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CORRELATION BETWEEN THE FACIAL GROWTH PATTERN AND THE SMILE ARC IN MALE AND FEMALE PATIENTS IN THE DEPARTMENT OF ORTHODONTICS, SPECIALIST CLINIC OF DENTAL AND ORAL EDUCATION HOSPITAL, UNIVERSITAS AIRLANGGA

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Abstract–In orthodontic, forming an aesthetic smile is important and should be achieved as the result of the treatment. One of the key factors should be considered to predict the smile arc (non-consonant vs. consonant) is the facial growth pattern of the patient (horizontal vs. vertical type, respectively). The consonant smile arc is considered as an aesthetic smile. Here we studied the correlation between the facial growth pattern and the smile arc of 56 males and 56 female patients by analyzing the pre-treatment SnGoGn angle (the Steiner method) and the curvature of the anterior maxillary teeth from the anterior facial photograph of each patient, respectively. Data were analyzed using chi-square (SPSS 17). We found that the contingency coefficients are 0.331 in female and 0.338 in male (p=0.2 and p=0.16, respectively). In this study we learn that there are positive correlations between the smile arc and the facial growth pattern both in female and male patients; the vertical facial growth pattern would produce a consonant smile, thus more preferable as considered more aesthetic; while the horizontal face would likely have a non-consonant smile arc. These data may help the orthodontist to plan an individual treatment for each patient in order to have a beautiful smile.

INTRODUCTION

Smile is one of the important keys to produce an aesthetic facial feature. Therefore, orthodontic treatment must consider the aesthetic appearance of the face, especially the smile. Based on the previous research, 84.2% of respondents stated that having an ideal smile is important (Hunt *et al*., 2002). An ideal smile is an asset especially during job interviews, social interactions, and attracting the opposite sex. Many patients want to have an ideal smile as the end result of orthodontic treatment (Sabri, 2005; Siddiqui *et al*., 2016).

There are eight main components of a smile that must be considered in order to create an ideal smile during orthodontic treatment. They are the lip line, smile arc, curvature of the upper lip, buccal corridor, smile symmetry, the occlusal frontal plane, tooth component, and gingival component. From this, one that yet received much attention during orthodontic treatment is the smile arc. The smile arc is an alignment between the curvature of the incisal edge of the anterior maxillary tooth and the curvature of the lower lip. Consonant smile arc is considered to represent an ideal aesthetic smile (Sabri, 2005).

The facial growth pattern is thought to be a factor that influences the smile arc (Sarver, 2001). In general, facial growth patterns are divided into horizontal facial growth pattern and vertical facial growth pattern (Steiner, 1953). In horizontal facial growth patterns, the posterior maxillar occlusal plane grows more vertical than anterior. This causes a change in the relationship between the anterior occlusal plane and the curvature of the lower lip, causing the smile arc to become non-consonant and

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considered less aesthetic (Sarver, 2001; Wang *et al*., 2013). In theory, horizontal facial growth patterns tend to have an anterior maxillar occlusal plane that grows not in accordance with the direction of rotation of the clockwise tilt growth so that it does not form an ideal smile arc. On the other hand, the vertical facial growth pattern would produce a consonant and considered more aesthetic smile (Sarver, 2001).

MATERIALS AND METHODS

This current research is an analytic observational study with cross sectional design. Anterior facial photograph and lateral cephalometric x-ray from 56 male and 56 female patients in the Department of Orthodontics, Specialist Clinics of Dental and Oral Education Hospitals, Universitas Airlangga, Surabaya, Indonesia (2013 – 2017 periods; 18 – 42 years old) were studied. This patients had no facial asymmetry, no missing teeth, no supernumerary teeth, no dentures or restorations seen when smiling, having anterior teeth that grow normally, orthodontic treatment has never been done, do not have a history of facial trauma, facial plastic surgery, or orthognathic surgery.

This study analyzed secondary data of lateral cephalometric x-ray and anterior facial photograph in a smiling position showing the anterior maxillary teeth. Lateral cephalometric x-ray are used to determine facial growth patterns, by applying lateral cephalometric x-ray with transparent acetate paper on a tracing table at predetermined angles based on Steiner cephalometric analysis method (SNGoGn angle). The SNGoGn angle is the inclination of the mandibular plane against the base of the anterior cranium. This angle is formed from the assembly of the mandibular plane (GoGn) and SN line, with the normal value of the angle is 32°. The SNGoGn angle value smaller than 32° shows the horizontal facial growth pattern, and the SNGoGn angle which is greater than 32° shows the vertical facial growth pattern. Anterior facial photograph is used to determine the smile arc, by manually drawing a line using a waterproof pen on transparent plastic placed on top of a printed patient's photo. Determination of a smile arc based on two parallel lines between the incisal curvature of the maxillar anterior teeth with curvature of lower lip, if the two lines are not parallel, shows the non-consonant smile arc, if the two lines are parallel, shows the consonant smile arc.

Data analysis was done statistically using SPSS 17.0. To determine the correlation strength between the facial growth patterns and the smile arc (nominal data) the Chi-Square test was applied. The level of significance is $p<0.05$.

RESULTS

In this study, the male and female patients mostly have a vertical facial growth pattern compare horizontal facial growth pattern. This data can be seen in Table 1 and 2.

Furthermore, more the non-consonant smile arc was found in male patients; whilst in females, there were more consonant smile arc than the non-consonant type (Table 1-2). Both in male and female patients, positive parallel correlation between the facial growth pattern and the smile arc type were observed. The correlation strength between these two variables were 0.338 in males and 0.331 in female (Table 1-2), the p-values were 0.016 and 0.020 in males and females respectively.

DISCUSSION

From this study, the age of the patients ranged between 18 – 42 years old; the growth rate of the neurocranium are slowing down at the aged 14 – 17

Table 1. Results of correlation analysis of contingency coefficients between the facial growth pattern and the smile arc in males.

Facial growth pattern	Smile arc		Contingency coefficients (r-value)	p-value
	non-Consonant	Consonant		
Horizontal	19 (70.4%)	8 (29.6%)	0.338[a]	0.016[b]
Vertical	10 (34.5%)	19 (65.5%)		

a. There is a quite strong correlation between the facial growth pattern and the smile arc in males.
b. There is a significant correlation between the facial growth pattern and the smile arc in males with positive parallel correlation.

Table 2. Results of correlation analysis of contingency coefficients between facial growth pattern and smile arc in females.

Facial growth pattern	Smile arc		Contingency coefficients (r-value)	p-value
	non-Consonant	Consonant		
Horizontal	12 (63.2%)	7 (36.8%)	0.331[a]	0.020[b]
Vertical	10 (27%)	27 (73%)		

a. There is a quite strong correlation between the facial growth pattern and the smile arc in females.
b. There is a significant correlation between the facial growth pattern and the smile arc in females with positive parallel correlation.

years old than stabilized in 18 years old. The growth of maxillar and mandibullar of the splanchnocranium is steady at 15 and 17 in female and male respectively (Soetjiningsih, 1998; Rahardjo, 2008; Cobourne & Dibiase, 2010).

We observe that patients with horizontal facial growth pattern would have non-consonant whilst patients with vertical facial growth pattern would likely have a consonant smile arc. We found that there is a significant correlation between facial growth pattern and smile arc both in male and female patients. In previous study in India (2016), the facial growth pattern and the smile arc were also significantly correlated among 150 adult males and females (Siddiqui *et al*., 2016).

Correlation between the facial growth pattern and the smile arc are related to changes in the position of the posterior maxillar occlusal plane during growth (Wang *et al*., 2013). The position of the posterior maxillar occlusal plane is more inferior than anterior causing the ramus of the mandible to grow more vertical and results in a more flat plane of the mandible with an over bite in the anterior maxillar teeth. The misalignment between the curvature of the anterior maxillar teeth and the curvature of the lower lip viewed from frontal, result in a non-consonant smile arc (Sarver, 2001). The horizontal facial growth pattern would likely due to a more flat of the mandible cause by vertical of the ramus of the mandible (Wang *et al*., 2013).

In addition to facial growth patterns, the smile arc can also change after orthodontic treatment. In a study by Hulsey (1970), the incisial edge of maxillar anterior teeth was flat in patients who received orthodontic treatment. In a recent study, Ackerman *et al*. (1998) found that almost 40% received orthodontics treatment of the patients had visible change of the smile arc, with 32% had flattening of the smile arc; whilst in untreated patients the change in the smile arc was 13% with only 5% had a flattening smile arc. These may due to an over intrusion of maxillar incisor during orthodontic treatment. When maxillar incisor are over corrected in an over bite case without considering lip position at rest then the smile arc may become flatten (Zachrisson, 1998). Other factors include the position of the bracket which must be estimating the relationship between incisal edges to the lower lip curvature for each individual patient (Sabri, 2005).

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