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Research Paper

Evaluation of Changes in Bone Height And Bony Union In Free Fibula Flap for Microvascular Reconstruction of Mandible

Suresh Babu P [1],Sobhana C R [2],Delesh Krishnan K R [1],
Saurabh Kumar Rawat[1]

[1]*Department Of Oral and Maxillofacial Surgery, Government Dental College, Thiruvananthapuram, Kerala, India*
[2] *Department Of Oral And Maxillofacial Surgery, Government Dental College, Thrissur, Kerala, India*
Corresponding author: Saurabh Kumar Rawat,

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ABSTRACT
Objective: *This study was done to evaluate the changes in vascularised free fibula graft for mandible reconstruction with respect to height of fibula graft and bony union at the ends of graft and osteotomy sites.*
Methods: *A follow up study was conduted with 5 cases of mandibular resection due to aggressive benign tumor and reconstruction with vascularised free fibula flap. Changes in bone height were measured over time using serial panorex evaluation with respect to anatomic site of reconstruction immediate after surgery, after 3 , 6, 9 and 18 months postoperatively. Measurements were taken with vernier caliper in subsequent panorex examinations.*
Results: *Radiographic aanalysis showed bony of union of the graft ends and at the osteotonmy sites in 4 cases. One patient who had post operative infection bony union was not definite.The height of fibula for the central segment was initially 18 mm and it decreased to 14.28 percent of the initial height (mean 2.4 mm) after 12 months. The height of body part ranged from 14mm to 19 mm initially and decreased to 5.35 percent of initial height (mean 0.75 mm). For the mandibular ramal segment , the height ranged from 11mm to 12 mm initially, and it decreased to 13 percent of the initial height (mean 1.5 mm). The analysis revealed a monthly atrophy of the fibula bone of about 0.12 mm.*
Conclusion : *The vascularised free fibula flap is a durable method of osseous mandibular reconstruction.*
Keywords: *bone resorption, fibula , implants, microvascular surgery, mandibular reconstruction.*

I. INTRODUCTION

Mandibular reconstruction continues to be one of the most common surgical challenges faced by oral and maxillofacial surgeons. Until the advent of free tissue transfer, reconstruction of mandible was suboptimal. Anterior mandibular defects resulted in the so called *' andy gump'* deformity. The aggressive lesions of mandible are usually managed by resection of affected bone and associated soft tissues. Large defects of the mandible caused by resection may eventually result in abnormal mastication, speech and esthetics. The goal of reconstruction is to achieve a functional jaw muscle movements, possible osteointegrated implant insertion and speech. Vascularised free flap transfer has become the preferred method of the mandibular restoration after surgical resection. [1] In comparison with the alternative sites like ilium, radious, scapula, the free fibula has been shown to have many advantages. [1,2,3]

Bone mass is generally adequate for reconstruction of most defects and supports placement of osteointegrated implants.[4] Pedical length and vessel diameter facilitate microsurgical transfer without the need of vein grafts. The segmental blood supply allowmultiple osteotomies to match the shape of the mandible. [5] Although the role of osseous free flaps in mandible reconstruction is well established, potential drawbacks like lower vertical height and tendency for resorption over a period of time are also considered. This may complicate the rehabilitation by placement of osteintegrated implants. Compared to alternative free osseous free flaps, vascularised free fibula is reported to show minimal loss of bone height over a period of time. Thus, this study

was undertaken to evaluate loss of bone height and bony union after vascularised free fibula flap reconstruction of mandibular defects.

II. AIM

To evaluate the changes in vascularised free fibula flap for mandible reconstruction with respect to height of fibula flap and bony union at the ends of graft and osteotomy sites.

III. METHODS

A follow up study of 5 cases of mandibular reconstruction with vascularised free fibula flap was conducted in department of Oral and Maxillofacial Surgery , Government Dental College, Thiruvananthapuram, and department of Plastic and Reconstructive Surgery, Government Medical College, Thiruvananthapuram, Kerala.

3.1 Inclusion criteria

Patients with benign locally aggressive lesions of mandible (ameloblastoma, odontogenic myxoma, fibrous dysplasia) involving central segment, body, ramus, coronoid and condylar process and combinations of these.

3.2 Exclusion criteria

- Patients with malignant lesions and osteoradionecrosis of mandible,
- Patients with systemically compromised status like diabetes mellitus, bleeding disorders, hypertension.
- Extensive soft tissue involvement cases.

Informed written consent was taken from each patient.

3.3 Imaging modalities

Orthopantomogram(OPG)/ panorex veiw, CT- scan, doppler flowmetry

3.4 Type of fixation hardware

Titanium miniplates (2.0 mm)

Long reconstruction plates (2.5 mm)

Evaluation of height of bone graft and bony union was done at midportion with a vernier caliper using Panorex view at immediate post operative follow up, at 3,6,9,12 and 18 months follow up. (Fig. 1)

3.5 Surgical technique-

A two team approach working simultaneously did resection of mandibular tumor segment and harvesting of vascularised free fibula flap under general anesthesia with nasoendotracheal intubation.Conventional anterior approach was used in all patients for harvesting the flap. Fibula was shaped and contoured according to the defect using surgical template and fixed with titanium reconstruction plate (2.5 mm) before insetting. (Fig. 2) After fixing the flap with remaining mandible, microvascular anastomosis was performed between peronial vessels and facial vessels using 9-0 nylon suture. Heparin irrigation was used as anticoagulant at anastamosis site. (500 units in 100 ml. normal saline).

3.6 Statistical analysis

Data were analysed using computer software, statistical package for social sciences (SPSS) version 10. Data were expressed in its frequency and percentage as well as mean and standard deviation. Analysis of variance (ANOVA) was performed as parametric test to compare different periods of observations. For all statistical evaluations, a two tailed probability of value < 0.05 was considered significant.

IV. RESULTS

Mean age of the patients was 29 years. (Table 1) Out of 5 patients, 3 were females and 2 were males.(Table 2) In all cases resection were due to ameloblastoma of mandible. The mandibular defects were as following- 2 cases (body and ramus), 2 cases (body), 1 (symphysis and bilateral body). Radiographic analysis with OPG revealed bony union of the graft ends and at the osteotomy sites in 4 out of 5 patients (Table 3) except one who had post operative hematoma formation. Analysis was taken for mean decrease in bone height in defferent parts of the graft. The height of the fibula in central segment was 18 mm initially which decreased to 14.28 percent of initial after 12 months. The height of body part ranged from 14mm to 19 mm initially and it decreased to 5.35 percent of initial. For the mandibular ramal segment, the height ranged from 11mm to 12mm initially which decreased to 13 percent of the initialheight. The analysis revealed atrophy of fibula bone of about 0.12 mm per month.

V. Discussion

The advent of microsurgical techniques has revolutionized the current approach to mandible reconstruction. Vascularised bone and soft tissues, by means of free tissue transfer , reliably replace intraoral

and extraoral soft tissuesand segmental defects of mandible. Initially the commonly used osseous free flaps for this application include the ilium, radius, scapula, and more recently fibula flap. The later has emerged as the preferred flap for the reconstruction of segmental mandibular defects. Since the first description of the fibula as an osseous free flap for extremity reconstruction, much has been written about the changes in bone over time. [6] Radiographic follow up of the free fibula flap after extremity reconstruction has demonstrated maintenance of the bone in the majority of cases.[7,8,9,10]
It has been shown that vascularised free grafts have superior blood flow and osteocyte survival when compared with non vascularised grafts.when measured metabolically and there is less bone resorption in vascularised fibula than in their non vascularised counterparts.

Bone resorption can be documented bycomparing serial post operative radiographs.[10]In our study preservation of fibula heightover time was used as an indicator of preservation of fibula bone mass. Other techniques such as measuring bone density and metabolic bone turnover are more difficult requiring 3 H-tetracycline and 3H- proline to be given over extended periods. [11]Clinical observations in large numbers of patients undergoing osseous free flap mandible reconstruction has led to assumption that the free fibula is preserved over time. Indeed, the results of our study support this hypothesis. Mean fibula height decreased by 15 percent or less when evaluated with respect to patient age and length of follow up is not much significant to anatomic segment reconstructed.Disa, Hidalgo et al. [12] studied 48 patients having 24 months follow up with a mean age of 45 years. Osseous donor sites included fibula,radious, scapula and ilium. The main observations in the case of free fibula reconstruction in relation to bone height and bone union were that bony union rate was 97 percent. The mean loss in fibula height was 2 percent in central segment, 7 percent in body segment, and 5 percent in ramus segment. Compared to this in our study, 14 percent reduction was seen in central segment , 5 percent in body segment and 13 percent in ramus segment.Frank Holzle et al. [13] studied 54 patients who received free fibular flaps for mandibular reconstruction and revealed monthly atrophy of 0.04 ± 0.08 mm .In our study , monthly atrophy was found to be 0.12 mm.The absence of osteotomy site fracture and malunion in majority of our patients supports the view that multiple osteotomized microvascular fibula flaps have adequate blood supply and heal like normal bone.

VI. CONCLUSION

We conclude that the vascularised fibula flap is a durable method of mandible reconstruction with a negligible resorption rate and will provide excellent functional and aesthetic results.

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Table 1. Distribution of age in study population

Age (years)	Frequency	Percent
< 30	3	60
≥ 30	2	40

Total	5	100

Table 2. Distribution of gender in study population

Gender	Frequency	Percent
Male	2	40
Female	3	60
Total	5	100

Table 3. Bone union after 12 months in total population

Bone union	Frequency	Percent
Yes	4	80
No	1	20
total	5	100

Table 4. Analysis of variance (one way ANOVA) of central part, body part and ramus part bone height(mm) of the graft, comparing different period of observations

Bone part of the graft	Observation	Mean	± SD	F value	P value
Central	Immediate post operative	16.80	2.59		
	3 months follow up	16.60	2.41		
	6 months follow up	15.80	2.31	0.752	>0.05
	9 months follow up	14.60	3.44		
	12 months follow up	14.40	3.34		
Body	Immediate post operative	14.00	4.24		
	3 months follow up	13.75	4.60		
	6 months follow up	13.75	4.60	0.018	>0.05
	9 months follow up	13.50	4.24		
	12 months follow up	13.25	4.60		
Ramus	Immediate post operative	11.50	0.71		
	3 months follow up	11.00	1.42		
	6 months follow up	10.75	0.35	1.772	>0.05
	9 months follow up	9.75	1.06		
	12 months follow up	9.00	1.41		

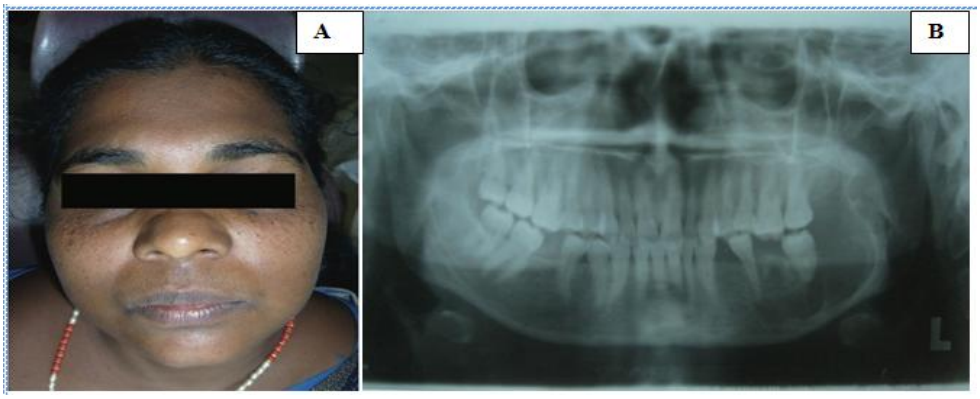

Fig.1 (A) Frontal view of patient, (B) OPG showing multilocularradiolucent lesion involving left body and ramus of mandible

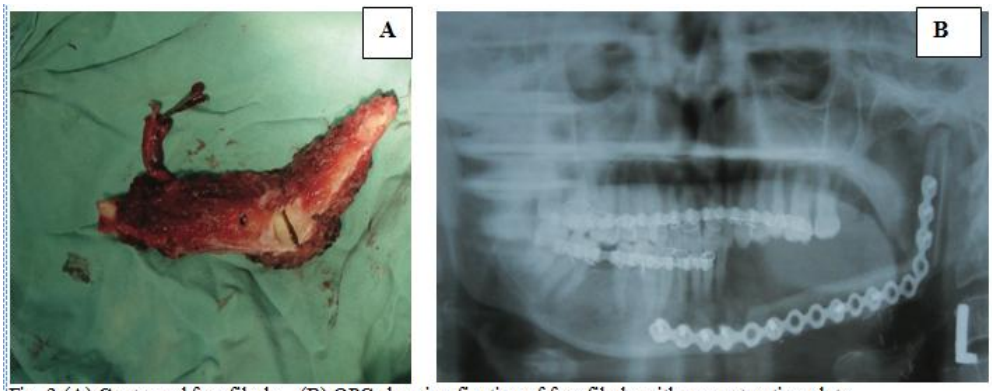

Fig. 2 (A) Contoured free fibula, (B) OPG showing fixation of free fibula with reconstruction plate.

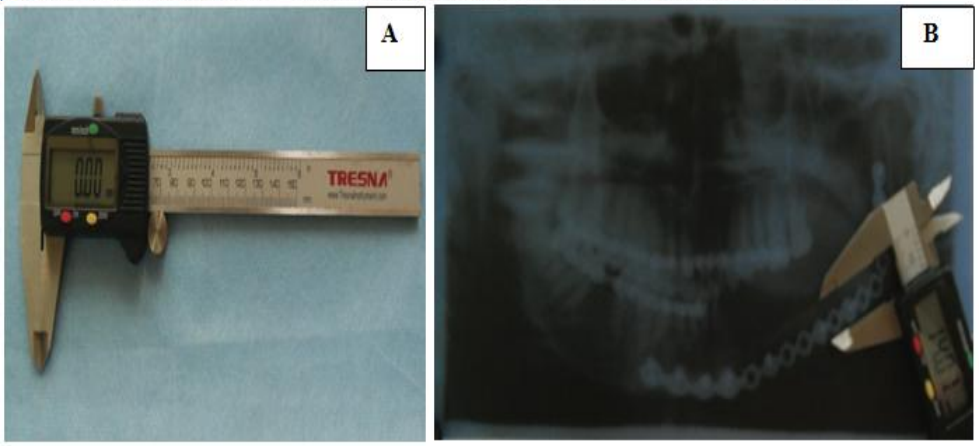

Fig. 3 (A) Vernier caliber, (B) Measuring height of body segment of fibula

*Sabzar Abdullah. "Fabrication of Complete Dentures for A Patient with Resorbed Mandibular Anterior Ridge Using All Green Technique." Quest Journals Journal of Medical and Dental Science Research 4.5 (2017): 83-87.