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Digital Planning For Reconstruction of Maxillofacial Osseous Defects with Free Fibula

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ABSTRACT
Reconstruction of maxillofacial continuity defects has invariably been a difficult task for oral surgeons over the years. [1] Maxillofacial bone defects are caused by the trauma, clefts, burns, and infection, benign, or malignant tumors. To reconstruct giant bony defects within the head and neck region remains a serious surgical challenge. [2] Free-flap reconstruction of oncological mandibular defects has become the fashionable commonplace of care. This paper reviews current technique of mandibular reconstruction employing a free fibula bone graft and virtual designing technique. [3]

KEYWORDS: Mandibular reconstruction; free flap; Fibula; Virtual planning and guided surgery; Central giant cell granuloma.

I. INTRODUCTION

Facial esthetics has a symbolic importance and is a window of an individual to the world. [1] Rather than relying exclusively on intraoperative manual approximation of facial reconstruction surgical models makes it easy. Hidalgo reported the utility of vascularized fibula flaps for mandibular reconstruction in 1989.[2]Free vascularized bone transplant is the gold standard for mandibular reconstruction, being easy to harvest with good dimensions and quality of bone and pedicle length. Conforming flap to defect, however, is a long and complex task that is critical for functional and esthetic outcome. [3].

Recently, computerized tools have been developed for surgeon's plan and perform the intervention, preoperative virtual planning, which provides cutting guides and preformed osteosynthesis plates to optimize conformation [4]. Aim of this paper is to spread the awareness of making a surgeons life easy and less complicated.

Material and methods

Patients came in the Department of Oral and Maxillofacial Surgery in Rural dental college, Pravara institute of medical sciences,Loni. After establishing the definitive diagnosis, including tumour characteristics and the size of the tumour, 3-D CT Face Plain, Contrast all cuts with 1 mm slice, in Saggital, Axial, Coronal section in open and closed mouth, DICOM images were advised along with CT- Angiography of both the Lower Limbs. Companies like Jajal Medical support surgeons with their diverse services by providing better 3D visualization of patients' anatomy, preparing virtual surgical plans, designing and manufacturing customized patient-specific 3d printed models, surgical guides, and custom implants. With this the 3D models were made Case report

A 15 years old female patient presented to the department of Oral and Maxillofacial Surgery, with a chief complaint of Swelling over lower half of face since 5-6 months. Patient was apparently alright 6 months back when she noticed swelling in anteriormandibular area which was initially smaller in size, gradually increasing, not associated with pain. On extra oral examination well defined large swelling seen involving lower one third of face extending supero-inferiorly from vermillion border of lip to inferior border of mandible and antero-posteriorly from left corner of mouth to mid pupillary line crossing midline of approximately 5 X 6 cm.

Intraoral examination revealedlarge swelling extending from 43-46 region of approximately 3 x 4cm, overlying mucosa appears stretched with bluish discoloration, enlargement of the buccal cortical plate in anterior region of the mandible.

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Swelling was firm in consistency, non-tender and afebrile.
Radiographic investigations showed a large, well defined radiolucency extending anteroposteriorly from 37-47 and super inferiorly from alveolar crest of anterior mandible to low border of mandible, suggesting of thinning and expansion of inferior border of mandible.
An incisional biopsy of the swelling from right side of mandible was taken. Overall histopathological features were suggestive of central giant cell granuloma.

Virtual surgical planning

Computed tomographic (CT) scan and angiographic CT scan of the lower legs (the donor site), of the patient sent to the modeling company for three-dimensional model of both the mandible and the fibula. The perforator vessels in the lower legwere identified using a hand-held Doppler and marked on the skin. The distance between the lateral malleolus and the perforator skin vessel was registered. Furthermore, preliminary measurements for the resective and reconstructive program were made on the CT scan. (Figure-1)

Surgery

Under all aseptic precaution in the OT, patient was induced under general anesthesia. LA with adrenaline was given for tissue separation. Access to the resection was via a visor flap. Access to the mandible was made and the cutting guides were secured in the planned position. Mandible and fibula cutting guides were provided with fixation holes for temporary fixation and trocar guides for PSP fixation screws. The osteotomies were completed following the cutting guides and the tumor was carefully removed. Finally, the resection of lesion was completed along with involved soft tissue. At the same time, a second surgical team proceeded to harvest the fibula. With the help of a hand-held Doppler and using the preoperative measurements of the distance between the malleolus and the perforator vessel, the position of the vessel itself was marked on the skin.

After identification of the perforator vessels and dissection, the fibular guides were secured to the bone to replicate the cuts for both the end and closing wedges in previously planned osteotomies .After positioning and fixation of the cutting guides, the fibular distal and proximal osteotomies were performed. A missing piece of fibula reconstructed mandible was re-created. The most important aspect in the process of bone filling design was maintenance of proper shapes and determination of leading curves to obtain a desired initial shape of the mandible (Figure 2).Harvesting free fibula and transferring it to the recipient site.After micro vascular anastomosis the closure was done.

II. RESULT

Transfer of the free fibula graft was successful. Post-operative radiograph done.

III. DISCUSSION

Virtual surgical planning technology in Head and Neck surgery, is especially useful in minimizing operating time, especially when multiple osteotomies also requires the resection to be scheduled with great precision, in advance of the time of surgery. [5]

Virtual planning and rapid prototyping provides: (1) a method to accurately evaluate the anatomy of a defect; (2) optimized presurgical planning; (3) accurate preplanning of osteotomies; (4) optimized fit of the graft without further need for osseous adaption; (5) shortened surgical time; (6) a highly predictable outcome of surgery, as Girod et al have reported; and (7) improved communication between surgeons and between the surgeon and the patient. [6]

Being able to always program in the most accurate fashion is a very important factor in order to obtain maximum accuracy in bone reconstruction, especially with the use of PSP.
Moreover, thanks to virtual surgical planning, all the phases of fibula modeling and mounting on the reconstruction plate can be performed before detaching the vascular pedicle

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IMAGES

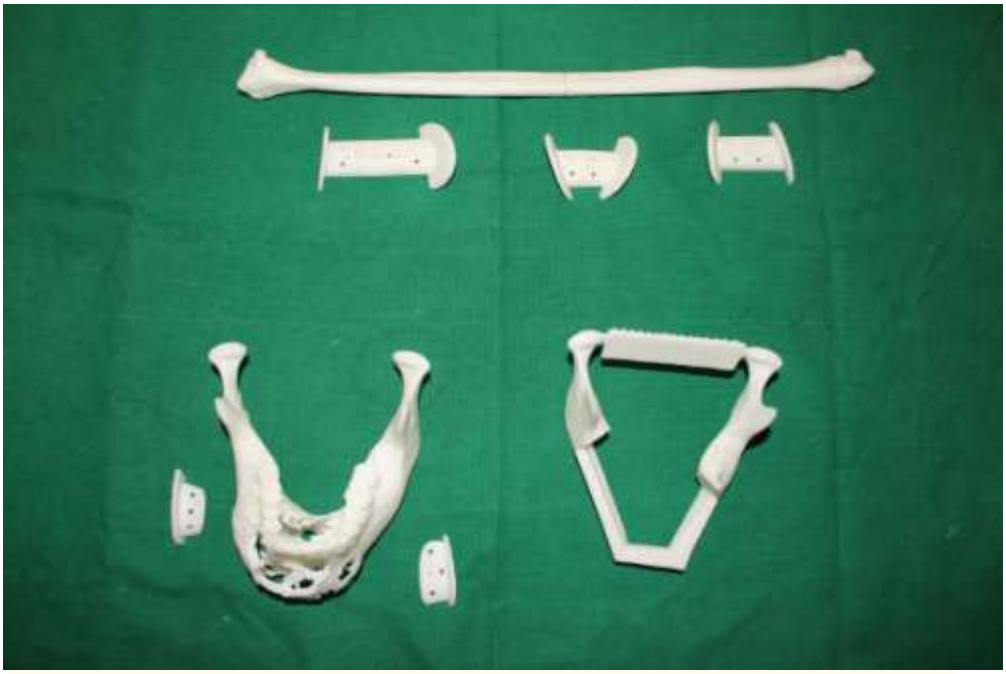

Figure 1: Three-dimensional CT reconstruction visualizing the large defect of the right mandible, A physical 3-D model was designed, which consisted of structurally unchanged elements and parts which needed reconstruction. Sectioning planes were defined based upon regions of cut mandible.

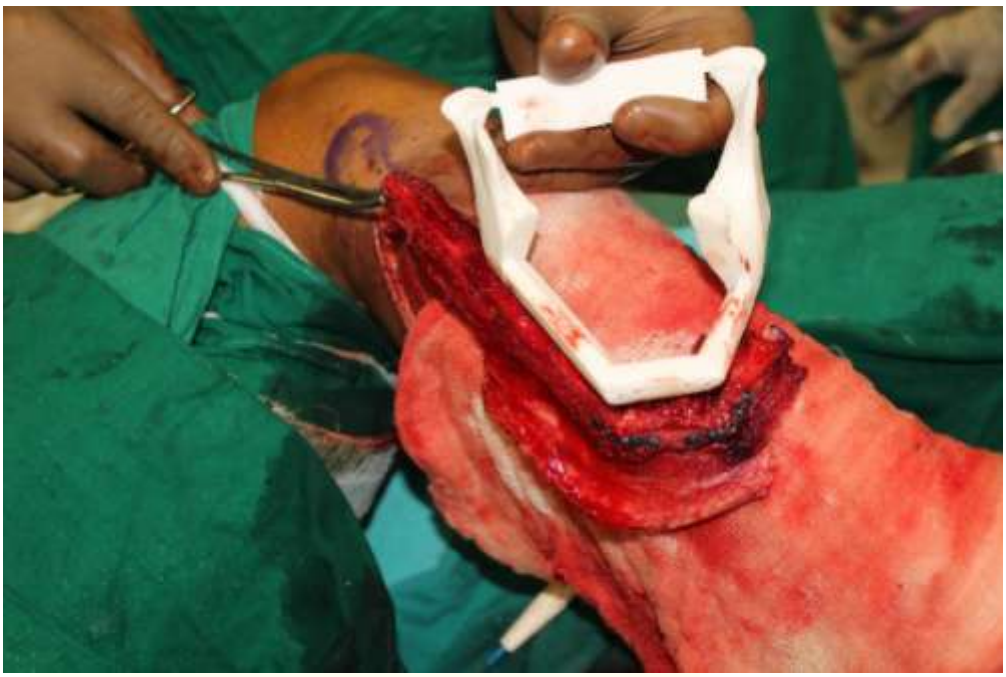

Figure 2: Shaped fibula secured to the PSP in the planned position and fixation of fibula at surgical defect.