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RELATIONSHIP OF THE HORIZONTAL FACIAL DIMENSIONS WITH THE WIDTH OF PERMANENT MAXILLARY ANTERIOR TEETH

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ABSTRACT

To determine the correlation between the width of permanent maxillary anterior teeth and the horizontal facial dimensions. This cross-sectional descriptive study included 82 participants. The inclusion criteria were adult patients of both genders, with complete set and good alignment of maxillary anterior teeth. Data were collected for age, gender, facial dimensions, and dental widths. Vernier calliper was used to measure the mesiodistal width [MDW] of the maxillary anterior teeth and facial dimensions (inter-pupillary distance [IPD], inter-canthal distance [ICD], and bi-zygomatic width [BZW]). The student t-test was used to compare facial and dental measurements between genders, while the Pearson correlation test was used to determine the relationship between dental and facial dimensions. The mean age of the participants was 24.54±4.94 years, with 44 (53.66%) of them being females. Statistically, dental and facial dimensions were larger in males than in females (p<0.05). There was a moderately positive and significant correlation between the central incisor and IPD (r=0.54, p<0.001), as well as the lateral incisor with IPD (r=0.4, p<0.001), and the canine with IPD (r=0.54, p<0.001). The correlation between the central incisor and ICD was high, positive, and significant (r=0.71, p<0.001), and similar results were found for the canine with IPD (r=0.71, p<0.001). The correlation between dental widths and BZW was moderately positive and statistically significant. Facial parameters can be used to predict the maxillary anterior tooth sizes.

Keywords: *Facial dimension, tooth mesiodistal width, anterior teeth, maxillary arch*

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INTRODUCTION

The aim of orthodontic treatment is to achieve harmonious occlusion and an aesthetic smile.[1] Correcting malocclusion or anterior missing teeth, whether due to trauma or congenital causes, presents a significant challenge for orthodontists.[2] Missing or diminutive maxillary lateral incisors are not uncommon in orthodontics, and a proper treatment plan is necessary to achieve the best aesthetic and functional occlusion.[3] Achieving an ideal relationship between the anterior teeth is essential for ensuring postoperative function, stability, and aesthetics.[4] As a result, it is crucial to discuss with patients the proportion of anterior teeth and its significance in potential treatment plans and expected outcomes.[5]

In orthodontics, some guides are used to predict the size of missing or diminutive teeth like Golden's proportion. The golden proportion suggests that the width of the lateral incisor should be 62% of the width of the central incisor in a properly proportioned smile.[6]

Facial measurements have been explored as a means of deciding on the MDW of maxillary anterior teeth, given the visibility of face and the influence on social acceptance.[7] Not only does dental and facial appearance affect an individual's attractiveness to others, but it also contributes to their self-confidence. Therefore, to achieve optimal aesthetic outcomes, the width of maxillary anterior teeth must align with facial measurements.[8]

The maxillary anterior teeth width is a crucial factor

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in achieving optimal aesthetic outcomes in orthodontic treatment, particularly for patients with tooth loss or for malocclusions that affect the shape or size of these teeth. Facial measurements can be a useful guide in determining the appropriate dimensions of maxillary anterior teeth for each individual patient, taking into account their unique facial form.[9] This study aimed to evaluate the relationships between the maxillary anterior teeth measurements and certain horizontal facial parameters. The findings of this study may provide insights into customized orthodontic treatment planning that considers the individual's facial form, allowing orthodontists to achieve better aesthetic outcomes and patient satisfaction. The aim of this study thus was to determine the correlation between the width of permanent maxillary anterior teeth and the horizontal facial dimensions.

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted at the Orthodontics Department, Rehman College of Dentistry, Peshawar. Participants were enrolled in the study using a non-probability consecutive sampling technique. After explaining the study purpose and protocol to the study participants, verbal informed consent was obtained from them. Ethical approval was obtained from the ethical review committee of the institute (EC Ref no. RCD-06-23-146). The calculated sample was 82 using correlation calculator (http://sample-size.net/correlation-sample-size/) at α=0.05, power of study (1-β)=90% and correlation coefficient between the widths of maxillary anterior teeth and facial dimension (r=0.35) from previous study.[10]

The inclusion criteria were adult patients of both genders, with complete set and good alignment of maxillary anterior teeth. Individuals with the following problems in maxillary anterior segment were excluded: spacing, overlapping, missing or traumatized teeth, abnormal size, shape or form teeth, caries, proximal restorations, abrasion and attrition in the teeth. Individuals with facial malformations and increased intercanthal width whether associated with a systemic syndrome or due to trauma were excluded from this study. To obtain direct facial and dental measurements, each participant was seated upright with the teeth in centric occlusion, relaxed lips, and an unsupported head. They maintained a natural head position and looked straight ahead while a digital vernier calliper was used to measure the soft tissue points with minimal pressure, measuring to the nearest 0.01 mm. For every distance measured, three readings were taken and the average was recorded as the final measurement. Three horizontal facial measurements (Figure 1) were taken: bizygomatic width (a, green line), which is the distance between the most prominent points on the zygomatic arch on either side of the face; inter-canthal width (b, black line), which is the distance between the inner corners of the eyes; and inter-pupillary distance (c, red line), which is the distance between the centres of the pupils. Additionally, the maximum mesiodistal widths of the maxillary central, lateral, and canine teeth were measured.

Data analysis was done in R version 4.1.2. For all numerical variables, such as age, facial measurements, and dental widths, the mean with standard deviation (SD) was calculated. For qualitative variables, such as gender, the frequency with percentages was computed. Independent t test was run to compare facial and dental widths between genders. To determine the correlation between facial measurements and dental widths, a Pearson correlation test was conducted, with a significant level of P<0.001.

RESULTS

The data reveals that the participants had a mean age of 24.54±4.94 years, with a range from 21 to 30 years. Out of the total participants, 44 (53.66%) were female and 38 (46.34%) were male. The majority of participants fell into the 21-24 age group, with 53 (64.63%) individuals, while the 28-30 age group had the least number of participants at 11 (13.41%) (Table I).

According to the collected data, among dental measurements, the highest width was for the central incisor (9.55±1.76mm) followed by the canine (8.81±1.24mm) and least for the lateral incisor (7.27±1.63mm). Mean distances for inter-pupillary, inter-canthal, and bizygomatic were 70.06±15.10mm, 34.57±4.83mm, and 103.39±9.56mm, respectively (Table II).

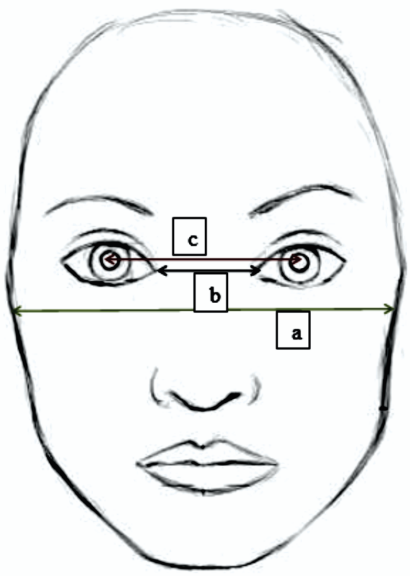

Fig 1: Facial measurements used in the study

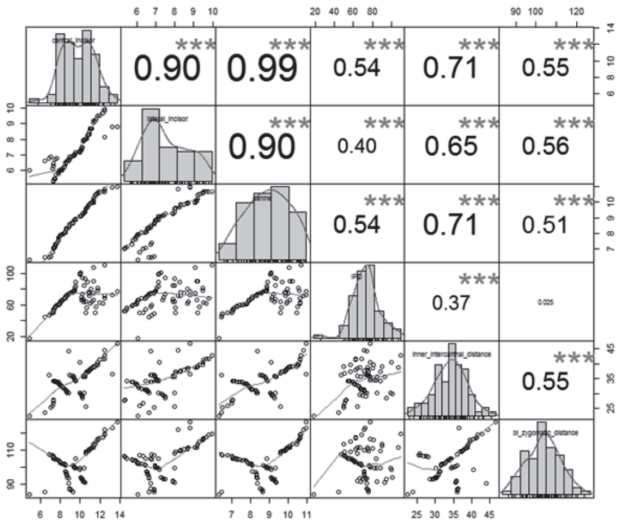

Fig 2: Correlation among facial measurements and dental widths

TABLE 1: DISTRIBUTION OF GENDER AND AGE OF THE PARTICIPANTS (N=82)

Variable	Characteristic	n(%)
Gender	Female	44 (53.66)
	Male	38 (46.34)
Age group	21-24	53 (64.63)
	25-27	18 (21.95)
	28-30	11 (13.41)

TABLE 2: MEAN VALUES OF DENTAL AND FACIAL MEASUREMENTS

Dental and facial measurements (mm)	Mean ±SD
Central incisor	9.55±1.76
Lateral incisor	7.27±1.63
Canine	8.81±1.24
Inter pupillary distance	70.06±15.10
Inner intercanthal distance	34.57±4.83
Bi-zygomatic distance	103.39±9.56

When the data comparing dental and facial measurement between genders were analysed, following results were obtained: the mean width of the central incisor was found to be significantly different between females (8.17 ± 0.96 mm) and males (11.14 ± 0.92 mm), with a p-value of <0.001. The mean width of the lateral incisor was also significantly different between females (6.92 ± 1.40 mm) and males (7.68 ± 1.79 mm), with a p-value of 0.038. However, the mean width of the canine was not significantly different between the two groups, with a p-value of 0.052. All three measurements were significantly different between females and males, with p-values of <0.001. Females had a smaller inter-pupillary distance (64.60 ± 12.82 mm) compared to males (76.37 ± 15.24 mm). Similarly, females had a smaller inner inter-canthal distance (32.51 ± 3.86 mm) compared to males (36.97 ± 4.77 mm). Finally, females had a smaller bizygomatic distance (99.63 ± 6.85 mm) compared to males (107.75 ± 10.46 mm) (Table III).

TABLE 3: SEXUAL DIMORPHISM FOR DENTAL AND FACIAL MEASUREMENTS

Dental and facial measurements (mm)	Female, n = 44 Mean ± SD	Male, n= 38 Mean ± SD	p-value*
Central incisor	8.17 ± 0.96	11.14 ± 0.92	<0.001
Lateral incisor	6.92 ± 1.40	7.68 ± 1.79	0.038
Canine	8.72 ± 1.13	8.90 ± 1.56	0.052
Inter pupillary distance	64.60 ± 12.82	76.37 ± 15.24	<0.001
Inner intercanthal distance	32.51 ± 3.86	36.97 ± 4.77	<0.001
Bi zygomatic distance	99.63 ± 6.85	107.75 ± 10.46	<0.001

*independent two samples t test

Fig 2 depicts a correlation plot among all dental and facial measurements. The correlation among dental widths was more than 90%, and it was statistically significant (p<0.001). The correlation between the central incisor and inter-pupillary- distance (IPD) was moderately positive and statistically significant (r=0.54, p<0.001). Similar results were found for the lateral incisor with IPD (r=0.4, p<0.001) and for the canine with IPD (r=0.54, p<0.001). The correlation between the central incisor and inter-canthal width was high, positive, and statistically significant (r=0.71, p<0.001). Similar results were found for the canine with IPD (r=0.71, p<0.001). The correlation between dental widths and bizygomatic widths (BZW) was moderately positive and statistically significant, i.e., central incisor vs. BZW (r=0.55, p<0.001), lateral incisor vs. BZW (r=0.55, p<0.001), and canine vs. BZW (r=0.51, p<0.001).

DISCUSSION

The objective of the study was to find out the correlation between the MDW of maxillary anterior teeth and the horizontal facial dimensions. Our findings indicate that there is a positive and statistically significant correlation between dental widths and facial

measurements. Specifically, we found a high correlation between the maxillary anterior teeth widths and ICW, and a moderate correlation between dental width and both IPD and BZW. These findings suggest that significant correlations exist between dental and facial measurements, which may have important implications for orthodontic treatment planning and diagnosis.

In this study, the researchers directly measured facial dimensions and mesiodistal dental widths. This was done because after growth completion, facial parameters do not change significantly, and dental widths remain constant as teeth do not grow mesiodistally after eruption.[10, 11] By directly measuring these parameters, the researchers were able to obtain more accurate and reliable data compared to using impressions, which can shrink or get distorted, and dental stone can also get fractured. Additionally, it is not practical to take impressions of facial tissue.[4]

Our findings show that dental and facial dimension were larger in males than in females, statistically. This finding suggests that there are inherent anatomical differences between males and females when it comes to dental and facial dimensions. These differences could be due to a variety of factors, including genetics, hormonal influences, and environmental factors. A retrospective study conducted on a group of 200 subjects, of which 50% were females, and aged between 18 to 30 years found that anterior teeth are larger in males than females.[12] Another study, using a sample of 180 subjects with an age range of 18 to 25 years, reported that statistically significant sexual dimorphism exists for all the teeth.[13]

The current study demonstrated a positive correlation between the size of maxillary anterior teeth and facial dimensions, with correlation coefficients ranging from moderate (r=0.54) to high (r=0.71). Interestingly, the findings of our study are supported by a previous study conducted on a similar population. This study reported a perfect correlation between facial dimension (IPD) and the width of the central incisor (r=0.99), lateral incisor (r=0.99), and canine (r=0.94).[14] These results suggest that there is a strong association between the size of maxillary anterior teeth and overall facial dimensions, which could be useful in dental and orthodontic treatment planning. Another study conducted in Iraq also reported moderate correlation (r=0.35) between anterior teeth width and the facial dimension.[10] However, study conducted in Karachi, Pakistan reported weak correlation between facial dimensions (IPD, ICD, and BZW) and maxillary central incisor.[9]

There are several limitations to this study that should be taken into consideration. Firstly, the study did not take into account the facial type of the participants, which could have had an impact on the results. Different facial types may have different dental and facial dimensions, which could have affected the strength and direction of the correlations observed. Secondly, the study was conducted in a hospital setting, which may limit the generalizability of the findings to the overall population. Participants in a hospital setting may not be representative of the general population in terms of their age, gender, and health status. Therefore, caution should be taken when extrapolating the findings of this study to the wider population. It is important to acknowledge these limitations as they may impact the external validity and generalizability of the findings. Further research, taking into account these limitations, is needed to confirm and expand on the findings of this study.

CONCLUSION

Within the limitations of this study, it can be concluded that there is a positive and statistically significant correlation between maxillary anterior dental widths and the horizontal facial measurements. Facial widths can be a useful guide in determining the appropriate dimensions of maxillary anterior teeth for each individual patient, taking into account their unique facial form.

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1 Aneela Nausheen:	Conceptualization, study design and methodology, data collection, manuscript writing, final revision
2 Faizan Ul Hassan:	Data collection, data analysis and interpretation, final revision
3 Amna Farrukh:	Manuscript preparation, referencing, critical revision
4 Salman Khan:	Manuscript preparation, critical revision