

Perception of Repaired Cleft Lip Aesthetics among Professionals, Laypersons and Patients with Cleft Using Three-Dimensional Images

Siti Adibah Othman^{1*}, Mabel Low^{1,2}

1. Department of Paediatric Dentistry and Orthodontics, Faculty of Dentistry, University of Malaya, Malaysia.
2. Orthodontist, Oral Health Programme, Ministry of Health, Malaysia.

Abstract

This was a prospective cross-sectional quantitative study to determine the differences in perception on lip aesthetic between repaired cleft lip and non-cleft lip's three-dimensional (3D) images by professionals, laypersons, and patients with cleft; and to examine the influence lip asymmetry has on perception of aesthetics.

Sixteen standardised 3D lip images of repaired cleft and non-cleft lips were presented in random order to three groups of raters; dental professionals (orthodontists and oral surgeons), laypersons and patients with cleft. For each image, the raters had to evaluate lip attractiveness using the visual analog scale (VAS) score. Differences in mean VAS score were analysed using one-way analysis of variance (ANOVA). Pearson's correlation coefficient was utilized to identify any possible relationship between lip asymmetry and aesthetic scores.

The average VAS score for the repaired cleft images was 3.64 lower than non-cleft images (5.19 vs 8.83), and this difference was found to be statistically significant ($p < 0.05$). No significant differences in the VAS scoring between the three rater groups were observed. Although not significant, a negative correlation was found between the degree of lip asymmetry and VAS score. Repaired cleft lips had significantly lower aesthetic scores than non-cleft normal lips. The professional background of raters did not influence their perception of lip aesthetics and the level of asymmetry also did not affect their aesthetic scoring.

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Introduction

Specialized treatment is necessary for patients who suffer from cleft lip and palate (CLP) from childhood to adulthood to improve their facial appearance and function. However, the scars formed and the asymmetry in the lip area often remain. These impaired facial appearances can have a negative effect on an individual's psychosocial well-being and ultimately, their quality of life. Patients with CLP were perceived to have learning disabilities, a tendency to be more depressed, and lower self-esteem.^{1,2} It has

been reported previously that 3 per cent of patients with cleft lip, 49 per cent of patients with cleft palate, and 56 per cent of patients with CLP had problems that warranted a psychosocial consult.³

Noor and Musa⁴ interviewed 60 parents and patients with CLP to determine how satisfied they were with the treatment that they received. Nine of them reported that their self-confidence was "very much affected", and up to 83 per cent of the respondents felt their self-confidence was negatively affected by their cleft conditions. They also found that the lips were the second biggest concern, which both patients and parents felt needed more attention. It has also been reported that the majority of the female patients asked for further treatment, particularly for corrections of the upper lip and nose.⁵

A difference in perception may exist among professionals, laypersons and patients when evaluating morphological characteristics around the dentofacial region. Raters with

***Corresponding author:**

Professor Dr Siti Adibah Othman,
Department of Paediatric Dentistry and Orthodontics,
Faculty of Dentistry,
University of Malaya,
50603 Kuala Lumpur, Malaysia
E-mail: sitiadibah@um.edu.my

different backgrounds evaluate facial aesthetics of patients with cleft differently. Patients with cleft may tend to rate aesthetics of their operated cleft lips worse compared to professionals.⁶ On the other hand, professionals might give a lower score compared to patients with cleft patients.⁷ The differences that were observed may be due to the differences in level of knowledge, perception, and exposure between the groups. Clinicians often focus on obtaining the best clinical results for their patients and may form their own opinions on the aesthetic results. However, there is currently more emphasis on patients' own views or perception on what they want to achieve at the end of their treatment. As clinicians play a critical role in determining the aesthetic future of a patient's face, the patient's perception of his or her own appearance must be taken into account before treatment planning. For that reason, clinicians are required to study and consider facial beauty, balance, and harmony as perceived not just through their own eyes, but through the eyes of the general public as well. Therefore, the purpose of this study was to analyse the perception of lip aesthetics by dental professionals, laypersons, and patients with cleft lip using three-dimensional (3D) facial images of patients with repaired and non-cleft lip.

Materials and methods

This was a prospective cross-sectional quantitative study, whereby standardised 3D lip images of both repaired cleft and non-cleft cases were presented in random order to three groups of raters. The patients that were selected for 3D facial image capturing were recruited from the Orthodontic and the Combined Cleft Clinics, Faculty of Dentistry, University of Malaya. Recruitment of patients was conducted from September 2016 to December 2016. The inclusion criteria were as follows: (1) adult patients; (2) patients under the cleft group received treatment with primary closure of the lip conducted between the ages of 3-6 months; (3) the patients with repaired cleft lip and/or palate may or may not have had lip revisions at a later stage; and (4) the patients with non-cleft had Class I malocclusions with no severe skeletal asymmetry or discrepancy. A total of 16 images (8 repaired cleft lip and 8 non-cleft lip) were captured and used so as to not discourage or cause fatigue among the raters by producing too

many sets of images for assessment.⁸

The raters consisted of dental professionals (orthodontists and oral surgeons), laypersons, and patients with cleft lip. The power and sample size were calculated using G*Power Software Version 3.1.9.2 based on a previous study which investigated patients' evaluation of aesthetic outcome in cleft repair.^{5, 9} With a possible 10 per cent dropout rate, a power of 0.8 and significance level of 0.05, a total of 30 raters were needed. Hence, a minimum of 10 raters were recruited in each group with the following inclusion criteria: (1) must be 18 years and above; and (2) under the dental professionals' group, the raters must have had experience of working in a cleft team for at least 5 years. Patients whose 3D images were used in the study were excluded as the raters. Ethical approval was granted by the Medical Ethics Committee, Faculty of Dentistry, University of Malay (DF CD1610/0063(P)). Verbal and written consent were obtained from the patients and raters who fit the inclusion criteria and voluntarily wished to participate in the study.

The 3D facial images of the 16 patients were captured using the VECTRA-M5 360° Imaging System (Canfield Scientific Inc. Fairfield, NJ, USA) 3D for full-face imaging. The cameras were calibrated according to the manufacturer's guidelines to ensure consistency and magnification. The images were taken at rest (not smiling) and without any lipstick or piercings. All the captured images were then cropped to display just the lips. To standardise the cropping, four landmarks were marked on each pair of lips, then the images were cropped 8 mm above *ls*, below *li*, to the left of *chR*, and to the right of *chL* (Figure 1).



Figure 1. Cropped 3D lip image. *ls* = laberale superiorus, *li* = laberale inferiorus, *chR* = right cheilion, *chL* = left cheilion

The cropped images were then transferred to a laptop for evaluation by the raters. To measure asymmetry of each image, the outline on the right side of the upper lip was first plotted, and then its surface area was measured using Mirror® software (Canfield Fairfield, NJ, USA). This step was repeated to measure the surface area on the left side of the upper lip. The differences in surface area between the left and right sides would give the amount of asymmetry.

Measurement errors could be produced as a consequence of inaccurate placement of points while measuring surface areas on the lip. An expert in the field of craniofacial anthropometry was invited to carry out the asymmetry measurements for calibration purposes. Both sets of data were compared and analysed. To assess the reproducibility of asymmetry measurements on the lip images, five images were selected at random. The randomisation process was done by assigning each image to a number and these numbers were then kept in an opaque envelopment. After a two-week interval, five numbers were drawn out from the envelope and the asymmetry measurement was carried out again on images that corresponded to these numbers. Intraclass correlation coefficient test (ICC) was conducted on the repeated measurements.

Lip attractiveness was evaluated by the raters on each of the 16 lip images from a laptop using the Visual Analogue Scale (VAS) score. The calibration of the VAS score was first carried out by the authors (LM and SAO) and analysed with the ICC test. For each image, the raters evaluated lip attractiveness by placing a mark on the horizontal line of the VAS. Zero (0) corresponded to least aesthetic and 10 corresponded to most aesthetic. During evaluation, they could manipulate the 3D images on the laptop in every direction, and no time limit was set for scoring.

To analyse the difference in mean VAS scores of repaired cleft lip and of non-cleft images, the independent t-test was used. One-way analysis of variance (ANOVA) was used to calculate the mean scores given by all rater groups. Pearson Correlation Coefficient was utilized to find any possible relationship between asymmetry of the lips and VAS scores given by the raters. All statistical analyses were carried out using Statistical Package for Social Sciences version 23.0 (SPSS for Window, SPSS Inc.,

Chicago, IL, USA). The level of significance was set at $p < 0.05$.

Results

The ICC values indicated good reliability (0.77) and excellent reliability (0.90) for inter- and intra-observer measurements of lip asymmetry respectively. Calibration of the VAS indicated good reliability with an ICC value of 0.82 (Table 1). Overall, the images of repaired cleft lip had a mean VAS score of 5.19, which was lower than that of non-cleft lip (8.83) by 3.64 (Table 2). This difference was found to be statistically significant (p -value < 0.05).

Groups	Interclass Correlation	95% Confidence Interval		Significance
		Lower bound	Upper bound	
Inter-observer for the lip asymmetry measurement	0.77	0.38	0.92	0.002
Intra-observer for the lip asymmetry measurement	0.90	0.09	0.99	0.021
VAS score	0.82	0.21	0.94	0.000

Table 1. Reliability test of the lip asymmetry measurement and the VAS score.

Type of image	N	Mean VAS Scores	SD	Std. Error Mean	t	p-value	Std. Error Difference
Repaired cleft lip	8	5.19	0.62	0.21	15.90	0.000*	0.2289
Non-cleft lip	8	8.83	0.17	0.06		0.000*	

Table 2. Mean VAS score and p-value for repaired cleft lip and non-cleft lip images by all raters. * $p < 0.05$.

Mean VAS Scores		ANOVA			
		Sum of squares	Degree of freedom	F	p-value
Repaired cleft lip	Between groups	7.46	2	2.55	0.09
	Within groups	39.38	27		
	Total	46.84	29		
Non-cleft lip	Between groups	3.24	2	1.98	0.15
	Within groups	22.09	27		
	Total	25.34	29		

Table 3. ANOVA of mean VAS score by different rater groups. * $p < 0.05$.

Mean VAS Scores		ANOVA			
		Sum of squares	Degree of freedom	F	p-value
Repaired cleft lip	Between groups	8.05	3	1.80	0.17
	Within groups	38.78	26		
	Total	46.84	29		
Non-cleft lip	Between groups	3.28	3	1.28	0.29
	Within groups	22.06	26		
	Total	25.34	29		

Table 4. ANOVA of mean VAS score by different rater groups, with the dental professional group further divided into oral surgeons and orthodontists. * $p < 0.05$.

There was no statistically significant difference in mean VAS scores from the different groups of raters with *p*-values of 0.09 and 0.15 for the repaired cleft and non-cleft lip images respectively (Table 3). When oral surgeons and orthodontists from the dental professional group were separated into two different rater groups, the results were still not significant (Table 4). The patient group gave the lowest mean VAS scores compared to the dental professional and layperson groups for both repaired cleft lip (mean of 4.3) and non-cleft lip (mean of 8.5) images. Interestingly, the layperson group had the widest standard deviation of mean VAS scores in both sets of images.

The relationship between asymmetry and aesthetic perceptions had a negative correlation, which meant that the more asymmetric a lip image, the lower its aesthetic score. However, this relationship was not statistically significant (Table 5).

Correlation	N	Pearson Correlation	<i>p</i> -value
Asymmetry and mean VAS score by dental professionals	16	-0.37	0.15
Asymmetry and mean VAS score by laypersons	16	-0.42	0.10
Asymmetry and mean VAS score by patients with cleft	16	-0.36	0.16

Table 5. Pearson correlation coefficient on lip asymmetry and mean VAS score according to the three rater groups. **p* < 0.05.

Discussion

Mean VAS Scores of Repaired Lip and Normal Lip

The difference between the mean VAS scores for repaired cleft and non-cleft lips was significant in this study. The unfavourable aesthetic perception of patients with cleft might be caused by the imperfections that are still present in these patients even after surgical correction, such as discrepancies in vertical lip length and symmetry, malaligned obicularis oris muscle, and scarring. Eichenberger et al.¹⁰ obtained a similar result, but with a lower difference in mean VAS scores (1.97) between the repaired cleft and non-cleft lips. The differences may be due to a larger number of images (60) and the use of only 2D photographs. Another study comparing aesthetics using

images of patients with repaired cleft, severe orthognathic patients with skeletal Class III, and patients with skeletal Class I also reported that the repaired cleft images were significantly less attractive.¹¹ Standardised frontal photos of the patients were taken; however, they were not cropped. The images in the current study on the other hand were cropped to display just the lips, yet a significant difference in aesthetic score between repaired cleft and non-cleft lips was observed. Hence, it can be concluded that the raters were able to detect enough differences between those two types of lips without having them visualise the whole facial appearance.

Raters observed the cleft images for a longer duration during evaluation compared to the unaffected faces which was proven by an eye-tracking camera.¹² Additionally, raters with a cleft themselves paid greater attention to the features that are anomalous on their own faces compared to raters without clefts. The lower face, especially the nasolabial region, prevails for happy and cheerful expressions.¹³ Residual scars or asymmetries located in this decoding area for happy and cheerful expressions, may appear more obvious for raters. This might have caused the lower scores for the cleft's images.

Aesthetic Scores by Different Rater Groups

Patients with cleft gave the lowest mean VAS score for the repaired lip images compared to laypersons and dental professionals although the difference was not significant. This result is similar to previous studies where the patients rated the aesthetic outcome of cleft lip correction worse than the professionals.^{5, 6} A different study on the other hand, reported that professionals rated the repaired cleft photographs lower than patients with cleft and laypersons.⁷ The rating panel in that study included general dentists and psychologists, in addition to orthodontists which may have influenced the difference in aesthetic rating.

The current study revealed that the layperson group gave a lower aesthetic score than the dental professionals. Papamanou et al.¹⁴ also found that laypersons were less satisfied with the repaired lip than dental professionals. Laypeople had no previous experience or exposure related to clefts. On the contrary, both surgeons and orthodontists are expected to exhibit a type of professional bias since they are familiar with the obstacles encountered when

treating such cases. This may cause them to be more tolerant towards undesirable aesthetic results. A layperson's perception in a society within which cleft patients live can affect how successful these individuals fare in work, education, and social situations. It has been reported that the low aesthetic score given by laypeople were correlated with the increased self-reported influence of the cleft condition in the patients' social activities and professional life¹⁵. Therefore, clinicians should not only treat what is considered meaningful by his/her speciality or the patients' concerns, but also those of their social environment.

The majority of the dental professionals in the present study gave a low VAS score for the repaired lip images, indicating that they had higher aesthetic standards than patients with cleft and laypersons. Individuals with a cleft are familiar with orofacial clefting and have higher awareness of the condition and its impact on facial appearance. Patients with cleft have lived through the condition and its chronological management that spans from birth to adulthood. It could be this awareness that made them more receptive and flexible towards the aesthetics of the repaired lip. In contrast, dental professionals especially orthodontists and oral maxillofacial surgeons, are driven to achieve good results both functionally and aesthetically for their patients. They are more focused in reaching these objectives, hence have a higher aesthetic aim on the repaired lip. As for the non-cleft lip images, the perception of aesthetics was more similar among the three rater groups. It can be concluded that it is easier to gauge a normal image than an image that is out of the norm.

Lip Asymmetry and Aesthetic Perception

Facial symmetry has been accepted as the aesthetic gold standard for a long time.¹⁶ Although non-cleft faces are not perfectly symmetrical, it is deemed to be more pronounced in patients with cleft.¹⁷ The face of a patient with CLP clearly appears more symmetrical after undergoing surgery. However, even the most advanced interventions do not necessarily guarantee a completely normal facial appearance. In the present investigation, there was no significant correlation between the amount of asymmetry and lip aesthetics. A weak relationship between asymmetry and aesthetics in subjects with complete unilateral CLP had

previously been reported.¹⁸ When more severe unilateral CLP was compared to patients with unilateral cleft lip, a poor association between nasolabial asymmetry and aesthetics was observed too.¹⁹ The more drastic the cleft type, the less influential the nasolabial asymmetry is towards aesthetic perception.

Asymmetry in individuals with cleft lip involves not only the lip, but the nose as well. The type and severity of the deformity could also influence how raters show differing levels of attentional bias to the lip area.²⁰ The images used in the current study had been cropped to just the lips and the repaired lip images were not further classified into types of residual deformities or asymmetry. This could explain the non-significant finding, as raters may need a wider view of the facial region in order to rate the images more accurately. By including the nose for assessment, the amount of asymmetry for each image may inevitably increase, given that more areas were to be measured.

A large degree of lip asymmetry affected the aesthetic judgment of dentists and patients with cleft, albeit they were tolerant to mild asymmetries.²¹ It reflects how comparable dentists were to patients with cleft with regards to perceived variation of the smile from the norm. It also showed that patients with cleft had a reasonable tolerance to lip asymmetry, as a small degree of asymmetry is not perceptible by them. It is therefore imperative to consider these observations when planning lip revision surgery and to inform patients if any significant lip asymmetry is to be expected.

Several genes involved in the aetiology of the orofacial cleft and it can be a single gene disorder or alteration of the chromosome.²² One of it is the O6-methylguanine DNA methyltransferase (MGMT) gene which encodes a DNA repair protein and plays a role in the orofacial cleft congenital malformations. Although all individuals with and without orofacial cleft have some degree of methylation of the MGMT promoter, it is found to be significantly higher in individuals with cleft. Hence, it suggests a possible risk of reduced DNA repair ability in patients with orofacial cleft.²³

This study has several limitations. Due to incomplete information on the patients with cleft, lip repair and variability in their surgical techniques, we were unable to assess if these factors would have influenced the VAS scores

given by the raters. The facial images used in the study were recruited patients from a multiracial background. Thus, the different skin tones of the patients, might affect the raters' judgment during evaluation. The surrounding skin tone was still visible even though the images were cropped to the lips.

Conclusions

Repaired cleft lips had a significantly lower aesthetic score than the non-cleft lips. However, professional background of the raters did not influence aesthetic perception. There was also no correlation between lip asymmetry and aesthetic perception.

Declaration of Interest

The authors declare that they have no competing interest.

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