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Original Article

The Differences of Perception of Asymmetry on Chin and Lip in Facial Asymmetry Patients Rated by Laypersons and Orthodontists

Thejsit Thanasanwanich* Poonsak Pisek** Araya Pisek*** Natthawee Phaoseree***

Abstract

Background: The perception of facial asymmetry plays a critical role in the diagnosis and treatment planning in orthodontics. **Objective:** This study aimed to evaluate the perception of chin deviation and lip canting and to compare the differences in perception between laypersons and orthodontists. **Materials and methods:** Fifty-five new patients presenting with facial asymmetry were examined. Subjects were categorized into four groups based on the severity of chin deviation and lip canting. Three-dimensional (3D) facial images and corresponding mirror images were generated. A total of twenty-six laypersons and orthodontists were asked to compare the original and mirror images, after which they categorized the asymmetry into three levels: normal, acceptable, and unacceptable. **Results:** For chin deviations of 0–2 mm, laypersons generally perceived the asymmetry as normal, while orthodontists classified it as either normal or acceptable. In cases of chin deviation exceeding 2–4 mm, laypersons tended to rate it as acceptable, whereas orthodontists judged it as unacceptable. When the chin deviation exceeded 4 mm, both groups perceived it as unacceptable. Regarding lip canting of 0–1 mm, both laypersons and orthodontists classified it as normal. When lip canting increased to over 1–2 mm, laypersons still considered it normal, while orthodontists classified it as acceptable. Lip canting exceeding 2–3 mm was generally perceived by both groups as acceptable, and canting greater than 3 mm was considered unacceptable by both laypersons and orthodontists. **Conclusion:** Orthodontists exhibited greater sensitivity than laypersons in perceiving both chin deviation and lip canting.

Keywords: Chin deviation, Facial asymmetry, Lip canting, Perception

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Corresponding author: Natthawee Phaoseree
E-mail: Nattpha@kku.ac.th

* Dentist, Senior Professional Level, Kumphawapi Hospital, Kumphawapi, Udonthani, Thailand
** Associate Professor, International College of Dentistry Walailak University, Bangkok, Thailand
*** Lecturer, Faculty of Dentistry, Khon Kaen University, Mueang Khon Kaen, Khon Kaen, Thailand

Introduction

A symmetrical face is rare in the general population. Most human faces exhibit some degree of asymmetry, particularly in the midface and lower facial regions.[1] Jacobson et al. reported that 36 % of individuals displayed asymmetry in the midface, while 74 % showed asymmetry in the lower face. As noted in previous studies, the lower face is the most common region where asymmetry is observed.[2] For example, chin deviation refers to the misalignment of the soft tissue Menton (Me') relative to the midsagittal plane, whereas lip canting is defined as the discrepancy in the level between the right and left Cheilion (Ch) compared with a horizontal reference line.

In recent years, patients have become increasingly concerned with facial esthetics.[3] In cases where facial asymmetry is noticeable, it may affect not only esthetic appearance but also function and psychosocial well-being. Before initiating treatment, it is essential to assess the chief complaint, medical and dental history, the patient's perception of asymmetry, and both extraoral and intraoral examinations. Therefore, in addition to objective facial asymmetry assessments and comprehensive clinical evaluations, subjective perception also plays a crucial role in informing appropriate treatment planning.[4] Despite this, there is currently no clinical guideline defining the degree of chin deviation or lip canting that should be accepted or corrected.

The perception of chin deviation and lip canting has been the subject of study for decades. Some research has shown that laypersons can detect chin deviations greater than 4 mm.[5] One study reported that the normal range of chin deviation was 5.60 ± 2.70 mm when evaluated by laypersons and 3.60 ± 1.50 mm when assessed by orthodontists.[6] However, many prior studies have certain limitations. For example, some created artificial chin deviation and lip canting using computer software, resulting in unnatural images that may have influenced perception. Additionally, other studies relied on two-dimensional (2D) photographs, where improper head positioning during image capture may have led to inaccurate assessments.[7,8] However, there remains limited evidence regarding the perception of chin deviation and lip canting using unaltered three-dimensional (3D) images. Therefore, this study utilizes unmodified 3D facial images from a diverse Thai population. The findings may inform orthodontic, surgical, or cosmetic treatment considerations. The perception of orthodontists should be used as a reference for ideal treatment planning, whereas the perception of laypersons may be useful for planning acceptable or compromised treatment outcomes. Consequently, this study aims to evaluate the range of chin deviation and lip canting classified as normal, acceptable, or unacceptable, as rated by both laypersons and orthodontists, and to compare the differences in their perception.

Materials and methods

A consecutive sampling method was initially used to screen all new patients presenting at the Orthodontic Clinic, Faculty of Dentistry, Khon Kaen University, who met the inclusion criteria. Subsequently, purposive sampling was used to select participants based on varying degrees of facial asymmetry. The study population comprised the following:

1) Subjects were new patients with facial asymmetry, aged between 18 and 35 years, who had no history of orthodontic treatment, cosmetic procedures, or facial trauma. Individuals with congenital malformations or systemic diseases were excluded from the study.

2) Raters were candidates who assessed the degree of chin deviation and lip canting. They were divided into two groups:

a. Laypersons were orthodontic patients aged between 18 and 60 years who voluntarily participated in the study. They had no affiliation with medical or dental education or employment.

b. Orthodontists were those who had completed

a postgraduate orthodontic program and either had at least five years of clinical experience in orthodontic treatment or held diplomate status from the Thai Board of Orthodontics.

The required sample size was calculated based on the study by Kaipainen et al.,[9] using a 95 % confidence level, $\propto$ = 0.05 ($Z_{\propto}/2$ = 1.96), and an allowable error (e) of 0.50 mm. As a result, the number of subjects assessed was 16 patients, with 13 laypersons and 13 orthodontists included as raters.[10]

All subjects underwent comprehensive orthodontic record collection, which included intraoral and extraoral clinical examinations, two-dimensional intraoral photographs, three-dimensional extraoral photographs (Bellus 3D Inc., Campbell, CA, USA), study models, and both lateral and posteroanterior cephalometric radiographs (Sirona Dental Systems Inc., Long Island, NY, USA).

3D Image Collection and Preparation

Patients were positioned with relaxed lips and in a natural head position, maintaining a distance of 30 centimeters from the camera (Apple Inc., Cupertino, CA, USA). The scanning software captured each subject over a 10-second period and generated a three-dimensional (3D) facial image, saved in Object file (OBJ) format. These OBJ files were subsequently imported into the Dolphin Imaging software (Patterson Dental Supply Inc., Chatsworth, CA, USA).

Each 3D image was then analyzed by identifying six midline and one pair of bilateral soft tissue anatomical landmarks for the purpose of asymmetry measurement (Table 1, Figure 1).

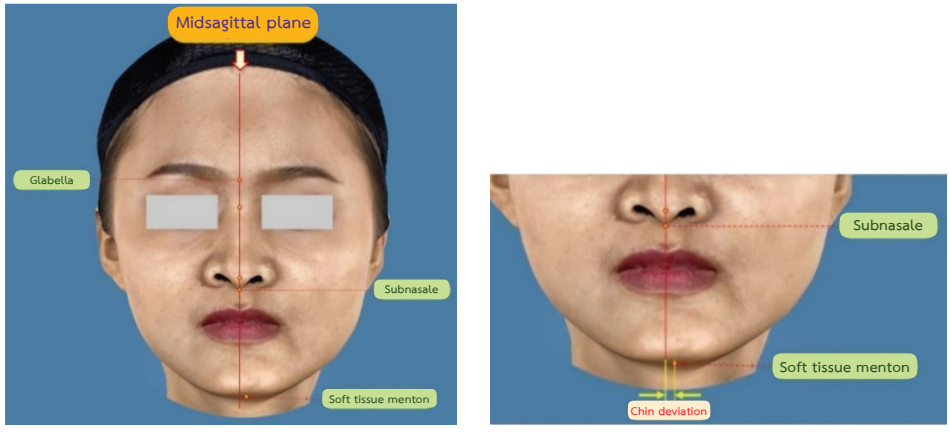

Figure 1 Landmark identification and measurement of chin deviation

Figure 2 Landmark identification and measurement of lip canting

Table 1 Description of 3D landmarks used in the study

Landmark	Abbreviation	Definition
Midline structures		
Glabella	G	The most prominent center point between the eyebrows
Soft tissue nasion	N'	The most posterior center point of the nasal root
Pronasale	Prn	The most prominent midpoint on tip of the nose
Subnasale	Sn	The point at which philtrum merges with columella in the midsagittal plane
Soft tissue pogonion	Pog'	The most prominent center point of the chin
Soft tissue menton	Me'	The lowest median landmark on the lower border of the chin
Bilateral structure		
Cheilion	Ch	The point located at the angle of the mouth

Table 2 Group classification by amount of chin deviation and lip canting

Group	Amount of chin deviation (mm)	Amount of lip canting (mm)
1	0 - 2	0 – 1
2	> 2 - 4	> 1 – 2
3	> 4 - 6	> 2 - 3
4	More than 6	More than 3

The assessment of facial asymmetry included the following measurements:

1) Chin deviation: Defined as the linear distance from the soft tissue menton (Me') to the midsagittal plane (Figure 1).

2) Lip canting: Determined by comparing the height difference between the right and left cheilion (Ch) relative to a horizontal reference line perpendicular to the midsagittal plane (Figure 2).

Subjects were categorized into four groups based on the severity of asymmetry, as described by previous research.[11] Four subjects were randomly selected from each group to compile the dataset for rating (Table 2).

Three-dimensional mirror images (symmetry images) were used for comparison with the original facial images. These were created by establishing a midsagittal plane and merging one side of the face using the Dolphin Imaging program.

File Preparation for Raters

A PowerPoint file was used to present the rating protocol. It randomly displayed both original and 3D mirror images (Figure 3). Raters were blinded to which images were mirrored and were required to answer each question within 10 seconds.

1) Question I: Are there any noticeable differences between the left and right images?

If the answer was Yes, the rater proceeded to Question II.

If the answer was No, the rater confirmed the absence of perceived asymmetry. In this case, the

response, combined with the corresponding soft tissue measurement, was categorized as a normal asymmetry value.

2) Question II: Based on your perception of chin deviation and lip canting, please classify this patient into one of the following groups:

Group A: Symmetry

Group B: Mild asymmetry, no treatment required

Group C: Obvious asymmetry, treatment required

Rater responses were subsequently categorized into three levels of perceived asymmetry as follows:

Group A: Normal asymmetry

Group B: Acceptable asymmetry

Group C: Unacceptable asymmetry

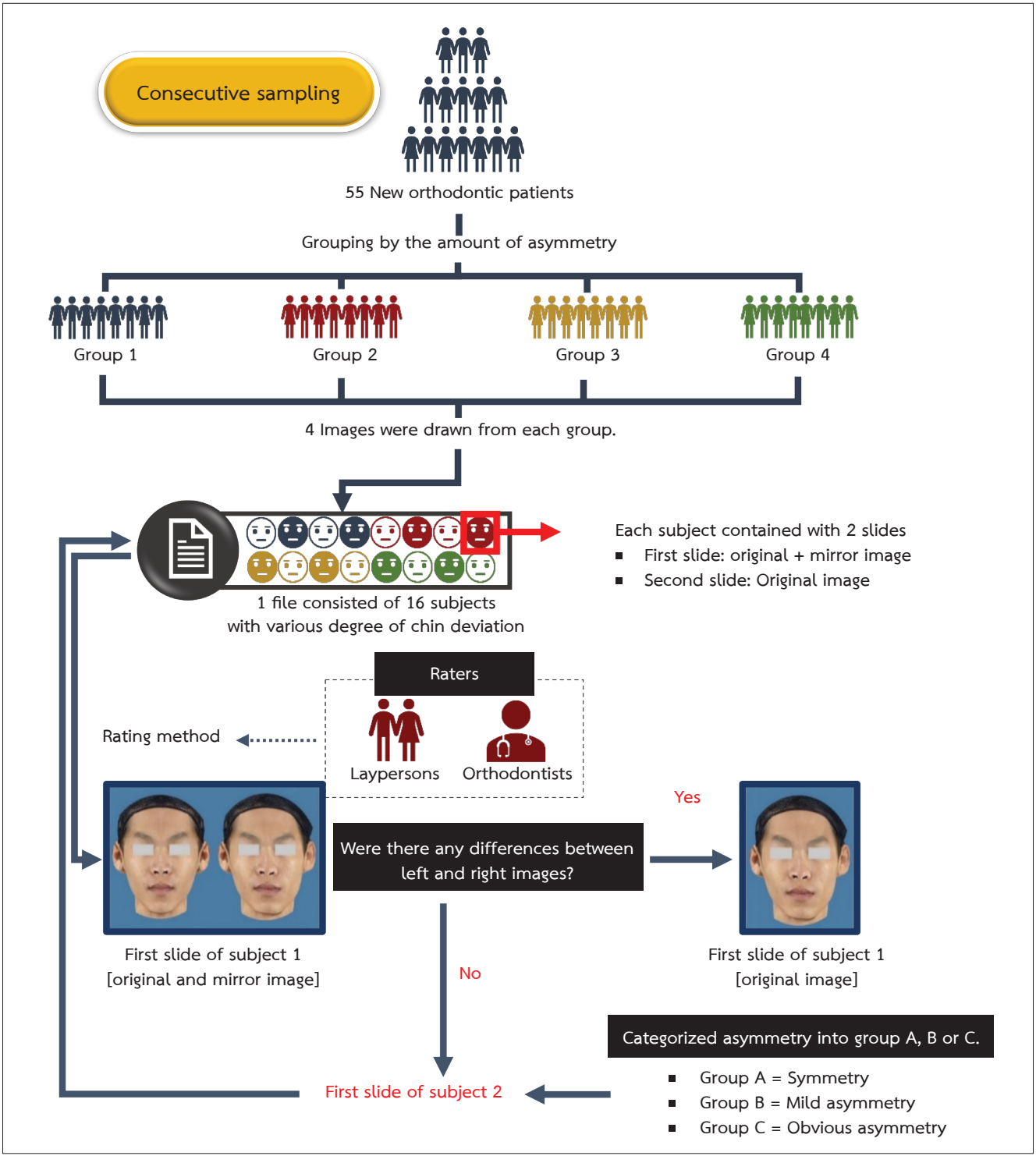

Figure 3 Overview of the study design

Table 3 Demographic information of subjects

N (%)		Age (years) (mean ± sd)	Chin deviation (mm) (mean ± sd)	Lip canting (mm) (mean ± sd)
Gender				
Male	22 (40 %)	25.00 ± 6.09	3.30 ± 3.55	1.10 ± 1.14
Female	33 (60 %)	22.97 ± 5.37	2.85 ± 3.01	0.92 ± 1.07
Total	55 (100 %)	23.78 ± 5.71	3.03 ± 3.21	1.00 ± 1.09

Statistical analysis

Clinical characteristics and the distribution of facial asymmetry among the subjects were described using mean ± standard deviation (SD). The levels of perceived asymmetry were described in terms of proportion.

The reliability and validity of soft tissue landmark identification were assessed using the intraclass correlation coefficient (ICC). The ICC ranged from 0.88 to 0.98, indicating a high level of reliability and validity in the measurements. To compare the proportions of normal, acceptable, and unacceptable asymmetry across the chin deviation groups, a Chi-square test was employed. The significance level was set at $P < 0.05$. All statistical analyses were conducted using SPSS version 28.0.0.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 55 patients with facial asymmetry participated in this study, consisting of 22 male with a mean age of 25 ± 6.09 years and 33 female with a mean age of 22.90 ± 5.37 years. According to research methodology, 16 subjects were randomly selected from this pool for the perception assessment of chin deviation and lip canting. The rater group consisted of 26 participants, including 13 laypersons (mean age = 27.85 ± 7.89 years) and 13 orthodontists (mean age = 40.15 ± 6.99 years).

Measurement analysis revealed that the average chin deviation was 3.03 ± 3.21 mm, and the average lip canting was 1.00 ± 1.09 mm. (Table 3)

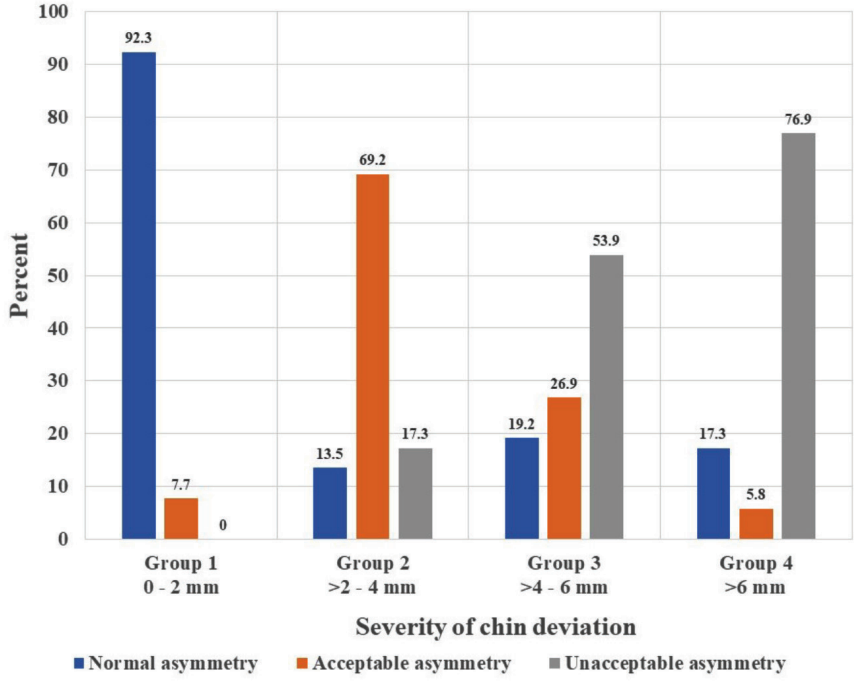

Figure 4 The proportion of chin deviation perception rated by laypersons

Table 4 Comparisons of the proportions of perception among the severity of chin deviation rated by laypersons

	Chin Deviation (N, %)				
	Group 1 0-2 mm	Group 2 > 2-4 mm	Group 3 > 4-6 mm	Group 4 > 6 mm	*P* value
Perception					
Normal asymmetry	48 (92.30 %)	17 (13.50 %)	10 (19.20 %)	9 (17.30 %)	< 0.001*
Acceptable asymmetry	4 (7.70 %)	36 (69.20 %)	14 (26.90 %)	3 (5.80 %)	< 0.001*
Unacceptable asymmetry	0 (0.00 %)	9 (17.30 %)	28 (53.80 %)	40 (76.90 %)	< 0.001***
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	

* Chi-square test: statistically significant difference at $P < 0.05$

** P value was adjusted by Bonferroni method: statistically significant difference at $P < 0.05$

*** Fisher's exact test: statistically significant difference at $P < 0.05$

THE PERCEPTION OF CHIN DEVIATION

Laypersons

Laypersons perceived group 1 chin deviation as normal asymmetry in 92.30 % of cases, while 69.20 % rated group 2 chin deviation as acceptable. Additionally, chin deviation greater than 6 mm was perceived as unacceptable asymmetry in 76.90 % of cases. (Figure 4)

A statistical comparison of the perceptions revealed that group 1 chin deviation was considered normal asymmetry, and group 2 chin deviation was categorized as acceptable asymmetry, which was significantly different from other chin deviation groups (P value < 0.05). In contrast, for unacceptable asymmetry, groups 3 and 4 had higher proportions compared to groups 1 and 2, though no significant difference was found between groups 3 and 4. (Table 4)

Orthodontist

53.80 % of orthodontists recognized group 1 chin deviation as an acceptable asymmetry, while 46.20 % perceived it as a normal asymmetry. For group 2 chin deviation, the majority of orthodontists (67.30 %) classified it as unacceptable asymmetry. There was an obvious tendency among orthodontists to categorize group 3 and group 4 chin deviations as unacceptable asymmetry. (Figure 5)

The perception of normal asymmetry in group 1 chin deviation was statistically different from that in the other groups. Acceptable asymmetry was more frequently classified in groups 1 and 2, but no significant difference was found between these two groups. Similarly, unacceptable asymmetry was more commonly perceived in groups 3 and 4, with no significant difference between these two groups (Table 5).

The comparison of perception between laypersons and orthodontists

In group 1 chin deviation, the majority of laypersons (92.30 %) perceived it as normal asymmetry, while 53.80 % of orthodontists rated it as acceptable, followed by 46.20 % who considered it normal asymmetry.

For group 2 chin deviation, most laypersons (69.20 %) classified it as acceptable asymmetry, while the majority of orthodontists (67.30 %) perceived it as unacceptable. No orthodontists considered this chin deviation normal asymmetry.

In group 3, more than half of the laypersons (53.80 %) regarded the chin deviation as unacceptable,

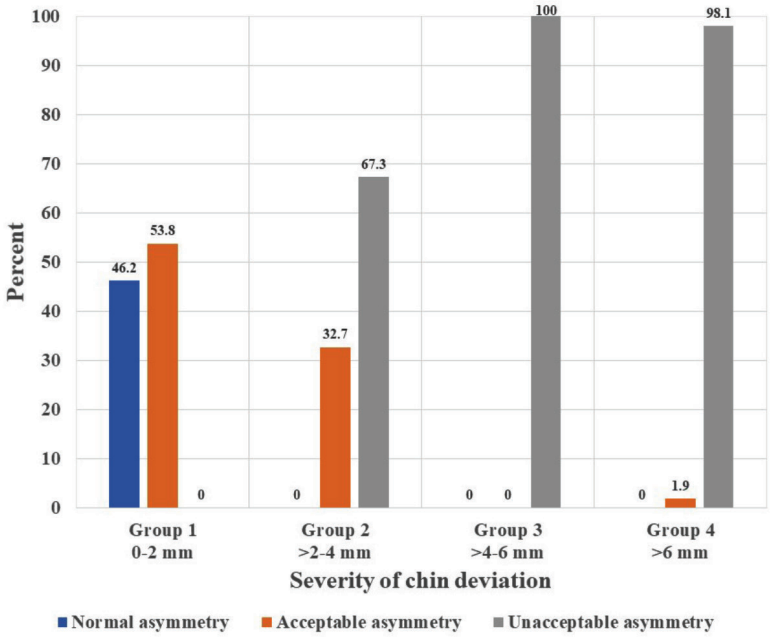

Figure 5 Proportion of chin deviation perception rated by orthodontists

Table 5 Comparisons of the proportions of perception among the severity of chin deviation rated by orthodontists

	Chin Deviation (N, %)				
	Group 1 0-2 mm	**Group 2 > 2-4 mm**	**Group 3 > 4-6 mm**	**Group 4 > 6 mm**	***P* value**
Perception					
Normal asymmetry	24 (46.20 %)	0 (0.00 %)	0 (0.00 %)	0 (0.00 %)	< 0.001*
Acceptable asymmetry	28 (53.80 %)	17 (32.70 %)	0 (0.00 %)	1 (1.90 %)	< 0.001*
Unacceptable asymmetry	0 (0.00 %)	35 (67.30 %)	52 (100 %)	51 (98.10 %)	< 0.001*
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	

* Fisher's exact test: statistically significant difference at $P < 0.05$

** *P* value was adjusted by Bonferroni method: statistically significant difference at $P < 0.05$

*** *P* value was adjusted by Bonferroni method: statistically significant difference at $P < 0.05$

while all orthodontists (100 %) classified it as unacceptable. For group 4 chin deviation, the majority of both laypersons (76.90 %) and orthodontists (98.10 %) perceived it as unacceptable asymmetry. (Figure 6)

The comparison of normal asymmetry perception between laypersons and orthodontists revealed that laypersons had a statistically higher perception of normal asymmetry compared to orthodontists in all groups of chin deviation ($P < 0.05$). (Table 6)

For group 1 chin deviation, orthodontists rated acceptable asymmetry significantly higher than laypersons. However, laypersons rated acceptable

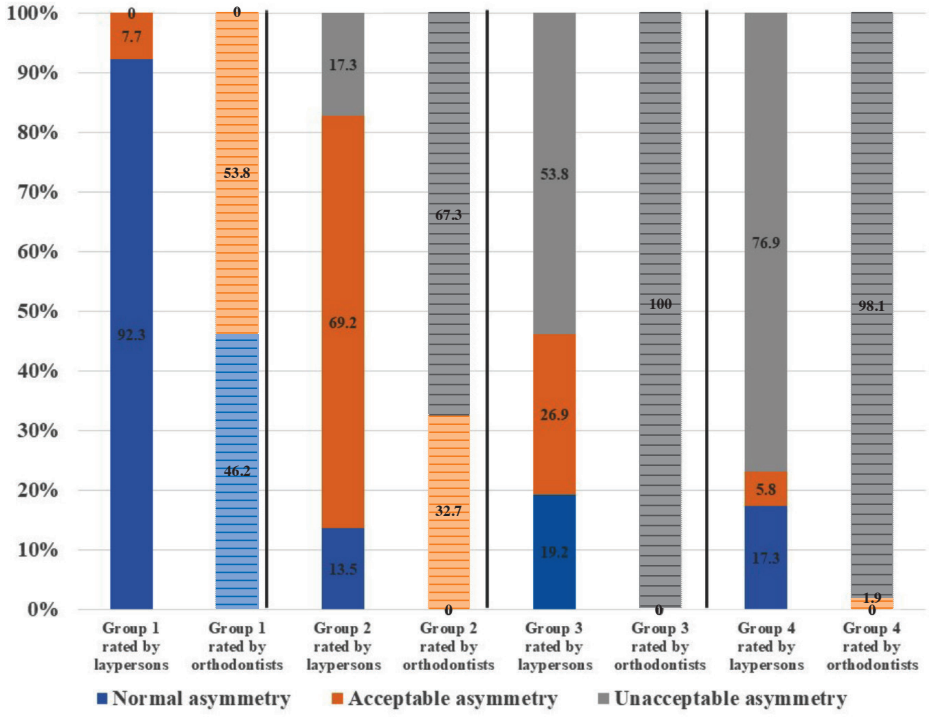

Figure 6 Proportion of chin deviation perception rated by laypersons and orthodontists

Table 6 Comparisons of proportions of perception within the chin deviation groups between laypersons and orthodontists

Preception	Group of chin deviation							
	Group 1 (0-2 mm)		Group 2 (> 2-4 mm)		Group 3 (> 4-6 mm)		Group 4 (> 6 mm)	
	L	O	L	O	L	O	L	O
Normal asymmetry	48 (92.30 %)	24 (46.20 %)	7 (13.50 %)	0 (0.00 %)	10 (19.20 %)	0 (0.00 %)	9 (17.30 %)	0 (0.00 %)
Acceptable asymmetry	4 (7.70 %)	28 (53.80 %)	36 (69.20 %)	17 (32.70 %)	14 (26.90 %)	0 (0.00 %)	3 (5.80 %)	1 (1.90 %)
Unacceptable asymmetry	0 (0.00 %)	0 (0.00 %)	9 (17.30 %)	35 (67.30 %)	28 (53.80 %)	52 (100 %)	40 (76.90 %)	51 (98.10 %)
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)

L = Laypersons, O = Orthodontists

* Chi-square test: statistically significant difference at $P < 0.05$

asymmetry significantly higher than orthodontists in groups 2 and 3 chin deviation. In contrast, for unacceptable asymmetry, orthodontists rated it higher than laypersons in groups 2, 3, and 4 chin deviation.

THE PERCEPTION OF LIP CANTING

Laypersons

For group 1 and group 2 lip canting, the majority of laypersons (98.10 % and 88.50 %, respectively)

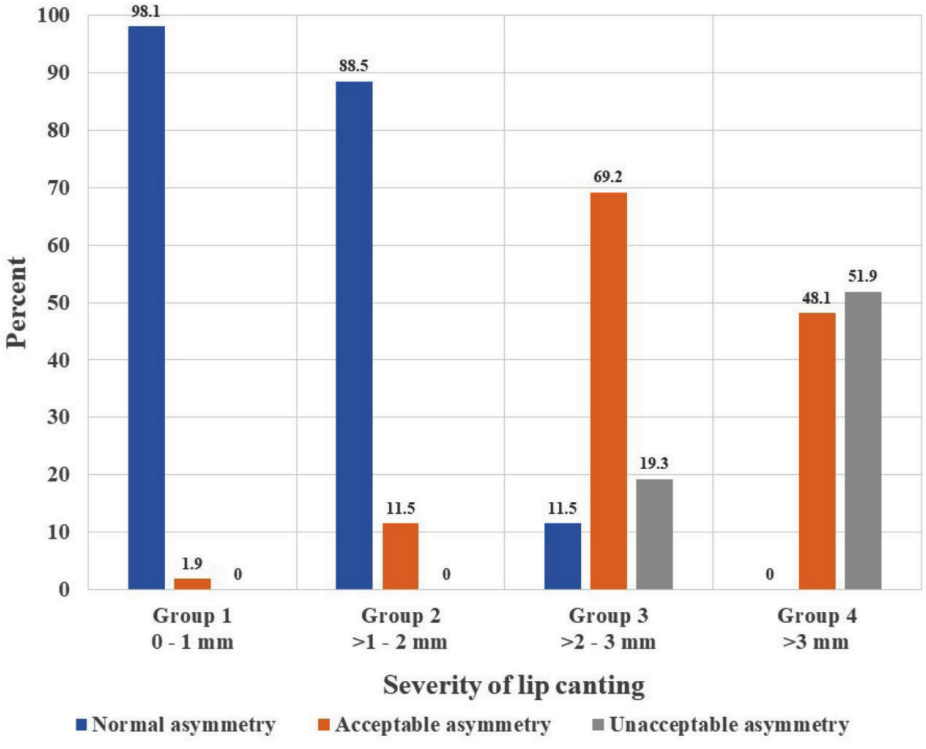

Figure 7 Proportion of lip canting perception rated by laypersons

Table 7 The comparisons of the proportions of perception among the severity of lip canting rated by laypersons

	Lip Canting (N, %)				
	Group 1 0-1 mm	Group 2 > 1-2 mm	Group 3 > 2-3 mm	Group 4 > 3 mm	*P* value
Perception					
Normal asymmetry	51 (98.10 %)	46 (88.50 %)	6 (11.50 %)	0 (0.00 %)	< 0.001*
Acceptable asymmetry	1 (1.90 %)	6 (11.50 %)	36 (69.20 %)	25 (48.10 %)	< 0.001*
Unacceptable asymmetry	0 (0.00 %)	0 (0.00 %)	10 (19.30 %)	27 (51.90 %)	< 0.001*
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	

* Chi-square test: statistically significant difference at $P < 0.05$

** *P* value was adjusted by Bonferroni method: statistically significant difference at $P < 0.05$

*** Fisher's exact test: statistically significant difference at *P* value < 0.05

perceived it as a normal asymmetry. Additionally, no participants considered 0–2 mm lip canting to be an unacceptable asymmetry.

For group 3 lip canting, most laypersons (69.20 %) perceived it as an acceptable asymmetry, and 51.90 % perceived group 4 lip canting as an unacceptable asymmetry. (Figure 7)

In terms of normal asymmetry, there was no significant difference between group 1 and group 2 (0–2 mm of lip canting). Similarly, the perception of acceptable asymmetry between groups 3 and 4 (> 2–3 mm, > 3 mm) also showed no significant differences.

For unacceptable asymmetry, the perception of group 4 lip canting as an unacceptable asymmetry was significantly different from the other groups of lip canting (Table 7).

Orthodontists

All orthodontists perceived lip canting of 0–1 mm as normal asymmetry. Furthermore, more than 80 % of orthodontists classified group 2 and group 3 lip canting as acceptable asymmetry.

Regarding the perception of group 4 lip canting, 65.40 % of orthodontists identified it as unacceptable asymmetry. However, a notable portion (34.60 %) categorized it as acceptable asymmetry. (Figure 8)

The Chi-square test revealed statistically significant differences in the perception of group 1 lip canting as normal asymmetry and group 4 lip canting as unacceptable asymmetry (*P* value < 0.001). However, no significant difference was observed in the proportion of acceptable asymmetry between group 2 and group 3. In terms of comparisons within the perception of unacceptable asymmetry, the perception of group 4 lip canting was significantly different from that of the other groups. (Table 8)

The comparison of perception between laypersons and orthodontists

In group 1 lip canting, almost all laypersons (98.10 %) perceived it as normal asymmetry, which was consistent with the perception reported by all orthodontists.

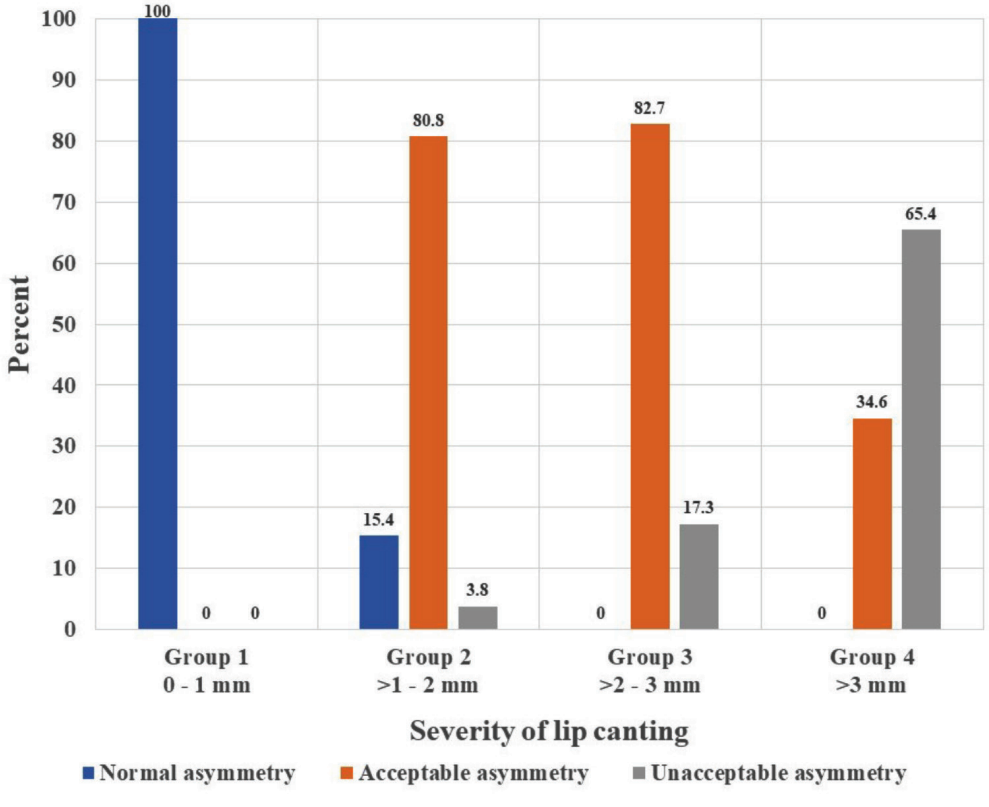

Figure 8 Proportion of lip canting perception rated by orthodontists

Table 8 The comparisons of proportions of perception among the severity of lip canting rated by orthodontists

	Lip Canting (N, %)				
	Group 1 0-1 mm	Group 2 > 1-2 mm	Group 3 > 2-3 mm	Group 4 > 3 mm	*P* value
Perception					
Normal asymmetry	52 (100 %)	8 (15.4%)	0 (0.00 %)	0 (0.00 %)	< 0.001*
Acceptable asymmetry	0 (0.00 %)	42 (80.80 %)	43 (82.70 %)	18 (34.60 %)	< 0.001*
Unacceptable asymmetry	0 (0.00 %)	2 (3.80 %)	9 (17.30 %)	34 (65.40 %)	< 0.001*
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	

* Chi-square test: statistically significant difference at $P < 0.05$

** *P* value was adjusted by Bonferroni method: statistically significant difference at $P < 0.05$

*** Fisher's exact test: statistically significant difference at $P < 0.05$

In group 2 lip canting, most laypersons (88.50 %) also perceived it as normal asymmetry, whereas 80.80 % of orthodontists classified this degree of lip canting as acceptable asymmetry.

Regarding group 3 lip canting, most laypersons (69.20 %) and orthodontists (82.70 %) perceived it as acceptable asymmetry.

For group 4 lip canting, more than half of laypersons (51.90 %) and orthodontists (65.40 %) identified it as unacceptable asymmetry, while 48.10 % of laypersons and 34.60 % of orthodontists classified it as acceptable asymmetry. (Figure 9)

There was no statistically significant difference between laypersons and orthodontists in the perception of normal asymmetry for group 1. Similarly, no significant differences were found in the perception of acceptable asymmetry between laypersons and orthodontists in groups 3 and 4.

In terms of unacceptable asymmetry, there was also no statistically significant difference in the perception between the two groups. (Table 9)

Discussion

Chin Deviation

With respect to normal asymmetry, the majority of laypersons (92.30 %) and nearly half of orthodontists (46.20 %) perceived a chin deviation of 0–2 mm as a normal asymmetry. However, more than half of the orthodontists (53.80 %) classified chin deviation in this range as an acceptable asymmetry. Previous studies have reported that facial asymmetry becomes perceptible when the chin deviates more than 2 mm. Moreover, Keulen and Masuoka et al. further suggested that facial asymmetry is recognizable when the chin deviates more than 4 mm.[5,12] Therefore, the present findings indicate that both laypersons and orthodontists generally perceive a chin deviation of 0–2 mm as representing normal asymmetry.

Among laypersons, 69.20 % identified a chin deviation of more than 2 to 4 mm as an acceptable asymmetry. In contrast, only 32.70 % of orthodontists classified this range of deviation as acceptable. The comparison revealed that the proportion of

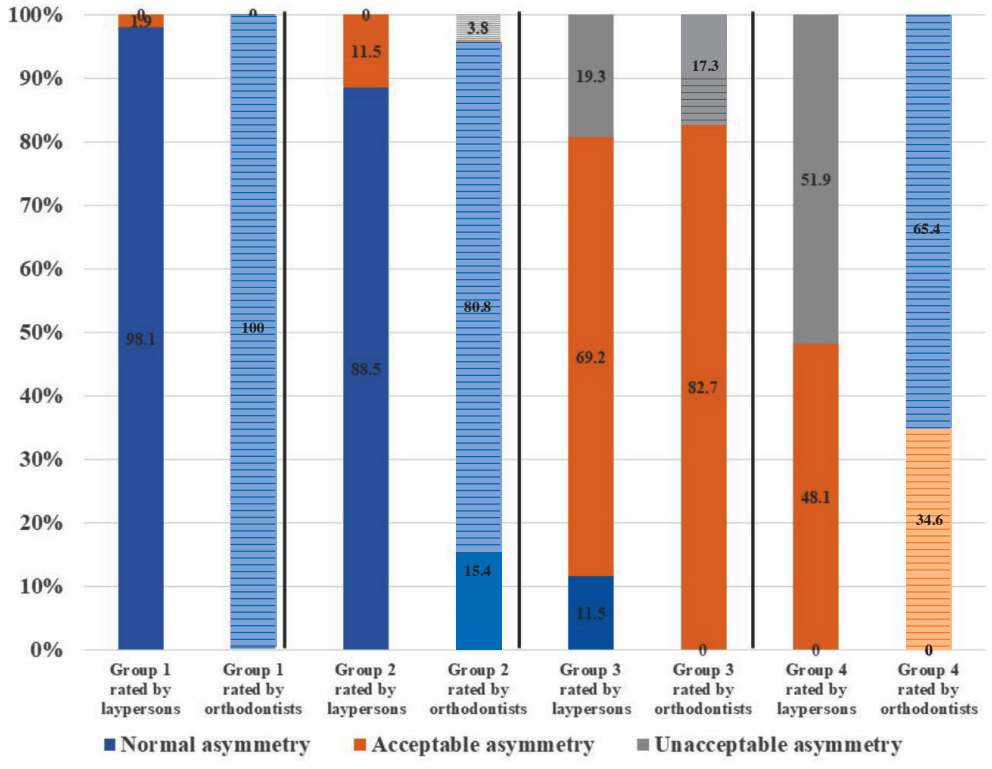

Figure 9 Proportion of lip canting perception rated by laypersons and orthodontists

Table 9 Comparison of the proportions of perception within each lip canting group between laypersons and orthodontists

Perception	Group of lip canting							
	Group 1 (0-1 mm)		Group 2 (> 1-2 mm)		Group 3 (> 2-3 mm)		Group 4 (> 3 mm)	
	L	O	L	O	L	O	L	O
			*		**			
Normal asymmetry	51 (98.10 %)	52 (100 %)	46 (88.50 %)	8 (15.40 %)	6 (11.50 %)	0 (0.00 %)	0 (0.00 %)	0 (0.00 %)
			*					
Acceptable asymmetry	1 (1.90 %)	0 (0.00 %)	6 (11.50 %)	42 (80.80 %)	36 (69.20 %)	43 (82.70 %)	25 (48.10 %)	18 (34.60 %)
Unacceptable asymmetry	0 (0.00 %)	0 (0.00 %)	0 (0.00 %)	2 (3.80 %)	10 (19.30 %)	9 (17.30 %)	27 (51.90 %)	34 (65.40 %)
Total	52 (100 %)	52 (100 %)	52 (100 %)	52 (100 %)	52(100 %)	52 (100 %)	52 (100 %)	52 (100 %)

L = Laypersons, O = Orthodontists

* Chi-square test: statistically significant difference at $P < 0.05$

** Fisher's Exact test: statistically significant difference at $P < 0.05$

acceptable asymmetry perception rated by laypersons was statistically higher than that of orthodontists ($P < 0.05$). However, orthodontists rated the 0–2 mm chin deviation as the most acceptable (53.80 %). As noted in Table 9, although there was no statistically significant difference in the acceptable asymmetry ratings by orthodontists between the 0–2 mm group and the > 2–4 mm group, the proportion rated as acceptable

by orthodontists was statistically higher than that of laypersons ($P < 0.05$). These findings suggest that laypersons tend to perceive a chin deviation of 2–4 mm as acceptable, whereas orthodontists consider this deviation more severe and likely requiring correction. These findings were consistent with previous studies by Krystian et al. and Zhang et al., which concluded that orthodontists were more sensitive and accurate in detecting facial asymmetry compared to laypersons.[13,14] Similarly, McAvinchey et al., who compared the perception of facial asymmetry across five observer groups, including laypersons, dental students, dental care professionals, dental practitioners, and orthodontists found that orthodontists demonstrated the highest sensitivity to chin deviation.[6]

In terms of unacceptable asymmetry, more than half of laypersons identified chin deviations of > 4–6 mm and > 6 mm as requiring correction (53.80 % and 76.90 %, respectively). This perception was consistent with that of orthodontists. When unacceptable asymmetry perceptions between laypersons and orthodontists were compared, statistically significant differences were found across all groups, except between the > 4–6 mm and > 6 mm chin deviation groups. This suggests a consensus among both laypersons and orthodontists that chin deviations exceeding 4 mm warrant correction. These findings are supported by Ting et al., who reported that facial asymmetry becomes perceptible when the chin deviation exceeds 4 mm. Additionally, Kim et al. found that among 48 patients who underwent orthognathic surgery, the average chin deviation was 5.70 ± 2.60 mm.[15]

Lip Canting

The perception of normal asymmetry rated by laypersons primarily included the lip canting range of 0–1 mm (98.10 %) and > 1–2 mm (89.50 %). In contrast, all orthodontists classified only the 0–1 mm range as normal asymmetry. A previous study by Choi et al. reported that both professionals and non-professionals considered lip canting within 0–2 degrees to be within the normal asymmetry range.[16] However, direct comparisons with the present study are difficult due to differences in the methods used to analyze lip canting.

Regarding acceptable asymmetry, 69.20 % of laypersons and 82.70 % of orthodontists perceived lip canting of more than 2–3 mm as acceptable. Notably, most orthodontists (80.80 %) also considered the 1–2 mm range as acceptable. Statistical comparison revealed no significant difference in perceptions of acceptability between laypersons and orthodontists for the 2–3 mm group. However, orthodontists rated the 1–2 mm range as acceptable at a significantly higher rate than laypersons. These findings suggest that laypersons regarded 2–3 mm of lip canting as acceptable, while orthodontists perceived the broader range of 1–3 mm as acceptable.

In terms of unacceptable asymmetry, more than half of the laypersons (51.90 %) believed that lip canting greater than 3 mm warranted correction. This view aligned with orthodontists, who also perceived lip canting beyond 3 mm as unacceptable.

Soft tissue asymmetry, particularly in visible areas like the lips, has significant implications for facial esthetics and psychosocial well-being. Therefore, accurate assessment of soft tissue asymmetry is essential in treatment planning. This study focused on soft tissue asymmetries, particularly chin deviation and lip canting, which are commonly seen in the lower third of the face. Samman et al. reported that asymmetries in this region are prevalent,[17] and Severt and Proffit found that over 70 % of patients in North Carolina exhibited asymmetry in the lower facial third.[18] Studies by Lee et al. and Zhang et al. further identified chin deviation as the most influential and frequently reported concern among patients.[7,14] Moreover, lip canting often occurs in conjunction with chin deviation and maxillary canting, reinforcing the importance of evaluating both features.

Another complicating factor in the assessment of facial asymmetry is improper head posture, which may be used by patients to compensate for deformities.[7,8] Such compensations can distort the actual perception of asymmetry, making it appear less severe. To address

this, Fourie et al. advocated for 3D imaging techniques such as 3D laser scanning and 3D stereophotogrammetry as being more accurate and reliable than 2D methods.[19] Patel et al. also supported the use of 3D facial scanning, noting its simplicity and speed.[20] Accordingly, this study employed 3D images and analysis software for the evaluation of chin deviation and lip canting.

In facial asymmetry assessment, accurate identification of the vertical reference plane is crucial. However, deviations in midface structures such as the nasal tip can compromise this identification. Notably, the subjects in this study did not exhibit nasal deviation. The anatomical landmarks used for establishing the vertical plane were based on the study by Kim et al., and included a line connecting the soft tissue glabella (G'), soft tissue nasion (N'), pronasale (Prn), and subnasale (Sn).[15] Reddy et al. found the mean chin deviation to be 2.60 ± 1.42 mm.[21] Choi et al. reported average lip canting of 1.60° ± 1.00° based on frontal photographs of 585 Korean patients.[16] In the current study, which included 55 subjects, the mean chin deviation and lip canting were 3.03 ± 3.21 mm and 1.00 ± 1.09 mm, respectively. It is important to note that, unlike previous studies which used angular measurements, this study assessed lip canting in millimeters due to the visual difficulty of evaluating angles.

The findings from this study would be beneficial in clinical decision-making. While orthodontists' assessments can serve as expert guidelines for ideal treatment planning, individual treatment decisions ultimately depend on each patient's perception and preference. Thus, layperson perspectives should also be incorporated into alternative treatment strategies.

Besides chin deviation and lip canting, other structural factors such as ramus inclination and gonial angle asymmetries may also influence the perception of lower facial asymmetry. These aspects should be explored in future studies.

This study had several limitations. First, due to the use of unaltered 3D images, the sample included few subjects with severe lip canting. Second, subjects with marked nasal deviation and zygomatic asymmetry were excluded through purposive sampling, as such features could interfere with perception assessments.

Conclusion

The perceptions of chin deviation and lip canting based on its severity are summarized as follows:

Chin deviation of 0-2 mm: Laypersons perceived this as a normal asymmetry, whereas orthodontists considered it either normal or an acceptable asymmetry. Chin deviation of more than 2-4 mm: Laypersons regarded this range as an acceptable asymmetry, while orthodontists viewed it as unacceptable asymmetry.

Lip canting of 0-1 mm: Both laypersons and orthodontists considered this to be a normal asymmetry. Lip canting of more than 1-2 mm: Laypersons continued to perceive this range as normal, whereas orthodontists classified it as an acceptable asymmetry. Lip canting of more than 3 mm: Both laypersons and orthodontists perceived this level of asymmetry as unacceptable.

Author contributions

TT: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing-Original draft, Writing-Reviewing and Editing, Visualization, and Project administration; PP: Methodology, Writing-Reviewing and Editing, Visualization, Supervision and Funding acquisition; AP: Methodology, Validation, Formal analysis, Writing-Reviewing and Editing and Visualization; NP: Conceptualization, Methodology, Validation, Formal analysis, Resources, Data curation, Writing-Reviewing and Editing, Visualization, Supervision, Project administration and Funding acquisition.

Ethical statement

The Khon Kaen University Ethics Committee ethically approved this prospective study in human research (KKUEC; HE632082).

Disclosure statement

The authors have no conflicts of interest.

References

1. Haraguchi S, Takada K, Yasuda Y. Facial asymmetry in subjects with skeletal Class III deformity. Angle Orthod 2002;72(1):28-35.
2. Jacobson A. The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. Am J Orthod Dentofacial Orthop 1998;113(6):697-8.
3. Manosudprasit M, Manosudprasit A, Manosudprasit A, Traisrisin K. Dentofacial asymmetry: a literature review. J Med Assoc Thai 2017;100(Suppl 6):S50-60.
4. Thiesen G, Gribel BF, Freitas MP. Facial asymmetry: a current review. Dental Press J Orthod 2015;20(6):110-25.
5. Masuoka N, Muramatsu A, Ariji Y, Nawa H, Goto S, Ariji E. Discriminative thresholds of cephalometric indexes in the subjective evaluation of facial asymmetry. Am J Orthod Dentofacial Orthop 2007;131(5):609-13.
6. McAvinchey G, Maxim F, Nix B, Djordjevic J, Linklater R, Landini G. The perception of facial asymmetry using 3-dimensional simulated images. Angle Orthod 2014;84(6):957-65.
7. Lee MS, Chung DH, Lee J-w, Cha K-s. Assessing soft-tissue characteristics of facial asymmetry with photographs. Am J Orthod Dentofacial Orthop 2010;138(1):23-31.
8. Kim H, Hwang HS. Frontal cephalogram study on the natural head position of facial asymmetry patients. Korean J Orthod 2000;30:535-42.
9. Kaipainen AE, Sieber KR, Nada RM, Maal TJ, Katsaros C, Fudalej PS. Regional facial asymmetries and attractiveness of the face. Eur J Orthod 2016;38(6):602-8.
10. Lee SF, Dumrongwongsiri S, Lo LJ. Perception of lip cant as a sign of facial deformity: assessment by laypersons and professionals on composite face photographs. Ann Plast Surg 2019;82(1S Suppl 1):S140-3.
11. Sakunteo P, Nisalak P, Verayangkura P, Charoenying H, Pongpirul K. Frontal symmetrical facial esthetic perception and treatment judgements: the differences among dental professionals, orthodontic patients and laypeople. Bangkok: Mahidol University; 2006.
12. Van Keulen C, Martens G, Dermaut L. Unilateral posterior crossbite and chin deviation: is there a correlation? Eur J Orthod 2004;26(3):283-8.
13. Jarosz KF, Bosio JA, Bloomstein R, Jiang SS, Vakharia NS, Cangialosi TJ. Perceptions of chin asymmetries among dental professionals and laypersons. Am J Orthod Dentofacial Orthop 2018;154(2):201-12.
14. Zhang M, Lyu L, Li J, Yan H, Zhu Y, Yu T, et al. Subjective evaluation of facial asymmetry with three-dimensional simulated images among the orthodontists and laypersons: a cross-sectional study. BMC Oral Health 2023;23(1):500.
15. Kim EJ, Palomo JM, Kim SS, Lim HJ, Lee KM, Hwang HS. Maxillofacial characteristics affecting chin deviation between mandibular retrusion and prognathism patients. Angle Orthod 2011;81(6):988-93.
16. Choi J, Kim S-D, Cho J-H, Kim S-H, Kim† M-S. Evaluation of the perception of lip-line canting. Korean J Oral Anatomy 2020;41(1):21-8.
17. Samman N, Tong AC, Cheung DL, Tideman H. Analysis of 300 dentofacial deformities in Hong Kong. Int J Adult Orthodon Orthognath Surg 1992;7(3):181-5.
18. Severt TR, Proffit WR. The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. Int J Adult Orthodon Orthognath Surg 1997;12(3):171-6.
19. Fourie Z, Damstra J, Gerrits PO, Ren Y. Evaluation of anthropometric accuracy and reliability using different three-dimensional scanning systems. Forensic Sci Int 2011;207(1-3):127-34.
20. Patel A, Islam SM, Murray K, Goonewardene MS. Facial asymmetry assessment in adults using three-dimensional surface imaging. Prog Orthod 2015;16:36.
21. Reddy MR, Bogavilli SR, Raghavendra V, Polina VS, Basha SZ, Preetham R. Prevalence of facial asymmetry in Tirupati population: a posteroanterior cephalometric and photographic study. J Int Soc Prev Community Dent 2016;6(Suppl 3):S205-12.