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Virtual Surgical Planning For Correction Of Laterognathia – A Case Report

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Abstract
Orthognathic surgery, aimed at correcting jaw deformities, requires precise planning to achieve optimal functional and aesthetic outcomes. Traditional methods, reliant on two-dimensional imaging and manual model surgery, present limitations in accuracy and predictability. Virtual Surgical Planning (VSP), utilizing three-dimensional imaging and computer-aided design, has emerged as a transformative tool in this field. The integration of VSP in orthognathic surgery demonstrated a significant improvement in the accuracy of surgical outcomes, with a high correlation between the planned and actual postoperative skeletal positions. VSP also contributed to reduced surgical time and minimized intraoperative errors. Additionally, patient satisfaction scores were notably higher due to enhanced aesthetic and functional results.

Keyword*: Laterognathia, Virtual surgical Planning in Orthognathic Surgery, Surgical Guides Class III malocclusion, CAD CAM,3D printing*

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I. Introduction

In order to correct skeletal malocclusion, dentofacial deformities & facial asymmetry, orthognathic surgery & orthodontic treatment are done . Orthognathic surgery comprises of preoperative planning, accurate implementation of the planned surgery , postoperative care & post-surgical orthodontics if necessary . Traditional surgical planning involves clinical examination , 2 dimensional (2D) photography , lateral cephalograms assessment , making study models , performing mock surgery , making the intermediate & final splints. Even a small mistake in any of the above mentioned procedures could result in a less favourable surgical outcome which may also not be acceptable to the patient aesthetically & functionally. Virtual surgical planning facilitates these procedure digitally, reduces errors & helps in soft tissue prediction as well. With the development of computer aided designing (CAD) & computer aided manufacturing (CAM) the unwanted surgical outcome due to deficient planning can be avoided . It encourages surgeons to design appropriate osteotomy planes and to assess different surgical scenarios in a computerized virtual environment. Once the final surgical plan is decided , a surgical cutting guide & splint is fabricated ,with the use of which the surgery is carried out .This case report is of a patient with laterognathia who was already under orthodontic treatment for malpositioned teeth ,the patient was planned for orthognathic surgery for correction of the facial asymmetry with the use of VSP .

II. Case Report

A 23 year old male patient had reported to the department of Oral & Maxillofacial Surgery, Government Dental College, Cuddalore dt with the chief complaint of deviated lower jaw towards right side for the past 4 years . Patient was apparently normal 4 years ago, he noticed the deviation in the jaw later, patient has been under orthodontic treatment for the past 2 years. On history taking, there were no associated familial history & his prenatal & natal history were also normal.

On clinical examination the patient was moderately built, had straight facial profile & straight divergence with competent lips (Fig 1). The lower facial height was increased ,mento-labial sulcus was shallow, FMA was high . On functional examination the mastication, respiration, deglutition were normal.

Figure 1 -Pre-OP Profile Pictures

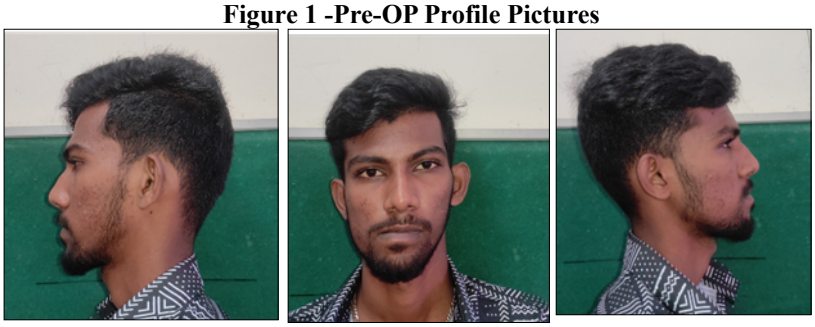
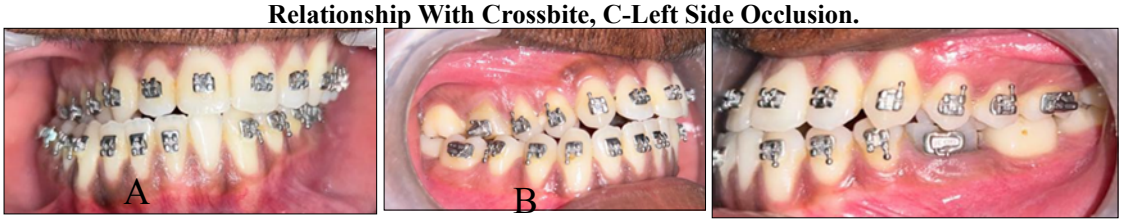


Figure 2-A Intraoral Picture Showing The Shift In The Dental Midline, B- Class II Molar & Canine Relationship With Crossbite, C-Left Side Occlusion.



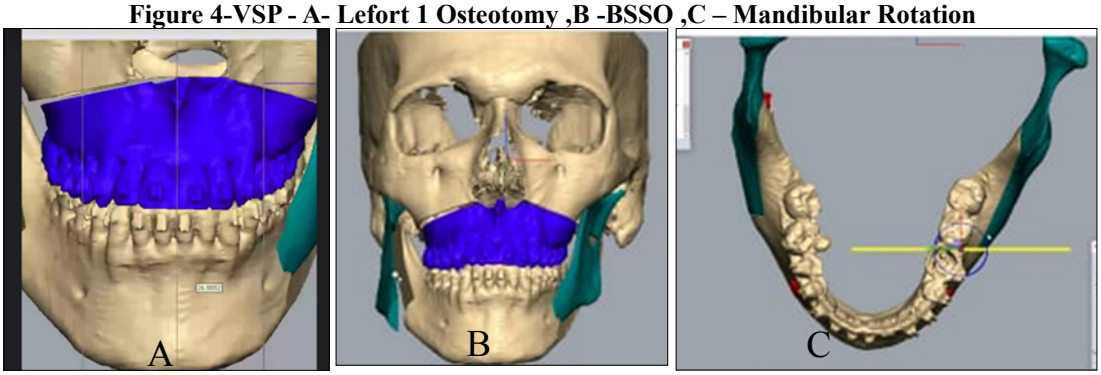
The dental midline was shifted to right side & there was mild occlusal cant. From the cephalometric analysis (Fig -3) it was inferred that the patient had orthognathic maxilla, prognathic mandible & Skeletal Class III malocclusion

Figure 3- Lateral Cephalogram

Primary impression was taken, model casts were poured & occlusal record were taken. Patient was advised to take CT facial bones with the thickness of 0.5mm thickness. The CT was sent to the engineer who changed it into Digital Imaging & Communication in Medicine (DICOM) pattern. Once the DICOM pattern was procured

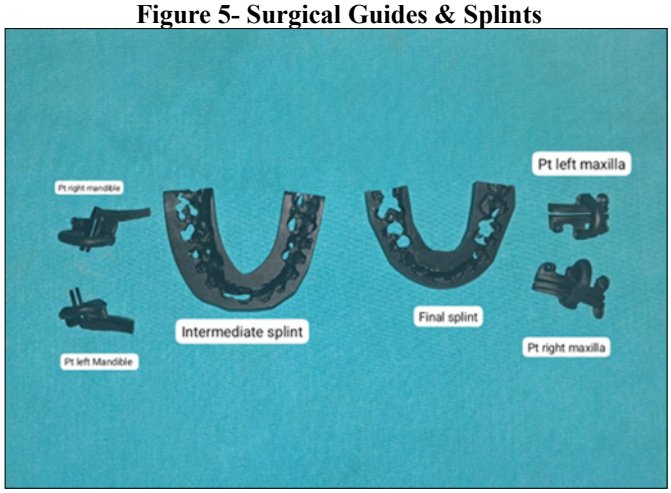
,3D reconstruction was done & VSP was planned where the engineer & the operating surgeon joined the virtual platform to decided the surgical plan . Lefort I osteotomy with 5 mm of shift towards right side & Bilateral sagittal split osteotomy & shift toward left side with bone augmentation on left side.(Fig 4-A)

Figure 4-VSP - A- Lefort 1 Osteotomy ,B -BSSO ,C – Mandibular Rotation



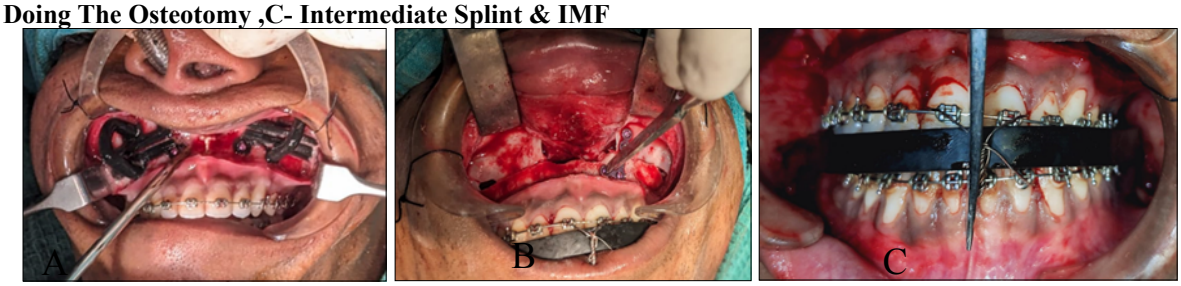
Pre- surgical workup with proposed surgery was done with cast model & an intermediate & final splint were fabricated . Simultaneously surgical cutting guides & intermediate & final splint were also fabricated in the lab as well (Fig 5) .The patient was admitted in the ward prior to the surgery & all the routine blood investigations were taken & anaesthetist opinion was obtained .Patient was explained about the surgery & consent was also obtained .The surgical guides & splints were sterilised according to the standard protocols.

Figure 5- Surgical Guides & Splints



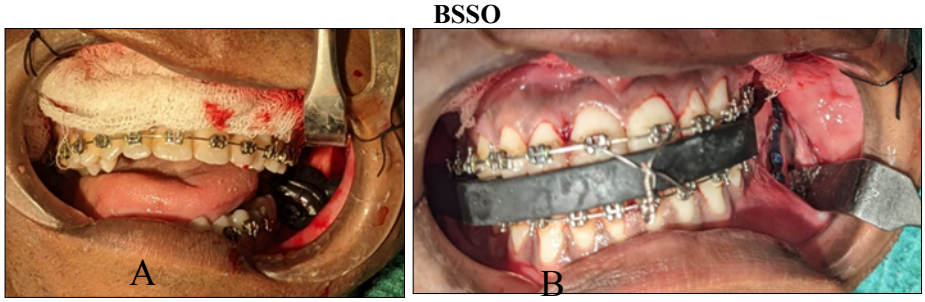
The surgery was carried out with nasal intubation under general anaesthesia. Complete betadine irrigation was done intraorally. First the incision for Lefort 1 osteotomy was placed in the vestibular region from 17 to 27 region & the maxillary region along with the buttress exposed. Surgical guides placed over bilateral maxillary wall region & fixed with 1.5 *6 mm Ti screws. Osteotomy cuts placed with the guides in place for Lefort 1 osteotomy with long shank bur & the guides were removed. Osteotomy cuts completed with osteotome & mallet. The maxilla was shifted towards right side by 5mm. Intermediate splint placed & secured with 26 gauze wire by maxillomandibular fixation(1) (Fig -6 A-C)

Figure 6-Intraop Pictures In Maxilla ,A- Placing The Surgical Guides , B- Fixation With Ti Plates After Doing The Osteotomy ,C- Intermediate Splint & IMF



Incision placed over the ascending anterior border of ramus till vestibule the 2nd molar on right side . Full thickness mucoperiosteal flap elevated exposing the anterior border of ramus along with coronoid. The mandibular guide for sagittal osteotomy cut is placed & secure with 1.5* 6 mm Ti (Titanium) screw, the medial horizontal cut & vertical cut is placed. Both the cuts are joined with lateral external oblique cut. The guides are removed . The osteotomy is completed with chisel & mallet & Smith's split spreader. The same procedure is completed on left side with 7 mm of bone removed & then the mandible shifted towards left. The maxilla is down fractured with finger pressure & the final splint is placed (2) , the maxilla & mandible is secured in occlusion with intermaxillary fixation .(Fig -7)

Figure 7- Intraop Images For BSSO ,A- Placing The Surgical Guide On Left Side & B- Fixations After BSSO



The maxillary osteotomized segment is fixed with 1.5 mm Ti L plate & 1.5 mm Ti 4HWG 'T' plate & Ti screws on right side over the pyriform & maxillary buttress region . The maxillary osteotomized segment is fixed with 1.5 mm Ti L plate & 1.5 mm Ti 5 HWG 'T' plate secured with & Ti screws on left side over the pyriform & maxillary buttress region .

The autogenous bone graft from the left side osteotomized segment is placed between medial and proximal portion of the sagittal split on the right side. The segment is fixed with 2mm Ti 4 HWG plate on both sides & Ti screws (6) .

Wound closure done with 3-0 vicryl in the mandibular vestibule region. Wound closure done with 3-0 vicryl over maxillary vestibule with simple continuous sutures & V-Y closure done in the anterior maxillary vestibule with 3-0 ethilon. Patient was extubated uneventfully & post operative IV antibiotics & fluids were administered. Patient was put on Ryle's tube feed for the initial few post operatively to prevent infection intraorally & unnecessary excessive occlusive forces. The occlusion, lateral protrusive movements & condyles were checked. After 1 week post operatively the patient was discharged (Fig -8-A) & was advised for regular follow up (Fig 8 - B, C) & continue the orthodontic treatment .Post op lateral cephalogram (Fig -9)were taken & orthodontic treatment was also completed(Fig 10) .

Figure 8 – Post OP Profile- A- After 1 Week, B- 3 Weeks Post OP , C- 2 Months Post OP

Figure 9-Post OP Cephalogram

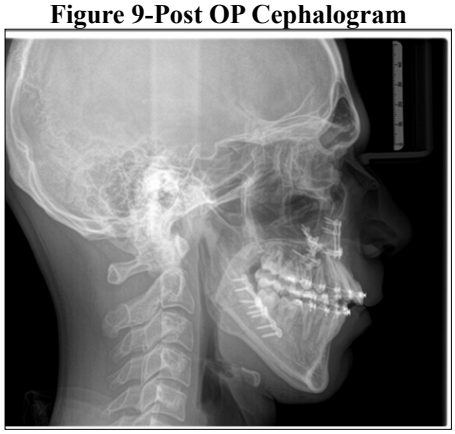


Figure 10 – Post Operative Occlusion

III. Discussion

The term laterognathia describes a lateral bite in the lower jaw and is often associated with an unilateral crossbite in the posterior teeth and asymmetry in the whole of the lower face. (4) Treatment of laterognathia is either possible with orthodontic tooth movement or a surgical relocation of the lower jaw. (5)

Virtual Surgical Planning is ideal for correcting laterognathia & skeletal malocclusion & orthognathic surgical planning (3) as it provides for precise and predictable movements of the maxillofacial skeleton in an efficient and precise manner compared with traditional model surgery.

It saves the time spent in all pre surgical procedures such as dental impressions, laboratory workups etc. All these procedures are subject to human error & even minute inaccuracy could lead to less desired surgical outcomes, sometimes leading to the need of second surgeries which can be avoided in VSP – guided work flow. VSP provides an insight preoperatively into the desired orthognathic corrections. It allows an anatomic appreciation of anticipated segment orientation & positioning, and bony interferences & the soft tissue prediction as well. It also addresses the rigid fixation & possible need for grafting in case of osteotomy gap.

DATA COLLECTION & PRE SURGICAL WORK UP

CLINICAL EXAMINATION , MODEL CASTS ,CT SCAN ,CEPHALOMETRIC ANALYSIS ,CLINICAL PHOTOGRAPHS

VIRTUAL SURGICAL PLANNING

SEGMENTATION OF DIGITAL IMAGE , 3D RECONSTRUCTION ,OSTEOTOMY PLANNING , ,SPLINT DESIGN , GUIDE FABRICATION,STL MODELS

SURGERY

TRANSFER OF THE VIRTUAL PLAN TO OPERATING ROOM

USE OF SURGICAL GUIDES TO PERFORM OSTEOTOMY

OCCLUSAL SPLINTS TO REPOSITION THE BONY SEGMENT

The web meeting for the planned surgery is coordinated with the biomedical engineer & the surgeon enabling them to generate different osteotomies virtually, closely mimicking those to be performed intraoperatively. Virtual manipulation of the maxilla to correct the occlusal cant & the midline is done first done followed by correction of the mandibular osteotomy. It is directed towards sound orientation of the bony segments. Once the planning is completed, design of the cutting guide & splint is decided at the last session of the web meet.

VSP comes to help in patient education as well. The patient is explained about the surgery to be carried out with the use of VSP & models. The post operative jaw position was explained. A surgical guide fabricated from VSP & 3D printing aids in orientation of the osteotomy (7).VSP has proved to be more accurate & result in improved clinical outcomes compared to traditional orthognathic surgeries. Despite the inadequate visibility of the surgeon can identify the osteotomy site with the use of surgical guide.

Studies show that the operative time & costs were significantly high in traditional orthognathic surgeries compared to VSP assisted orthognathic surgeries as more time is spent prior to the surgery & hence a less intra-operative time & less postoperative complication (8).This could also be attributed to the less invasive surgery due to precise planning , quick recovery hence improving the patient experience .Post operative complications such as bleeding ,nerve damage ,delayed healing ,undesirable bone segmentation & relapse are reported with traditional surgical planning .

Regardless of the various advantages of virtual surgical planning, the different methods transferring a virtual surgical plan into reality may influence the outcome. Given the economical constraints the additional cost of incorporating the VSP CAD-CAM technology may be a burden to the patient as well the medical system which with time & advances could be overcome (9) .

IV. Conclusion

As today's surgery is based more towards patient centric care, the demand for personalised surgical methods increases, making the surgeons tailor surgeries the individuals' anatomy & desired outcomes. The amalgamation of VSP with surgical planning is paving way for advanced patient care in orthognathic surgery. With adequate training & skills to operate the software for the 3D models & surgical guides one can entirely benefit from this emerging technology.

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