

Influence of chin height on perceived attractiveness in the orthognathic patient, layperson, and clinician

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ABSTRACT

Objective: To determine an objective and quantitative evaluation of how severity of chin height variations influence perceived attractiveness.

Materials and Methods: The chin height of an idealized male and female frontal facial image was altered in 2.5-mm increments from -12.5 to 22.5 mm (male images) and from -10 to 20 mm (female images). These images were rated on a seven-point Likert scale by a preselected group of pretreatment orthognathic patients, clinicians, and laypeople.

Results: The classical lower facial proportional canon of upper lip height as one third (33.3%), lower lip height as one third (33.3%) and chin height as one third (33.3%) of lower anterior face height (LAFH) may be used as an "ideal" proportional ratio. However, chin height variations within a given proportional range are largely unnoticed, ie, from approximately 30% chin height in relation to LAFH (male and female) up to approximately 40% (males) and 50% (females) chin height in relation to LAFH. Additionally, surgery is only desired with greater variations in chin height: greater than 50% and less than 20%–23% of LAFH in males, and greater than 58% and less than 20%–22% of LAFH in females. Patients and clinicians are more critical than laypeople, but no significant differences were found between clinicians and patients.

Conclusions: In relation to the classical canon, surgical correction of chin height deformities are desired with chin height greater than 50% and less than 20%–23% of LAFH in males, and greater than 58% and less than 20%–22% of LAFH in females. (*Angle Orthod.* 2012;82:88–95.)

KEY WORDS: Attractiveness perception; Chin height

INTRODUCTION

The chin forms a significant esthetic unit of the lower face. In frontal view, the significance of the chin region depends primarily on the chin height, particularly in relation to the lower and total anterior face heights.¹

A facial deformity often results from a significant deviation of one or more facial parameters from the

accepted norm for a population. The magnitude of the deviation is an important factor in decision making when jaw surgery may be required. If the magnitude of the discrepancy of a facial parameter is great (for example significant increase in chin height) then the treatment planning decision may be relatively straightforward. However, there are a significant number of patients who are regarded as borderline in terms of need for surgical treatment. In such patients, the decision-making process may be transferred from subjective clinical judgment to objective, evidence-based guidance based on data from studies investigating perceptions of facial attractiveness.²

Chin height is a potentially important factor in the perception of facial attractiveness. To date, there have been no investigations on the perceptions of attractiveness in relation to chin height. The principal aim of this investigation was to quantitatively evaluate the influence of chin height on perceived attractiveness and to determine the clinically significant threshold value or cutoff point beyond which a chin height discrepancy is perceived as unattractive and treatment

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Accepted: June 2011. Submitted: May 2011.

Published Online: July 25, 2011

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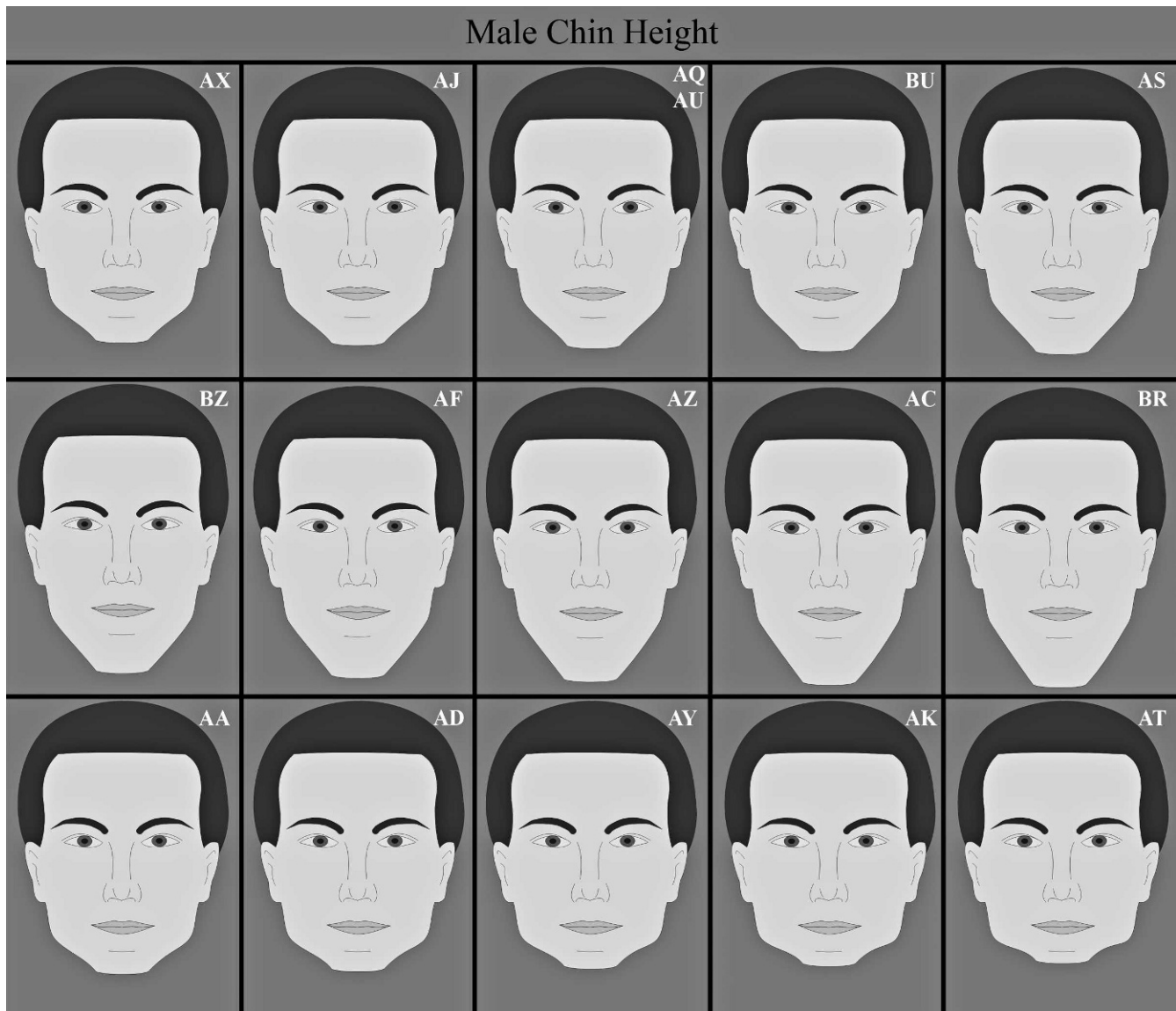


Figure 1. Chin height variations (male face).

is desired. The perceptions of orthognathic patients, clinicians, and laypeople were also compared.

MATERIALS AND METHODS

Ethical approval was sought and granted for the study. Two-dimensional facial profile silhouettes have been routinely used to assess the perceptions of facial profile attractiveness.^{3,4} However, it is not easily possible to assess frontal facial views using silhouettes.⁵ Therefore, “ideal” male and female symmetrical frontal facial images were created with computer software (Adobe Photoshop CS2; Adobe, San Jose, Calif), with proportions⁶ and soft tissue measurements⁶⁻¹¹ based on currently accepted criteria, as previously described.¹²

For chin height, the images were manipulated in 2.5-mm increments, from -12.5 to 22.5 mm for the male

images and from -10 to 20 mm for the female images, representing both reduction and increase in chin height (Figure 1 and 2).

The Observers

Based on the results of a pilot study and power calculation, a total of 185 observers took part in the study, separated into 3 groups (Table 1), with the following selection criteria:

- *Orthognathic patients*
- Pre-treatment,
- Primary concern was facial appearance,
- No previous orthodontic or facial surgical treatment,
- No history of facial trauma,
- No severe psychological issues eg, body dysmorphic disorder.

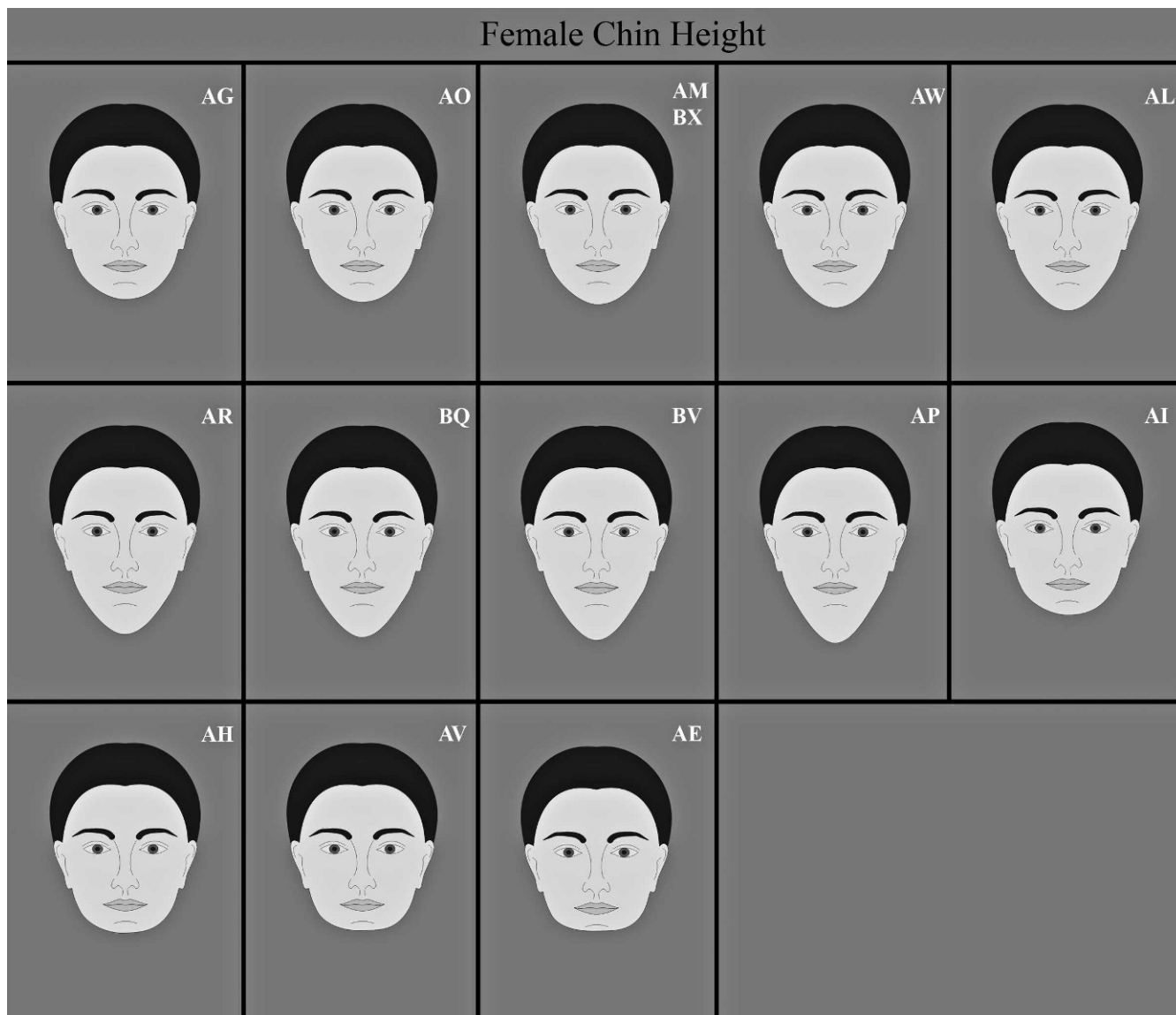


Figure 2. Chin height variations (female face).

Laypeople

- No previous orthodontic or facial surgical treatment,
- No facial deformities,
- No history of facial trauma.

Clinicians

- Involved in the management of patients with facial deformities.

Questionnaire

Each observer was given a questionnaire and asked to provide the following information: age, sex, ethnic origin (White or non-White), how would you rate the attractiveness of *your* facial appearance, and how important do you think it is to have an attractive facial appearance.

Table 1. Observer Demographics

Observer Group	No.	Mean Age, y	95% CI	Age range, y	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%

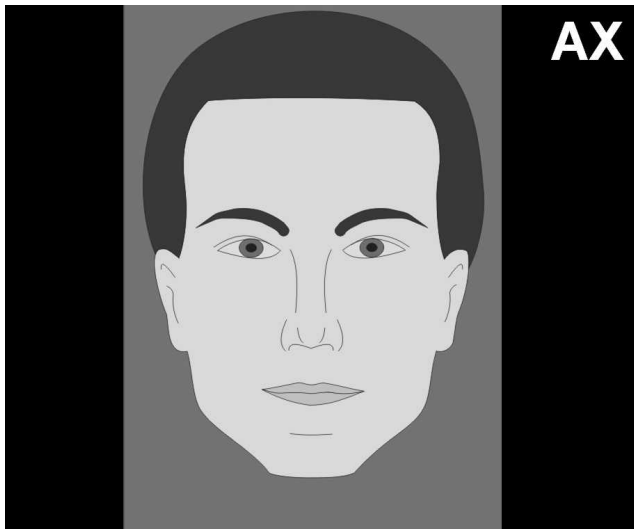


Figure 3. An example of an image viewed by study observers on the monitor during data collection.

The observers rated each facial image using the following scale:

1. Extremely unattractive
2. Very unattractive
3. Slightly unattractive
4. Neither attractive nor 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.

The images were placed in random order into Microsoft PowerPoint (Microsoft, Redmond, Wash). Each image was identified by a randomly assigned double letter in the top right corner of the screen (eg, AX; Figure 3). A duplicate of one of the male images (AQ and AU) and one of the female images (AM and BX) 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 frontal face images, when viewed on the monitor, had the same dimensions as a normal human head, 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.

Rating Method

The Likert-type rating scale is largely accepted in the psychology literature as the most useful rating method.¹³

Statistical Analysis

Mixed regression was used to assess the differences in ratings for the observer groups 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, face height, and the chin height variations of the images. The multivariate regression models are fitted in a stepwise manner, including all those variables that reach a significance below $P = .25$ univariately.

RESULTS

All the laypeople and clinicians were skeletal class I, while 96% of the patients were skeletal class II (49%) or III (47%).

Reliability Analysis

The variability between observers was highly significant ($P < .0001$), indicating little variation in the intraobserver ratings and very good reliability.

Perceived Attractiveness of Images

From the univariate mixed linear regression analysis, only the observer's age, sex, jaw relationship, and the degree of chin height variation of the images were found to have a significant effect on rating.

Table 2 shows the results of the multivariate mixed linear regressions for the outcome rating. An effect of observer's age was found ($P = .01$), with older observers giving higher ratings. For both female and male faces the mean rating increased by 0.01 of a level of the Likert scale for each year of increase in age. An effect of the observer's sex was only seen for female faces, with men giving on average 0.28 of a level of the Likert scale greater rating than women ($P = .02$).

The type of chin height deviation (increase or decrease) was found to have a highly significant association with ratings of attractiveness. Mean ratings were greater for images with no deviation both in relation to those with reduced chin height (similar for male and female faces) and those with increased chin height, though slightly more pronounced for male than for female faces.

Ratings for attractiveness decreased by about 0.16 of a level of the Likert scale for every unit deviation in chin height above or below normal ($P < .0001$); this effect was similar for male and female images.

Mean ratings were found to be significantly different between the groups, with

- clinicians giving a greater mean rating than patients when assessing male faces but not female faces, and

Table 2. Multivariate Mixed Linear Regression for Rating

Description	Overall		Images of Male Faces		Images of Female Faces	
	Coefficient (Interval)	P value	Coefficient (Interval)	P value	Coefficient (Interval)	P value
Age	0.01 (0.00, 0.02)	.01	0.01 (0.00, 0.02)	.01	0.01 (0.00, 0.02)	.04
Sex					0.28 (0.04, 0.51)	.02
Degree of chin height deviation of image, mm	-0.16 (-0.17, -0.15)	.0000	-0.15 (-0.16, -0.14)	.0000	-0.17 (-0.18, -0.16)	.0000
Observer group		.03		.01		.02
Laypeople vs patients	0.33 (0.09, 0.57)	.01	0.34 (0.08, 0.60)	.01	0.28 (0.02, 0.55)	.04
Clinicians vs patients	0.19 (-0.10, 0.48)	.20	0.45 (0.14, 0.76)	.01	-0.13 (-0.45, 0.19)	.42
Laypeople vs clinicians	0.14 (-0.14, 0.42)	.33	-0.11 (-0.41, 0.19)	.48	0.41 (0.11, 0.72)	.01

- laypeople giving a greater mean rating than patients and clinicians (for female faces).

Ratings for attractiveness decreased on average by 0.71 for each 2.5-mm reduction in chin height for female faces (first noticeable at -2.5 mm) and 0.65 for male faces (first noticeable at -2.5 mm), and decreased on average 0.47 for each 2.5-mm increase in chin height for female faces (first noticeable at 7.5 mm) and 0.37 for male faces (first noticeable at 5 mm). The pattern of change was similar for the three observer groups.

Desire for Surgery

Multivariate logistic regression (Table 3) demonstrated that:

- The odds of desire for surgery decreased by 3% for each year increase in observer age.
- The odds of desire for surgery were 54% and 33% less, respectively, when rating male and female faces for male observers.
- Chin height deviation was very significant. The odds of desire for surgery increased by 35% for each unit increase or decrease in the chin height in relation to normal, regardless of whether rating male or female faces.

Significant differences were found between the observer groups. The odds of desire for surgery were

60% less for clinicians than for patients when looking at male faces and similar when looking at female faces; the odds were greater for laypeople than for clinicians, threefold when looking at male faces but similar when looking at female faces. No differences were detected between laypeople and patients.

The linear values at which observers began considering surgery is shown in Table 4. The proportional values in terms of percentage of lower anterior face height at which observers first noticed and also began considering surgery are shown in Table 5.

Most Attractive and Least Attractive Images

The lowest-rated images represented significant degrees of chin height variation from the norm (Table 6). The highest-rated images represented the norm or slight increases of up to 5 mm. The overall trend demonstrated that milder degrees of chin height variation, eg, 5 mm, were rated higher, and greater degrees of variation were rated progressively lower and thereby less attractive.

DISCUSSION

In order to determine and validate the correct facial proportions with which to plan clinical treatment, two sources of information are required.² First, population averages, which permit comparison of an individual's

Table 3. Multivariate Mixed Logistic Regression for Binary Outcome: Desire for Surgery

Description	Overall		Images of Male Faces		Images of Female Faces	
	OR (Interval)	P value	OR (Interval)	P value	OR (Interval)	P value
Age	0.97 (0.96, 0.99)	.001	0.96 (0.94, 0.98)	.0000	0.98 (0.97, 1.00)	.05
Sex	0.56 (0.37, 0.85)	.006	0.46 (0.27, 0.79)	.004	0.67 (0.45, 1.01)	.06
Observer's vertical lower anterior face height	1.88 (0.92, 3.83)	.08				
Degree of chin height deviation of image, mm	1.35 (1.3, 1.4)	.0000	1.37 (1.34, 1.41)	.0000	1.35 (1.32, 1.39)	.0000
Observer group		.07		.01		.93
Laypeople vs. patients	0.95 (0.58, 1.56)	.83	1.17 (0.65, 2.14)	.60	1.04 (0.66, 1.66)	.85
Clinicians vs. patients	0.54 (0.30, 0.97)	.04	0.40 (0.19, 0.82)	.01	0.94 (0.54, 1.64)	.84
Laypeople vs. clinicians	1.76 (1.02, 3.02)	.04	2.95 (1.47, 5.93)	.002	1.11 (0.65, 1.88)	.71

Table 4. Linear Values at Which Desire for Surgery Becomes Significant

Type of chin height discrepancy	Values at Which Desire for Surgery Becomes Significant, mm					
	Patients		Laypeople		Clinicians	
	Male Images	Female Images	Male Images	Female Images	Male Images	Female Images
Increase	10	11	11	11	14	11
Reduction	7	5	8	6	9	6

facial measurements and proportions to the population norms. Such data must be age, sex, and ethnicity specific and are available from anthropometric studies⁷ and long term cephalometric growth studies of normal individuals.¹⁴⁻¹⁶ Secondly, the perceived attractiveness of the proportions must be confirmed by the judgment of patients and the lay public and ideally compared to the judgment of treating clinicians. This was the main purpose of this investigation.

Ratings for attractiveness decreased by about 0.16 of a level of the Likert scale for every unit deviation in chin height above or below normal; this effect was similar for male and female images.

Discrepancy in chin height was noticed when it was at least 5 mm taller in male faces, 7.5 mm taller in female faces, or -2.5 mm shorter (male or female faces) than normal. Therefore, between -2.5 mm and 5 mm (7.5 mm female), chin height discrepancies are largely unnoticed. Results were similar for the three groups of observers. However, attractiveness ratings decreased more rapidly for reductions in chin height. For example, with -7.5 mm shorter chin height than normal, the rating was reduced by 2 levels of the Likert scale, whereas only at 12.5 mm taller chin height than normal did the Likert scale decrease by 2 levels.

The results indicate that patients and clinicians are more critical than laypeople with regards to facial variations from the norm. However, no significant differences were found between clinicians and patients. Clinicians will develop enhanced critical faculties as a result of their training, and it may be that the very existence of a chin height discrepancy will lead to patients developing a greater sensitivity to noticeable differences in facial appearance from the "ideal." Previous studies have found significant differences

between the perceptions of facial profile attractiveness of orthodontists and maxillofacial surgeons compared with laypeople.¹⁷ Attractiveness studies often use laypeople as observers but seldom use patients. The finding that orthognathic patients are more critical than laypeople suggests that in future studies, greater emphasis might be put on evaluating the perceptions of patients as opposed to only a lay population.

The odds of wanting surgery reduced with an increase in the age of the observer, with a reduction of about 3% for each year increase in age. The reasons for this may be manifold, including a potentially greater preoccupation with facial appearance at a younger age and possibly more stability in lifestyle in older individuals. The effect of observer sex was found to have a significant effect on desire for surgery and more marked for male than for female faces. The odds of desire for surgery when looking at male and female faces were, respectively, 54% and 33% less for male observers than for female observers. The effect of chin height deviation was very significant. The odds of desire for surgery increased by 35% for each unit increase or decrease in the chin height in relation to the norm, regardless of whether the observers were rating male or female faces.

The odds of desire for surgery were 60% less for clinicians than for patients when looking at male faces and similar when looking at female faces; desire for surgery was greater for laypeople than for clinicians, threefold when looking at male faces but similar when looking at female faces. Interestingly, no differences were detected between laypeople and patients.

The highest-rated images represented the norm or slight increases of up to 5 mm. The overall trend demonstrated that milder degrees of chin height

Table 5. Proportional Values at Which Observers First Notice and Also Begin Considering Surgery^a

	Male Images, % of LAFH				Female Images, % of LAFH			
	Chin Height Increase First Noticed	Surgery Desired (Increase in Chin Height)	Chin Height Decrease First Noticed	Surgery Desired (Decrease in Chin Height)	Chin Height Increase First Noticed	Surgery Desired (Increase in Chin Height)	Chin Height Decrease First Noticed	Surgery Desired (Decrease in Chin Height)
Patients	40.5	49	30	23	50	58	28	22
Laypeople	40.5	49	30	22	50	58	28	20
Clinicians	40.5	54	30	20	50	58	28	20

^a LAFH indicates lower anterior face height. "Ideal" value for chin height is 33.3% in relation to LAFH.

Table 6. Mean Observer Ratings and Confidence Intervals, Ordered From Worst to Best Rating^a

Image	Chin Height				
	Deviation, mm	Mean	(95% CI)		Median
AP	20f	2.11	1.98	2.24	2
AE	-10f	2.11	1.96	2.26	2
AT	-12.5m	2.21	2.07	2.35	2
AZ	17.5m	2.23	2.08	2.38	2
AC	20m	2.24	2.10	2.39	2
BR	22.5m	2.27	2.10	2.44	2
BV	17.5f	2.28	2.13	2.42	2
AK	-10m	2.50	2.34	2.66	2
AF	15m	2.56	2.39	2.73	2
BQ	15f	2.61	2.46	2.75	3
AR	12.5f	2.90	2.74	3.05	3
AY	-7.5m	2.98	2.82	3.13	3
AV	-7.5f	3.08	2.93	3.23	3
BZ	12.5m	3.15	2.98	3.32	3
AS	10m	3.40	3.20	3.59	3
AH	-5f	3.48	3.30	3.66	3
AL	10f	3.56	3.35	3.77	3
BU	7.5m	3.92	3.72	4.12	4
AU	5m	4.26	4.04	4.47	4
AW	7.5f	4.34	4.16	4.52	4
AI	-2.5f	4.48	4.30	4.67	4
AQ	5m	4.50	4.29	4.71	5
AD	-5m	4.67	4.49	4.85	5
AA	-2.5m	4.77	4.60	4.95	5
AM	5f	4.85	4.65	5.05	5
AG	0f	4.97	4.80	5.14	5
AJ	2.5m	4.99	4.80	5.18	5
BX	5f	5.01	4.82	5.19	5
AX	0m	5.05	4.86	5.23	5
AO	2.5f	5.35	5.18	5.52	5

^a Positive values represent increases and negative values represent reductions in chin height. m indicates male; f, female.

variation, ie, up to 5 mm, were rated higher, and greater degrees of variation were rated progressively lower and thereby less attractive.

The proportional relationships used in clinical practice are based on a combination of classical canons and modern anthropometric and cephalometric population studies. Leonardo da Vinci (c. 1490) subdivided the LAFH into thirds, with the upper lip height one third and the lower lip and chin height as two thirds. The lower lip and chin height was further divided into the lower lip height (one third) and the chin height (two thirds).⁶ The proportional relationship of one third as upper lip height and two thirds as lower lip and chin height was subsequently confirmed in contemporary cephalometric studies by Worms et al.¹⁸ and Legan and Burstone¹⁹; however, both found that the greater part of the lower facial height was occupied by the chin height and the smallest by the lower lip height in both males and females. Albrecht Dürer (1528) subdivided the lower anterior face height into quarters, with the upper lip and lower lip heights each 25% and chin height 50% of lower anterior facial height.²⁰

In a cephalometric study of 56 “normal White adults” with class I dental and skeletal relationships, Scheideman et al.²¹ found the LAFH greater than the middle anterior face height in men, mainly due to a greater lower lip-chin height. They also found that upper lip height was 32% (31% in females), lower lip height 25% (27% in females), chin height 43% (40% in females), and lower lip-chin height 68% (67% in females) of LAFH. In an anthropometric study of White adults, Farkas et al.⁷ found that upper lip height was 31%, lower lip height 26%, chin height 43% and lower lip-chin height 69% of LAFH in males and females.

Mommaerts and Moerenhout²² asked 20 orthofacial patients to rank the images of “beautiful faces” retrieved from yearly polls of magazines. They concluded that a proportional canon of upper lip height as 30% and lower lip-chin height as 70% of LAFH was the contemporary ideal. This supports the previous results of Scheideman et al.²¹ and Farkas et al.⁷

The results of this current attractiveness study demonstrate that Leonardo’s canon of upper lip height as one third (33.3%), lower lip height as one third (33.3%), and chin height as one third (33.3%) of lower anterior face height may be used as an “ideal” proportional ratio. This supports previous evidence from anthropometric and cephalometric population studies.^{7,18,19,21} However, the results also demonstrate that chin height variations within a given proportional range are largely unnoticed, ie, from 30% chin height in relation to LAFH (male and female), up to 40% (males) and 50% (females) chin height in relation to LAFH. Additionally, there was some variation in the values at which observers began considering surgery. Surgery was only desired with even greater variations in chin height, ie, male images with chin height greater than 50% and less than 20%–23% of LAFH and female images with chin height greater than 58% and less than 20%–22% of LAFH.

CONCLUSION

- In relation to the classical lower facial proportional canon, surgical correction of chin height deformities are desired with chin height greater than 50% and less than 20%–23% of LAFH in males and greater than 58% and less than 20%–22% of LAFH in females.

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