

**MICRO VASCULAR RECONSTRUCTION OF MAXILLA USING FREE FIBULA
FLAP**

*A Dissertation submitted in
partial fulfilment of the requirements
for the degree of*

MASTER OF DENTAL SURGERY

BRANCH – III

ORAL AND MAXILLOFACIAL SURGERY



THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

Chennai – 600 032

2010 - 2013

CERTIFICATE



This is to certify that **Dr.S.JEYASINGH**, Post Graduate student (2010-2013) in the Department of Oral and maxillofacial surgery, Tamilnadu Government Dental College and Hospital, Chennai-600 003, has done dissertation titled “**MICRO VASCULAR RECONSTRUCTION OF MAXILLA USING FREE FIBULA FLAP**” under our direct guidance and supervision in partial fulfillment of the regulation laid down by **The Tamilnadu Dr. M.G.R. Medical University, Guindy, Chennai-32** for **Master of Dental Surgery, Oral and Maxillofacial Surgery (Branch III) Degree Examination.**

GUIDED BY

Prof. Dr. G. UMA MAHESWARI MDS

Prof & H.O.D, Department of Oral and Maxillo Facial Surgery

Tamilnadu Government Dental College & Hospital

Chennai - 600 003.

Prof. Dr.K.S.G.A.NASSER MDS,

Principal

Tamilnadu Government Dental College & Hospital,

Chennai - 600 003.

ACKNOWLEDGEMENTS

I am extremely grateful to my esteemed guide Prof. Dr.G.Uma Maheswari. M.D.S, Professor and Head of the Department, Department of Oral and Maxillofacial Surgery, Tamilnadu Govt. Dental College and Hospital, for her filial attitude, valuable guidance, encouragement, lending me her precious time and never ending patience without which this study would not have been possible and also for constant inspiration throughout my post-graduation period.

I am greatly thankful to Prof. Dr.B.Saravanan. M,D.S, Professor, Department of Oral and Maxillofacial Surgery, Tamilnadu Govt. Dental College and Hospital, for his timely suggestions and constant encouragement.

I am very much grateful to Prof. Dr.Durairaj M,D.S, Professor, Department of Oral and Maxillofacial Surgery, Tamilnadu Govt. Dental College and Hospital, for his unrestricted help and advice throughout the study period.

I offer with profound respect and immense gratitude to Prof. Dr.K.S.G.A Nasser M.D.S, Principal, Tamilnadu Govt. Dental College and Hospital, for his constant encouragement and support throughout my endeavor during my post-graduation period.

I express my special thanks to Dr.D.Karthikeyan. M.D.S my co-guide for helping me and providing me timely advice during my study period and thereafter.

I express my sincere thanks to Dr.S.B.Sethurajan. M.D.S, Dr.G.Sureshkumar. M.D.S, Assistant Professors in the Department of Oral and Maxillofacial Surgery, Tamilnadu Govt. Dental College and Hospital for their timely suggestion during course of the study.

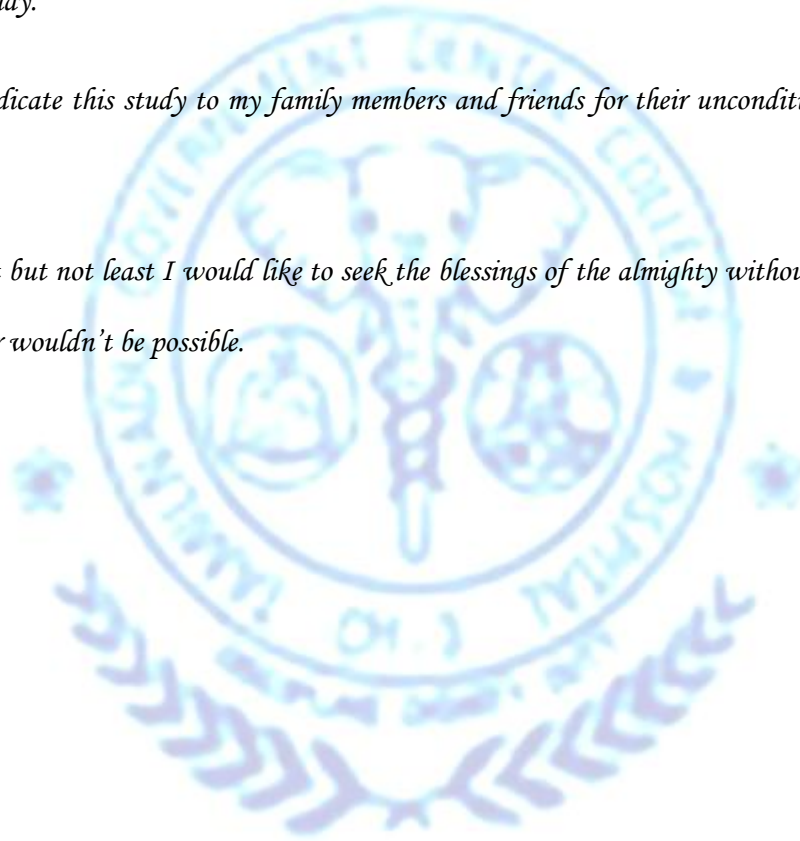
*I express my special thanks to **Prof.Dr.T.M.Balakrishnan M.Ch**, Dept. of Plastic and Reconstructive Surgery, Rajiv Gandhi Govt. General Hospital, Chennai for helping me in the microvascular procedure.*

Narrow border of language could never express my respect and gratitude to all patients who co-operated with me for this study.

*I express my thanks to my colleagues **Dr.Sandeep, Dr.Pradeep and Dr.Ramesh** for helping me in this study.*

I dedicate this study to my family members and friends for their unconditional love and concern.

Last but not least I would like to seek the blessings of the almighty without whose grace this endeavor wouldn't be possible.



DECLARATION

I, **Dr.S.JEYASINGH**, do hereby declare that the dissertation titled “**MICRO VASCULAR RECONSTRUCTION OF MAXILLA USING FREE FIBULA FLAP**” was done in the Department of Oral and Maxillo Facial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai 600003. I have utilized the facilities provided in the Government dental college for the study in partial fulfillment of the requirements for the degree of Master of Dental Surgery in the speciality of Oral and Maxillo Facial Surgery (Branch III) during the course period 2010-2013 under the conceptualization and guidance of my dissertation guide, **Prof. Dr. G.UMA MAHESHWARI. MDS.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

Signature of the PG student

Signature of Guide & Head of the Department

Signature of the Head of the Institution

TRIPARTITE AGREEMENT

This agreement herein after the “Agreement” is entered into on this day ____
_____ between the Tamil Nadu Government Dental College and Hospital represented by its **Principal** having address at Tamil Nadu Government Dental College and Hospital, Chennai - 600 003, (hereafter referred to as, 'the college')

And

Mrs. Dr. G.UMA MAHESWARI, 58 years working as **Professor & H.O.D** in the Department of Oral & Maxillofacial surgery, at the college, having residence address at No-1, Vaidya Rama street, T.Nagar, Chennai-600017. (herein after referred to as the Principal investigator')

And

Mr. Dr.S.JEYASINGH aged 27 years currently studying as **Post Graduate Student** in the Department of Oral & Maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, Chennai-03 (herein after referred to as the 'PG Student and co-investigator').

Whereas the PG student as part of his curriculum undertakes to research on “**MICRO VASCULAR RECONSTRUCTION OF MAXILLA USING FREE FIBULA FLAP**” for which purpose the Principal Investigator shall act as principal investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG student as to the extent possible as a Co-investigator

Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this regard.

Now this agreement witnessed as follows

1. The parties agree that all the Research material and ownership therein shall become the vested right of the college, including in particular all the copyright in the literature including the study, research and all other related papers.
2. To the extent that the college has legal right to do go, shall grant to licence or assign the copyright so vested with it for medical and/or commercial usage of interested persons/entities subject to a reasonable terms/conditions including royalty as deemed by the college.
3. The royalty so received by the college shall be shared equally by all the three parties.
4. The PG student and Principal Investigator shall under no circumstances deal with the copyright, Confidential information and know – how - generated

during the course of research/study in any manner whatsoever, while shall sole west with the college.

5. The PG student and Principal Investigator undertake not to divulge (or) cause to be divulged any of the confidential information or, know-how to anyone in any manner whatsoever and for any purpose without the express written consent of the college.
6. All expenses pertaining to the research shall be decided upon by the Principal Investigator/Co-investigator or borne sole by the PG student.(co-investigator)
7. The college shall provide all infrastructure and access facilities within and in other institutes to the extent possible. This includes patient interactions, introductory letters, recommendation letters and such other acts required in this regard.
8. The Principal Investigator shall suitably guide the Student Research right from selection of the Research Topic and Area till its completion. However the selection and conduct of research, topic and area of research by the student researcher under guidance from the Principal Investigator shall be subject to the prior approval, recommendations and comments of the Ethical Committee of the College constituted for this purpose.
9. It is agreed that as regards other aspects not covered under this agreement, but which pertain to the research undertaken by the PG student, under guidance from the Principal Investigator, the decision of the college shall be binding and final.
10. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996.

In witness where of the parties herein above mentioned have on this the day month and year here in above mentioned set their hands to this agreement in the presence of the following two witnesses.

College represented by its **Principal**

PG Signature

Witnesses

Student Guide

1.

2.

CONTENTS

S. No	TITLE	PAGE
1	INTRODUCTION	1
2	AIM OF THE STUDY	3
3	SURGICAL ANATOMY	4
4	REVIEW OF LITERATURE	8
5	MATERIALS & METHODS	25
6	SURGICAL PROCEDURE	30
7	CASE REPORTS	35
8	OBSERVATION & RESULTS	41
9	DISCUSSION	46
10	SUMMARY & CONCLUSION	51
11	BIBLIOGRAPHY	52
12	ANNEXURE	

ABSTRACT

Aim: The purpose of the study was to evaluate the aesthetic and functional outcome after free fibula flap reconstruction for maxillary defects.

Materials & methods: 3 patients were included in the study. Two patients were secondarily reconstructed due to post traumatic defect and mucormycosis, and third patient was primarily reconstructed after resection for squamous cell carcinoma.

Results: All the three patients had an improvement in speech and aesthetically acceptable results. One patient had wound dehiscence in the recipient site; one patient had pain in donor site for 3 weeks while walking downstairs. No difficulty in deglutition in any patients.

Conclusion: Low donor site morbidity, acceptable aesthetic and functional outcome recommends micro vascularized free fibula flap to be considered as one of the ideal option for maxillary reconstruction. It improves the quality of life by improving the speech and swallowing.

Keywords: Free fibula flap, maxillary reconstruction.

INTRODUCTION

INTRODUCTION

Maxilla forms the keystone in the reconstruction of midface. It contributes to mastication, deglutition, speech, nasal function, support of globe and orbital contents and most importantly esthetics.

Maxillary defects are the result of resections for tumors of odontogenic or non odontogenic origin or due to trauma. Morbidities from these resections can be significant. They not only affect the appearance and the structural integrity of the facial structures but also cause functional defects in swallowing, taste, speech, and vision²².

Reconstruction of maxillary defects poses functional and esthetic challenges to a surgeon. The goals of reconstruction must include the replacement of native tissue, the creation of a barrier between the oral cavity and nasal cavity, the reconstruction of maxillary architecture and the restoration of its structural integrity, the re-establishment of a scaffold against which the soft tissues of the face may be suspended, and finally, the restoration of dentition and the return of normal masticatory function.

Maxillary defects can be reconstructed with obturator, local flaps, pedicled flaps and free flaps.

Traditionally, surgical defects of maxilla are obturated with bulky dental prostheses. Though acceptable results can be achieved in many cases, patients may become dissatisfied for several reasons. The removable prosthesis must be retentive enough for adequate speech, swallowing, and cosmetic appearance. Poor retention

resulting from denture bulkiness and poor residual dentition can create leakage and oro-nasal regurgitation. The patients must maintain adequate hygiene at the surgical site and around the prosthesis⁹⁸.

Maxillary reconstruction with vascularized bone flap and osseointegrated implants is one of the significant improvements in head and neck reconstructive surgery.

Daniel et al²³ in 1973 was the first one who did microvascular anastomosis of soft tissue graft. **Taylor and colleagues in 1975** first used free fibula flap for lower extremity reconstruction. In **1989 Hidalgo³⁸** described its use for mandibular reconstruction. In **1993 Sadove et al⁹⁸** described simultaneous maxillary and mandibular reconstruction with free fibula flap.

Fibula flap has many advantages over other flaps. Ability to harvest bone, muscle and skin simultaneously is beneficial in reconstructing the complex anatomy maxilla. Multiple skin paddles can be obtained to line the orbit and separate the oral and nasal cavities.

At present the free fibula flap is not only the best choice for mandibular reconstruction but is also one of the ideal choices for maxillary reconstruction⁹⁸.

AIM

AIM OF STUDY

To assess the aesthetic and functional outcome in patients undergoing maxillary reconstruction with free fibula flap.

Objectives

The long term outcome is evaluated in the following manner,

1. Fibula as a suitable reconstruction method for maxillary defects.
2. Patient satisfaction

In terms of functional and aesthetic satisfaction at donor and recipient site. (annexure).

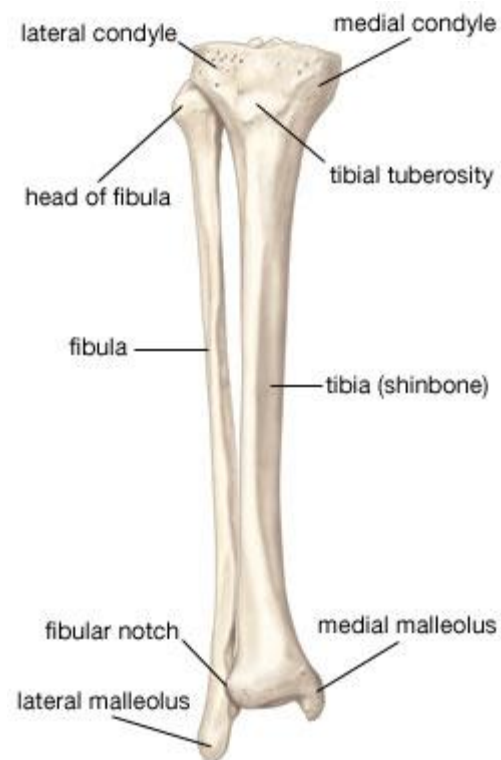
3. Wound infection and dehiscence.
4. Donor site morbidity.

SURGICAL

ANATOMY

SURGICAL ANATOMY

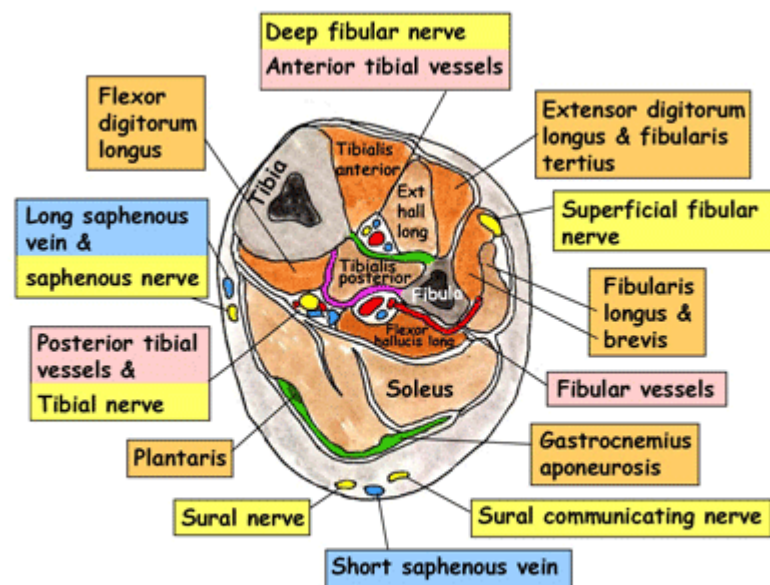
The fibula is the only long and straight bone that is not indispensable. Fibula is 40 cm long. It is situated lateral to tibia.



Fibula has a slender shaft with a thick corticalis. The fibula head articulates with the tibia 2 cm below the knee joint. The fibula can provide up to 26 cm for the transplantation. The long slender body is described as having anterior, interosseous and posterior borders and medial, lateral and posterior surfaces. Only the interosseous border is clear-cut, and borders and surfaces spiral so that they are difficult to follow.

The expanded lower end of the fibula is the lateral malleolus. It bears on its medial surface a facet for articulation with the talus. Below and behind this is a roughened fossa for the attachment of the posterior talofibular ligament.

MUSCLES



Lateral surface

The peroneus longus muscles arise from the upper two thirds of the lateral compartment, whereas the peroneus brevis muscle takes origin from the lower two thirds of the lateral surface of fibula, they overlap in the middle third.

Medial surface

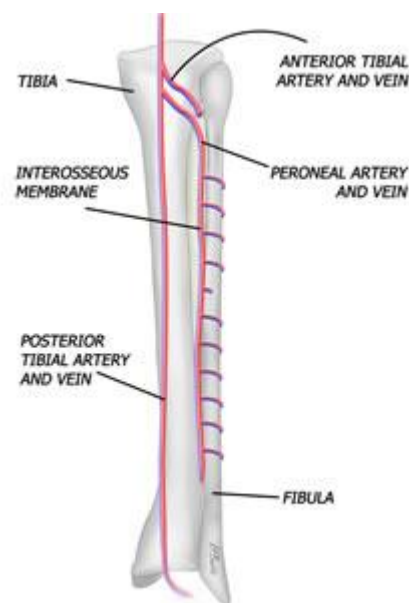
The extensor digitorum longus muscle arises almost entire length of fibula and adjacent intermuscular septum except the most distal 4 to 6 cm. The

extensor hallucis longus arises from the central half of the medial surface of the fibula and adjacent interosseous membrane.

Posterior surface

The soleus muscle has a horseshoe-shaped origin from the head and upper third of posterior surface of fibula and crosses the posterior tibial vessels and nerve with a tendinous arch. The tibialis posterior muscle is the most deeply situated muscle in the posterior compartment, lying between flexor hallucis longus and flexor digitorum longus muscle. It arises from the upper two third of posteromedial surface of fibula. The flexor hallucis longus muscle arises from lower two third of the posterior surface of fibula.

BLOOD SUPPLY



The fibula is supplied by periosteal branch of peroneal artery and by an endosteal vessel which divides and enters the fibula at the junction of middle and distal third. The peroneal artery is the largest branch of the posterior tibial artery arising 2 to 3 cm from its origin before it is crossed by the tibial nerve. It passes laterally across the tibialis posterior muscle to lie against the interosseous membrane and the fibula under cover of flexor hallucis longus muscle. It gives off muscular branches and a nutrient artery to fibula.

A little above the ankle it usually communicates with the posterior tibial artery, sends a perforating branch through foramen in the interosseous membrane to reach the lateral aspect of dorsum of foot, and give rise to lateral calcaneal and malleolar branches.

Proximally near its origin, the external diameter of the peroneal artery is 1.5 to 2.5 mm. Pedicle length however is short about 6 cm, but can be made longer by dissecting the fibula more proximally than planned osteotomies. Between 2 to 6 perforators emerge from the peroneal artery and run behind the fibula to perforate flexor hallucis longus supplying the longitudinally oriented area of calf skin. The most reliable area for harvesting skin paddle is found to be 6 to 12 cm above the ankle, an area corresponding to the junction between middle and distal thirds of fibula. **Lippert and Pabst and Kim et al** who reported that peroneal artery was the sole blood supply of the foot in 0.2% and congenitally absent in less than 0.1%.

Venous anatomy

Most of arteries of leg are accompanied by paired veins. Paired venae comitans travel along the peroneal artery. The external diameter is around 2 to 4 mm suitable for micro vascular anastomosis.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

CLASSIFICATION OF MAXILLECTOMY DEFECTS

Aramany M⁹ in 1978 gave the first classification for the maxillary defects. He divides defects into six types.

1. Class I defect did not cross the midline and preserved the teeth on the contralateral side of the maxillary arch.
2. Class II defects were more limited, with preservation of the contralateral maxillary teeth, the central incisors, and, if possible, the canines and premolars on the resection side.
3. Class III defects involved only the central hard palate, without resection of any teeth.
4. Class IV defects crossed the midline, preserving only the posterior teeth on the contralateral side.
5. Class V defects involved resections of the posterior portion of the maxillary arch, with preservation of the mesial abutment teeth on both sides.
6. Finally, class VI defects involved resection of the midline central maxilla, with preservation of the teeth posterior to those used for abutment.

Ronald H. Spiro, MD, Elliot W. Strong in 1997 classified maxillectomy according to involvement of no of walls of maxilla

Limited maxillectomy-1 wall involved

Subtotal maxillectomy -2 walls including roof involved

Total maxillectomy -all walls involved

Cordeiro PG & Santamaria E²¹ in 2000 expanded the 1997 Spiro classification scheme, subdividing maxillectomy into

Type I - Partial/limited

Type II -Subtotal

Type IIIa -Total with preservation of orbital contents

Type IIIb- Total with orbital exenteration

Type IV - Orbitomaxillectomy

James S. Brown, Simon N. Rogers et al⁴⁷ in 2000 made a classification on the basis of the assessment of 45 consecutive maxillectomy patients derived prospectively from the database (September 1992) and retrospectively from 1989. they came out with a practical classification attempts to relate the likely aesthetic and functional outcomes of a maxillectomy to the method of rehabilitation.

The classification of the vertical component is as follows:

Class 1- maxillectomy without an oro-antral fistula;

Class 2- low maxillectomy (not including orbital floor or contents);

Class 3- high maxillectomy (involving orbital contents); and

Class 4-radical maxillectomy (includes orbital exenteration);

The horizontal or palatal component is classified as follows:

a- Unilateral alveolar maxillectomy;

b- Bilateral alveolar maxillectomy; and

c- Total alveolar maxillary resection.

Okay et al²⁶ in 2001 proposed a maxillectomy defect classification system with

a view toward the assessment of functional outcome, prosthetic retention, and patient satisfaction.

Class Ia: no involvement of the tooth-bearing alveolus.

Class Ib: preservation of both canines.

Class II: resection of one canine or less than 50% of the hard palate

Class III: resection of both canines or greater than 50% of the hard palate.

Subclass f: involvement of the orbital floor.

Subclass z: involvement of the zygomatic arch

James S Brown and Richard J Shaw⁴⁶ in 2010 suggest a new classification based on their previously published classification, which is expanded to include the midface and is clarified in terms of the horizontal or functional aspect of maxillary loss.

Vertical classification:

I—maxillectomy not causing an oronasal fistula;

II—not involving the orbit

III—involving the orbital adnexae with orbital retention

IV—with orbital enucleation or exenteration;

V—orbitomaxillary defect

VI—nasomaxillary defect.

Horizontal classification:

a - palatal defect only, not involving the dental alveolus

b- less than or equal to 1/2 unilateral;

c- less than or equal to 1/2 bilateral or transverse anterior;

d- greater than 1/2 maxillectomy.

Avinash S. Bidra, Rhonda F. Jacob et al¹¹ in 2012 have classified maxillectomy based on six criteria that satisfy both surgical and prosthetic needs. They concluded that criteria-based description appears more objective and amenable for universal use than a classification based description.

ANATOMICAL CONSIDERATIONS

S. W. Choi et al⁸¹ in 2001 did a cadaveric study of 63 legs of Korean cadavers and demonstrated that in most cases the musculoperiosteal and septocutaneous branches of the peroneal artery were distributed at the middle and lower thirds of the fibula. There was double the number of musculoperiosteal perforators to the skin compared to musculoperiosteal branches.

W.H. Wang et al⁹⁴ in 2011 did a study to investigate the added value of preoperative computerized tomographic angiography (CTA) and three-dimensional reconstruction of the lower limb in vascularized fibular flap transfer and concluded that the course of peroneal artery is relatively invariable and its original external diameter was usually thick.

RECONSTRUCTION METHODS FOR MAXILLARY DEFECT

Yadranko Ducic⁹⁹ in 2001 reported the use of thermoplastic polymer for temporary obturation for maxillectomy defects.

Brian L. Schmidt et al in 2004 reported the use of zygomatic implants for reconstruction of extensive maxillectomy defects.

Masayuki Fukuda et al⁶² in 2004 and Claudio Rodrigues Leles et al in 2009 reported the use of implant supported obturators.

Sekou Singare et al in 2007⁸³ reported case reports of maxillary defects reconstructed with prefabricated titanium mesh prosthesis fabricated using rapid prototyping.

Pravinkumar G. Patil⁷⁵ in 2011 reported simple technique to fabricate an immediate surgical obturator by restoring the patient's original dentition and facial and palatal tissue form.

T.V. Padmanabhan et al⁹⁰ in 2011 reported rehabilitation of a maxillectomy with a two-piece hollow bulb obturator in which they have used magnetic retention.

VARIOUS MICROVASCULAR OPTIONS FOR MAXILLECTOMY DEFECTS

H. A. H. Winters et al³⁷ in 2003 used a horizontally placed deep circumflex iliac artery free flap with internal oblique muscle in four patients for maxillary reconstruction and concluded that this is a reliable method, the flap is easy to harvest, and the donor site morbidity is minimized by using only the inner table of the iliac crest.

Neal D. Futran⁶⁷ in 2005 reported the use of various micro vascular options and their advantages for the reconstruction of maxillectomy defects.

S. Duflo⁷⁹ et al in 2005 analyzed the quality of life in 30 cases of palatal defects were reconstructed using micro vascular radial forearm fasciocutaneous free flap and reported that radial forearm fasciocutaneous free flap for palatal reconstruction is a reliable technique and provides a definitive separation between oral and sinusal cavities and it improves quality of life by improving speech, swallowing and chewing. They stated that it should be considered an integral component of head and neck cancer therapy and rehabilitation.

R. González-García⁷⁷ et al in 2007 reported fifty-five patients who underwent reconstruction by means of the radial forearm free flap after resection for squamous cell carcinoma of the oral cavity and the results revealed that the radial forearm free flap is a reliable method for reconstructing a wide range of oral cavity defects with an acceptable low morbidity rate. It provides adequate bulkiness and pliability, resulting in adequate reconstruction of a wide variety of defects within the oral cavity

Kemal Ugurlu⁵¹ et al in 2007 reported nine cases whose wide composite palatomaxillary defects were repaired with free angular scapular bone flap combined with serratus anterior fascia based on subscapular vascular system, between 1999 and 2003. They concluded that the free angular scapular bone flap combined with serratus anterior fascia based on the subscapular vascular system is a flap with distinguished advantages, including its convenience of combining with other flaps, providing a thin composite tissue with resemblance to the palatomaxillary region.

Matthew M. Hanasono⁶³ et al in 2008 reviewed 39 patients who were treated with multiple simultaneous free flaps for head and neck reconstruction between 2001 and 2007 and they concluded that multiple simultaneous free flaps can be performed safely in patients, with acceptable recovery times and functional outcomes. In select cases, the authors advocate multiple free flap reconstruction to maximize quality of life even in patients with advanced cancers.

Deepak Kademani²⁵ et al in 2009 reported reconstruction of maxillary defect with medial femoral periosteal micro vascular free flap. They stated that the medial femoral condyle corticoperiosteal flap results in a limited donor defect because it provides a vascularized periosteum in addition to cortical and cancellous bone and it provides an excellent option for the treatment of limited composite defects of the maxilla, with minimal donor-site morbidity.

Iacopo Dallon et al⁴¹ in 2009 did an anatomical study of temporalis myofascial flap in cadavers and reviewed 9 patients who had undergone subtotal maxillectomy and immediate reconstruction with temporalis myofascial flap. They concluded that this flap is thin and reliable and can be used as an alternative to free flap tissue transfer in the reconstruction of partial defects of the upper maxilla

Amresh S. Baliarsing⁶ in 2010 reported 8 cases of maxillary reconstruction using deep circumflex iliac artery-based composite free flap. They reported that the contour of the iliac bone is similar to the maxilla and provides good esthetic result. They also added that deep circumflex iliac artery flap is difficult to harvest, has variable anatomy, and needs meticulous planning for optimum result.

Ilpo Anti Johannes Kinnunen et al⁴² 2010 did a retrospective analysis of 34 patients operated from 1995 to 2006 for maxillary reconstruction using temporal musculoperiosteal flap with or without free calvarial bone graft. They concluded that the application of pedicled temporal musculoperiosteal flap with or without free calvarial bone graft appears to be a viable option for the reconstruction of limited palatal and maxillary defects.

Thomas Mücke et al⁹³ in 2011 reported 83 patients with various types of maxillary defects that were reconstructed with different micro vascular free flaps including the radial forearm, perforator, anterolateral thigh, latissimus dorsi, iliac crest and fibula and stated that maxillary reconstruction is challenging because of the anatomical site of reconstruction creating a steep learning curve and if the reconstruction is successful, both facial appearance and oral function can be improved.

RECONSTRUCTION WITH FREE FIBULA FLAP

Xin Peng et al⁹⁸ in 2005 reviewed thirty-four consecutive cases of maxillary reconstruction with the free fibula flap and they concluded that alveolar arch defects can be reconstructed successfully using free fibula flaps and it has a high success rate and low perioperative complication rate, making it an ideal choice for maxillary defect reconstruction.

D. David Kim et al²² in 2007 reported that free fibula flap has many advantages like, the ability to harvest bone, muscle, and skin simultaneously is beneficial in reconstructing the complex anatomy of the maxilla. Multiple skin paddles can be

obtained to line the orbit and separate the oral and nasal cavities. The excellent periosteal blood supply allows multiple osteotomies that facilitate re-establishing the anatomic contours of the maxilla.

Boris Laure et al¹⁵ in 2008 reported a case of gunshot injury resulted in both maxillary and mandibular defects reconstructed with one single transfer of a free fibula osteocutaneous flap and concluded that gunshot injuries and tumors are the two main causes for concomitant maxillo-mandibular defect and single free fibular osteocutaneous flap is a good one-stage reconstruction option for this type of defect.

L. Ciocca et al⁵⁴ in 2008 reported gingival hyperplasia around implants in the maxilla and lower jaw which are reconstructed by fibula free flap and they suggested that skin grafts around implants seem to inhibit the overgrowth of granulomatous tissue, and to avoid acrylic provisional abutments which should be substituted with metal–ceramic restoration.

Shahram Nazerani et al⁸⁴ in 2008 reported 11 cases of maxillary reconstruction with the prefabricated free fibula flap between 1994 to 2005 and they stated that the prefabricated fibula with a “banking time” on the leg for flap maturation seems to be a better choice compared with other methods of using the fibula for reconstruction.

Yue He et al¹⁰² in 2009 reported reconstruction of composite total maxillectomy defects with fibula osteomyocutaneous flap flow-through from radial forearm flap and concluded that the fibula osteomyocutaneous flap is an ideal donor site in 3D total maxillectomy defect reconstruction, because of its thickness, length, and bone uniformity which makes ideal support for dental rehabilitation.

Caroline T. Nguyen et al¹⁶ in 2011 reported a case of chondrosarcoma of maxilla treated by maxillectomy and free fibula reconstruction followed by rehabilitation with implant retained prosthesis.

Jian Sun et al⁴⁸ in 2011 reviewed twenty patients who underwent reconstruction of high maxillectomy defects with fibula osteomyocutaneous flaps in combination with titanium mesh or a zygomatic implant and concluded that it is a feasible and acceptable option with a high success rate, a low complication rate, excellent postoperative cosmesis, and well-accepted function.

Eric Santamaria et al³⁰ in 2012 reported 14 patients who had prelaminated osteomucosal fibula flap for maxillary reconstruction in a two stage surgery and stated that prelamination delivers like tissue to the recipient site, obviates the need for debulking, and may reduce donor-site wound problems.

SURGICAL PLANNING

Andre Eckardt and Konstantinos Fokas⁷ in 2003 reviewed 500 cases of microvascular reconstruction and reported that immediate reconstruction following radical tumor resection has become preferable to secondary reconstruction.

Akihiro Homma⁴ et al in 2008 reported intraoperative computed tomographic guidance system (ICTGS) for maxillectomy and said that it helped the surgeon to recognize target points accurately in real time and it allows the surgeon to determine

the minimum accurate bone resection line, and to use the most direct route to reach the lesion.

Horst Kokemueller et al⁴⁰ in 2008 reported that patients with total loss of the maxilla including the orbital floor and preservation of orbital contents, primary reconstruction of orbital and zygomatic contours with individualized titanium implants using computer-assisted techniques in combination with simultaneous transplantation of free soft tissue flaps for vitalized defect refilling provides good functional and esthetic results with predictable outcome.

Yue He et al¹⁰² in 2009 reported that 3D model simulation and preoperative surgical planning are effective methods to refine reconstruction surgery, shorten the surgical time, and predict the outcome after operation.

Shu-Ying Chang et al⁸⁶ in 2010 reviewed 116 free fibula cases based on ischemia time and concluded that using the fibula osteoseptocutaneous flap for head and neck reconstruction, ischemia times less than 5 hours do not increase complication rates in different postoperative stages and the critical ischemia time of the fibula osteoseptocutaneous flap should be limited to 5 hours to reduce partial skin paddle loss and overall complications.

W.H. Wang et al⁹⁴ in 2011 reported that preoperative Computerized Tomographic Angiography and three-dimensional reconstruction of the lower limb, which are noninvasive, accurate and direct-viewing methods, play an important, preoperative role in vascularized fibular flap transfer for lower limb vascular assessment.

G. Rajasekhar et al³¹ in 2012 said that weber fergusson incision with Dieffenbach's modification is versatile and useful in accessing complex maxillary pathologies.

Patrick B. Garvey et al⁷² in 2012 did preoperative computed tomographic angiography mapping of the peroneal artery and its perforators and concluded that computed tomographic angiography accurately predicted the course and location of the peroneal artery and perforators and also provides valuable information to facilitate osteocutaneous fibula flap harvest.

Tao Zhang et al⁹¹ 2012 reviewed 178 micro vascular surgeries in which venous anastomoses was compared with anastomotic coupler device and hand sewing technique and reported that the micro vascular coupler is reliable for venous anastomosis in free flap head and neck reconstruction; dual-vein anastomoses appear to have better results than single-vein anastomoses.

Yi Shen et al¹⁰¹ in 2012 reported 11 patients of maxillary reconstruction which was performed with the guidance of preoperative virtual planning and using fibular osteotomy and reposition guide templates to replicate the virtual planning intra-operatively and they recommended that virtual surgical planning is helpful to perform accurate secondary maxillary reconstruction with a vascularized fibula flap.

COMPLICATIONS

M. Saleem et al⁵⁹ in 1998 reported a case a free fibula reconstruction of a 15 year old boy with a donor site morbidity of compartment syndrome. They recommended that

when harvesting free fibula flaps in children, skin grafting of donor site should be considered irrespective of the width of the flap, if there is any doubt about the tightness of the closure.

P. Hollows and J. P. Hayter³⁹ in 1999 reported a case with fracture of malleolus in a patient 4 months after fibula reconstruction due to athletic activity.

Andre Eckardt and Konstantinos Fokas⁷ in 2003 reported a review of 500 cases of micro vascular reconstruction. They identified smoking as well as prolonged anesthesia time (>8 h) as significant factors for developing medical and surgical complications.

Simon N. Rogers, Sundar R. Lakshmiah et al⁸⁷ in 2003 did a comparison between deep circumflex and fibula free flap for reconstruction for head and neck cancer. They did a retrospective analysis of 44 fibula free flaps and 73 deep circumflex artery free flaps and concluded that donor site problems are present in both the flaps but are relatively minor in nature.

Eric M. Genden et al²⁹ in 2004 has said that complications of micro vascular free tissue transfer may occur at the recipient site or at the donor site. Complications occurring at the recipient site are largely as a result of vessel thrombosis while complications occurring at the donor site may result from many causes, ranging from infection to those related to the harvesting of the flap. The author also stated that the radial forearm free flap (RFFF) and the fibula free flap present the most significant

risk for distal extremity ischemia. It is essential that collateral flow be assessed before harvesting from either donor site.

Clemens Klug et al²⁰ in 2005 prospectively analyzed 303 patients who had undergone preoperative radio-chemotherapy followed by free flap reconstruction. They found that flap success and flap related complications after 50 Gy focal radiation dosage were in comparable range as in published series of reconstructions in uncompromised tissue.

S. Podrecca et al⁸⁰ in 2005 evaluated 346 patients of free flap reconstruction for neoplasm and found that poor preoperative condition, previous treatment, and requirement for vein graft were significantly associated with increased risk of major complications after surgery.

Wenko Smolka and Tateyuki Iizuka⁹⁵ in 2005 evaluated the success rate of different techniques of repairing maxillary and midfacial defects according to their extent and showed that postoperative infection leading to transplant loss was the main reason for failure.

Alan Garrett, Yadranko Ducic et al⁵ in 2006 evaluated foot and ankle function in a series of patients undergone fibula micro vascular free tissue transfer. They came with the results using the ankle-hind foot scale and follow-up radiographs which support a low morbidity rate at the donor site after free fibula graft harvest.

Philipp Pohlenz et al⁷⁴ in 2007 retrospectively analyzed 202 cases of micro vascular reconstruction of head and neck and they confirmed that free flaps are extremely reliable in achieving successful reconstruction of the head and neck. The incidence of postoperative complications is related to the preoperative comorbidity.

Bernardo Bianchi et al¹⁴ in 2009 reviewed 376 free-flap transfers in 352 patients after cancer surgery and found that aetiology, patient's age, smoking history and the presence of comorbid conditions were in fact associated to higher rates of major and minor complications.

M. Halle et al⁵⁸ in 2009 showed an increased morbidity in free flap surgery in the head and neck region after preoperative radiotherapy and the time elapsed between the last radiotherapy session and surgery is associated with the risk of developing postoperative complications and they strongly suggested that free flap reconstruction should be performed within 6 weeks of the last radiotherapy session.

Thomas Mücke et al⁹² in 2009 reviewed 171 patients with free flap transfer and conclude that factors significantly affecting survival of patients with tumors of the maxilla and midface are resection margin status after tumor ablation and the type of reconstruction.

Xiao Feng Li and Xin Peng⁹⁷ in 2012 had an analysis of 42 relevant articles and described the incidences of donor site morbidity into early and late. Early donor site morbidity includes wound infection, 1.07 percent; wound dehiscence, 7.0 percent; wound necrosis, 7.3 percent; delayed wound healing, 17.4 percent; partial skin graft

loss, 8.1 percent; and total skin graft loss, 4.7 percent. Late donor-site morbidities include chronic pain, 6.5 percent; considerable gait abnormality, 3.9 percent; ankle instability, 5.8 percent; limited range of motion in the ankle, 11.5 percent; reduced muscle strength, 4.0 percent; claw toe, 6.1 percent; dorsiflexion of the great toe, 3.6 percent; and sensory deficit, 6.95 percent.

Adeyiza O. Momoh, Peirong Yu et al in 2011 showed donor site morbidity in 157 patients treated with free fibula flap .They showed that perioperative donor-site complications occurred in 31.2 percent of patients, including skin graft loss (15 percent), cellulitis (10 percent), wound dehiscence (8 percent), and abscess (1 percent). Preoperative chemotherapy was associated with increased complications. No significant difference in complication rates was observed between primary and skin graft wound closure. The timing of ambulation was not related to the development of complications. Long-term morbidities occurred in 17 percent of patients and included leg weakness (8 percent), ankle instability (4 percent), great toe contracture (9 percent), and decreased ankle mobility (12 percent).

Michael N. Mirzabeigi et al in 2012 retrospectively analyzed 2260 free flaps which include forty seven take back surgery for salvage surgery. They conclude that success of salvage can be predicted preoperatively with factors like thrombophilia and platelet count.

P. Pohlenz et al in 2012 did a study in which they analyzed outcome and complications of free flaps in 1000 cases. They did 120 free fibula reconstructions out of 1000 cases. They concluded that venous thrombosis and cervical hematoma are the

most common complications at the recipient site and are mainly responsible for flap failure, while complications occurring at the donor site may result from dehiscence and graft necrosis. When a compromised flap is identified, surgical re-exploration should not be deferred.

MATERIALS

&

METHODS

MATERIALS AND METHODS

This prospective study on “Micro vascular reconstruction of maxilla using free fibula flap” includes 3 patients who need primary or secondary reconstruction of maxillary defects. All patients reported To Department of Oral And Maxillofacial Surgery, Tamilnadu Government Dental College and Hospital, Chennai- 03 with maxillary defects.

CRITERIA ADOPTED FOR SELECTION OF PATIENT

1. Patient with primary /secondary maxillary defects due to benign /low grade malignant tumor who underwent
 - Partial maxillectomy
 - Total maxillectomy.
2. Patient with recurrent osteomyelitis who require ablative surgery.
3. Patient having maxillary defects due to trauma requiring reconstruction.
4. Patients presenting no medical contraindication for surgical procedure.
5. Patients who are willing for regular follow up.

EXCLUSION CRITERIA

1. High risk medically compromised patient.
2. Patient with generalized bone disorder.
3. Patient not willing for long term follow up.

There were 3 male patients included in this study. One patient had primary reconstruction after resection of squamous cell carcinoma of maxilla resulted in class II c of modified Brown's classification of maxillectomy defects. Second patient was reconstructed for post traumatic maxillary defect of left side maxillary arch, and the third patient was secondarily reconstructed for a maxillectomy defect due to treated mucormycosis of left maxilla. Both the post traumatic and post mucormycotic patients come under class II a of modified brown's classification of maxillectomy defects.

All the patients underwent preoperative clinical examination and Doppler study to rule out vascular abnormalities for rate, rhythm of blood flow at both recipient and donor site. None of the patients were rejected because of inadequate collateral blood circulation.

Preoperative CT scan with 3D reconstruction was made in all patients to plan the required length of fibula flap needed for reconstruction. Osteotomies were made as per patients need to achieve desired form and function.

All patients were treated similarly for maxillary reconstruction using micro vascular free fibula flap.

Surgeries were carried out with an integrated approach utilizing Department of Plastic and Reconstructive surgery, Rajiv Gandhi Government General Hospital, Chennai for harvest of fibula and microvascular anastomosis. Routine informed consent was obtained from all patients (annexure).

All cases were performed under general anesthesia. One patient had naso-endotracheal tube intubation. Other two patients we used submental intubation due to difficult nasal intubation.

Patient underwent excision of lesion with adequate surgical clearance in primary case and preparation of the recipient artery and vein.

Fibula Free flap was harvested from selected leg. Osteotomy cuts were made to simulate maxillary contour. Fibula flap fixed to the recipient site with stainless steel mini plates and 2×8 mm stainless steel screws as per the patient's need.

Micro-vascular anastomosis was performed by anatomizing recipient and donor vessels under the magnification of surgical loupes.

The immediate postoperative parameters which were used for clinical assessment of flap viability are

- i. Color of the flap.
- ii. Capillary refill time.
- iii. Flap temperature.
- iv. Blood flow from the flap.

Functional and aesthetic outcome assessment was given to all patients to record their function and aesthetic responses (annexure).

PRE-OPERATIVE ASSESSMENT

Evaluation of the patients includes thorough and detailed history, clinical examination, facial photographs and radiographic examination.

HISTORY

Includes chief complaints, history of present illness, previous surgical and medical history.

CLINICAL EXAMINATION

Extra-oral

- Facial asymmetry
- Mouth opening
- Nasal tone of speech

Intra oral

- Size of defect
- Size of lesion
- Communication of nasal cavity and maxillary sinus

Examination of leg

- Post traumatic scar
- Gait disturbance
- Posterior tibial and dorsalis pedis arterial pulse
- Knee and ankle joint stability
- Preexisting pain while walking
- Varicose veins
- Skin lesions

RADIOGRAPHIC EXAMINATION

Includes

- Orthopantomogram (OPG)
- PNS view
- 3D CT scan
- AP and lateral view of tibia and fibula

DOPPLER STUDY

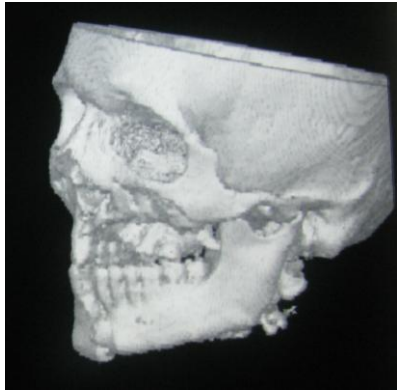
Color Doppler was used to study anterior and posterior tibial arterial blood flow and rhythm.

PREOPERATIVE PLANNING

- Preoperative upper and lower impressions were taken and working and study models were made.
- Preoperative 3D CT scans were taken which showed defect size in all dimensions.
- Defect size is measured in the impression model.
- According to the size of defect, impression compound was shaped as maxillary arch over the defect in the cast.
- This will give an idea of antero-posterior size of defect.

**PREOPERATIVE PLANNING IN A CASE OF MAXILLARY
DEFECT DUE TO TRAUMA**

3D CT SCAN



IMPRESSION MODELS



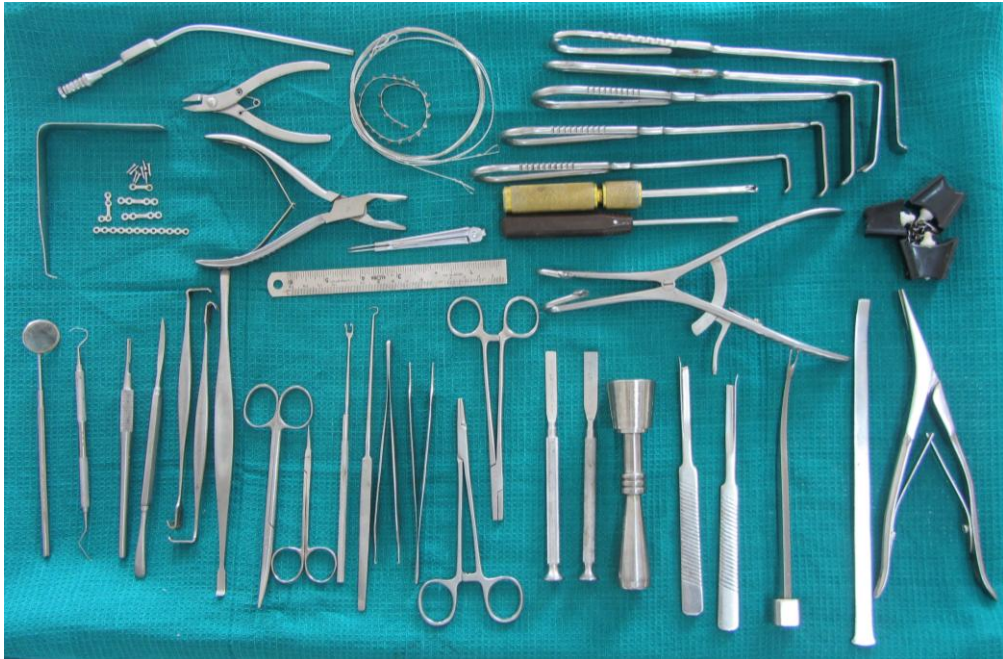
POSTERIOR MAXILLARY OSTEOTOMY



**DEFECT TO BE RECONSTRUCTED IS DEPICTED WITH IMPRESSION
COMPOUND**



ARMAMENTARIUM



MICROMOTOR AND HANDPIECE



HAND HELD OFFICE DOPPLER



SURGICAL LOUPE & MICROSURGICAL INSTRUMENTS



SURGICAL PROCEDURE

SURGICAL TECHNIQUE FOR HARVESTING OF FREE FIBULA FLAP

Position

The patient was placed in supine position with a pneumatic tourniquet placed proximally on the lower extremity and inflated to 300 mm of Hg. It should be released after a maximum of 1 hour to prevent ischaemic injury. The knee flexed at 135 degree and the hip flexed to 60 degree to facilitate dissection.

Marking

A line was drawn from the fibular head to lateral malleolus indicating course of fibula in the leg. The nutrient artery, a branch of peroneal artery identified and marked on this line with Doppler. The designing of the flap was dictated by a particular defect to be reconstructed. A septocutaneous portion was incorporated into the flap according to the palatal defect size.

Surgical procedure

The entire selected leg was prepared with antiseptic solution and selected leg exsanguinated with elastic wrap or Esmarch bandage and tourniquet inflated to 300 mm of Hg. The skin incision made along the marking of flap, in the middle to distal third of the palpable bone. Superiorly incision should not be extended close to fibular head because of the risk of subsequent damage to the common peroneal nerve. Inferiorly, at least 6-8 cm of bone should be left to maintain ankle joint stability.

The skin and subcutaneous fat raised from underlying muscle fascia by sharp dissection. The posterior crural septum was seen as a white line directly over

the lateral aspect of the fibula. Posteriorly soleus muscle identified and peroneus longus detached from the lateral surface of fibula using sharp dissection and retracted anteriorly. The dissection was continued anteriorly with the attachment of anterior crural septum, extensor digitorum longus and extensor hallucis longus and the interosseous membrane encountered. The anterior tibial artery, vein and deep peroneal nerve were seen lying between this membrane and underside of anterior tibial muscle. This vascular pedicle retracted and the membrane was incised along its length using sharp scissor from proximal to distal.

Periosteum was incised over the planned bone cut areas. A howarth elevator was gently passed around the deep surface of the fibula in the sub periosteal plane to protect the underlying pedicle. The osteotomies performed with an oscillating saw. The fibula was now carefully retracted laterally using bone clamps exposing the posterior tibialis muscle which was dissected staying close to the fibula.

This procedure gave greater access to the peroneal vessels and it was ligated and divided. Flexor hallucis longus and remaining muscles were released from the fibula, taken care that pedicle should not get damage.

During the harvesting of the fibula flap, the level of proximal osteotomy should be as high as possible. During contouring of the fibula bone, the osteotomies were made from distal end to proximal end so that any excess proximal bone could be discarded, thus increasing the pedicle length.

Osteotomies made as per particular patient's need to simulate maxillary form while taking care of vascular pedicle. The flap was transferred to the recipient site for fixation and micro vascular anastomosis. Harvested fibula was fixed to defect in maxilla and fixed with plates and screws to the body of zygoma above and to piriform

rim medially. Micro vascular anastomosis between facial and peroneal vessels was done by 9-0 Ethylon.

Wound irrigated with copious saline, suction drain placed in donor site. Skin graft harvested from thigh of same side and sutured over the donor site with 3-0 Ethylon after layer wise closure done with 2-0 vicryl.

SURGICAL TECHNIQUE FOR MAXILLARY RECONSTRUCTION

Preparation of surgical site

Maxillary reconstruction was approached by extra oral incision in all cases. The head was supported by head ring and neck is extended with a shoulder bag. The head was slightly tilted to the opposite side. Surgical site was painted with betadine and draped in a standard fashion.

Marking of incision

Weber Fergusson incision was marked on the recipient side with Dieffenbach's modification³¹ for good access. Incision was planned according to the extent of defect and access to the defect. In the last case Lateral Rhinotomy incision was used.

Skin incision and dissection

Incision was made with no 15 blade. Dissection was carried out layer wise from skin, subcutaneous tissue, SMAS layer and to the Periosteum. A small submandibular incision marked and incised. Layer wise dissection was done and facial artery and vein identified and preserved.

Exposure of the lesion or maxillary defect

Periosteum was incised sharply and flap elevated, and lesion or maxillary defect was exposed. Lesion was excised with safe margins. In case of secondary reconstruction the epithelialized skin and mucosal margins were trimmed.

Placement and fixation of flap at recipient site

Harvested free fibula flap was transferred to the maxillary defect where fibula bone replaces the alveolar arch and skin paddle replaces the palatal defect. Fibula

bone was fixed to body of zygoma and piriform ridge with stainless steel mini plates and screws.

Micro vascular anastomosis

Micro vascular anastomosis was performed between recipient and donor vessels held in position with acland's artery and venous clamps. The peroneal artery was anastomosed with facial artery in an end to end manner using 9-0 nylon suture under loupe magnification followed by venous anastomosis. While suturing, the end of vessel was frequently irrigated with heparin and saline (5000 unit of heparin in 500 ml of saline). During anastomosis one liter of 40 percentage low molecular weight dextran was given intravenously in a slow dose and continued for 48 hours.

Closure

Hemostasis achieved. Muscles and subcutaneous layer sutured with absorbable sutures (2-0/3-0 vicryl) and skin was closed with non-absorbable sutures (3-0 prolene).

**SURGICAL TECHNIQUE FOR HARVESTING FREE FIBULA
FLAP**

MARKING OF INCISION AND SKIN PADDLE FOR PALATAL DEFECT



INCISION PLACED



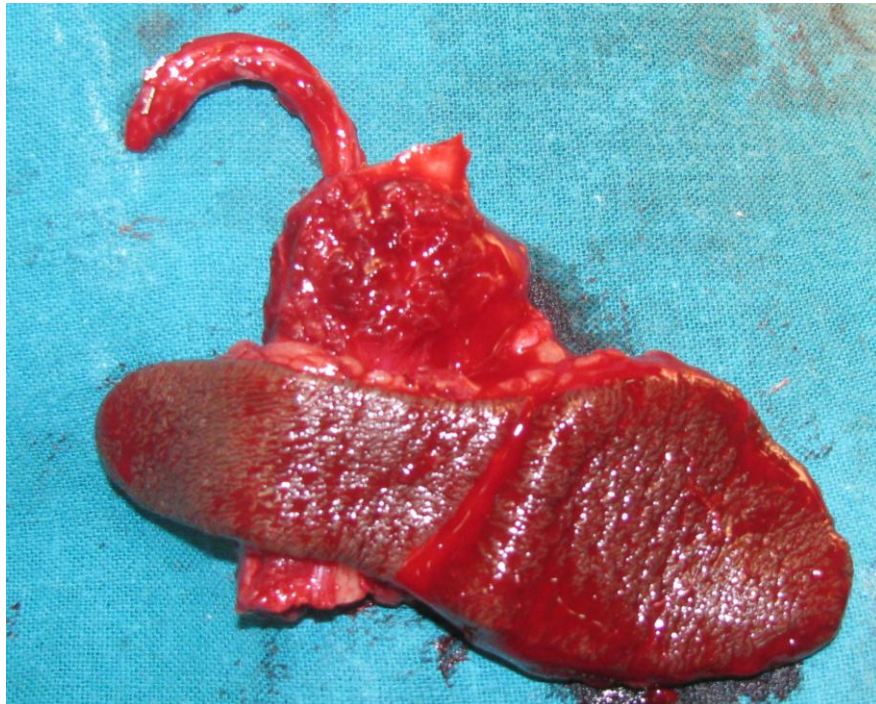
DISSECTION



OSTEOTOMY CUT COMPLETED AND FLAP HARVESTED



HARVESTED OSTEOCUTANEOUS FREE FIBULA FLAP

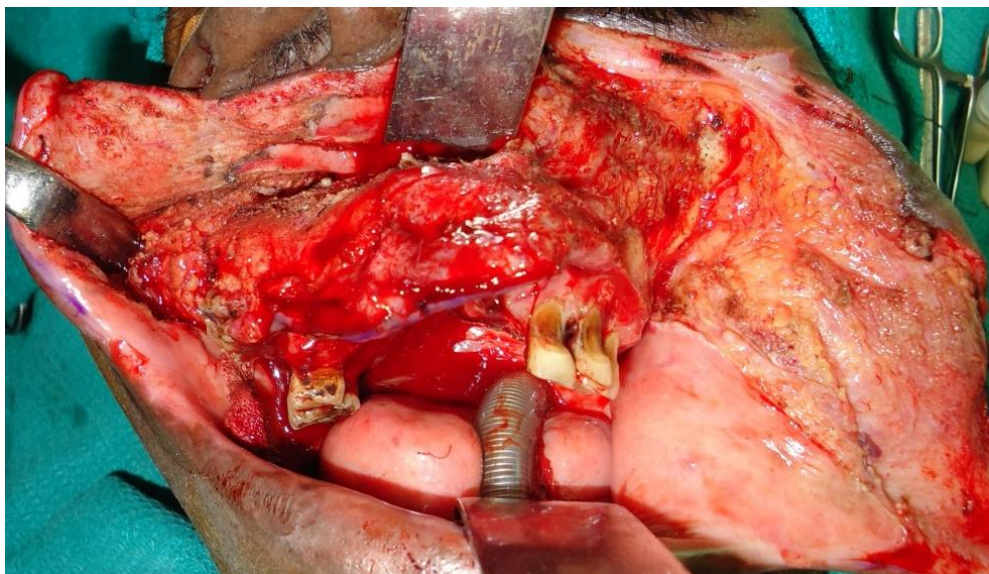


**SURGICAL TECHNIQUE FOR FIXATION OF FIBULA FLAP TO
MAXILLARY DEFECTS**

WEBER FERGUSSION INCISION MARKED



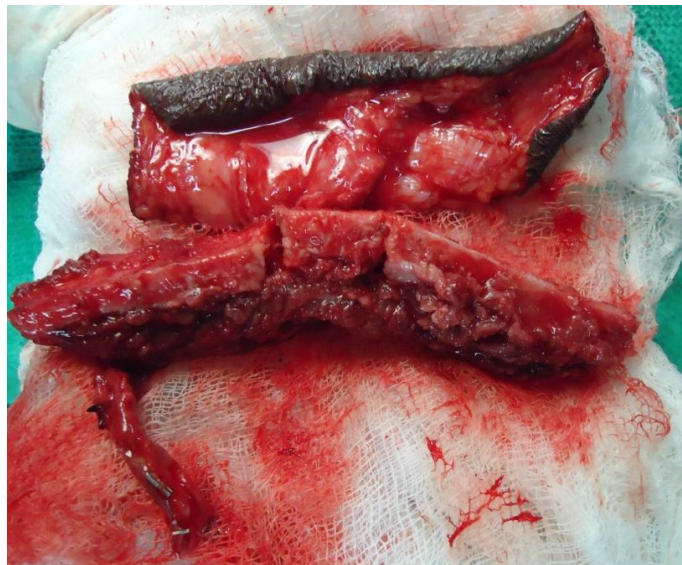
FLAP REFLECTED



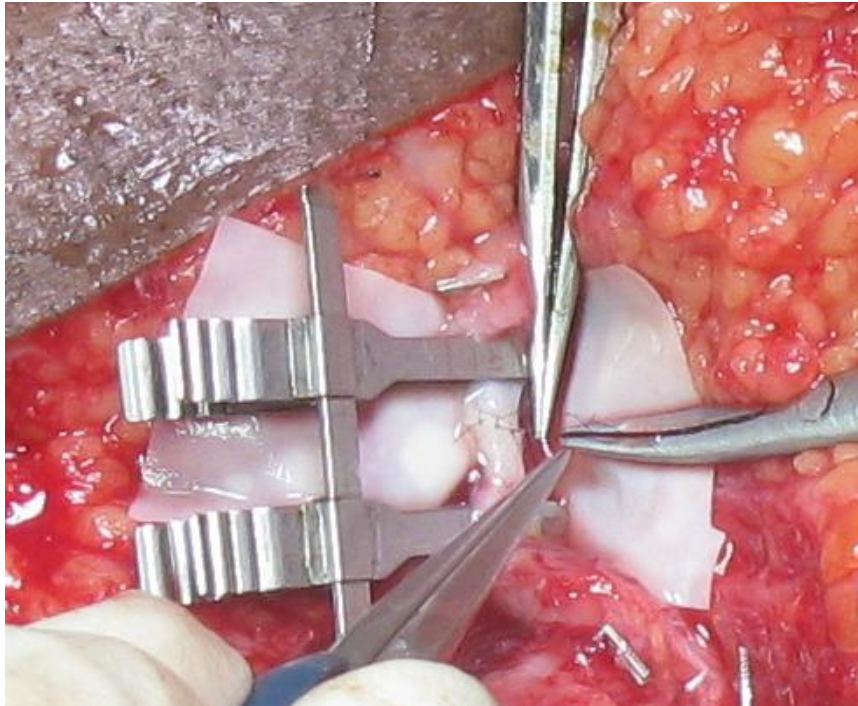
RESECTION OF MAXILLARY LESION



FIBULA SHAPED LIKE MAXILLA BY MAKING OSTEOTOMY CUTS



MICROVASCULAR ANASTOMOSIS



FIBULA FLAP FIXED TO MAXILLARY DEFECT AND SUTURED



CASE REPORTS

CASE REPORT – I

Name : Mr. Joseph

Age/sex : 45/M

Chief complaint: slurring of speech and nasal regurgitation of food for the past 3 months

History of presenting illness: patient had extraction of left upper posterior teeth before 6 months. He developed mucormycosis of left upper alveolus and the necrotic left maxilla distal to 22 was removed before 5 months after antifungal treatment. From then he is having nasal regurgitation when he takes food and nasal tone in his speech.

Past medical history: had medicines for urinary calculi 3 years back

Past surgical history: left partial maxillectomy 5 months back

General examination:

Moderately built and nourished.

Not anemic, acyanotic, not icteric, no pedal edema and no clubbing

Local examination:

Extra oral examination:

The following findings were noted.

- Hyper nasal voice

- No facial asymmetry
- Normal mouth opening
- No sensory disturbance over face

Intra oral examination:

- Loss of maxillary alveolus distal to 22, defect extending up to midline of palate
- Oro-antral and oro-nasal communication on left side
- Normal occlusion on right side

Leg examination:

- No scar
- Normal gait
- Both knee and ankle joint are stable

RADIOLOGICAL INVESTIGATIONS

OPG and PNS view showed maxillary defect on left side.

Ct scan with 3D reconstruction showed the exact extension of the defect size.

AP and Lateral view of tibia and fibula showed normal study at both legs.

Doppler study: showed normal triphasic pattern of blood flow of both legs

Diagnosis: Maxillary defect on left side secondary to treated mucormycosis

Treatment plan: Micro vascular reconstruction of maxilla using free fibula flap.

PREOPERATIVE

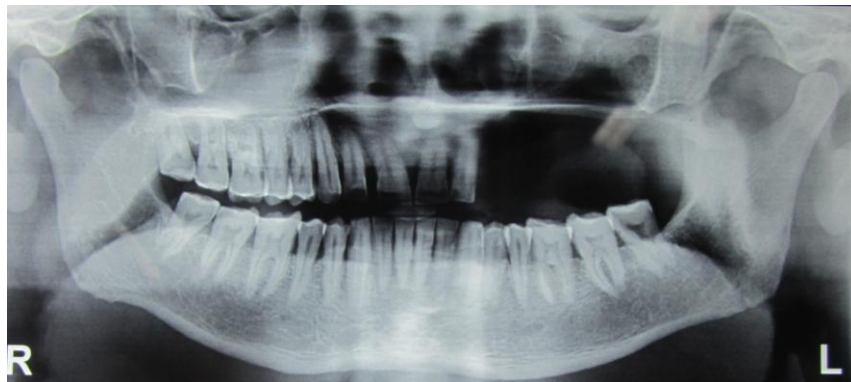
EXTRA ORAL



INTRA ORAL



ORTHOPANTOMOGRAPH



DEFECT IN 3D CT SCAN



PLANNED RECONSTRUCTION

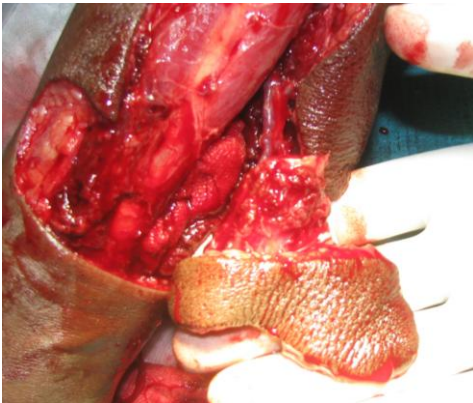


INTRAOPERATIVE

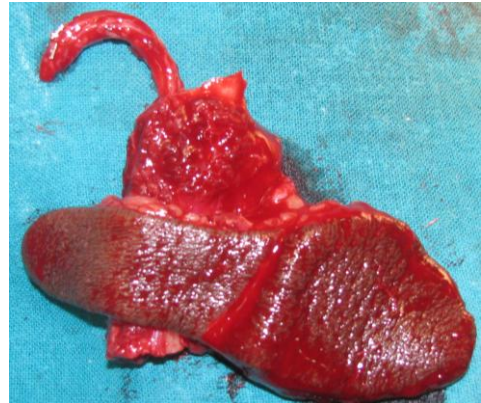
INCISION



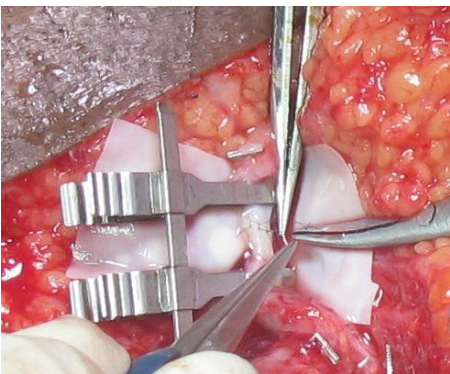
DISSECTION AND FLAP HARVEST



HARVESTED FREE FIBULA FLAP



MICROVASCULAR ANASTOMOSES



INTRAORAL FIXATION & CLOSURE



POST OPERATIVE

EXTRA ORAL



INTRA ORAL



ORTHOPANTOMOGRAPH



PARANASAL SINUS VIEW



DONOR SITE AFTER FOUR MONTHS



CASE REPORT – II

Name : Mr. Saamiayya

Age/sex : 55/M

Chief complaint: C/o growth in the upper jaw for the past 2 years

History of presenting illness: The patient noticed a swelling in the upper jaw of around 1cm behind the upper central incisors and gradually progressed to the present size of 4 cm. Patient c/o pain in the upper jaw, which is continuous and dull aching in type.

Past medical history: Patient reported to Tanjavur Government Hospital, and underwent biopsy of the lesion and was diagnosed as keratinising squamous cell carcinoma of the hard palate. He was treated with 30 cycles of radiotherapy for the primary lesion.

Past surgical history: Nil

Personal history: Habit of smoking and alcohol consumption for the past 20 years

General examination:

Patient is moderately built and nourished. Normal gait

Local examination:

Extra oral examination: swelling of face in upper jaw region

Intra oral examination: Ulceroproliferative growth involving the anterior third of the hard palate with the size of 5x4 cm, extending from upper

gingiva-labial sulcus to 5 cm posterior into the hard palate more on the left side ,eroding the alveolar process with loss of central and lateral incisors .Horizontally extending up to the alveolar arch.

Leg examination:

- No post traumatic scar
- Normal gait
- Both knee and ankle joint are stable

RADIOLOGICAL INVESTIGATIONS:

OPG and PNS view showed ill-defined radiolucent lesion in the anterior maxillary region.

CT scan: revealed ill-defined soft tissue lesion in the anterior mid-line maxillary region causing erosion of the alveolar process of maxilla and posterior extension into hard palate.

AP and Lateral view of tibia and fibula showed normal study at both legs

Doppler study: showed normal triphasic pattern of blood flow of both legs

Diagnosis: Squamous cell carcinoma of maxilla

Treatment plan: Resection of lesion followed by immediate reconstruction with free fibula flap.

PREOPERATIVE

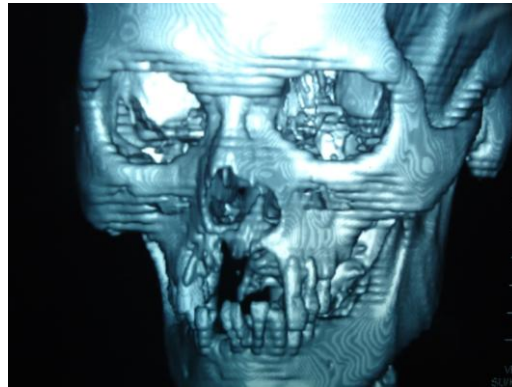
EXTRA ORAL



INTRA ORAL



PREOPERATIVE CT SCAN



PREOPERATIVE IMPRESSION MODEL

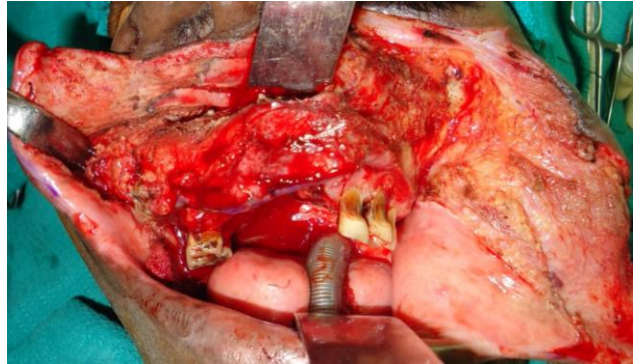


INTRA OPERATIVE

WEBER FERGUSSON INCISION



FLAP REFLECTED



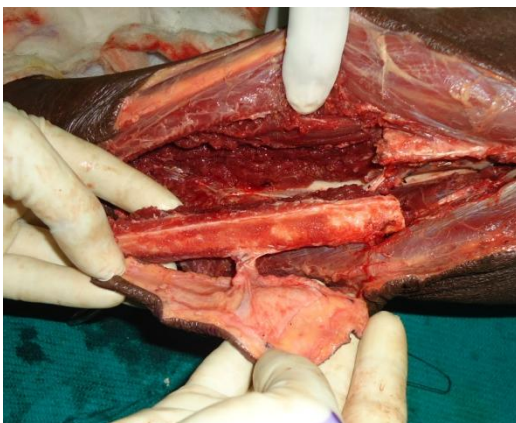
RESECTION OF LESION



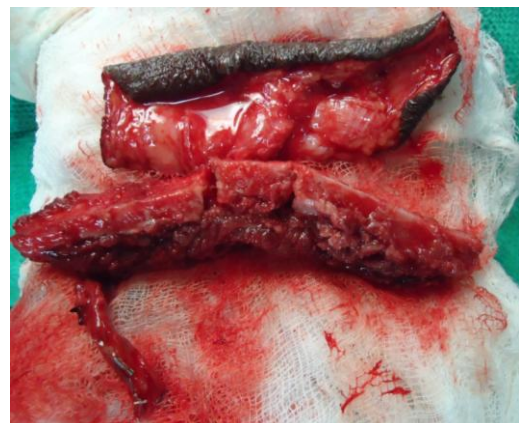
INCISION AND FLAP MARKED



DISSECTION AND HARVEST



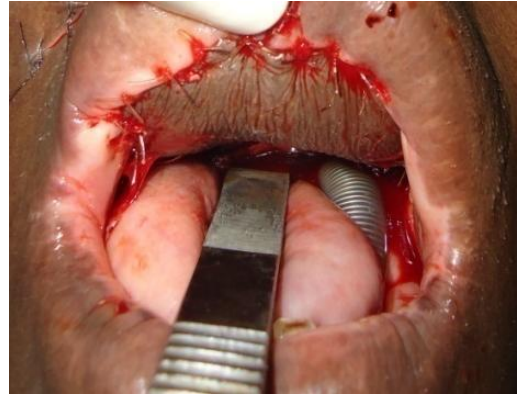
OSTEOTOMY CUT FOR SHAPING



MICROVASCULAR ANASTOMOSES



FLAP SUTURED



POSTOPERATIVE

EXTRA ORAL



INTRA ORAL



CASE REPORT – III

Name : Mr. Muthukumar

Age/sex : 27/ M

Chief complaint: complaints of nasal regurgitation and slurring speech for the past 2 years.

History of presenting illness: patient had trauma 2 years back. From then he was having nasal regurgitation and speech with nasal tone

Past medical history: nil

Past surgical history: nil

Past dental history : he had trauma to face 2 year back and got treatment in outside hospital.

General examination: moderately built and nourished.

Not anemic, acyanotic, not icteric, no pedal edema and clubbing present

Local examination:

Extra oral examination: mild facial asymmetry, nasal tone in voice

Intra oral examination: Oro nasal communication in anterior maxillary region. Occlusion deranged in left side. There is a collapse of the posterior maxilla.

Missing teeth 11,12,21,22,23,24,25,41,42,43,44

Leg examination:

- No scar
- Normal gait
- Both knee and ankle joint are stable

Radiological investigations:

OPG and PNS view showed mal-united old fracture of mandibular symphysis region and anterior wall of maxillary antrum left side.

CT scan with **3D** reconstruction confirmed the defect due to old trauma.

AP and Lateral view of tibia and fibula showed normal study at both legs.

Doppler study: showed normal triphasic pattern of blood flow of both legs

Diagnosis: Anterior maxillary defect secondary to trauma

Treatment plan: Repositioning of collapsed posterior maxilla and reconstruction of anterior maxillary defect with free fibula flap

PRE OPERATIVE

EXTRA ORAL



INTRA ORAL



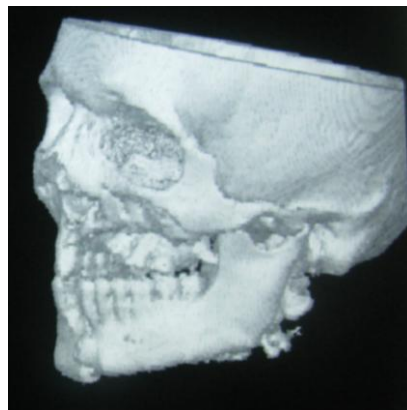
PNS VIEW



ORTHOPANTOMOGRAPH



3D CT SCAN



PREOPERATIVE IMPRESSION MODELS AND SURGICAL PLANNING

UPPER MODEL



MOCK SURGERY



AMOUNT OF GRAFT NEEDED IS MADE BY IMPRESSION COMPOUND



ADAPTED WITH MINIPLATE IN THE MODEL



INTRAOPERATIVE

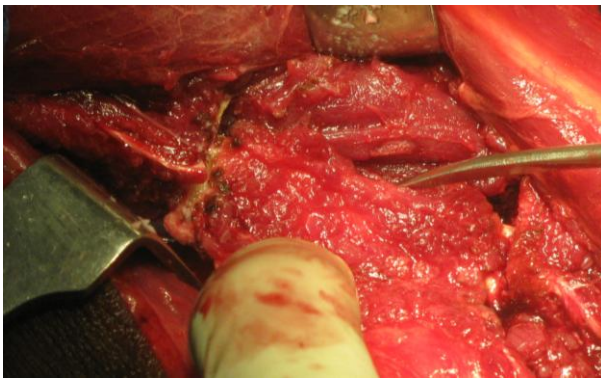
INCISION MARKED



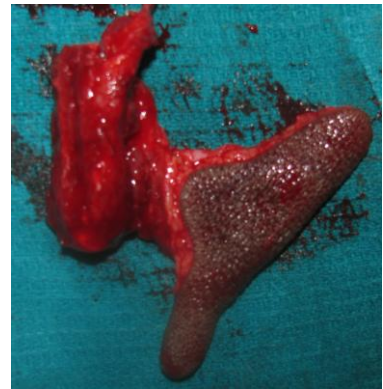
DISSECTION



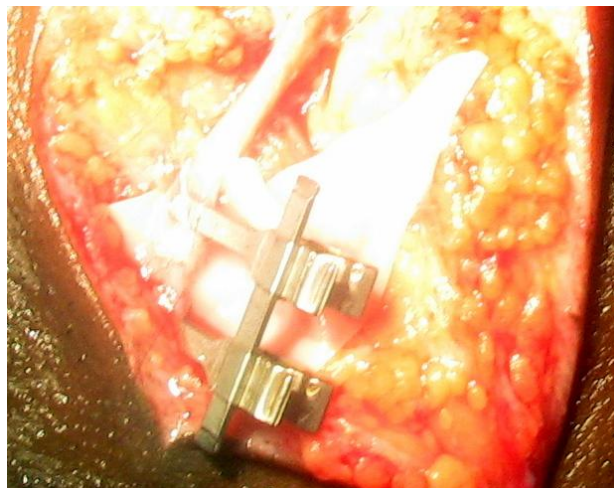
OSTEOTOMY OF FIBULA COMPLETED



HARVESTED FLAP



MICRO VASCULAR ANASTOMOSIS



LATERAL RHINOTOMY INCISION



POSTERIOR MAXILLARY OSTEOTOMY



AND FIXATION

FIBULA FLAP FIXED AND SUTURED



OBSERVATION

&

RESULTS

OBSERVATION AND RESULTS

In our study we operated 3 patients with maxillary defects using free fibula flap. Out of the 3 patients, one patient had squamous cell carcinoma of anterior maxilla. Other two were cases of secondary defects due to mucormycosis and trauma.

In all cases free fibula was harvested through lateral approach where incision was placed along the posterior border of fibula

The operation time varied from 9 to 11 hours. All patients were regularly followed monthly up to a period of 10 months

Preoperative

In all cases clinical, radiological and Doppler studies showed normal study at both legs; therefore none of the case was rejected.

Preoperative 3D CT scan and maxillary and mandibular impression models were taken for preoperative planning.

Postoperative

The outcome of maxillary reconstruction was evaluated using the following parameters

- Facial aesthetic
- Speech
- Postoperative facial nerve involvement
- Wound infection or dehiscence

- Plate exposure
- Flap rejection
- Donor site morbidity
- Overall patient satisfaction

Facial aesthetics

All patients had recorded their responses of outcome of reconstruction as good at recipient site (table 1).

Speech

All patients had an improved speech after reconstruction.

Postoperative facial nerve involvement

None of the patient had postoperative neurological symptoms in face.

Wound infection/ dehiscence

Palatal region: Case no 1 encountered wound dehiscence in the palatal region. It was re-sutured successfully and thereafter no dehiscence during follow up

Donor site: None of the patient had wound infection or dehiscence postoperatively at donor site.

Plate exposure

None of the patients had plate exposure.

Flap rejection

In the follow up period there were no signs and symptoms of graft rejection in any of the patients.

Donor site morbidity

This was assessed based on the following criteria

Gait disturbance: None of the patients had gait disturbance after 30 days

Parasthesia of the leg: none of patients had parasthesia of leg

Pain: There was mild occasional pain during the first to third postoperative week. No pain after 2 months.

Patient satisfaction

Patients were surveyed 3 to 10 months postoperatively and showed gratifying results.

ASSESSMENT OF CLINICAL OUTCOME

Functional as well as aesthetic of recipient and donor site were evaluated using four point scale. Patient recorded their functional response to parameter shown in table no. 2 & 3 as “**never, rarely, often and always**” and expressed their view of aesthetic outcome of the both sites using descriptions “**good, fair and poor**” as shown in table no 1.

Table 1: Postoperative aesthetic outcome

	Very good	Good	Fair	Poor
Recipient site		Case 1,2,3		
Donor site		Case 2 and 3	Case 1	

Table 2: Postoperative functional outcome at recipient site

	Never	Rarely	Often	Always
Pain	Case 2 & 3	Case 1		
Difficulties in mastication	Case 2 & 3	Case 1		
Difficulties in deglutition	Case 1,2 & 3			

Table 3: Postoperative functional results at the donor site

	Never	Rarely	Often	Always
Pain	Case 2 & 3	Case 1		
Oedema	Case 1,2 &3			
Gait disturbance	Case 1,2 &3			
Difficulties in going downstairs	Case 2 & 3	Case 1		
Spraining	Case 1,2 & 3			

DISCUSSION

DISCUSSION

Maxillary reconstruction remains a challenge for maxillo-facial surgeon. Maxillary defects always have an impact on aesthetics, mastication, speech and deglutition. The goals of maxillary reconstruction should replace the form and function lost due to ablative surgeries. In addition, it also has to provide possible support of the orbital contents to prevent enophthalmos and diplopia. It should also restore the midfacial contour with acceptable aesthetic results.

Prosthetic management of palatal defects has been employed for many years. **Claude Martin** first described the use of surgical obturator prosthesis in **1875**. Obturators were the choice of reconstruction of maxillectomy defects before surgical attempts were made for closure. Nowadays obturator design^{19, 62, 64, 75, 76} has made giant steps.

Micro vascular reconstructive surgeries using soft and hard tissues were first done as experimental studies in animals in 1900s. **Carl-Olof Siggesson Nylén (1892–1978)**, a Swedish otolaryngologist was considered the father of microsurgery. He first used microscope for surgery in animals. In humans microvascular surgeries were carried out after 1960.

The fibula free flap was first described by **Taylor and colleagues in 1975** for lower extremity reconstruction. In **1989 Hidalgo**³⁸ described its use for mandibular reconstruction. Since then micro vascularized fibula flap has become the mainstay for the reconstruction of oral cavity as it provides excellent length of bone with sufficient cross section for subsequent insertion of osseointegrated implants. In **1993 Sadove et al**⁹⁸ described simultaneous maxillary and mandibular reconstruction with free fibula flap.

Neal D. Futran (2005)⁶⁷ explained the common reconstructive goals which include

- 1) Consistently obtaining a healed wound;
- 2) Restoring palatal competence and function (separation of the oral and sinonasal cavity);
- 3) Support of the orbit or fill in the orbital cavity in cases of exenteration;
- 4) Obliterating a maxillary defect;
- 5) Restoring facial contours; and
- 6) Recreating a functional dentition.

Maxillary defects were classified^{26, 45, 46, and 47} by many authors. It implies in decision making in treatment options. There are various micro vascular flaps which were successfully used for maxillary reconstruction by various authors^{15,93,96, and 97}. All free flaps have its advantages and disadvantages.

Nowadays free fibula flap has been widely accepted for both maxillary and mandibular reconstruction. It has several advantages⁹⁸

- (1) Long vascular pedicle;
- (2) Wide diameter of the peroneal vessels;
- (3) Provision of fibula bone, skin paddle, and muscle tissues by the composite fibula flap;
- (4) Relatively easier flap-harvesting procedure and low donor morbidity;
- (5) Distant donor site from the head and neck, which makes a two-team operation possible;
- (6) Relatively accurate three-dimensional contouring of the fibula to simulate the alveolar processes;

(7) Fibula bone, which is a good recipient of osseo-integrated implants

Xin peng et al (2005)⁹⁸ described that fibula free flap is ideal for class I and class II maxillectomy defects compared to extensive class III and class IV defects.

Preoperative Doppler ultrasonography should be performed for accurate detection of cutaneous perforators from the peroneal artery, which enhance the reliability of the skin paddle for reconstructing soft-tissue defect.⁹⁸

In our study we used hand held Doppler for detection of perforators both in donor and residual site.

R. González-García et al (2007)⁷⁷ reported that primary reconstruction is preferable to secondary reconstruction.

In our study we did two cases of secondary reconstruction and one primary reconstruction. We used vein graft for one patient due to inadequate pedicle length.

Futran et al⁶⁷ used the fibula free flap for maxillary reconstruction in a large series of 27 patients. Excellent results were obtained for speech, swallowing, and aesthetics in 20 patients with limited defects of the inferior maxilla.

In our study nasal tone of speech markedly improved in both the cases that were secondarily reconstructed.

S. Podrecca et al⁸⁰ (2006) reported that success of free flap for head and neck reconstruction was 95% in their case reports.

Adeyiza O. Momoh et al² (2011) reported 8 % of wound dehiscence in donor site in their series of 157 cases. In our study we experienced wound dehiscence in recipient site in one case in first two weeks and secondary suturing was done.

Xin peng et al (2005)⁹⁸ reported that head should be maintained strictly motionless for the first 3 days after the operation, as head and neck movement may result in thrombosis at the site of vascular anastomosis and he also stated that routine postoperative anticoagulant therapy should be performed with low-molecular weight Dextran and aspirin.

Free fibula graft has some drawbacks when jaw reconstruction is contemplated: 1) the skin paddle, very useful in limb reconstruction, is a bulky tissue in the oral cavity. 2) It does not easily conform to jaw defects, especially if it needs several osteotomies. 3) The skin paddle thickness also makes implant insertion difficult⁸⁴.

Shahram Nazerani et al (2008)⁸⁴ reported a new method of two stage surgery for fibula harvesting to overcome these drawbacks. They reported that during the initial surgery the flap was transferred to the surface of the wound and the tissues beneath the flap were closed. For ease of future dissections, a silicone sheet was used to wrap around the pedicle to completely cover the pedicle, and then the fibula flap was covered by a split-thickness skin graft almost circumferentially. After 8 to 12 weeks the flap was ready for transfer and in this second stage the flap was dissected from the leg. By this method bulkiness of the skin paddle can be eliminated.

W.H. Wan⁹⁴ et al and Yue He¹⁰² et al reported the use of preoperative surgical planning with three dimensional CT scans and stereo lithographic models.

In our study we have used three dimensional computed tomogram and upper and lower impression models for preoperative planning.

The lateral approach to the fibula for free flap harvest was described by **Gilbert in 1979** and reiterated by **Flemming and colleagues in 1990²²**. In our study we have followed the lateral approach described by him and found that it is easy and rapid approach, and two team approach also feasible.

In our follow up of 3 to 10 months functional and esthetic outcome found to be good in both donor and recipient site.

Thus the free fibula flap provides a well vascularized flap for reconstruction of maxillectomy defects. The overall success of this flap has made this flap a valuable option for reconstruction of maxilla and midface. Based on our little experience with the use of free fibula flap it appears to be a safe, reliable, and convenient method of maxillary reconstruction.

SUMMARY

&

CONCLUSION

SUMMARY AND CONCLUSION

Midface reconstruction is a more complex operation than other part of facial region for a reconstructive surgeon, because the defect is considerably farther from the recipient vessels in the neck. Reconstruction can be achieved with predictable results using micro vascularized free fibula flap.

Outcome of our study and review of literature have shown that free fibula provides excellent quality of hard and soft tissue to reconstruct simple and composite maxillary reconstruction.

Though the amount of hard tissue provided is satisfactory for the defect, the soft tissue bulk is abundant. It would require careful trimming to accommodate in the oral cavity, hence proving to be a laborious task.

Though the number of cases in our study is less the results were satisfactory.

In conclusion, low donor site morbidity, acceptable aesthetic and functional outcome recommends micro vascularized free fibula flap to be considered as one of the ideal option for maxillary reconstruction. However long term results of success of the flaps and possibility of placement of implants in it requires a further study in a larger sample.

BIBLIOGRAPHY

BIBLIOGRAPHY

- 1. A. Gaggl, H. Burger, S. A. Virnik, F. M. Chiari.** An intraoral anastomosing technique for microvascular bone flaps in alveolar ridge Reconstruction: First clinical results. *Int. J. Oral Maxillofac. Surg.* 2009; 38: 921–927.

- 2. A.S. Punpale, J.S. Rajendra Prasad, K.P. Shetty, S. Kadam, V. Udupa.** An innovative design for simultaneous reconstruction of complex maxillo-mandibular defects with single free fibula osteocutaneous flap. *Journal of Plastic, Reconstructive & Aesthetic Surgery* (2006) 59, 96–101

- 3. Adeyiza O. Momoh, Peirong Yu, Roman J. Skoracki, Suyu Liu, M.S. Lei Feng, M.S. Matthew M. Hanasono.** A Prospective Cohort Study of Fibula Free Flap Donor-Site Morbidity in 157 Consecutive Patients. *Plast. Reconstr. Surg.* 128: 714, 2011.

- 4. Akihiro Homma, Masahiko Saheki, Fumiyuki Suzuki, Satoshi Fukuda.** Computer image-guided surgery for total maxillectomy. *Eur Arch Otorhinolaryngol* (2008) 265:1521–1526.

- 5. Alan Garrett, Yadranko Ducic.** Evaluation of fibula free flap donor site morbidity. *American Journal of Otolaryngology–Head and Neck Medicine and Surgery* 27 (2006) 29– 32.

- 6. Amresh S. Baliarsing, Vinay V. Kumar, Neelima A. Malik et al.** Reconstruction of maxillectomy defects using deep circumflex iliac artery based composite free flap. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109:8-13.
- 7. Andre Eckardt and Konstantinos Fokas.** Microsurgical reconstruction in the head and neck region: an 18-year experience with 500 consecutive cases. *Journal of Cranio-Maxillofacial Surgery* (2003) 31, 197–201.
- 8. Anne Marijn Kreeft, Ludwig E. Smeele.** Preoperative imaging and surgical margins in maxillectomy patients. *HEAD & NECK—DOI 10.1002/HED* NOVEMBER 2012.
- 9. Aramany M.** Basic principles of obturator design for partially edentulous patients. Part I: classification. *J Prosthet Dent* 1978;40(5):554–7;
- 10. Arik Zaretsk , Aharon Amir et al.** Free Fibula Long Bone Reconstruction in Orthopedic Oncology: A Surgical Algorithm for Reconstructive Options. *Plastic and reconstructive surgery*, June 2004.
- 11. Avinash S. Bidra, Rhonda F. Jacob, Thomas D. Taylor.** Classification of maxillectomy defects: A systematic review and criteria necessary for a universal description. *J Prosthet Dent* 2012;107:261-270.

- 12. B. LETHAUS, N. LIE, F. DE BEER.** Surgical and prosthetic reconsiderations in patients with Maxillectomy. *Journal of Oral Rehabilitation* 2010 37; 138–142.
- 13. Barbara S. Lutz, Fu-Chan Wei.** Microsurgical Workhorse Flaps in Head and Neck Reconstruction. *Clin Plastic Surg* 32 (2005) 421–430.
- 14. Bernardo BIANCHI, Chiara COPELLI, Silvano Ferrari, Prof, Andrea Ferri, Enrico Sesenna.** Free flaps: Outcomes and complications in head and neck reconstructions. *Journal of Cranio-Maxillofacial Surgery* (2009) 37, 438-42.
- 15. Boris Laure, Florent Sury, Thomas Martin, Arnaud Chabut and Dominique Goga.** Reconstruction of bony mandibular and maxillary defects with one single transfer of a free fibula osteocutaneous flap. *Journal of Plastic, Reconstructive & Aesthetic Surgery* (2008) 61, 200-203
- 16. Caroline T. Nguyen, Carl F. Driscoll and Dominick P. Coletti.** Reconstruction of a maxillectomy patient with an osteocutaneous flap and implant-retained fixed dental prosthesis: A clinical report. *J Prosthet Dent* 2011;105:292-295)
- 17. Christopher Glenn Wallace, Yang-Ming Chang.** Harnessing the Potential of the Free Fibula Osteoseptocutaneous Flap in Mandible Reconstruction. *Plast. Reconstr. Surg.* 125: 305, 2010.
- 18. Chun-Ming Chen, Gau-Tyan Lin, Yin-Chih Fu, Tien-Yu Shieh, I-Yueh Huang, Yee-Shyong Shen and Chung-Ho Chen.** Complications of free radial

forearm flap transfers for head and neck reconstruction. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;99:671-676.

19. Claudio Rodrigues Leles, Jose´ Luiz Rodrigues Leles, Carlos de Paula Souza, Rafael Ragonezi Martins & Elismauro Francisco Mendonc. Implant-Supported Obturator Over denture for Extensive Maxillary Resection Patient: A Clinical report *Journal of Prosthodontics* 19 (2010) 240–244.

20. Clemens Klug , Dominik Berzaczy, Martin Voracek, Georg Enislidis, Thomas Rath, Werner Milles, Rolf Ewers. Experience with microvascular free flaps in preoperatively irradiated tissue of the oral cavity and oropharynx in 303 patients. *Oral Oncology* (2005) 41, 738–746.

21. Cordeiro PG, Santamaria E. A classification system and algorithm for reconstruction of maxillectomy and midface defects. *Plast Reconstr Surg* 2000;105:2331–46.

22. D. David Kim, Mark A. Dreher. The Fibula Free Flap in Maxillary Reconstruction. *Atlas Oral Maxillofacial Surg Clin N Am* 15 (2007) 13–22.

23. Daniel RK, Taylor GI, Distant transfer of an island flap by micro vascular anastomoses. A clinical technique. *Plast Reconstr Surg* 1973; 52(2):111–7.

24. Daniel S. Brickman, Douglas D. Reh. Airway management after maxillectomy with free flap reconstruction. *HEAD & NECK—DOI 10.1002/HED MONTH* 2012.

- 25. Deepak Kademani, Thomas Salinas, Steven L. Moran.** Medial Femoral Periosteal Microvascular Free Flap: A New Method for Maxillary Reconstruction. *J Oral Maxillofac Surg* 67:661-665, 2009.
- 26. Devin J. Okay, Eric Genden, Daniel Buchbinder and Mark Urken.** Prosthodontic guidelines for surgical reconstruction of the maxilla: A classification system of defects. *J Prosthet Dent* 2001;86:352-63.
- 27. Eben Rosenthal, William Carroll.** Micro vascular reconstruction. *HEAD & NECK* November 2004.
- 28. E.D. Vaughan.** Functional outcomes of free tissue transfer in head and neck cancer reconstruction. *Oral Oncology* 45 (2009) 421–430.
- 29. Eric M. Genden, Alessandra Rinaldo, Carlos Sua´rez, William I. Weie, Patrick J. Bradley, Alfio Ferlito.** Complications of free flap transfers for head and neck reconstruction following cancer resection. *Oral Oncology* (2004) 40, 979–984.
- 30. Eric Santamaria, Susana Correa, Rachel Bluebond-Langner, Hector Orozco, Fernando Ortiz-Monasterio.** A shift from the osteocutaneous fibula flap to the prelaminated osteomucosal fibula flap for maxillary reconstruction. *Plast. Reconstr. Surg.* 130: 1023, 2012.
- 31. G. Rajasekhar, Nanda Gopal Vura, R. Sudhir, Srikanth Dhanala, Aditya Mohan Alwala.** Versatility of Dieffenbach’s modification of weber fergusson’s

approach for treatment of maxillary pathologies. *J. Maxillofac. Oral Surg.* (Oct-Dec 2012) 11(4):416–419.

32. Gan Muneuchi, Kazunori Miyabe. Postoperative complications and long-term prognosis of microsurgical reconstruction after total maxillectomy. *Microsurgery* 26:171–176, 2006.

33. Gr Hoffman, Islam, Rl Eisenberg. Micro vascular reconstruction of the mouth, face and jaws. Oro mandibular reconstruction – free fibula flap. *Australian Dental Journal* 2012; 57: 379–387.

34. H. Mukohyama, M. Haraguchi. Rehabilitation of a bilateral maxillectomy patient with a free fibula osteocutaneous flap. *Journal of Oral Rehabilitation* 2005 32; 541–544.

35. H. Yoshida, Y. Furuya. Spectral characteristics of hyper nasality in maxillectomy patients. *Journal of Oral Rehabilitation* 2000 **27**; 723–730.

36. Hakan Bilhan, Onur Geckili. Prosthetic Rehabilitation of a Patient after Surgical Reconstruction of the Maxilla: A Clinical Report. *Journal of Prosthodontics* 20 (2011) 74–78 2010.

37. H. A. H. Winters, S. M. Harten. Maxillary reconstruction using a horizontally placed iliac crest flap. *Eur J Plast Surg* (2003) 25:410–414.

- 38. Hidalgo, D. A.** Fibula free flap: A new method of mandibular reconstruction. *Plast. Reconstr. Surg.* 84: 71, 1989.
- 39. Hollows and J. P. Hayter.** Traumatic medial malleolar fracture of a fibula flap donor leg. *British Journal of Plastic Surgery* (2000), 53, 166-170.
- 40. Horst Kokemueller, Frank Tavassol, Martin Ruecker and Nils-Claudius Gellrich.** Complex Midfacial Reconstruction: A Combined Technique of Computer-Assisted Surgery and Microvascular Tissue Transfer. *J Oral Maxillofac Surg* 66:2398-2406, 2008.
- 41. Iacopo Dallan, Riccardo Lenzi¹, Stefano Sellari-Franceschini¹, Manfred Tschabitscher, Luca Muscatello.** Temporalis myofascial flap in maxillary reconstruction: anatomical stud and clinical application. *Journal of Cranio-Maxillofacial Surgery* (2009) 37, 96-101.
- 42. Ilpo Antti Johannes Kinnunen, Aleks Schrey, Juhani Laine, Kalle Aitasalo.** The use of pedicled temporal musculoperiosteal flap with or without free calvarial bone graft in maxillary reconstructions. *Eur Arch Otorhinolaryngol* (2010) 267:1299–1304.
- 43. Jacob Yetzer and Rui Fernandes,** Reconstruction of Orbitomaxillary Defects. *J Oral Maxillofac Surg*, 2012.

- 44. James E Freije, Bruce H.Campbell.** Reconstruction after infrastructure maxillectomy using dual free flaps. *Laryngoscope* 107;694-697, may 1997
- 45. James S Brown.** Maxillary reconstruction. *Indian J Plast Surg* 2007 vol 40 supplement.
- 46. James S Brown, Richard J Shaw.** Reconstruction of the maxilla and midface: introducing a new classification. *Lancet Oncol* 2010; 11: 1001–08.
- 47. James S. Brown, , Simon N. Rogers, Deborah N. McNally, Mark Boyle.** A modified classification for the maxillectomy defect. *HEAD & NECK* January 2000.
- 48. Jian Sun, Yi Shen, Jun Li, Zhi-yuan Zhang.** Reconstruction of High Maxillectomy Defects with the Fibula Osteomyocutaneous Flap in combination with Titanium Mesh or a Zygomatic Implant. *Plast. Reconstr. Surg.* 127: 150, 2011
- 49. John H. Phillips, Benjamin Rechner.** Mandibular growth following reconstruction using a free fibula graft in the pediatric facial skeleton. *Plast. Reconstr. Surg.* 116: 419, 2005
- 50. Jonathan R. Clark, Martin Vesely.** Scapular angle osteomyogenous flap In postmaxillectomy reconstruction: defect, Reconstruction, shoulder function, And harvest technique. *HEAD & NECK*—DOI 10.1002/ January 2008

- 51. Kemal Ugurlu, Bulent Sacak, Ilkay Hüthüt, Semra Karsidag, Damlanur Sakız and Lütfü Bas.** Reconstructing wide palatomaxillary defects using free flaps combining bare Serratus anterior muscle fascia and scapular bone. *J Oral Maxillofac Surg* 65:621-629, 2007.
- 52. Kao-Ping Chang, Chung-Sheng Lai, Tung-Ying Hsieh, Yi-Chia Wu and Chih-Hau Chang.** Two-year quality of life after free flap reconstruction in tumor-site discrepancy among Taiwanese with moderately advanced oral squamous cell carcinoma. *World Journal of Surgical Oncology* 2012, 10:145.
- 53. Kemal Ugurlu, Bulent Sacak.** Reconstructing Wide Palatomaxillary Defects Using Free Flaps Combining Bare Serratus Anterior Muscle Fascia and Scapular Bone. *J Oral Maxillofac Surg* 65:621-629, 2007.
- 54. L. Ciocca, G. Corinaldesi, C. Marchetti, R. Scotti.** Gingival hyperplasia around implants in the maxilla and jaw reconstructed by fibula free flap. *Int J Oral Maxillofac. Surg.* 2008; 37: 478–480.
- 55. Laith Barnouti And David Caminer.** Maxillary tumors and bilateral reconstruction of the maxilla. *ANZ J. Surg.* 2006; 76: 267–269
- 56. Lim C M, Lim J, Loh K S Tan L K S.** Early experience in free tissue transfer in the reconstruction of head and neck defects. *Singapore Med J* 2007; 48(7):652–655.
- 57. M.A. Germaina, D.M. Hartl.** Free flap reconstruction in the treatment of tumors involving the hard palate. *EJSO* 32 (2005) 335–339.

- 58. M. Halle, I. Bodin, P. Tornvall, M. Wickman, F. Farnebo, C. Arnander.** Timing of radiotherapy in head and neck free flap reconstruction of a study of postoperative complications. *Journal of Plastic, Reconstructive & Aesthetic Surgery* (2009) 62, 889-895.
- 59. M. Saleem, E Hashim and M. Babu Manohar.** Compartment syndrome in a free fibula osteocutaneous flap donor site. *British Journal of Plastic Surgery* (1998), 51, 405-407.
- 60. Mark G. Shrime and RalphW. Gilbert.** Reconstruction of the Midface and Maxilla. *Facial Plast Surg Clin N Am* 17 (2009) 211–223.
- 61. Massimo Maranzano and Andrea Atzei.** The versatility of vascularized iliac crest with internal oblique muscle flap for composite upper maxillary reconstruction *Microsurgery* 27:37–42, 2007.
- 62. Masayuki Fukuda, Tetsu Takahashi, Hirokazu Nagai and Mitsuyoshi Iino.** Implant-supported edentulous maxillary obturators with milled bar attachments after maxillectomy. *J Oral Maxillofac Surg* 62:799-805, 2004.
- 63. Matthew M. Hanasono, Y. Etan Weinstock and Peirong Yu.** Reconstruction of Extensive Head and Neck Defects with Multiple Simultaneous Free Flaps. *Plast. Reconstr. Surg.* 122: 1739, 2008.

- 64. Mauricio A. Moreno, Roman J. Skoracki, Ehab Y. Hanna, Matthew M. Hanasono.** Microvascular free flap reconstruction versus palatal obturation for maxillectomy defects. *HEAD & NECK—DOI 10.1002/* July 2010.
- 65. Michael N. Mirzabeigi, Theresa Wang, Stephen J. Kovach, Jesse A. Taylor, Joseph M. Serletti, Liza C. Wu.** Free Flap Take-Back following Postoperative Micro vascular Compromise: Predicting Salvage versus Failure. *Plast. Reconstr. Surg.* 130: 579, 2012.
- 66. Natalya Chernichenko, Douglas A. Ross, Joseph Shin, Jen Y. Chow, Clarence T. Sasaki and Stephen Ariyan.** Arterial coupling for micro vascular free tissue transfer. *Otolaryngology–Head and Neck Surgery* (2008) 138, 614–618
- 67. Neal D. Futran.** Primary Reconstruction of the Maxilla Following Maxillectomy With or Without Sacrifice of the Orbit. *J Oral Maxillofac Surg* 63:1765-1769, 2005.
- 68. Neal D Futran, Eduardo Mendez.** Developments in reconstruction of midface and maxilla. *Lancet Oncol* 2006; 7: 249–58.
- 69. P. Pohlenz, J. Klatt, G. Schön, M. Blessmann, L, R. Schmelzle.** Micro vascular free flaps in head and neck surgery: complications and outcome of 1000 flaps. *Int. J. Oral Maxillofac. Surg.* 2012; 41: 739–743.
- 70. Paolo Tosco, Giulia Tanteri.** Surgical treatment and reconstruction for central giant cell granuloma of the jaws: A review of 18 cases. *Journal of Cranio-Maxillofacial Surgery* (2009) 37, 380-387.

- 71. Pao-Yuan Lin, Kevin C. Lin.** Oro-mandibular Reconstruction: The History, Operative Options and Strategies, and Our Experience. *ISRN Surgery Volume 2011*, Article ID 824251.
- 72. Patrick B. Garvey, Edward I. Chang, Jesse C. Selber, Roman J. Skoracki, John E. Madewell, Jun Liu, Peirong Yu, Matthew M. Hanasono.** A prospective study of preoperative computed tomographic angiographic mapping of free fibula osteocutaneous flaps for head and neck reconstruction. *Plast Reconstr Surg.* 130: 542, 2012.
- 73. Paul D. Kim and Keith E. Blackwell.** Latissimus-Serratus-Rib Free Flap for Oro mandibular and Maxillary Reconstruction. *Arch Otolaryngol Head Neck Surg.* 2007;133 (8):791-795.
- 74. Philipp Pohlenz, Marco Blessmann, Max Heiland, Felix Blake, Rainer Schmelzle, Lei Li.** Postoperative complications in 202 cases of micro vascular head and neck reconstruction. *Journal of Cranio-Maxillofacial Surgery* (2007) 35, 311–315.
- 75. Pravinkumar G. Patil.** New Technique to Fabricate an Immediate Surgical Obturator Restoring the Defect in Original Anatomical Form. *Journal of Prosthodontics* 20 (2011) 494–498

- 76. Pravinkumar G. Patil & Smita P. Patil.** Fabrication of a hollow obturator as a single unit for management of bilateral subtotal maxillectomy. *Journal of Prosthodontics* 21 (2012) 194–199.
- 77. R. González-García, F. J. Rodríguez-Campo, L. Naval-Gías, J. Sastre-Pérez, M. F. Muñoz-Guerra, J. L. Gil-Díez Usandizaga and F. J. Díaz-González.** Radial forearm free flap for reconstruction of the oral cavity: clinical experience in 55 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:29-37.
- 78. Roger G. Graham, Marc C. Swan, Donald A. Hudson, Jacobus E. van Zyl**
The fibula free flap: advantages of the muscle sparing technique. *The British Association of Plastic Surgeons* (2003) 56, 388–394.
- 79. S. Duflo, F. Liefb, J. Paris, A. Giovanni, S. Thibeault, M. Zanaret.** Microvascular radial forearm fasciocutaneous free flap in hard palate reconstruction. *EJSO* (2005) 31, 784–791.
- 80. S. Podrecca, P. Salvatori, M. Squadrelli Saraceno, D. Fallahdar, L. Calabrese, G. Cantu, R. Molinari.** Review of 346 patients with free-flap reconstruction following head and neck surgery for neoplasm. *Journal of Plastic, Reconstructive & Aesthetic Surgery* (2006) 59, 122–129.
- 81. S. W. Choi, H. J. Kim, K. S. Koh, I. H. Chung, I. H. Cha.** Topographical anatomy of the fibula and peroneal artery in Koreans. *Int. J. Oral Maxillofac. Surg.* 2001; 30: 329–332.

82. Samer G. Hakim, Hans-Christian Jacobsen, Peter Sieg. Fibula raspatory: a new tool for harvesting microvascular fibular transplants. *British Journal of Oral and Maxillofacial Surgery* 50 (2012) 185–186.

83. Sekou Singare, Yaxiong Liu, Dichen Li, Bingheng Lu, Jue Wang & Sanhu He. Individually Prefabricated Prosthesis for Maxilla Reconstruction. *Journal of Prosthodontics* (2007) 1–6.

84. Shahram Nazerani, Hossein Behnia and Mohammad Hosein Kalantar Motamedi. Experience With the Prefabricated Free Fibula Flap for Reconstruction of Maxillary and Mandibular Defects. *J Oral Maxillofac Surg* 66:260-264, 2008.

85. Shepherd G. Pryor, Eric J. Moore. Coronoid-Temporalis Pedicled Rotation Flap for Orbital Floor Reconstruction of the Total Maxillectomy Defect. *Laryngoscope*, 114:2051–2055, 2004.

86. Shu-Ying Chang, Jung-Ju Huang, Chung-Kan Tsao, Anh Nguyen, Krithi Mittakanti, Chia-Yu Lin, Ming-Huei Cheng. Does Ischemia Time Affect the Outcome of Free Fibula Flaps for Head and Neck Reconstruction? A Review of 116 Cases. *Plast. Reconstr. Surg.* 126: 1988, 2010

87. Simon N. Rogers., Sundar R. Lakshmiah, Badri Narayan, Derek Lowe, Peter Brownson, James S. Brown and E. David Vaughan. A Comparison of the Long-Term Morbidity following Deep Circumflex Iliac and Fibula Free Flaps for

Reconstruction following Head and Neck Cancer. Plastic and reconstructive surgery, November 2003.

88. Steven P. Davison, David A. Sherris

An Algorithm for Maxillectomy Defect Reconstruction

Laryngoscope, 108:215-219,1998

89. Sun J, Shen Y, Li J, Zhang ZY

Reconstruction of high maxillectomy defects with the fibula osteomyocutaneous flap in combination with titanium mesh or a zygomatic implant

Plast Reconstr Surg. 2011 Jan;127(1):150-60

90. T.V. Padmanabhan, V. Anand Kumar, K. Kasim Mohamed & Nandini

Unnikrishnan. Prosthetic Rehabilitation of a Maxillectomy with a Two-Piece Hollow Bulb Obturator. A Clinical Report. Journal of Prosthodontics 20 (2011) 397–401.

91. Tao Zhang, Joshua Lubek, Andrew Salama, John Caccamese, Domenick

Coletti, Donit Dyalram and Robert Ord. Venous Anastomoses Using Microvascular Coupler in Free Flap Head and Neck Reconstruction

J Oral Maxillofac Surg 70:992-996, 2012.

92. Thomas Mucke , Denys John Loeffelbein, Bettina Hohlweg-Majert, Marco

Rainer Kesting, Klaus-Dietrich Wolff, Frank Hölzle. Reconstruction of the maxilla and midface – Surgical management, outcome, and prognostic factors. Oral Oncology

45 (2009) 1073–1078.

- 93. Thomas Mücke, Frank Hölzle, Denys John Loeffelbein, Andreas Ljubic, Marco Kesting, Klaus-Dietrich Wolff et al.** Maxillary reconstruction using microvascular free flaps. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;111:51-57.
- 94. W.H. Wang , J.Y. Deng , M. Li , J. Zhu, B. Xu.** Preoperative three-dimensional reconstruction in vascularized fibular flap Transfer. *Journal of Cranio-Maxillo-Facial Surgery* (2011) 1-5
- 95. Wenko Smolka, Tateyuki Iizuka.** Surgical reconstruction of maxilla and midface: Clinical outcome and factors relating to postoperative complications. *Journal of Cranio-Maxillofacial Surgery* (2005) 33, 1–7
- 96. Wolfgang Zemann.** Extensive ameloblastoma of the jaws: surgical management and immediate reconstruction using microvascular flaps. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;103:190-6.
- 97. Xiao Feng Li and Xin Peng.** What Is the Price to Pay for a Free Fibula Flap? A Systematic Review of Donor-Site Morbidity following Free Fibula Flap Surgery. *Plast. Reconstr. Surg.* 129: 657, 2012.
- 98. Xin Peng, Chi Mao, Guang-yan Yu, Chuan-bin Guo, Min-xian Huang and Yi Zhang.** Maxillary Reconstruction with the Free Fibula Flap. *Plast. Reconstr. Surg.* 115:1562, 2005.

99. Yadranko Ducic. An Effective, Inexpensive, Temporary Surgical Obturator Following Maxillectomy. *Laryngoscope* 111:356-357; February 2001.

100. Yang-Ming Chang, Christopher G. Wallace. Dental Implant Outcome after Primary Implantation into Double-Barreled Fibula Osteoseptocutaneous Free Flap-Reconstructed Mandible. *Plast. Reconstr. Surg.* 128: 1220, 2011.

101. Yi Shen, Jian Sun , Jun Li , Mei-me Li, Wei Huang, Andrew Ow. Special considerations in virtual surgical planning for secondary accurate maxillary reconstruction with vascularized fibula osteomyocutaneous flap. *Journal of Plastic, Reconstructive & Aesthetic Surgery* (2012) 65, 893-902

102. Yue He, Han guang Zhu, Zhi yuan Zhang, Jie He and Robert Sader, Three-dimensional model simulation and reconstruction of composite total maxillectomy defects with fibula osteomyocutaneous flap flow-through from radial forearm flap *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108: 6-12.

ANNEXURE

CASE REPORT FORM

**‘MICROVASCULAR RECONSTRUCTION OF MAXILLA
USING FREE FIBULA FLAP’.**

Patient’s Name : _____

Age/ Sex : _____

Patient’s Identification No : _____

Contact Address : _____

Contact No : _____

Institution : Tamilnadu Govt. Dental College &
Hospital, Chennai - 600 003

Centre : Dept. of Oral & Maxillofacial Surgery,
TN. Govt. Dental College and Hospital,
Chennai - 600 003.

Patient’s Identification / O P No: _____ Date : _____

DETAILS OF SURGERY

Procedure followed : Maxillary reconstruction with
Micro vascularized free fibula flap

Duration of Surgery :

Any other information :

Details of Drug therapy :

Name of the Investigator :

Signature of Investigator :

INFORMATION SHEET

We are conducting a study on reconstruction of maxillary defects with free fibula flap among patients attending TNGDC & H, Chennai-3, and for that study we are selecting patients. The purpose of this study is to assess 1) the functional and aesthetic satisfaction. 2) To evaluate wound dehiscence/infection and donor site morbidity. The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared. Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled. The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator

Signature of participant

Date: