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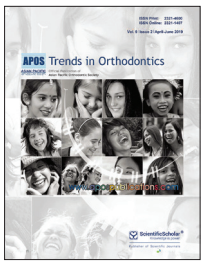

Original Article

Indonesian orthodontists and laypeople's perception of the four components of smile analysis in individuals with various vertical skeletal patterns

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ABSTRACT

Objectives: The objective of this study was to analyze the difference towards orthodontists' and laypeople's perceptions of four smile analysis components in individuals with various vertical skeletal patterns.

Material and Methods: Each of the 100 orthodontists, and laypeople aged 26–65 years old were asked to complete an online questionnaire about four smile analysis components in individuals with various vertical skeletal patterns. The questionnaire consists of 36 modified photos according to various smile curves, buccal corridors, gingival displays, and incisor displays in normal, hypodivergent, and hyperdivergent skeletal patterns. Perceptions were assessed using a visual analog scale.

Results: Significant differences were found in straight and parallel smile curve, maximum buccal corridor, and gingival display 4 mm components in all vertical skeletal patterns. Additionally, differences were also found in the medium buccal corridor in hypodivergent skeletal pattern, gingival display 2 mm in normal and hypodivergent skeletal patterns. Moreover, significant differences were also observed in the 100% incisor display in normal vertical skeletal pattern, and 50% incisor display in hyperdivergent skeletal pattern

Conclusion: Orthodontists and laypeople have similar perceptions toward the most esthetic components (parallel smile curve, minimum buccal corridor, gingival display 0 mm, and incisor display 75%) in all vertical skeletal patterns.

Keywords: Orthodontists' perception, Laypeople's perception, Smile analysis components, Vertical skeletal pattern

INTRODUCTION

An esthetically pleasing smile includes harmony in three different elements, including the lips, gingiva, and teeth. Therefore, in the assessment of smile analysis according to Sabri, there are eight components that are the main concern, namely, lip lines or smile lines, smile curves, upper lip curves, buccal corridors, symmetry smile, frontal occlusal plane, dentition component, and gingival component.[1,2] The topic of smile esthetic has gained interests among orthodontists because many patients begin to assess the overall results of orthodontic treatment, including smile, on facial appearance, although orthodontic treatment still prioritizes the occlusal relationship.[3] Smile was one of the esthetic components and its assessment can be measured using perception. There are various things affecting individual perception of esthetics assessment,

including race, culture, ethnicity, gender, age, level of education, and profession.[4,5]

The previous research on differences in the esthetic perception of the smile on the components of the smile analysis has been done, especially among orthodontists and laypeople, for example, studies carried out by Kokich *et al.*,[6] Flores-Mir *et al.*,[7] An *et al.*,[8] and many other studies. Research on esthetic perception of the smile in relation to vertical skeletal pattern is somewhat insufficient although some studies exist. These studies mostly discussed only one component of smile analysis, for instance, the study conducted by De Lima *et al.*[9] that only assess the gingival component of smile analysis or research assessing the buccal corridor component carried out by Zange *et al.*[10] Consequently, this study will discuss the differences in the perception of orthodontists, and laypeople to the four components of smile analysis in individuals with various vertical skeletal patterns.

MATERIAL AND METHODS

This was a comparative analytic study with a cross-sectional design and it was conducted in September–October 2021. This research has been approved by the Faculty of Dentistry, University of Indonesia's Research Ethics Commission,with the approval number 55/*Ethical Approval*/FKGUI/X/2021. The number of samples taken was 100 Orthodontists and 100 Indonesian laypeople as respondents for the questionnaire. Inclusion criteria were orthodontists and laypeople aged 26–65 years old.Orthodontists who are members of the Indonesian Association of Orthodontists with minimum five years of working experience as an orthodontist were included in the study. Additionally, laypeople with a minimum educational background of bachelor's degree in non-dentistry, working in a field that is not related to dentistry, and also never had orthodontic treatment or orthognathic surgery beforehand were included in the study. Exclusion criteria were orthodontists and laypeople who did not meet the study inclusion criteria.

Photos of a smiling face model were required for the questionnaire with the model criteria including women aged 18–40 years old. Notably, women who never had an orthodontic treatment, orthognathic surgery, or functional orthodontic appliances before and had complete dentition with no rotation, especially in the anterior region The photo was taken frontally with a straight sitting position, and the head position is in accordance with the natural head position. The photo of the smiling face that had been taken was manipulated using image editor software (Adobe Photoshop CS 6 for Windows, Adobe Inc., California, USA) based on the smile analysis components in the form of smile curve, buccal corridor, incisor display, and gingival display with three variations of increments and adjustments to variations in normal, hypodivergent, and hyperdivergent skeletal patterns, resulting 36 different photos [Figure 1]. These variations of vertical skeletal patterns were classified from clinical and radiographic photographs of the model in accordance with classifications from Siriwat dan Jarabak.[11] Then, an online questionnaire was made using a paid website (www.alchemer.com, Alchemer Survey, Louisville, USA) by including all the manipulated photos along with questions, timers, page transitions, and visual analog scales for esthetic perception assessment. The example of questionnaire page is shown in [Figure 2].

Statistical analysis

Respondents were asked to answer each question on the online questionnaire by giving an assessment for each photo of a smiling face according to their esthetic perception using a visual analog scale below every image. Respondents could drag the analog pointer from the least esthetic parameter on the left side to the most esthetic parameter on the right side. The data obtained was then processed using the statistic software (Statistical Package for the Social Sciences ver. 20.0, IBM, Chicago, USA). Reliability and validity of the questionnaire were both carried out using Cronbach's Alpha analysis and Corrected Item – Total Correlation analysis, respectively. The normality of the data was analyzed using the Kolmogorov–Smirnov test because there were more than 50 samples taken. Perceptions between orthodontists and laypeople on the components of smile analysis were analyzed using the Mann–Whitney test because the data were not normally distributed and not homogeneous.

RESULTS

The subjects in this study were 200 respondents consisting of 100 orthodontists and 100 laypeople with an age range of 26–65 years who were asked to assess the smiling face photos presented through an online questionnaire. Testing of the questionnaire was conducted on ten people from each group of the trial sample. The trial sample was taken from the same sample population as the research sample. Statistics results of each smile analysis component are shown in tables below.

[Table 1] showed the differences in the perception of orthodontists and Indonesian laypeople toward the smile curve component in various vertical skeletal patterns. *P*-values obtained for the components of the parallel smile arch in the three vertical skeletal patterns are 0.422, 0.709, and 0.104 ($P > 0.05$). This means that orthodontists and laypeople have similar perceptions toward these components. While *P*-value obtained for the straight and reverse smile curve components in all three vertical skeletal patterns is 0.000 ($P < 0.05$), so it can be concluded that there is a different perception between orthodontists and laypeople on these components.

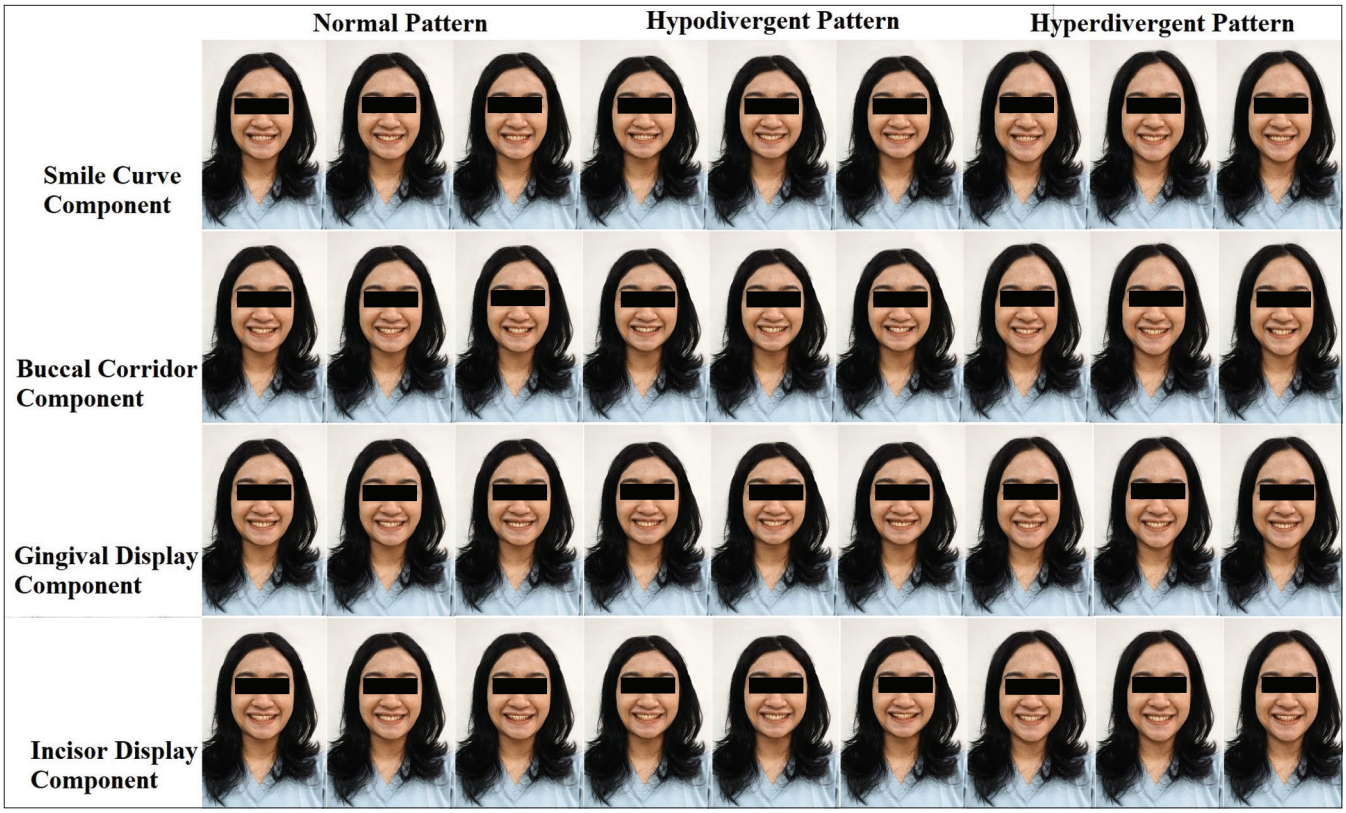

Figure 1: 36 modified smiling photos according to four smile analysis components (smile curve, buccal corridor, gingival display, and incisor display), with each three increments in normal, hypodivergent, and hyperdivergent skeletal pattern.

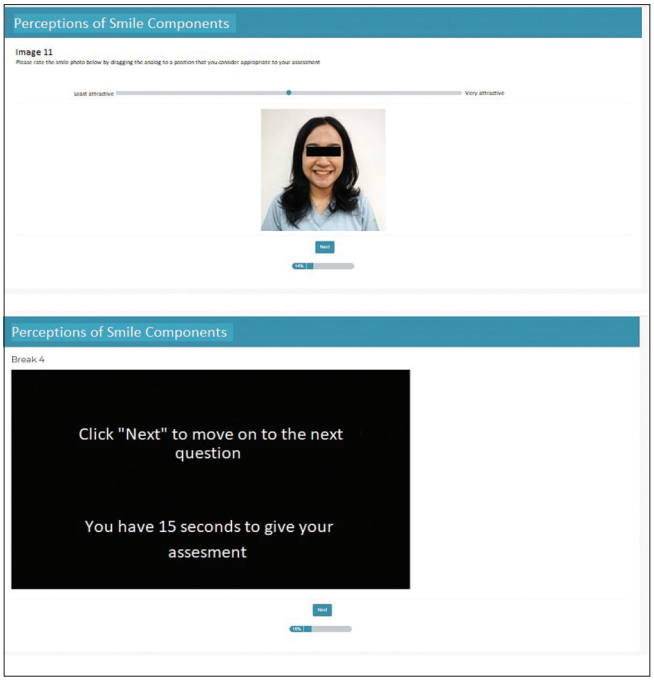

Figure 2: Example of question and transition pages of the online questionnaire as displayed on the web.

[Table 2] showed the differences in the perception of orthodontists and Indonesian laypeople towards the buccal corridor component in various vertical skeletal pattern. *P*-values obtained for the minimum buccal corridor component in the three vertical skeletal patterns were 0.262, 0.263, and 0.529, respectively, and the medium buccal corridor in normal and hyperdivergent skeletal patterns showed values of 0.188 and 0.268 ($P > 0.05$). It can be concluded that orthodontists and laypeople have similar perceptions of these components. Meanwhile, *P*-value obtained for the maximum buccal corridor component in the three vertical skeletal patterns was 0.000 and 0.002,and the medium buccal corridor in the hypodivergent skeletal pattern showed a value of 0.047 ($P < 0.05$), so it can be concluded that there are differences in the perception of orthodontists with laypeople toward these two components.

[Table 3] showed the differences in the perception of orthodontists and Indonesian laypeople toward the gingival display component in various vertical skeletal patterns. *P*-values obtained for the 0 mm of gingival display component in all three vertical skeletal patterns were 0.258, 0.908, and 0.969, respectively, and the 2 mm of gingival display in the hyperdivergent skeletal pattern obtained a

Table 1: Comparative analysis of the smile curve component in normal, hypodivergent, and hyperdivgerent skeletal patterns.

Vertical Skeletal Pattern	Smile Curve	Orthodontist VAS±SD	Laypeople VAS±SD	*p* Value
Normal	Parallel	64.18±16.04	65.74±20.99	0.422*
	Straight	39.20±20.59	53.53±23.82	0.000*
	Reverse	24.60±17.12	38.33±23.69	0.000*
Hypodivergent	Parallel	65.23±17.59	66.40±19.27	0.709*
	Straight	39.56±18.11	50.19±23.05	0.000*
	Reverse	22.47±15.04	35.85±26.78	0.000*
Hyperdivergent	Parallel	59.32±17.30	63.49±19.89	0.104*
	Straight	38.00±18.84	47.83±23.82	0.000*
	Reverse	22.65±16.89	35.01±24.40	0.000*

*p<0.05=significant difference statistically, VAS: Visual analogue scale, SD: Standard deviation

Table 2: Comparative analysis of the buccal corridor component in normal, hypodivergent, and hyperdivergent skeletal patterns.

Vertical Skeletal Pattern	Buccal Corridor	Orthodontist VAS±SD	Laypeople VAS±SD	*P* Value
Normal	Minimum	64.88±16.80	61.72±21.23	0.262*
	Medium	58.08±16.84	61.70±21.62	0.188*
	Maximum	48.59±18.83	59.05±21.65	0.000*
Hypodivergent	Minimum	62.67±20.88	59.90±20.58	0.263*
	Medium	57.77±17.52	62.97±19.53	0.047*
	Maximum	48.24±19.65	55.99±22.91	0.002*
Hyperdivergent	Minimum	48.59±17.59	65.26±21.93	0.529*
	Medium	48.24±18.11	63.23±19.63	0.268*
	Maximum	47.04±15.04	63.33±20.26	0.000*

*p<0.05=significant difference statistically, VAS: Visual analogue scale, SD: Standard deviation

Table 3: Comparative analysis of the gingival display component in normal, hypodivergent, and hyperdivergent skeletal patterns.

Vertical Skeletal Pattern	Gingival Display	Orthodontist VAS±SD	Laypeople VAS±SD	*P* Value
Normal	0 millimeter	63.89±16.03	60.77±21.10	0.258*
	2 millimeter	56.26±18.90	62.27±19.75	0.022*
	4 millimeter	39.02±17.89	54.42±23.46	0.000*
Hypodivergent	0 millimeter	62.98±17.37	63.63±19.45	0.908*
	2 millimeter	52.66±20.84	59.75±20.98	0.007*
	4 millimeter	33.80±19.63	46.27±24.318	0.000*
Hyperdivergent	0 millimeter	62.84±16.57	62.10±21.32	0.969*
	2 millimeter	62.22±18.06	64.36±19.28	0.442*
	4 millimeter	42.44±21.59	58.77±24.06	0.000*

*p<0.05=significant difference statistically, VAS: Visual analogue scale, SD: Standard deviation

value of 0.442 ($P > 0.05$). This means that orthodontists and laypeople have similar perceptions. While *P*-value obtained for the 4 mm of gingival display component in the three vertical skeletal patterns is 0.000,and the 2 mm of gingival display in normal and hypodivergent skeletal patterns is 0.022 and 0.007 ($P < 0.05$), it can be concluded that orthodontists and laypeople have different perception towards these components.

[Table 4] showed the differences in the perception of orthodontists and Indonesian laypeople toward the incisor display component in various skeletal patterns. *P*-values obtained for the 75% incisor display component in the three vertical skeletal patterns were 0.239, 0.712, and 0.160, respectively. The 100% of upper incisor display in the hypodivergent and hyperdivergent skeletal patterns were 0.434 and 0.884. Furthermore, 50% of incisor display in normal

Table 4: Comparative analysis of the incisor display component in normal, hypodivergent, and hyperdivergent skeletal patterns.

Vertical	Incisor Display	Orthodontist	Laypeople	*p* Value
Skeletal Pattern		**VAS±SD**	**VAS±SD**	
Normal	100%	57.77±18.315	63.66±19.73	0.037*
	75%	51.60±18.59	54.53±19.63	0.239*
	50%	33.26±17.17	36.53±25.62	0.269*
Hypodivergent	100%	61.37±17.26	63.449±20.48	0.434*
	75%	52.29±19.46	53.42±22.53	0.712*
	50%	34.58±19.36	37.295±24.45	0.482*
Hyperdivergent	100%	64.51±15.83	63.48±19.89	0.884*
	75%	55.05±17.26	58.53±20.49	0.160*
	50%	33.19±17.18	41.97±24.30	0.016*

*p<0.05=significant difference statistically, VAS: Visual analogue scale, SD: Standard deviation

and hypodivergent skeletal patterns were 0.269 and 0.482 ($P > 0.05$); hence it can be concluded that orthodontists and laypeople have similar perception toward these components. While *P*-value obtained for the 100% incisor display in a normal vertical skeletal pattern and the 50% incisor display in the hyperdivergent skeletal pattern, respectively, was 0.037 and 0.016 ($P < 0.05$), it was concluded that there was a difference in perception between orthodontists and Indonesian laypeople toward these components.

Comparative analysis of the overall perception between orthodontists and Indonesian laypeople on each component of the smile analysis on the three vertical skeletal patterns was also carried out. Analysis of perception between orthodontists and Indonesian laypeople on the smile curve (parallel, straight, and inverted) in individuals with normal, hypodivergent, and hyperdivergent skeletal patterns resulting $P = 0.000$ ($P < 0.05$); so it can be concluded that orthodontists and laypeople have different perceptions of these components. Analysis of perceptions between orthodontists and Indonesian laypeople on the buccal corridor (minimum, medium, and maximum) in individuals with normal, hypodivergent, and hyperdivergent skeletal patterns showing $P = 0.05$ ($P < 0.05$), therefore it can be concluded that there is a significant difference between the perception of the buccal corridor component between orthodontist and laypeople. Analysis of perception between orthodontists and laypeople on the gingival displays component (0 mm, 2 mm, and 4 mm) in individuals with normal, hypodivergent, and hyperdivergent skeletal patterns showing $P = 0.001$ ($P < 0.05$), so it can be concluded that there is a significant difference between the perception of orthodontists and laypeople on these components. Analysis of perceptions between orthodontists and laypeople on the incisor display component (100%, 75%, and 50%) in individuals with normal, hypodivergent, and hyperdivergent skeletal patterns resulting $P = 0.169$ ($P > 0.05$) and it can be concluded that orthodontists and laypeople have similar perception toward these components in general.

DISCUSSION

The previous research on the smile esthetic perceptions has been conducted and has resulted in differences in the esthetic perception of the smile between orthodontists, dentists, and laypeople. This was presumably because the perception of orthodontists is considered to be more objective and more specific compared to the perception of dentists, while the perception of laypeople is very dependent on the social environment.[12] Esthetic perceptions from the perspective of dentists, especially orthodontists, were also considered to have a lower tolerance than laypeople regarding certain dental conditions.[13] Kokich *et al*.[6] also stated that in certain esthetic aspects of the smile, orthodontists are considered to be more responsive in detecting the presence of certain esthetic dental discrepancies, even the minor ones.

The purpose of this study was to determine the differences in esthetic perception of the four components of the smile, namely, the smile arch, buccal corridor, gum appearance, and upper incisor appearance in individuals with normal, hypodivergent, and hyperdivergent skeletal patterns. This research was conducted by assigning Indonesian orthodontists,and laypeople as respondents in filling out the questionnaire. Inclusion criteria for the orthodontist group were men or women aged 26–65 years old, who have completed specialist education in the field of orthodontics, have work experience as an orthodontist for at least five years, and have registered as official members of the Indonesian Association of Orthodontists. The five years of work experience was considered to be sufficient for the orthodontists' group to make professional assessments in esthetic perception of this study. The inclusion criteria for the laypeople were men or women aged 26–65 years with a minimum education of a bachelor degree in the non-dentistry field and did not have a job related to dentistry. The selection of inclusion criteria in this study was based on the assumption that age, gender, educational background, as well as education level, and income can affect esthetic perception.[6,14-16]

Esthetic perceptions between orthodontists and laypeople of the parallel component of the smile arch in all vertical skeletal patterns were found to be similar to the study conducted by Simões *et al.* where parallel smile arches are considered the most esthetic.[17] In contrast to the straight and inverted smile arch components, both the orthodontist and laypeople tended to have less preference when compared to parallel smile arches. The orthodontists group generally gave a lower esthetic value than the group of laypeople,and this was in line with the opinion expressed by Pinho *et al.*,[13] where orthodontists are generally more sensitive in providing esthetic assessment. There was a slight difference from the group of laypeople who indeed rated the inverted smile arc with low esthetic value, but for the straight smile curve, the assessment given is considerably well and not significantly different from the assessment of the parallel smile arch. It was possible that the laypeople were less able to distinguish between parallel and straight smile curves so that the assessments given were quite similar. Kokich *et al.*[6] mentioned that orthodontists are generally more responsive in detecting certain esthetic discrepancies. This was because orthodontists have the appropriate educational background and broader knowledge in orthodontic field, especially those related to smile esthetics, compared to laypeople who do not have similar knowledge in the same field, so their tolerance and sensitivity in esthetic judgments are lower. The effect of differences in educational background was more or less in line with some previous studies.[9,16,18] Esthetic perceptions between orthodontists and Indonesian laypeople on the components of the smile arch were generally different.

The width of the buccal corridor can be measured from the mesial line of the maxillary first premolar to the interior of the lip commissure.[19] The esthetic perception of the minimal buccal corridor component between orthodontists and laypeople in all vertical skeletal patterns tends to be quite the same. It was in line with the study conducted by Parekh *et al.*[20] in which a minimal buccal corridor was preferred among orthodontists, and laypeople. Likewise, in the medium buccal corridor, there were similar perceptions between orthodontist and laypeople except for the hypodivergent skeletal pattern. This was presumably because the hypodivergent skeletal pattern emphasizes the imbalance in the transverse dimension so that the medium buccal corridor component has increased sensitivity in esthetic assessment and the similar found was also stated by Ackerman.[21] The difference in perception between orthodontists and laypeople was found in the maximum buccal corridor component in all three vertical skeletal patterns. This showed that the maximum buccal corridor was not a preference, especially for the orthodontists' group,and the results of this study were in line with the previous studies by Moore *et al*.[22] and according to him, the maximum buccal corridor should be included in the problem in determining the diagnosis and orthodontic treatment plan. In general, orthodontists and laypeople have similar perceptions on buccal corridor component.

Esthetic perceptions between orthodontists and laypeople on the components of the gingival display have more varied comparisons of results. Differences in perception were found in 2 mm and 4 mm of gingival display in the normal and hypodivergent skeletal pattern, and the 4 mm of gingival display in the hyperdivergent skeletal pattern. This is slightly contrary to research by De Lima *et al*.[9] which states that the tolerance for gingival displays that is considered unesthetic is smaller in the hyperdivergent skeletal vertical pattern, although this result is similar to the research conducted by Adani *et al.*[23] and Abu Alhaija *et al*.,[24] respectively. Excessive gingival display is indicated to affect psychosocial effects, especially if accompanied by severe malocclusion, as in the results of a study by Paula *et al*.[25] where the psychosocial effect is quite high in adolescents with more than 3 mm of gingival display. In general, the perception of orthodontists and Indonesian laypeople on the gingival display components can be said to be different.

The esthetic perception of the incisor display component between orthodontists and laypeople was mostly alike, except for 100% of incisor display in a normal skeletal vertical pattern and 50% of maxillary incisor display in a hyperdivergent vertical pattern. The orthodontists' group gave an overall assessment of the incisor display components in all vertical skeletal patterns lower than the laypeople group. This showed that the esthetic tolerance according to the orthodontist's perception is lower than that of the laypeople. The difference in the mean score that is significantly different in 100% and 75% of incisor display in all vertical skeletal patterns, indicating that the two variations of the components can still be considered quite esthetic. This is in accordance with the statement of Cobourne and DiBiase[26] where when smiling, the maxillary incisor crown height is expected to range from 75 to 100%. The lowest esthetic assessment of this component was obtained by an assessment of the 50% maxillary incisor display in hyperdivergent skeletal pattern and this was given by the orthodontists group. This supports the opinion stated by Ackerman[21] that hyperdivergent skeletal patterns can emphasize facial imbalances in the vertical dimension. There are similarities in overall esthetic perception of the incisor display component between orthodontists and laypeople.

The similar perceptions among the most esthetic smile analysis components between orthodontists and Indonesian laypeople obtained from this study may be beneficial,especially in determining orthodontic treatment plans and goals. The result of this study was expected to provide information regarding smile esthetic perceptions as well as educational materials regarding treatment plans for the patients.

CONCLUSION

This study showed that orthodontists and Indonesian laypeople have the same perception in assessing the most esthetic smile analysis components, namely, parallel smile curve, minimal buccal corridors, 0 mm of gingival display, and 75% of incisor display in all vertical skeletal patterns. Orthodontists and Indonesian laypeople have different perceptions n of the following components: straight and reverse smile curve in all vertical skeletal patterns, maximum buccal corridor in all vertical skeletal patterns,and medium buccal corridor in the hypodivergent skeletal pattern, 4 mm of gingival display in all vertical skeletal patterns and 2 mm of gingival display in normal and hypodivergent skeletal patterns, as well as 100% of incisor display in normal skeletal pattern and 50% of incisor display in hyperdivergent skeletal pattern. In general, Indonesian orthodontists and laypeople have different perceptions of the smile curve and gingival display components, but they have similar perceptions throughout the buccal corridor and incisor display components in various vertical skeletal patterns.

Ethical approval

This research has been approved by the Faculty of Dentistry, University of Indonesia's Research Ethics Commission,with the approval number 55/Ethical Approval/FKGUI/X/2021.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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