

ORTHOGNATHIC WORK INSTRUCTION

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1 Objective

This work instruction aims to give a detailed overview of all steps to be performed in the preparation, planning, and design of an Orthognathic case by a company designer using 3-Matic Medical Materialise software to ensure high quality, standardized, and production process.

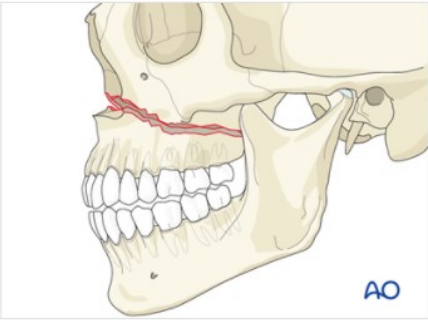
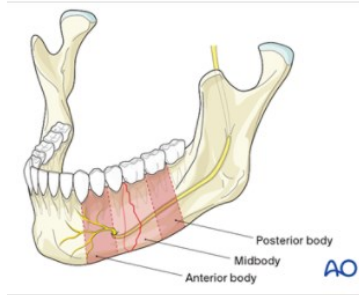
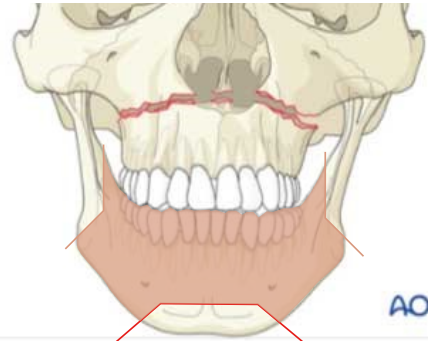
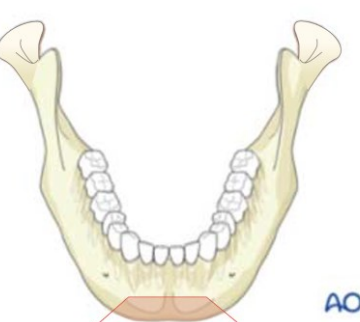
2 Introduction to Orthognathic Surgery – Clinical Background

Orthognathic surgery is a surgery designed to correct conditions of the jaws and face related to bone structure, malocclusion, skeletal deformities, asymmetries, growth, sleep apnea, TMJ disorders, or other orthodontic problems that cannot be easily treated with braces.

There are 4 types of orthognathic surgeries:

- **Maxilla only surgery:** Is only involved the upper jaw
- **Mandible only surgery:** Is only involved the lower jaw
- **Bi-maxillary surgery:** Are involved both jaws.
- **Genioplasty surgery:** Only involved the chin.

Table 1: Types of orthognathic surgeries. Figures Taken from AO Foundation [1].

Maxillary Surgery	Mandible Surgery
 A lateral view of a human skull showing a red line indicating a surgical incision along the upper jaw (maxilla). The AO logo is in the bottom right corner.	 A lateral view of a human skull showing a red shaded area on the lower jaw (mandible). Labels point to the 'Posterior body', 'Midbody', and 'Anterior body' of the mandible. The AO logo is in the bottom right corner.
Bimaxilla Surgery	Genioplasty Surgery
 A frontal view of a human skull showing red lines indicating surgical incisions on both the upper and lower jaws. The AO logo is in the bottom right corner.	 A frontal view of a human skull showing a red shaded area on the chin (genia). The AO logo is in the bottom right corner.

2.1 Standard Osteotomies

The most common Osteotomy in orthognathic cases that are performed in company is the Le Fort I osteotomy, and the Bilateral Sagittal Split Osteotomy (BSSO).

- **Le fort I:** A simple osteotomy line extends from the piriform aperture through the lateral maxillary and lateral nasal walls to the posterior region and often includes a pterygoid plate segment [1].

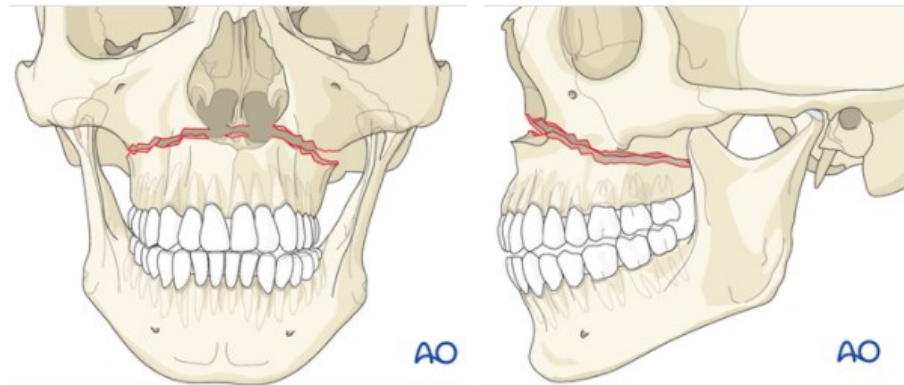


Figure 1 Lefort I Surgery [1].

- **BSSO:** is a type of jaw surgery where the lower jaw is separated and repositioned. The purpose of these cuts is to separate the jaw in such a way that will create a broad overlap of bone between the cut surfaces. A bilateral sagittal split indicates horizontal mandibular excess, deficiency, and/or asymmetry [2].

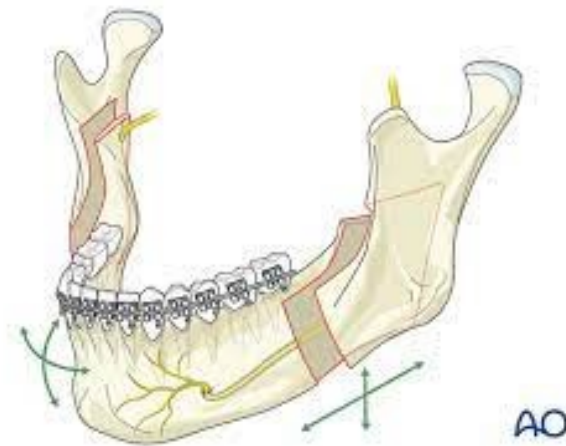


Figure 2 BSSO Surgery [1].

2.2 Other Osteotomies

- **High Le fort I:** A simple fracture modification extends within the rectangular malar region just below the 2 infraorbital foramen and the upper lip [3]. To locate the le fort I cutting plane, it is important to take a distance of 5mm from the roots of the canines and the last molars.

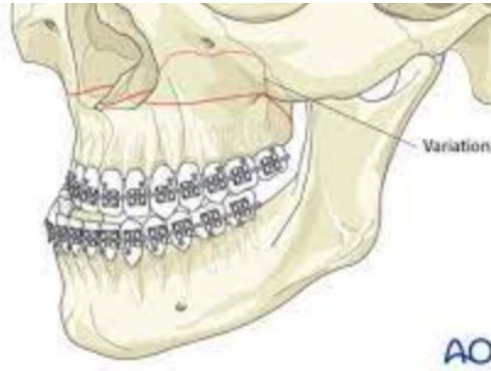


Figure 3 High Le Fort I osteotomy [1].

- **Le fort II:** The Le Fort II osteotomy is also referred to as a pyramidal fracture. It commonly extends from the pterygoid plate through the maxilla, through the nasal orbital ethmoid area, and the nasofrontal bone [1].

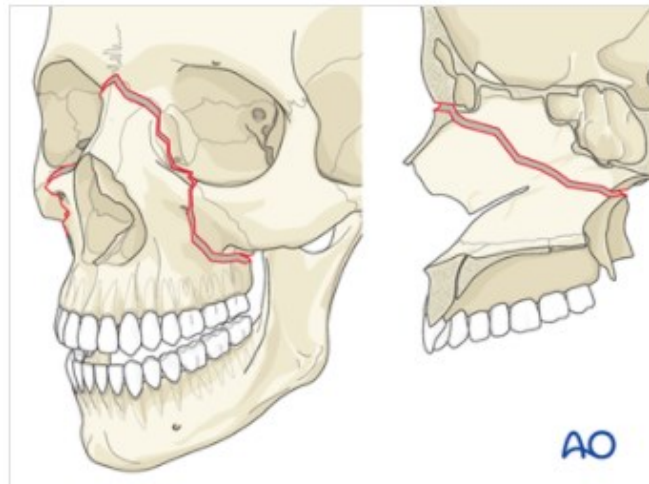


Figure 4 Le Fort II osteotomy [1]

- **Le fort III:** The Le Fort III fracture is also referred to as craniofacial disjunction. The fracture line begins at the frontozygomatic suture along the lateral aspect of the internal orbit along the sphenozygomatic suture line to the inferior orbital fissure, extends medially across the floor of the orbit up the medial wall of the orbit towards the dorsum of the nose where it crosses and proceeds to the opposite side in the same manner [1].

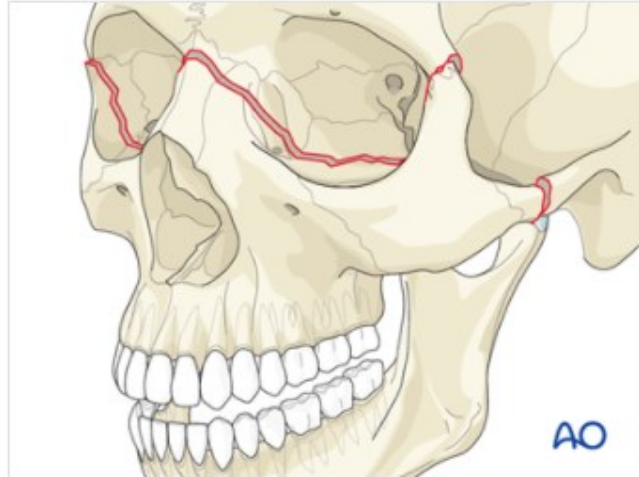


Figure 5 Le Fort III osteotomy [1].

- **Intraoral Vertical Ramus Osteotomy:** IVRO is used in the management of horizontal mandibular excess. Is a procedure whereby full-thickness osteotomies of the rami are performed. When performed bilaterally they divide the mandible into two smaller condyle bearing segments and a large segment consisting of the anterior ramus and mandibular body including the teeth and chin [1].



Figure 6 Intraoral Vertical Ramus Osteotomy (IVRO [1].

- **Inverted-L Osteotomy of Ramus** is a surgical procedure used to correct mandibular prognathism. The horizontal cut was then made above and behind the lingula with the inferior alveolar nerve using a reciprocating saw. Then an oscillating saw was used to complete the vertical cut from the inferior border of the mandible to the previously made horizontal osteotomy of the ramus [4]

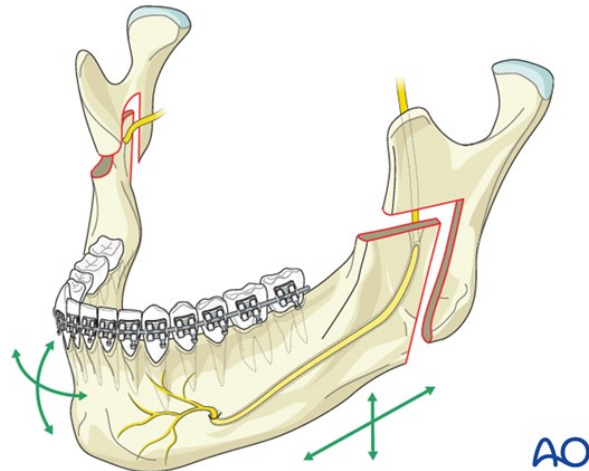


Figure 7 Inverted-L Osteotomy of Ramus [1].

- **Segmentary Subapical osteotomy:** This is a technique for orthognathic surgery used in cases of dentoskeletal malocclusions that cannot be dealt with only by conventional orthodontic treatment. Its use has been focused to achieve occlusal stability through dentoalveolar movement [5].

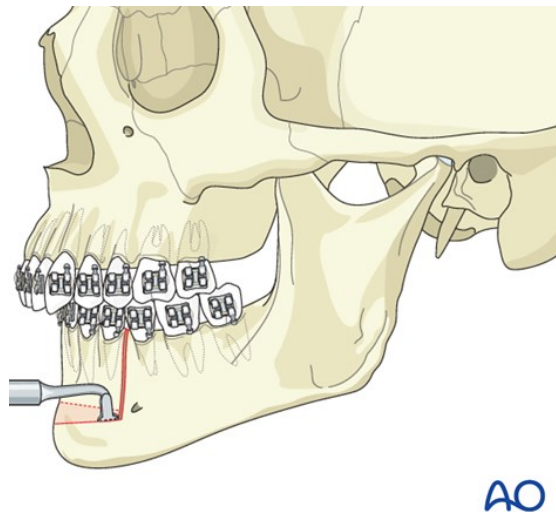


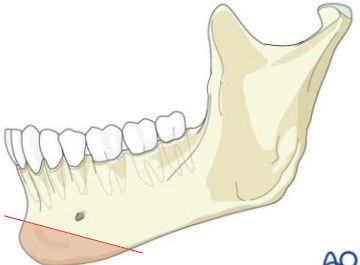
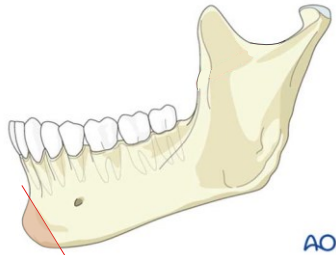
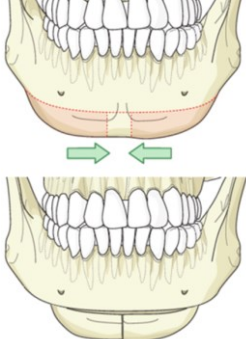
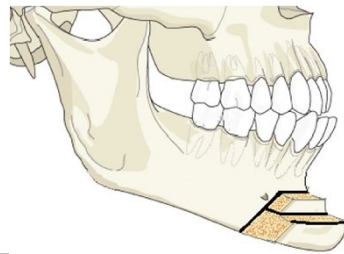
Figure 8 Segmentary subapical osteotomy [1].




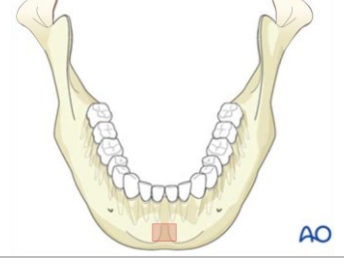
2.3 Genioplasty Osteotomies

Genioplasty is an operation on the chin that uses either an osteotomy or an implant to change the position of the chin [6]. The transverse osteotomy in the genioplasty is made approximately 3 mm below the mental foramina to protect the intraosseous course of the mental nerves and the canine tooth roots. The trajectory of the osteotomy can be varied depending on the type of correction required [7].

The types of genioplasty that you can perform during the surgical planning requested by the specialists are described below:

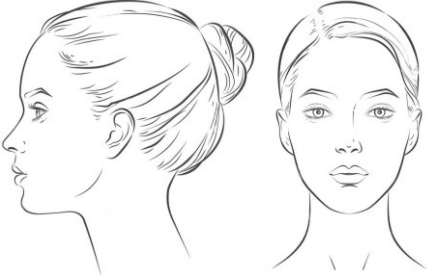
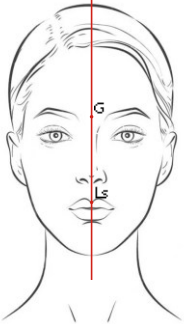
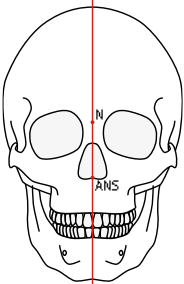
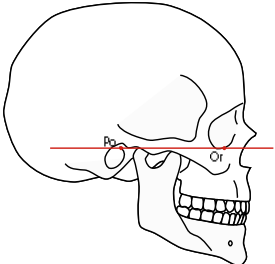
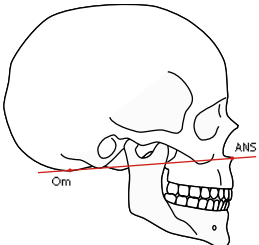
Table 2 Genioplasty osteotomies. Figures Taken from AO Foundation [1].

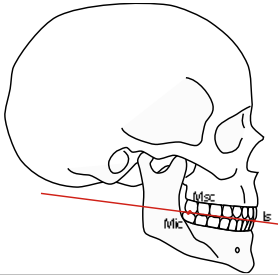
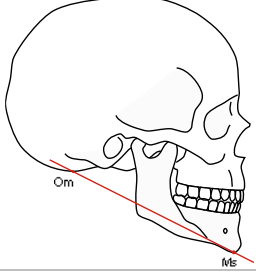
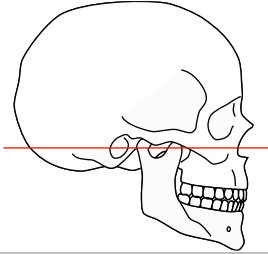
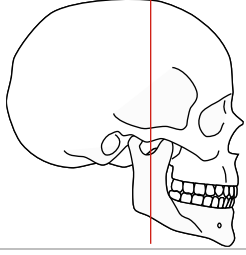
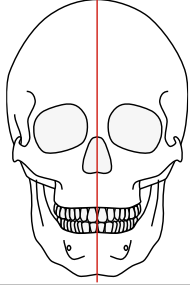
Genioplasty Standard Osteotomy	
Description:	 AO
Reduction	
Description:	 AO
Feminization	
Description:	
More than 10mm advancement	
Description:	

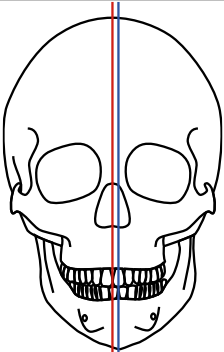
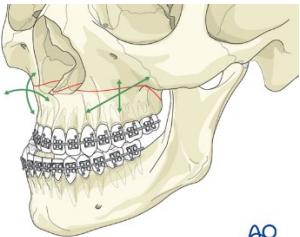
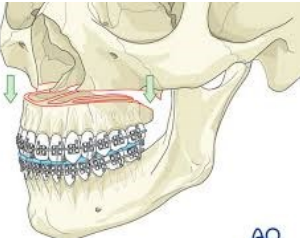
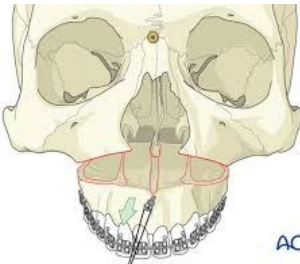
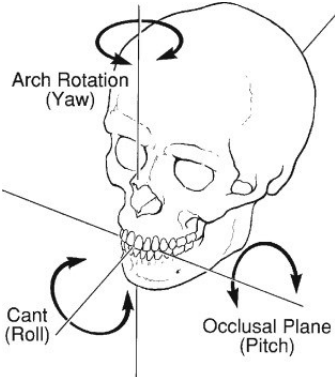
Trapezoidal Cut	
Description:	
S Trapezoidal Cut	
Description:	
Wing osteotomy	
Description:	
Sleep Apnea	
Description:	

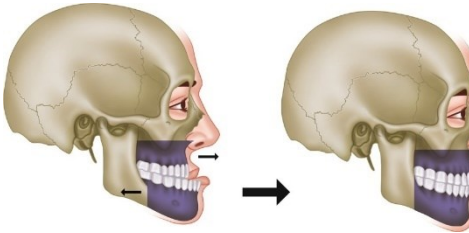
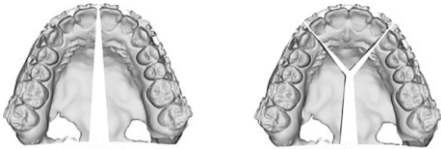
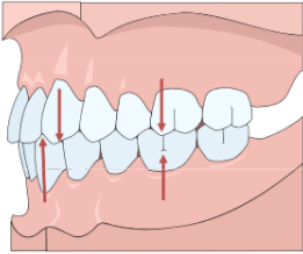
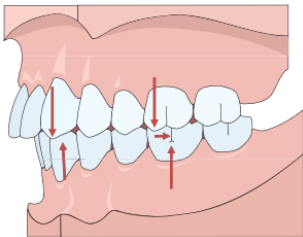
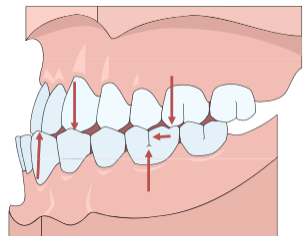
2.4 Orthognathic Terminology

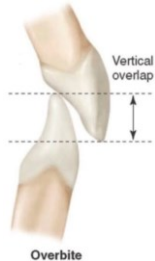

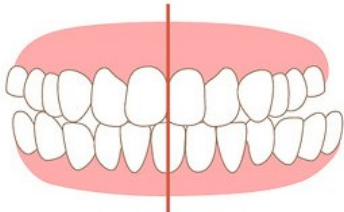


The next table is given a brief description of the most used terms during orthognathic cases.

Term	Description	Example
Neutral head Position	When you are sitting or standing, the head should be balanced directly between your shoulders. The chin should be level and, generally, the gaze of the eyes should be forward.	
Facial midline	It's the line created between the (G) glabella point and the (Ls) labrale superius or the (Pg) Pogonion point.	
Skeleton midline	It's the plane created between the (N) nasion and the (ANS) anterior nasal spine point.	
Frankfurt plane	It's the plane created between the (Po) porion and the (Or) orbital point.	
Maxillary plane	It's the plane created between the (ANS) anterior nasal spine and the (Om) opposition or (PNS) posterior nasal spine	

occlusal plane	It's the plane created between the (IS) Incisor superior point and the (Msc) maxillary first molar central sulcus or (Mic) mandibular first molar central sulcus point	
Mandibular plane	It's the plane created between the (Ms) menton point and the (Om) opposition or the (Go) gonion point	
Axial plane	Any plane that divides the body into superior and inferior parts, roughly perpendicular to the spine.	
Coronal plane	Any vertical plane that divides the body into anterior and posterior (belly and back) sections.	
Sagittal plane	Any plane parallel to midline plane	

Midline correction	It is the correction between the skeleton midline and the facial midline or between the maxillary skeleton midline and the mandibular skeleton midline.	
Impaction	It refers to the upward vertical movement of the maxilla, impaction is the overlapping of these bony tissues	
Disimpaction/ Elongation	Refers to the downward vertical movement of the maxilla, disimpaction is the distance from these bony tissues	
Differential Impaction	It refers to the total distance resulting from the movements made in the maxilla	
Cant Yaw Pitch	This type of movement is done to rotate the maxilla in any of the three axes.	

Advancement and setback	<p>Is the anterior or posterior movement of the maxilla or mandible. These movements are made to correct the profile in the coronal plane.</p> 
Medio Buccal Cusp	<p>A cusp is an elevation or round projection on the surface of a tooth. The mesial cusp refers to the more anterior direction while the buccal refers to the more lateral/outer ones.</p>
Segmented Maxilla	<p>When the maxilla is cut into 2 or more pieces to achieve a better occlusion.</p> 
Class I Occlusion	<p>Class I is a normal relationship between teeth, jaw, and jaw. This is the correct occlusion, and it gives the person a well-balanced profile in the anteroposterior plane.</p> 
Class II Occlusion	<p>occurs when the lower dental arch is posterior to the upper one. In this malocclusion, the upper front and maxillary teeth project more forward than the lower teeth and the jaw. The patient has a convex appearance, with a retracted chin and lower lip.</p> 
Class III Occlusion	<p>is when the lower molars are very forward and do not fit their corresponding upper molars. In this faulty relationship, the lower teeth, and the jaw project more forward than the upper and maxillary teeth.</p> 

	the profile has a concave appearance, with a prominent chin.	
Overbite	The vertical distance between the maxillary incisal tip and the mandibular incisal tip.	 <p>Vertical overlap</p> <p>Overbite</p>
Overjet	The horizontal distance between the maxillary incisal tip and the mandibular incisal tip.	 <p>Horizontal overlap</p> <p>Overjet</p>
Cross-bite	A malocclusion where some of your upper teeth are inside of your lower teeth when you bite down. This malocclusion influences the midline correction.	
"Gummy Smile"	Is a smile that shows an excessive amount of gum under the upper lip. It is a common unaesthetic clinical condition, which can be caused by an abnormal dental eruption, hyperfunction of the upper lip elevator muscle, excessive vertical growth of the maxilla bone, over-eruption of the maxillary anterior teeth, or a combination of the above-described factors.	 <p>Before</p>  <p>After</p>

2.5 Surgical Approach - Orthognathic Surgery

This procedure involves fitting an implant around your natural bone to create a more pronounced, Cuts are typically made inside the mouth, so you must think about the thickness implant and how will be located, when the implant is big the best option is an implant by sections. Generally, the implants are fixed with screws.

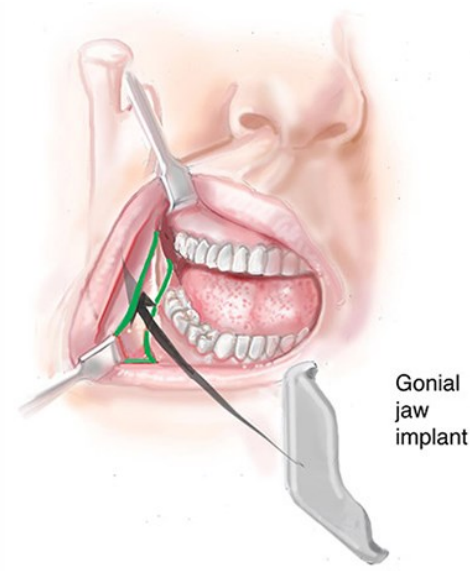


Figure 9 Surgical approach in jaw implant

2.6 Teeth Numbering

The models facilitate the observation of the occlusal and dental relationship of the patients. The adult human being has 32 healthy teeth, and for their dental identification, there are 2 types of nomenclature common in the medical field. The “*Federation Dentaire Internationale nomenclature*” consists of dividing the two jaws, upper and lower, into 4 quadrants from the centerline, between the central incisors backward.

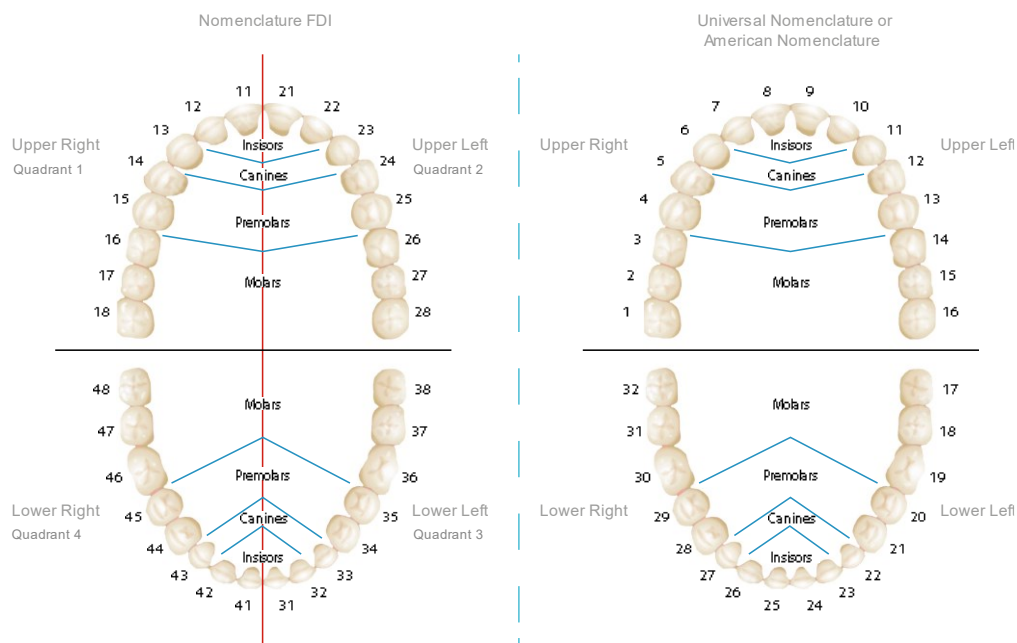


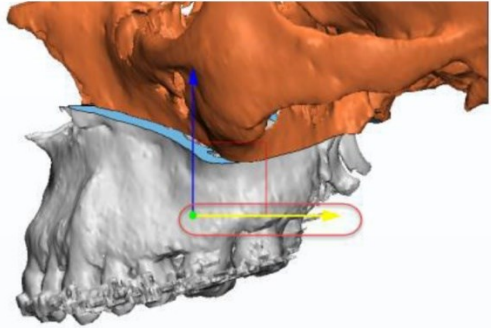
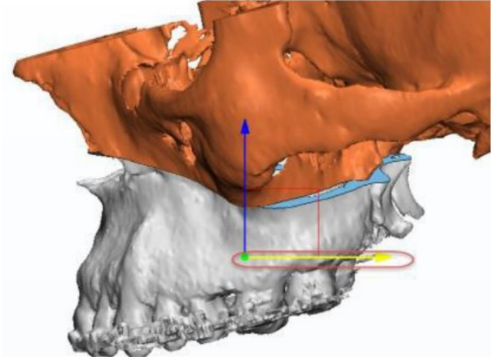
Figure 10 FDI nomenclature and Universal nomenclature

The “*universal nomenclature*” or “*American Nomenclature*” that begins with the number 1 in the upper right third molar and then numbered the piece of the entire upper arch continuously until the third left molar with the number 16, for the lower arch continues with the lower third molar left with number 17 until reaching its contralateral with number 32.

2.7 Cephalometric analysis

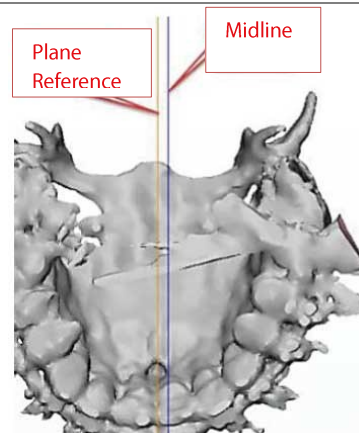
3 3-Matic training focused on orthognathic tools

3.1 Maxillary movements.

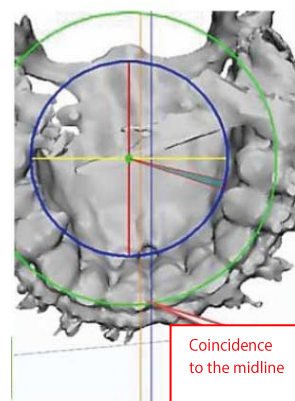
Advance	
Step 1	<p>Use the “interactive translate”, but first active the option “enable snapping” and add the value to move the maxilla. This movement is performed in a lateral view towards the anterior or front of the skull.</p>
	
Regression	
Step 1	<p>Use the “interactive translate”, but first active the option “enable snapping” and add the value to move the maxilla. This movement is performed in the lateral view towards the posterior or behind the skull.</p>
	
Yaw	

This type of movement is performed by rotating the maxilla. This movement is done using the “Interactive rotary” tool from the “Aling” tab. It can be done in a frontal view.

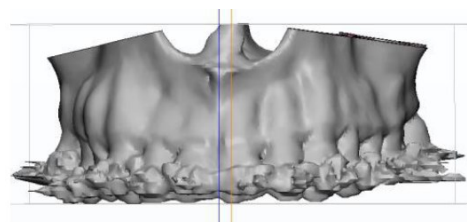
Note *Example: turn to the right side 2mm to match the midline.*



Step 1 Duplicate the original maxilla and create a reference plane in the middle of the 2 incisors Figure 21. With the “Interactive Rotate” tool and in a frontal or caudal view rotate so that the space between the incisors coincides with the midline.



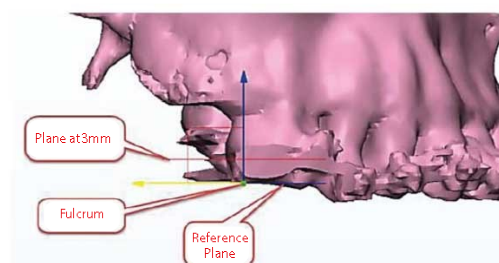
Step 2 Finally, verification is done in a front view.



Pitch

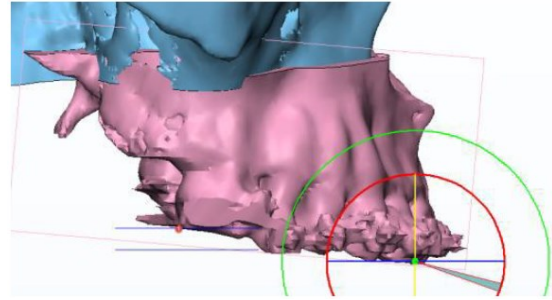
Note *For this movement set a fulcrum point, is generally set by the specialist in the planning process. usually for posterior impaction, the fulcrum point is the edge of the incisor teeth and for anterior impaction, the fulcrum point is the posterior nasal spine.*

Step 1 Duplicate the maxilla and locate it in a lateral view.



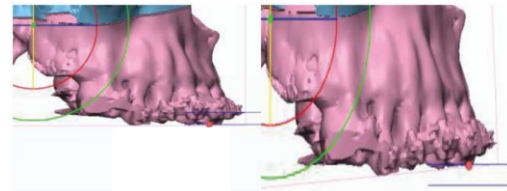
Step 2 Create two XY planes, the first as a reference (the reference at the level

of the molar cusp) at the initial position of the maxilla and the second at the requested Impaction distance. For this case Two examples are proposed, the first will be a 3mm posterior impaction with a fulcrum point in the incisors, the second will be a 3mm anterior impaction with a fulcrum point in the posterior nasal spine.

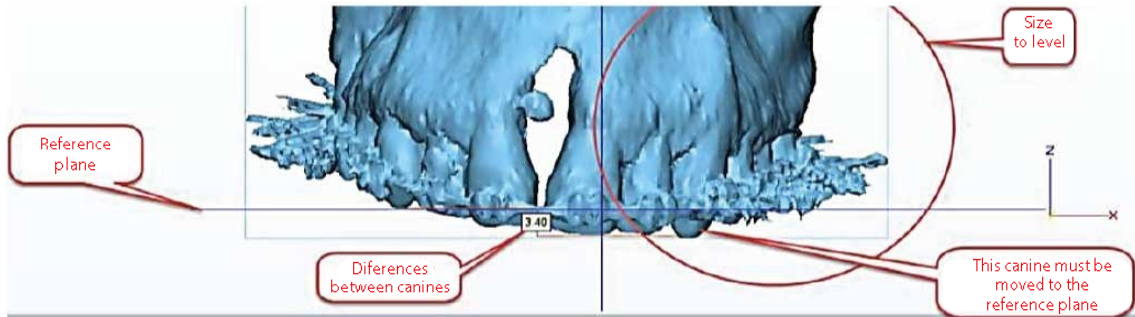


Step 3 The movement can be done with the “Interactive rotate” tool by locating the point of rotation on the edge of the incisor teeth.

Note For anterior impaction, the reference planes should be located on the edges of the incisors and the fulcrum point on the posterior nasal spine.



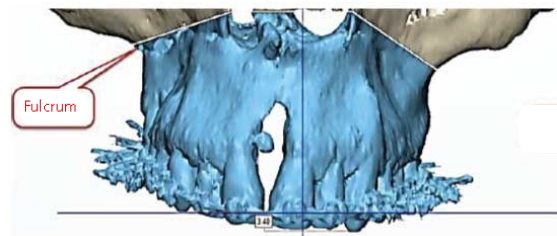
Cant



Note This movement is done by rotating the maxilla in the front view. Use the “interactive translate”, but first active the option “enable snapping” and add the value to move the maxilla.

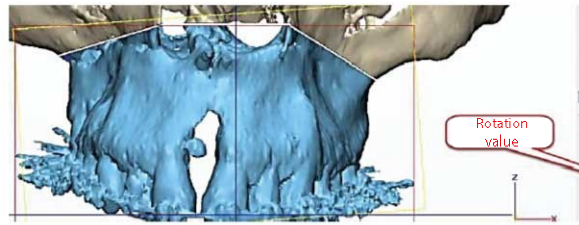
Step 1 Locate the reference plane on the canine opposite the Impaction side, the other canine must be at the same level of the reference plane.

Step 2 Create the top fulcrum point at the opposite corner by selecting the Y direction and placing the origin point at the opposite corner. With the “Create line” tool.



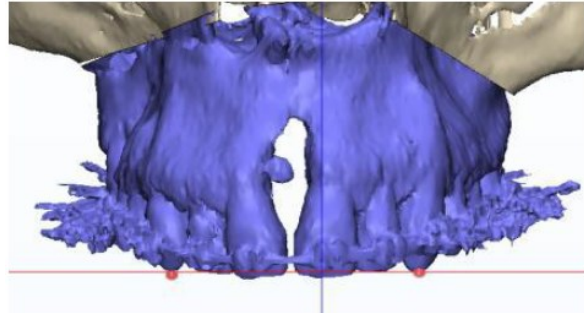
Step 3

With the “Rotate” tool, the angle of rotation is approximated to level the maxilla.



Step 4

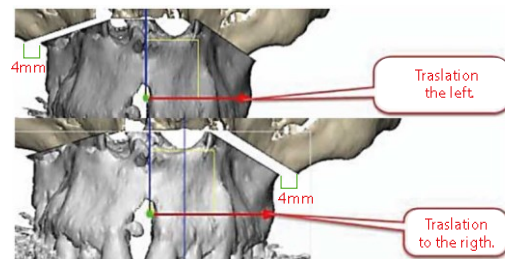
Finally, check with the reference plane that it should be at the same level as the canines, in this example the angle was -6 degrees.



Translation

Note

This movement is performed in the front view towards the right or left direction. Use the “interactive translate”, but first active the option “enable snapping” and add the value to move the maxilla.

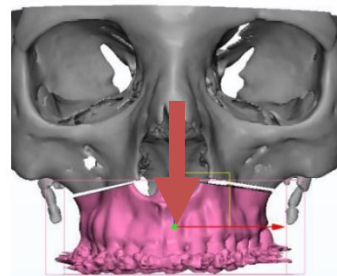
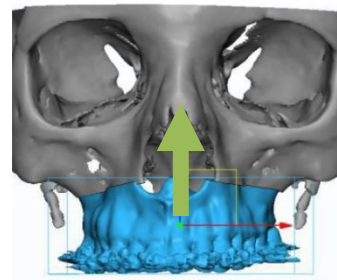


Impaction / Descent

It is like the translation, but you move the maxilla towards up or down

Note

Use the “interactive translate”, but first active the option “enable snapping” and add the value to move the maxilla.



3.2 Perform the planning with the surgeon.

Step I: The first step is to ask the surgeon which midline is going to work, with the skeletal or facial midline.

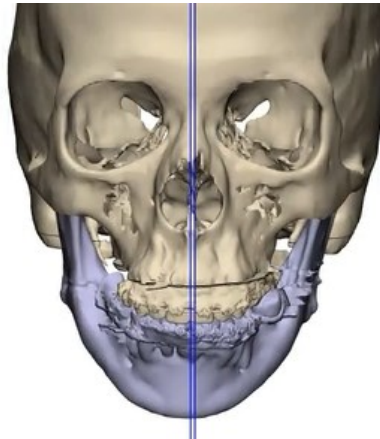


Figure 11 Select the midline to work.

Step II: You must measure the cant of the maxilla from the canines and the first molars to the Frankfurt plane.

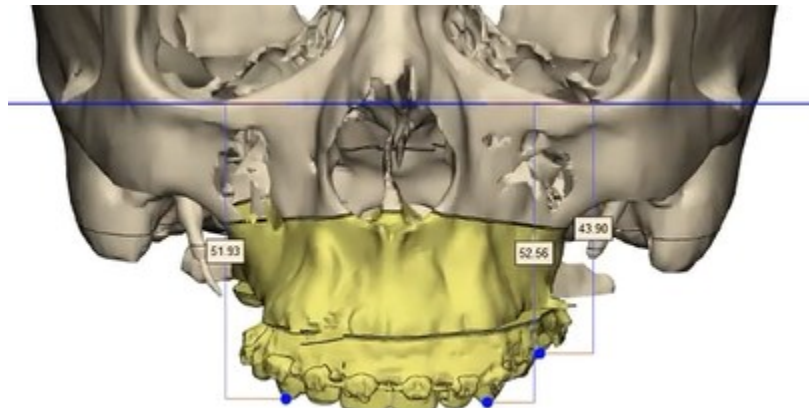


Figure 12 Measure the cant

Step III: Ask the surgeon what the first movement is to perform. For this case, the first movement is the advance of the maxilla. Use the “*Interactive translate*” tool with translation step= the measure requested by the surgeon (4.0mm).

Step IV: Ask the surgeon where the fulcrum will be located for the pitch. for this case, the fulcrum will be located on the Is (incisor superior) point, and you can perform the rotation. Create two axial planes: the first is located on molar 15 and the second plane is translated to the extent requested by the surgeon. Then, use the “*interactive rotate*” tool and rotate

the required until the molar touches the second plane. Finally, impaction until the maxilla touches the skull.

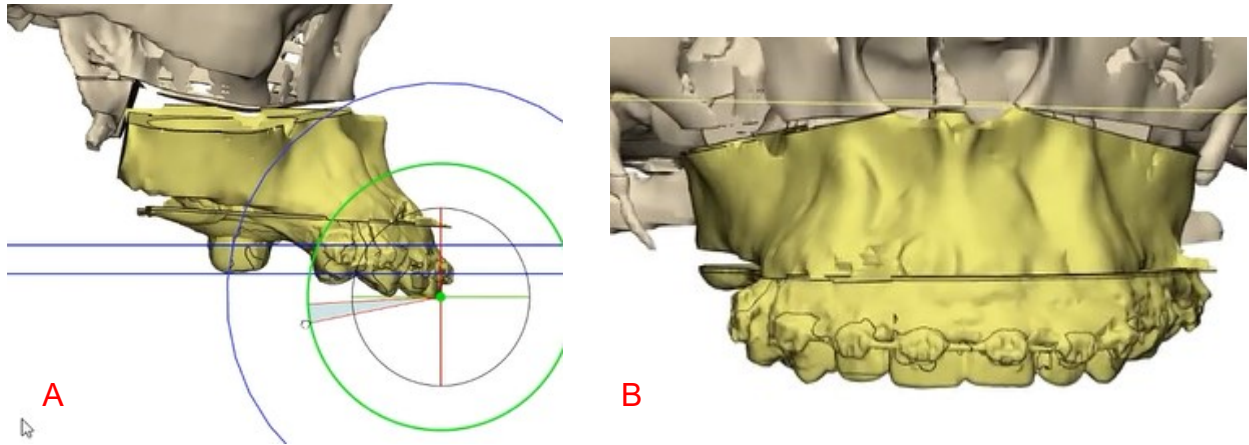


Figure 13 Advance and pitch the maxilla

Step V: You must evaluate the occlusion with the surgeon, review the overjet and overbite, the midline, and the cant. For this step, you can use the “*interactive translate*” and “*interactive rotate*” tools.

Step VI: Use “*interactive rotate*” to move the ramus, you must locate the fulcrum on the maxillary condyle.

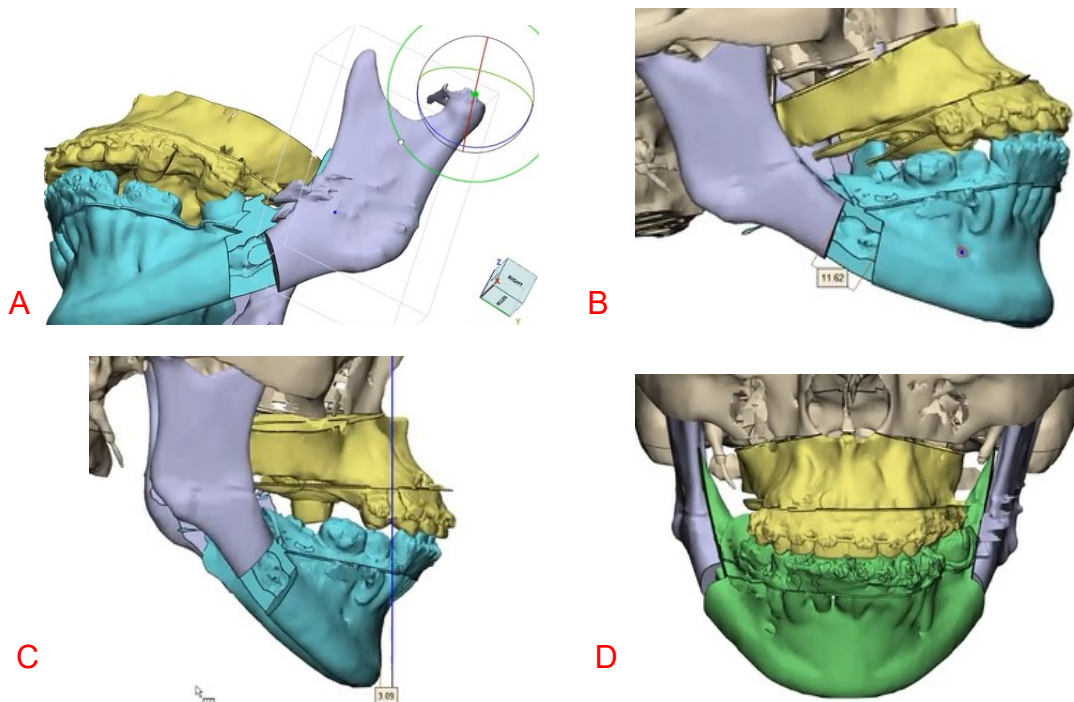


Figure 14 A) Move the ramus. B) Measure the differential distance. C) Measure the pogonion respect coronal plane. D) Resulting movements.

Step VII: Use the “trim” tool to cut the chin with the trimming method= preserve the inner and outer. Then, hide the mandibular occlusion and select the cutting surface click-right → separate → copy to part → create new.

Step VIII: Use the “Extend surface” tool with distance= 3.0mm, select both surfaces, click-right → merge.

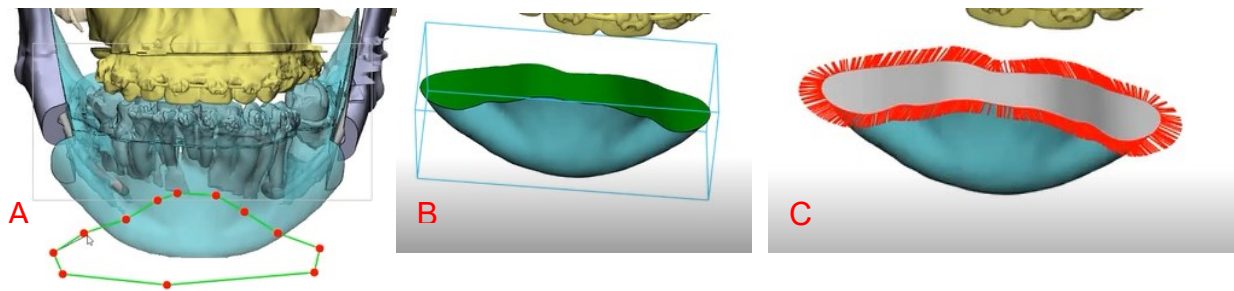


Figure 15 A) Trim. B) Select the cutting surface. C) Extend surface

Step IX: select the cutting surface and use the "move surface" tool to create the blade thickness =0.3 or 0.5mm

Step X: Use “Boolean subtraction” to cut the mandible.

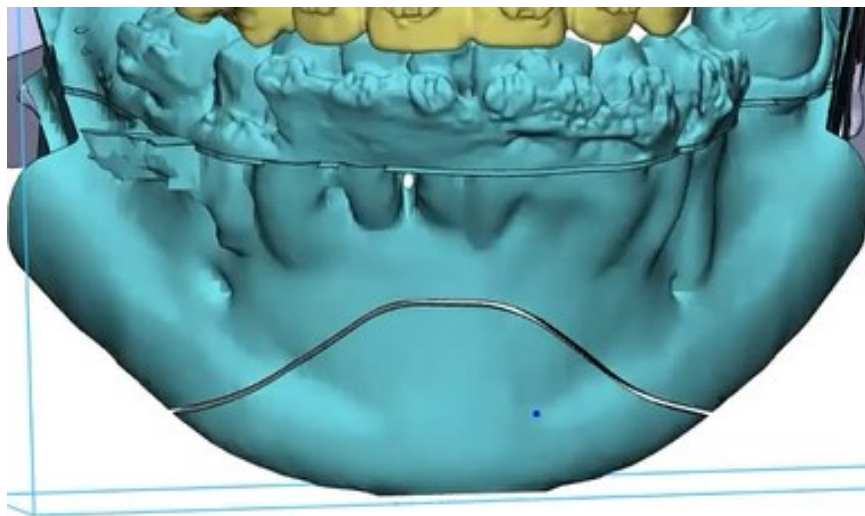


Figure 16 Chin cut result

Step XI: Finally, move the chin= 4.0mm to align concerning the coronal plane as shown in the figure.

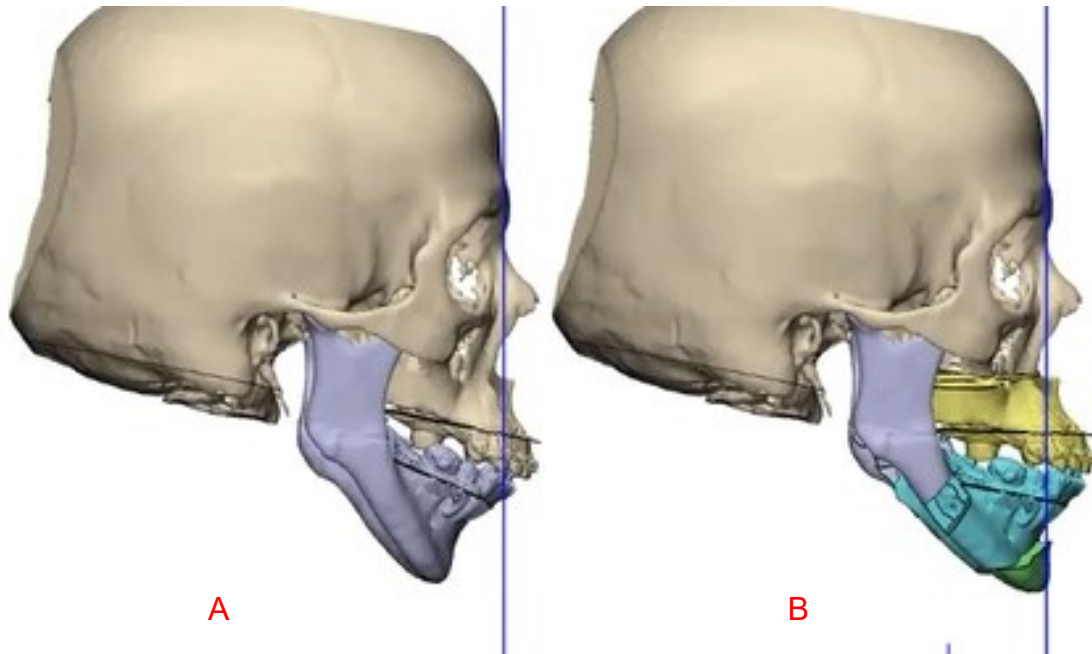


Figure 17 pre-operative state B) Post-operative planning

Step XII: Ask the surgeon how many devices are requested to design (splints, cutting guides, etc). Ask him if he is going to perform mandible first or maxilla first. Also, ask for the date of surgery and schedule a delivery date for the devices.

Step XIII: Save the file as TDS-code.

Step XIV: Use the "Fix Wizard" until the items come into view green to avoid problems.

3.3 Create the medical devices

3.3.1 splints:

Step I: create a "New Sketch" about the molars. Then, import the maxilla to the sketch, select the contour of the teeth and use the "offset" tool with 0.3mm. Select the contour and click on the parameters as construction line.

Step II: Go to the sketch and "create spline" for the contour of the dental tray (taking at least 5 teeth, including the canine) as shown in the figure.

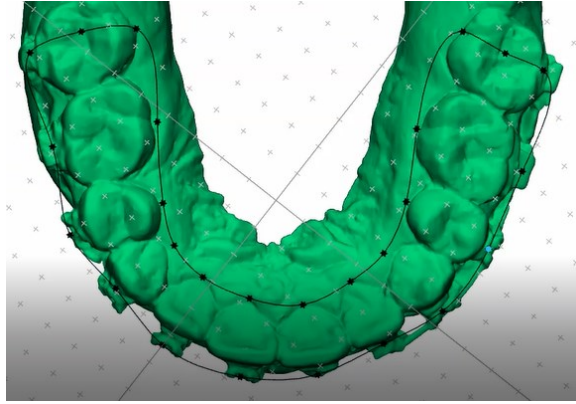


Figure 18 Create a spline

Step III: “*Extrude*” =1.5mm in both directions and try not to touch the brackets (3.00mm).

Note: If need, you can rotate and translate the splint to involve all teeth.

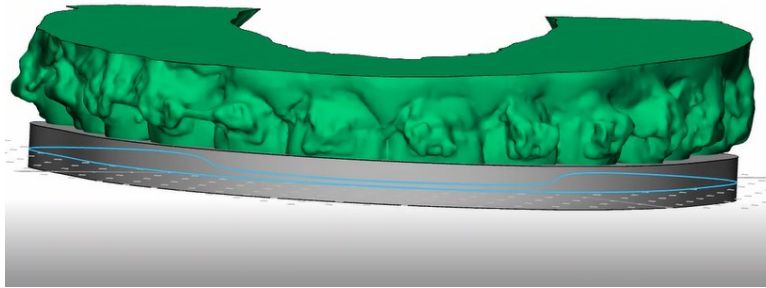


Figure 19 Create polysurface

Step IV: Use “*Fillet*” and select both contours with 0.5mm.

Step V: Use the “*trim*” to cut the unnecessary parts of the splints. Then, select all surfaces, click-right → merge.

Note: For this case, it is necessary duplicate the splint and trim for involve the molars teeth. As show in the figure.

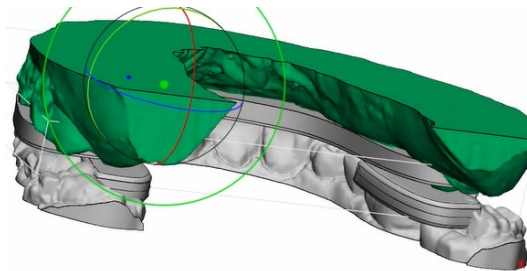


Figure 20. Add polysurfaces to the molars teeth

Step V: Use “*Improve mesh*” with a minimum edge height = 20.0, select “*Smooth*” with a smooth factor = 0.8, and apply the “*Smooth*” tool until you have a suitable surface shape.

Step XII: Use “*Fillet*” and select both contours with 0.5mm.

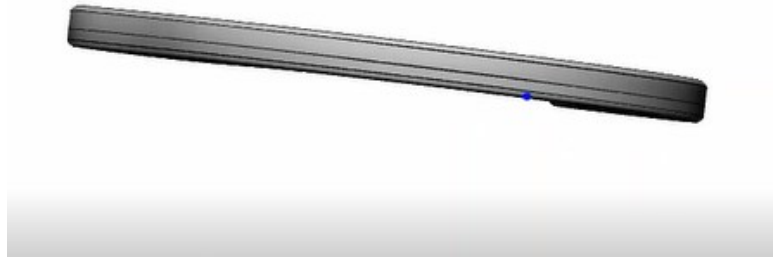


Figure 21 fillet contours

Note: sometimes the operation generates problems, for this use subdivide, improve mesh, and finally use smooth edge with 0.5mm.

Step VII: Use the “Boolean union” tool with polysurfaces as show in the picture.

Step VIII: Use “Wrap” to Gap clousing =10.0mm, and merge.



Figure 22 Boolean union and wrap results.

Note: Verify that the thickness cannot be less than 2.00mm.

Step XII: Use the “Boolean subtraction” tool to rest tooth surfaces.

Step XIII: Click in the “undercut” tool, then select the normal of the surface according to the input direction to use the splint. Repeat with the mandibular arch.

Step XIV: Duplicate the implant and use the “*Quick label*” to mark implants with the TDS code and right and left ubication.

Note: By company standard, the arches must have a 0.1mm wrap to perform the subtraction and allow the fit.

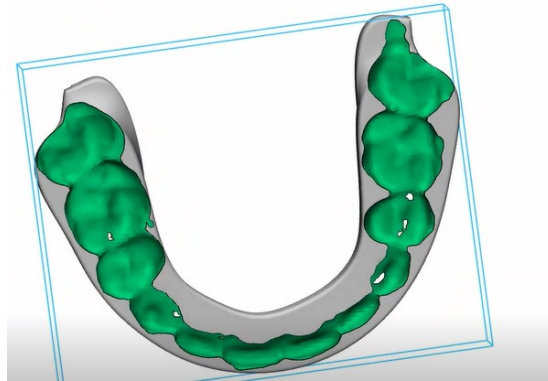


Figure 23 Boolean subtraction and undercut results.

Step XIV: Duplicate the implant and use the “Quick label” to mark implants with the TDS code and right and left location.



Figure 24 Mark the splint.

Step XXII: Use the “Fix Wizard” until the items come into view green to avoid problems in the manufacturing process.

Step XXIII: Save the file as TDS-code, and then, click on “file” → export → STL.

3.3.2 Intermediate splint

To make the intermediate splints, you must return the arch to its initial position, which is going to be moved last.

Step I: you must rotate the mandible, but for this movement use the “create a line” tool, an axis must be created between the two condyles. Use the “rotate” tool to select the entities mandible arch, the left and right ramus. Then in the parameters, select method= around the line and put angle= 0.3° click on apply until the suitable move.

Step II: create a “New Sketch” about the molars of the upper and lower arch. Then, import the maxilla to the sketch.

Step III: Go to the sketch and “*create spline*” for the contour of the dental tray (taking at least 5 teeth, including the canine) as shown in the figure.

Step IV: “*Extrude*” 1.5mm both directions and try not to touch the brackets (3.00mm).

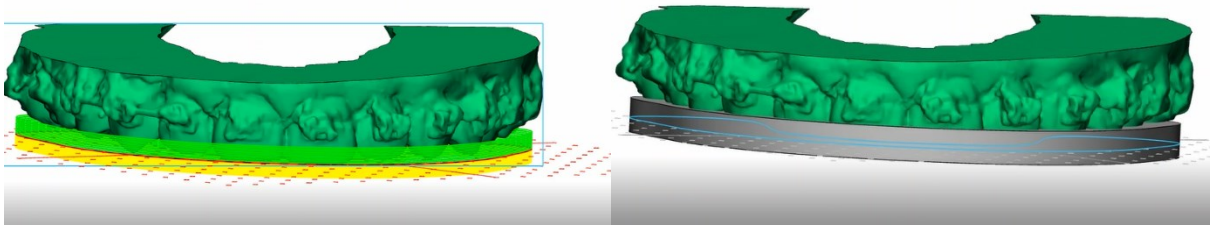


Figure 25 Extrude in both directions.

Note: If need, you can rotate and translate the splint to involve all teeth.

Step V: Repeat the step II, III and IV for the lower arch.

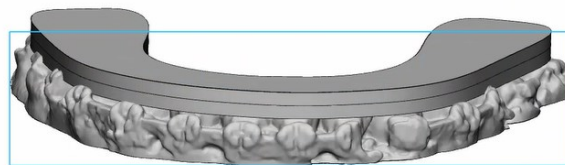


Figure 26 Lower arch splint

Note: For this case, it is necessary duplicate the lower splint and trim for involve the molars teeth. As show in the figure.

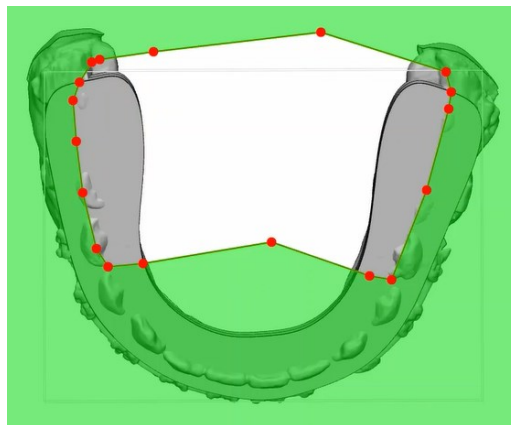


Figure 27 Trim to molars teeth

Step VI: Use “*Fillet*” and select both contours with 0.5mm.

Step VII: Use the “Boolean union” tool with polysurfaces as show in the picture.

Step VIII: Use “Wrap” to Gap clousing =10.0mm, and merge.

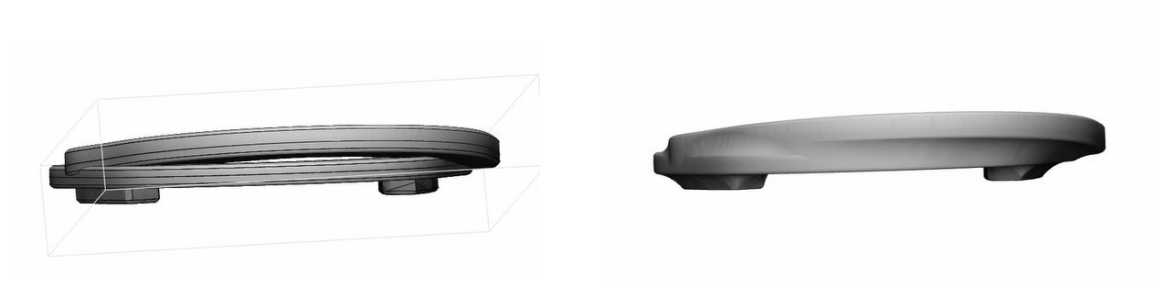
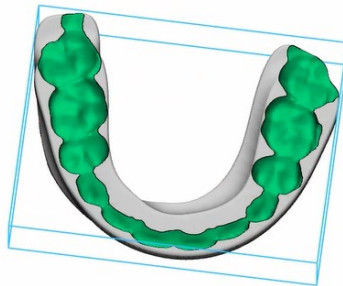


Figure 28 Boolean union, and wrap

Step IX: Use the “Fix Wizard” until the items come into view green to avoid problems in the manufacturing process.

Step X: Use the “Boolean subtraction” tool to rest tooth surfaces.



Step XIII: Click in the “undercut” tool, then select the normal of the surface according to the input direction to use the splint. Repeat with the mandibular arch.

Step XIV: Duplicate the implant and use the “Quick label” to mark implants with the TDS code and right and left ubication.



Figure 29 Label the intermediate splint

Step XXII: Use the “Fix Wizard” until the items come into view green to avoid problems in the manufacturing process.

Step XXIII: Save the file as TDS-code, and then, click on “file” → export → STL.

3.3.3 Surgical guide with splints:

Step I: create a “New Sketch” about the molars. Go to the sketch and create a “spline line” for the contour of the dental tray (taking at least 5 teeth, including the canine) as shown in the figure.

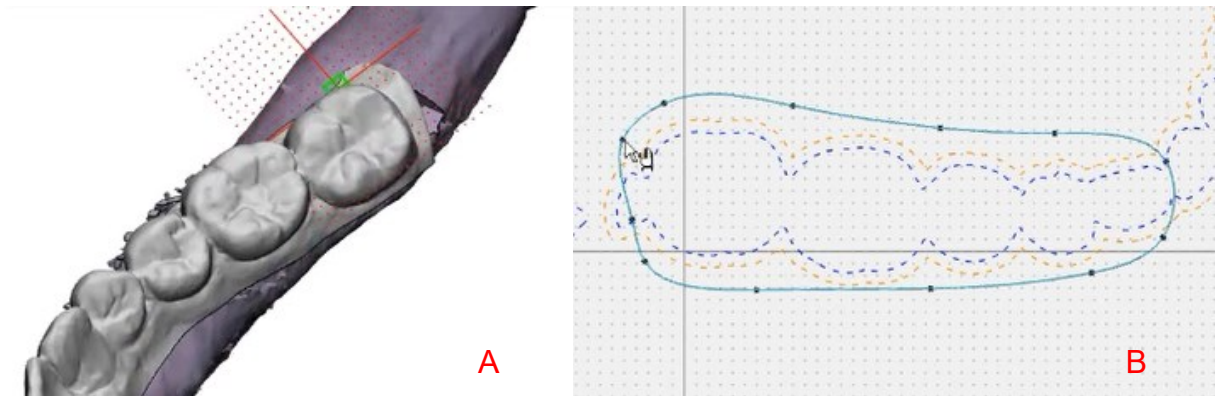


Figure 23. A) New Sketch. B) Spline contour.

Step II: Use the "extrude" tool, select the outline of the splint, and extrude 5mm. Then, Use the "extrude" tool, select the splint outline, and extrude 5mm, then use fillet and select the splint outlines with a 0.5mm fillet.

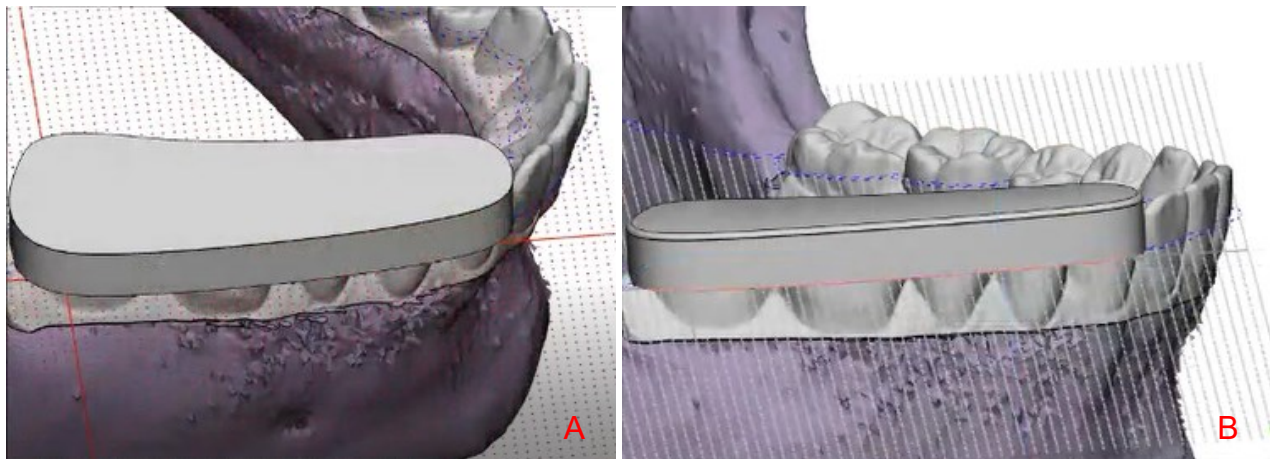


Figure 24. A) Extrude the splint. B) fillet.

Step III: Finally use “Boolean Subtraction” to subtract the teeth in the splint.

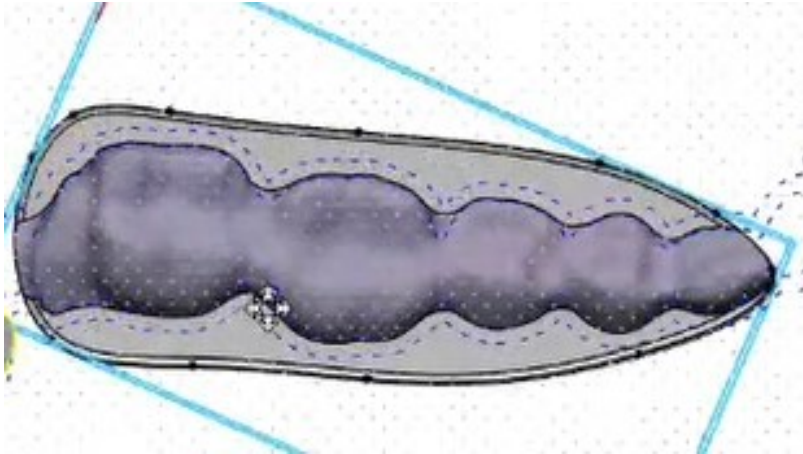


Figure 25. Ferule

Step IV: Create a cut plane with the "create datum plane" tool then click on "Cut" between the plane and the jaw. then select the surface resulting from the cut on the mandible, right-click separate →copy to part →create new.

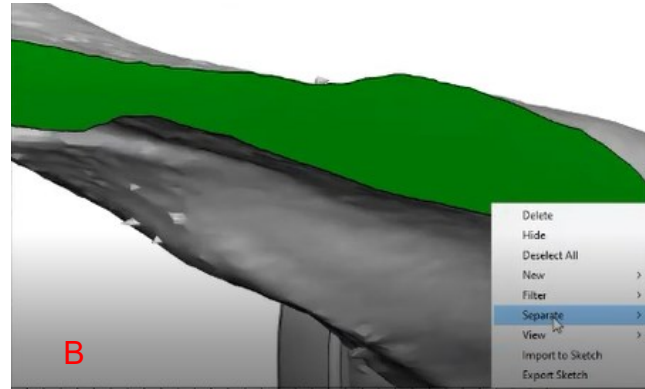
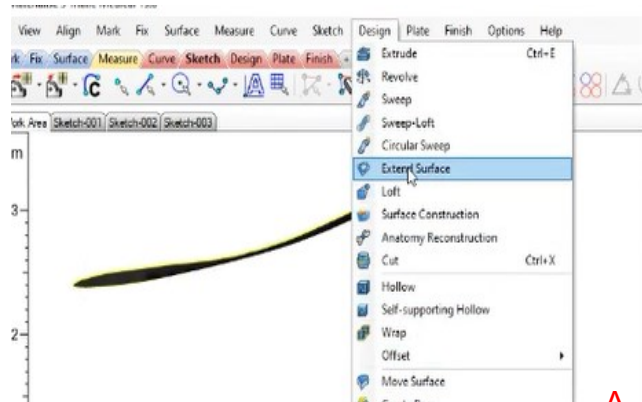
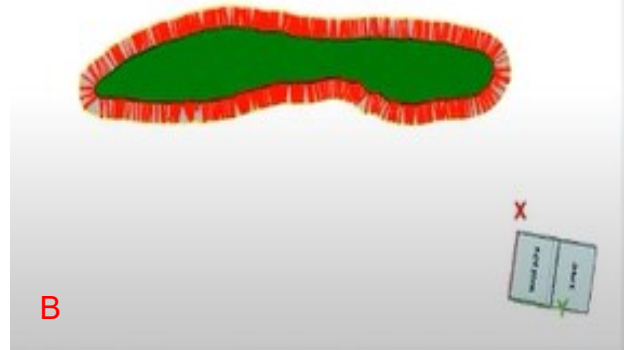


Figure 26. A) Create a new datum plane. B) Separate the surface.

Step V: Select the surface and click "extend surface" with 2,5mm as shown below.



A



B

Figure 27. Extend surface

Step VI: Hide the bone element to be removed and the pieces that are not currently required for the design of the guide. Make a wrap with an offset value of 0.1mm to the mandible.

Step VII: Select the "Wave brush mark" tool to select the surface of the cutting guide. Then right-click on the surface →separate →copy to part →create new.

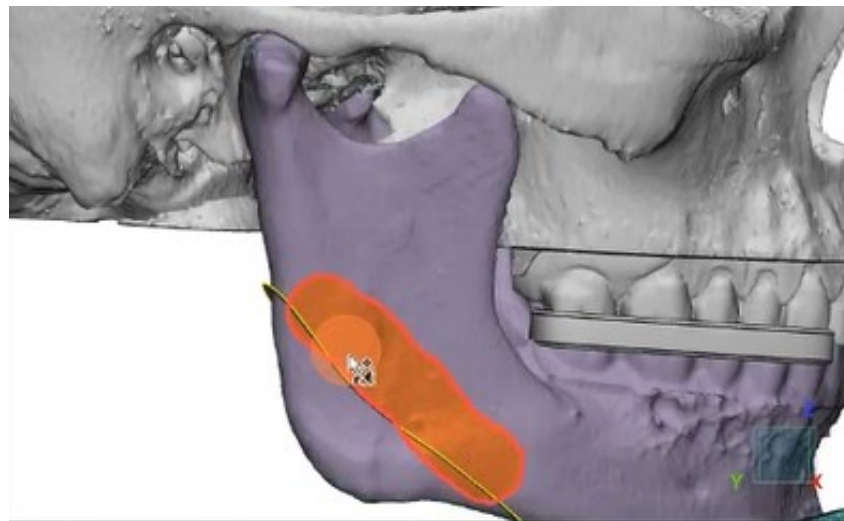


Figure 28. Wave brush Mark.

Step VIII: Select the "create a base" tool with a thickness of 2.5mm to generate the poly-surface of the cutting guide. Then select the surface of the bone cut and use the "move surface" tool to create the flange for guide.

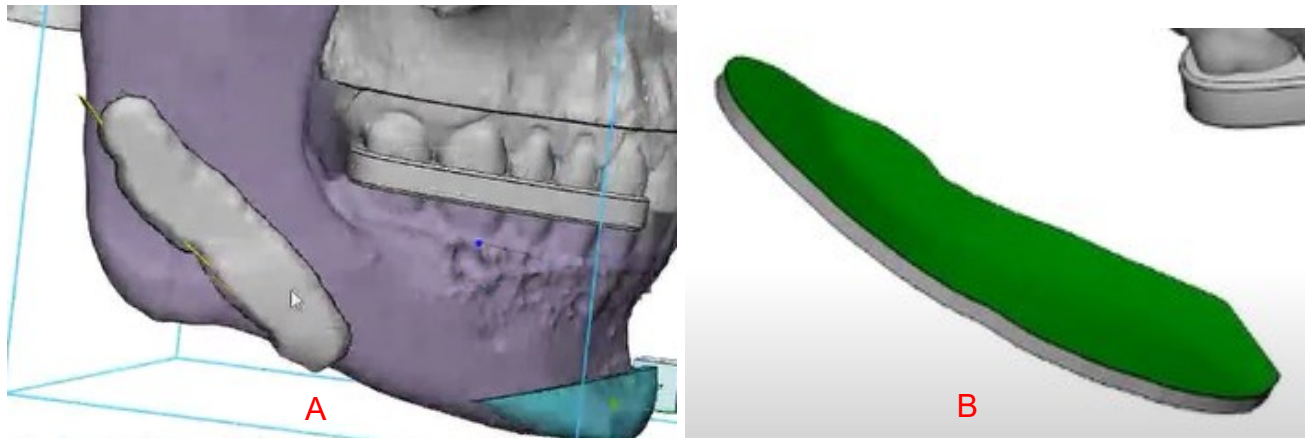


Figure 29. A) Poly-surface, B) Flange for guide.

Step IX: Use “Wrap” to offset=3.8mm for the original mandible, next use the “Reduce” tool to geometrical error = 0.5, then use "Improve Mesh" of maximal geometrical error = 0.05 and maximal edge height = 20.00, finally apply "Smooth" of 0.7.

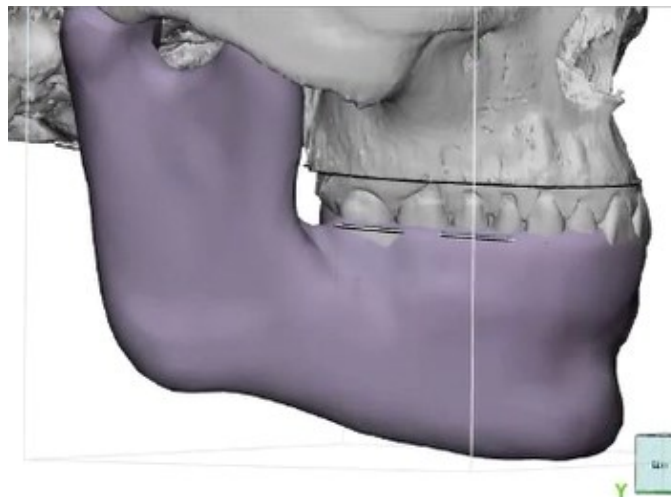


Figure 30. Improve mandible.

Step X: Select the “Boolean intersection” between the mandible wrapped and the flange.

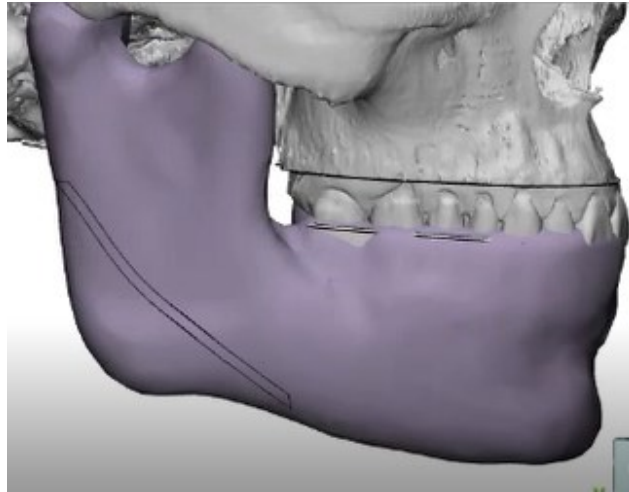


Figure 31. Improve mandible.

Step XI: Use the "Trim" tool to remove the unnecessary part, and use "Boolean Union" to merge the flange and poly-surface parts. Name the result as guide base + flange, cut the piece with the surface and remove the unnecessary part.

Step XII: Click Create primitive → to create a torus with tube radius = 2.7mm and torus radius = 25.00mm. Then align the torus with the "interactive rotate" tool. Once the torus is located, use Trim to remove unnecessary parts as shown in the figure.

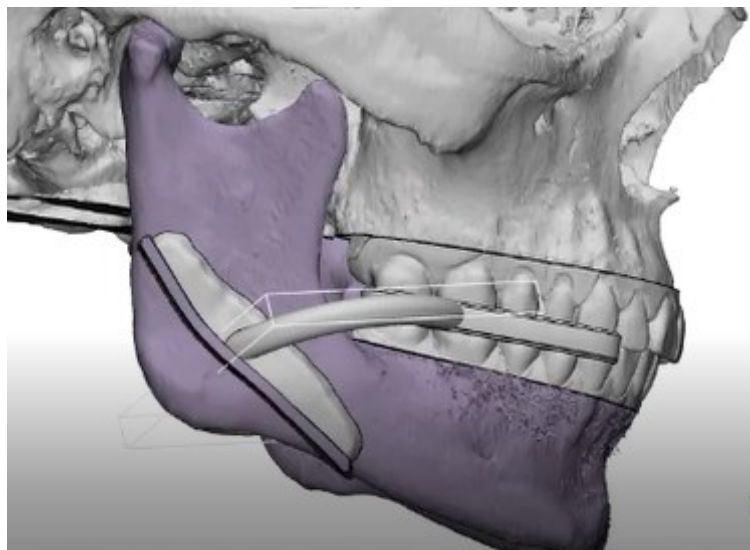


Figure 32. Boolean subtraction.

Step XIII: Use "Boolean subtraction" between the torus with the mandible and the splint. Then mark triangles, click on the invert and remove the noise. Finally, use "Boolean Union" to merge the parts.

Step XIV: Select the "remove undercut" tool and click on the normal triangle in the guide direction of interest.



Figure 33. Surgical guide.

Step XV: Mark the piece with the TDS code + the patient's initials + right guide.



Figure 34. Mark piece.

Step XVI Finally, use the "Repair Wizard" until the items appear green to avoid problems in the manufacturing process. Name the piece right cutting guide.

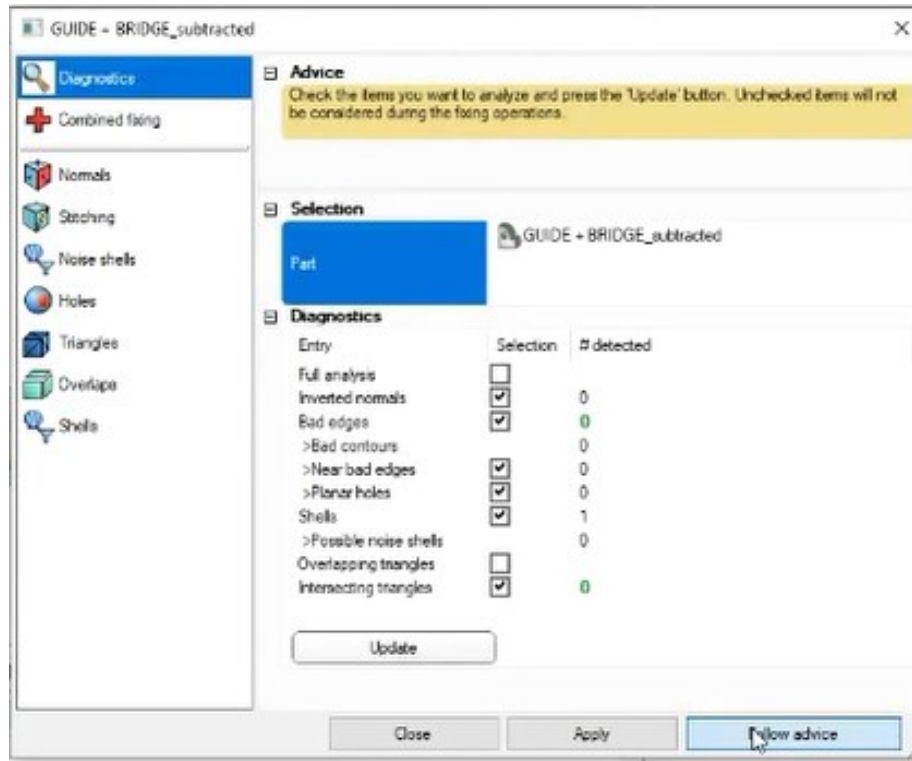


Figure 35. Mark piece.

Step XVIII: Save the file as TDS-code, and then, click on file → export → STL.

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