

Osteotomies to correct mandibular asymmetries. Series of cases

Osteotomías para corregir assimetrias mandibulares. Serie de casos

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ABSTRACT: Asymmetries are the most difficult dentofacial deformities to treat with orthognathic surgery. This occur due the anatomic alterations in mandibular form and contour, sometimes on body, ramus or condyle, or in all. In the most of cases, the first step is the uncoordinated condylar growth. So, some tools to solve this are the osteotomies to recontour the face. It's known that mandibular growth with asymmetry can result in maxillary alterations, with plan tilted and unaesthetic smile. One of the most likely etiologies to these deformities are the hemimandibular hyperplasia resulting from condylar growth. The orthognathic surgery are a group of techniques performed to correct the maxilla, mandible and menton deformities. In some cases, hig condylectomy are done to prevent postoperative growth. To complement, the osteoplasties to recontour the mandible are done to improve aesthetic to the face. Series of cases are presented with different kinds of osteotomies in mandibular body, ramus and menton. Some cases need high condylectomy associated. The Virtual Surgical Planning (VSP) is an important step and tool to do cases with asymmetries.

KEY WORDS: Osteotomy, mandibular asymmetries.

INTRODUCTION

Patients with asymmetry require a combination of orthodontics and orthognathic surgery for esthetic and functional improvement (Kim *et al.*, 2015; Bishara *et al.*, 1994; Pirttiniemi, 1994). Asymmetry usually presents as deviation of the chin or changes maxillae and mandible. However, asymmetry that is caused by differences in bone volume may require additional contouring surgery procedures, such as bone grinding, corticotomy, or ostectomy (Lee & Kim, 1999; Chen *et al.*, 2013; Jiang *et al.*, 2012; Lo *et al.*, 2010; Bertolini *et al.*, 2001).

Facial asymmetry mainly occurs in the mandible, which is diagnosed in almost 50% of patients with skeletal Class III malocclusion (Chew, 2006; Samman *et al.*, 1992; Proffit *et al.*, 2013). Although orthognathic surgery has been successful in to modified the position of the mandible and increasing facial contour symmetry, there are still some

skeletal asymmetries after the surgery (Jung *et al.*, 2008; Sforza *et al.*, 2007). In theory, soft tissues cover bony structures, and changes in hard tissues can be related to soft tissues (Huang, 2021).

Hemimandibular Hyperplasia (HH) is a developmental deformity, first reported by Adams in 1836 (Adams, 1873). HH presents changes in mandibular height, which usually benefits from inferior border ostectomy (Lo *et al.*, 2010). HH characterizes of unilateral 3-dimensional (3D) enlargement of the mandible including the condyle, the condylar neck, the ascending ramus, and the mandibular body, which usually is used at the symphysis. The prognathism, with mandibular enlargement, are difficult to correct and challenge for surgeons. It results in class III malocclusion, with big transverse discrepancy into maxilla and mandible.

In some cases, the alveolar nerve repositioning in mandible may also be required (Lo *et al.*, 2010). Another option is to move the area using dental intrusion technique in the affected area. Using this approach, nerve repositioning is not necessary and the amount of lower border osteotomy is minimized. In another cases, when we have condylar hyperplasia, condylectomy is necessary. Surgical approaches for condylectomy show differences in term of technique. Pre-auricular approach is the most common since it provides good visual access of the condyle, condylar neck, and glenoid fossa (Hernandez-Alfaro *et al.*, 2016).

The virtual surgical planning (VSP) turn the orthognathic surgery predictability more real, safe and easy. So the osteotomies, condylectomy area and the movements are seen with more accuracy.

Patients and Surgical Techniques

This study was conducted in HFC Healthy and Unimed Hospital, Piracicaba, São Paulo State, Brazil and was approved by Ethics Committee of Unimed University of Piracicaba. Asymmetric patients treated with orthognathic surgery were included. Their presurgical and follow up clinical data, photographs and TC were collected for evaluation.

All the patients were planned using VSP and the adjusted head position (AHP). In these cases, due the asymmetries, natural compensations are common (Fig. 1). It is necessary to take careful with the head in three special planes, using the clinical photography and evaluation of movements. The diagnosis involve facial analysis, dental check with positions, rotations, angulations, and airway evaluation. The condyle position in mandibular fossa, the morphology and pathology are important to predict the result. Some asymmetries are result from condylar growth (Fig. 2) and need surgical interventions as high condylectomy or temporomandibular joints prosthesis.

The maxilla surgery were done with Le Fort I osteotomy, and some variations were performed when hypoplasia was diagnosed. In these cases higher osteotomy was performed with a quadrangular format to create more projection in the paranasal area. The surgical approach to treat the maxilla was small in size and sufficient to carry out the osteotomies. We use the minimally invasive philosophy in orthognathic surgery when it is possible.

The osteotomy in mandible is short (Posnick & Kinar, 2021), with minimal detachment. But in cases with big asymmetries we need more detachment to do the mandibular recontouring. The mandibular basis osteoplasties are done with piezo surgery.

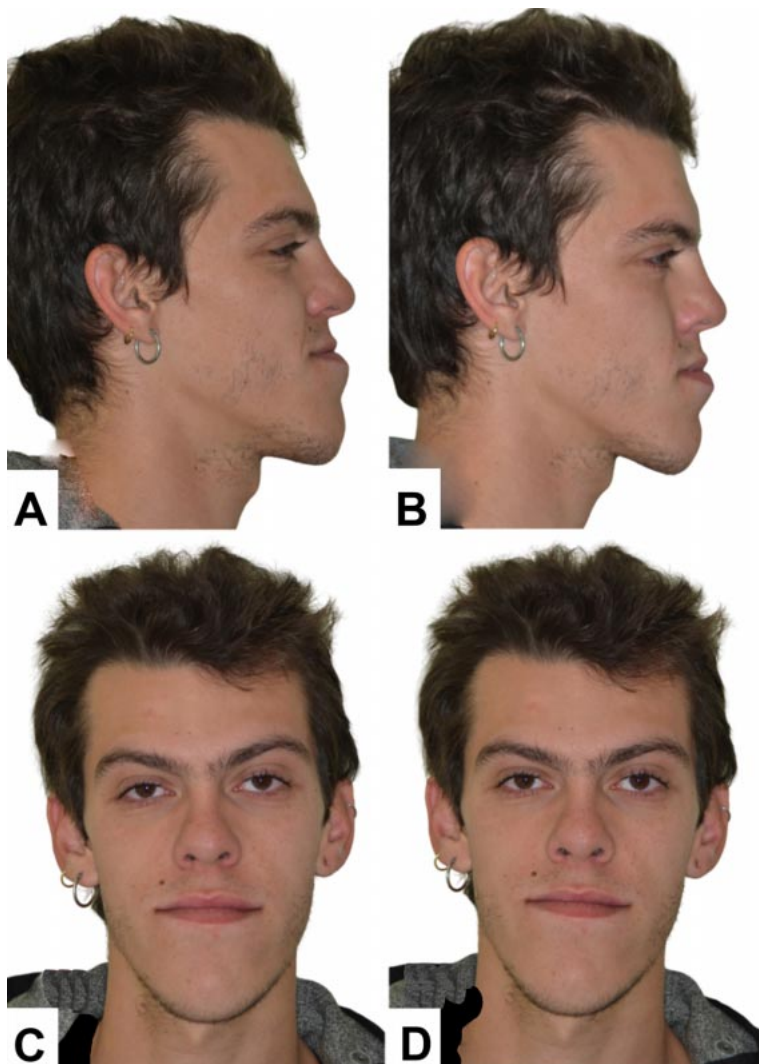


Fig. 1. Head with compensation and after adjusted head position (AHP). A- Natural head position, lateral view; B- Adjusted Head Position (AHP), lateral view; C- A- Natural head position, frontal view; D- Adjusted Head Position (AHP), frontal view.

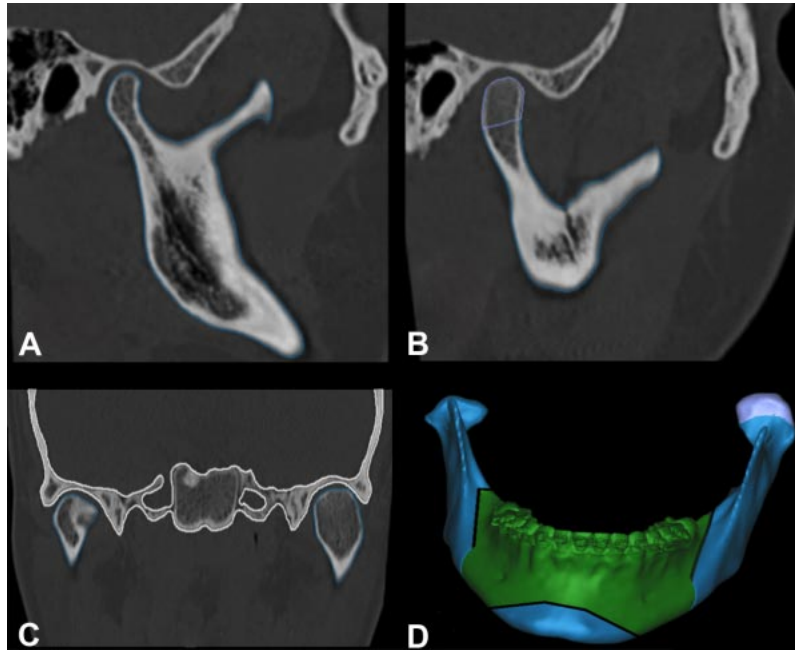


Fig. 2. Condyle tomogram show the hyperplasia in left side. A- Right side, normal condyle in sagittal view; B- Left side, hyperplastic condyle in sagittal view; C- Coronal view show the larger dimensions in left condyle; D- 3D view show the area of high left condylectomy.

Case 1

A 29-year-old female with facial asymmetry and no underlying disease came to our outpatient for orthognathic surgery. She received camouflage orthodontic treatment and rhinoplasty before orthognathic surgery. Although her chewing function was good, she was still eager to correct her facial asymmetry. After explaining the surgical plans and possible outcomes with VSP, she decided to not receive orthodontic treatment again and correct her facial appearance by surgery only. She presented maxilla cant and anteroposterior deficiency. An important mandibular asymmetry with midline deviation. The left condyle was without activity with no changes in the last 10 years. The surgical plan and results were shown in Fig. 3. No surgical plan was done to left condyle. So, we believe that HH occur during growth. The Le Fort I osteotomy, bilateral sagittal split ramus osteotomy (BSSRO), genioplasty and mandibular osteoplasties were done. In order to keep the presurgical occlusion, bony fixation were implemented in maxilla before BSSRO. Was done 2-mm maxillary advancement, 1-mm downward reposition, maxillary cant correction and 4 degree counter clockwise rotation to put the pogonion backward. In

mandible, 3-mm midline correction to right side, occlusal plane leveling and setback. Then, the genioplasty was done to correct midline deviation and osteoplasty in B-point to correct the anatomy. So the mandibular osteoplasties were executed to better contour of face in V-line technique. Was used piezosurgery to minimize the soft tissues injury.

Case 2

A 23-year-old male with facial asymmetry, zygomatic, maxilla and paranasal deficiencies were diagnosed. The prognathism was severe, with both condyles with large dimensions. He received orthodontic treatment to orthognathic surgery. The VSP was maxilla advancement, zygomatic osteotomies to enlargement the middle third of face, BSSRO to correct the mandible midline, genioplasty to superior repositioning and mandibular osteoplasties to contour the face. The removed bone of genioplasty was used to graft the zygomatic gaps. Due the previous HH diagnoses, high bilateral condylectomy were done. The first

step was this, 5- mm bone removed in top condyles. Then, the second step were the BSSRO to correct the 2.7- mm midline to right side. In sagittal plane, the lower incisor stayed in the same anteroposterior position and 3.6-mm upward. Due the asymmetry, adjustment in the distal segment on left side was necessary, to major passivity and adaptation of condylar segment. Then the genioplasty osteotomy was done to bone removed. Seven millimeters upward and 1-mm forward chin movements were performed. The objectives were vertical reduction and improvement aesthetic in the chin. In sequency, the maxillary osteotomy were executed with zygomatic osteotomies. The osteotomy in maxilla was more high, with quadrangular form, to improve the soft tissues support in paranasal area. The movement was big, with 9-mm advancement, 3-mm midline correction to left side, 3-mm upward and transverse leveling of occlusal plane. Turbinectomy, septoplasty and piriform nasal correction were done. Maxilla was fixed and the zygomatic area were grafted. So, the genioplasty fixation and mandibular osteotomies were done to better contour in face (Fig. 4).

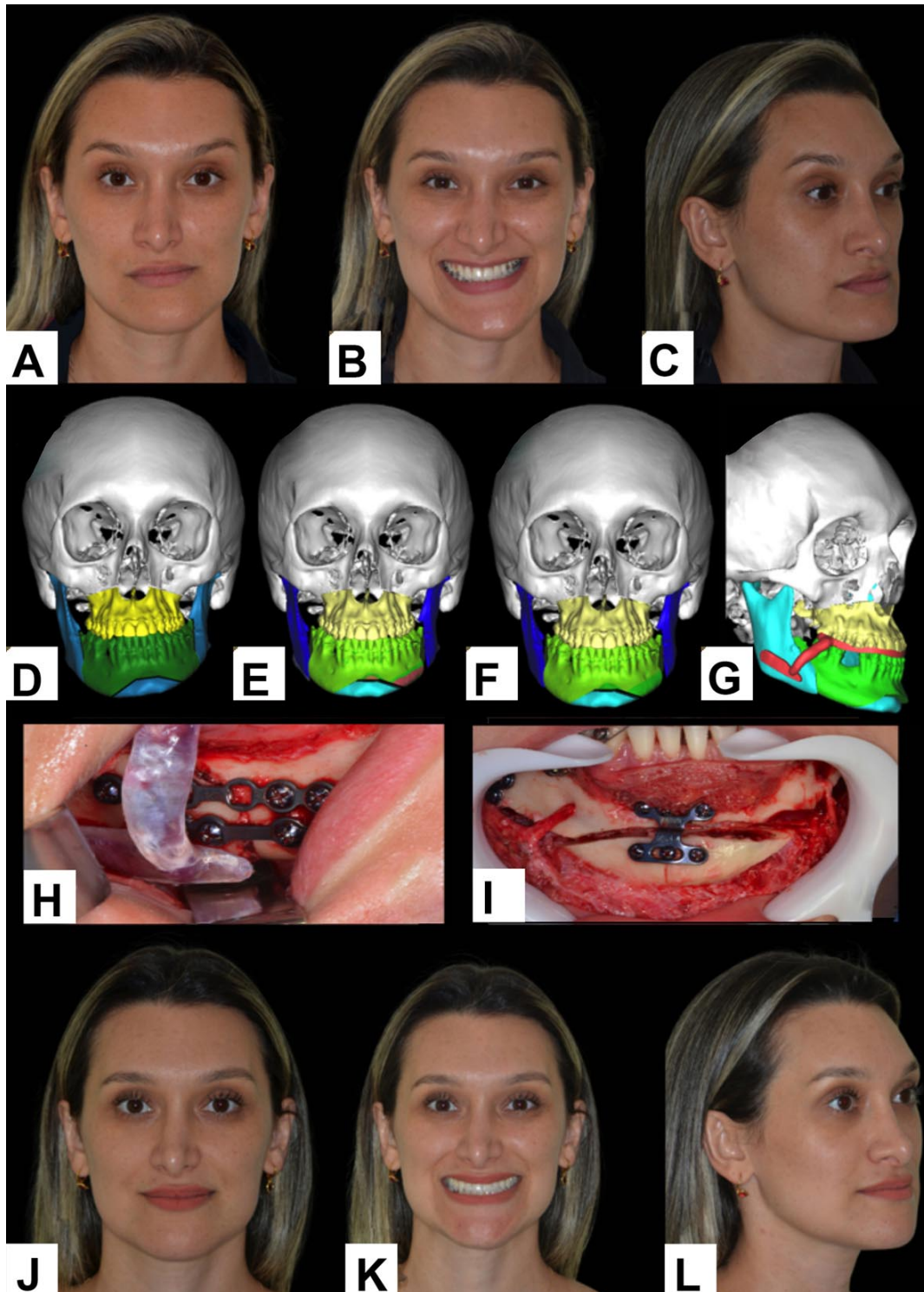


Fig. 3. A- Preoperative frontal view show asymmetry with mandibular deviation to left side; B- Smile asymmetry; C- Maxilla deficiency; D- Compound skull; E- Correction of the maxilla, mandible and menton, associated with mandibular body osteoplasties; F- Virtual osteoplasties performed; G- Cut guide to mandibular ramus; H- Intra-operative surgical guide to left mandibular ramus; I- Genioplasty and body basis osteotomies; J- Post operative frontal view show the good aesthetic, with midline correction; K- Smile's line correction; L- Projection of the maxilla and good mandibular contour.

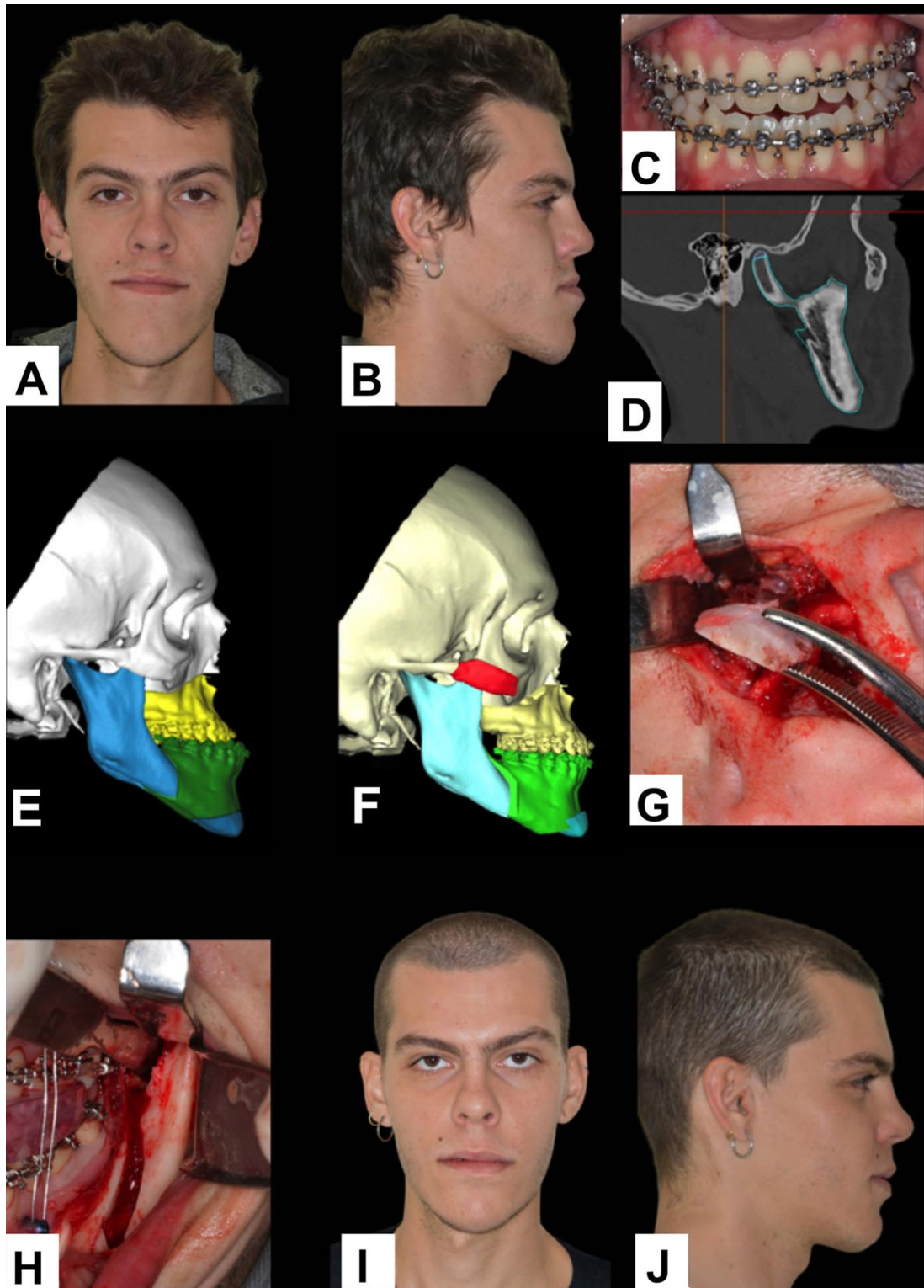


Fig. 4. A- Preoperative frontal view show mandibular deviation to right side, with lower third of the face increased; B- Lateral view with mandibular vertical growth; C- Anterior open bite, class III malocclusion; D- Bilateral condylar hyperplasia in sagittal view; E- Preoperative compound skull; F- VSP with count clockwise rotation, zygomatic osteotomy to enlargement of the middle third of face; G- High bilateral condylectomy; H- BSSOR short; I- Postoperative result, with increasing facial harmony; J- Good profile.

Case 3

A 27-year-old female with important facial asymmetry, with maxillary cant, nasal dorsum deviation, laterognathism and mandibular contour deformation was treated with orthodontic compensation. The left condyle presented large dimensions than the opposite side. Possibly these dimensions occurred during facial growth. No activity in temporomandibular joint was noted in consult moment. Impressive in this case was the occlusal plane in diagnosis, with 3 negative degree. No surgical care was done in temporomandibular joint. The surgical plan was maxilla 2-mm advancement, 3-mm midline correction to right side, count clockwise rotation of occlusal plane in 8 degrees, correction of the Y axis, nasal septoplasty corrective, cartilage graft in nasal domus. Due the major high of the right mandibular ramus, an osteoplasty was done in inferior border. The 4.9-mm mandibular deviation was correct to right side, with rotation in Y axis, needing osteoplasty in left mandibular body. With the chin 4-mm setback and midline correction, a bone tip was created in point B region. Then, another osteotomy was done. An additional adjustment was necessary in distal segment on right side due the mandibular rotation. This prevent condylar torque and possible resorption (Fig. 5).

Case 4

A 18-year-old female with vertical facial pattern, prognathism, mandibular deviation to right side, high mandibular occlusal angles, maxilla deficiency, and large nose tip (Fig. 6). Her condyles presented large dimensions, but without activity and appeared stables. No surgical plan was done to temporomandibular joints, but follow-up is necessary for being a young patient. The surgical plan and VSP were: correct the mandibular and occlusal angles, with 1 degree clockwise rotation; genioplasty to 3-mm advancement, 6-mm upward reposition and 2.3-mm midline correction to left side; maxilla was operated to midline correction; and, cartilage graft in nasal tip associated with rhino structuring with suture threads. Again, this cartilage was removed of the inferior part of the septal cartilage. Then, two osteoplasties were performed in the transition of mandibular body to the chin, to correction mandibular contour and smooth the step in both sides. This created a female jaw.

Case 5

A 21-year-old female, presented bilateral condylar hyperplasia, with large mandibular arch, prognathism, maxilla hypoplasia, class III malocclusion. She was prepared to orthognathic surgery with decompensation orthodontics. The maxillary arch had a much smaller diameter than the mandibular arch. The surgical plan and the VSP were bilateral condylectomy, BSSO, V-line osteotomy to face feminization, genioplasty to advanced and upward, maxilla segmentation with 4-mm advancement. The genioplasty was performed to obtain a good mentolabial sulcus. Rectilinear mandibular symphysis can be seen on preoperative tomography. The LeFort I osteotomy was modify, with a quadrangular format to provide a better support to nasolabial fold and with segmentation to arch expansion. Finally, the V-line osteotomy in mandibular border decreased the arch perimeter, making the mandibular contour smoother and more feminine (Fig. 7).

Case 6

A 37-year-old female (Fig. 8), class III malocclusion with compensation, presented chief complaint the facial asymmetry. During the clinical examination, the smile deficiency, maxilla without vertical growing, poor upper incisors exposure, associated with transversal plane alteration, resulted in mandibular asymmetry too. Basically the occlusion teeth was bad prepared to surgery, without overjet. So, the surgical plan was correct the 0,9-mm mandibular asymmetry with BSSO to the left side, performed 5 degrees count clockwise rotation, genioplasty to 2.6-mm midline correction to right side and 2-mm backward reposition. Then, the maxilla transversal plane was corrected with LeFort I osteotomy. The maxilla was 5-mm advanced to better projection of the paranasal area and nasolabial fold support. The maxillary cant was corrected with 3-mm impaction in right side. Finally, osteotomies to recontour the mandibular angles were done. Custom surgical guides were used to perform the osteoplasties and genioplasty. The objective is obtain symmetric osteotomies, with better results. This technique provide good result and facial harmony.

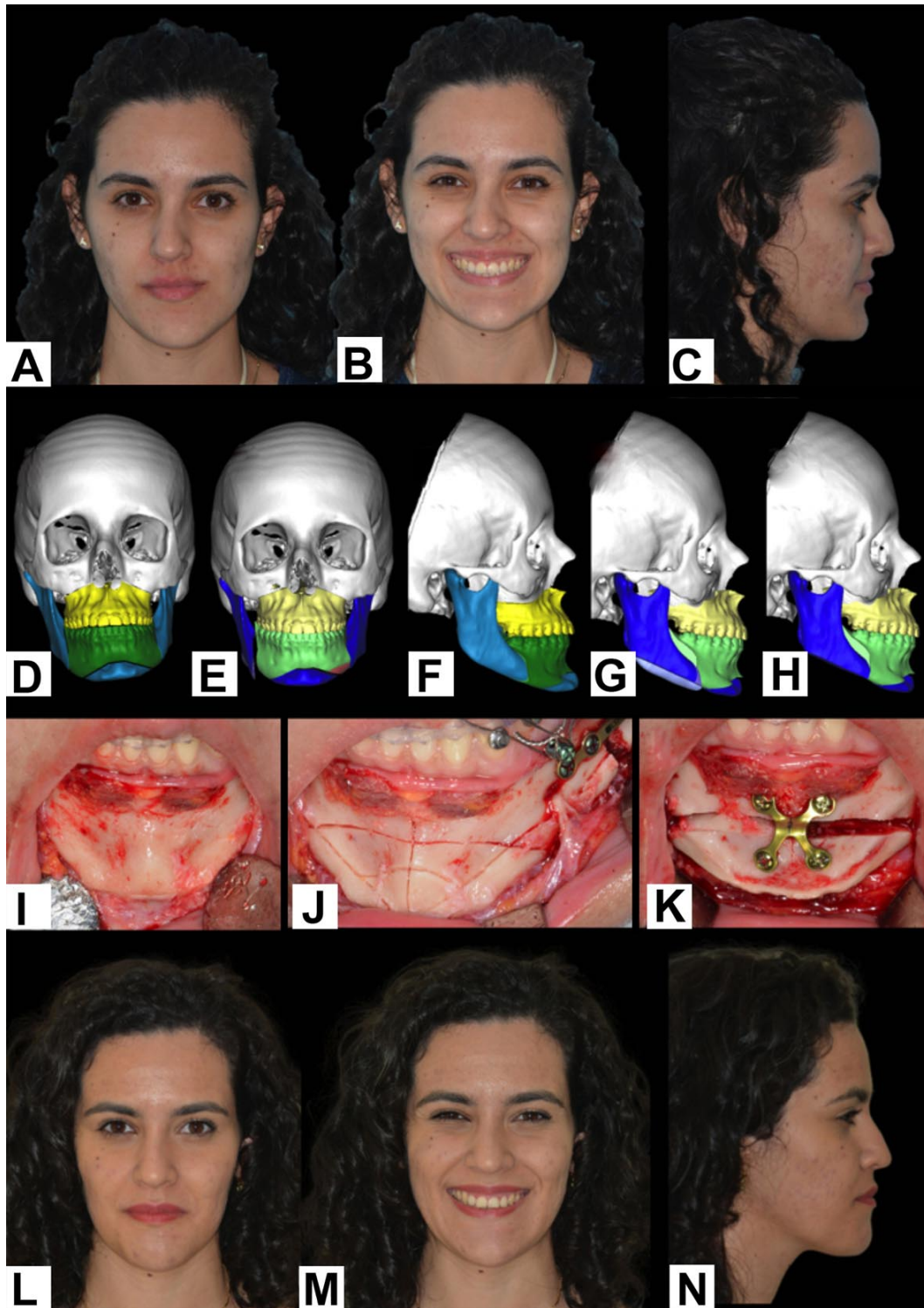


Fig. 5. A- Frontal view with mandibular deviation to left side, nasal dorsum deviation; B- Maxillary Cant, with asymmetric smile; C- Lateral view show anteroposterior deficiency and nasal tip downward; D- Compound skull show the big symmetry; E- Lateral correction and the mandibular osteoplasties demarcation; F- Lateral view show de the pronounced chin; G- Osteoplasties demarcated; H- Osteoplasties in VSP; I- Genioplasty approach; J- Osteoplasties design; K- Osteoplasties performed; L- Post operative frontal view; M- Maxillary cant correction; N- Best nasal and maxillary soft tissue supports.

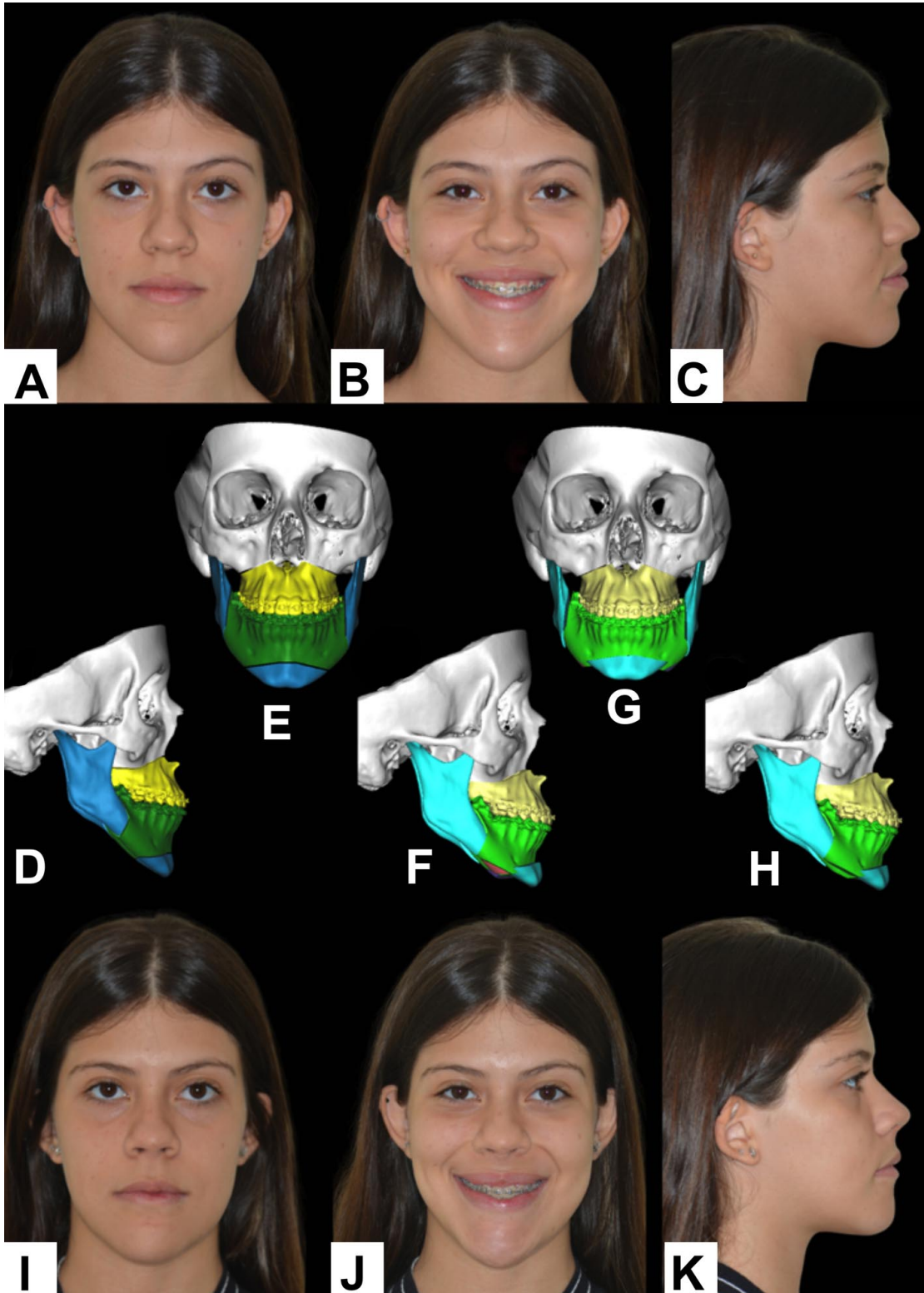


Fig. 6. A- Lower third of the face increased; B- Maxilla with slight deficiency; C- Profile show the vertical growth of the mandible and the prognathism; D- Compound skull in frontal view; E- Vertical reduction of the lower third of face; F- Lateral view; G- VSP and osteoplasties demarcation; H- Better mandibular plane with basal osteotomies; I- Post operative frontal view; J- Good smile; K- Harmonic profile.

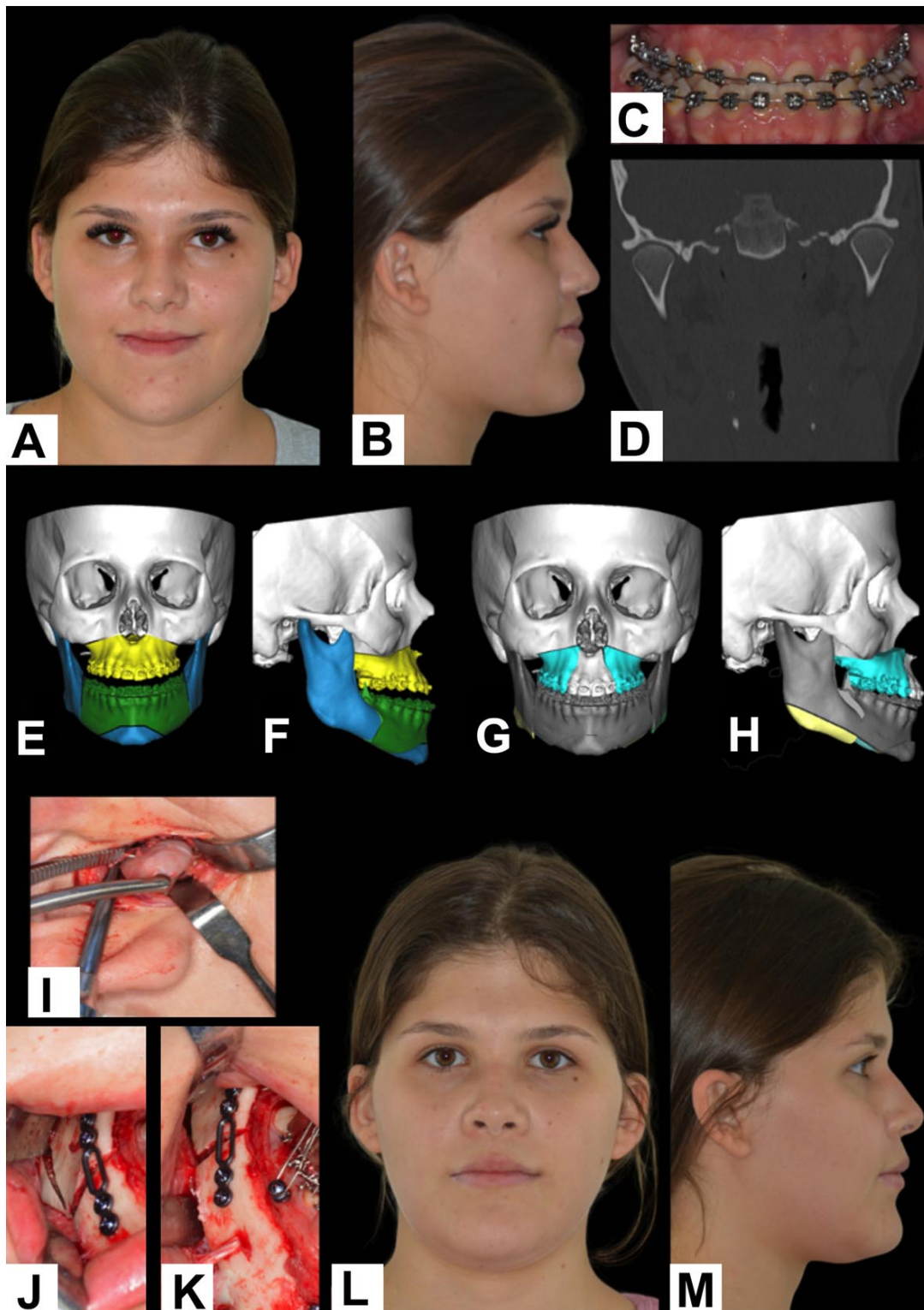


Fig. 7. A- Preoperative frontal view with increased lower third of the face; B- In lateral view: prognathism; C- Class III malocclusion; D- Bilateral condyles enlargement; E- Compound skull show the anterior open bite; F- Lateral view; G- Maxillary segmentation to expand the posterior region; H- Mandibular setback and V-line osteoplasties demarcation; I- Bilateral high condylectomy; J and K- Mandibular V-line osteoplasty; L- More harmony face; M- Good profile.

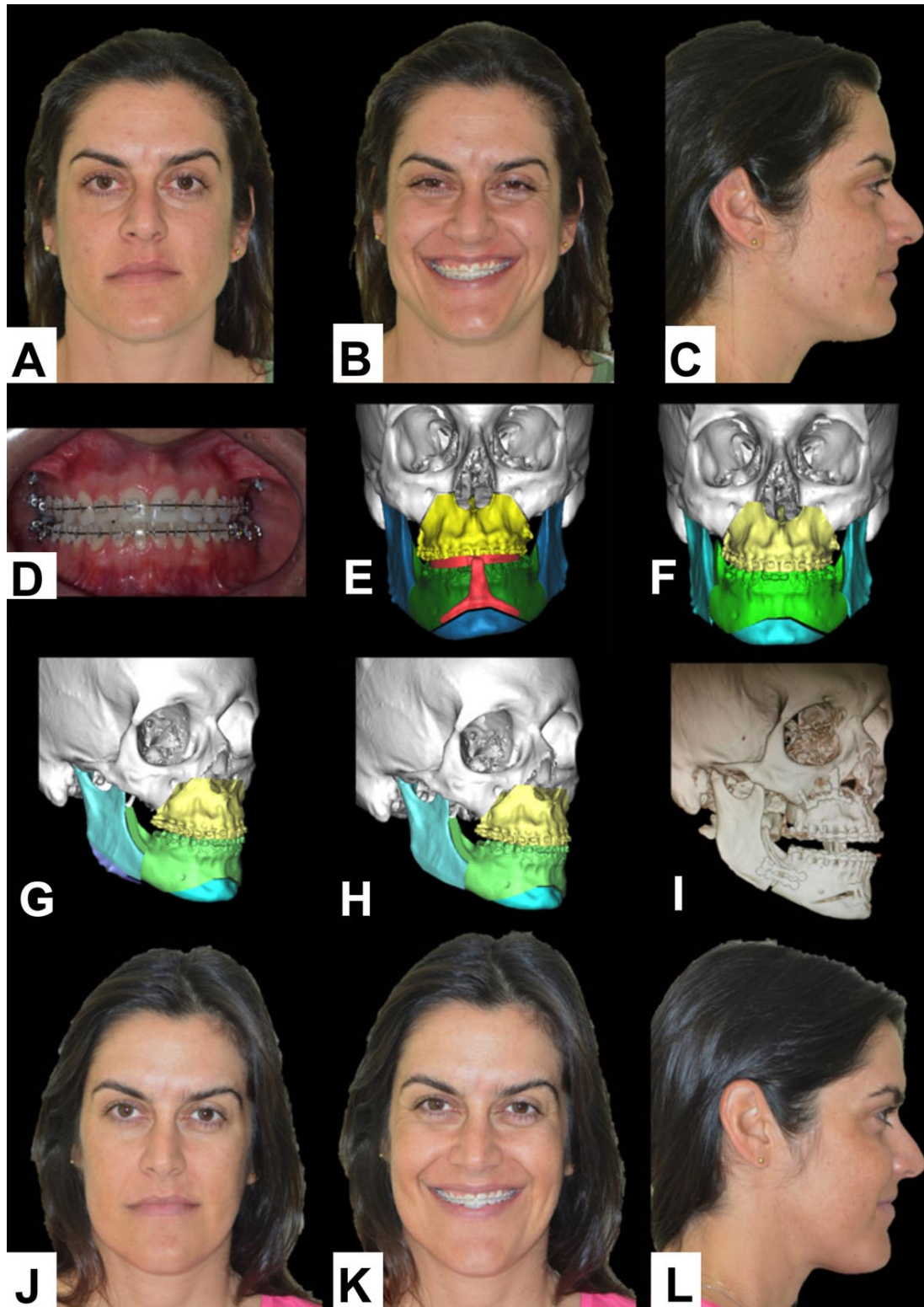


Fig. 8. A- Laterognathism with mandibular deviation to the left side; B- Smile asymmetry, and maxillary cant; C- Lateral view show maxillary deficiency; D- Occlusal compensation; E- Compound skull and guide to genioplasty cut; F- VSP, note the bone excess in mandibular bilateral rami; G- Osteoplasty demarcation; H- Mandibular osteoplasty; I- Post operative CT; J and K- Facial harmony; L- Good profile.

Case 7

A 22-year-old female with important laterognathism, mandibular midline deviation to right side, maxilla transversal plane changed, anteroposterior deficiency, with smile alteration and asymmetric gun exposure. These were result of a left condylar hyperplasia, repercussing in a facial midline deviation with HH (Fig. 9). The left mandibular ramus were bigger than the opposite side, and condylar presented large dimensions. The piriform aperture was asymmetric and the anterior nasal spine deviation of midline too. The surgical plane and VSP were: 1- left high 5-mm condylectomy using endaural preauricular approach and discopexy with anchors; 2- correction the mandibular asymmetry with BSSO and clockwise rotation with advancement; 3- then, genioplasty was done with a custom surgical guide, using the occlusion guide with reference; 4- we used LeFort I osteotomy to 5-mm advance and 2-mm upward the maxilla, and correct the transversal plane. In this case was done sub nasal osteotomy due the deviation of anterior nasal spine when compare with de upper incisors midline; 5- septoplasty and piriformplasty were done to complement the case; 6- finally, the V-line osteotomy in inferior border was done, to aesthetic refinement of the mandibular body. This case remember us: bigger bone asymmetries produce bigger soft tissues asymmetries. Then, some results maybe come limited.

DISCUSSION

Hemimandibular hyperplasia is a 3-dimensional enlargement of one side of the mandible, and involves the condyle, condylar neck, ramus, and body, usually terminating at the symphysis (Lo *et al.*, 2020; Kaya *et al.*, 2017; Joondeph, 2000). The chin deviates to the unaffected side, the lower mandibular border is asymmetric, and the occlusal plane is tilted (Obwegeser & Makek, 1986; Lippold *et al.*, 2007). In advanced forms of HH there is overgrowth of the maxillary and mandibular alveolar bone and compensatory cant, with a significant functional malocclusion. This usually requires a bimaxillary surgical correction (Lo *et al.*, 2020; Obwegeser & Obwegeser, 2010; Chen *et al.*, 1996). We can see this situation in cases 1, 3, 6 and 7. Every cases required maxillary cant correction due condyle growth and the mandibular osteoplasties were useful to gain facial harmony.

Some methods to treat HH has been reported

(Motamedi, 1996; Tehranchi & Behnia, 2000; Koumoura & Kountouris, 1988; Li *et al.*, 2001; Sugawara *et al.*, 2002). Lippold *et al.*, in 2007, performed mandibular condylectomy of the affected side in 6 patients. During the 2-year follow-up, they reported stable symmetric mandibles with remodeling of the joint and concluded that condylectomy can successfully correct HH even in patients with active condylar growth. In our study, ^{99m}Tc scintigraphy of both condyles was performed in all patients before surgery, and condylectomy was indicated when the uptake ratio between the affected and the normal condyle was >1.2 (Pogrel, 1985). We did condylectomy in cases 2, 5 and 7. In cases 2 and 5, the patient showed bilateral condylar activity. So, our option was remove 5-mm of condyles top. In case 7, the activity was only in left condyle, and our option was operated this; these three cases are young patients, with big growth potential and presented condyles activities. The other cases are adult and did not presented condylar activity.

Orthognathic surgery with or without condylectomy is commonly considered for treatment of HH, which is indicated through abnormal imaging manifestations and bone scans. A previous study recommended that a relative percentage uptake is more than 55% in the affected condyle using SPECT indicates an active one and thus warrants condylectomy (Pogrel, 1985). So, our preference is perform the condylectomy when the scintigraphy is positive.

The major problem associated with HH is the altered anatomy produced in neck condyle, ramus and mandibular body. Another problem is the maxillary inclinations, with tilted the occlusal plane in three planes. By this, Le Fort I osteotomy was performed to correct the compensatory maxillary growth on the affected side, which led to titled occlusal planes. BSSRO as well as mandibular angle and body contouring were performed to further correct the mandibular asymmetry. After BSSRO, both ends of the proximal mandibular segment were free before fixation, particularly on the affected side. Usually, it is difficult for surgeons to ensure appropriate position of the condylar stump under poor vision during surgery. Although virtual navigation can provide assistance during surgery and can validate results immediately after surgery, it is still difficult to avoid all errors during condylar positioning.

When assessing symmetry, landmarks in the distal segments of the maxilla and mandible shows better symmetry than the respective proximal segments. It was difficult to

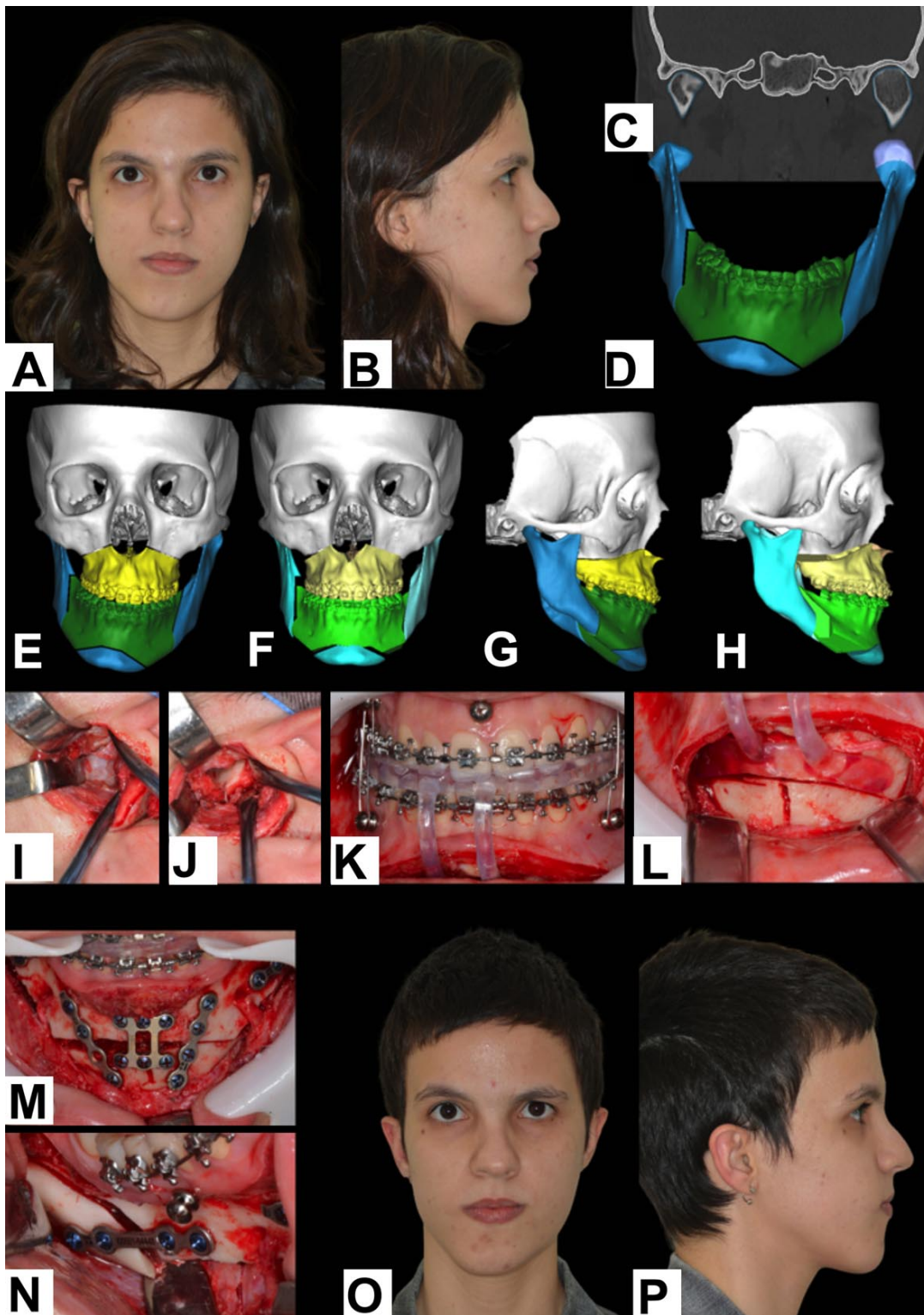


Fig. 9. A- Important mandibular midline deviation; B- Lateral view; C and D- Left side condylar hyperplasia; E- Compound skull; F- VSP with mandibular osteoplasties; G- Lateral view of preoperative asymmetry; H- Mandibular osteoplasties performed in VSP; I- Left high condylectomy; J- Disc reposition with anchors; K and L- Surgical guide to genioplasty; M- Genioplasty fixation; N- Mandibular osteoplasty; O and P- Post operative result.

determine the exact degree of mandibular contouring required to achieve bilateral symmetry (Han *et al.*, 2018). In agree with this, we do the corrective osteotomies in the end of the surgery, as a last step. In this situation we can visualize the entire mandible and do the necessary osteotomy.

Current research has applied computer-assisted 3-dimensional surgical planning for treatment of asymmetry (Bertolini *et al.*, 2001). Successful treatment of hemimandibular hyperplasia show that the right and left mandible have symmetric shape and size. In most cases, a large amount of inferior border osteotomy is required, which in turn makes inferior alveolar nerve repositioning a requirement. Nerve dissection usually carries a high risk of damage to the nerve and increases surgical time. We can observe this in all cases presented in this paper. Obviously, more detachment and more tissues dissection produce more damage and slowly nerve recovery.

CONCLUSION

Based on the results of our series cases, we can conclude that simultaneous orthognathic surgery, condylectomy when necessary and osteotomies in mandibular asymmetries are reliable and precise treatment technique. The VSP is an important tool and step in the process, as a guide to the surgeon during the procedure.

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RESUMEN: Las asimetrías son las deformidades dentofaciales más difíciles de tratar con cirugía ortognática. Esto ocurre debido a las alteraciones anatómicas en la forma y contorno mandibular, a veces en cuerpo, rama o cóndilo, o en todas las áreas anatómicas. En la mayoría de los casos, el primer paso es el crecimiento condilar descoordinado. Entonces, algunas herramientas para solucionar esto son las osteotomías para recontornear la cara. Se sabe que el crecimiento mandibular con asimetría puede resultar en alteraciones maxilares, con plan torcido y sonrisa antiestética. Una de las etiologías más probables de estas deformidades es la hiperplasia hemimandibular resultante del crecimiento condilar. La cirugía ortognática son un grupo de técnicas que se realizan para corregir las deformidades del maxilar,

la mandíbula y el mentón. En algunos casos, se realizan grandes condilectomías para prevenir el crecimiento postoperatorio. Complementariamente se realizan las osteoplastias para recontornear la mandíbula para mejorar la estética del rostro. Se presentan series de casos con diferentes tipos de osteotomías en cuerpo mandibular, rama y mentón. Algunos casos necesitan una condilectomía alta asociada. La Planificación Quirúrgica Virtual es un paso y una herramienta importante para tratar casos con asimetrías.

PALABRAS CLAVE: Osteotomía, Asimetría mandibular.

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