

# Presurgical assessment of dentofacial anomalies using computed axial tomography: What the radiologist should always report

## Valoración prequirúrgica de anomalías dentofaciales mediante tomografía axial computarizada: lo que el radiólogo siempre debería informar

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## Summary

Dentofacial anomalies (DFA) are a frequent reason for consultation in maxillofacial surgery departments, since diagnostic imaging is important for surgical planning and follow-up. DFA refers to significant deviation from the normal proportions of the maxillomandibular complex, which negatively affects dental occlusion. The management of these alterations is mainly performed with orthognathic surgery, which seeks the repositioning of dental and facial skeletal components through a combination of procedures. Computerized axial tomography studies allow maxillofacial surgeons to establish the type of anomaly, identify associated findings —breathing alterations—, perform surgical simulations and define precise surgical planning. Interdisciplinary working groups and minimal knowledge of the language used in the management of DFAs allow a better approach to imaging modalities, as well as the reporting of relevant information for the clinical management of patients.

## Resumen

Las anomalías dentofaciales (ADF) son un motivo frecuente de consulta en los servicios de cirugía maxilofacial, puesto que el diagnóstico por imagen es importante para la planificación y el seguimiento quirúrgico. Las ADF se refieren a la desviación significativa de las proporciones normales del complejo maxilomandibular, que afectan negativamente la oclusión dental. El manejo de estas alteraciones se realiza principalmente con cirugía ortognática, que busca el reposicionamiento de los componentes dentales y del esqueleto facial mediante una combinación de procedimientos. Los estudios de tomografía axial computarizada permiten a los cirujanos maxilofaciales establecer el tipo de anomalía, identificar los hallazgos asociados —alteraciones de la respiración—, realizar simulaciones quirúrgicas y definir una planificación quirúrgica precisa. Los grupos de trabajo interdisciplinarios y el conocimiento mínimo del lenguaje utilizado en el manejo de las ADF permiten un mejor abordaje de las modalidades de imagen, así como el reporte de información relevante para el manejo clínico de los pacientes.

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## Introduction

Dentofacial anomalies (DFA) are a frequent reason for consultation in maxillofacial surgery departments, making diagnostic imaging important for surgical planning and follow-up. Increasingly, radiology services are requested to perform pre and post-surgical assessment of these pathologies by means of computed axial tomography (CT) images.

Radiologists do not have sufficient tools to deal with these pathologies, the dental terminology is strange to them or they do not know what information is needed by maxillofacial surgeons in their reports. This article aims to review the current literature and to reach a consensus with maxillofacial surgeons on the main information that radiologists should take into account in their reports.

## Review of dentofacial anomalies

FDAs, also known as dentofacial deformities, refer to significant deviation from the normal proportions

of the maxillomandibular complex, which adversely affects dental occlusion (1).

Diagnostic images such as panoramic and lateral cephalometric radiographs, images of the temporomandibular joint (TMJ), conventional CT or cone beam tomography (CB-CT) of the face, and functional nuclear medicine tests such as bone scintigraphy with simple positron emission computed tomography (SPECT) of the TMJ are available for the evaluation of the patient to diagnose hyperplasia of the mandibular condyle (2-5).

In some complex cases, advanced three-dimensional analysis techniques based on CT data are used to establish the type of anomaly, identify associated findings and establish precise surgical planning; for example, virtual planning from CT can generate simulations of the required surgeries, cutting guides to preserve anatomical structures and surgical splints to replicate the planned surgical approach directly from the CT to the real patient (2-5).

## Classification of dentofacial anomalies

FDA are alterations in the size or position of the maxilla and mandible involving the three planes of space (longitudinal, anteroposterior and transverse), with secondary dental malocclusion, considering that these structures represent the bony base where the positioned teeth are located (1).

Affected individuals have different degrees of compromise in breathing, swallowing, chewing and speech, in addition to a facial dysmorphology that has a negative impact on self-esteem and other psychosocial components.

These alterations are mainly managed with orthognathic surgery, which seeks the repositioning of the dental components and the facial skeleton to provide an adequate function and harmony of the face, a procedure generally performed by maxillofacial surgeons (6).

*Occlusion* is defined as the morphological and functional relationship between all the components of the stomatognathic system such as teeth, muscles and craniofacial skeletal system. Malocclusion is the loss of this normal relationship (7).

Malocclusion can occur due to dental problems, such as malposition of the teeth (intrinsic), or skeletal problems, due to alterations in the size or position of the maxilla, mandible or both (extrinsic), as in the case of FDA (8-9). Among the causes, heredity, congenital defects, trauma and local factors such as anomalies in the number, size and shape of the teeth have been described (7, 8).

There are several classifications for these alterations, the most widely used for malocclusion is Angle's, described by Edward Angle in 1899, which catalogs the alterations from the anteroposterior plane. It is based on the concept that the first molar and upper canine are the most stable dentition and are used as a reference for occlusion. In this context, malocclusions are defined by alterations in the position of the mandible (10) and are divided into three major groups (11) (Figure 1):

- Class I: the mesiobuccal cusp of the upper first molar occludes in the mesiobuccal sulcus of the lower first molar, to achieve a normal relationship (11).
- Class II: the lower first molar is more distal (posterior) in relation to the upper first molar, therefore, the mandible is retracted. It is divided into two subgroups: in class II-a, the upper and anterior teeth are deviated forward (dental protrusion, overjet or augmented), and in class II-b, the upper and lower anterior teeth are recessed and the bite is deep (overbite) (11).
- Class III: the lower first molar is more mesial (anterior) to the upper molar, so the mandible is forward. The upper incisors can coincide with the lower incisors (vis a vis bite) or be protruded, generating an anterior inverted bite. There is a lingual inclination of the lower incisors and canines, which is accentuated the more severe the case, due to the pressure of the lower lip in its attempt to close the mouth and disguise the malocclusion. The neuromuscular system is abnormal, mandibular bone protrusion, maxillary retrusion or both are found (11).

Another classification is the facial skeletal profile, which establishes the relationship between the maxilla and mandible in the anteroposterior plane, also includes three main groups (12) (Figure 2):

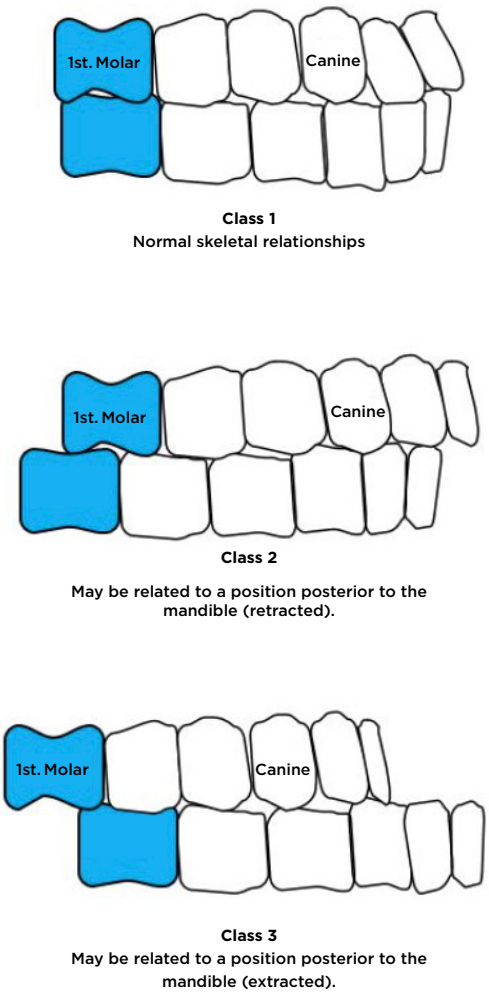



Figure 1. Angle's classification of molar relations. Schematic of molar relation classes 1, 2 and 3 as described by Angle in 1899 and adapted by Hurt in 2007 (11).




Figure 2. Classification of facial skeletal profiles. Facial CT in sagittal reconstructions showing skeletal classes I, II and III, respectively.

- Skeletal class I: adequate relation between the maxilla and mandible with respect to the skull base (12).
- Skeletal class II: in this class the mandibular base is posterior (caudal) to the maxillary base, due to maxillary prognathism (maxillary excess or "long face" syndrome), mandibular retrognathism or both (12).
- Skeletal class III: the mandibular base is anterior (ventral) to the maxillary base, due to maxillary retrognathism (maxillary deficit, "short face" syndrome), mandibular prognathism or both (12).

The terms *protrusion* and *retrusion* are also used to describe the position of the maxilla or mandible. The terms maxillary or mandibular *hyperplasia* and *hypoplasia* are not recommended because they are considered vague, as they can be used to refer to both volumetric size and position in space.

Other basic terms used in dentistry that the radiologist should know are summarized in Table 1 (12).

**Table 1. Basic glossary of dentistry**

| Term | Definition |
|---|---|
| **Terms used to describe orientation** | |
| Buccal | Pertaining to or adjacent to the mucosa of the cheek |
| Lingual | Pertaining to or adjacent to the tongue |
| Labial | Pertaining to or adjacent to the lip |
| Palatino | Pertaining to or adjacent to the palate |
| Distal | Away from the mid-sagittal plane along the dental arch |
| Mesial | Toward the mid-sagittal plane along the dental arch |
| **Terms used to describe the individual position of a tooth within the dental arch** | |
| Proclination | Anterior (labial) angulation of the tooth |
| Retroclination | Posterior (lingual) angulation of the tooth |
| Mesioversion | Mesial to normal position |
| Dystoversion | Distal to normal position |
| Infraversion | Away from the line of occlusion (above the maxilla or below the mandible) |
| Supraversion | Extends beyond the line of occlusion (inferior to the maxilla and superior to the mandible) |
| Axioversion | Incorrect axial inclination |
| Rotation | Rotation around its long axis |
| Transversion | Also called transposition, an incorrect order in the dental arch |

## Surgical management

Surgical management is performed in any of the FDA, which corresponds to approximately 40% of the indications for orthognathic surgery (13).

Most frequently, a Le Fort I type maxillary osteotomy, sagittal mandibular ramus osteotomy or chin osteotomy is performed (14).

Since anomalies can occur in any of these locations, surgical correction usually requires a combination of procedures.

The Le Fort I type maxillary osteotomy follows the path of the Le Fort I fracture in a controlled fashion, from the maxillary tuberosity and pterygoid process to the transverse opening of the piriformis. It allows forward or backward, downward or upward movement, enabling three-dimensional facial change. Maxillary backward movement is the most restricted, as it collides backward with the pterygoid processes (12).

The sagittal osteotomy of the mandibular ramus divides the mandible into a proximal segment corresponding to the vertical ramus of the mandible with a TMJ and a distal segment corresponding to the mandibular body, teeth and dental and mentonian nerves. This separation allows to mobilize in any direction the segment containing the teeth (distal segment) without modifying the position of the branch and its temporomandibular joint (proximal segment). Mentoplasty by osteotomy is used to modify the shape, symmetry, height or projection of the chin. A horizontal osteotomy is performed in the mandibular symphysis below the chin holes, which allows mobilizing the free lower fragment in any direction depending on the morphological alteration of the chin to be treated (12).

These are the most commonly used procedures; however, there are other techniques depending on the patient's conditions.

## Evaluation of the FDA in computed axial tomography

There should be a specific protocol for these studies and evaluate the bony structures involved, the airway and the nostrils.

The protocol carried out for the acquisition of the images has some variations with respect to the conventional one. The patient must be instructed to breathe normally through the nose, remove all intraoral attachments that can be removed, keep the mouth closed without close contact of the dental arches and avoid any movement, for which the head can be fixed. Maintaining the patient's occlusion is very important, since if the patient makes an opening, it alters the real position of the mandible and the anatomical assessment.

For the virtual analysis for surgical planning a special protocol should be performed: the axial orientation plane is through Frankfort's horizontal plane (craniometric horizontal reference plane formed by the junction of the infraorbital rim with the upper edge of the external auditory canal) without any degree of head inclination, with the *gantry* at 0°. It is suggested to fix the head to avoid movements. Include from the superior border of the orbits to approximately 2 cm caudal to the hyoid bone. This allows the correct tracing of the cephalometric points and the evaluation of the airway (Figure 3).

The intermaxillary relationship should be taken in closed mouth (occlusion) without dental contact. The patient should be instructed by the surgeon on the desired position and all removable oral devices should be removed.

The slice thickness should be 0.625 mm. Axial images should be sent in bone algorithm and DICOM format, as they are used to construct virtual three-dimensional or stereolithographic models (6, 15).

An investigation was conducted on the role of CT in pre-surgical treatment planning of patients with FDA and the most important features to evaluate them. Then a correlation was made with cases from the institution to which the authors of this article belong.

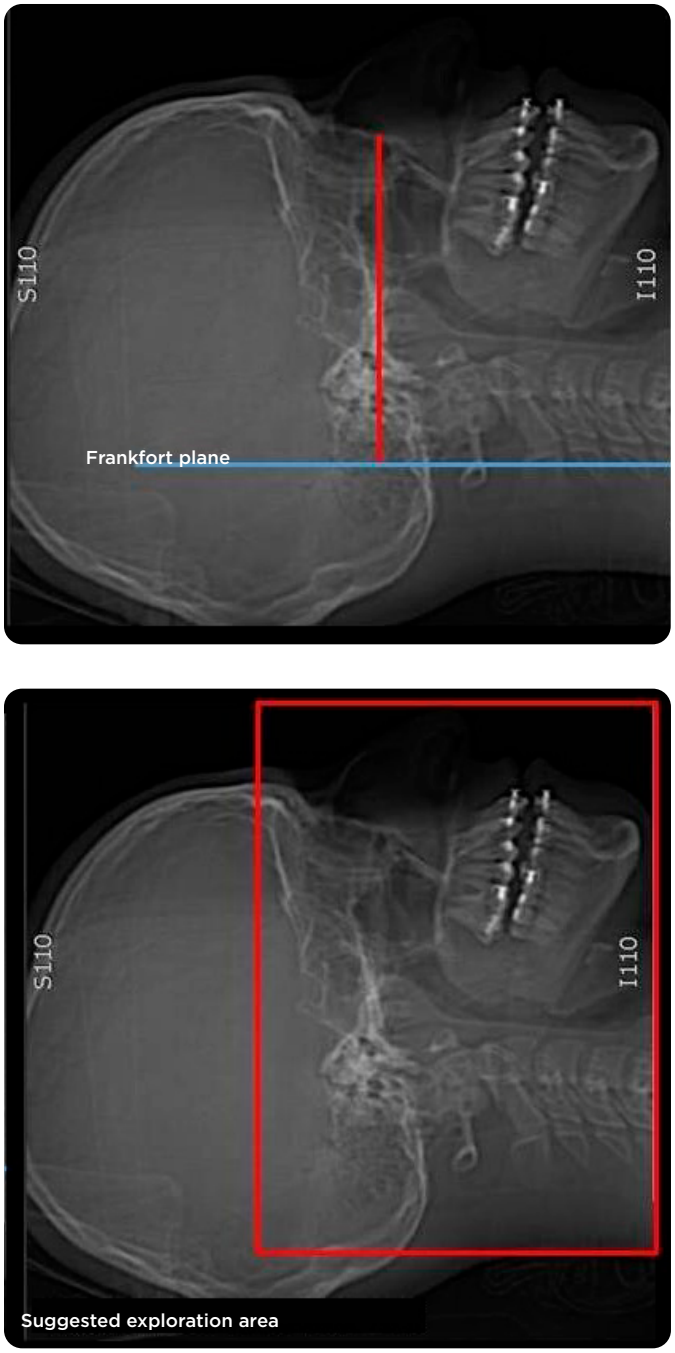



Figure 3. Special CT protocol for surgical planning of dentofacial anomalies. Schematic scan of the Frankfort plane and suggested scan area.

## Virtual pre-surgical evaluation of FDAs

Virtual models based on thin-slice CT acquisitions allow for surgery simulations, cutting guides to avoid anatomical structures and surgical splints to replicate what is planned. Surgery is performed by Le Fort I type maxillary osteotomy, sagittal osteotomy of the mandibular ramus or chin osteotomy. Remodeling of the piriform aperture and nasal floor can also be performed, but usually requires a combination

of procedures. Virtual preoperative evaluation also allows calculation of the airway diameter and simulation of its variations after surgery.

Seven items should be considered in this virtual presurgical evaluation:

- CT-cephalometry.
- Mandibular condyle and condylar fossa.
- Airway evaluation.
- Position of the hyoid bone.
- Evaluation of the maxillary structures (nasal floor, piriform aperture, nasal septum, turbinates and adenoids).
- Facial asymmetry due to mandibular deviation.
- Height of the piriform aperture.

### *CT-cephalometry*

Cephalometry deals with the quantification of the dimensions of the human head. It is most often associated with the diagnosis and treatment of dentofacial anomalies (11, 16). Using established reference points, lines and planes are formed and described in terms of lengths, angles and proportions (Figure 4) (Table 2).

**Table 2. CT cephalometric benchmarks**

| Point | Description |
|---|---|
| S (Sella) | Center of the sella turcica |
| N (Nasion) | Union of nasal and frontal bones |
| Or (Orbitale) | The lowest point of the orbital rim |
| Po (Porion) | The upper point of the external auditory meatus |
| ANS | Anterior nasal spine, the most anterior and superior point of the anterior maxillary contour |
| PNS | Posterior nasal spine, most posterior point of the hard palate |
| Point A | Most posterior point of the anterior maxillary contour |
| Point B | Posterior most point of the anterior mandibular contour |
| Pg (Pogonion) | Most anterior point of the anterior mandibular contour |
| Gn (Gnation) | The most anterior and inferior point of the symphysis |
| Me (Menton) | The most inferior point of the symphysis |
| Go (Gonion) | The lowest and most posterior point of the mandibular angle |
| Co (Condylion) | The superior and most posterior point of the mandibular condyle |

The position of the maxilla and mandible is defined with angular and linear measurements (17). The following is a description of the measurements to be taken in CT in sagittal reconstruction (16):

1. Ratio of the maxilla in the horizontal plane 2:
   - Angle saddle-nasion point1* A (S-N/A) (Steiner) (Figure 5).
   - Description: Angle formed by the saddle and the nasion point A. Normal value: 82° (± 2°).
   - Interpretation: Indicates the anteroposterior position of the maxilla with respect to the skull base. Greater angles indicate

*Sagittal craniometric point located at the intersection of the frontonasal suture with the frontal and internasal sutures; corresponds to the midpoint of the frontonasal suture.

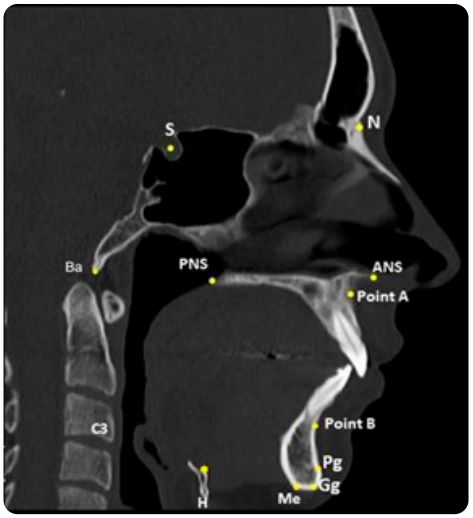



Figure 4. CT-cephalometric landmarks. Facial CT mid-sagittal reconstruction with landmarks annotated.

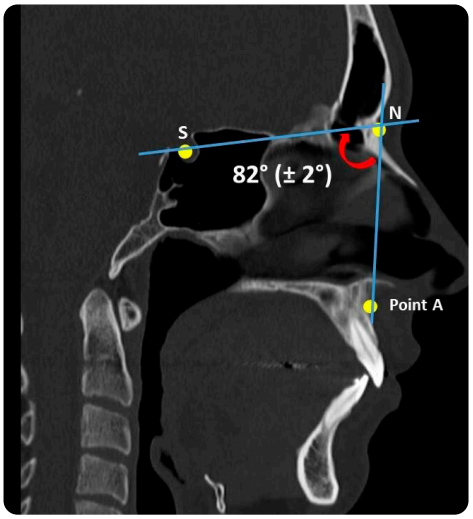



Figure 5. Facial CT sagittal reconstruction demonstrating sillanasion angle point A (S-N/A) (Steiner).

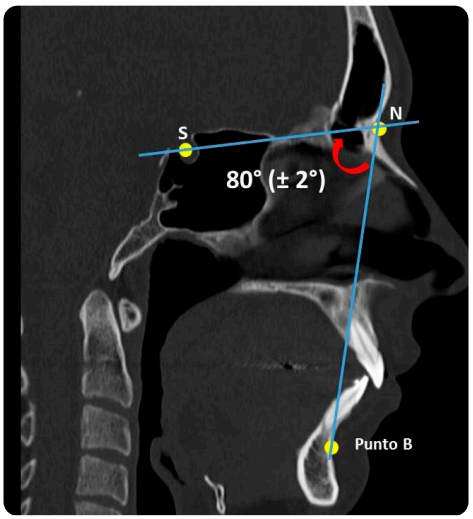



Figure 6. Sagittal facial CT sagittal reconstruction demonstrating saddle-nasion-point B (S-N/B) angle (Steiner).

an advanced or protruding maxilla, and a lesser angle indicates a reconstructed maxilla.

2. Horizontal mandibular relationship
   - Silla-nasion-point B (S-N/B) angle (Steiner) (Figure 6).
   - Description: angle formed by the saddle-nasion (S-Na) and nasion-point B (Na-B) planes.
   - Normal: 80° (± 2°)
   - Interpretation: indicates the anteroposterior location of the mandible in relation to the skull base. Larger angles indicate advanced mandibles, and smaller angles indicate reformed mandibles in relation to the skull base. This measurement may be altered due to the location of the nasion. A short cranial base increases the angle and a long cranial base decreases the angle.
3. Angle point A-nasion / point B (A-N/B) (Steiner) (Figure 7).
   - Description: The angle formed by the planes nasion-point A (N-A) and nasion-point B (N-B). Normal: 2º (± 2º)
   - Interpretation: indicates the anteroposterior relationship between the maxilla and mandible. Increased angles (> 4°) indicate a class II relationship, while negative angles (<0°) indicate a class III relationship. Negative angles occur when the N-B plane is ahead of the N-A plane. Although this angle indicates the maxillomandibular relationship, it does not indicate whether the problem is due to the mandible or maxilla. A short cranial base produces an open angle and a long one will close it.

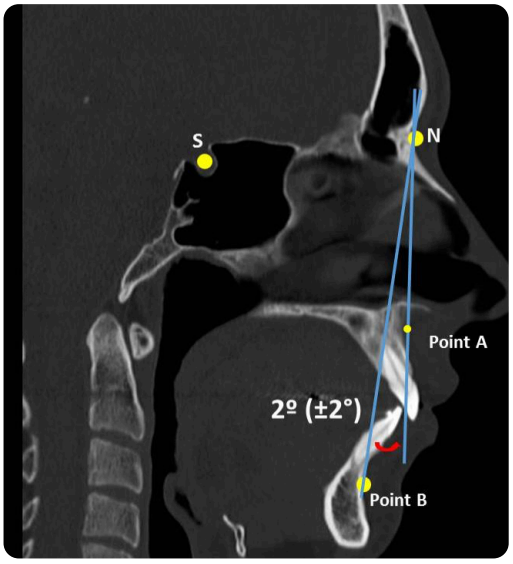



Figure 7. Facial CT in sagittal reconstruction demonstrating the angle point A-nasion/point B (A-N/B) (Steiner).

## *Mandibular condyle and condylar fossa*

The relationship between the condyle and the fossa, the concentric position of the condyles and the symmetry between the right and left sides should be evaluated. The head should be positioned so that the table is perpendicular to the mid-sagittal and Frankfort planes.

Axial slices are the most appropriate to evaluate the symmetry between the condyles in the anteroposterior and lateral aspect, because it shows both condyles in the same image. Sagittal reconstructions are the most appropriate to evaluate the relationship between the condyle and the fossa, they allow to analyze the concentricity of the condyle by comparing the anterior and posterior articular space, as well as the depth of the mandibular fossa.

The following measurements can be taken in the sagittal plane (18):

- Mandibular fossa depth: measured from the most superior point of the fossa, with respect to a plane formed by the lowest point of the articular tubercle, to the lowest point of the external auditory meatus (Figure 8).
- Anterior articular space: the shortest distance between the most anterior point of the condyle and the posterior wall of the articular tubercle (Figure 9a).
- Superior articular space: the shortest distance between the highest point of the condyle and the highest point of the mandibular fossa (Figure 9b).
- Posterior joint space: the shortest distance between the most posterior point of the condyle and the posterior wall of the mandibular fossa (Figure 9c).
- In the axial plane the anteroposterior and mediolateral diameters of the mandibular condyle can be evaluated (18) (Figures 10, 11).

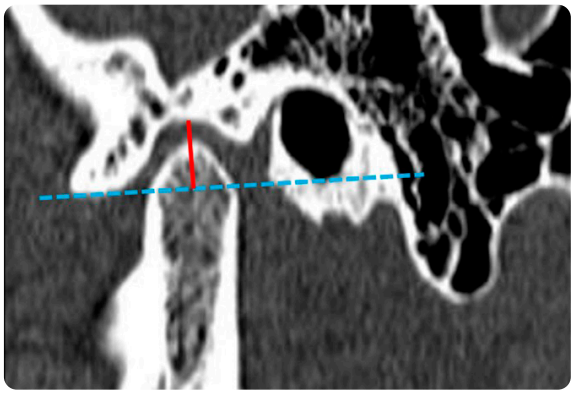


Figure 8. Facial CT in sagittal reconstruction to evaluate the depth of the mandibular fossa.

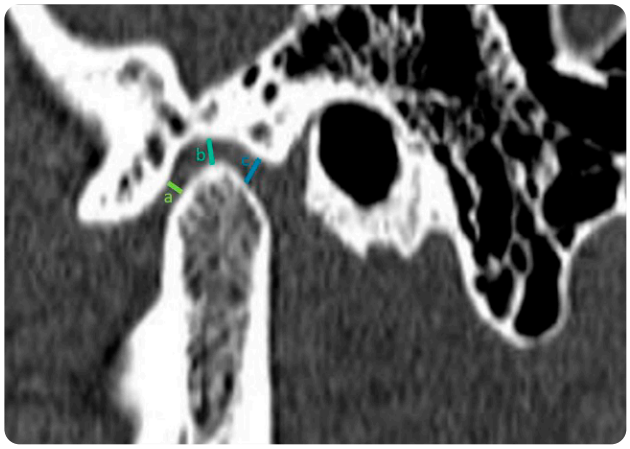



Figure 9. Facial CT in sagittal reconstruction to evaluate: a) anterior articular space; b) superior articular space, and c) posterior articular space.

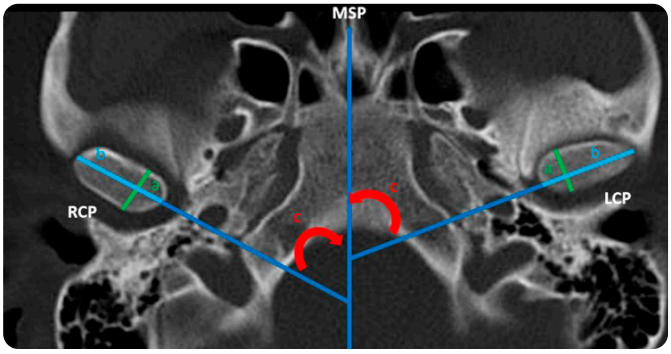



Figure 10. Axial CT. a) Distance between the center of the condylar process to the mandibular plane. b) Mediolateral diameter of the mandibular condylar process. c) Medial sagittal (MSP). b) Anteroposterior difference of the cond-ylar processes. Angle of the lateromedial plane of the condylar process/mid-sagittal process). Left condylar process (LCP), right condylar process (RCP), mid-sagittal plane (MSP).

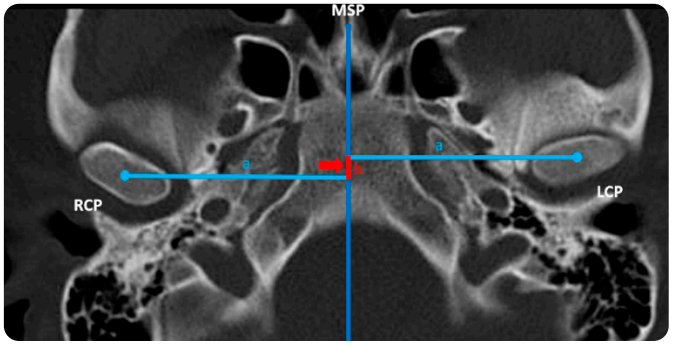



Figure 11. Axial CT image. a) Anteroposterior greater diameter of the condyle.

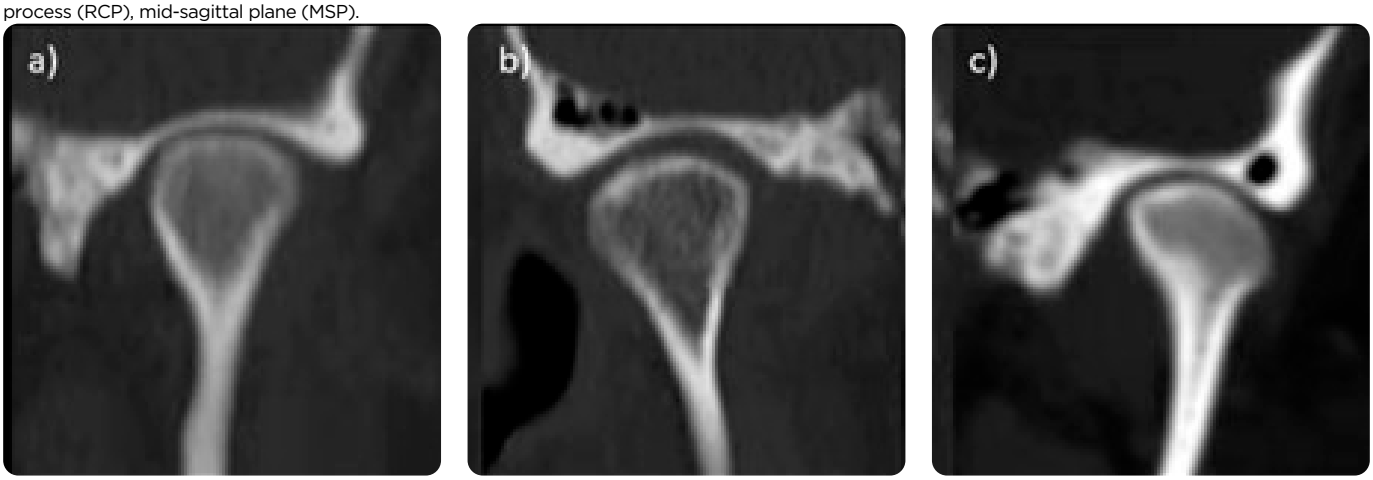



Figure 12. Facial CT in coronal reconstruction evaluating the morphologic classification of the condyles: a) round; b) convex; c) angulated.

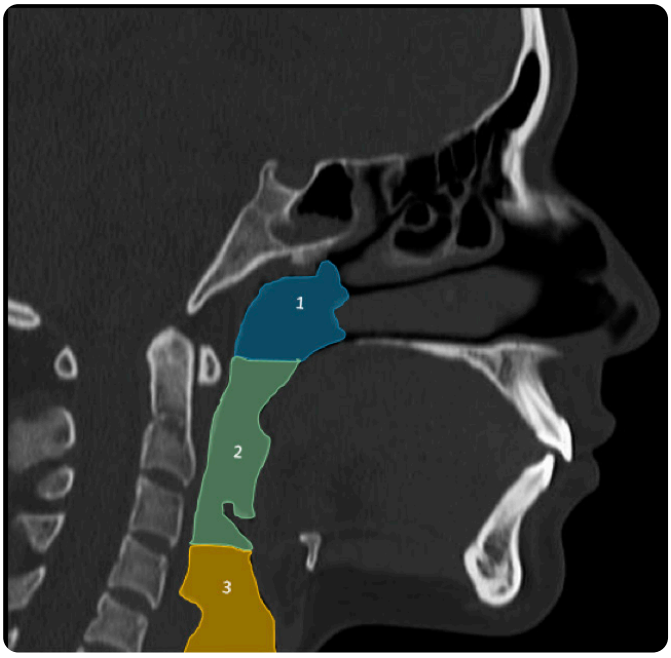



Figure 13. Facial CT. Sagittal reconstruction illustrating: 1) Nasopharynx (from the basioesphenoid to the superior border of the soft palate); 2) Oropharynx (from the superior border of the soft palate to the hyoid bone). 3) Hypopharynx (from the hyoid bone to the cricoid cartilage).

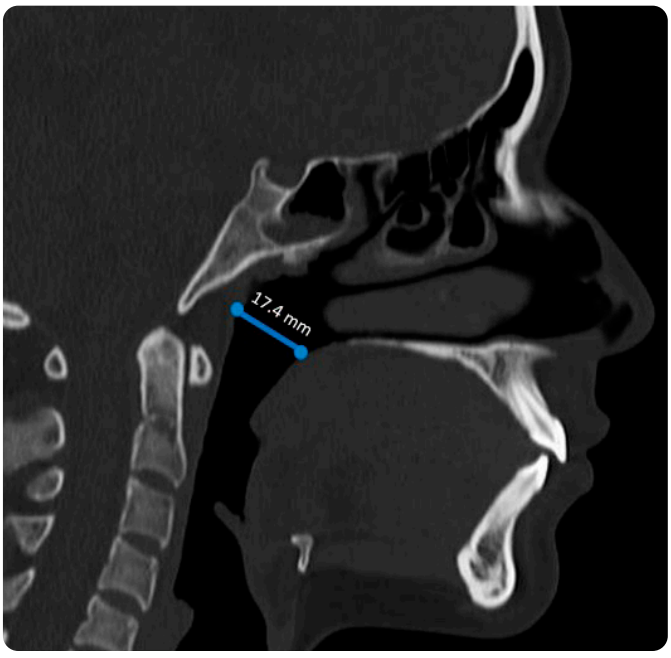



Figure 14. Facial CT. Sagittal reconstruction to evaluate the upper pharyngeal space.

Asymmetries of the condyles generate mandibular asymmetries (transverse plane) and occur by excess (hyperplasia of the mandibular condyle) or defect (underdevelopment of the mandibular condyle). It has been observed that there is no condylar centralization and that the anterior articular spaces are smaller than the posterior ones (18, 19).

In the coronal plane of the condyle it is possible to evaluate its morphology, according to the classification of Kinzinger et al. into round, convex and angulated (19) (Figure 12).

It is important to determine if the condyle presents resorption characteristics, taking into account the relationship between dentofacial anomalies and condylar morphology alterations, especially class II FDA (idiopathic condylar resorption) (19).

### *Airway evaluation*

FDA are associated with respiratory alterations generated by structural factors of the nasal cavity and pharynx, so it is important to describe them so that the surgeon can intervene on them if necessary. Hypertrophy of the adenoid tissue or palatine tonsils, sinuous nasal septum or with bony spurs, hypertrophy of the inferior turbinate, a narrow nasal opening or elevated nasal floor are alterations susceptible to repair at the time of surgery.

Orthognathic surgery, especially for the correction of class III malocclusion, may decrease airway width and lead to obstructive sleep apnea syndrome (OSAS) (20, 21).

The position and size of the maxilla and mandible are directly related to the diameter of the airway; for this reason, nowadays, before performing any movement with orthognathic surgery, the diameter of the upper airway is evaluated, mainly in those procedures that require posterior movements of the mandible or maxilla.

The soft palate and the muscle groups that insert into the maxilla determine the upper pharyngeal space; anterior movements of the upper pharyngeal space favor an increase in the diameter of this space.

The suprahyoid musculature that inserts in the anterior and lateral maxilla and in the hyoid bone can be modified with anterior or posterior movements of the mandible, all anterior movements of the mandible imply an enlargement of the airway in the lower pharyngeal space, so it is used for the surgical management of sleep apnea/hypopnea syndrome; posterior movements of the mandible should be evaluated in detail before surgery, since they can cause a decrease in this diameter.

Several methods have been described for the measurement of the airway, by cephalometry or with computer programs, which allow the area and volume to be calculated.

As reference points for the delimitation of the nasopharynx, it is taken from the nasion-S line (or roof of the nasopharynx) to the ENP-basion** plane; the oropharynx from this plane to the inferior border of C3, and the hypopharynx to the inferior border of C4 (22) (Figure 13).

The points that correlate with a greater obstruction or decrease in diameter are (23):

- The area posterior to the soft palate, in the axial plane, is the shortest distance between the soft palate and the posterior pharyngeal wall.
- The oropharyngeal area, in the axial plane, is the shortest distance between the base of the tongue and the posterior pharyngeal wall.
- The hypopharyngeal area, in the axial plane, is the distance at the level of the tip of the epiglottis.

McNamara's cephalometric analysis (24) describes two measurements and values:

- Upper pharyngeal space: the distance from the anterior half of the soft palate to the posterior pharyngeal wall is taken (Figure 14). Normal values: 17.4 mm, +/- 3.4 in women and 4.3 in men.
- Inferior pharyngeal space: to obtain this measurement in CT it is suggested to move in the sagittal images to the plane of the mandibular angle (figure 15) and then, having it as a reference, the point of intersection between the posterior contour of the tongue and the plane of the inferior border of the mandible is looked for, and it is measured from there to the posterior pharyngeal wall (figure 16).
- Normal values: women 11.3 mm +/- 3.3 mm and men 13.5 mm +/- 3.4.

### *Position of the hyoid bone*

The suprahyoid musculature has insertion in the mandible, then, when changes in the position of the mandible are made, the position of the hyoid is also affected, and the dimensions of the upper airway vary. The measurement of H-Me and H-Y (perpendicular line from H to a horizontal to S) and C3-H (25, 26) allow to assess the position of the hyoid (figure 17).

### *Evaluation of jaw structures*

There are structural conditions that predispose to nasal airway obstruction, such as nasal septal deviation, inferior turbinate hypertrophy, elevated or irregular nasal floor, and narrow piriform aperture.

- Normal values of the pyriform aperture dimension (30):
- Australian: 30.2 mm
- Afro-descendants: 27.9 mm.
- Germans: 24.9 ±3.2 mm
- Koreans: 25.9 mm ± 3.8 mm

The vertical excess of the maxilla is a condition that is related to the elevation of the nasal floor and the narrow piriform opening. To evaluate it, a perpendicular line should be drawn from the palatal plane to the edge of the upper central incisor (Figure 18), and correlated with the measurements established according to the Riolo Atlas, in which it is considered abnormal if it is greater than three standard deviations (27-29). Normal value in adults: women 30 mm, SD 2.9 mm and men 33 mm, SD 3.2 mm.

### *Facial asymmetry due to mandibular deviation*

It is related to the asymmetric position and morphology of the mandible. For example, differences in mandibular body length, mandibular ramus height or condylar growth. Most mandibular deviations are to the left (85%).

**Located at the lower end of the sphenoid bone contour. Represents the most anterior point of the foramen magnum at the base of the occipital bone.



Figure 15. Facial CT. Sagittal reconstruction showing the mandibular angle.

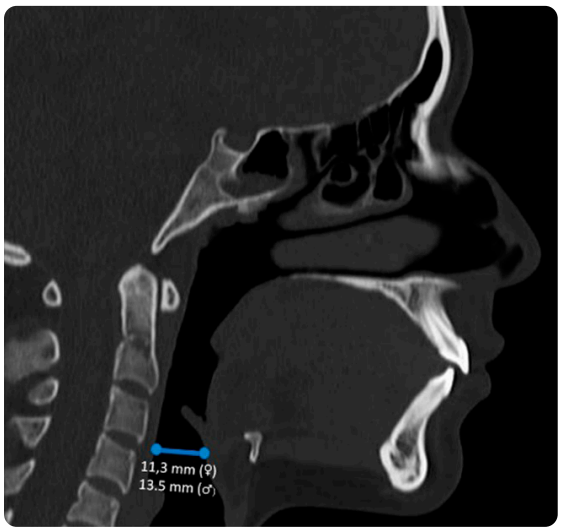



Figure 16. Facial CT. Sagittal reconstruction to evaluate the inferior pharyngeal space.

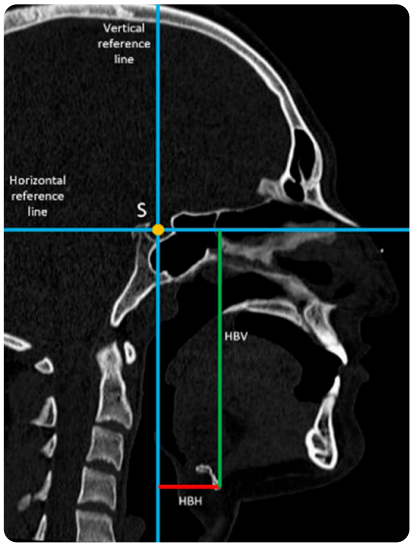



Figure 17. Facial CT. Sagittal reconstruction with horizontal (HBH, red), vertical (HBV, green) measurements. Landmarks: H (hyoid), Me (chin), S (sella turcica), Y line (blue, perpendicular to S), horizontal reference line (blue, parallel to S).

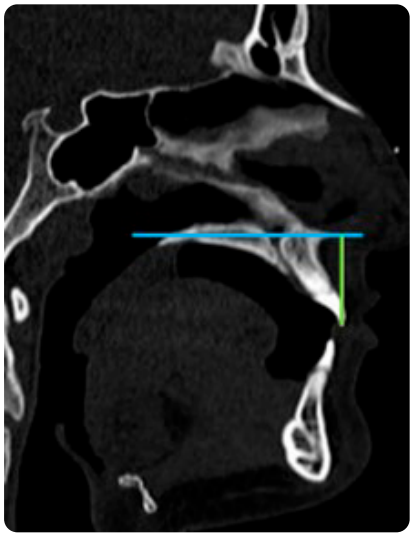


Figure 18. Facial CT. Sagittal reconstruction of craniofacial growth, according to the Riolo Atlas (Mean ± 30 mm).

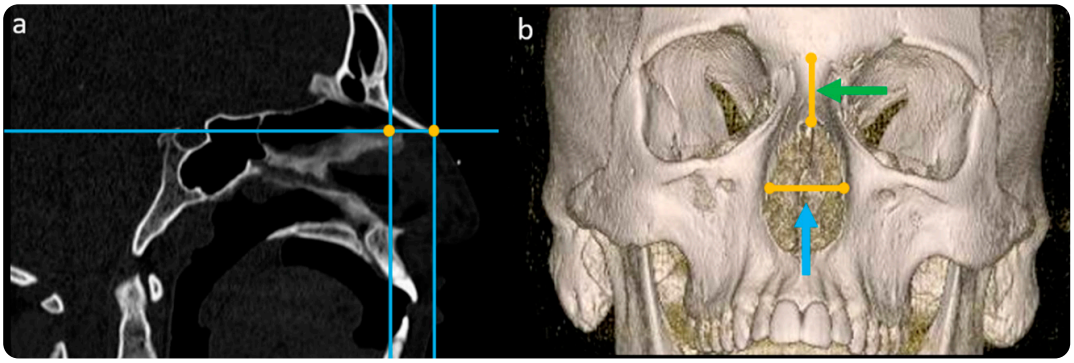



Figure 19. a) Facial CT sagittal reconstruction illustrating the distance between the points corresponding to the rhinion-nasal projection; b) 3D facial reconstruction. The distance between the points corresponds to the length of the nasal bone (green arrow) and the width of the piriform aperture (blue arrow).

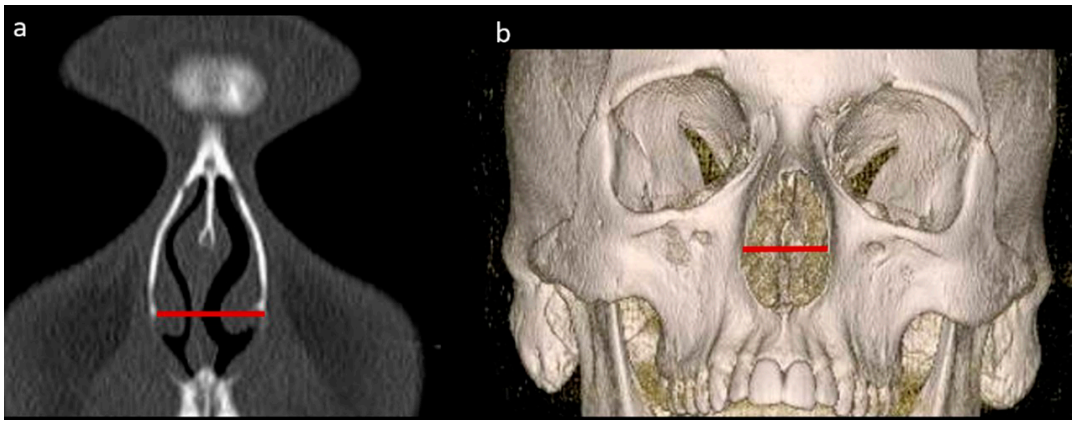



Figure 20. a) Coronal CT facial reconstruction illustrating the distance between the dots; b) corresponds to the width of the piriform aperture.

In a coronal plane, where the anterior nasal spine (ANS) is seen, a line is drawn between it and the middle between the nasal bones to the mandible. This is described as the mandibular midline which may be deviated to the right or to the left. Height of the piriform aperture

### *Height of the piriformis aperture*

The piriform aperture is the anterior nasal osseous orifice which is delimited by the nasal bones themselves and the maxillary nasal processes (Figures 19, 20), it represents the narrowest part of the nasal airway. Its measurement is made from the bony wall of the nasal fossa to the septum on each side, in the axial section at the level of the inferior meatus or in the three-dimensional reconstructions at the widest point of this (30); it can also be measured in the coronal reconstruction at the inferior border of the nasal bone and the measurements of the two sides are added (26). The width of the pyriform aperture varies according to race; it has been found to be narrower in Oriental people than in Westerners, but there are no conclusive results due to the different methods used (26). Some of the values found in studies are: in Anatolian population, 18.1 mm; Australia, 21.6 mm, and India, 22.67 mm, and they are narrower pyriform apertures compared to Chinese (24.56 mm), Malays (24.05 mm) and Korean populations (24.01 mm), while Africans (26.5 mm) have the widest pyriform aperture. It is suggested that this phenomenon is due to the need for climate regulation. It is suggested that this phenomenon is due to the need for climate regulation (31).

## Important values to take into account in the evaluation of dentofacial anomalies

### *Normal values of the pyriform aperture width (32) (figure 20):*

- Males: 21.9 ± 2.1 mm (18-27 mm)
- Females: 21 ± 2.2 mm (17-26 mm)

### *Evaluation of intranasal anatomy (27):*

- Septal deviation? "Yes" bone and cartilage 7.
- Hypertrophy of inferior turbinate? "Yes"
- Narrow nasal entry? "Yes"
- Elevated nasal floor? "No."

### *How is the airway affected by this condition?*

- Dimension of upper and lower pharyngeal spaces: decreased.
- Intranasal structures are affected by high or narrow nasal cavities.
- Position of the hyoid bone (33-36).
- The anatomical features of the temporomandibular joint are very important for the space between the condyles of the mandible and the glenoid cavity.

## Conclusions

The formation of interdisciplinary working groups allows a better approach to the studies in order to report the information that is really useful in the clinical management of patients. A minimum knowledge of the language used in the management of dentofacial anomalies is necessary to provide accurate information.

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