ASSOCIATION OF SOFT TISSUE FACIAL FORM & DENTAL ARCH FORM: A CROSS SECTIONAL COMPARATIVE STUDY

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Abstract:

Objective: Clinical preformed arch wires are routinely used by the orthodontist irrespective of the face types which raises a question on post treatment stability, esthetics, and periodontal health. The purpose of this study was to find out the association between soft tissue facial form and arch form and to find out particular arch form for particular face form. *Material & Methods:* Three hundred untreated adults (140 males and 160 females) whose initial records were taken for orthodontic treatment were included in this study. Mean age of the patient was 20 ±4 years. The subjects were classified into three different groups on the basis of soft tissue facial form. Soft tissue facial form was determined using Adobe photoshop and each subject was assigned to one of the three group according to facial index. Arch form was determined by the of method occlusogram and arch forms were divided into three groups, tapered, ovoid and square.

Results: Regarding the distribution of facial form in the entire sample of 300 subjects, 39 percent of the individuals had mesofacial soft tissue facial form followed by dolichofacial (34%) and brachyfacial (27%). Considering the entire sample size, the most frequent arch form in maxilla was tapered and ovoid in mandible. In dolichofacial individuals the most predominant arch form was tapered while in brachyfacial individuals, square arch form was common. Mesofacial soft tissue facial form shows the predominance of both square and ovoid arch forms. The overall result shows a non-significant association between facial form and arch form. *Conclusion:* No significant association was found between soft tissue facial form and dental arch form.

Keywords: Soft tissue facial form, Arch-forms, OrthoformTM templates

INTRODUCTION

One of the most important aspects of orthodontic diagnosis and treatment planning is evaluation of individual facial type which in turn provides the clue regarding the growth pattern of the individual [1]. It is well documented in orthodontic literature that vertical skeletal growth pattern can determine the facial and arch form of the individual; that is subjects with steep mandibular plane angle tend to have long faces and narrow arches, and ones with flat mandibular plane often have short faces with wide arches but the association does not hold true among all cases [2–4].

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Dental arch form on the other hand has a multifactorial genetic trait that follows the underlying skeletal pattern and the potential effect of surrounding musculature to configure arch form [5]. Arch form has been also defined in the literature as position and relationship of teeth to each other in all three dimensions [6]. Many classifications have been reported in the literature to classify the dental arch form but usually they are tapered, oval or square [7–9]. Correct identification of individual arch form is necessary and maintenance of existing dental arch form is one of the important goals of orthodontic treatment to achieve the stable result [10].

A question that therefore arises is what the relationship between vertical skeletal growth pattern and dental arch form is. Several studies have been done in the past to address this question, but the results were very inconclusive. The classical study done by Howes [11] and Issacson et al [12] found that steep mandibular plane angle tends to have narrow arches and decreased intermolar width. According to Fida and Anwar, [13] a correlation exists between dental arch dimension and vertical skeletal pattern but particular arch form for particular face vertical pattern was considered in their study. Kageyama et al [14] reported that facial type can determine the dental arch form and when selecting preformed arch form orthodontist should respect the facial type, usually brachy-facial and hypodivergent faces tend to have broad dental arches while dolichofacial and hyperdivergent tends to have narrow arches. A research conducted on Southern European

population revealed that no preformed arch form exactly fits to the patients [15].

It is noteworthy that these classical studies correlate vertical skeletal pattern and dental arch form on lateral cephalogram. The limitation of lateral cephalometric radiography is that it lacks the most important third dimension that is facial breadth, neglecting facial soft tissue and surrounding musculature. Until 1960, it was believed that soft tissue is the reflection of underlying skeletal pattern but latter studies proposed that soft tissues have an independent growth and factors like the facial musculature, growth pattern and body mass index (BMI) have a potential effect on determining the facial and arch form of an individual [16]. Clinically preformed arch wires are routinely used by orthodontists irrespective of facial types which raises a question on post-orthodontic treatment stability, esthetics and periodontal health.

Previously the association between vertical facial pattern and various arch forms has been studied [11,15] but soft tissue facial form and dental arch forms has not been studied in orthodontic patients till date. Based on this premise, the aim of this study was to find out association between the soft tissue facial forms and dental arch forms in orthodontic patients and to find out a predominant arch form for particular soft tissue facial form.

MATERIAL & METHODS

This was a retrospective study carried out in the department of orthodontics at Sardar Begum Dental College & Hospital, Peshawar over a period of ten months from February 2021 to Dec 2021. Three hundred adults (140

males and 160 females) with the mean age of 20 ±4 years, whose initial records were included in this study. Inclusion criteria were full complement of teeth up to 2nd permanent molar, mild to moderate crowding, and age ranging from 12 to 35 years with no previous orthodontic treatment. Exclusion criteria included gross facial asymmetry, presence of dentofacial anomalies and previous maxillofacial trauma or craniofacial syndromes. The sample was selected and then for descriptive purposes, the subjects were assigned into three different groups on the basis of soft tissue facial form; that is brachyfacial, dolichofacial and mesofacial.

The soft tissue facial type was determined according to the facial index formula [17] using frontal facial photograph [18]. According to this method, soft tissue facial type is determined by calculating the ratio between bizygomatic width and anterior face height. Frontal facial photograph of each individual was put into ADOBE PHOTOSHOP (version 9.2). The above ratio was calculated, and then each subject was assigned to one of the three group according to facial index i.e., brachyfacial ratio smaller than 84.9, mesofacial ratio between 85 to 89.9 percent and dolichofacial greater than 90 percent [17]. **Figure 1.**
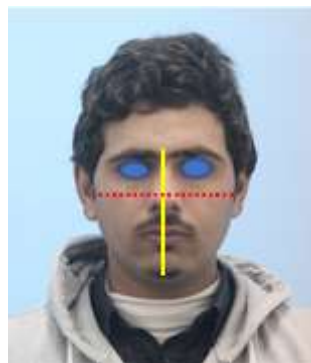

Figure 1. Soft tissue facial dimensions

Dental arch form was determined by the method of occlusogram [19]. Pretreatment dental cast of the same patient were obtained, buccal cusp of the posterior teeth and incisal edges of the anterior teeth on plaster model were marked with HB pencil. Acetate paper sheet were placed over the occlusal surface of the marked cast and then pressed gently over

the cast in order to facilitate and transfer the marks on acetate paper. The marks were then joined by HB pencil (0.7 mm) to give the arch from of individual. Three types of arch form were used to categorize the sample by overlay method i.e., ovoid, tapered, and square based on Chuck classification of arch form [7]. **Figure 2.**

Tapered arch form-OrthoForm™ I modified   Square arch form-OrthoForm™ II   Ovoid arch form-OrthoForm™ III
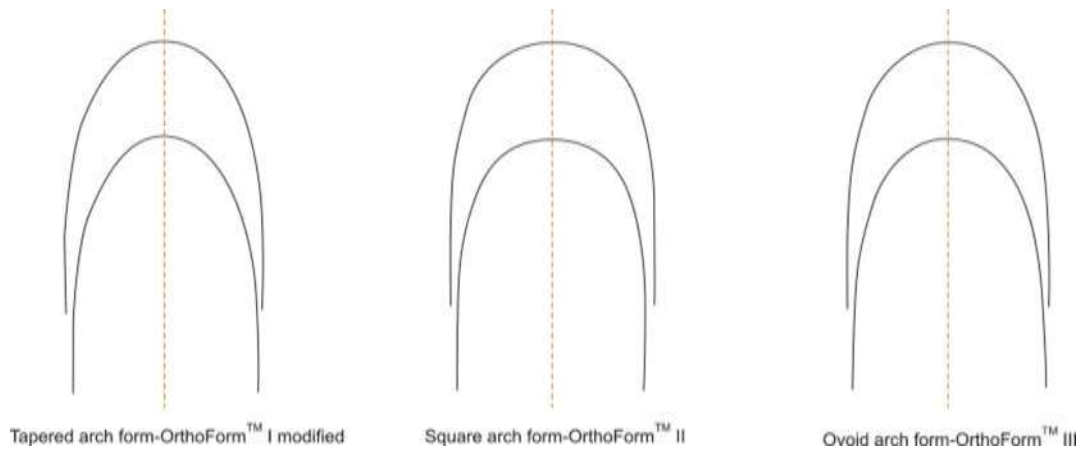
Figure 2- Types of Arch Forms™ (Orthoform templates by 3M Unitek)

All the individual arch forms were assigned into one of the three groups according to the above classification method. Obtained data was recorded on a data collection form designed for the study.

Statistical analysis

Data were Analyzed using IBM® SPSS® Statistics 23 (IBM, Armonk, NY, USA). Frequency and percentages were calculated for categorical data i.e., Gender, soft tissue facial form and arch. Mean and standard deviation were calculated for quantitative data i.e., Age.

Pearson chi squared test was used to find out association among soft tissue facial form and arch form.

RESULTS

Among 300 individual, 46.7 percent were males and 53.3 percent were females with the mean age of 20±4 years. Regarding the distribution of facial form in the entire sample size, 39 percent of the individuals had mesofacial form followed by dolichofacial and brachyfacial respectively. **[Table 1]**

Table I: Distribution of Soft tissue Facial Form Among the Sample

SOFT TISSUE FACIAL FORM	GENDER OF THE PATIENT		TOTAL
	MALE	FEMALE	
BRACHYFACIAL	36	45	81 (27%)
MESOFACIAL	62	55	117 (39%)
DOLICHOFACIAL	42	60	102 (34%)
TOTAL	140 (46.7%)	160 (53.3%)	300

Table 2 shows the distribution of maxillary arch form in various soft tissue forms. Ovoid arch form was common in mesofacial soft tissue facial forms. In dolichofacial the most predominant arch form was tapered (14%) whereas in brachyfacial group square arch form was more prevalent. Considering entire sample, the tapered arch form was more frequent in maxilla.

Table 2: Distribution of Maxillary Arch Form in Various Soft Tissue Facial Form.

SOFT TISSUE FACIAL FORM	ARCH FORM OF THE PATIENT			TOTAL
	SQUARE	OVOID	TAPERED	
BRACHYFACIAL	30 (10%)	24 (8%)	27 (9%)	81 (27%)
MESOFACIAL	40 (13.3%)	42 (14%)	35 (11.7%)	117 (39%)
DOLICHOFACIAL	27 (9%)	33 (11%)	42 (14%)	102 (34%)
TOTAL	97 (32.3%)	99 (33%)	104 (34.7%)	300

Table 3 shows distribution of mandibular arch form among various soft tissue facial forms. In dolichofacial individuals tapered arch form were seen with highest frequency followed by ovoid, whereas in brachyfacial and mesofacial the most frequent arch forms were square and ovoid respectively. Regarding the entire sample, the predominant arch form in mandible was ovoid followed by square arch form.

Table 3: Distribution of Mandibular Arch Form in Various Soft Tissue Facial Form.

SOFT TISSUE FACIAL FORM	ARCH FORM OF THE PATIENT			TOTAL
	SQUARE	OVOID	TAPERED	
BRACHYFACIAL	31 (10.3%)	25 (8.3%)	25 (8.3%)	81 (27%)
MESOFACIAL	41 (13.7%)	46 (15.3%)	30 (10%)	117 (39%)
DOLICHOFACIAL	31 (10.3%)	34 (11.3%)	37 (12.3%)	102 (34%)
TOTAL	103 (34.3%)	105 (35%)	92 (30.7%)	300

Association among facial forms with respective maxillary and mandibular arch form was determined using Pearson chi square test. The overall results showed non-significant association between soft tissue facial form and arch form in both the arches, as shown **Table 4**.

Table 4: Association of Soft Tissue Facial Form and Arch form

	Value	df	p-value
Maxillary Arch Form	4.403	4	0.354
Mandibular Arch Form	3.955	4	0.412

Test of Significance: chi-square test.
Level of Significance: less than 0.05.

DISCUSSION

Evaluation of individual face plays an important role in the diagnosis and treatment planning. It provides an idea about the underlying vertical skeletal growth pattern and arch form. Arch form is a multifactorial genetic trait and its characterization is desirable for space availability, esthetics and post treatment stability. The fundamental goal of orthodontic treatment is to maintain the pre-treatment arch form which leads to the post treatment stability; therefore, it is important that clinician should respect the arch form when selecting the preformed arch wires. The aim of this study was to find out a possible association between soft tissue facial form and dental arch form. Our result showed that 39 percent of the individuals had mesofacial soft tissue form followed by dolichofacial (34%) and brachyfacial (27%).

In dolichofacial soft tissue facial form, the most predominant arch form in maxilla was tapered (14%) followed by ovoid (11%) and square (9%). In mandible, the predominant arch form was tapered (12.3%) followed by ovoid (11.3%) and square (10.3%). However, the results were not statistically significant, but our results were in agreement with the classical studies done by Ricketts et al [2] and Issacson

et al [12]. They reported that tapered arch forms were predominant in dolichofacial pattern. However, in contrast to our findings, Fida and Anwar [13] reported that wide arches were pre-dominant in hyperdivergent facial pattern and narrow arches were found in both hypodivergent and normo-divergent individuals. A reason for this contrast was the small sample size. In recent study [20] done by south Indian population that dolichofacial usually have tapered arches. In our study no significant association was found that tapered arch form were associated with dolichofacial soft tissue facial form. Rationale for this contradiction could be a racial and ethnic difference. The probable cause of high variation in our sample are multiple epigenetic and environmental factors that come into play in the formulation of the ultimate arch form of an individual, and particular arch form for particular face is un-prevalent in nature.

High variability in arch forms were seen in brachyfacial sample with the highest prevalence of square arch form (10% and 10.3%) followed by ovoid (8% and 8.3%) and tapered (9% and 8.3%) in both maxilla and mandible. Although not statistically significant, our results are similar to the findings of Graber [21] who reported that brachyfacial individuals usually had square arch form. Recent study

[13] done on facial pattern and arch form does not support our findings. According to them wide arches were predominant in both dolichofacial & brachyfacial pattern. Rationale for this difference could be the scarcity of brachyfacial individuals in our sample. The relationship between arch form and soft tissue facial form still remains unclear. Formulation of arch form depends on diverse genetic, muscular and environmental factors and specific arch form could not be associated with facial type.

In mesofacial soft tissue facial form, it is interesting to note that ovoid arches were more prevalent in both maxilla (14%) and mandible (15.3%). This is contrary to the findings by Paranhos et al, [22] who reported that square arches were more prevalent in mesofacial form followed by ovoid and tapered. They concluded that ethnic differences influence the size and shape of the teeth and arches, and it is not recommended to consider any single form as ideal.

Considering the overall sample of 300 individuals, diverse variation of arch form was seen in all three soft tissue facial forms. The predominant form in maxilla was tapered (34.7%) followed by ovoid (33%). The predominant form in the mandible was ovoid (35%) followed by square (34.3%) shows the diversity of human dental arch form. This variability could be due to the fact that arch form depends on multiple genetic and environmental factors and the interplay between them causes formulation of the ultimate arch form of an individual, therefore, a particular arch form for the particular soft

tissue face could not be found from the present study results.

Based on our results, no significant association was found between soft tissue facial form and arch form. The use of soft tissue facial form as method to select arch form for a patient is not an appropriate method and individualized arch form for particular patient is the only way to avoid post treatment instability. Further research is required to associate soft tissue facial form and arch form using 3D technology.

CONCLUSION

No significant association was found between soft tissue facial form and dental arch form.

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