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Analysing chin prominence in relation to the lower lip: The lower lip-chin prominence angle

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ABSTRACT

The purpose of this investigation is to describe a potentially useful analysis in assessing the required extent of sagittal chin augmentation or set-back, by relating chin prominence to lower lip position using the 'lower lip-chin prominence angle'. The secondary aim was to quantitatively evaluate the influence of this angle on perceived attractiveness and desire for surgery. Having described this angular analysis, a quantitative evaluation was undertaken by incrementally altering the angle on an idealised profile image to create a range of images that were rated on a 7-point Likert scale by a pre-selected group of pre-treatment orthognathic patients, clinicians and laypeople. In treatment planning alterations in chin prominence, an 'ideal' sagittal position with soft tissue pogonion on or just behind a true vertical line through the most prominent point of the lower lip may be used. Chin retrusion or prominence up to an angle of 15° retrusion to −5° prominence is deemed acceptable. Surgery is desired from chin prominence of greater than −15° and retrusions greater than 25°. The greater the retrusion or prominence of the chin from an angle of 0°, the less the perceived attractiveness and the greater the desire for surgical correction.

1. Introduction

A number of aesthetic parameters are relevant to the observed attractiveness of the chin region, including soft tissue chin projection, chin height proportion relative to lower face height and the contour of the labiomental fold, particularly the morphology of the transition from the lower lip to the chin. These parameters are directly or indirectly related to osseous chin prominence, the thickness of the overlying soft tissue chin pad, the mandibular incisor inclination and sagittal projection, the position of the mandibular basal bone in relation to the craniofacial complex, and the lower lip morphology, thickness and position in repose. All these parameters must be considered during diagnosis and treatment planning. A number of soft tissue facial aesthetic analyses, e.g. the zero-degree meridian (Gonzalez-Ulloa, 1962; Naini, 2014), vertical line perpendicular to the Frankfort plane (Wolford and Bates, 1988), true vertical line through either soft tissue nasion or glabella (Naini, 2011), true vertical line through subnasale (Bell et al., 1986; Bass, 1991), the vertical corneal plane (Naini, 2011), the angle of facial soft tissue profile convexity (Legan and Burstone, 1980), the facial angle (Holdaway, 1983), the Riedel plane (Riedel, 1957), the E-line (Ricketts, 1960), S-line (Steiner, 1953) and Z-line (Merrifield, 1966), and cephalometric analyses, e.g. S-N-B angle (Riedel, 1952) and S-N-D angle (Steiner, 1959), have been described to assess these, though none evaluates directly the relationship between lower lip and chin prominence.

Some patients have true horizontal microgenia (sagittal chin deficiency) and would benefit from an advancement osseous genioplasty or alloplastic augmentation of the chin. Alternatively, it is not unusual for patients with mandibular retrognathia (which describes sagittal under-projection of the entire mandibular corpus and mandibular dentition) but a functioning dental occlusion to be unwilling to undergo orthognathic surgery but willing to have a camouflage genioplasty. In both circumstances, aesthetic evaluation of the chin in relation to its closest neighbouring structures becomes paramount. The lower lip is anatomically the closest facial aesthetic unit in relation to the chin. Thereby, the relationship

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between these neighbouring promontories is aesthetically important to establish, particularly in profile view (Naini, 2011). The morphology of either facial unit is likely to affect the perceived attractiveness of the other. Rosen made the anecdotal observation that for ideal aesthetics the chin should not be advanced farther than the most anterior position of the lower lip (Rosen, 1995).

In facial aesthetic analysis, the significance of an angular relationship compared to linear relationships is that it is independent of the size of an image. Therefore, angular relationships may be assessed and measured from a profile photograph or lateral cephalometric radiograph of any magnification. Additionally, they can sometimes be measured at the chair side using a simple protractor.

The primary aim of this investigation is to describe a potentially useful angular analysis in assessing the required extent of chin augmentation or set-back, by relating chin prominence to lower lip position using the 'lower lip-chin prominence angle'. The secondary aim was to quantitatively evaluate the influence of this angle on perceived attractiveness and desire for surgical correction.

2. Materials and methods

Ethical approval was sought and granted for the study by the National Research Ethics Service (UK). The lower lip-chin prominence angle and corresponding analysis of chin prominence described in this investigation requires the introduction of a new anthropometric and cephalometric soft tissue landmark, the labrale inferius anterioris (Lia) point, which may be defined as the most anterior/prominent midline point on the lower lip, with the lips in repose, teeth lightly in occlusion and the subject in natural head position (Fig. 1). In most patients when their lips are in repose, the Lia point will lie approximately above and somewhat anterior to labrale inferius.

In order to undertake the analysis, the patient should stand in their natural head position, with their teeth lightly together and, most importantly, with their lips in repose. Asking the patient to make a prolonged M sound and then to relax allows their circumoral musculature to relax. In front of the patient should be a plumb line hanging from the ceiling, which acts as an extracranial true vertical line (TrV). A clinical photograph taken in profile view permits the TrV line to be drawn, and a line parallel to this may be constructed through the Lia point, which may be referred to as the Lia-Vertical line, or 'LiaV'. This is effectively a true vertical line through the most prominent point on the lower lip. From Lia point, a second line is constructed to soft tissue pogonion (Pog′). The angle formed between the LiaV line and the Lia-Pog′ line may be termed the LiaV-Pog′ angle, i.e. the lower lip-chin prominence angle (Fig. 2).

Facial profile silhouettes have been used routinely to assess the perceptions of facial profile attractiveness (Barrer and Ghafari, 1985; Naini et al., 2012). A profile silhouette image was created with computer software (Adobe® Photoshop® CS2 software; Adobe Systems Inc, San Jose, CA). The image was then manipulated using the same software to construct an 'ideal' facial profile image with proportions (Naini, 2011) and soft tissue measurements (Farkas et al., 1984, 1985; Farkas and Kolar, 1987; Naini et al., 2012) based on currently accepted criteria, as previously described (Naini et al., 2012). The chin prominence of the idealised profile image was altered incrementally, from a LiaV-Pog′ angle of −30 to 45°, in order to represent prominence and retrusion of the chin respectively (Fig. 3).

Based on the results of a pilot study and associated power calculation one hundred and eighty-five observers were recruited and separated into three groups (pre-treatment orthognathic

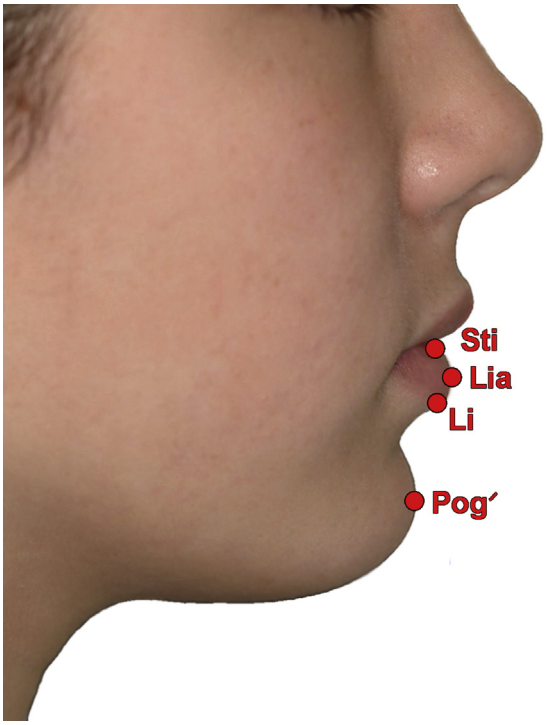

Fig. 1. Definitions of anthropometric landmarks: **Stomion inferius (Sti)**: The most superior midline point of the lower lip. **Labrale inferius anterioris (Lia)**: The most anterior/prominent midline point of the lower lip, with the lips in repose, teeth lightly in occlusion and the subject in natural head position. **Labrale inferius (Li)**: The midline point representing the mucocutaneous vermilion border of the lower lip. **Soft tissue pogonion (Pog′)**: The most prominent midline point of the soft tissue chin pad.

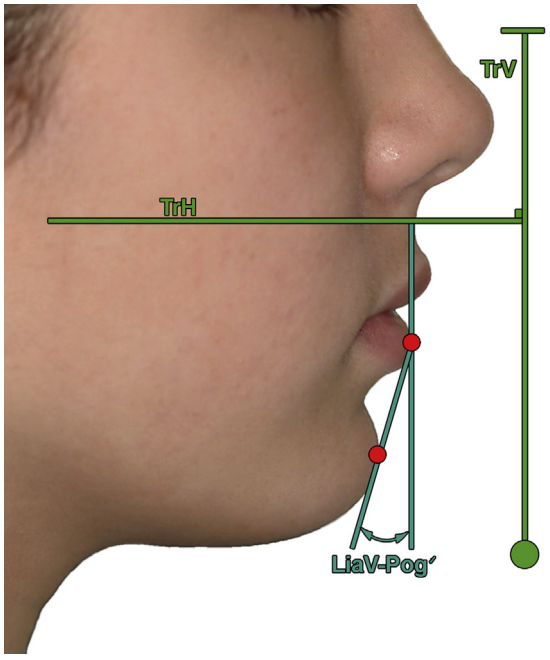

Fig. 2. The lower lip-chin prominence (LiaV-Pog′) angle: In front of the patient there is a plumb line hanging from the ceiling, which acts as an extra-cranial true vertical line (TrV). Perpendicular to the TrV may be constructed the true horizontal line (TrH). A line parallel to the TrV, and perpendicular to the TrH, this may be constructed through the Lia point, which may be referred to as the Lia-Vertical line, or 'LiaV'. This is effectively a true vertical line through the most prominent point on the lower lip. From Lia point, a second line is constructed to soft tissue pogonion (Pog'). The angle formed between the LiaV line and the Lia-Pog′ line may be termed the LiaV-Pog′ angle, i.e. the lower lip-chin prominence angle.

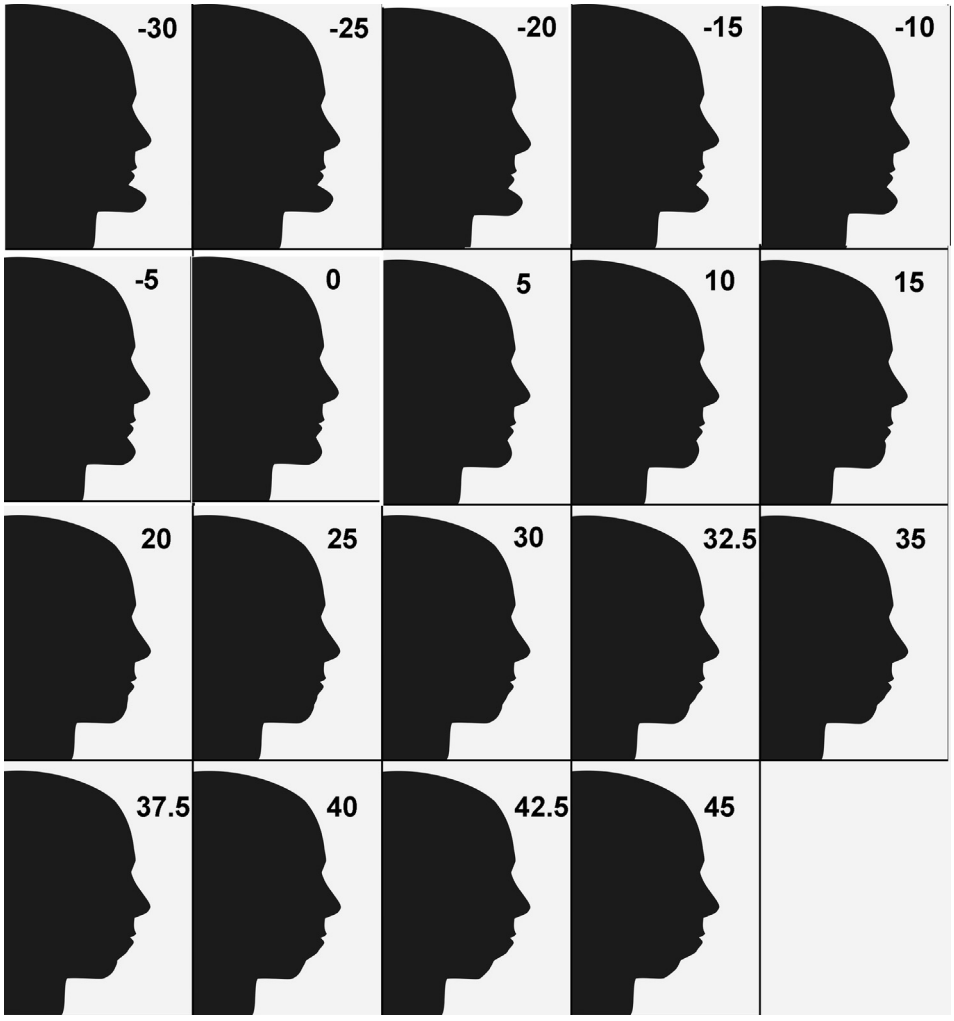

Fig. 3. The chin prominence of the idealised profile image was altered incrementally, from a lower lip-chin prominence (LiaV-Pog′) angle of −30 to 45°, in order to represent prominence and retrusion of the chin respectively.

patients, laypeople and clinicians) (Table 1). Selection criteria for the orthognathic patients were: pre-treatment; primary concern was facial appearance; no previous orthodontic or facial surgical treatment; no history of facial trauma; and no severe psychological issues e.g. body dysmorphic disorder. Selection criteria for the laypeople were: no previous orthodontic or facial surgical treatment; no facial deformities or history of facial trauma; and non-health care employees. The clinician group were maxillofacial surgeons and orthodontists involved in the management of patients with facial deformities.

Each observer was given a questionnaire and asked to provide the following information: age, sex, ethnic origin, how would you rate the attractiveness of *your* facial appearance, and how important do you think it is to have an attractive facial appearance. An instruction sheet accompanied the questionnaire, asking the observers to rate each image in terms of facial attractiveness using the following rating scale: 1, extremely unattractive; 2, very unattractive; 3, slightly unattractive; 4. neither attractive or unattractive; 5, slightly attractive; 6, very attractive; 7, extremely attractive. In addition, observers were asked whether they would consider surgery to correct the appearance if this was their facial appearance (yes or no).

The images were placed in random order into the software application Microsoft PowerPoint®. Each image was identified by a randomly assigned double letter in the top right corner of the screen, e.g. BG, which corresponded to the LiaV-Pog′ angle. A duplicate of the −10° image was used in order to assess intra-examiner reliability. Each observer sat undisturbed in the same room in front of the same computer and 17″ flat screen monitor. The presentation and the images were created in such a way that each of the profile silhouette images, when viewed on the 17″ flat screen monitor, had the same dimensions as a normal human head,

Table 1
Observer demographics.

Observer Group	Number	Mean age (years)	95% c.i.	Age range	Sex (% Male)	Ethnicity (% White)
Orthognathic Patients	75	22	20, 24	13–60	42%	66%
Laypeople	75	31	28, 35	16–79	31%	49%
Clinicians	35	31	30, 33	24–39	33%	72%

based around an average lower anterior facial height. This would help to reduce the potential effect of image magnification or size reduction on the observer's perception. Each observer examined the images in the PowerPoint® presentation by pressing the 'Page Down' button on the keyboard, in their own time.

The Likert-type rating scale is largely accepted in the psychology literature as the most useful rating method (Langlois et al., 2000). The seven-point Likert scale described above was used by each observer to rate each image in terms of attractiveness.

2.1. Statistical analysis

Mixed regression was used to assess the differences in ratings for the three groups (pre-treatment orthognathic patients, laypeople, and clinicians) while adjusting for the concurrent effects of age, sex, ethnicity, self-rating for facial attractiveness, the importance given to an attractive facial appearance, the observer's anteroposterior jaw relationship (Class I, II or III), the observer's vertical face height (average, increased or decreased), observer's facial asymmetry (yes/no) and the degree of sagittal chin prominence of the images. The multivariate regression models are fitted in a stepwise manner, including all those variables that reach a significance below $P = 0.25$ univariately. Given the recognised low power of the relevant test, the benchmark for a significant interaction was set at the 10% level. The mixed regression uses a multi-level approach to consider the clustering effect by observer. The model was validated using a logarithmic transformation for the rating scale to assess the effect of departure from normality.

3. Results

All the laypeople and the clinicians were skeletal Class I while 96% of the patients were skeletal Class II or III. There was no significant difference in perceptions of attractiveness between observers with skeletal Class II and III jaw relationships ($P = 0.91$) but they appeared to differ significantly from those with skeletal Class I. When skeletal Class was fitted on the patient group alone no difference was detected between skeletal Classes II and III ($P = 0.86$).

3.1. Reliability analysis

A duplicate of the -10° image was used in order to assess intra-examiner reliability. On long one-way analysis of variance, the variability between observers for the replicated images was highly significant ($P < 0.0001$): the value of the F (184,185) statistic was 3.03. These results indicate that there was little variation in the intra-observer ratings for these images. The intra-class correlations was ICC = 0.50 (95% c.i. 0.40 to 0.61) (moderate reliability).

3.2. Perceived attractiveness of images

Univariate and multivariate mixed linear regressions demonstrated that the most important factor influencing rating is the degree of sagittal chin projection, the effect being more marked when the chin is prominent than when it is retrusive. From the baseline position of the chin being in line with the lower lip, ratings reduce for each 5-degree unit of variation. The effect is slightly more marked for chin prominence than retrusion, but in both cases begins after 2 units (i.e. 10°) of change.

Most variables were not significant, with an effect of observer group found only for rating of images with chin prominence, with laypeople giving a higher rating for attractiveness than clinicians. No significant differences in the mean ratings were found between the different skeletal Classes.

3.3. Outcome: Desire for surgery

The univariate and multivariate mixed logistic regressions for desire for surgery demonstrated that the most important factor influencing desire for surgery was the extent of chin projection, the effect being more marked with chin prominence than retrusion. The odds of desire for surgery increased by 41% ($P = 0.01$) for each unit increase in the chin retrusion and by 90% ($P = 0.01$) for each extra unit in the chin prominence.

Observer age influenced the likelihood of desire for surgery. The odds of desiring surgery decreased by 4% for each year increase in the age of the observer ($P = 0.01$), the effect being similar for chin prominence and retrusion. An effect of observer sex was found for images with chin retrusion only; the odds of desiring surgery were 63% less for men than women ($P = 0.003$). No significant effect of observer group on the likelihood of desire for surgery was found.

The extent of sagittal chin prominence above which observers began to desire surgery depended on whether the deviation was protrusive or retrusive, but did not differ much between the groups of observers. For chin retrusion, the values from which surgery was desired were 25° for laypeople and slightly greater for patients and clinicians. For chin prominence, the angle from which surgery was desired was -15° for all the observer groups.

3.4. Most attractive and least attractive images

The highest rated and thereby most attractive perceived image was 0°, representing the idealised facial profile with soft tissue pogonion on the true vertical line (Table 2). Other highly rated images exhibited minor degrees of chin retrusion (5°, 10°, and 15°) or very minor chin prominence (-5°). The lowest rated images demonstrate the most severe degrees of chin protrusion and retrusion, -30 and 45°, respectively (Fig. 4).

4. Discussion

A considerably prominent or retrusive chin may be a significant reason for patients seeking orthognathic surgery and/or genioplasty. Due to the importance of the perceived attractiveness of the chin, clinicians require data on variability of chin projection linked

Table 2
Mean observer ratings and confidence intervals, ordered from best to worse rating (positive angles represent chin retrusion and negative angles represent chin prominence) (LiaV-Pog′ angle, the lower lip-chin prominence angle).

LiaV-Pog′ Angle (degrees)	Mean	Standard error	95% Confidence Interval		Median
0	5.4	0.1	5.2	5.5	5
5	4.9	0.1	4.8	5.1	5
10	4.5	0.1	4.3	4.7	4
−5	3.9	0.1	3.7	4.1	4
15	3.8	0.1	3.7	4.0	4
20	3.7	0.1	3.5	3.9	4
25	3.2	0.1	3.0	3.3	3
−10	2.9	0.1	2.7	3.1	3
30	2.7	0.1	2.6	2.9	3
−10	2.6	0.1	2.5	2.8	3
32.5	2.6	0.1	2.4	2.7	3
35	2.3	0.1	2.2	2.5	2
37.5	2.2	0.1	2.1	2.4	2
−15	2.1	0.1	2.0	2.3	2
42.5	2.0	0.1	1.9	2.2	2
40	2.0	0.1	1.8	2.1	2
−25	1.9	0.1	1.7	2.0	2
−20	1.8	0.1	1.6	1.9	2
45	1.8	0.1	1.6	1.9	1
−30	1.4	0.1	1.3	1.5	1

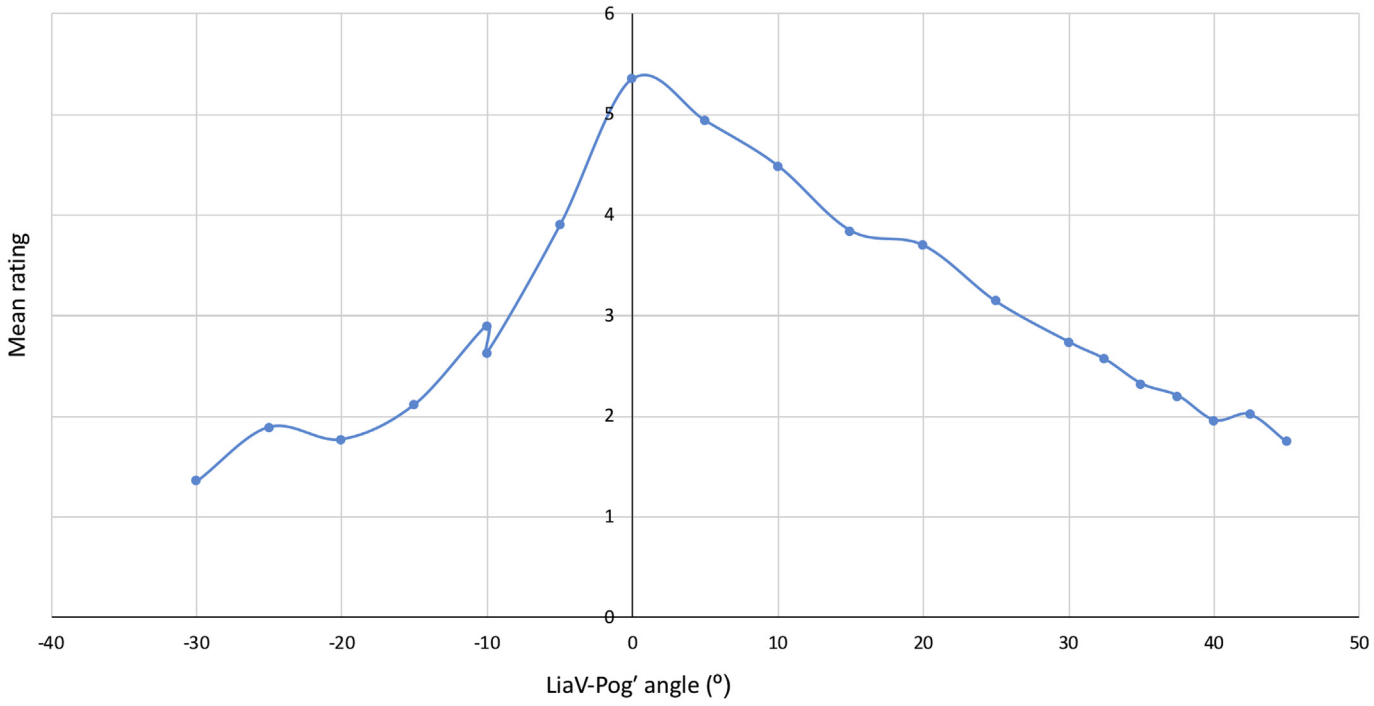

Fig. 4. Observer ratings vs. the lower lip-chin prominence (LiaV-Pog′) angle.

to attractiveness ratings, and methods of assessing chin projection. The main purpose of this investigation was to evaluate an easily measurable angular relationship between the sagittal projection of the chin and its nearest aesthetic neighbour, the lower lip, and to quantitatively evaluate the influence of this angle on perceived attractiveness and desire for surgical correction.

The results of this investigation demonstrated that in relation to all the variables investigated the most important parameter influencing ratings of attractiveness was the degree of sagittal chin projection, being more marked when the chin was prominent than when it was retrusive. Ratings decreased for each 5-degree unit increase in chin prominence and retrusion from the baseline 0-degree LiaV-Pog′ angle, with a more marked effect for prominence. For chin retrusion the difference begins after 10 degrees of change, and for chin prominence after only 5 degrees of change.

The extent of sagittal chin projection and LiaV-Pog′ angle above which observers began to desire surgery depended on whether the chin was prominent or retrusive, but did not differ significantly between the groups of observers. For chin retrusion, the LiaV-Pog′ angle value from which surgery was desired was approximately 25° for all three observer groups. For chin prominence, the LiaV-Pog′ angle values from which surgery was desired was approximately −15° for all three observer groups.

Although previous investigations have found differences in perception between maxillofacial surgeons and orthodontists (Cochrane et al., 1999), in the present study an effect of observer group was found only for ratings of images with chin prominence, with laypeople on average giving a higher rating for attractiveness than clinicians, otherwise no significant effect of observer group on the likelihood of desire for surgery was found.

Regarding desire for surgical correction, the most influential parameter was the extent of chin projection. The effect was more marked for chin prominence than retrusion. The odds of desire for surgery increased by approximately 40% for each unit increase in the chin retrusion and almost doubled for each extra unit in the chin prominence. Observer age influenced the likelihood of desire for surgery. The odds of wanting surgery decreased by 4% for each year increase in the age of the observer. This effect was similar for chin protrusion and retrusion. An effect of observer sex was found for images with chin retrusion only; the odds of desire for surgery were over 60% less for men in relation to women. The extent of sagittal chin prominence above which observers began to desire surgery depended on whether the deviation was protrusive or retrusive, but did not differ much between the groups of observers. For chin retrusion, the values from which surgery was desired were 25° for laypeople and slightly greater for patients and clinicians. For chin prominence, the angle from which surgery was desired was −15° for all the observer groups.

The highest rated and thereby most attractive perceived image was with a LiaV-Pog′ angle of 0°, representing the idealised facial profile with soft tissue pogonion on the true vertical line from Lia point (Table 2). Other highly rated images exhibited minor degrees of chin retrusion (LiaV-Pog′ angles of 5, 10 and 15°) or very minor chin prominence (LiaV-Pog′ angle of −5°). The lowest rated and thereby least attractive images (−30 and 45°) demonstrate the most severe degrees of chin prominence and retrusion. The overall trend demonstrated that milder degrees of chin retrusion and prominence were rated as more attractive and greater degrees of deviation from the baseline LiaV-Pog′ angle of 0-degrees were rated as progressively less attractive, though the tendency was for chin prominence to be perceived as less attractive than retrusion.

As with other facial parameters it is generally acknowledged that chin projection has a range of normal individual variability. As a starting point for comparative purposes, it is useful to look at the LiaV-Pog′ angle in idealized images from classical and Renaissance art and sculpture (Table 3). The Doryphorus, or 'Spear-Bearer', is generally considered to epitomise male beauty and proportions from classical Greece, and its sculptor, Polykleitos of Argos, wrote the first known treatise on ideal human proportions (Naini, 2011). The LiaV-Pog′ angles from the remaining Doryphorus statues is approximately 13–15°, and from other male classical Greek statues appears to be in the range of 5–15°.

Table 3
The lower lip-chin prominence (LiaV-Pog′) angle in idealized images from classical and Renaissance art and sculpture.

Artwork	Artist	Era	Lower lip-chin prominence (LiaV-Pog′) angle (degrees)
Doryphorus (Pompeii, now in Naples)	Polycleitos of Argos	Classical Greece	15
Doryphorus (Minneapolis)	Polycleitos of Argos	Classical Greece	13
Heracles (Naples)	Polycleitos of Argos	Classical Greece	7
Idolino (Rome)	Unknown (After Polycleitos)	Classical Greece	12
Hermes (Naples)	Apollonius	Classical Greece	15
'Hera' Borghese (Female head; Copenhagen)	Unknown (Possibly Polycleitos)	Classical Greece	5
Male head in profile detail (Biblioteca Ambrosiana, Milan)	Piero della Francesca	Italian Renaissance	15
Head of a youth in profile (male), (Uffizi Gallery, Florence)	Leonardo da Vinci	Italian Renaissance	0
Profile study of a youth (male head) (Royal Collection, Windsor Castle)	Leonardo da Vinci	Italian Renaissance	0
Head and shoulders of a youth in profile (male head) (Royal Collection, Windsor Castle)	Leonardo da Vinci	Italian Renaissance	0
Study of the valves and muscles of the heart (male head in profile) (Royal Collection, Windsor Castle)	Leonardo da Vinci	Italian Renaissance	0
Woman's head in profile (Royal Collection, Windsor Castle)	Leonardo da Vinci	Italian Renaissance	8
La Bella Principessa	Leonardo da Vinci	Italian Renaissance	10
Idealised head of a woman (British Museum)	After Leonardo da Vinci (unknown artist)	Italian Renaissance	5
Head of a woman in profile (Louvre, Paris)	Giovanni Antonio Boltraffio	Italian Renaissance	5
'Ideal' male craniofacial proportions in three dimensions (three figures)	Albrecht Dürer	German Renaissance	−5, 0 and 5 respectively
Primavera (Middle sister, profile) (Uffizi Gallery, Florence)	Botticelli	Italian Renaissance	15
Woman's profile (from The Three Ages of Man) (National Gallery, Edinburgh)	Titian	Italian Renaissance	3

Heracles, considered potentially the most masculine male statue, has an angle of 5°, though this angle is also evident on the female Hera. From a number of idealized male and female profile images painted in the Renaissance, the earliest is from Piero della Francesca, which has a LiaV-Pog′ angle of 15°. A number of male profiles by Leonardo da Vinci have a LiaV-Pog′ angle of 0°, with female profiles by Leonardo and his students being in the range of 5–10°. The three 'ideal' profiles drawn by Albrecht Dürer have a LiaV-Pog′ angle of 5, 0 and −5° respectively. The LiaV-Pog′ angles in these classical and Renaissance art works appears to be concordant with the range of variability of sagittal chin projection found to be attractive in this investigation.

Additionally, there is more contemporary evidence that a straight or orthognathic profile is more attractive than convex or concave profiles (Hönn et al., 2005; Ioi et al., 2007; Kerr and O'Donnell, 1990; Phillips et al., 1995). The results of the present study confirm this, as the 'ideal' orthognathic profile (LiaV-Pog′ angle of 0-degrees) was rated as the most attractive image. The results of the present study demonstrate that although chin deviations from the 'ideal' are noticeable from approximately 5° prominence or 10° retrusion, surgery is desired with relatively smaller protrusive deviations (from −15°) compared to retrusive deviations (from 25°). Objective evidence from normative population samples (Bhatia and Leighton, 1993; Farkas et al., 1984; Subtelny, 1959; Worms et al., 1976), demonstrates that the angle of soft tissue profile convexity of the lower face tends to be with the chin slightly retrusive; none of the normative population data demonstrates chin prominence or a Class III profile as within normal limits. Such population data corroborates the results of the present study, in that chin prominence appears to be less attractive and also leads to a greater desire for surgical correction than chin retrusion.

The question may be asked as to how the described lower lip-chin prominence angle helps to distinguish the requirement for mandibular advancement/set-back and/or genioplasty in orthognathic surgical planning in clinical practice? The major advantage of the lower lip-chin prominence angle described in this article is that it relates the sagittal prominence of the chin to its nearest neighbour, the lower lip, rather than an arbitrary point on the upper face. In a patient with an otherwise normal position of their lower lip and mandibular body, but sagittal chin deficiency (retrogenia), the angle and data presented allows the chin prominence to be diagnosed and the degree of advancement or set-back of the chin to be planned in relation to the lower lip. However, in a patient with mandibular retrognathism or prognathism, even though the mandibular body will need to be advanced or set-back respectively, once the orthodontic decompensation of the mandibular incisors has been achieved, the lower lip-chin prominence angle may be used to assess whether a concomitant osseous genioplasty will also be required or not, as the pre-orthognathic lower lip position and Lia point can be used to evaluate the chin prominence even before the mandibular advancement or set-back.

In terms of additional cephalometric analyses, in order to assess the sagittal mandibular body position, we would suggest a combination of facial aesthetic analysis (e.g. position of soft tissue B-point in relation to zero-degree meridian line), and cephalometric analyses, e.g. S-N-B (sella-nasion-skeletal B-point) angle, and S-N-D (sella-nasion-point D) angle, where D-point is the middle point in the chin symphysis region. These analyses exclude the hard tissue and soft tissue pogonion and thereby the chin prominence, whilst evaluating the sagittal mandibular body position in relation to the cranial base.

It is possible to evaluate the lower lip-chin prominence angular relationship on a three-dimensional model if that is a clinician's preference; there is no need for additional data as both the new anthropometric landmark "Lia" and soft tissue pogonion (Pog') are midline points on the face, therefore the same data would be valid on a three-dimensional model. Additionally, the angle may be measured at the chair side using a simple mathematical protractor and clinical "eyeballing".

5. Conclusions

The understanding of ideal morphological and relative positional relationships of individual facial components, such as the sagittal prominence of the chin, is vital for correct treatment planning. From the results of this study, it is recommended that:

- In treatment planning to alter the sagittal prominence of the chin, an 'ideal' sagittal position with soft tissue pogonion on or just behind LiaV line (a true vertical line through the most prominent point of the lower lip) may be used, although chin retrusion or protrusion up to a LiaV-Pog′ angle of 15° retrusion to −5° prominence is essentially acceptable.
- Surgery is desired from chin prominence of greater than −15° and retrusions greater than 25°.
- The overall direction of aesthetic opinion appears to be the same for all the observer groups, i.e. the greater the retrusion or prominence of the chin from the baseline LiaV-Pog′ angle of 0°, the less attractive the perceived attractiveness and the greater the desire for surgical correction.

The described lower lip-chin prominence (LiaV-Pog′) angle may be a useful additional analysis in the evaluation of chin prominence prior to genioplasty and/or mandibular advancement surgery.

Ethical approval

Granted by NRES (UK); REC reference: 06/Q0806/46.

Financial disclosure/sources of funding

None.

Conflicts of interest

There is no conflict of interest for any author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcms.2019.06.002.

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