



Use of 3D Printing in Mandibular Reconstruction: A Case Report

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Date of Submission: 25-07-2024

Date of Acceptance: 05-08-2024

ABSTRACT: This clinical case presented a newer method of segmental mandible reconstruction using 3D-printed titanium implant with a scope of placing dental implants to rehabilitate occlusion. A 30-year-old male had recurrent OKC was treated for the same 2 years ago. The 3D-printed Patient Specific Implant (PSI) was simulated and fabricated with the help of STREOVIZ software. The PSI was successfully inserted, and the discontinuous mandible defect was rehabilitated without postoperative infection or foreign body reaction during follow-ups, until 5 years. The 3D-printed Patient Specific Implant would be the one of the suitable treatment modalities for mandible reconstruction considering all the aspect of mandibular functions

KEYWORDS: Patient Specific Implant, Odontogenic Keratocyst, Reconstruction of Mandible, OKC, PSI, KCOT

I. INTRODUCTION

Personalized medicine is a form of medicine that uses information about a person's gene, proteins, and environment to prevent, diagnose, and treat disease (National Cancer Institute). It refers to a shift away from the "one-size-fits-all" approach designed for the average patient toward treatments tailored for the individual.¹

Patient specific implants, a recent development of Personalized medicine, are currently used in multiple areas of oral and maxillofacial surgery, including temporomandibular joint (TMJ) total joint replacement, reconstruction of the maxillofacial skeleton, and orthognathic surgery. The decreasing cost of this technology has also made it more affordable and accessible to patients. There are many challenges unique to bony reconstruction of the maxillofacial skeleton, including anatomic diversity, complex movement of the mandible, saliva contamination, and dental rehabilitation²

Many reconstruction modalities have been

reported to achieve optimal functional and aesthetic results. Conventional modalities for mandibular reconstruction include reconstruction plate, micro vascular fibula free flap, iliac bone graft, costochondral ribbone graft, and alloplastic prosthesis³. When the segmental defect is large, micro vascular free flap has been the gold standard of mandibular reconstruction. It allows dental implant installation, enabling the recovery of mandibular function as well as mandibular shape and aesthetics. Autogenous graft, however, has its disadvantages such as donor site morbidity, extended operation time, and potential graft failure due to tissue necrosis³. Recent development in three-dimensional (3D) printing technology enabled fabrication of customized prosthesis. 3D-printed PSI has successfully been used for the reconstruction of facial bone defect including the mandible. The advantage of 3D-printed PSI is that it can be designed according to the defect size and morphology⁴. PSI can be fitted accurately in the defective site without interference. It allows for reduced operating time and recovers the original contour of the mandible and facial symmetry⁵

II. HISTORY OF PSI

A major advancement to patient-specific implants was the rapid prototyping of stereo-lithic models to scale, first described in oral and maxillofacial surgery by Brix and Lambrecht in 1987.⁶

The first case report of a patient-specific implant (Recon Plate) used in mandibular reconstruction was in 2012 by Ciocca and colleagues⁷

III. CASE REPORT

A 30 years old, male patient, came to our OPD with pain & swelling in the left side of lower jaw since last 6 months

On inspection there was no apparent swelling extra orally as well as intraorally no sinus tract or fistula present and overlying skin appears normal. On palpation there was a small swelling



over left ramus area. Mild tenderness was elicited but no history of paraesthesia.

Patient was previously treated for Odontogenic Keratocyst 2 years ago.



PRE-OP: EXTRAORAL



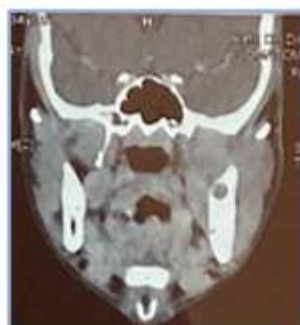
PRE-OP: INTRAORAL

We advised him for a CECT scan. CECT scan showed lytic changes of left mandible. Lobulated lytic lesion was seen in left ramus of

Mandible (27.7 x 18.5 mm) showing ill-defined central-lucency with peripheral sclerosis in the left side body of mandible



PRE-OP: OPG



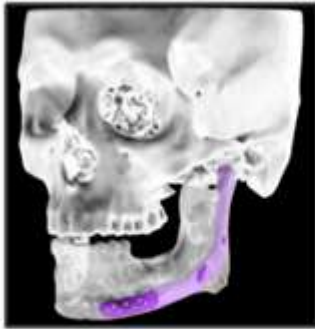
PRE-OP: CORONAL VIEW



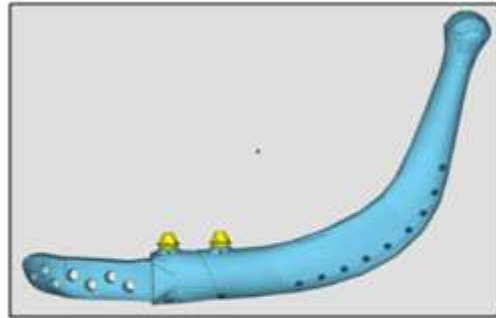
PRE-OP: AXIAL VIEW

SLM model was fabricated. Surgical plan of resection and design of Patient Specific Implant was carried out with help of virtual planning software (STREOVIZ)

Treatment plan was Brown's Class I mandibulectomy extending from 35 with disarticulation of left condyle followed by reconstruction with patient specific implant (PSI) with help of screws



PLANNING



PLANNED PSI WITH PROVISION OF IMPLANTS

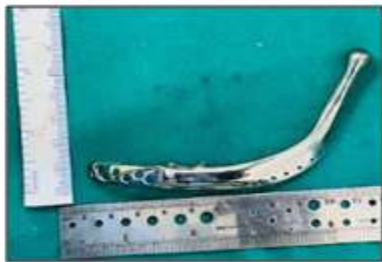
Unilateral modified apron incision placed on the left side with extension from the midline of mandible to mastoid process. Layer by layer dissection carried out through the subcutaneous tissue, platysma, investing layer of deep cervical fascia then muscle, the periosteum and the mandible is exposed.

Left Facial artery and vein were ligated and skeletonised. Osteotomy was performed at 35 region with bur. The mental and inferior alveolar neurovascular bundle were ligated.

Brown's Class 1c mandibulectomy extending from 35 with disarticulation of left

condyle was performed. During osteotomy, guidance was taken from the stereo lithographic model and the adaptive surface of patient specific implant. Patient specific implant was fixed to the mandible with 10 screw (2.5*12 mm). Layer by layer primary closure done with 3-0 vicryl followed by skin stapler.

Patient was put under IMF for 4 weeks followed by active jaw exercise. 1 month post-op mouth opening was 30 mm which is satisfactory. Now this case has been followed up to 5 years but there is no recurrence or complain till now



PSI



PSI FIXED WITH MANDIBLE



RESECTED SPECIMEN



POST OP 1 MONTH: OCCLUSION



POST OP 1 MONTH: MOUTH OPENING



POST OP 1 MONTH: OPG



IV. DISCUSSION

The odontogenic keratocyst has been infamous for its aggressive behaviour and aproclivity for recurrence. The reasons proposed for these recurrences include leaving behind epithelial remnants of the primary lesion during enucleation, the presence of satellite or daughter cysts in the cyst wall, and microcysts present in the overlying mucosa that may become activated after failure to remove the mucosa along with the cyst.⁸ In order to ensure that no epithelial remnants are left behind, in toto enucleation of the cyst lining is the most desirable aim for the surgeon. Unfortunately, the cyst lining of most OKCs is quite thin and exceedingly friable, which makes in toto enucleation extremely challenging to achieve,⁹ especially in lesions that are large and multilocular, coupled with cortical perforation and soft tissue extension. Consequently, contemporary recurrence rates for this lesion range from 9% to 62.5% following enucleation.¹⁰ It is, therefore, evident that enucleation alone cannot be considered the preferred modality for the management of such lesions. Adjunctive procedures are frequently used along with enucleation to eradicate the lesion from suspicious-looking enucleated defects. These procedures include curettage, peripheral ostectomy, chemical cauterization using Carnoy's solution, peripheral ostectomy + Carnoy's solution, cryotherapy, and excision of the overlying mucosa.¹⁰

Radical surgery, even in large multilocular cysts, would represent an overkill, and such surgeries must be reserved for unresponsive and/or complicated lesions. Based on the results of this study, **Mohanty et al.** have devised a treatment algorithm to guide the management of the OKC and urge surgeons to consider the same.¹⁰

Recent application of 3D printing technology to medicine allows precise patient-specific preoperative design of implants. Surgeons can design the implant in ways to restore the original features, and greater implant stability is expected with an accurate fit in the defective site without interference.¹¹ 3D printing has many advantages over traditional methods such as its ability to fabricate complex structures, its improved customization, and its time efficiency. 3D-printed PSI has been used in various fields of facial reconstruction including the mandible for its mechanical strength that can support mandibular movement.¹² Unlike other facial compartments, reconstruction of the maxilla or mandible requires careful consideration of dental rehabilitation. Mastication and pronunciation are important functions of the mandible that can be restored with

dental rehabilitation. The most widely used method for dental rehabilitation is the installation of dental implants to the vital bone for osseointegration. However, the use of titanium implant for occlusal rehabilitation is limited in that dental implants cannot be installed to the implant body itself. There are several ways to install fixed prosthesis on titanium implants, one of which is via the abutment designed as part of the titanium implant.¹³ Lee et al. reported the use of titanium mandibular implant with 2 abutment projections to rehabilitate occlusion.¹³

V. CONCLUSION

3D-printed Patient Specific Implant can be a suitable treatment modality for mandible reconstruction considering all aspects of mandibular functions. This case also demonstrated the possibility of conventional dental implant installation into PSI for occlusal rehabilitation using the concept of submerged dental implant.

CONFLICTS OF INTEREST

None

ACKNOWLEDGEMENTS

I wish to acknowledge my G.N.I.D.S.R OMFS Team.

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