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Comparison of Chu's Probe Method with the Actual Dimension of Maxillary Anterior Teeth and Evaluation of Gingival Parameters in Individuals Who Do Not Need Orthodontic Treatment: Methodological Study

Ortodontik Tedavi İhtiyacı Olmayan Bireylerde Chu's Sondu Yönteminin Maksillar Anterior Dişlerin Gerçek Boyutları ile Karşılaştırılması ve Diş Eti Parametrelerinin Değerlendirilmesi: Metodolojik Çalışma

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ABSTRACT Objective: This study aims to compare the real width/length ratio of the maxillary anterior teeth with values obtained through Chu's probe and to assess periodontal parameters. **Material and Methods:** 128 individuals with Class I occlusion and no need for orthodontic treatment were included. Maxillary incisor width and length were measured using calipers and Chu's probe. Keratinised gingival height, pocket depth, gingival thickness and need for gingivectomy were also measured. Statistical analyses were performed using the independent samples t-test for continuous variables, the chi-squared test for categorical variables, and the kappa statistic for method comparisons. **Results:** No significant difference between methods was observed for each tooth. Highest keratinized gingiva amount was in upper left lateral incisor in females (5.141±1.46) and upper right lateral incisor in males (5.542±1.55). The tooth with the deepest pocket depth was upper left canine in females (2.301±0.54) and upper right canine (2.40±0.58) and upper left canine (2.40±0.63) in males. Thin phenotype was common in upper right lateral incisor in females (n=46), while thick phenotype was seen in upper right central incisor (n=30) and upper left lateral incisor (n=30). Teeth with highest and lowest gingivectomy needs were upper left canine in females (n=37) and upper right lateral incisor (n=11), and upper left central incisor (n=28) and upper left lateral incisor (n=10) in males, respectively. **Conclusion:** When the crown width-to-height ratio is 0.78 in terms of aesthetics, Chu's probe is practical in clinical use and gives similar results to caliper measurements.

Keywords: Esthetics; incisor

ÖZET Amaç: Bu çalışmanın amacı üst çene anterior dişlerin gerçek genişlik/uzunluk oranını ile Chu'nun sondu ile elde edilen değerlerle karşılaştırmak ve diş eti parametrelerin değerlendirilmesidir. **Gereç ve Yöntemler:** Çalışmaya ortodontik tedaviye ihtiyacı bulunmayan sınıf I oklüzyona sahip 128 birey dâhil edildi. Bireylerin maksiller kesici dişlerinin genişlik ve uzunlukları hem kumpas hem de Chu'nun sondu ile ölçüldü. Ayrıca ölçüm yapılan dişlerin keratinize diş eti yüksekliği, cep derinliği, diş eti kalınlığı ve gingivektomi ihtiyaçları belirlendi. Sürekli değişkenler bakımından bağımsız örneklem t-testi, kategorik değişkenler için ki-kare test, yöntemlerin karşılaştırılması için ise Kappa istatistik yöntemleri elde edilen verilerin istatistiksel karşılaştırılması için kullanıldı. **Bulgular:** Ölçümü yapılan her diş için yöntemler arasında istatistiksel olarak anlamlı bir fark gözlenmedi. En yüksek keratinize diş eti miktarı kadınlarda üst sol yan kesici dişte (5,141±1,46), erkeklerde ise üst sağ yan kesici dişte (5,542±1,55) gözlendi. Cep derinliğinin en yüksek olduğu diş, kadınlarda üst sol köpek diş (2,301±0,54), erkeklerde ise üst sağ köpek (2,40±0,58) ve üst sol köpek (2,40±0,63) dişleri oldu. Diş eti kalınlığı açısından, kadınlarda ince fenotip en çok üst sağ yan kesici dişte (n=46); kalın fenotip ise üst sağ orta kesici diş (n=30) ve üst sol yan kesici dişinde (n=30) gözlendi. Gingivektomi ihtiyacı en yüksek ve en düşük olan dişler sırasıyla kadınlarda üst sol köpek diş (n=37) ve üst sağ yan kesici diş (n=11), erkeklerde ise üst sol orta kesici diş (n=28) ve üst sol yan kesici diş (n=10) olarak bulundu. **Sonuç:** Estetik açıdan kron genişlik-yükseklik oranı 0,78 olduğunda Chu'nun sondu klinik kullanımda pratiktir ve kumpas ölçümlerine benzer sonuçlar verir.

Anahtar Kelimeler: Estetik; kesici

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Micro-aesthetic concepts are important for ideal facial aesthetics.[1] The width, height, and ratio of the upper incisors to each other are especially among the important determinants of facial aesthetics and symmetry.[2] Changes in the height and width of the teeth can be achieved by adding restorative material or by changing the gingival contours. However, changing the gingival contours and ensuring symmetry are priorities for achieving aesthetic goals. Notably, the width-to-height ratio of the upper incisors is very important for smile aesthetics.[3]

There are various opinions about the width and height of the upper incisors and the ratios of these values from the past to the present, such as the golden ratio, Preston ratio, golden percentage, and recurring aesthetic dental ratio.[4-7] Although these ratios represent mathematical expressions from art to architecture, studies from anthropology to facial aesthetics have indicated that these ratios may not be valid between the widths of the maxillary incisors.[8-11] The evaluation of these ratios is based on the visibility of the upper incisors from the frontal plane. However, criteria for ideal occlusion are important for orthodontists.[12] At this point, the mesiodistal widths of the teeth are important not only for aesthetic criteria but also for the ideal relationship of the teeth.[13]

When studies on the ratio of the mesiodistal width of the teeth to the height are analyzed, ratios between 0.62 and 0.86 have been reported.[4,14-17] Proffit et al. stated that the ratio of the mesiodistal width of the tooth to the height should be 0.8.[1] Chu and Hochman developed a probe with which the tooth width and height can be evaluated very simply in the clinic.[18] In their study, they reported that the central tooth width should be between 8 and 9 mm, the lateral tooth width should be between 6 and 7 mm, the canine tooth width should be between 7 and 8 mm, and the crown width-to-height ratio should not exceed 78%.[18] At this point, it should be evaluated not only after orthodontic treatment but also before orthodontic treatment, and the width-to-height ratios of the teeth and the need for treatment in soft tissues should be assessed.[1]

In light of this information, our study aimed to compare the width-to-height ratio of the upper incisors in the mouth with the data obtained with Chu's probe in individuals who do not need Angle class I orthodontic treatment and to determine the need for gingivectomy in incompatible teeth. The first null hypothesis (H0) of our study is expressed as follows: "There is no difference between the actual width-to-height ratio of the teeth and the values obtained with Chu's probe." The second H0 hypothesis of the study can be expressed as "There is no difference between the teeth in terms of surgery needs in maxillary anterior teeth according to width and height ratios".

MATERIAL AND METHODS

STUDY DESIGN

The sample size was calculated using the statistical package G-Power (G-Power 3, version 3.1.9.6, Heinrich-Heine University, Germany).[19] The sample size was determined as 128 individuals for each group when calculated using effect size of 0.25 and a power of 80%. Ethical approval for this study was obtained from Yüzüncü Yıl University Clinical Research Ethics Committee (date: 13.06.2022; decision no: 09). The study was conducted in accordance with the 1975 Helsinki Declaration, and informed consent was obtained from the individuals included in the study.

Individuals who had not previously received orthodontic treatment, who were in the permanent dentition period, who had skeletal and dental class I, who did not have maxillary anterior missing teeth, who did not have gingival or periodontal problems that would disrupt the relationship between teeth and surrounding tissues, who did not have crowding or diastema in their maxillary anterior teeth, and who had not had prosthetic or restorative intervention on their maxillary anterior teeth were included in the study. Individuals with congenital dental anomalies, filling, fracture or prosthetic restoration in the maxillary anterior teeth, erosion of the original tooth structure due to erosion, tooth grinding or clenching habits, any parafunctional habits any periodontal disease, previous periodontal surgery, gingival recession, maxillary anterior missing teeth, crowding, or diastema in the maxillary anterior teeth were excluded from the study.

METHOD OF MEASUREMENT OF DIMENSIONS OF MAXILLARY ANTERIOR TEETH

a. Use of the "T" Bar end of Chu's Aesthetic Proportion Gauges

The T-bar tip of Chu's aesthetic ratio gauge (Hu-Friedy, Chicago, IL) was used to intraorally measure the heights and widths of six maxillary anterior teeth (Figure 1). This gauge allows for the simultaneous measurement of height and width dimensions and has color-coded bands with a preset height/width ratio.[20] The T-bar has blue, red, and black vertical bars (height measurements) and a corresponding horizontal bar (width measurements). The bands are 1.5 mm thick and account for 78% of the recurrent aesthetic dental proportion. These bands are located 1 mm apart.

During the measurement, the head of each participant was noted while seated in the dental chair with the Frankfort horizontal plane parallel to the floor. A cheek retractor was used for visibility and accessibility. The color code corresponding to the distance from the cutting edge to the zenith point at the gingival margin was recorded as height. The color code corresponding to the width of the tooth in the horizontal direction was recorded as the width (Figure 1).

b. Use of Digital Calipers

The crown width and height of the maxillary anterior teeth were measured using a digital caliper (Mitutoyo Digimatic Caliper, Japan) calibrated in mm to an accuracy of 0.01 mm. When determining the height of the tooth, the distance from the cutting edge to the zenith point was considered. The amount obtained was noted as the clinical crown length. When measuring the width of the tooth, the mesiodistal distance, where the tooth was widest, was taken as a reference (Figure 2). Teeth with a mesiodistal width-to-height ratio between 0.71 and 0.82 were considered compatible.

FIGURE 1: Chu's probe used in the measurements and the width-to-length ratio measurement of tooth 21 with Chu' probe.

FIGURE 2: Callipers used in measurements and measuring the width-to-length of the tooth 21 with calipers.

CLINICAL PERIODONTAL PARAMETERS

The probable pocket depth (PD) of the maxillary 6 anterior teeth was measured at three sites (mesiobuccal, midbuccal, and distobuccal) and averaged. The amount of keratinized attached gingiva width (KAGW) was recorded as the highest distance from the mucogingival line to the gingival margin. Gingival thickness (GT) was categorized as thin or thick according to the visibility of the probe.[20-22] All parameters were recorded using a UNC-15 periodontal probe (Hu-Friedy, USA). Based on these values, each patient's need for gingivectomy or crown lengthening with resective bone surgery was assessed. Based on these assessments and tooth size measurements, we noted whether a "cosmetic crown lengthening operation" was required for any of the patient's six anterior teeth. Because if there is not enough PD, cosmetic crown lengthening operation may be preferred instead of gingivectomy to maintain biologic width or supracrestal tissue attachment. In case of insufficient KAGW, care should be taken in the amount of gingiva to be excised and even in this case, an apical positional flap may be preferred instead of gingivectomy to preserve the KAGW. Finally, if a cosmetic crown lengthening operation is to be performed, the thin or thick gingival phenotype is also a point to be considered in the flap elevation. In the process of deciding on the type of operation, these parameters were taken into consideration and measurements were made. Evaluation of Chu's probe, gingival width and height and clinical periodontal parameters were recorded by a periodontologist (…) for 7 years.

STATISTICAL ANALYSIS

Descriptive statistics for continuous variables were expressed as mean, standard deviation, minimum, and maximum values, whereas categorical variables were expressed as numbers and percentages. Shapiro-Wilk test was applied to evaluate the normality distribution of continuous variables. In terms of continuous variables, the Independent samples t-test was used in comparisons according to gender. A chi-square test was used to determine the relationship between categorical variables. In addition, the Kappa statistic was calculated to determine the agreement between the two methods. The statistical significance level was set to 5%, and the SPSS (IBM Corp. Armonk, NY, Ver: 21) statistical package program was used for calculations.

RESULTS

The number of individuals included and their mean age according to gender are presented in Table 1. There was no statistical difference between male (24.09±2.27) and female (23.98±2.03) subjects in terms of age (p=0.774). The width-to-height ratios of the teeth numbered 13, 12, 11, 21, 22, and 23 were found to be 0.98, 0.95, 0.95, 0.95, 0.97, and 0.98, respectively. According to the Shapiro-Wilk test, it was determined that these ratios were normally distributed.

The descriptive statistics and comparative results of the mesiodistal width, inciso-gingival height, and width-to-height ratios of the measured teeth according to the gender of the individuals are shown in Table 2. Whereas no statistically significant difference was observed in the width/height values of teeth 11, 12, 21, and 22 in terms of gender, a statistically significant difference was found in teeth 13 (female, W/L=0.83±0.08; male, W/L=0.79±0.08) and 23 (female, W/L=0.82±0.07; male, W/L=0.78±0.07) (p=0.016, p=0.001, respectively).

The frequencies, percentages, and comparative statistics of the number of congruences of the measured teeth according to the caliper and Chu's probe methods are presented in Table 3. No statistically significant difference was observed between the methods for each measured tooth.

The descriptive statistics of the KAGW and PD data according to gender are presented in Table 4. Accordingly, the tooth with the highest KAGW was tooth 22 (5.141±1.46) in females and tooth 12 (5.542±1.55) in males. The females had higher average KAGW than males in teeth 13, 11, 21, and 23. In terms of PD value, the teeth with the highest PD were tooth 23 (2.301±0.54) in females and teeth 13 (2.40±0.58) and 23 (2.40±0.63) in males.

Figure 3 shows the need for gingivectomy or resective crown length surgery and GT according to Chu's probe values for each tooth Figure 3. Shows that the thin phenotype was most common in tooth 12 (n=46) in females and tooth 23 (n=29) in males,

TABLE 1: Descriptive statistics of the research group and comparison of ages in terms of gender.

	Female			Male			
	n	X̄-SD	Minimum-maximum	n	X̄-SD	Minimum-maximum	p value
Age (Year)	64	23.98-2.03	21-29.5	64	24.09-2.27	21.08-29.05	0.774

Independent Samples-t test, p<0.05, SD: Standart deviation.

TABLE 2: Descriptive statistics of the width, length and ratio of width to length of the teeth measured.

		Female				Male				
		X̄	SD	Minimum	Minimum	X̄	SD	Minimum	Minimum	p value
13	W	7.41	0.48	6.61	8.98	7.96	0.68	6.46	9.51	**0.001***
	L	9.03	0.84	7.42	11.43	10.10	1.14	8.09	12.80	**0.001***
	W/L	0.83	0.08	0.69	0.99	0.79	0.08	0.62	0.98	**0.016***
12	W	6.35	0.82	4.93	9.53	6.41	0.92	4.26	9.97	0.682
	L	8.19	0.93	6.04	10.53	8.44	1.00	6.02	10.92	0.145
	W/L	0.78	0.13	0.57	1.17	0.76	0.10	0.59	1.07	0.333
11	W	8.28	0.55	7.35	9.96	8.59	0.57	7.50	9.82	**0.002***
	L	9.80	0.92	8.13	12.31	10.31	0.89	7.72	11.87	**0.002***
	W/L	0.85	0.10	0.68	1.23	0.84	0.07	0.69	1.01	0.360
21	W	8.25	0.53	7.35	9.48	8.64	0.52	7.66	9.90	**0.001***
	L	9.79	0.92	7.84	12.19	10.38	0.84	8.22	11.90	**0.001***
	W/L	0.85	0.09	0.68	1.08	0.84	0.07	0.69	1.02	0.335
22	W	6.24	0.56	5.14	7.46	6.48	0.81	4.17	8.14	0.057
	L	8.36	0.89	6.12	10.84	8.58	1.00	6.41	10.98	0.195
	W/L	0.75	0.09	0.55	0.98	0.76	0.09	0.61	0.96	0.675
23	W	7.44	0.45	6.63	8.82	7.95	0.72	6.17	9.68	**0.001***
	L	9.10	0.80	7.72	11.72	10.29	1.01	7.98	12.82	**0.001***
	W/L	0.82	0.07	0.67	1.00	0.78	0.07	0.65	0.93	**0.001***

*Independent samples t-test, p<0.05, W: Mesiodistal width of the tooth (mm); L: Length of tooth (mm); W/L: Ratio of tooth width to lenght; SD: Standart deviation; 13: Upper right canine; 12: Upper right lateral; 11: Upper right incisor; 21: Upper left incisor; 22: Upper left lateral; 23: Upper left canine.

TABLE 3: Frequencies and percentages of agreement and comparative statistics of the ratios of width to length of each of the teeth measured according to the various methods.

		Caliper (%)	Chu's gauge (%)	*K**
13	D	69 (53.9)	56 (43.8)	0.520
	H	59 (46.1)	72 (56,3)	
12	D	57 (44.5)	62 (48.4)	0.263
	H	71 (55.55)	66 (51.6)	
11	D	51 (39.8)	59 (46.1)	0.397
	H	77 (60.2)	69 (53.9)	
21	D	55 (43)	54 (42.2)	0.473
	H	74 (57)	74 (57.8)	
22	D	65 (50.8)	63 (49.2)	0.313
	H	63 (49.2)	65 (50.8)	
23	D	70 (54.7)	58 (45.3)	0.349
	H	58 (45.3)	70 (54.7)	

*Kappa coefficient, k<0.05, H: Harmonious; D: Disharmonious; 13: Upper right canine; 12: Upper right lateral; 11: Upper right incisor; 21: Upper left incisor; 22: Upper left lateral; 23: Upper left canine.

and the thick phenotype was most common in teeth 11 (n=30) and 22 (n=30) in females and tooth 21 (n=43) in males. In addition, when each tooth was compared separately, the number of teeth with a thick phenotype was higher in males than in females. Furthermore, when the need for tooth-based surgery was evaluated, the highest number of surgeries was required for tooth 23 (n=37) in females and tooth 21 (n=28) in males, and the lowest number was required for tooth 12 (n=11) in females and tooth 22 (n=10) in males.

In Table 5, the need for surgery was statistically compared between compatible and incompatible teeth for each tooth. No statistical difference was observed in tooth 22 (p=0.205). In teeth 12, 11, and 21, more compatible teeth were observed, and this difference was statistically significant (p=0.006, p=0.000, p=0.000, and p=0.000, respectively). In teeth 13 (n=69) and 23 (n=70), incompatible teeth were observed more, and this difference was statistically significant (p=0.000 and p=0.002, respectively).

DISCUSSION

The width-to-length ratio of the teeth is an important factor that determines microaesthetic concepts.[23] In recent years, instead of caliper measurements, probes

TABLE 4: Descriptive statistics of KAGW, PD, gingival thickness and need for gingivectomy according to gender.

		Female				Male			
		Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum
13	KAGW	5.09	1.49	2.00	8.00	4.70	1.28	2.00	7.00
	PD	2.12	0.57	1.00	3.00	2.40	0.58	1.00	3.60
12	KAGW	5.06	1.73	2.00	9.00	5.542	1.55	2.00	9.00
	PD	1.98	0.55	1.00	3.00	2.20	0.63	1.00	3.00
11	KAGW	4.92	1.37	3.00	8.00	4.90	1.33	2.00	8.00
	PD	2.20	0.76	1.00	5.00	2.27	0.62	1.00	3.00
21	KAGW	5.00	1.49	2.00	8.00	4.85	1.20	2.00	7.00
	PD	2.02	0.51	1.00	3.00	2.32	0.62	1.00	3.00
22	KAGW	5.141	1.46	2.00	8.00	5.25	1.44	3.00	9.00
	PD	2.248	0.58	1.00	3.00	2.37	0.65	1.00	3.30
23	KAGW	4.516	1.39	2.00	8.00	4.42	1.31	3.00	8.00
	PD	2.301	0.54	1.00	3.00	2.40	0.63	1.00	3.00

KAGW: Keratinized attached gingival width (mm); PD: Pocket depth (mm); SD: Standart deviation; 13: Upper right canine; 12: Upper right lateral; 11: Upper right incisor; 21: Upper left incisor; 22: Upper left lateral; 23: Upper left canine.

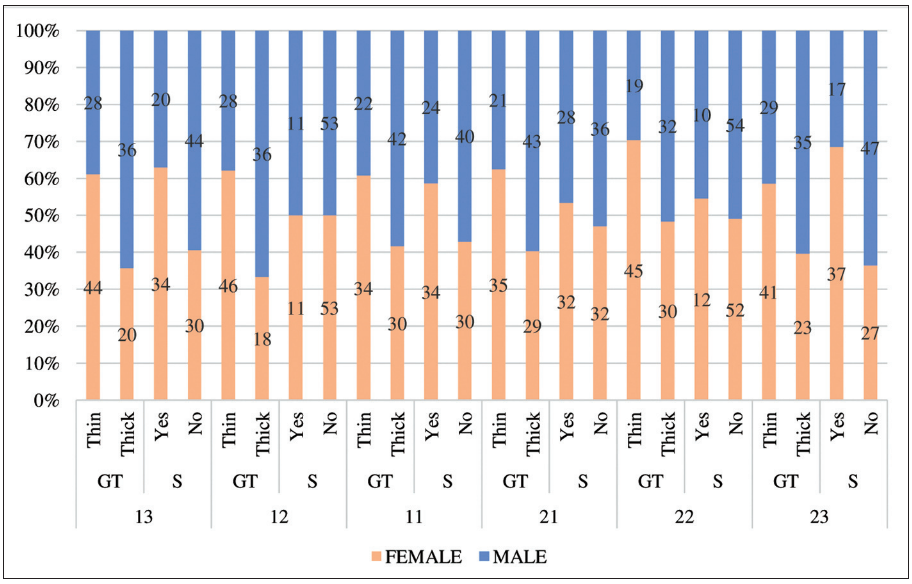

FIGURE 3: The frequencies of the measured teeth, gingival thickness and the need for surgery.
13: Upper right canine; 12: Upper right lateral; 11: Upper right incisor; 21: Upper left incisor; 22: Upper left lateral; 23: Upper left canine; GT: Gingival thickness; S: Surgery.

TABLE 5: Comparison of the width to length ratio of the measured teeth between compatible and incompatible teeth in terms of surgery.

	13		12		11		21		22		23	
	H	D	H	D	H	D	H	D	H	D	H	D
Surgery	59	69	71	57	77	51	73	55	63	65	58	70
p value	**0.000***		**0.006***		**0.000***		**0.000***		**0.205**		**0.002***	

Chi-square test. *p<0,05; H: Harmonious; D: Disharmonious; 13: Upper right canine; 12: Upper right lateral; 11: Upper right incisor; 21: Upper left incisor; 22: Upper left lateral; 23: Upper left canine.

that visually proportion numerical data in a clinically practical way have been developed.[18,24] Considering the findings of the current study, which aimed to obtain more practical data instead of caliper measurement, no statistically significant difference was observed between caliper measurement and Chu's probe method for each tooth measured. Therefore, the first H0 of our study was accepted. Our second hypothesis H0 is partially rejected.

The maxillary central incisor incisogingival height normally varies between 9 and 12 mm in adult individuals, with an average of 10.6 mm in males and 9.6 mm in females. Furthermore, the width-to-height ratio of the maxillary central incisor should be 0.8.[25] According to this ratio, the mesiodistal width of the central teeth should be 8.48 in males and 7.68 in females. An analysis of studies examining the width and length of maxillary incisors indicates that the minimum and maximum values are outside the values of 9-12 mm, but the average values are compatible with the above values.[26] Hasanreisoglu et al. evaluated the width and length of the upper incisors of 100 dental students in the Turkish population and reported that the central incisor width was found to be 8.6 mm, the lateral incisor 6.7 mm, and the canine 7.7 mm.[10] The findings regarding the lengths of the same teeth are compatible with the data in our study.

If the incisor positions and incisor appearance at rest are within the normal values and the patient has a gingival smile with a short clinical crown length, the crown height can be increased by gingivectomy to extend the clinical crown length.[27] In current practice, it is necessary to evaluate the teeth in terms of aesthetic criteria before or after orthodontic treatment, both at the beginning and end of the treatment. Chu's probe has been developed to make this evaluation practical in the clinic.[18] The width-to-length ratio of the upper incisors varies between 0.76 and 0.86.[14-16] In Chu's probe, this ratio is accepted as 0.78.[18] When measuring the width of the teeth, measurements using Chu's probe increase by 1 mm for each transversely colored band. When looking at the colors measuring height, measurements increase by 1 and 1.5 mm, respectively.

In our study, the specified ranges of Chu's probe were used as a basis to determine whether the teeth were congruent in the group measured with calipers. For example, if the mesiodistal borders of the teeth pass through the outer edge of the red band, the height should also pass above the red band. At this point, if the height was below the center of the red band, it was considered incompatible. Considering that the width was constant, half of the band thickness was subtracted from the band height (11 mm), and the tooth width was divided by the newly discovered height (10.25 mm) to obtain the maximum limit obtained according to Chu's probe. This ratio was 0.82. When the minimum limit was calculated with the same logic, the ratio was 0.71. Therefore, in our study, ratio values between 0.71 and 0.82 were accepted as compatible in individuals measured with calipers. In addition, Cooper et al.[28] stated that very long incisors (i.e., ratios of 0.70 and below) are the least attractive teeth, and the most attractive incisors have a ratio of 0.82. However, in current study, the maxillary incisors were observed between 0.76 and 0.84 in females and 0.75 and 0.85 in males.

Wang et al. reported that there was no difference in the dimensions of the teeth between the right and left, but this may be affected by gender and the ethnic structures of societies.[26] Therefore, we preferred to compare our measurements between men and women in our study. Although the width and height of the teeth varied according to ethnic groups, we observed that the averages were within the specified values. The width-to-height ratio of the teeth was found to be 0.79 in the study by George and Bhat in a south Indian population, 0.85 in the study by Orozco-Varo et al. in a European population, and 0.85 in the study by Sah et al. and statistically significant differences between the sexes were reported in these studies.[29-31] When the results of our study were examined, no difference was observed between males and females in terms of width, length, and width-to-length ratio in teeth 12 and 22, whereas a statistically significant difference was found in width and length in teeth 11 and 21 and in the width, length, and width-to-length ratio in canines.

Wagh et al. evaluated the width-to-height ratios in the maxillary anterior region with Chu's probe and a caliper and found that the most unaesthetic tooth was tooth 23 (43.75%), according to Chu's probe, and teeth 12 and 22 (85%), according to the caliper.[32]

In the current study, we observed a mismatch by evaluating the harmony of crown width and height, so the tooth that could not be accepted as the most aesthetic tooth was tooth 21, according to Chu's probe, and tooth 11, according to the caliper. In this respect, our study could not obtain parallel results with the mentioned study.

Resective periodontal surgical techniques, such as gingivectomy or crown lengthening surgery, which involve reshaping the tooth with bone, are operations performed to restore the normal gingival anatomy and improve gingival aesthetics. Patients may be referred for such operations to maintain periodontal health during orthodontic treatment, after orthodontic treatment, or with or without the need for orthodontic treatment to regenerate ideal width-to-height ratios to achieve an aesthetic smile.[33,34] In our study, the need for an operation, such as gingivectomy or resective crown length surgery, was evaluated for teeth that were incompatible in at least one of the two methods in patients who did not need orthodontic treatment. We found a statistically significant difference between congruent and incongruent teeth in terms of the need for surgery in teeth 12, 11, and 21, and the need for surgery tended to be higher in congruent teeth among these teeth. However, the need for surgery tended to be significantly higher in incompatible teeth in teeth 13 and 23. Accordingly, teeth with a higher tendency to be incompatible were canine teeth, regardless of gender. When the need for surgery was evaluated only according to Chu's probe, the highest number of teeth was 23 in females and 21 in males. To provide ideal aesthetics in these teeth, we recommend performing an aesthetic crown lengthening procedure using Chu's probe, as in the literature.[35]

The limitations of our study include the evaluation of class I individuals only, the limited sample size representing part of the geographical area, the practical use of the probe, and the visual judgment of the fit of the teeth.

CONCLUSION

The width-to-length ratio of maxillary incisors was observed between 0.75 and 0.85 in females and 0.76 and 0.85 in males.

There was no statistically significant difference between males and females in terms of the width-to-height ratios of teeth 12, 11, 21, 22, whereas a statistically significant difference was observed in teeth 13 and 23.

Considering a Chu's probe value of 0.78 is practical in clinical use and is consistent with caliper measurements. Therefore, Chu's probe can be used as a fast and easy method to achieve smile aesthetics for Angle class I individuals who do not need orthodontic treatment.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Murat Tunca, Dicle Altındal;* ***Design:*** *Yasemin Tunca, Dicle Altındal;* ***Control/Supervision:*** *Murat Tunca, Dicle Altındal;* ***Data Collection and/or Processing:*** *Dicle Altındal, Yasemin Tunca;* ***Analysis and/or Interpretation:*** *Yasemin Tunca;* ***Literature Review:*** *Dicle Altındal;* ***Writing the Article:*** *Murat Tunca, Dicle Altındal;* ***Critical Review:*** *Yasemin Tunca.*

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