

# VIRTUAL SURGICAL PLANNING AND PATIENT SPECIFIC PLATES FOR SIMULTANEOUS LE FORT III & LE FORT I OSTEOTOMIES

WING SHAN CHOI, MING YIN LEUNG, RUI WANG  
Oral & maxillofacial surgery, Faculty of Dentistry, The University of Hong Kong

Case History: 18/F presented with severe midface deficiency involving the malar, paranasal, inferior orbital, maxilla, nasal bridge; and mandibular hyperplasia



**Surgical plan**

- Modified oblique Lefort III osteotomy
- Simultaneous Lefort I with 2-piece segmentalisation
- Bilateral Sagittal Split Osteotomies

**Virtual surgical planning (VSP)**

- Full skull CBCT imported to VSP software
- Dental models scanned with 3D scanner and imported to VSP software
- Osteotomy planes, surgical movements finely controlled in VSP software
- After finalizing the segments of the Lefort III and Lefort I, STL files were exported for titanium plate and intra operative occlusal wafer design
- 3D facial simulation of soft tissue done in VSP software

**Surgical Movements:**

Anticlockwise rotation of naso-zygomatic segment , differential advancement of nasion (+3mm) and zygoma (+5mm)

**Titanium Plates for fixation**

Nasion (0.6mm thickness), Zygomatic buttress for Lefort I (0.8mm), Zygoma for Lefort III (1.0mm)

**Surgical Procedure**

**Le Fort III osteotomy**

- Naso-endotracheal
- Coronal flap was raised down to preauricular region. Superficial temporal arteries were cauterized.
- Frontal bone, nasal bone and zygoma exposed. Orbital contents protected and lifted to expose the lateral wall of the orbital and floor
- Surgical guides were temporarily fixed
- Modified oblique cut from lateral orbital rim down to zygoma; and nasofrontal region
- Lateral canthal ligament stripped
- Osteotomies with piezoelectric saw at medial orbital wall and floor; lacrimal sac and infraorbital nerve preserved
- Maxillary tuberosity osteotomised for maxillary dysjunction
- Connecting osteotomies to Le Fort III level performed with oscillating saw
- Rows disimpaction forceps used to separate and mobilise midface from the calvarium

**Le Fort I osteotomy in 2 pieces**

- Maxillary vestibular incision. Mucoperiosteal flap raised
- Lefort I osteotomy performed according to the surgical guides
- Maxilla down-fractured and segmentalised into 2-piece with horseshoe cut on palatal bone
- Occlusion established with arch bar and wafer
- 3D printed plates used for fixation of the midface at nasofrontal bones, bilateral zygoma, and maxilla

**Mandible**

- Standard bilateral sagittal split osteotomies were performed to setback mandible by 7mm
- Bone trimmed during Sagittal split used to graft advancement gap at zygomatic region.
- Bilateral lateral canthoplexy done. Layered wound closure. Bilateral suction drains placed at scalp wound.

**Post operative care**

Patient was sent to the intensive care unit and was extubated on the first day post-surgery. In general, the recovery was uneventful. Scalp drains were removed on postoperative day 4 and she was discharged on post operative day 5. Post-surgical orthodontic treatment was completed at post-operative 10 months.

**Conclusion**

Virtual surgical planning and patient specific implant is an invaluable tool in ensuring accurate surgical movements in orthognathic surgery. The precision control of **guided osteotomy cuts** combined with **patient specific fixation plates** allows **fine control of surgical movements, especially advancement, expansion and rotational movements**. Computer planning with patient specific plates has been popularized greatly for orthognathic surgery within the decade and we believe it provides a larger degree of control and accuracy in comparison to conventional methods of pre-bending plates on 3D printed skull models with occlusal wafers and customized arch bars especially in Le Fort III with simultaneous Le Fort I surgeries.

Computer planning also provides the additional benefit of clear visualization with simulated soft tissue outcomes and allows for easier communication of surgical plans and expected outcomes to patients. We would recommend virtual surgical planning and patient specific implants for future Le Fort III with simultaneous Le Fort I surgeries.

**Diagnosis**

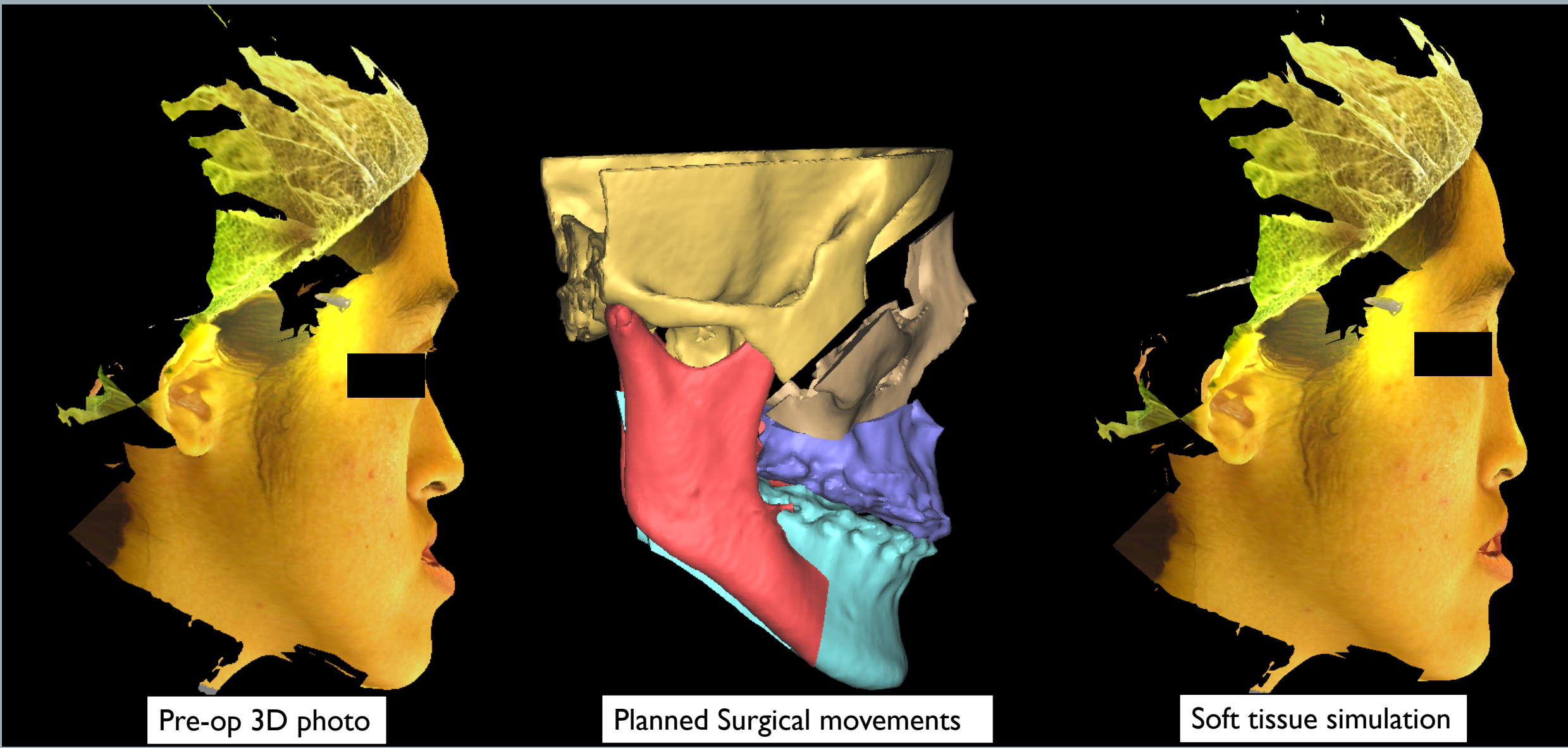
- Zygomatic-maxillary complex hypoplasia in anteroposterior dimension
- Maxillary hypoplasia in transverse dimension
- Mandibular hyperplasia in anteroposterior dimension

**Pre-surgical orthodontics**

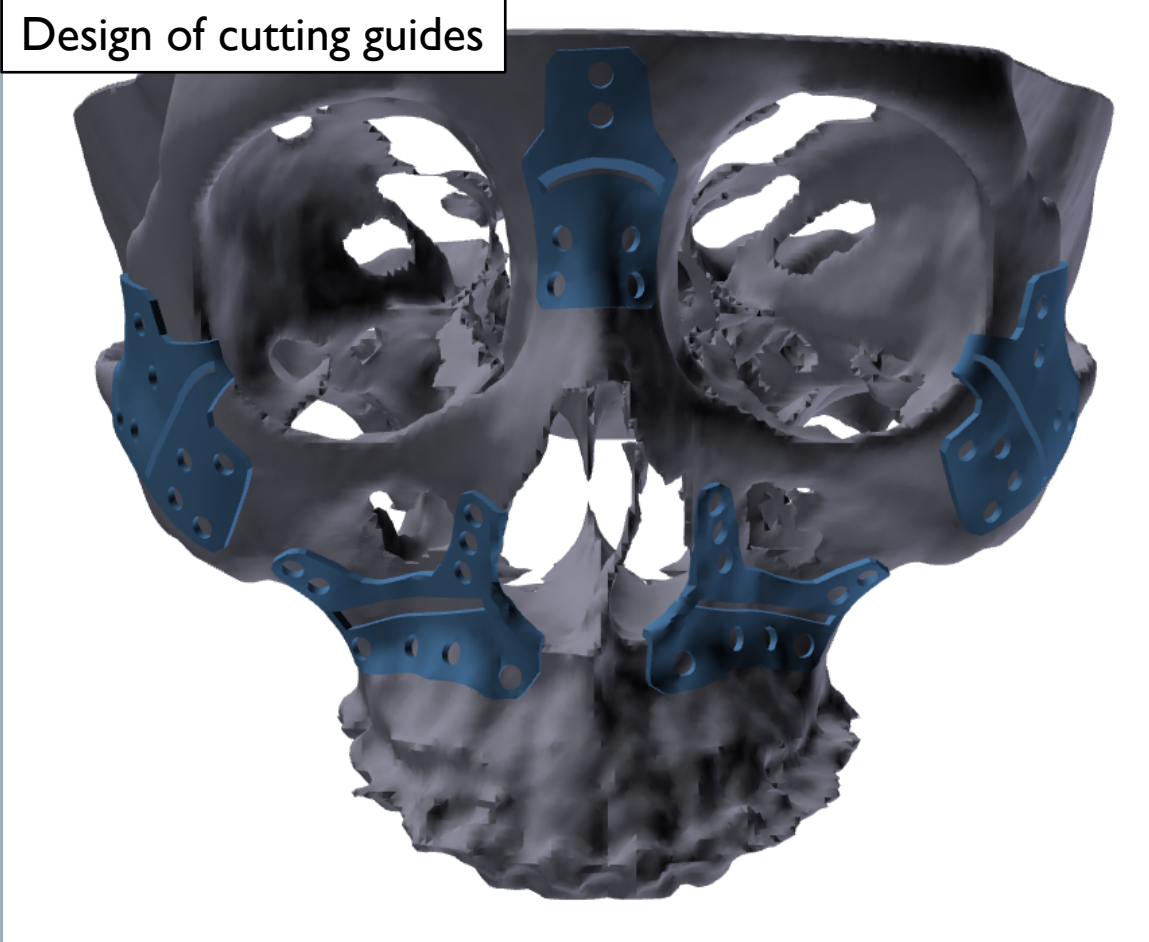
- Upper first premolar extraction
- Retraction of upper incisors to allow more midface surgical advancement and avoid severely acute nasolabial angle.
- Curve of spee leveled
- Mandibular incisor angulation decompensated

**Pre-surgical planning**

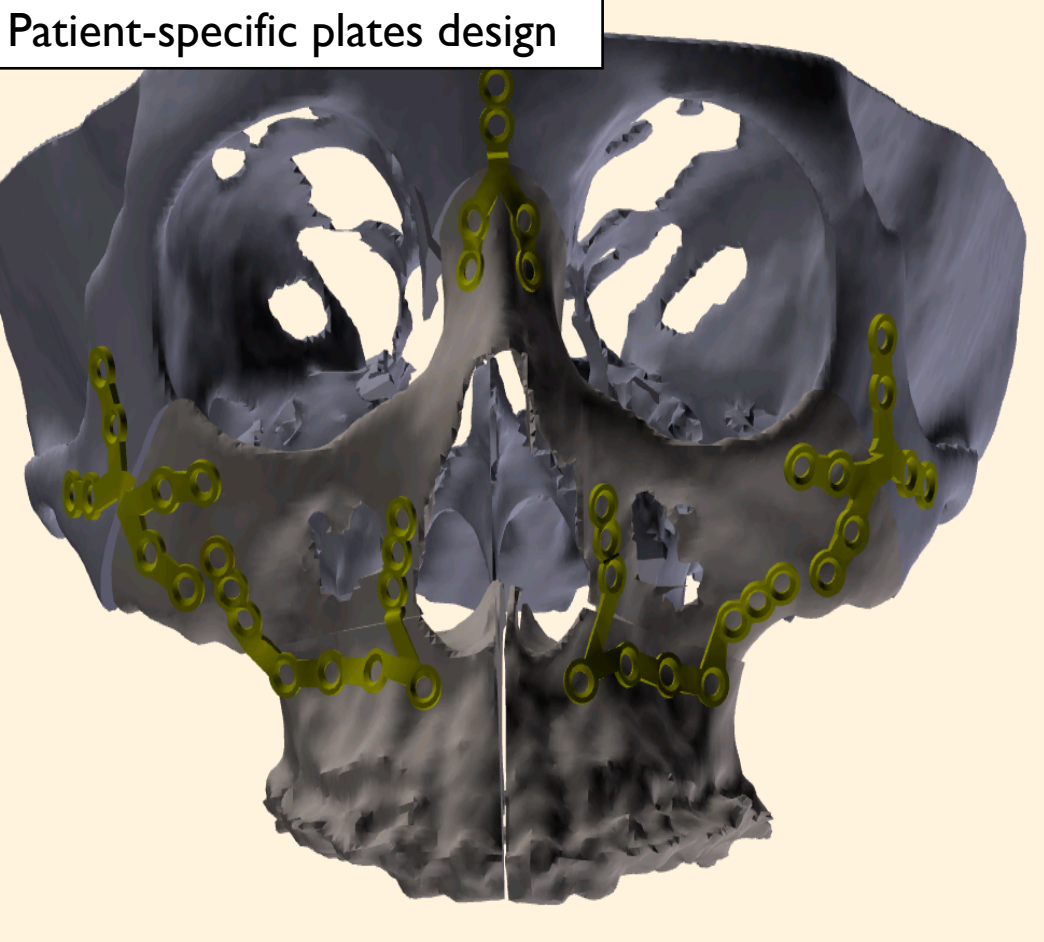
Serial tracing of cephalograms and growth review confirmed skeletal maturity  
Full Skull CBCT, 3D photographs  
Conventional stone casts, model scanning, model surgery



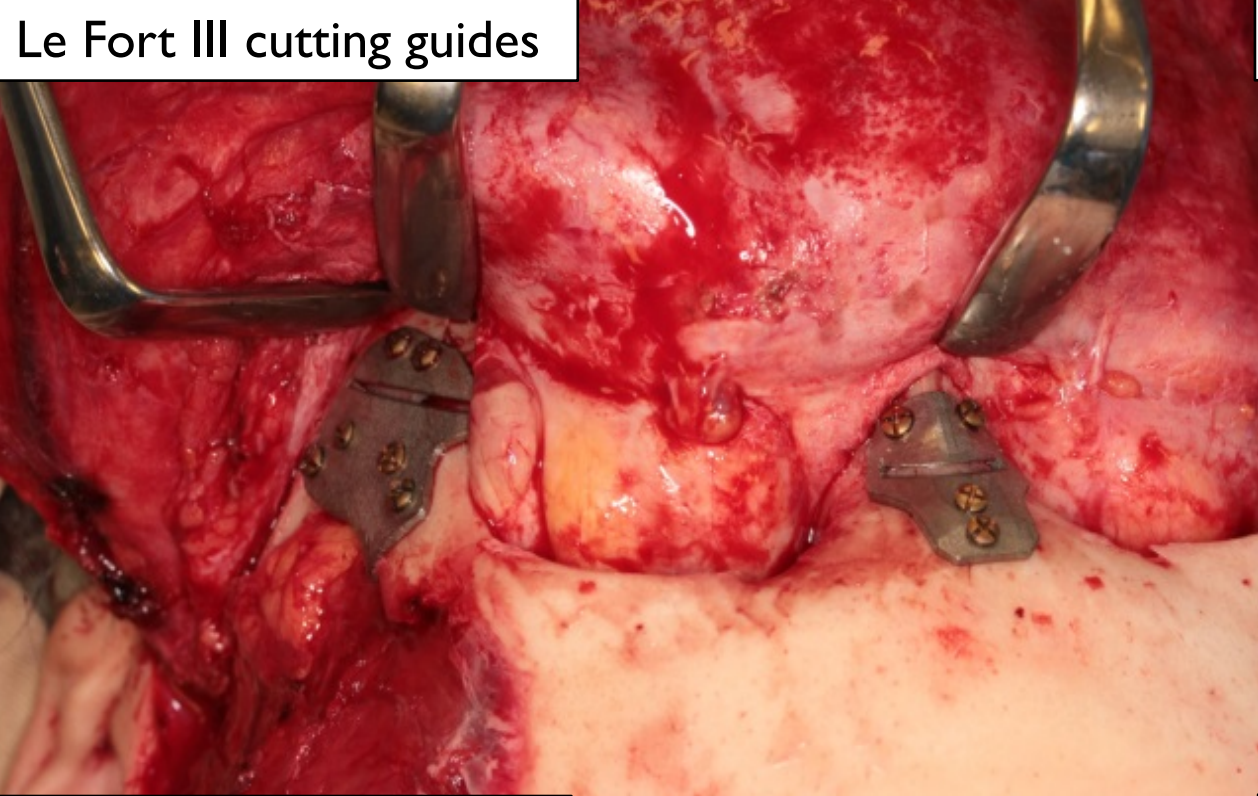
Design of cutting guides



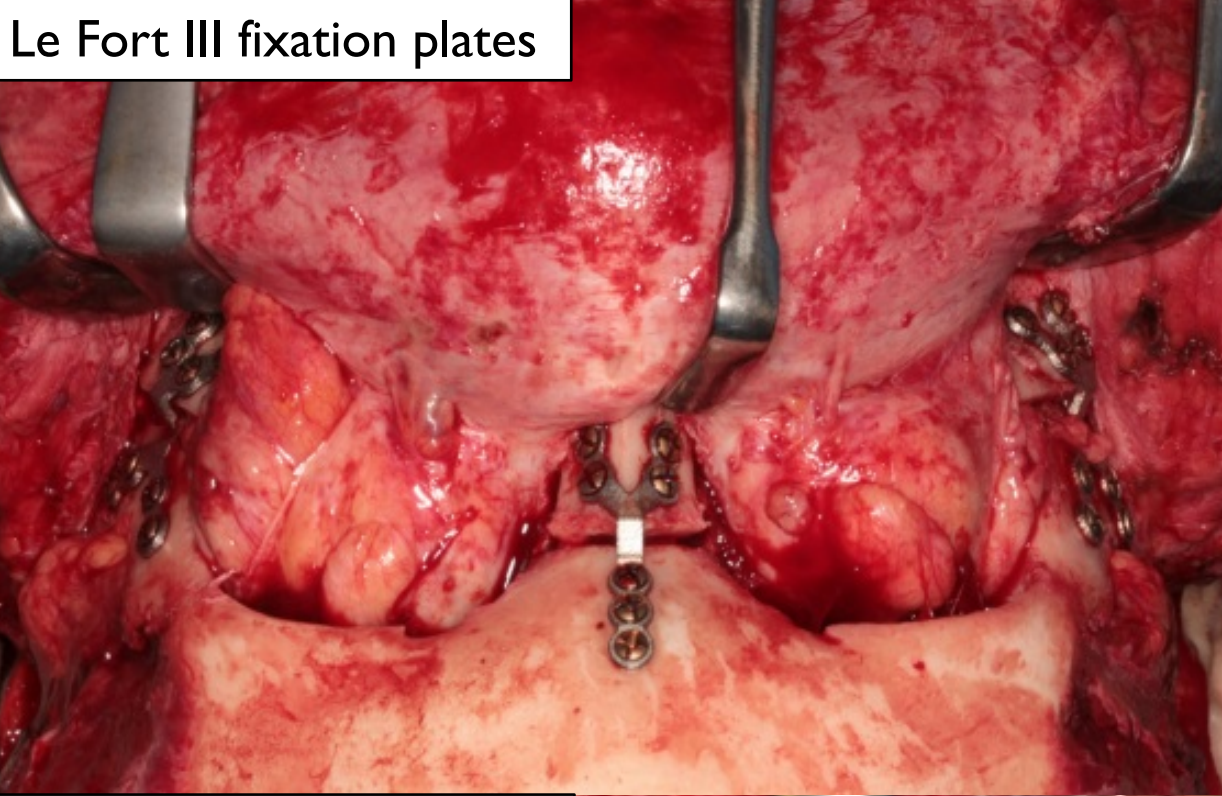
Patient-specific plates design



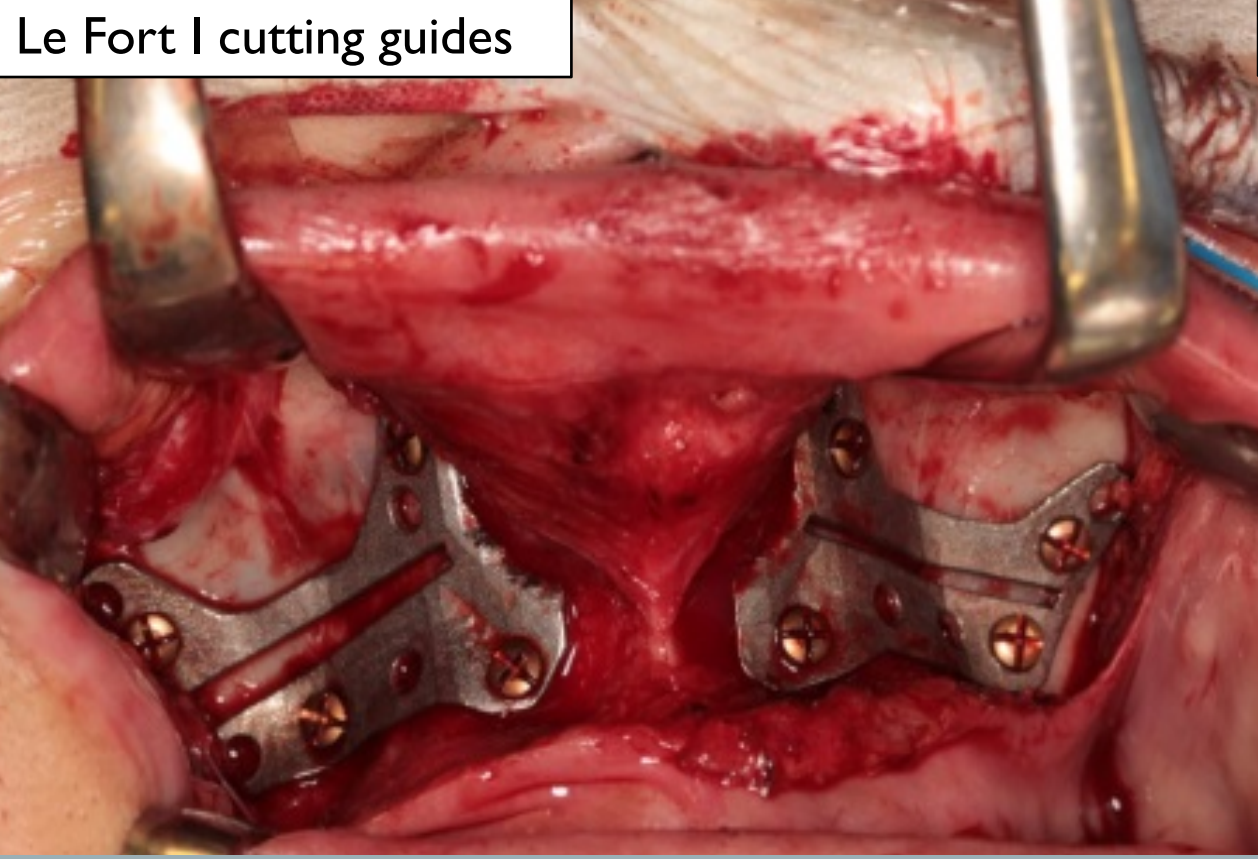
Le Fort III cutting guides



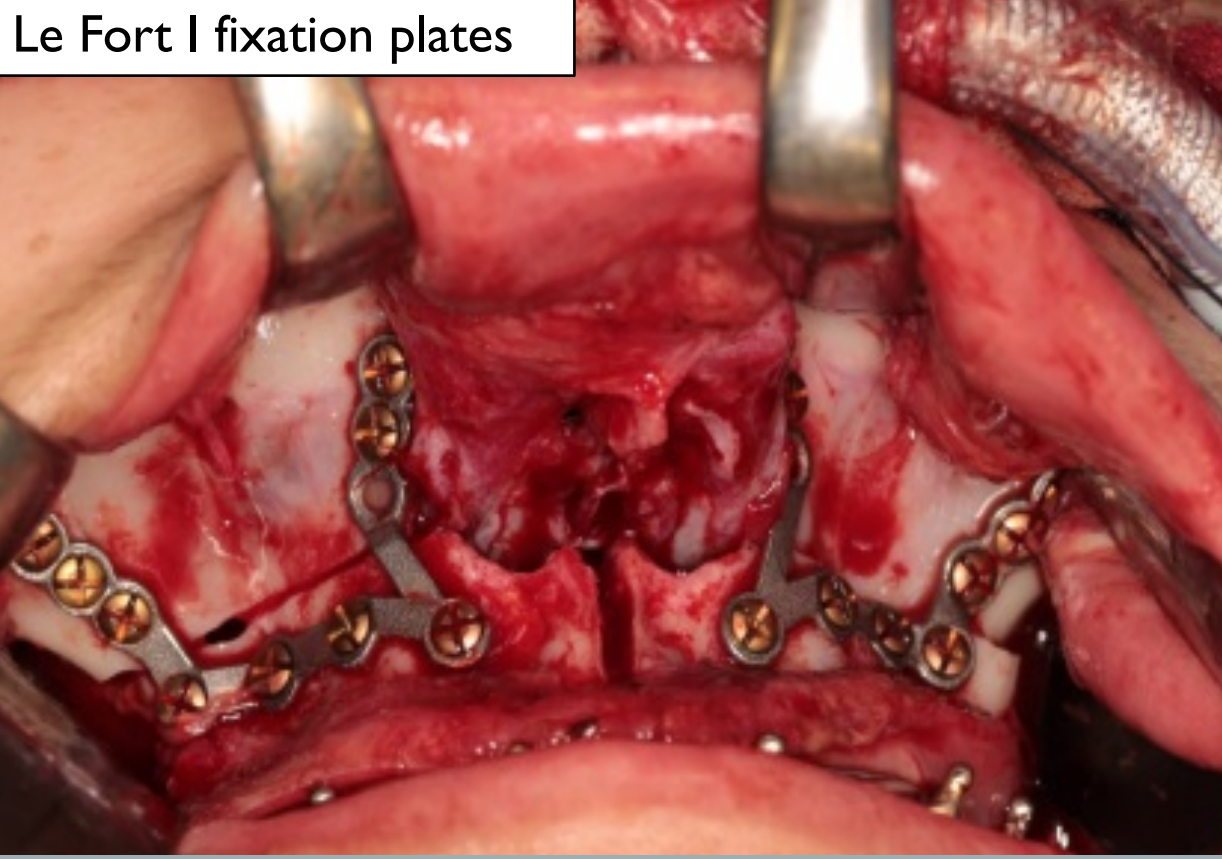
Le Fort III fixation plates



Le Fort I cutting guides



Le Fort I fixation plates



**Accuracy**

CBCT was taken at post operative 10 months and matched to pre-operative computer planning to compare the accuracy of surgical and planned movements. Analysis demonstrated less than **0.6-1.2mm** discrepancy of the nasal bridge, infraorbital rim, zygoma and paranasal region. Area with greater discrepancy corresponds to the positions of fixation plates, as demonstrated in the hot map below.

