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Changes in the Airway after Mentoplasty (Genioplasty). Systematic Review

Cambios en la Vía Aérea Después de una Mentoplastia (Genioplastia). Una Revisión Sistemática

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SUMMARY: The aim of this research was to evaluate the changes obtained with the mentoplasty technique in the increase of the airway imaging. A systemic review was performed using the parameters of the prism matrix, in the PubMed, Science Direct, Redalyc database, covering the years 1984 to 2019 with the use of defined inclusion criteria. The authors independently applied the selected parameter of data extraction, study selection and risk-to-bias assessment. A total of 1,251 articles were obtained among the 3 databases, of which 10 met the inclusion criteria. The variables studied were: type of research, sample size, sex, age, dento-skeletal diagnosis, airway classification, diagnosis of obstructive sleep apnea syndrome (OSAS), type of imaging evaluation, variables evaluated in the image, pre and post-operative values, surgical technique and type of fixation used, other surgical procedures applied, and complications. In the cases of linear evaluation with cephalometric analysis (9 articles) they used PAS (posterior airspace), MP-H (mandibular plane to the hyoid) and SNB (saddle-nasion-point B), and SCSA (section area as the most relevant points, smallest cross section) and VT (total volume) in the volumetric evaluations (2 articles). The average change in posterior airspace achieved by the cited authors is 4.2 mm with standard deviation of 1.4 mm with the use of advancement mentoplasty. The most widely used technique was mentoplasty with a horizontal osteotomy by 5 authors. Based on the research there is a positive relationship between the increase in the airway and the advancement mentoplasty procedure, however, more standardized studies associated with the way of measuring and evaluating the relationship between advancement and the airway are necessary.

KEY WORD: Airway; Mentoplasty; Genioplasty; Genioglossal advance.

INTRODUCTION

The airway constitutes the upper part of the respiratory system through which air flows from the environment to the lungs, passing through anatomical structures such as: nasal cavity (occasionally oral cavity), nasopharynx, oropharynx, larynx, (passing to through the vocal cords) and trachea (Coloma & Álvarez, 2011). In the past, differential pressure measurements allowed calculating the resistance of the upper airway. However, this modality does not provide an adequate anatomical representation of the soft tissue structures surrounding the airspace. Imaging technology, meanwhile, has provided such information. Various imaging modalities have been used to assess the upper airway and the surrounding structure of bone and soft tissue, including fluoroscopy, nasopharyngoscopy, conventional cephalometry, computed tomography, and magnetic resonance imaging (Schwab & Goldberg, 1998).

In the early 1950s, the lateral cephalic was used to assess the growth of the craniofacial skeleton, however, since 1983 it has been applied to the problem of patients with respiratory sleep disorders (Olszewska *et al*., 2008). It is a simple, inexpensive, easily available, and reproducible method of evaluating obstruction of the upper airway,

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especially in relation to the craniofacial structure. Linear and angular measurements are made, divided into 5 compartments: craniofacial, soft palate, tongue, hyoid, and upper airway. To evaluate the latter, the measures are frequently used: SPAS or PAS (posterior space of the upper airway), MAS (space of the middle airway), IAS (space of the lower airway) and VAL (vertical space of the airway). The literature suggests that the measurements obtained in the cephalometric analysis can be compared with the measurements obtained in a computed tomography. (Kim *et al*., 2012; Arias Contreras & Sepúlveda Vizcaíno, 2016).

Computed tomography (CT) can provide information in multiple dimensions of real-time images, when performed at different phases of respiration, it can also provide information about the cross section of the airways and the site of collapse, allowing an accurate evaluation, this technique offers a sensitivity of 86.67 % and specificity of 64.29 % for respiratory disorders such as obstructive sleep apnea syndrome (OSA) (Bhattacharyya *et al*., 2000; Abramson *et al*., 2010). Airway areas can be evaluated by four transverse planes, whose measurements include: PNS (posterior nasal spine) - posterior air plane, the area of the plane of the soft palate, the area of the plane from the most posterior point of the base of the tongue and the area of the plane from the root of the epiglottis. The upper airway is then divided into four parts by the four planes mentioned above, as well as the plane that passes through the PNS-chair line and is perpendicular to the sagittal plane. These parts include the palatopharyngeal part, the oropharyngeal part, the glossopharyngeal part, and the laryngeal part. Regarding bone tissue, the three-dimensional location of the hyoid bone is frequently evaluated by comparing the relative position change between point N and point H (Du *et al*., 2017).

All these imaging tools provide information on anatomical abnormalities and the level of pharyngeal narrowing, which is essential in practice as a complement to select the appropriate treatment for each patient (Arias Contreras & Sepúlveda Vizcaíno). After the pre-surgical evaluation, the patient should be classified according to the site of the obstruction, Riley *et al*. (1993) classifies them as Type I oropharynx, Type II oropharynx and hypopharynx and Type III hypopharynx. Other authors such as Fujita (1991) classify them equally according to the site of obstruction in Type I oropharynx, Type II oropharynx / tongue base and Type III hypopharynx. For their part, Bravo *et al*. (2012) were based on volumetric measurements of the cross-sectional area of the airway, classifying them as narrow <70 mm2 and normal> 70 mm2, according to values established in the literature and related to the presence of respiratory pathologies.

Among respiratory pathologies we have obstructive sleep apnea syndrome (OSAS), which is a disorder characterized by repetitive episodes of obstruction of the upper airway during sleep, causing a complete interruption of air flow (apnea) or partial (hypoapnea) for more than 10 seconds, accompanied by transient awakenings during sleep (Benumof, 2001). There are 3 types of sleep apnea: 1. Central apnea: characterized by the absence of movements, both at the level of the diaphragm and other accessory muscles of respiration. 2. Obstructive apnea: there is no air flow exchange at the level of the upper airways despite the persistence of stimuli at the level of the central nervous system, as evidenced by diaphragmatic mobility and the progressive accentuation of the activity of the respiratory muscles. 3. Mixed apnea: characterized by an initial central component followed by an obstructive component (Lam *et al*., 2010). The severity of OSAS will be determined with the apnea-hypopnea / hour index: mild, moderate or severe, with an apnea-hypopnea / hour index of 5-15, 15-30 or greater than 30, respectively (Quan *et al*., 1999).

Treatment varies depending on the etiology of the disease and the severity of OSAS (Epstein *et al*., 2009) initially a conservative treatment is described that consists of lifestyle correction, management of obesity as a risk factor, elimination of habits such as alcohol, tobacco, drugs, proper body position. Followed by the use of extraoral devices such as the continuous positive airway pressure mask (CPAP), use of intraoral devices that modify the position of the jaw and tongue, and finally surgical treatment. (Ho, Matthew & Steven, 2011).

The basis of OSAS surgical treatment is multilevel surgery, which follows a protocol based on the severity and location of the obstruction. In phase I surgery, patients with type I obstruction (soft palate) receive uvulopalatopharyngoplasty (UPPP) and patients with type III obstruction (base of the tongue) receive advance genioplasty with myotomy and hyoid suspension (GAHM). Patients with type II (palate and base of the tongue) receive UPPP and GAHM at the same surgical time. If patients have nasal deformities, nasal reconstruction is performed during phase I surgery. If after 6 months of follow-up the desired success is not obtained (reduction of signs and symptoms and increase of the airway confirmed by imaging) it should be passed to phase 2: maxillo-mandibular advancement (Riley *et al*., 1993; Barrera, 2016).

Orthognathic surgery has the ability to produce modifications in the skeletal and soft tissue components of the orofacial complex. The pharyngeal airway space (PAS) can be changed when treating dento-maxillofacial deformities by means of bilateral mandibular branch sagittal osteotomy (BSSRO), Le Fort I osteotomy, mentoplasty, etc. (Du *et al*.).

Mentoplasty is a procedure indicated for the resolution of skeletal facial deformities and in addition to the aesthetic component, this procedure has been described as a surgical solution to treat obstructive sleep apnea, allowing the air volume to be increased (Vargo *et al*., 2017). It is well established in the literature that chin advancement procedures generally achieve an advancement target of 8 to 14 mm, thereby increasing tension in the pharynx, genioglossus, and geniohyoid muscles with the aim of reducing the severity of the sleep apnea (Barrera).

There is extensive information in the literature about changes in the airway in patients undergoing orthognathic surgery, however, it is not specifically determined whether each isolated procedure is called maxillary, mandibular, or mentoplasty surgery, it achieves the objective of improving the conditions of the patient's respiratory function. On the other hand, the increase achieved by each procedure, especially with mentoplasty, is not quantitatively established, which is relevant in the treatment of respiratory disorders such as obstructive sleep apnea, or other cases where the solution could come alone of the movement achieved with the mentoplasty, without the need for the combination with mandibular and or maxillary advances.

The purpose of this study is to evaluate the changes obtained with the mentoplasty technique in the increase in airway imaging.

MATERIAL AND METHOD

This research was carried out through a systematic review of the articles published according to the PRISMA Statedment and protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes). A protocol which includes all the methodological aspects of a systematic review which were developed prior to the start of this review. This includes defining a precise question, the PICO question (Patient, Intervention, Comparison, Outcome); a defined search strategy, an inclusion criterion, determine the measurement of results, visualization methods, data extraction and its analysis and synthesis. The search protocol was carried out by 2 independent operators, and the results were compared. If there are discrepancies in the search, an agreement is reached between the authors.

In this research, the PICO question was P: Patients with airway obstruction. I: Mentoplasty. C: Imaging evaluation of the airway after mentoplasty. O: Increased airway. The definition of Question was: Are there significant changes in the airway of patients undergoing a surgical mentoplasty procedure?

An electronic search was performed in the following databases: PUBMED, SCIENCE DIRECT, REDALYC; without discriminating in years; under the following keywords: "genioplasty", "airway," "evaluation", "imaging", "genioglossus advancement" using standard combinations among them based on the word airway. A manual selection protocol was also applied in selected journals and with them, content limitation due to lack of indexing.

Inclusion Criteria:

A. Articles where patients have undergone mentoplasty as the only skeletal procedure.
B. Pre and post-operative imaging evaluation of patients (linear or volumetric).
C. Articles associated or not with OSAS.
D. Published articles type: controlled clinical trials, case reports, case series, cohort studies, prospective and retrospective clinical studies and prospective randomized studies.
E. Access to the full article. Articles of the topic in English or Spanish languages.

Exclusion Criteria:

A. Articles whose applied treatment consists of mentoplasty combined with another orthognathic surgery procedure (maxillary and / or mandibular osteotomy).
B. Little postoperative follow-up of patients without post-operative imaging evaluation.
C. Studies of patients with congenital syndromes.
D. Digital publications like books, verbal presentations, posters, conferences, letters to the editor, literature reviews, systematic reviews.
E. Studies of corpses.
F. Animal studies.
G. Articles in a language other than English or Spanish.

Titles and abstracts of the selected studies were independently viewed by 2 evaluators (IG, HG). The visualization was based on the question: Are there significant changes in the airway of patients undergoing the mentoplasty surgical procedure? In case of discrepancy between the evaluators, a mutual agreement was reached after discussion of the articles.

The following data was extracted: type of investigation, authors and year of publication, sample, gender, age, dento-skeletal diagnosis, airway classification, diagnosis of obstructive sleep apnea syndrome (OSAS), type of imaging evaluation, evaluation criteria, pre and post-operative values, surgical technique and type of fixation used, other surgical procedures applied, complications, conclusions.

Due to the data obtained, a comparative analysis could be carried out according to the different mentoplasty techniques performed, the type of imaging evaluation and its values, and the impact on the airways of the patients studied. The data was extracted from the selected articles

Table I. Characteristics of the studies included in the review.

Authors and year	Sample	Dento-skeletal diagnosis	Classification of airways	OSAS diagnosis	Surgical technique	Fixing type	Other procedures	Complications
Du W., He D., Wang Y., Liu H., Liao C., Fei W., Luo E. 2017 (13)	12	Mental retrognathia without maxillary deformity (Class I or II angle)	Not specify	Not specify	Advance mentoplasty (horizontal)	Rigid internal fixation with 2 ,4,6, and 8 mm titanium plates and screws	None	Not specify
Anchlia, S.; Vyas, S. M.; Dayatar, R. G.; Domadia, H. L. & Nagavadiya, V. 2018 (3)	25	Temporomandibular ankylosis and facial asymmetry (does not specify class I, II, III)	Not specify	OSAS moderate (6) Mild OSAS (12) Without OSAS (7)	Genioplasty (horizontal) of advancement and translation	Not specify	Arthroplasty with rotation of temporal muscle flap, oral fat or abdominal fat Coronoidectomy Reconstruction of condyle and ramus unit	Transient paresthesia of temporal (18) and zygomatic branches (4) of the facial nerve Wound dehiscence (1) Intraoperative hemorrhage (3)
Dos Santos J., Abraham M., Gregorio L., Zanato A., Gumieiro E. 2007 (12)	10	Mandibular retrognathism	Hypopharyngeal obstruction (type III) or hypopharyngeal and oropharyngeal obstruction (type II) according to Fujita et al.	Mild to moderate (>5 <30)	Mentoplasty (horizontal) for advancement of the genioglossus muscle Feed: 10mm (5) 8mm (5)	Rigid internal fixing with a Paulus "double L" plate and 4 system 2.0 screws	Septoplasty (2) Uvulopalatopharyngoplasty (6)	Paresthesia, edema, ecchymosis, suture dehiscence, infection
Riley R., Powell N., Guilleminault E. 1986 (25)	5	Mandibular deficiency (1)	Not specify	Not specify	Lower sagittal osteotomy of the mandible with myotomy and suspension to the hyoid	Wire	Hyoid suspension	Transient paresthesia of the mental nerve (2)
Frapier L., Janssen A., Cachou J., Goudo P., Dauviller Y., Picot MC. 2010 (15)	25	Mandibular retrognathism (class II)	Not specify	No	Genioplasty of advancement and vertical reduction	Rigid internal fixation with osteosynthesis plate	Third molar germectomy (24 cases)	Does not refer
Yin, S.; Yi, H.; Lu, W.; Wu, H.; Guan, J.; Cao, Z. & Chen, T. 2007 (30)	18	Mild mandibular deficiency (8)	Type II according to Fujita et al.	Severe	Genioplasty (horizontal) for advancement of the genioglossus and geniohyoid muscle	Rigid internal fixing with titanium plate and screws	Uvulopalatofaringoplastia Hyoid suspension	Transient mental paraesthesia, hematoma floor of the mouth (1 patient)
Cillo, J.; Thakker, P. & Dattilo, D. 2012 (10)	23	Not specify	Not specify	Mild to moderate (>5 <30)	Mentoplasty to advance the genioglossus with elliptical window	2 straight plates with 4 holes with 4 screws +2 bicortical screws	Hyoid suspension with 2 Mitek anchors	Does not refer
Miller, F.; Watson, D. & Boseley, M. 2004 (20)	24	Not specify	Type II according to Riley	Moderate or severe	Trephine system for advancement of the geni tubercle and genioglossus muscle	Pre-folded fixing plate system	Uvulopalatofaringoplastia Hyoid suspension	Transient paresthesia of the lower lip (all), persistent paresthesia of the lower central incisors (5 patients), exposure of the osteosynthesis material (3 patients), hematoma on the floor of the mouth (2 patients)
Riley R., Guilleminault C., Powell N. & Derman D. 1984 (24)	1	Class I	3 millimeters (narrow according to author's criteria)	Moderate	Advance genioplasty (horizontal)	Wire	Palatopharyngoplasty 4 months prior to genioplasty Hyoid suspension	Does not refer
Bedoucha V., Boutin F., Frapier L. 2015 (6)	47	Class II	Moderate or severe	No	Genioplasty of advancement and vertical reduction	Osteosynthesis plate	Third molar germectomy	Not specify

and distributed in different tables and discussed according to the order and analyzed in a descriptive way for the presentation of results.

To assess the risk of bias, the selected articles were evaluated with different evaluation systems depending on the type of study: SIGN (Scottish Intercollegiate Guidelines Network, 2012) for the cohort, case-control, prospective randomized clinical study articles, and the evaluation of Murad *et al*. (2018) for clinical case or case series.

RESULTS

A total of 1,251 articles were obtained among the 3 databases. After review of duplicate, search engines, as well as reference by other articles, a total of 397 articles were discarded (Fig. 1), to subject the rest to filters such as: language, title attractiveness, keywords, studies on cadavers or animals, literature reviews, little explicit content and content not available or accessible; finally, 10 articles were included in this systematic review published from 1984 to 2019 (Table I).

Of the total of the selected articles, there were 3 prospective case series studies representing 30 % (Riley *et al*., 1993; Dos Santos Junior *et al*., 2007; Anchlia *et al*., 2018), 3 prospective cohort studies corresponding to 30 % (Yin *et al*., 2007; Frapier *et al*., 2010; Du *et al*.), 2 retrospective series studies of cases of 20 % (Miller *et al*., 2004; Cillo *et al*.), 1 case report (Riley *et al*., 1984) and 1 case control study (Bedoucha *et al*., 2015), which represents 10 % respectively (Table II).

Table II. Type of research.

Type of Investigation	Amount of publications	%
Prospective study (case series)	3	30
Prospective cohort study	3	30
Retrospective study (case series)	2	20
Case report	1	10
Case-control study	1	10

A total of 190 patients underwent mentoplasty as a surgical treatment to increase the airway, for the purposes of distributing said population by gender, 178 patients were taken into account since in one of the publications they were not explicit with this data (Du *et al*.), being predominant the masculine gender in 68 % with 121 patients and the feminine gender with 32 % equivalent to 57 patients. . Regarding age, the range included was from 10 to 68 years, with an average of 39 years ± 12.8.

In term of skeletal diagnosis, 4 articles showed the dento-facial and / or Angle classification (Riley *et al*., 1984; Frapier *et al*.; Bedoucha *et al*.; Du *et al*.), with Class II being predominant with 72 patients, followed by Class I in 1 patient. On other hand, some articles showed patients under facial asymmetry (Anchlia *et al*.) (1 patient), retrognathism or mandibular deficiency (Riley *et al*., 1986; Dos Santos Junior *et al*.; Yin *et al*.) (3 patients) and in 2 cases they do not specify (Cillo *et al*.; Miller *et al*.) (Table III).

Table III. Dento-skeletal diagnosis.

Dento-skeletal diagnosis	Quantity of articles
Class I	1
Class II	2
Mental retrognathia without maxillary deformity (class I or II of Angle)	1
Retrognathism or mandibular deficiency	3
Facial asymmetry	1
Not specify	2

From 10 included articles, 4 papers presented the airway obstruction classification: 2 articles take into account the Fujita classification, one classifies patients as type II (Yin *et al*.) and another article studies type II and type III patients (Dos Santos Junior *et al*.). Another classifies according to (Riley *et al*., 1993) in type II (Miller *et al*.), 1 article refers to it as moderate or severe (Bedoucha *et al*.). The rest of the articles (n = 6) do not specify anything about this variable (Riley *et al*., 1984; Yin *et al*.; Frapier *et al*.; Cillo *et al*., 2012; Du *et al*.; Anchlia *et al*.).

Regarding the diagnosis of OSAS, 6 articles classify their patients according to severity (Quan *et al*.), while 2 do not specify (Riley *et al*., 1986; Du *et al*.) and in the other 2 the patients did not present a diagnosis of OSAS (Frapier *et al*.; Cillo *et al*.; Bedoucha *et al*.) (include patients with mild to moderate OSAS in their study. Grouping the patients of the 6 articles that used the classification, a higher frequency of patients with moderate OSAS was obtained (27 patients), followed by mild (20 patients) and severe (18 patients).

In term of the imaging diagnosis of patients, the use of lateral cephalic was predominant in 8 of the 10 articles, making cephalometric tracings to obtain linear and angular measurements (Riley *et al*., 1984, 1986; Miller *et al*.; Dos Santos Junior *et al*.; Frapier *et al*.; Cillo *et al*.; Bedoucha *et al*.; Anchlia *et al*., 2019). In one study they used lateral cephalic and combined MRI or computed tomography (Yin *et al*.) and in another they only used computed tomography (Philips Brilliances 16, Best, The Netherlands), whose images were transformed to DICOM format and reconstructed with Dolphin Imaging Software. 11.0 and Mimics Software 16.0 (Du *et al*.) (Table IV).

The criteria for evaluation in the articles was the cephalometric evaluation, and the authors used different combinations of measurements and angles. Of the 9 articles, 6 used the PAS (posterior airspace) measurement in their evaluation (Riley *et al*., 1984, 1986; Miller *et al*.; Dos Santos Junior *et al*.; Yin *et al*.; Anchlia *et al*., 2019), 4 used the MP-H plane (distance from the hyoid to the mandibular plane) (Riley *et al*., 1984, 1986; Dos Santos Junior *et al*.; Yin *et al*.) and 4 the SNB angle (silla-nasion-point B) (Dos Santos Junior *et al*.; Yin *et al*.; Frapier *et al*.; Bedoucha *et al*., 2015), the most frequent combination being PAS and MP-H (4 articles) (Riley *et al*., 1984, 1986; Dos Santos Junior *et al*.; Yin *et al*.). As for the tomographic evaluation, only 2 articles used it as part of their diagnosis and there is no coincidence in the measures used by each author (Du *et al*.; Yin *et al*.) (Table IV).

In the evaluation of the quantitative increase in the airway by each author, the measures mentioned above were used, showing an average increase in SBP of 4.2 mm for the linear measurements. As for the volumetric, Du *et al*. (2017) reported an average increase in the airway of 29 mm^2 and Yin *et al*. of 22.6 mm^2 (Table V).

Regarding the surgical technique most frequently used, we have horizontal genioplasty to advance the genioglossal musculature (Riley *et al*., 1984; Dos Santos Junior *et al*.; Yin *et al*.; Du *et al*.; Anchlia *et al*.), 2 articles do not specify the type of genioplasty (Frapier *et al*.; Bedoucha *et al*.), 1 performed the elliptical window (Cillo *et al*.), another used the trephine system (Miller *et al*.) and one author describes the lower sagittal osteotomy of the mandible (Riley *et al*., 1986). Regarding the type of fixation used, the most frequent was rigid internal fixation with a plate and screw type osteosynthesis system in 7 of the publications studied (Miller *et al*.; Dos Santos Junior *et al*.; Frapier *et al*.; Cillo *et al*.; Bedoucha *et al*.; Du *et al*.), 2 used fixation with wire (Riley *et al*., 1984, 1986) and one does not refer type of fixation (Anchlia *et al*.).

Table IV. Type of images evaluated, pre and post values for every evaluation criteria.

Authors	Type of imaging evaluation	Imaging evaluation criteria	Pre average values	Post average values	Variations
Anchlia S., Mahesh S., Gyrish R. 2018 (3)	Lateral cephalogram	N-Pg	'-21,6 mm	'-14,4 mm	-7.2
		P-Pg	9,5 mm	17,4mm	7.9
		N-A-Pg	14,7°	7,9°	-6.8
		Cg-ANS-Me	8,1 mm	1,3mm	-6.8
		Neck-chin angle	149,4°	117,8°	-31.6
		Labiomental angle	166,9°	131,5°	-35.4
		Apnea- Hiponea Index (AHÍ)	10.6	3.5	-7.1
		N-PAS	4,4 mm	7,3 mm	2.9
Riley, R., Guilleminault, C.,	Lateral cephalogram	PAS	3 mm	8 mm	5 mm
		MP-H	36 mm	24 mm	-12 mm
Bedoucha, V., Boutin, F., Frapier, L. 2015 (6)	Lateral cephalogram Cephalometric tracing software: MYSTAT	SNPog °	GE: 77,13 GC: 76,48	Not specific	GE: 3,16 GC: 0,38
		ANB °	GE: 6,29 GC: 5,85	Not specific	GE: -1,6 GC: -0,7
		SNB °	GE: 76,73 GC: 76,0	Not specific	GE: 0,39 GC: 0,04
		ANS-PNS/MP °	GE: 33,88 GC: 33,29	Not specific	GE: -5,2 GC: 0,17
		EHP mm	GE: 27,26 GC: 25,47	Not specific	GE: 2,17 GC: 2,20
		Hy/ANS-PNS mm	GE: 54,98 GC: 53,71	Not specific	GE: 3,9 GC: 5,4
		EVP mm	GE: 7,80 GC: 7,74	Not specific	GE: 1,6 GC: 0,2
		ELP mm	GE: 7,80 GC: 7,74	Not specific	GE: 1,87 GC: -0,05
Cillo, J., Thakker,P., Datillo D, 2012 (10)	Lateral cefalogram (Laser1000; Panoramic, Fort Wayne, IN)	Pg'-Pg mm	11.54	11.15	-0,39
		Me'-Me mm	8.85	9.69	0.84
		G'-G mm	10.08	10.69	0.61
		B-B' mm	10.11	10.72	0.71
		LI-Lii mm	13.23	13.31	0.08
		Sn-Pg' mm	-1.23	-0.62	0.61
Dos Santos, J., Abrahão, M., Gregório, L., Zonato, A., Gumieiro, E. 2007 (12)	Lateral cephalogram	MacNamara: APF °	157.2	Not	
		SNA °	82.1	Not	
		SNB °	75.7	Not	
		Co-Gn	117.1	123.9	6.8
		H-PM	25.5	23.3	2.2
		PAS	7.9	10.8	2.9
Du W, He D, Wang Y, Liu H, Liao C, Fei W, Luo E, 2017 (13)	Computed tomography (Philips Brilliances 16, Best, The Netherlands) They were carried out during 3 different periods: - T0: 1 week preoperative. - T1: 1 week post-operative. - T2: at least 1 postoperative year.	VT (mm^3)	20,919.80	T1: 20.981,2 T2: 22.413,7	1.49
		VP(mm^3)	6802.7	T1: 6777,4 T2: 6762,7	-40
		VO(mm^3)	6100.4	T1: 6045,6 T2: 6318,9	218.5
		VG(mm^3)	4251.1	T1: 4193,8 T2: 4833,2	582.1
		VL(mm^3)	3672.7	T1: 3526,8 T2: 4247,5	574.8
		PPA(mm^2)	555.1	T1: 549,6 T2: 552,1	-3
		SPA(mm^2)	143.9	T1: 142,7 T2: 152,9	9
		PTA(mm^2)	145.6	T1: 138,1 T2: 158,2	12.9
		EA(mm^2)	203.3	T1: 202,6 T2: 224,6	21.3
		H-N (A-P) (mm)	48.4	T1: 48,2 T2: 44,6	-4,1
		H-N (T-B) (mm)	113.7	T1: 112,9 T2: 113,5	-0.2
		H-N (L-R) (mm)	0.1	T1: 0,14 T2: 0,13	0
		Avance mm		5.6	
Frapier, L., Jaussen, A., Yachou, J., Goudo, P., Dauvillier, Y., Picot, MC. 2010 (15)	Lateral cephalogram in 5 times: - P2: After orthodontic treatment (before surgery). - P3: 1 month post-surgical. - P4: 6 months post - P5: 12 months post - P6: 18 months post.	Bjork-Steiner analysis: SNPog °	75	Not specific	Variación entre: P2 -P3: -5 P3- P4: 0 P3- P5: 0 P3- P6: 0
		SNB°	74	Not specific	P2-P3: -1 P3-P4: -1 P3-P5: -1 P3-P6: -1
		PP/PM°	32	Not specific	P2-P3: -1 P3-P4: -1 P3-P5: -1 P3-P6: -1
		sPogs (mm)	13	Not specific	P2-P3: -9 P3-P4: 0 P3- P5: 0 P3- P6: 0
		sMes (mm)	10	Not specific	P2-P3: -9 P3-P4: 0 P3- P5: 0 P3- P6: 0
		vMes (mm)	48	Not specific	P2-P3: 6 P3- P4: 0 P3-P5: 0 P3-P6: 0
		RI°	1	Not	-1
		AI (mm)	0	Not	-2
		MR°	1	Not	-1
Miller, F., Watson, D., Boseley, M. 2004	Lateral cephalogram	PAS (mm)	7.9	12.6	4.7
Yin, S.; Yi, H.; Lu, W.; Wu, H.; Guan, J.; Cao, Z. & Chen, T. 2007 (30)	Lateral cephalogram Magnetic resonance or computed tomography of the upper airway.	`SNB ° PAS (mm) MP-H (mm)	77,7 ± 1,5 7,8 ± 1,2 22,5 ± 3,3	77,7 ± 1,5 7,8 ± 1,2 22,5 ± 3,3	1,4 3,6 12,6
		SCSA (mm^2)	42,4 ± 15,5	65 ± 29,4	22.6
Riley, R., Powell, N., Guilleminault, C. 1986 (25)	Lateral cephalogram	PAS (mm)	4.8	11.4	6.6
		MP-H (mm)	28.2	16.6	11.6

Table V. Values and variation of PAS.

Article	PAS Pre-operative	PAS Post-operative	Variation
Riley *et al.,* 1984.	3 mm	8 mm	5mm
Riley *et al*., 1986.	4,8 mm	11,4 mm	6,6
Miller *et al.,* 2004.	7,9 mm	12,6 mm	4,7
Dos Santos *et al*., 2007.	7,9 mm	10,8 mm	2,9
Yin *et al*., 2007.	7,8 mm	11,4 mm	3,6
Anchlia *et al*., 2018.	4,3 mm	7,3 mm	2,9
Average + D.S	5,9 mm ± 2,1	10,2 mm ± 2,1	4,2 mm ± 1,4

In term of risk of bias, 3 articles were found to be low risk (Miller *et al.*; Frapier *et al*.; Bedoucha *et al*.) and 7 medium risk (Riley *et al*., 1984, 1986; Dos Santos Junior *et al.*; Yin *et al.*; Cillo *et al*.; Du *et al*.; Anchlia *et al*.). There were no high-risk-bias articles (Table VI).

Other procedures were performed as a complement to genioplasty, the most frequent being: hyoid suspension (5 articles) (Riley *et al*., 1984, 1986; Miller *et al*.; Yin *et al*.; Cillo *et al*.), uvulopalatopharyngoplasty (3 articles) (Miller *et al*.; Dos Santos Junior *et al*.; Yin *et al*.), third molar germenectomy (2 articles) (Frapier, *et al*.; Bedoucha *et al*.), septoplasty (1 article) (Dos Santos Junior *et al*.), arthroplasty (1 article) (Anchlia *et al*., 2019)and in 1 article they reported not having performed any additional procedure in the study population. (Du *et al*.)

The follow-up included varies from 1 week to 31.9 months. Most of the cases had an average of 12 months control, both clinical and imaging. The most frequent complications were transient paresthesia (5 articles) (Riley *et al*., 1986; Miller *et al*.; Dos Santos Junior *et al*.; Yin *et al*.; Anchlia *et al*.), bruising / hematoma on the floor of the mouth (3 articles) (Miller *et al*.; Dos Santos Junior, *et al*., 2007; Yin *et al*.), wound dehiscence (2 articles) (Dos Santos Junior, *et al*.; Anchlia *et al*.), other less frequent complications were exposure of the osteosynthesis material (1 article) (Miller *et al*.), intraoperative hemorrhage (1 article) (Anchlia *et al*.), infection (1 article) (Dos Santos Junior *et al*.), persistent paresthesia of lower incisors due to more 6 months (1 item) (Miller *et al*.).

Table VI. Assessment of bias risk.

Authors	Check List	Assessment
	Cohort studies	
Du *et al*.	Checklist SIGN Methodology 3	Medium risk
Frapier *et al*.	(cohort studies)	Low risk
Yin *et al*.		Medium risk
	Reports and case series	
Anchlia *et al*.	Murad *et al.* Methodological quality	Medium risk
Dos Santos, *et al*.	and synthesis of case series and case	Medium risk
Riley*et al*	reports	Medium risk
Cillo *et al*.		Medium risk
Miller *et al.*		Low risk
Riley *et al*.		Medium risk
	Case-control Study	
Bedoucha*et al*.	Checklist SIGN Methodology 4 (Case-control studies)	Low risk

DISCUSSION

Over the past two decades, obstructive sleep apnea syndrome (OSAS) has been recognized as a clear clinical entity, characterized by repeated narrowing or collapse of the upper airway during sleep. OSAS is estimated to affect approximately 20 % of the population, of which 5 % experience excessive daytime sleepiness. It can affect anyone, at any age, even in childhood (Arias Contreras & Sepúlveda Vizcaíno).

In this systematic review we studied a population of 190 patients (not all diagnosed with apnea) who underwent mentoplasty as a surgical treatment to increase the airway, whose age range ranges from 10 to 68 years, however, the largest study group was found between the second and third decades of life, as they are growing patients (Riley *et al*., 1984, 1986; Yin *et al*.; Frapier *et al*.; Bedoucha *et al*.; Du *et al*.; Anchlia *et al*.).

It was found that only 4 of the studied authors took the dento-skeletal classification into account in the diagnosis of patients, since dysfunctional breathing disorders contribute, during craniofacial development, to reducing the jaw width and significantly increasing the skeletal dimension vertical with decreased mandibular ramus height and an increase in the divergence angle values in the lower third and a decrease in the mandibular sagittal projection, this cited by different authors such as (Frapier *et al*.) in this review. In this study, the most frequent dento-skeletal relationship was class II due to mandibular anteroposterior deficiency, which suggests that these patients are the most affected, and this may be an etiological factor for developing respiratory disorders (Posnick *et al*., 2018) coincide with the aforementioned study that class II dento-skeletal individuals with retrognathic mandible have a 50 % prevalence of OSAS, in a recent study that also revealed an overall prevalence rate of 16 % " silent " OSAS undiagnosed with various dento-skeletal patterns seeking orthognathic treatment. Such findings indicate the importance of investigating associations between jaw movements and their effect on the pharyngeal airways. In this review, therefore, the authors 'classification of patients' airways was taken as a relevant variable, despite the fact that the selected authors methodologically do not comply with this parameter.

Dos Santos Junior *et al*. and Yin *et al*. take into account the Fujita classification, while Miller *et al.* classifies according to Riley *et al*. (1993), both classifications take into account the site of airway obstruction, taking this relevance to determine the appropriate surgical treatment in each case. It is a methodological obstacle not to standardize the airway obstruction through a classification because it is up to the author's discretion to determine if an airway is narrow or normal and if it should be treated surgically.

Regarding the imaging evaluation of patients in this study, conventional cephalometry predominated over computed tomography, in some cases associated with the years in which they were published (Riley *et al.*, 1984, 1986) and in others (Miller *et al.*; Dos Santos Junior *et al.*; Frapier *et al*.; Cillo *et al*.; Bedoucha *et al*.; Anchlia *et al*.) cephalometry was used for its simplicity, easy access for patients and general representation of the soft tissue and bone profile of the lower facial third. On the other hand, (Du *et al*.) refer that computed tomography and reconstructive imaging techniques are widely used to assess the airways of patients, visualization of the upper airway and calculation of the volume of the posterior airspace (PAS) could be extremely useful in diagnosis and treatment of obstructions in the airway. This measure became relevant in our study, most of the authors (Riley *et al*., 1984, 1986; Miller *et al*.; Dos Santos Junior *et al.*; Yin *et al.*; Anchlia *et al.*) used it as part of the cephalometric analysis both pre and post-operatively (Du *et al.*) highlight its importance not only as a linear measure but as volume. Due to this, we based this measure to determine whether or not there were imaging changes in the airways of the patients undergoing mentoplasty, whose answer is yes, there were significant changes with a PAS that went on average from 4.8 mm to 11.4 mm. (Riley *et al*., 1986), with a gain in millimeters of 6.6, allowing greater air flow, which undoubtedly improves the quality of life of these patients. This is corroborated in several investigations that attempted to evaluate the effect of genioplasty for genioglossal muscle advancement in SBP in patients with retrogenesis. These studies have found that genioplasty for the advancement of the genioglossus could increase the PAS immediately after surgery. The results suggested that genioplasty could be considered as an option for the surgical treatment of patients with hypopharyngeal obstruction (Du *et al*.).

There was a disagreement when evaluating the pre and post-operative values because not all the articles, after expressing the values of the pre-operative cephalometry, expressed the post-operative values one by one. Apparently, they expressed the most relevant for the evaluation of surgical success and others only determined the difference or variability with the initial points without expressing the post-operative value per se.

Volumetrically, Yin *et al.* demonstrated the significant change where they evaluated the smallest cross-sectional area (SCSA) of the airway of pre and post mentoplasty patients, finding an increase in air volume of 22.6 mm^2.

Once the treatment for this airway obstruction, whether due to dento-skeletal deformity or associated with OSAS, has been determined to be surgical, advancement mentoplasty represents an effective procedure to correct chin deformities and increase posterior airway space respiratory by the anterior traction exerted on the geniohyoid and the genioglossus (Anchlia *et al*.).

In this review, the different mentoplasty techniques used by the authors and the possible relationship between millimeters of chin advancement with increased airway were evaluated. The most frequently used technique was horizontal osteotomy mentoplasty (Riley *et al*., 1984; Dos Santos Junior *et al*.; Yin *et al*.; Du *et al*.; Anchlia *et al*.) whose technique consists of an osteotomy line that is located 3 ~ 4 mm below the mental hole to avoid damaging the alveolar nerve lower and must continue above the pogonion. The osteotomized bone is fixed with titanium plates and screws so that the genioglossus, geniohyoid, mylohyoid muscle and most of the anterior digastric muscle extend forward. Only 2 of the selected articles (Du *et al.*) (Anchlia *et al.*) establish a quantitative parameter of relationship between chin advancement and airway augmentation. Their results show in the case of (Du *et al.*), whose evaluation was volumetric, that the ratio is 5mm of chin advance, gains 9mm2 of volume in the airway. On the other hand, Anchlia *et al*. establish a relationship of chin advancement-cephalometric evaluation of airway augmentation with PAS of 7 mm-2.92 mm, respectively. This relationship, which should be the center of these investigations, was made by this team of authors, but not by the cited researchers.

Other authors such as (Riley *et al*., 1986) describe the technique of lower sagittal osteotomy of the mandible with an extraoral approach because it is accompanied by myotomy and hyoid suspension, achieving by this technique the greatest increase in the airway among the authors. However, as it is a technique necessarily combined with myotomy and hyoid suspension, it cannot be determined whether mentoplasty alone would achieve efficient results.

Complications of mentoplasty are rare, in our study only 5 authors describe any (Riley *et al*., 1986; Miller *et al*.; Dos Santos Junior *et al*.; Yin *et al*.; Anchlia *et al*.) and agree that the most frequent are transient paresthesias and hematoma / ecchymosis on the floor of the mouth, resolved without additional complications, Anchlia *et al*. report that the most serious and life-threatening complication of genioplasty is hematoma on the floor of the mouth with the resulting elevation of the tongue and obstruction of the airways. Ideally, preventive management of judicious hemostasis of both soft tissue and bone. Another method is the placement of a drain, making its outlet extraoral. Yin *et al*. did describe in their study as a complication a hematoma on the floor of the mouth which remained in intensive care for constant monitoring the first 3 postoperative days and the patient was discharged without complications.

Based on the research carried out, it can be concluded that there is a positive relationship between the increase in the airway and the isolated advancement mentoplasty procedure, however, more standardized studies associated with the way of measuring and evaluating the relationship between advancement and airway are necessary.

The authors suggest: 1) Medical histories must include in the anamnesis a section dedicated to the evaluation of the airway and the possibility of suffering from obstructive sleep apnea syndrome to make the accurate diagnosis and classification. 2) Request the two types of imaging tools: lateral cephalic and computed tomography for the complete evaluation of the airway. 3) Classify the airway in a standard way: for cephalometry use the classification of Riley *et al*. (1993) and for tomography the classification of Bravo *et al*. 4) Standardize the basic cephalometric measurements to be evaluated: PAS, MP-H, SNB, N-Pg. And the SCSA volumetric measurements. 5) If the patient has a SBP less than 7mm, advancement mentoplasty can be done with a minimum of 5mm to achieve airway augmentation, however, further studies are necessary.

GONZALEZ, I.; GARCIA-GUEVARA, H.; VIAMONTE, M.; JENSEN, D. & HERNANDEZ, A. Cambios en la Via Aeres Despues de una Mentoplastia (Genioplastia). Una Revisión Sistemática. Systematic Review. *Int. J. Morphol., 40 (4)*:1025-1034, 2022.

RESUMEN: El objetivo de esta investigación fue evaluar los cambios obtenidos con la técnica de mentoplastia en el incremento de la via aérea. Una revisión sistemática fue realizada utilizando parámetros de la matriz prisma, en PubMed, Science Direct, Redalyc database, cubriendo los años 1984 a 2019 con criterios de inclusión definidos. Los autores aplicaron de forma independiente los parámetros de selección y extracción de datos, selección de estudios y riesgos de sesgo. Un total de 1251 artículos fueron obtenidos de las 3 bases de dato, donde 10 artículos cumplieron los criterios de inclusión. Las variables estudiadas fueron: tipo de investigación, tamaño de la muestra, genero, edad, diagnóstico dento esqueletal, clasificación de la vía aérea, diagnostico de síndrome de apnea del sueño (SAOS), tipo de evaluación de la imagen, variables evaluadas en la imagen en pre y postoperatorio, técnica quirúrgica y tipo de fijación utilizada, otros procedimientos quirúrgicos y complicaciones. En el caso de la evaluación linear con cefalometria (9 artículos), usaron PAS (posterior airspace), MP-H (plano mandibular hacia el hueso hioide) y SNB (silla turca- nasion-punto B) y SCSA (sección de puntos mas relevantes, menores transfversales) y el VT (volumen total) en las evaluaciones volumétricas (2 artículos). El promedio de cambio posterior de la vía aérea citado por autores fue de 4,2 mm con una desviación estándar de 1,4 mm con el uso de la mentoplastia de avance. La técnica mas habitual fue la mentoplastia con osteotomía horizontal (5 autores). Basados en esta investigación existe una relación positiva entre el incremento de la vía aérea y el avance con genioplastia; sin embargo, mas estudios estandarizados junto con medidas definidas y la evaluación correcta del avance y la vía área son necesarios.

PALABRAS CLAVE: Vía aérea; Mentoplastia; Genioplastia; Avance geniogloso.

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