

Free Fibular Flap in Mandibular Defect Reconstruction in Perspective of a Tertiary Care Hospital of Bangladesh

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Abstract

Introduction: The principal objectives of reconstruction after mandible resection are to restore physiological articulation, chewing, swallowing functions and esthetics of the patient. Metal plate and bone graft are usually used to achieve this purpose. From the point of view of bone resorption and augmented exposure to infection, free vascularized fibular flap (FFF), comprising alive bone, have shown a lower infection rate and high rate of success. **Materials and Methods:** The study population of this clinical report included undertaking mandibular reconstruction by transplantation of a free vascularized fibular flap at the Department of Oral and Maxillofacial Surgery at the Dhaka Dental College between May 2014 to November 2014. The factors consider for studying were as following- age, sex, primary disease, period of reconstruction, mandibular defect classification, mandible resection range, height of reconstructed mandibular bone, number of locations of mandible osteotomy, vascular anastomosis and complication. **Results:** Primary disease comprised one was ameloblastoma, one was recurrent ameloblastoma, and another was post-surgical facial deformity. According to the CAT classification body was the most commonly observed defect. All mandibular bones were left as single barrel. There were 2 cases of primary reconstruction and 1 of secondary reconstruction. Free fibular flap ranges from 12-18 cm. No postoperative complications were seen in any case. **Conclusion:** Vascularized fibular flap is good choice in wide-range faults hard to fill with an iliac block graft. Further studies including greater samples of patients undertaking fibular bone transplantation are needed to comparatively investigate its merits in more detail.

Keywords: Mandibular defects, Reconstruction, Free Fibular Flap (FFF), Bangladesh.

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Introduction

After mandible resection impairment of functions are seen including articulation, chewing, swallowing, and esthetics. The Principal objectives of reconstruction are to restore the functions. Metal plate and bone graft are usually used to achieve this purpose. At present, a free vascularized fibular flap is the most frequently used biomaterial for this purpose. Iliac horn bone is similar to that of the mandible in ration of cortex and cancellous. Suchlike grafts are deliberated to be the most appropriate for mandibular reconstruction¹. From the point of view of bone resorption and augmented exposure to infection, free vascularized fibular flap(FFF), comprising alive bone, have shown a lower infection rate and high rate of success². That's why now a day's free vascularized fibular flap is standard use in mandibular reconstruction^{3,4,5}.

The application of FFF in transplantation was first reported in 1975 by G IAN Taylor in Melbourne, Australia⁶. And their pioneer practice in the craniocervical region was reported in 1989 by David A Hidalgo⁷. Peroneal artery and vein were trusted as the main feeding vessel⁴. It is possible to reap flap of greater than 20cm in length creating it as a convenient apparatus in the reconstruction of wide range of mandibular bone defect⁴.

Osteotomies can to be performed at multiple locations and also can reap with the patient in the supine position. Postoperative complications which are associated to the site of harvest are very little. According to PubMed and Google Scholar no study has been conducted in Bangladesh regarding reconstruction of mandibular defects with free fibular flap (FFF). This delineation designates mandibular reconstruction using vascularized fibular flap at the Oral

and Maxillofacial surgery department of Dhaka Dental College, Bangladesh. In designing of manuscript we follow the pattern of clinical report of The Bulletin of Tokyo Dental College by Yamamoto N et.al.

Materials and Methods

Patient

The study population of this clinical report included undertaking mandibular reconstruction by transplantation of a free vascularized fibular flap. All had undertaken segmental resection of the mandible at the Department of Oral and Maxillofacial Surgery at the Dhaka Dental College & Hospital over a period of 06 months, between May 2014 and November 2014.

Essential factors consideration in cases

The factors consider for studying were as following- age, sex, primary disease, period of reconstruction, mandibular defect classification, mandible resection range, height of reconstructed mandibular bone, number of locations of mandible osteotomy, vascular anastomosis and complication. Nobuharu Yamamoto considered the following factors in his study⁴. According to CAT system of Hashikawa Mandibular defect classification was carried out (Condylar Head, Mandibular Angle, mental Tubercle)⁸.

The inclusion and exclusion criteria for fibular transplantation

Patients with systemic illness in whom it would have been problematic to execute surgery under general anesthesia, and those supposed of having deep vein thrombosis were excluded from the study. Informed written consent was taken from all patients for inclusion in this study.

Infection or necrosis of bone transplanted at the time of primary reconstruction; multiple failure of the metal plate for reconstruction; an extensive defect range in the mandible, making reconstruction by transplantation of an iliac bone block graft potentially difficult; and radiation osteomyelitis.

As per fibular flap is alive bone with blood flow, it has tough resistance to infection, creating it the most appropriate type of flap for a wide range of defects. Considering of these benefit, fibular bone grafts are nominated at our department as the primary treatment in cases of mandibular reconstruction.

CAT classification

According to Yamamoto N et al. three factors are used to determine the CAT classification. Creating total of 6 bilaterally customary points: the Condylar Head, Mandibular Angle, and Mental Tubercle. The mandibular defect is classified by a combination of these points. If a defect contains a typical point, it is classified as C, A, or T; if it contains multiple usual point, it is classified as CA, AT, or CAT. If a case includes resection at standard points, it is not included in the classification. If a fault is limited to the mandibular ramus with no typical point, it is classified as Neck; if it is restricted to the body of the mandible, it is

classified as Body. According to Yamamoto N et al. the CAT classification may be summarized as follows: 1) there are 14 classification patterns; 2) only bone defects are included (soft tissue defects are not addressed); and 3) classification is simple to perform (fig 1).

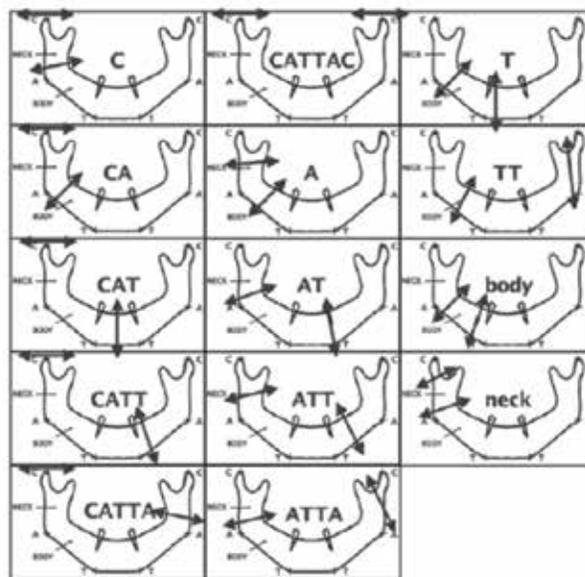


Figure-1: CAT classification (Condylar Head, Mandibular Angle, and Mental Tubercle).

Method

The principal disease, mandible resection range, and number of mandible osteotomy sites, presence or absence of postoperative complications were considered. A skin flap was also reaped during engraftment of the bone flap and assessed as an observing factor.

Mandibular defects including standard point were described as C, A, or T; defects with multiple standard points were classified as CA, AT, or CAT. If resection was performed at standard point, it was not classified as defect. Defect of mandibular ramus only was classified as Neck, while that for the body of the mandible only was classified as Body. Classification patterns are listed as C, A, T, CA, AT, ATT, CATT, ATTA, CATTAC, Neck or Body.

The vascular anastomotic was set as in case of artery, the peroneal artery with facial artery; and in case of vein, the peroneal vein with jugular or lingual or facial vein. Prolene (8-0) was used to ligature in all vascular anastomosis cases. All segment osteotomies were shaped with reconstruction plate.

Results

Two of the patients were men, and one was women. Age ranged from 25-26 years. Primary disease comprised one was ameloblastoma, one was recurrent ameloblastoma, and another was post-surgical facial deformity. According to the CAT classification, Body was the most commonly observed defect. The resection range of the mandible was 11-20 (mean 15.5 cm). All mandibular bones were left as single barrel. There were 2 cases of primary reconstruction

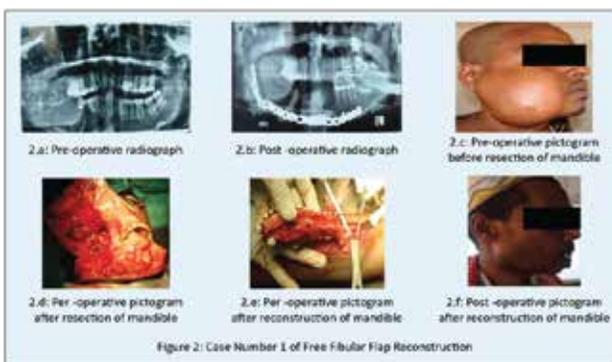
and 1 of secondary reconstruction. Subtotal mandibulectomy was done in all cases. Free fibular flap ranges from 12-18 cm; segmented osteotomy ranges from 3-5 segments. No postoperative complications were seen in any case. Patient's information summary has been shown in table I.

Table-I: Patients information summary.

Case	Age	Gender	Primary Disease	Reconstruction	Mandibular resection range	Mandibulectomy type	Fibular flap range	Segmented osteotomy	postoperative complications
1	26	M	Ameloblastoma	Primary	12cm	Subtotal	12 cm	3 segment	No
2	25	M	Recurrent Ameloblastoma	Primary	18cm	Subtotal	18 cm	5 segment	No
3	26	F	Post-operative deformity	Secondary	15cm	Subtotal	15cm	5 segment	No

Cases

Case 1 comprised a 26 years old man with ameloblastoma on right side of the mandible. His CAT classification was CATT. The mandibular defect range was 12cm; the number of mandible osteotomy sites was 4; and the height of the mandible reconstruction was single barrel. Subtotal mandibulectomy done from left canine to right Condyle (disarticulation) on 28/5/2014. Free fibular flap from right leg (12cm fibula with FHL muscle with 4X2 cm²) is harvested by 3 segment osteotomies & shaped with reconstruction plate (20 holes without condyle) by 11 screws. Vascular anastomosis was - right peroneal artery with right facial artery; peroneal vein with right anterior jugular vein (end to end), ligature by 8-0 prolene. Relevant pictogram are shown in figure 2.



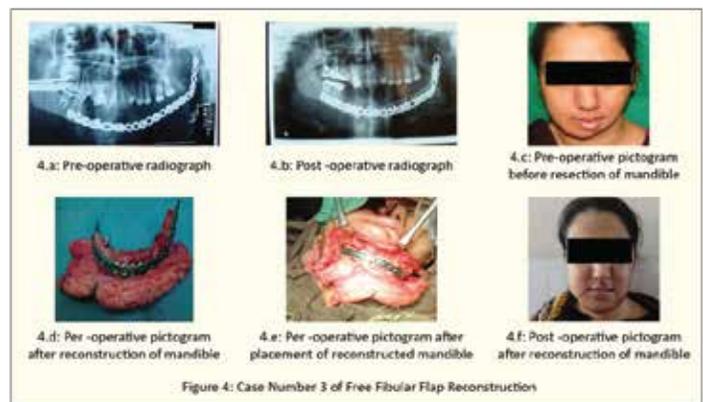
Case 2 comprised a 25 years old man with recurrent ameloblastoma on right side of the mandible. His CAT classification was CATTAC. The mandibular defect range was 18 cm; and the height of the mandible reconstruction was single barrel. Subtotal mandibulectomy done from left angle to right Condyle (disarticulation) on 19/8/2014. Free fibular flap from right leg (18cm fibula with FHL muscle) is harvested by 5 segment osteotomies & shaped with reconstruction plate (without condyle) by 10 screws. Vascular anastomosis was - right peroneal artery with right facial artery; peroneal vein with right facial vein and right anterior jugular vein (end to end), ligature by 8-0 prolene.

Relevant pictogram are shown in figure 3.



Figure-3: Case number 2 of free fibular flap reconstruction.

Case 3 comprised a 26 years old female with post-surgical facial deformity on left side of the mandible. His CAT classification was -TTAC. The mandibular defect range was 15 cm; the number of mandible osteotomy sites was 5; and the height of the mandible reconstruction was single barrel. Subtotal mandibulectomy done from right first molar to left condyl on 19/11/2014. Free fibular flap from right leg (15cm fibula with FHL muscle) is harvested by 5 segment osteotomies & shaped with reconstruction plate (without condyle) by 15 screws. Vascular anastomosis was - right peroneal artery with right facial artery; peroneal vein with right facial vein and right anterior jugular vein (end to end), ligature by 8-0 prolene. Relevant pictogram are shown in figure 4.



Discussion

According to Nagamatsu S et al. reconstruction with only a metal plate was useful as a provisional solution, but that it had long-term problems⁹. On the contrary, block transplant by free iliac bone also has drawbacks, for example limitations of the quantity of bone which can be harvested, and bone resorption after transplant⁴.

Studies have recommended that this difficult can be overcome by reconstruction the mandible by vascularized osteocortical flap in combination with microvascular surgery^{7,10}. The fibula is exclusively fit for mandibular reconstruction in relationships of bone length, strength, multiplicity of cortical bones, adaptability to bone formation, and disturbance of the site of harvest⁴. Peter G. Cordeiro recommended the fibula as the principal choice in mandibular reconstruction¹¹.

Former studies have noted a number of other benefits with a fibular flap in this admiration. These comprise a high

engraftment ration; on experimental bone resorption; applicability in most cases up to 20cm; osteotomy of bone graft, allowing 3-dimensional conformation of mandibular bone, if the alveolar area can be reconstructed by folding into two (double barrel method); and suitability for insertion of implant^{3,7}. No implants were worn to re-establish occlusion, here. This does not indicate that implants will be lined out in future patients. Conversely the conclusion will have to be made based on complete concern of both fibular height and soft tissue conditions. In this situation the width of the attached gingival of soft tissue should also be measured.

Mandibular reconstruction has been reproduced using reconstruction plates for many years at Dhaka Dental College. It was found that better precision could be achieved if the bone to be transplanted was familiar in harmony with plaster moulded 3-dimensional models in order to confirm compatibility first. Fibular transplant requires a microsurgical angiostomy. The correlations between the number of fibular osteotomy sites, mandible resection range, primary disease, and fibular necrosis were also investigated. No association was observed among fibular necrosis and the number of fibular osteotomy sites or range of mandibular resection.

In our study primary disease comprised ameloblastoma, recurrent ameloblastoma, and post-surgical facial deformity. Body was the most commonly observed defect by the CAT classification. All mandibular bones were left as single barrel among these 2 cases were primary reconstruction and 1 of secondary reconstruction. Subtotal mandibulectomy from incisors to condyle was done in two cases. Vascular anastomosis was peroneal artery with facial artery and peroneal vein with Facial vein and Ant. jugular vein (end to end). No postoperative complications were seen in any case.

In the case of supplementary soft tissue defect, a fibula graft can be harvested with various reliable skin paddles¹². which allow a one-stage reconstructive method of composite mandibular defects^{13,14}. Numerous modifications of skin paddles have been described¹⁵. An extra benefit of the free vascularized fibula graft is the capability to have two teams working at the same time with the patient in the supine position by reducing operating time, which is related with reduced blood loss and lower rates of infection¹⁶. As well, the blood supply can be monitored postoperatively with an implantable Cook-Swartz Doppler probe^{17,18}. The donor site morbidity of the FFF is always acceptable among different studies, and is typically avoidable with suspicious planning and appropriate technique¹⁹.

One difficulty of the free fibula flap is the height difference between the native mandible and the transplanted fibula, particularly at the anterior segment. The 'double-barreling' of the fibula is a practical modification with good aesthetic and functional outcomes^{20, 21}. The 'double-barreling' of the

fibula enables instant osseointegrated dental implantation²². Preoperative virtual surgery planning using 3D technology has shown convincing improvements in postoperative outcomes²³.

According to Yamamoto et al. when a fibular transplant is performed in a patient with radiation osteomyelitis of the mandible, a number of steps will have to be taken further along. These comprise: 1) performing the surgery after improvement of infection of the mouth and neck; 2) selecting appropriate postoperative antibiotics that are effective against osteomyelitis and performing drainage more strictly; and 3) displaying caution when selecting a blood vessel for anastomosis outside the exposure field.

Conclusion

The results of the current study suggest free vascularized fibular flap is good choice in wide-range faults hard to fill with an iliac block graft. Further studies including greater samples of patients undertaking fibular bone transplantation are needed to comparatively investigate its merits in more detail.

Conflict of Interests: None

Acknowledgement

In designing of manuscript we follow the pattern of clinical report of The Bulletin of Tokyo Dental College by Yamamoto N et.al. The faculties of oral & maxillofacial surgery of Dhaka dental college & hospital. The authors wish to declare no conflict of interest with regard to this paper.

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