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.Microgenia: a Clinical Classification of Chin Projection

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Abstract

Background: in 2020, approximately fifty thousand chin augmentations were performed in the United States⁴. To date, there is no simple classification of chin projection based on soft tissue landmarks which enables one to compare before and after treatment results and to objectively evaluate data for clinical outcome studies. **Objective:** to provide a clinical classification based on measurements in the profile and frontal view, using soft tissue landmarks. To facilitate training of residents and surgeons and aid communication between different practitioners and disciplines. **Methods:** staging of chin projection using this classification was applied to clinical cases to demonstrate its utility. Representative before and after photographs demonstrate staging of chin projection in the preoperative and postoperative condition were analyzed. **Conclusion:** Classification is simple to apply and is a useful aid in evaluating clinical cases and a practical benchmark in outcome analysis.

Introduction.

My mentor and Chief, when asked by me, how he measured something clinically, replied “scientifically by eye¹”. Facial proportions are indeed difficult to ‘measure’. A great deal of weight is placed on observation and assessment “by-eye”. ‘A balanced and harmonious facial appearance is a complex phenomenon and essentially can be described as a ‘visual experience’ of the onlooker². For this reason, Bass² described, positioning the patient's face on the cephalogram around the Aesthetic Horizontal Line (AHL), a horizontal axis which is pre-determined by the *observer*, looking at the face from the side.

The lack of a simple clinical classification of the retrusive chin is confusing and adds to the difficulty in agreement and consensus on the nature of the aesthetic deformity and its clinical solution. The author has previously published a simplified staging of skin types² and breast ptosis³. This article describes a simple classification of chin projection, based on soft-tissue landmarks alone. This is for the purpose of preoperative assessment, review of treatment options and objective measurement of outcomes.

In 2019, approximately 50,000 chin augmentations were performed in the United States by aesthetic practitioners, according to the American Society of Plastic Surgeons⁵.

Indications for chin augmentation are most commonly inadequate chin projection, with or without a deficiency of vertical chin length.

Microgenia may be developmental or may occur as a result of aging. Associated deformities which may be improved by chin augmentation are:

- a. Obtuse *cervico-mental angle*.
- b. Platysmal banding and skin laxity in the submental area.
- c. Rugae or wrinkling of the anterior chin as a result of overactivity of the mentalis muscle.
- d. Marionette lines and jowling involving the mandibular margin
- e. Loss of volume and or ptosis of the chin fat pad.

Methods of correction of chin deformities include orthodontia, soft-tissue augmentation using filler or fat, alloplastic implants such as silicone and polytetrafluoroethylene and bony genioplasty (with or without orthognathic surgery for mandibular and/or maxillary deformity).

Methods

A classification should ideally provide:

- A simple common language between practitioners.
- An objective verifiable measurement.
- An aid to indications for a procedure such as a chin implant.
- Objective and verifiable measurements for treatment and outcomes.

Although this article is focused on the retrusive chin (microgenia), the classification includes protruding chin (macrogenia) for the sake of completeness. The classification is described (Figure 1 and Table A).

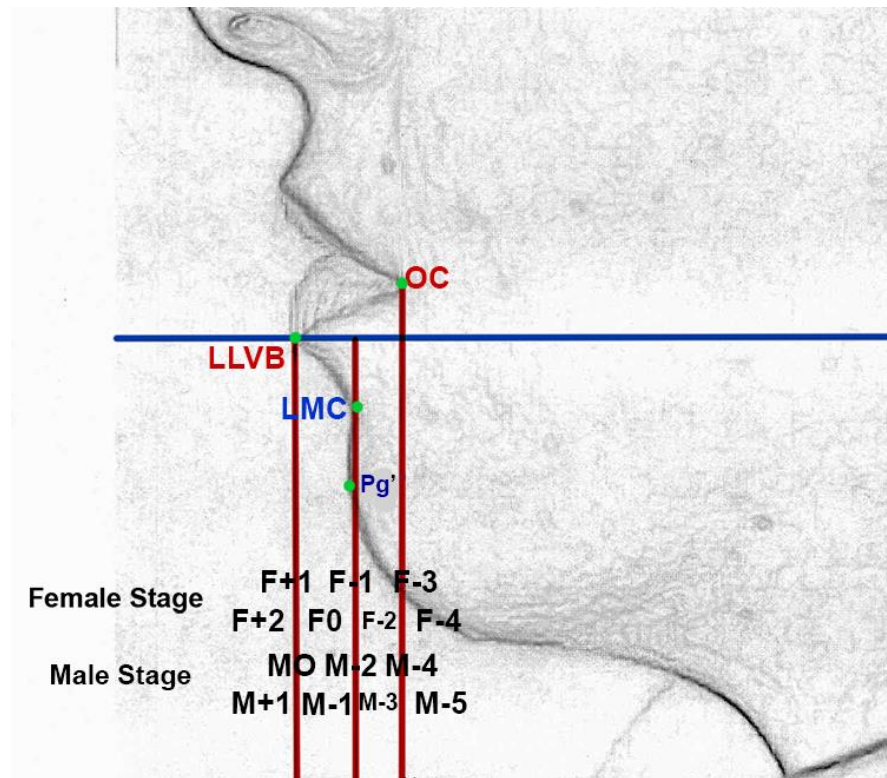


Figure 1. Chin Projection Classification

Profile View	Profile View	Profile View	Sex	Sex
Lower Lip Vermilion Border (LLVB)	Labio-mental Crease (LMC)	Oral Commissure (OC)	Female (F)	Male (M)
Anterior to LLVB	Anterior to LMC	Anterior to OC	+2	1+
At LLVB	Anterior to LMC	Anterior to OC	+1	0 (ideal)
Posterior to LLVB	Anterior to LMC	Anterior to OC	0 (ideal)	-1
Posterior to LLVB	At LMC	Anterior to OC	-1	-2
Posterior to LLVB	Posterior to LMC	Anterior to OC	-2	-3
Posterior to LLVB	Posterior to LMC	At OC	-3	-4
Posterior to LLVB	Posterior to LMC	Posterior to OC	-4	-5

Table A. Chin Projection Classification.

Staging is further illustrated by applying it to clinical cases as illustrated in Figures 2-6. Stage is assigned first by sex (F/M) then by sequential numerical levels, +2 (anterior) to -5 (posterior); based on the degree of chin projection (CP). CP is defined by the position of the soft tissue pogonion (Pg') in relation to three anatomical soft tissue landmarks. These are, in the profile view, from anterior to posterior:

1. Lower Lip Vermilion Border (LLVB). The LLVB is also described as the labrale inferius or Li.
2. Labio-Mental Crease (LMC).
3. Oral Commissure (OC).

In the female, microgenia (CP) is staged from Stage 0 to -4 and in the male from Stage 0 to -5. For a specific patient, stages are written with the prefix CP for Chin Projection followed by sex (M or F), numerical stage (0) to (-5) and a '/' after which descriptors may be added (see below). Descriptors are *optional* and aid in evaluation and surgical planning. in both sexes.

Stage 0 represents the ideal projection of the soft tissue pogonion. In the female, Stage CPF0 represents a Pg' position midway between the vertical planes of the LLVB and the LMC. Stage CPF-1 represents a Pg' position posterior to Stage 0 and at the vertical level of the LMC (Figure 1). Stage CPF-2 represents a Pg' position posterior to the LMC but anterior to the OC. Stage CPF-3 represents a Pg' position posterior to the LMC and at the level of the OC. Stage CPF -4 represents a Pg' position posterior to the OC.

In the male, all of these stages are transposed anteriorly by one Stage. Stage 0 (the ideal projection) now represents a Pg' that is at the vertical plane of the LLVB. Because Stage 0 is anterior, as compared to the female, staging for microgenia has one extra stage, the additional stage being CPM-5, representing a Pg' position posterior to the OC.

Descriptors are identified first in the profile view (A-C) and second, in the frontal view (D-F).

Profile view:

- A. Volume loss of the chin fat pad abbreviated as 'V'.
- B. Marionette lines extending to the jawline, abbreviated as 'M'.
- C. Loss of projection of either or both the upper and lower lips, abbreviated as 'LL'.

Frontal view:

- D. Rugae of the chin as a signifier of mentalis strain⁶, abbreviated as 'R'.
- E. Vertical deficiency of the chin, being less than 2/3 of the lower third of the face, abbreviated as 'C'. This is best evaluated as the distance from the lower lip vermilion border, (labrale inferius (Ls) or Lower Lip Vermilion Border (LLVB)) to the caudal soft tissue border of the chin or soft tissue menton (Me'). This eliminates any contribution from the lower lip vermilion.
- F. Vertical excess of the upper lip, being greater than 1/3 of the lower third of the face, abbreviated as 'L'. This is best evaluated as the vertical distance from the base of nose where it meets the upper lip or subnasale (sn), to the junction of the skin and vermilion

of the upper lip or labrale superius (Ls). This eliminates any contribution from the upper lip vermilion.

Profile descriptors are placed first, followed by frontal descriptors. For example, Stage - 1 in a female with loss of chin fat pad volume, marionette lines, loss of lip volume, and a long upper lip is written: **CPF-1** / V, M, LL, UL

To stage chin projection, a profile picture is taken with a digital SLR camera, using a lens with a focal length of 90-105mm. The face is at rest (not animated) and the head is in the *Aesthetic Horizontal Position*². I prefer a black background, not the light blue, as recommended by *Photographic Guidelines in Plastic Surgery*⁷. Two slave flashes with supplied diffusers (available from a company such as Neewer®) are used to avoid shadows and create an even illumination. Alternatively, fixed strobe lights are used. The image is saved to a digital archiving system such as Mirror® by Canfield Scientific or uploaded directly to the computer. The image is then imported to Adobe Photoshop 2021 (Adobe Inc.) (Ps). The image is cropped and rotated to ensure that the AHL is indeed, horizontal. Perpendicular vertical lines are dropped from the AHL through the LLVB, the LMC and the OC. (Figure 1). In Figures 2 and 3, the profile photograph was cropped and modified in Ps with the *Find Edges* Tool (Filter>Stylize>Find Edges). The image can be further defined and embellished in Ps, using *Brightness/Contrast* controls under the *Image* menu (Image>Adjustments>Brightness/Contrast), with or without the *Oil Paint* tool (Filter>Stylize>Oil Paint) (Figures 2 and 3). Text is added using the Text tool, again in Ps. Alternatively, the image can be imported into Mirror® and *Labels*

applied. In Mirror® one can also perform a direct overlay of 'before and after' surgical views using the *Compare Images* tool. Mirror® has calibration and measurement tools which allow one to measure distances in a two-dimensional plane and draw vertical and horizontal lines. The measurement tool will also calculate horizontal and vertical proportions and measure angles such as the mento-cervical and cervico-mental angles⁸. Mirror® does not allow free rotation of the image to ensure that the AHL is horizontal, although Vectra® does. Vectra®, also by Canfield Scientific, creates a three-dimensional image and will allow surface measurements along the physical soft tissue contour of the face. I prefer to measure upper lip length with a soft ruler.

Discussion

'Evaluation, and treatment of chin abnormalities often has a great impact on facial appearance. It is clear that all attractive faces have an underlying balance and structural symmetry to the facial skeleton⁹. Proper balance of the facial skeleton requires harmony and proportion of all bones of the face in all three planes of space. The chin should therefore be evaluated as it relates to important adjacent structures such as the lips, teeth, and nose¹⁰'. Appropriate treatment of aesthetic deformities of the chin will contribute to facial harmony and will often improve the appearance of the mouth, lips, and nose. It is for these reasons that every face should be carefully studied to determine why the chin appears unattractive. This will enable the surgeon to correct the deformity and improve facial proportions⁶.'

The Frankfort horizontal plane (FH; also called the auriculo-orbital plane) was established at the World Congress of Anthropology, in Frankfort, Germany in 1882. This plane was first defined as passing through the center of the external auditory meatus to the lowest point of the inferior margin of each orbit. The Frankfort agreement then modified this definition, so that the plane would pass through the upper borders of each ear canal or external auditory meatus (Porion/Po), and through the inferior border of the orbital rim (Orbitale/Or)¹¹.

Bass² used the Aesthetic Horizontal (AH) position rather than the Frankfort horizontal plane. The Frankfort horizontal plane cannot be used to judge soft tissue facial aesthetics as it is based on hard tissue structures in the skull which show considerable individual variation, particularly in the position of Porion² The position of soft tissue

pogonion is a key factor in the harmonious profile and this has been shown to be as prominent in females as in males¹². In females, however, the lips are slightly more forward giving the impression of a more recessive chin¹³.

Further, the position of soft tissue nasion or glabella has little or no influence on the harmony and balance of the lower facial third; an individual with a receding or sloping forehead does not look more harmonious with a receding chin and similarly and an individual with a prominent brow does not have a better-balanced facial appearance with a protrusive mandible². To determine ideal chin projection, Bass² described a point 'V', midway between bony point A (subspinale), the most concave point of anterior maxilla and soft tissue subnasale (sn). Bass² drew a line perpendicular to the AH through Point V. This gives the posterior limit for a harmonious soft tissue chin position. Behind this, the chin *looks* retrusive. A line perpendicular to AH through subnasale, defines the anterior limit of the chin for a balanced profile. Anterior to this, the chin *looks* protrusive².

Guyuron¹⁴ recommended Reidel's line to determine chin projection. The most projecting portions of the upper lip, lower lip and chin being all tangential to Reidel's line when lower facial harmony is present. If posterior to Reidel's line, patient has microgenia. If anterior, macrogenia. Augmentation or atrophy of the lips would seem to affect the position of Reidel's line.

Guyuron classified chin deformities into seven groups. Group II, microgenia, is classified into three subsets: horizontal (*antero-posterior*), vertical (*cephalo-caudad*) or

a combination of the two. Group III represents a combined microgenia and macrogenia, with biplanar defects, which are subdivided again into two sub-categories: vertical excess / horizontal deficiency or horizontal excess / vertical deficiency. Group IV describes the asymmetric chin with three further subcategories based on lower anterior facial vertical height: normal, short, and long, without any reference to horizontal or anteroposterior projection. Group VI is pseudo-microgenia resulting from vertical maxillary excess and clockwise rotation of the mandible. Group VII is the Witch's chin deformity. Guyuron¹⁴ recommended augmentation genioplasty with an implant in the older patient with mild horizontal deficiency, while recommending an osteotomy as a better choice for the younger patient¹⁴. No guidance is offered as to the distinction between mild, moderate, and severe microgenia. Removal of excess soft tissues through a 'submental elliptical incision', is recommended for Group VII¹⁴.

Arroyo⁹ reviewed the various methods of analysis of ideal projections of the chin, showing the advantages and disadvantages of each, based on a literature review through the PubMed database. The following methods for chin analysis were reviewed: Gonzalles-Ulloa¹⁵, Goode¹⁶, Merrifield¹⁷, Silver¹⁸, Legan¹⁹, Gibson¹⁶, cervico-mental angle²⁰, and mento-cervical angle²⁰. Gonzalles-Ulloa, Goode, Merrifield, and Silver all evaluated chin projection, using the Frankfort line as a reference. Legan, Gibson, and the cervico-mental and mento-cervical angles are all based on soft tissue landmarks. Legan proposed an "ideal" angle to evaluate facial convexity. Legan's angle is measured between a line traced from the glabella to the subnasale point and another from the sub-nasal point to the pogonion. An optimal value of 12 degrees is suggested,

which may vary from 8° to 16 degrees.¹ An inferior face triangle was proposed by Gibson defined by three points: the tragus (T), the subnasal point (S), and the point of chin definition (C). Point C is the intersection of an arc centered in T that is tangential to the chin. The SC line and the T angle reflect the height of the lower third of the face. It proposes as ideal measures a TC/TS ratio of 1.15 to 1.19 and the angle S from 88° to 93 degrees. The cervico-mental (CMA) and mento-cervical angles (MCA) describe angles between the chin and neck and the face and neck respectively. The MCA includes analysis of the nasal tip, neck position, and chin projection. This angle increases with the increase in nasal projection and *vice versa*

Sykes⁶ described chin projection as 'deficient', 'normal' or 'excessive' in an anteroposterior axis and 'deficient', 'slightly deficient', 'normal', or 'excessive' in a vertical axis. The various facial analyses used to determine the ideal chin projection were discussed^{21,22,23,24}. Sykes references the Frankfort horizontal. 'An accurate chin analysis using the lateral cephalogram involves dropping a vertical line from the Frankfort horizontal through the soft tissue subnasale⁶. and 'the most frequently used evaluation of the chin drops a perpendicular line from the vermilion border of the lower lip and compares the AP position of this line with the soft tissue pogonion' (Figure 27-7)⁶. There is no mention from which line the perpendicular line is drawn. Sykes⁶ in this paper, distinguishes ideal chin projection between the sexes. The ideal female Pg' being 'just posterior' to the LLVB and the ideal male Pg' being at the level of the LLVB.

Sykes²⁵ describes the development and validation of a photonumeric scale (Allergan Chin Retrusion Scale) for the assessment of chin retrusion based on intra and inter-observer statistical analysis. This system is useful in that it again uses the LLVB. The chin 'area of assessment' is defined in the lateral view, as 'the area between the lower lip vermilion border, the most projected part of the chin (bony pogonion), and the most inferior point of the chin (bony menton)'. This, despite the photonumeric scale being based on clinical photographs and therefore soft tissue landmarks alone. No distinction is made in the photonumeric scale between male and female microgenia. No reference is made to the Frankfort horizontal or the Aesthetic Horizontal Line². Further there is no scale for macrogenia and no reference to the relationship of the pogonion (bony or soft tissue) to the oral commissure.

The numerical staging of this author's classification is different for male and female. The ideal female Pg' is posterior to the LLVB and anterior to the labio-mental crease (LMC), whereas the ideal male Pg' is at or slightly anterior to the LLVB. The desired staging after surgery is Stage 0 in both sexes (Figure 1). By classifying chin projection thus, one can document objective improvement in chin projection with any treatment modality, using soft tissue landmarks alone.

The author admits to the inherent limitations in this classification, in that it does not account for biplanar defects (Guyuron, Group III), complex asymmetric chins (Guyuron, Group IV), and pseudo-microgenia (Guyuron, Group VI). In these, a cephalometric analysis is required to determine the correct management. However, many such cases

still opt for alloplastic augmentation versus orthodontia and/or orthognathic surgery, with or without bony genioplasty.

Genioplasty, despite its proponents and its obvious benefits, also has a long list of potential complications. Guyuron¹⁴ lists these potential complications and their management (Table 13.3¹⁴). For many patients, microgenia is unaccompanied by complicating factors and the need for orthognathic surgery. This is particularly true of the aging chin which has associated contributory factors such as loss of volume and ptosis of the chin fat pad, submental fat and platysmal diastasis. Further, to include every anatomical variation, would not only make this classification cumbersome but also decrease its utility. By staging CP in this way, one creates a simple guide to treatment (Table B).

Stage	Treatment	Treatment	Treatment	Treatment	Treatment	Treatment
Physical Finding	Chin Fat Pad Volume loss (V) (Male and Female unless otherwise specified)	Marionette line at jawline (M)	Vertical height chin: <2/3 of lower 1/3 face (C)*	Vertical height Upper Lip: >1/3 of lower 1/3 face (L)*	Diminished vermilion volume: vertical height and or projection	Asymmetry (A)
-1	Filler Fat Chin implant	Male: Extended or square implant Female: Extended implant	Filler/Fat. Consider vertical lengthening implant (Male option: square implant) Genioplasty	Upper lip shortening With or without fat injection to lips	Filler or Fat injection to lips	Position chin implant asymmetrically. Genioplasty
-2	Filler Fat Chin implant	Male: Extended or square implant Female: Extended implant	Filler/Fat. Consider vertical lengthening implant (Male option: square implant) Genioplasty	Upper lip shortening With or without fat injection to lips	Filler or Fat injection to lips	Position chin implant asymmetrically. Genioplasty
-3	Filler Fat Chin implant Genioplasty	Male: Extended or square implant Female: Extended implant	Filler/Fat. Consider vertical lengthening implant (Male option: square implant) Genioplasty	Upper lip shortening With or without fat injection to lips	Filler or Fat injection to lips	Position chin implant asymmetrically. Genioplasty
-4	Chin implant Genioplasty	Male: Extended or square implant Female: Extended implant	Filler/Fat. Consider vertical lengthening implant (Male option: square implant) Genioplasty	Upper lip shortening With or without fat injection to lips	Filler or Fat injection to lips	Position chin implant asymmetrically. Genioplasty
-5	Chin implant Genioplasty	Male: Extended or square implant Female: Extended implant	Filler/Fat. Consider vertical lengthening implant (Male option: square implant) Genioplasty	Upper lip shortening With or without fat injection to lips	Filler or Fat injection to lips	Position chin implant asymmetrically. Genioplasty

* Shortening a long upper lip or lengthening a chin, will alter the ratio of the lip to the chin. A shorter upper lip will make a vertically deficient chin appear longer. Lengthening a chin will make the upper lip appear shorter. Augmentation of both the upper and lower lips will reduce the visual height of the upper lip and the chin respectively.

Table B. Treatment guidelines for each chin projection stage.

Further, no prior classification has used the OC as a soft tissue landmark. The position of the oral commissure in the profile view may or may not vary depending on the width of the stomium. In a random examination of my own patients of different facial configurations and ethnicities, the position of the oral commissure seems to be remarkably consistent, being at the level of the medial canthus on the lateral view with the head in the Aesthetic Horizontal position and the mouth at rest. Smiling and other facial expressions will obviously change the position of the OC and possibly efface the LLVB and the LMC. Smiling or facial expressions also alter the contour of the chin fat pad and therefore invalidate an evaluation of the soft tissue Pg' position.

As a further comment previous authors^{6,14,26} have recommended soft tissue excision or a suspended internal flap for the management of the Witch's chin deformity. In my experience, the Witch's chin deformity can be corrected with a chin implant alone, which resuspends the mentalis and the levator labii inferioris muscles as well as the overlying fat pad. I have never excised soft tissue or performed an internal flap to correct the problem although I recognize that this is an accepted treatment.

Conclusion

Microgenia and chin retrusion is a common aesthetic deformity. It is multifactorial in origin and affects the aesthetic balance of the lower third of the face² and also the appearance of the nose. There are multiple methods for improving or correcting chin retrusion or microgenia. This paper is not intended as a discussion of the methods of treatment. The author proposes a clinical classification using easily defined soft tissue landmarks alone in the Aesthetic Horizontal position, without reference to bony points. These soft tissue landmarks are: LLVB, LMC, OC and Pg'; the purpose being to provide a simple staging and a treatment algorithm for trainees, experienced plastic surgeons and aesthetic practitioners, alike. Prior classifications may require cephalometric X-rays^{2,6,9,14}, or soft-tissue images whilst referencing hard tissue landmarks²⁵. Prior classifications use soft tissue landmarks which may vary dependent on lip¹⁴ or nasal tip projection or inclination of the head²⁰. They may be vague; with descriptors such as mild, moderate, and severe¹⁴ slightly deficient 'normal', or 'excessive'⁶. The classification described in this paper uses a profile image aligned on the Aesthetic Horizontal (AH) position as 'measured by eye', rather than the Frankfort horizontal plane, and uses only the soft-tissue landmarks referenced above. The classification provides a simple measurable language for communication between different practitioners and disciplines in order to evaluate degrees of deformity, proposed treatments, results, and outcomes. The classification is not intended to cover every chin deformity but should suffice as a practical roadmap for most clinical cases.

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Legends

in order of citation in manuscript.

Figure 1. Chin projection: soft tissue landmarks and stages.

Table A. Chin projection classification

Figure 2. Chin projection CPF-1 converted to CPF0 with silicone chin implant, landmarks, and guidelines to staging.

Figure 3. Chin projection CPF-4 converted to CPF0 with silicone chin implant, landmarks, and guidelines to staging.

Figure 4A. CPF-1/LL,L converted to CPF0 with silicone chin augmentation, upper and lower lip fat injection, upper lip shortening and nasal tip-plasty, 12.5-year follow-up of chin augmentation, profile view.

Figure 4B. CPF-1/LL,L converted to CPF0 with silicone chin augmentation, upper and lower lip fat injection, upper lip shortening and nasal tip-plasty, 12.5-year follow-up of chin augmentation, front view.

Figure 5A. CPF-4 converted to CPF-1, 60-year-old, silicone chin augmentation, endoscopic browlift, facelift, upper and lower eyelid blepharoplasty, 12 years follow-up, profile view

Figure 5B. CPF-4 converted to CPF-1, 60-year-old, silicone chin augmentation, endoscopic browlift, facelift, upper and lower eyelid blepharoplasty, 12 years follow-up, front view

Figure 6A. Chin Projection CPF-2 converted to CPF0 with silicone chin implant; patient also had an endoscopic brow lift, 7-year follow-up, side view

Figure 6B. Chin Projection CPF-2 converted to CPF0 with silicone chin implant; patient also had an endoscopic brow lift, 7-year follow-up, front view

Table B. Treatment guidelines for each chin projection stage.

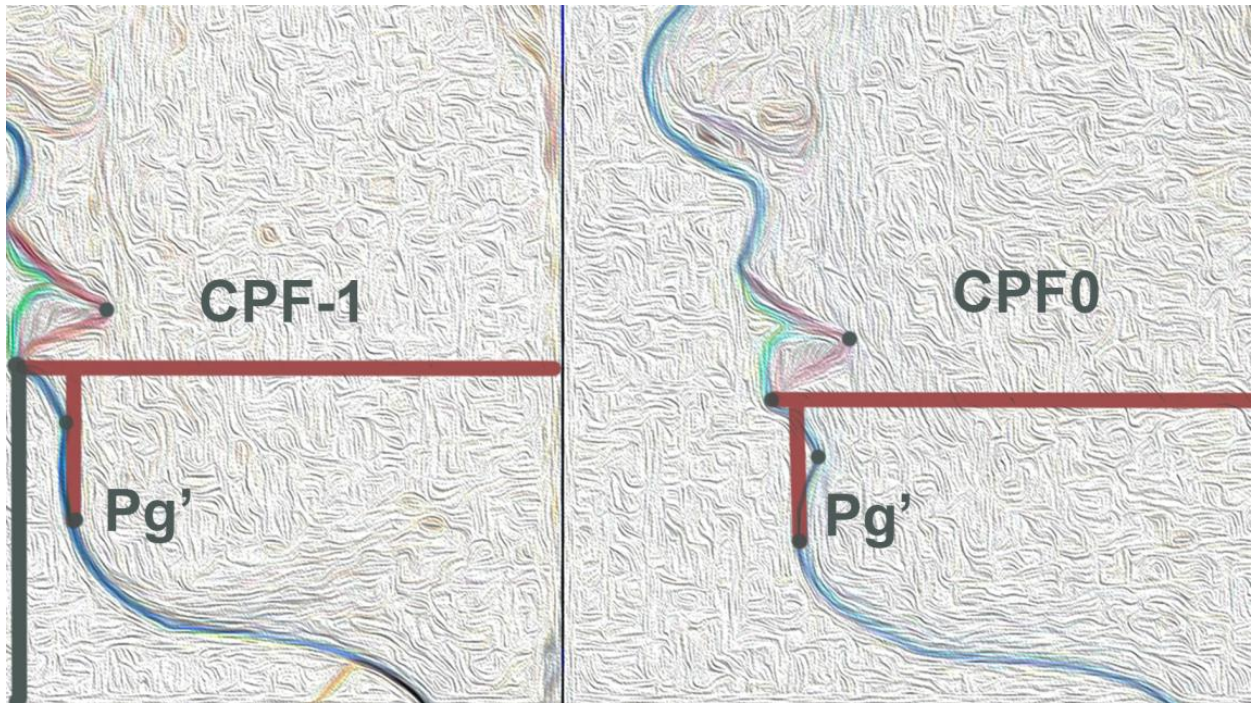


Figure 2. Chin projection CPF-1 converted to CPF0 with silicone chin implant, landmarks, and guidelines to staging.

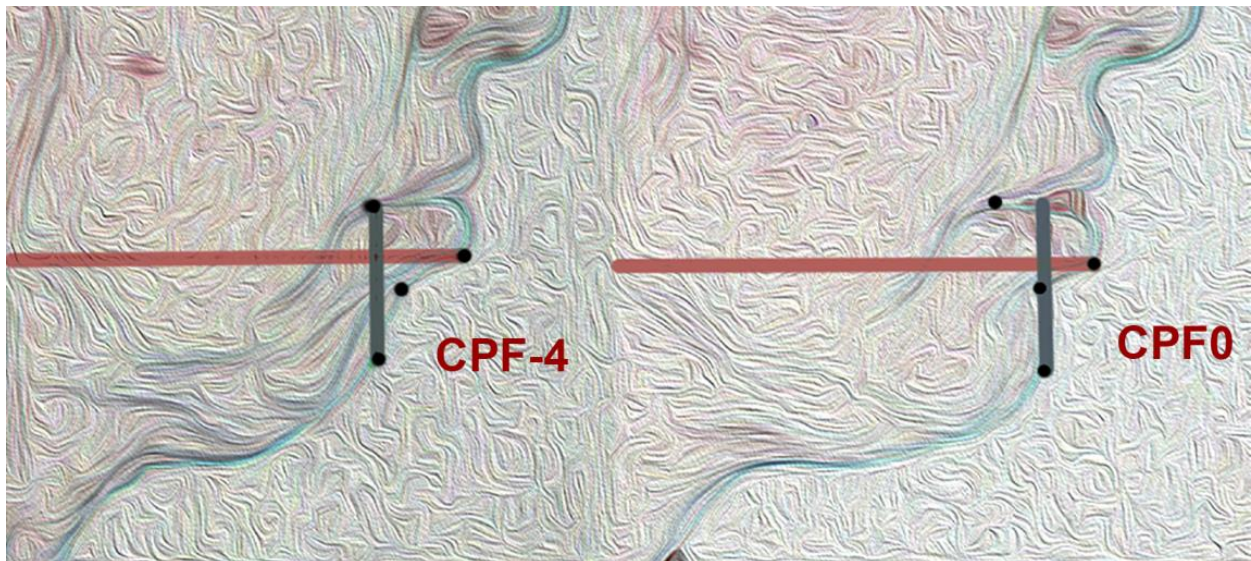


Figure 3. Chin projection CPF-4 converted to CPF0 with silicone chin implant, landmarks, and guidelines to staging.



Figure 4A. CPF-1/LL,L converted to CPF0 with silicone chin augmentation, upper and lower lip fat injection, upper lip shortening and nasal tip-plasty, 12.5-year follow-up of chin augmentation, profile view.



Figure 4B. CPF-1/LL,L converted to CPF0 with silicone chin augmentation, upper and lower lip fat injection, upper lip shortening and nasal tip-plasty, 12.5-year follow-up of chin augmentation, front view.



Figure 5A. CPF-4 converted to CPF-1, 60-year-old, silicone chin augmentation, endoscopic browlift, facelift, upper and lower eyelid blepharoplasty, 12 years follow-up, profile view



Figure 5B. CPF-4 converted to CPF-1, 60-year-old, silicone chin augmentation, endoscopic browlift, facelift, upper and lower eyelid blepharoplasty, 12 years follow-up, front view



Figure 6A. Chin Projection CPF-2 converted to CPF0 with silicone chin implant; patient also had an endoscopic brow lift, 7-year follow-up, side view



Figure 6B. Chin Projection CPF-2 converted to CPF0 with silicone chin implant; patient also had an endoscopic brow lift, 7-year follow-up, front view