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Important Aspects to Consider in Facial Analysis for Orthognatic Surgery

Aspectos Importantes a Considerar en el Análisis Facial para la Cirugía Ortognática

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SUMMARY: The process of facial analysis for orthognathic surgery has become of utmost importance over the last several decades, many studies show that the correction of occlusion in a dentofacial deformity does not always reach the desired facial proportions. There is no face completely symmetrical; However, the absence of some asymmetry is essential for an aesthetic outcome. Moreover, the perfect understanding of the face balance prior to treatment is critical to obtain the success of the treatment plan. Thus, the search for facial harmony requires an organized process of facial evaluation; which we intend to address in this article.

KEYWORDS: Facial Analysis; Orthognathic Surgery; Facial Aesthetic.

INTRODUCTION

The objective of combined orthodontic-surgical treatment is the restoration of functional occlusion associated with facial harmony. Most subjects seek orthognathic surgery for aesthetic improvement. Occlusal results should provide long-term stability with minimal tooth wear and can be achieved in a very objective manner. However, both professionals and subjects may have different opinions regarding facial harmony or facial balance. It is worth mentioning that the search for facial aesthetics cannot be based on any given beauty concept; which individually considered may result in different opinions. The search for facial aesthetics should be based on standards or patterns of facial tissue positioning established over the years and reported in scientific papers.

The soft tissue positioning is directly proportional to the bone movements generated by the orthognathic surgery. Therefore, understanding the effects of osteotomies associated with soft tissue evaluation before surgery should define the treatment plan. The cephalometric study at this point may not be the most important factor to be considered, but the precise diagnosis of the proportion of soft tissues that cover the bone tissue.

Thus, the correct facial evaluation should determine the maxillo-mandibular movement required and optimize the expected aesthetic-functional result.

Correct and detailed preoperative facial analysis before orthognathic surgery should provide the surgeon with means to properly assess the proportionality of facial thirds, facial contour, alignment of midlines, projection of orbital border and mandibular angles, nasal projection, presence of nasolabial and mentocervical angles, as well as dental exposure at rest and smile. It should be taken from front and lateral norms at rest and smile (Arnett & Bergmann, 1993a, b; Arnett *et al*., 1999).

For a correct facial evaluation, the accurate positioning of the subject's head for facial analysis is fundamental (Betts & Zweig, 2000). It's important to find the natural position of the head and avoid deviations (Lundström & Lundström, 1995) as well as the parallelism between the bipupilar plane and the ground in frontal norm (Fig. 1). In lateral norm we must pay attention to the parallelism between the Frankfort plane and the ground (Fig.2). Subject and surgeon should be at the same hight for the correct evaluation;

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which should occur with the subject in centric relation and relaxed lips (Arnett & Bergmann, 1993a, b).

Fig. 1. Frontal norm for facial analysis. Bipupilar plane parallel to the ground and subject in a natural head position.

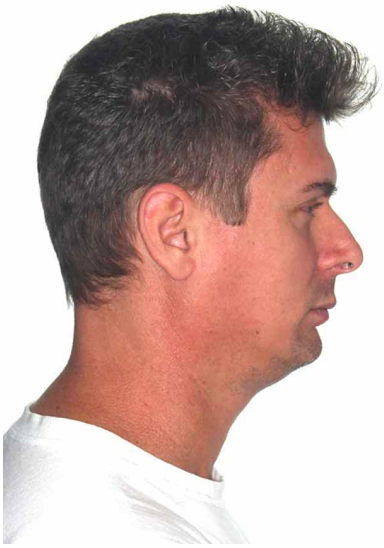

Fig. 2. Lateral norm for facial analysis. Frankfort plan parallel to the ground and subject in natural head position.

The face can be vertically divided into three thirds. The upper third extends from the hairline (Trichion) to the glabella; the middle third extends from the Glabella to the base of the nose and the lower third, extends from the base of the nose to the lower portion of the mentum. Each facial third proportionally represents 1/3 of the face vertically. Deformities of the upper third will hardly be treated by us. However, discrepancies between the middle and lower thirds deserve to be correctly evaluated. The middle and lower thirds should be proportional (Arnett & Bergmann, 1993a, b) (Fig. 3).

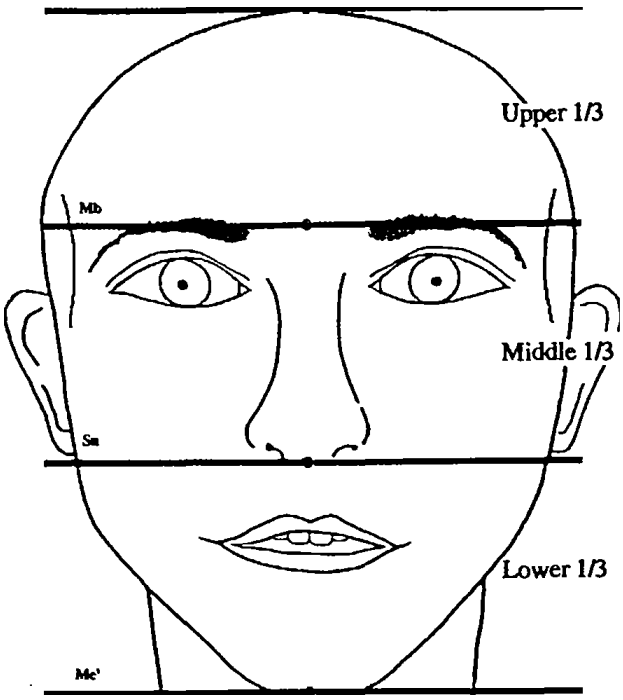

Fig. 3. Facial Thirds (Upper/ Middle and Lower). Adapted from: Arnett, G. W, & Bergmann, R. T. Facial Keys to Orthodontic Diagnosis and treatment planning. Part II. Am. *Am. J. Orthod. Dentofacial Orthop.,116(3)*:239-53, 1999. p. 243

In frontal view, within the middle third, the most important measures are the intercanthal distance (distance between the mesial edges of the corner of the eye); which are also used as reference for the alar base width (34 ± 2 mm). The interpupillary distance is 60 - 65 mm. Additionally, zygomatic projection, infraorbital rhyme and bilateral paranasal areas can be identified as deficient or suitable for surgical planning (Arnett & Bergmann, 1993a, b; Arnett *et al*.).

We should also evaluate nose symmetry which may need a procedure compatible with orthognathic surgery. Septorhinoplasty may be associated with the treatment of dentofacial deformity and must be performed before the orthognathic surgical treatment (Gil & Claus, 2009).

The lower third should be evaluated with lips relaxed and smiling (Burstone, 1967). Initially we should pay attention to the fact that lip asymmetry or muscle hyperfunction may alter the planning of bone surgery. Speech therapy or physiotherapy may be associated with treatment in cases of hypo or hyperfunction of the lips (Gil & Claus). The length of a female lip may vary between 19 and 21 mm and of a male lip between 22 and 24.5 mm. The interlabial distance in males should be 2.5 mm and in females 3.5 mm (Arnett & Bergmann, 1993b). Upper incisors exposure with respect to upper lip, measured from the incisal edge of the incisors, which should measure 2 - 3 mm at rest and 8 mm (± 2 mm) smiling and the upper/lower lip length ratio should be 1⁄2 (Burstone, 1967; Arnett & Bergmann, 1993a, b; Arnett *et al*.; Profitt *et al*., 2002).

During the treatment of vertical maxillary excess, it is important to emphasize that the impaction need must be evaluated at rest (Gil & Claus, 2009). Another important measure is the lower central incisors exposure with respect to the lower lip, which should measure 1 mm (Profitt *et al*.). Vertically, the normal height from the incisal edge of the lower incisors to the mandibular base in the region of the mentum, should be 40 mm for females and 44 mm for males (Arnett & Bergmann, 1993b).

In the frontal view we can also determine whether there is an alteration in the maxillary occlusal plane (Gil & Claus). This can be easily noticed with the aid of a wooden spatula placed against the upper teeth and by measuring the distance to the pupil bilaterally (Gil & Claus) (Fig.4) The relationship of the facial middle line to the dental middle lines can also be defined with the help of dental wire or tape guided by the midline of the hair (Trichion) to the mandibular midline in the chin region (Fig. 5). There are five medium lines to be determined. Also, it is important to observe the relationship of the middle line of the face to the maxilla, to the mandible and to the mentum separately. Further, the maxillomandibular midline ratio and average mandibular line coinciding or not with the mandibular midline (chin) (Arnett & Laughlin, 2000; Cho *et al*., 2015).

In the lateral view, the facial thirds will initially define the existing facial types. The angle formed by the lines delineated by the glabella, subnasale and pogonion will define straight, concave or convex profiles (Class I, Class II or Class III) (Arnett & McLaughlin, 2004).

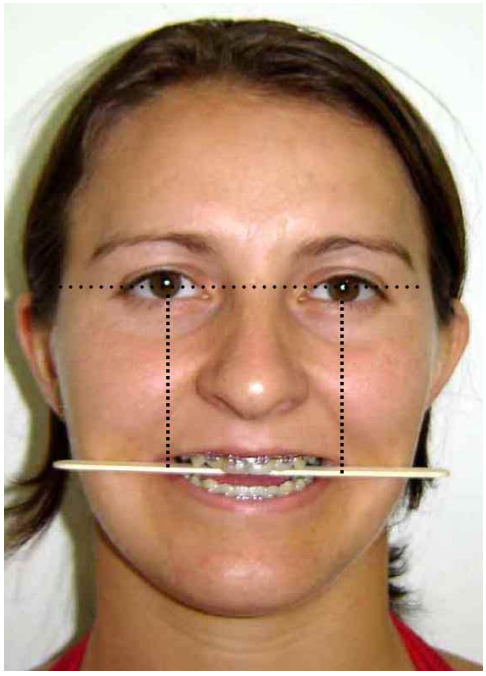

Fig 4. Clinical determination for maxillary occlusal plane alteration.

Fig. 5 Determination of maxillo-mandibular and face lines.

The middle third presents profuse information to determine balance and facial harmony. The nasal dorsum lies between 5 and 8mm anterior to the cornea (Arnett & Bergmann, 1993b). The nasolabial angle (formed by the intersection of the columella and upper portion of the upper lip) varies from 90º to 110º (Arnett & Bergmann, 1993b; Arnett & McLaughlin; Cho *et al*.). The understanding of facial analysis directly affects treatment possibilities, such as the decision of tooth extraction in the upper arch when the nasolabial angle is open (close to 105º). This could compromise facial aesthetics as it would reduce the possibility of maxillary

projection (Arnett & Bergmann, 1993b). The maxillo-mandibular contour, the orbital rhyme and the zygomatic and nasal projections are also defined in the evaluation of the middle third.

The mentolabial groove and the mentocervical length are important for defining the treatment plan with respect to the lateral lower third in lateral norm. The mentolabial angle varies from 100º to ± 10º and the mentocervical distance is 50 mm to ± 5 mm (Arnett & Bergmann, 1993b; Arnett & McLaughlin). A line drawn from the subnasal point (SN) to pogonium (Pg) is related to the upper lip. It should be 3.5 mm to ± 1.4 mm to the front of the SN-Pg line and the lower lip should be 2.2 mm to ± 1.6 mm (Burstone; Arnett & Bergmann, 1993b; Arnett *et al*.) (Fig. 6).

Fig. 6. Anteroposterior projection of the upper and lower lip with respect to the SN-Pg Line' Adapted from: Arnett, G. W, & Bergmann, R. T. Facial Keys to Orthodonc Diagnosis and treatment planning. Part II. *Am. J. Orthod. Dentofacial Orthop., 103(5)*:395-411, 1993b.

The relationship of a line perpendicular to the Frankfort plane passing through subnasal to the upper lip, lower lip and pogonium is called the true vertical line (TVL). The upper lip projection should be between 0 and 2 mm from the true vertical line. The lower lip should be 2 mm posterior to the upper lip and the pogonium should be between 2 and 4 mm anterior to the true vertical line (Arnett *et al*.; Arnett & McLaughlin). These norms represent a face closer to the ideal in terms of facial harmony (Fig. 7).

Therefore, in accordance with established norms for the evaluation of facial patterns, Arnett and

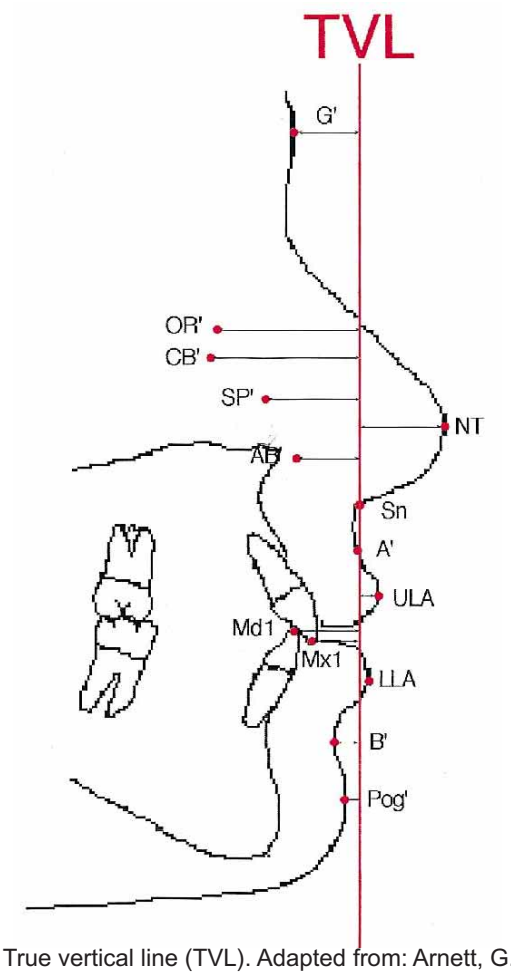

Fig. 7. True vertical line (TVL). Adapted from: Arnett, G. W.; Jelic, J. S.; Kim, J.; Cummings, D. R.; Beress, A.; Worley, C. M. Jr.; Chung, B. & Bergman, R. Soft tissue cephalometric analysis: diagnosis and treatment planning of dentofacial deformity. *Am. J. Orthod. Dentofacial Orthop.,116(3)*:239-53, 1999. p. 243

Bergmann 2 establish 08 standard facial types for the diagnosis and treatment plan of facial deformities. Class 1 subjects with maxillary vertical excess or deficiency; class II subjects with maxillary protrusion and/or mandibular retrusion and vertical maxillary excess; and class III subjects with maxilla retrusion and / or vertical maxilla deficiency and/or mandibular protrusion (Arnett & Bergmann, 1993b).

Diverse clinical features should be expected for each facial pattern and the accurate diagnosis will optimize orthodontic surgical planning.

Facial and dental pattern class I subjects may present excess (long face) or vertical deficiency of maxilla (short face), with the lower third enlarged or

reduced. Interlabial space and nasolabial angle accentuated or reduced. The nasal projection will be normal and the upper incisors may or may not be overexposed. The facial profile tends to be straight (Arnett *et al*.).

Facial and dental pattern class II subjects may present a protruded maxilla with or without vertical excess. Dental extractions may be necessary or surgical correction for maxillary impacting (Arnett *et al*.). the mandible may be retruded and mandibular advancement associated with chin surgery may be necessary. Facial profile aesthetics usually does not please and there may be increased nasal projection, decreased mentocervical length and reduced lower third. Surgical treatment offers the subject deep bone changes, restoring balance and facial harmony (Arnett *et al*.; Betts *et al*., 2000; Gil & Claus; Arnett & McLaughlin).

Facial and dental pattern class III subjects will present a mandibular protrusion associated with retrusion and/or vertical maxilla deficiency. Again, dental extractions may be necessary. The convex facial profile is not usually pleasing and there may be a decreased nasolabial angle, nasal projection, deficiency in the paranasal region, increased mentocervical distance and need for upper incisor teeth exposure; which can be obtained with single or bimaxillary surgical correction (Arnett *et al*.; Arnett & McLaughlin; Betts *et al*.; Gil & Claus; Cho *et al*.).

In addition to changes in facial profiles, the correct diagnosis in the frontal facial analysis will determine the need for adjustment of median lines, maxillary cant and upper central incisors.

CONCLUSION

The literature review evidences the deficiency in orthodontic – surgical planning performed only through cephalometrics. There is a number of information on the need for standardized clinical evaluation and the use of facial references in order to obtain a correct diagnosis and planning. Clinical evaluation is predominant on radiographic examination.

Therefore, it is a fact that facial evaluation is the most important step in planning in orthognathic surgery and that the understanding of balance and facial harmony should be objective for the surgeon in the search for excellence in his results.

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RESUMEN: El proceso de análisis facial para la cirugía ortognática se ha vuelto de suma importancia en las últimas décadas, muchos estudios muestran que la corrección de la oclusión en una deformidad dentofacial no siempre alcanza las proporciones faciales deseadas. No hay rostro completamente simétrico; sin embargo, la ausencia de alguna asimetría es esencial para un resultado estético. Además, la comprensión perfecta del equilibrio facial antes del tratamiento es fundamental para obtener el éxito del plan de tratamiento. Por lo tanto, la búsqueda de armonía facial requiere un proceso organizado de evaluación facial; que intentamos abordar en este artículo.

PALABRAS CLAVE: Análisis facial; Cirugía ortognática; Estética facial.

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