle completely; **D** reconstruction and fixation with 2.5 mm reconstruction plates and bicortical screws; and **E** postsurgical posteroanterior view showing reconstruction

border of the mandible with eight-hole reconstruction plates and bicortical screws to restore the height and aesthetics. The distal end was fixed to the intact/undiseased mandible on the contralateral side (Fig. 2B–E). Microvascular anastomosis was done by the plastic surgeon by anastomosing the peroneal vessel with the internal jugular vein. The reconstruction procedure took 110 minutes. Flap survival was ensured by providing postoperative anticoagulants and low-molecular-weight heparin 6000 units thrice daily for 4 days. The skin paddle being monitored underwent necrosis on the second postoperative day, with dark blood on pricking suggestive of venous congestion.

Nevertheless, flap vitality, aesthetics, and functions were restored, and the patient is scheduled for prosthetic rehabilitation with implants.

Case 3

A 23-year-old Indian male reported to the department of maxillofacial surgery in March 2024 with complaints of swelling of the left lower jaw for the previous 5 months and paraesthesia in the left lower lip for the previous month. The patient was histopathologically diagnosed with odontogenic keratocyst on the left mandible crossing the midline from region 43 to the left ramus (Fig. 3A).

Midline lip-split incision, segmental resection, and reconstruction were performed with the free fibula flap (Fig. 3B–F).

After harvesting, the graft was not detached from the main pedicle initially; multiple osteotomies were done to fit the contour of the surgical defect. The fibula was secured to prebended reconstruction plates and fixed with 2.5×10 mm bicortical screws. The pedicle was transected, and the graft was fixed to the remnant mandible with miniplates and screws. Flap survival was ensured, and the patient was discharged after 1 week. The patient's facial symmetry and function were restored completely on 2 months' follow-up. Now, the patient is scheduled for rehabilitation with dental implants.

Case 4

A 55-year-old Indian female came to the department of oral and maxillofacial surgery with a post-hemimandibulectomy defect and plate exposure in the maxilla from 6 months prior.

The patient had a history of spindle cell carcinoma of the maxilla and mandible, and she underwent hemiresection 10 years prior. Her left maxilla was reconstructed with a radial forearm free flap.

On clinical examination, it was seen that the reconstruction plate extended from region 43 to the

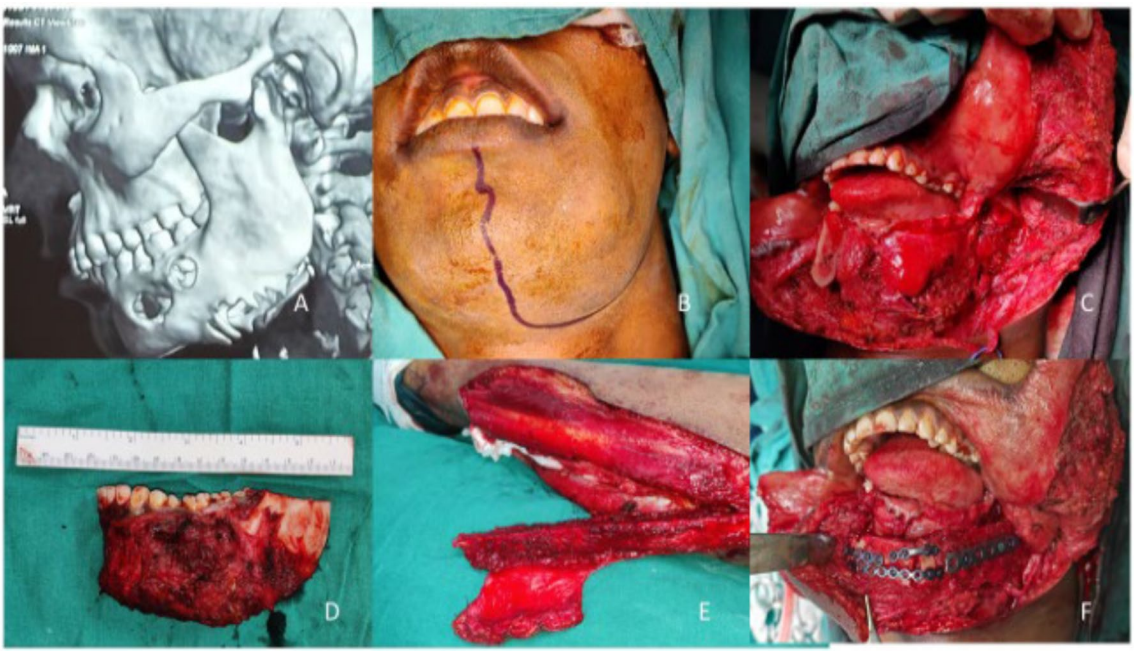

Fig. 3 **A** Three-dimensional computed tomography showing buccal cortical expansion and destruction in relation to the body and ramus of left mandible; **B** markings of midline lip-split incision; **C** site exposed by the midline lip-spit approach; **D** resected specimen with a clear margin; **E** free fibula graft harvested; and **F** free fibula reconstruction

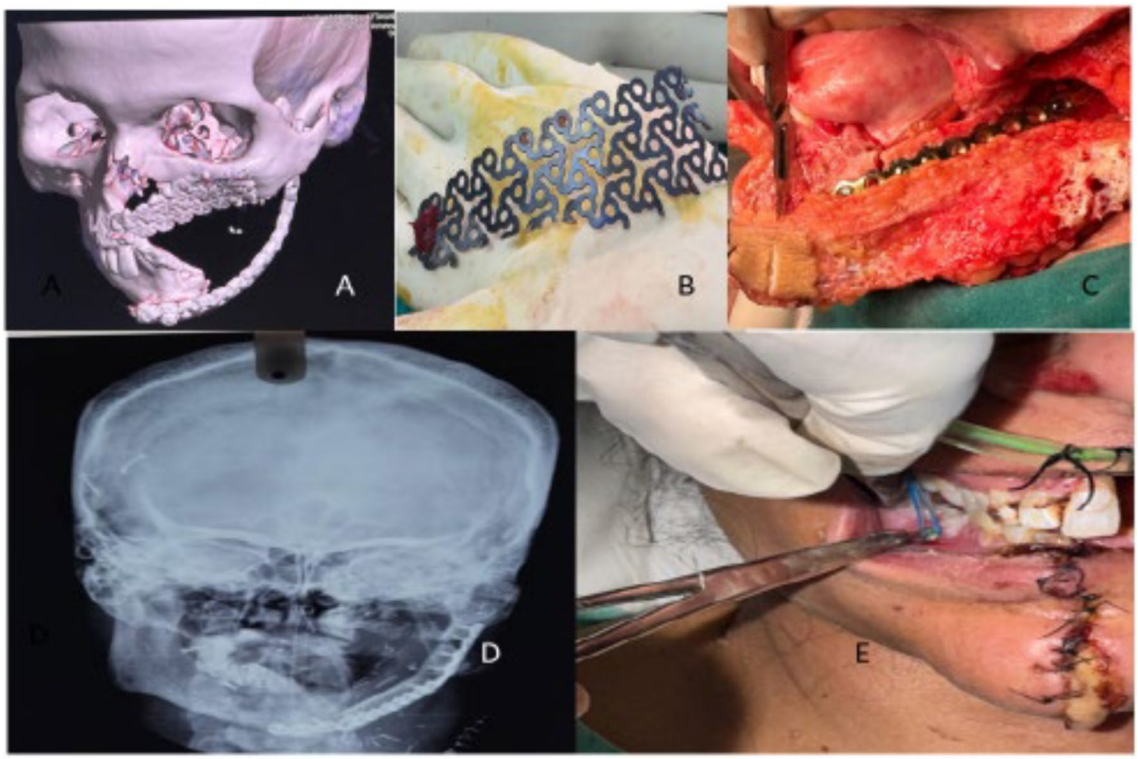

Fig. 4 **A** Three-dimensional computed tomography revealing malocclusion on left side and superolateral placement of the coronoid; **B** mesh on left maxilla removed; **C** free fibula reconstruction; **D** posteroanterior view showing reconstruction of the mandible; and **E** occlusion achieved

left condyle region; there was a shift of the mandible toward the left side with malocclusion and exposure of plate on the left infraorbital region (Fig. 4A).

The aims of the treatment included restoring the occlusion and aesthetics.

The plate or mesh was removed by vestibular incision on the left side without damaging the previously reconstructed radial for arm free flap (Fig. 4B).

A midline lip-split incision was performed to expose the malposed plate, condyle, and coronoid on the left side; the plate was removed and coronoidectomy was done. The condyle was repositioned, and the patient was put into occlusion. The fibula was secured with reconstruction plates and screws. Facial form, occlusion, and aesthetics were achieved (Fig. 4C–E).

Discussion

From Case 1 mentioned above (Fig. 1A–E), mishaps included lingual plating and the selection of a short reconstruction plate. Review of literature sheds little light on evidence of lingual plating in free fibula reconstruction. Disadvantages are as follows:

1. From Case 1 mentioned above (Fig. 1A–E), mishaps included lingual plating and selection of a short reconstruction plate. Review of literature sheds little light on evidence of lingual plating in free fibula reconstruction.
2. Technical challenges of lingual plating of fibula include the lack of access to the lingual side for fixation.
3. The bulk of the pedicle flap is on the buccal side, owing to severe swelling of cheek, and there is a chance for compression of the pedicle owing to flap failure.
4. There can be difficulty in the removal of the plate and screw in the case of recurrence, osteomyelitis, or fracture of the plate.

Advantages of lingual plating include little or no chance of plate exposure even post-radiation, as the bulk of the flap is covering the buccal side, and less chance of plate fracture.

Another incidental mishap was the selection of reconstruction plate with inadequate length, which imposed the requirement of plating the distal end of fibula to the intact mandible with two miniplates on the

buccal side. According to Roby *et al.* [6], regarding a miniplate versus a reconstruction plate, the choice does not appear to affect the overall rate of complications in free fibular reconstruction of the mandible. According to Sobti *et al.* [7], meta-analysis shows that miniplate fixation has a higher chance of exposure and fistula formation.

Reconstruction of the condylar head of the resected mandible with a fibula osteocutaneous flap has been well-reported in literature for many years, with various modifications noted to improve long-term success, negating the need for alloplastic materials in the temporomandibular joint region [8–10]. In the above case, the skin paddle was de-epithelized to form the articulating disc and sutured to the temporalis and pterygoid muscles to form the TMJ complex, posing less threat for ankylosis (Fig. 1D).

Conventionally, the articulating disc is formed by the periosteum of the fibula flap or temporalis muscle [11].

Incidental mishap in the second case (Case 2) was due to lack of planning among surgeons before surgery. Before the late secondary reconstruction, the left ramus and coronoid were pulled superiorly by the temporalis and masseter. Hence, the reconstruction plate was unscrewed and fixed in a new position inferiorly to restore the height of mandible. Other salvage procedures include the stripping of the temporalis muscle or intentionally fracturing the coronoid process, hence negating the muscle pull and restoring the mandible height.

Another mishap was the skin paddle necrosis on the second postoperative day; this might be due to the compressive dressing provided in the immediate postoperative period and the difference in laterality of the paddle in relation to the flap [12]. This condition was managed by administering low-molecular-weight heparin 20,000 IU daily for 5 days.

The mishaps from the two above cases were addressed in the third case; osteotomy was done and adapted to reconstruction plate. Fibula osteotomy to replicate the mandible was done without detaching the pedicle from the main blood supply of the fibula, hence harnessing adequate time for osteotomy with accuracy.

Flap loss can be partial or complete. Free fibula flap failure rates range from 4% to 12% for complete loss and from 4% to 7.8% for partial flap loss [13, 14]. The main characteristic of partial flap failure is continued blood supply by the vascular pedicle.

Singh *et al.* [15] describe fibula flap failure without skin paddle necrosis. An embolus from the anastomosis site may have dislodged and obstructed the vessel immediately distal to the origin of the proximal perforator. As the bony segments of the fibula were perfused by periosteal blood flow, the ischemia most likely resulted in periosteum degradation and bone loss. The skin paddle utilized for defect coverage and monitoring was effectively perfused owing to the intact proximal perforator, but it did not represent the underlying bone state. As a result, early partial bone-only free fibula flap loss is possible, even with an intact skin paddle. This illustrates that skin paddles used to check fibula flaps might be misleading, especially in patients with atherosclerosis.

In Case 4, we encountered difficulty in repositioning the left condyle and coronoid. The coronoid and condyle were pulled by the temporalis muscle; thus, left coronoidectomy was performed to antagonize the action of the temporalis muscle. The condyle was repositioned into the TMJ, and occlusion was achieved. Soft tissue bulk on the left side was increased by splitting the skin paddle and engaging it to the buccal side; in this way, the aesthetic outcome was improved.

A study by Seok *et al.* [16] describes a mandibular body fracture accompanied by superolateral condyle dislocation. The condyle head's medial pole was fractured, and the mandibular body was totally detached. After reduction, the condyle section was prone to dislocation. The displacement of the condyle may have been influenced by the temporalis muscle on the condyle segment. To successfully minimize the displaced condyle, coronoidectomy was performed to interfere with the temporalis muscle's function on the condyle.

Conclusion

Although free fibula flap is the conventional method for reconstruction, there is a risk of error hidden in each of its subtle steps, contributing to flap failure. Therefore, meticulous planning is required for successful execution of the treatment plan. Although complications are inevitable, it should not overshadow the learning opportunities from each respective case.

Acknowledgements
None.

Author contributions
All the authors have sufficiently contributed for the publication of the article.

Funding
None.

Availability of data and materials
Data and materials are available for open access.

Declarations

Ethics approval and consent to participate
Ethics approval and consent to participate were obtained from the institution.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests
No conflict of interest among authors.

Received: 20 November 2024 Accepted: 6 February 2025
Published: 11 March 2025

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