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Outcome of Mandibular Reconstruction Using Free Fibula Flap in Patients Treated at a Tertiary Care Center in Nepal

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Abstract: Mandibular defects resulting from neoplasm, trauma, or infectious etiology are a major reconstructive challenge. Free fibula flap (FFF) is now considered the gold standard technique for restoring mandibular function and aesthetics with the development of microsurgery. However, in a developing country with a tertiary center, where resources are limited and patients often lack adequate financial and insurance support, the study's outcomes are limited. A retrospective study was conducted on 11 patients who underwent mandibular reconstruction using the Free fibula flap (FFF) from 2021 to 2025. Variables included demographics, etiology, defect classification, flap outcome, postoperative complications, and oral feeding timeline. The data were collected from the medical records section and entered into Microsoft Excel 2019. The study was approved by the Institutional Review Committee (IRC) of the Institute of Medicine (IOM), Tribhuvan University. Out of 11 patients (7 men and 4 women), 6 had cancer-related issues, while 5 had non-cancerous conditions. One individual faced flap loss, resulting in a flap survival rate of 90.9%. Additionally, 6 patients encountered postoperative complications such as wound dehiscence, surgical site infections, and venous congestion. Those who did not experience complications were able to resume oral feeding within 2 weeks, whereas others required a longer recovery period. There was one case of donor site SSI. FFF-based mandibular reconstruction is feasible and effective even in resource-constrained settings. Despite limited access to advanced tools such as 3D planning and CT angiography, successful outcomes can still be achieved with skilled surgical teams and institutional support.

Keywords: *Mandibular reconstruction, Free fibula flap, Microsurgery, Resource-limited setting, Complication, Nepal*

Conflicts of interest: None
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1. Introduction

The mandible is the integral structure of head and neck region which serves both form and function (Kokosis et al., 2016). The ultimate goal of reconstruction is restoration of form and function necessitating its evaluation (Colletti et al., 2023). The vascularized free fibula flap was popularized by Hidalgo in 1989 (Hidalgo, 1989). Further, it provides sufficient length and good caliber vessel for micro-anastomosis with good contouring potential (Zhang et al., 2016)

Free fibula flap reconstruction has been extensively studied in high-income countries, particularly for its effectiveness in addressing complex limb defects resulting from trauma, infections, or oncological conditions (Di Summa et al., 2024; Zhu et al., 2024). While the fibula flap is recognized as a reliable option for reconstructive surgery, with numerous studies highlighting its clinical applications, surgical outcomes, and complications, data from low-resource settings remains limited.

A study by Spanish researchers discusses fibula flap reconstruction, highlighting its effectiveness in mandibular reconstruction using virtual surgical planning, stereolithographic models, and CAD/CAM titanium mesh, achieving a high osseointegration success rate of 94.7% and favorable aesthetic and functional outcomes in patients (Navarro et al., 2021). The fibula flap is a gold standard for reconstructing mandible, maxilla, and long bones in India, with a success rate of 89% in a study involving 38 patients, highlighting its versatility and effectiveness in various reconstructive surgeries

(Venkatesh et al., 2021). Nepal faces similar resource constraints, yet only limited studies have examined microvascular reconstruction outcomes, with no focused analysis of fibula flaps. This study presents the first comprehensive evaluation of mandibular reconstruction using free fibula flaps at a Nepalese tertiary center. While numerous studies have documented outcomes of FFF, the literature from low-resource settings like Nepal remains poor. Challenges such as limited access to higher center with teams specialised in microvascular free flap reconstruction, absence of virtual surgical planning, lack of insurance and financial constraints, and lack of timely follow-up capacity significantly affect reconstructive planning and outcomes. This study aims to fill this knowledge gap by presenting early experiences and outcomes of FFF-based mandibular reconstruction in a tertiary care center in Nepal. The findings aim to establish benchmark data for Nepal while contributing to the global understanding of microvascular reconstruction in resource-limited environments (Kotagal and Horvath, 2015).

2. Materials and methods

The study was a retrospective cross-sectional study that consisted of consecutive patients who underwent mandibular resection for various etiologies and were reconstructed using the vascularized free fibular flap between 2021 and 2025. All procedures were performed in the same hospital and by the department of Plastic and Reconstructive Surgery for various etiologies.

The medical records of the patient were reviewed retrospectively from the medical record section. The inclusion criteria were all patients who underwent mandibular reconstruction using a free fibula flap, and the excluded patients were those with incomplete data. Patients age, sex, etiology, type of mandibular defect, Flap survival and complications were reviewed. In addition, patients post-operative day of initiation of oral feeding was also reviewed.

The mandibular defect was classified according to the HCL method, where H referred to any defect that was located unilaterally and included the condyle, L referred to any defect that was located unilaterally and excluded the condyle, and C referred to central defects between the bilateral canines. All data were collected and analysed using Microsoft Excel 2019.

The knee was flexed while the fibula was harvested in a supine position. The center point for a skin paddle, which is harvested with the flap, is the posterior border of the bone. The incision was made along the length of the fibula, extending from 2cm below the head of the fibula to a few centimetres of the lateral malleolus, ensuring that at least 6 cm of the fibula is preserved for the stability of the ankle joint. Initially, the lateral compartment muscles are visualised. A small muscle cuff was left after the lateral compartment muscles were separated from the fibula, enabling the perfusion of the periosteum. Subsequently, the anterior compartment was dissected, where the tibialis anterior, extensor digitorum longus, and extensor hallucis longus were identified and dissected from the fibula. These muscles were then retracted. Subsequently, the interosseous membrane is divided along its length. Then, it proceeded to the superficial posterior compartment, where the gastrocnemius and soleus muscles are identified and separated.

Proximal and distal osteotomies are performed, preserving the common peroneal nerve proximally. The continuation of the peroneal nerve is visualised up to the bifurcation and ligated. Bone clamps are applied to the bone and are distracted out of the leg. The tibialis posterior muscle was divided.

Following the harvest, the study fabricated a neo-mandible from the fibula using a K-wire template. The K-wire is shaped according to the prior specimen, and osteotomies were executed at the appropriate angle. Osteotomies were performed with connected pedicles, hence reducing ischemia duration. After creation of the neo-mandible, the pedicle was detached and placed into the defect, and an inset was done with miniplates and screw, which was practised in our institution due to easy moulding and better manoeuvrability. Anastomosis was performed with suitable vessels in the neck. In the institution, anastomosis was performed with one artery and two veins.

3. Results

A total of 11 patients (7 males, 4 females) were treated in our department in the last 5 years for reconstruction of mandibular defects using the free fibula vascularized flap. Patient's data and outcome are summarised in Table 1. Six patients had malignant causes, and five had a non-malignant etiology.

Table 1: Demographic and sex

Age Group (years)	**Male (n=7)**		**Female (n=4)**		**Total (n=11)**
10–20	1	Ameloblastoma	2	Ossifying Fibroma, Ameloblastoma	3
21–40	1	Ossifying Fibroma	1	Post-trauma (Bear maul	2
41–60	3	SCC	1	SCC	4
61+	2	SCC	-		2

Six patients with malignant etiology (SCC) underwent combined resections including neck dissection which was 54.5% (n=6). All of the patients underwent FFF on the same settings. Among them, one patient had an osteomyocutaneous flap with FHL, a chimeric flap for reconstruction of the floor of the mouth simultaneously with mandibular reconstruction. Wound dehiscence was seen in two patients; one had the implant exposure, and another had wound gapping at the floor of the mouth. Both cases were managed with debridement, nutrition was optimised and DP (delto-pectoral) flap coverage. One patient had complete flap loss due to recurrent thrombosis of the artery, and later the flap was taken down, wound debrided, and the defect was managed with a reconstruction plate and PMMC flap coverage. Patient with no major complication started oral feeding after 2 weeks, and the patient with a complication started after 4 weeks in the patient with a malignant etiology, thus increasing hospital stay days. One patient had a recurrence after 1 year, for whom palliative chemotherapy was administered. There was no incidence of the post-radiotherapy exposure of the implants or wound dehiscence.

Five patients with non-malignant etiology underwent a Free osteo-cutaneous fibula flap, which was 45.4% (n=6). All of the patients underwent free fibula flap on the same setting. Two had an Ameloblastoma, two had an ossifying fibroma of the mandible, and one had a traumatic aetiology (bear maul). Two of the patients had a hemimandibular defect requiring a prosthesis. Among them, three of the patients had complications, one had an SSI with wound dehiscence, which required debridement and the removal of the prosthesis. Another had the loss of the RAFF flap, which was the covering of the fibula flap from outside, which was required to be taken down and later covered with the PMMC flap. Another case had flap congestion, which was identified on the 2nd POD. The patient was immediately rushed to OT, and flap re-exploration was done. Venous thrombus was removed using a Fogarty catheter, and venous re-anastomosis was performed. No direct loss of the fibula occurred in overall cases. There was no exposure of the implant later.

The patient following resection had five individuals with lateral defects (L), four with central defects (C), and two with a hemi-mandibular defect (H). The age range spanned from 14 to 61 years. The youngest recipient was a 14-year-old male.

Table 2: Mandibular defect types

Defect Type	**No. of Patients**	**Percentage**
Lateral (L)	5	45.4%
Central (C)	4	36.3%
Hemi-mandibular (H)	2	18.8%
Total	11	

Eleven consecutive patients underwent mandibular reconstruction utilising free fibula flaps. One patient experienced complete flap loss, while six others encountered postoperative complications that were successfully addressed. So, our flap survival rate was 90.9% (n=10) and overall complication rate was 63.6% (n=7), which is shown in Tables 3 and 4. A single donor site complication occurred, a surgical site infection, which was effectively managed with debridement, antibiotics, and negative pressure wound therapy. No patients experienced donor site morbidity or gait disturbances. Nearly all patients resumed ambulation within two weeks of surgery.

Table 3: Flap Outcomes and Complications

Outcome	**Count (n=11)**	**Percentage**
Flap survival	10	90.9%
Complete flap loss	1	9.1%
Postoperative complications	7	63.6%
Donor site complication	1	9.1%

Table 4: Postoperative Complications

Complication Type	**Number of Cases (n=7)**	**Percentage**
Wound dehiscence/Implant exposure	3	27.2%
Complete flap loss	1	9.09%
Venous thrombosis	1	9.09%
RAFF flap loss	1	9.09%
Donor site SSI	1	9.09%

Postoperatively, patients with uneventful flap recovery commenced oral feeding within two weeks, while those with complications experienced a delayed initiation of oral intake, resulting in prolonged hospital stays. The initial oral feeding post-operatively is shown in Table 5. Routine physical examination included palpation of the anterior tibial, posterior tibial, and dorsalis pedis arteries. While CT angiography was not routinely performed, no instances of peroneal arteria

magna were observed. The facial artery served as the primary recipient vessel for flap pedicle anastomosis (n=8), meticulously performed under loupe magnification.

Table 5: Post-operative oral feeding

Oral feeding (POD)	Number of Patients (n=11)	Percentage
≤ 14 days	5	45.4%
14–28 days	2	18.1%
≥ 28 days	4	36.6%

Following surgery, none of the patients underwent dental rehabilitation. In cases of flap loss, extensive wound dehiscence, or implant exposure, the pectoralis major myocutaneous flap and deltopectoral flap emerged as the workhorse salvage options.

4. Discussion

The reconstruction of the mandible is a complex procedure and continues to be a challenge in reconstructive plastic surgery (Kokosis et al., 2016). Mandibular reconstruction using the free fibula flap (FFF) has become the most popular technique for restoring both form and function following segmental mandibulectomy (Chai et al., 2019; Awad et al., 2019). Since its introduction in the 1980s by Hidalgo, this technique has now been widely adopted (Hidalgo, 1989). However, there is no published literature from Nepal documenting the application and outcomes of such a complex procedure. This study shares our experiences of mandibular reconstruction using FFF in a tertiary care center in Nepal, thereby contributing valuable information from a resource-limited setting.

Our study involved 11 patients who underwent mandibular reconstruction using a free fibula flap for various etiologies. The youngest patient was 14 years old, and the oldest was 61 years old. The overall outcomes were hopeful, as no direct flap failures occurred in cases except one, which resulted in complete flap loss. However, we encountered post-operative complications that were challenging and were managed through a team effort.

Despite these successes, the challenges encountered in our setting were significant. Microsurgical reconstruction demands a well-coordinated surgical team of microsurgeons, an experienced scrub nurse, Critical care and ICU staff with equipment to monitor free flaps (Nagole et al., 2015). The CT angiography, as a routine preoperative investigation in our centre, was not done; instead, clinical examination by palpating all three peripheral arteries in the legs, the Anterior tibial artery, the Posterior tibial artery, and the Dorsalis pedis artery, was performed to assess the vascular status of the leg.

7 out of 11 patients had a complication post-operatively, which included SSI, implant exposure, flap dehiscence, Wound gapping, venous thrombosis in one patient, and complete flap loss in one patient. Flap loss, with a flap survival rate of 90.9% and 54.5%(n=6), with partial complications such as SSI, wound dehiscence, implant exposure and venous congestion. This was quietly relatable with an existing literature, where flap survival was 95 to 98% success in a meta-analysis by Sphitizier et al. 1997. This makes the fibula an excellent choice for mandibular reconstruction. The most common complication was wound dehiscence and implant exposure, seen in 27.2% of cases (3 out of 11 patients). This is higher than the rates reported in large-scale studies such as Knitschke et al. (2021), where complications like wound dehiscence and implant exposure were from 9% (n=16 out of 180), likely due to improved access to virtual surgical planning and optimised perioperative nutrition.

In our study, complete flap loss occurred in 1 out of 11 patients (9.09%), which appears higher than reported by Knitschke et al. (2021), 3.3% (6 out of 180) and Sah et al. (2023), 3.4% (1 out of 29). However, this difference should be interpreted cautiously due to our small sample size and the fact that this reflects the early phase of implementing microsurgical reconstruction at our center.

Venous thrombosis was observed in 1 out of 11 patients (9.09%). Knitschke et al. (2021) documented venous complications in 9 out of 180 cases (5%) in their 19-year review. Similarly, Sah et al. (2023) reported 1 case of venous thrombosis among 29 patients (3.4%). However, our successful salvage via re-exploration and re-anastomosis underscores the importance of a timely surgical response even without advanced flap monitoring devices.

Lastly, donor site surgical site infection (SSI) occurred in one patient (9.09%), which aligns with previously reported rates ranging from 3% to 10% (Nakarmi et al., 2018; Chai et al., 2019).

Collectively, while our overall complication rate of 63.6% may appear higher than global averages, it is consistent with findings from other resource-limited environments, such as the study by Nangole et al. (2015), and reflects the steep learning curve and infrastructural challenges associated with initiating complex microvascular programs in low-income countries.

The result is the successful management of this complication, which was done with careful monitoring, surgical re-exploration, and salvage flaps like the pectoralis major myocutaneous (PMMC) and deltopectoral flaps, highlighting the importance of these workhorse flaps as a recuse/alternative flap. Cases with chimeric flaps for floor-of-mouth reconstruction show the increasing skill of our center.

One of the major limitations and technical shortcomings in all patients was the lack of use of virtual planning, unlike developed nations and centres that have access to computer-aided surgical planning for precise bony cuts and implant positioning. In our setting, surgeries are manually templated (Akashi et al., 2019). None of the patients in our series underwent dental rehabilitation, a critical step for restoring full oral function. The lack of rehabilitation was largely due to financial constraints and inadequate public insurance coverage. This highlights a significant gap in the continuum of care. To address this, future models of care in Nepal must integrate dental services into surgical pathways and include dental procedures as essential services, especially following head and neck reconstruction following cancer excision, as the government provide certain monetary help for these patients. Our journey demonstrates that performing advanced surgery in developing countries presents significant challenges and offers substantial rewards. It needs not only surgical skill but also strong support from institutions, good training, multidisciplinary teamwork, and a focus on patient care during surgery. The lack of published data from Nepal makes this series particularly important for future studies and serves as a guide for surgical practices. This research has some limitations, primarily due to its small sample size and retrospective nature. The small sample size (n=11) limits the statistical power of the study. However, this reflects the rarity and complexity of free fibula flap mandibular reconstruction, which is not commonly performed in Nepal. Due to its retrospective design, the study is susceptible to data incompleteness and selection bias. The absence of long-term follow-up restricts our ability to evaluate outcomes such as implant survival, functional oral rehabilitation, facial aesthetics, and patient-reported quality of life. Prospective studies with larger cohorts and extended follow-up are essential to validate these findings and guide future practices. The results come from a single specialised center, which may limit their applicability. Furthermore, the absence of long-term follow-up, particularly regarding functional aspects such as speech, chewing, and overall quality of life, limits our ability to assess the impact of the findings fully.

5. Conclusion

Mandibular reconstruction using FFF is a reliable technique that requires microsurgical expertise and is feasible in the context of a developing country with adequate resources. Experience plays an important role in optimizing results, as evidenced by progressive improvements in outcomes and a reduction in complications over time. Successful implementation requires coordinated teamwork among surgeons, anesthesiologists, and nursing staff, along with established and effective postoperative monitoring protocols. While challenges exist in developing countries regarding access to advanced technologies and rehabilitation services, the technique remains viable with appropriate adaptation to local conditions. Continued refinement of surgical skills, development of training programs, and establishment of standardized protocols will further enhance outcomes. Future efforts should focus on expanding microsurgical capacity while addressing barriers to comprehensive rehabilitation to maximize long-term patient outcomes.

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