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Comparative Analysis of Maxillary Central Incisor Width, Length, and Proportions between Genders

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ABSTRACT

Objective: To compare the width, length, and width-to-length ratio of the right and left maxillary central incisors between males and females.

Study Design: A cross-sectional study

Place and Duration of Study: Department of Prosthodontics, Saidu College of Dentistry, Saidu Sharif, Swat, Pakistan; from January 2023 to December 2023.

Materials and Methods: One hundred fifty participants (75 males; 75 females) were included. Mesiodistal width and gingivo-incisal length of right and left MCI were measured on casts using a digital Vernier caliper (0.01 mm). Group means were compared with independent-samples t-tests (two-sided $\alpha = 0.05$); Cohen's d and 95% CIs were reported.

Results: Males showed larger MCI dimensions than females. For the right MCI, width was 8.6 ± 0.4 mm in males vs 8.2 ± 0.3 mm in females ($p < 0.001$; $d = 0.89$), and length was 11.2 ± 0.5 mm vs 10.8 ± 0.4 mm ($p < 0.001$; $d = 0.82$). For the left MCI, width was 8.5 ± 0.4 mm vs 8.1 ± 0.3 mm ($p < 0.001$; $d = 0.87$), and length was 11.1 ± 0.5 mm vs 10.7 ± 0.4 mm ($p < 0.001$; $d = 0.80$). Differences in the W/L ratio were small (right: $p = 0.051$; $d = 0.32$; left: $p = 0.034$; $d = 0.35$).

Conclusion: Maxillary central incisors exhibit clear sexual dimorphism in size—males have broader and longer crowns—while the W/L ratio remains relatively stable between sexes, indicating maintained proportionality. These findings inform aesthetic tooth selection and forensic identification.

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Key Words
Lasers, Endodontic, Root Canal Therapy, Disinfection, Dentists, Attitude

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INTRODUCTION

Dentists have difficulty in manufacturing dentures that are both acceptable in functionality and aesthetics, especially during their selection of teeth in the aesthetic zone. Choosing the right size of the upper six front teeth is more critical because they play an important role in the attractiveness and self-esteem of a person, particularly in the area of dental aesthetics [1].

According to the Glossary of Prosthodontic Terms (GPT), dental aesthetics can be defined as the philosophy and theory of beauty in dentistry, specifically regarding form and/or color of a dental restoration, the subjective and objective elements and principles that inform the attractiveness and beauty of an object, design, or principle invented in dentistry [2]. The dental-facial appearance has a lot to do with the social attractiveness of an individual. In the case of patients having missing teeth in the aesthetic area, oftentimes, dentists find it difficult to offer restorations, which can be fixed or removable prosthesis.

In order to recover successfully, it is mandatory to determine the proportions of anterior teeth, especially the maxillary central incisor (MCI). MCI is an anterior segment that is one of the most visible teeth and has more control over the appearance of the smile. It is visible in complete visibility when it comes to a posed smile, and plays a significant role in facial aesthetics. Sexual dimorphism affects the differences in the length of teeth among populations that are mediated by a lot of different determinants, such as genetic, epigenetic, and environmental factors [3]. Studies indicate that gender, ethnicity, and the left, right-side symmetry of

the mouth may affect the dimensionality of the MCI, in addition to the method employed in the way it is measured. These factors are indicated in many works, and each of them has a different way of considering their effects on MCI dimensions [4].

Literature has suggested additional categories for dental-facial aesthetics. First, macro asthetics pertains to the face and its aesthetically proportionate harmony across many structural dimensions. Second, mini esthetics pertains to the visibility of teeth to viewers and their perception by observers. Third, micro esthetics encompasses the dental aspects, including the placement of teeth in the arch, as well as the proportionality of shade, form, and size.This study will adopt the Micro esthetics approach, particularly focusing on the dimensions (width, length, and width-length ratio) of MCI [5].Numerous studies have shown the influence of gender on width, length, and the width-length ratio, with varying results for the typical values of width, width-length ratio, and length for both male and female individuals [6, 7]. Some studies show that the width, length, and the width-length ratio of the MCI are influenced by gender, although there is an inconsistency in the results of typical values. A study conducted by Qamar et al. consisted of the measurement of the length of the MCI using a digital caliper and demonstrated statistically significant gender differences, where the average length of the MCI was 9.08 mm in males and 9.42 mm in females. Likewise, Botross et al.'s study recorded a mean length of MCI in males of 10.37 mm and females of 10.14 mm [8, 9]. The mean MCI width in males was 8.87 mm and 8.69 mm in females; in both males and females, the width-to-length ratio was equal to 0.86. Moreover, Alvarez-Alvarez et al. demonstrated that the width-length ratio was different in males and females with $p < 0.01$.

The objective of the current study is to examine the gender-specific variations in the width (Wd), length (L), and width-to-length (W/L) ratio of the MCI of patients at Bacha Khan College of Dentistry. The study will aid dentists in practice, both undergraduate and postgraduate dental students in choosing of suitable type of artificial MCI teeth in complete and removable partial denture based on both male and female patients. The purpose of the study is to enhance the knowledge about the discrepancy in the width, length, and width-length ratio of the MCI, which could benefit clinical practices.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Prosthodontics, Saidu College of Dentistry, Saidu Sharif, Swat, Pakistan; from January 2023 to December 2023, following the acquisition of approval from the institutional review board. A successive non-probability sampling method was employed to select participants.

The sample size was determined based on the prevalence data derived from the study by Qamar K et al., which reported a mean crown length of the maxillary right central incisor as 10.22 mm, a mean crown width of 7.99 mm, a standard deviation (SD) of 0.84 mm, and a crown width-length ratio of 0.91. Based on the findings of the study conducted by Khan et al. and the World Health Organization (WHO) sample size calculator, the calculated sample size was 150 patients with a 95% confidence interval and a 5%margin of error.

Inclusion Criteria

The inclusion criterion of the study was:

- Male and female individuals aged between 18 and 40 years,
- Participants with Angle Class I Occlusion and anterior permanent teeth,
- Patients with physically intact MCI(maxillary central incisors)from which accurate diagnostic casts can be made,
- Participants who have not undergone any restorations to MCI.

Inclusion Criteria

The exclusion criteria included:

- Individual with gingival alterations such as hyperplasia, inflammation, gingival recession, macrodontia, ormicrodontia,
- A history of periodontal surgery, any form of restorations associated with MCI, or trauma,
- Attrition, occlusal adjustments, intruded, extruded, or rotated MCI, malposition, or diastema,
- Prior orthodontic treatment, or the presence of supplemental or supernumerary teeth near the MCI.

Data collected was carried out using a customized proforma.For each patient, an impression of the maxillary arch was obtained using irreversible hydrocolloid material (alginate) in a metallic tray. The powder and liquid of the impression substance were combined according to the specified guidelines in a rubber bowl using a spatula.Preloading was performed to ensure precise measurement of interdental groove regions. Once the impression was removed from the mouth, it was carefully examined for any apparent faults. If any faults were observed, the impressionwas

repeated. To adhere to and uphold the disinfection protocols, impressions were rinsed with water, subsequently immersed in the disinfectant solution for one minute, gently rinsed again with running tap water, covered with damp cotton, and poured with dental stone within ten minutes in the laboratory. Upon the removal of the cast from the imprint, a subject number denoting (M) for male and (F) for female was inscribed on the cast using a permanent marker.The dimensions of the teeth weremeasured by the principal investigator using a digital Vernier caliper with a precision of 0.01 mm. The maximum mesiodistal width and the maximum gingiva-incisal length of teeth were recorded. The length, width, and width-length ratio values were measured in millimeters (mm) from the casts and documented in Table 1.

Data were analyzed utilizing the Statistical Package for Social Sciences (SPSS version 26). Descriptive statistics were reported for both categoricaland continuous variables. Mean ± S.D. was computed for quantitative factors such as age, length, width, and width-length ratio. Categorical characteristics, such as gender, were presented as frequency and percentage. Effect modifiers such as age, gender, and BMI were controlled throughstratification. Normality of each continuous variable within sex strata was assessed with the Shapiro–Wilk test, and homogeneity of variances was checked with Levene's test. For males vs. females, we used independent-samples *t*-tests (two-sided $\alpha = 0.05$). For each comparison we report the mean difference with its 95% confidence interval and Cohen's *d* (pooled SD). We pre-specified six primary comparisons (W, L, and W/L on right and left MCIs); no formal multiplicity adjustment was applied because outcomes were correlated and our inference emphasized effect sizes and CIs. Analyses were performed in SPSS v26. Units were millimeters (mm) for W and L; W/L is unitless.

RESULTS

The sample used in the study was 150 participants, of which there was an equal proportion of gender: 50% male (75 respondents) and 50% female (75 respondents). This balanced gender setting makes the study findings representative and applicable to both genders. The age bracket was very well balanced with three groups of participants, indicating that 33.3% of the participants belonged to the age category of 18-25 years, 33.3% belonged to the 26-30 years age category, and 33.3% belonged to the 31-35 years age category. This sampling gives a general picture of participants with all ages being broadly represented, and this increases the generalizability of the outcomes. In relation to the area of residence, 60% of the participants resided in urban areas and 40% resided in rural areas. This means that urban areas are better represented, but this does not decrease the level of diversity in geographical orientation, which can shape numerous socio-demographic variables. Regarding the dental arch type, a large percentage (66.7%) showed a normal arch, 20% presented with crowding, and 13.3% percent were showing spaced dentition. This morphological difference in the dental feature emphasises the natural variability of the sample population and the possible effect caused by the type of arch on the results of the study.

Table 1: Demographic Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	75	50.00%
	Female	75	50.00%
Age Group (Years)	18-25	50	33.30%
	26-30	50	33.30%
	31-35	50	33.30%
Region	Urban	90	60.00%
	Rural	60	40.00%

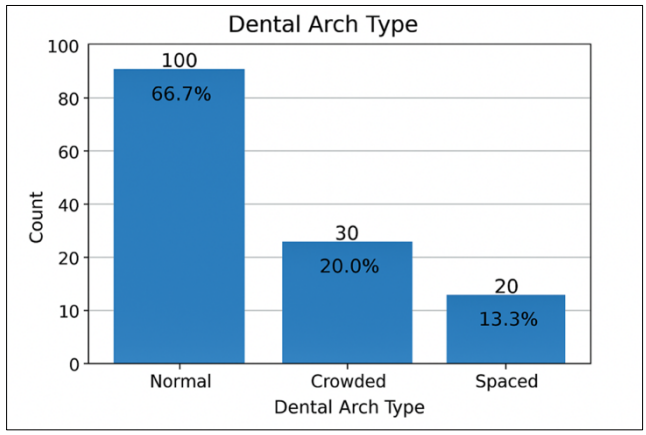

Figure 1: Distribution of Dental Arch Types in the Sample (n = 150)

Bars display percentage of participants with normal, crowded, or spaced arches; axis labels and legend as shown.

The findings demonstrate that males typically possess larger maxillary central incisors than females in terms of both breadth and length. The breadth of the right maxillary central incisor (MCI) was greater in males (8.6 ± 0.4 mm) than in females (8.2 ± 0.3 mm), and the length of the right MCI was also larger in males (11.2 ± 0.5 mm) compared to females (10.8 ± 0.4 mm). A comparable trend was noted for the left MCI, with

men exhibiting a mean width of 8.5 ± 0.4 mm and a length of 11.1 ± 0.5 mm, whereas females displayed a width of 8.1 ± 0.3 mm and a length of 10.7 ± 0.4 mm. Notwithstanding these size discrepancies, the width-to-length (W/L) ratio exhibited relative consistency between genders, with negligible fluctuations (right MCI: Male = 0.77 ± 0.02, Female = 0.76 ± 0.02; left MCI: Male = 0.76 ± 0.02, Female = 0.75 ± 0.02). The data indicate that although males possess larger incisors, the proportionate morphology is consistent across genders.

Table 2: Descriptive Statistics

Variable	Gender	Mean ± SD (mm)	Min	Max
Right MCI Width	Male	8.6 ± 0.4	7.8	9.2
	Female	8.2 ± 0.3	7.6	8.8
Right MCI Length	Male	11.2 ± 0.5	10.5	12.1
	Female	10.8 ± 0.4	10	11.7
Right MCI W/L Ratio	Male	0.77 ± 0.02	0.74	0.8
	Female	0.76 ± 0.02	0.73	0.79
Left MCI Width	Male	8.5 ± 0.4	7.7	9.1
	Female	8.1 ± 0.3	7.5	8.7
Left MCI Length	Male	11.1 ± 0.5	10.4	12
	Female	10.7 ± 0.4	9.9	11.6
Left MCI W/L Ratio	Male	0.76 ± 0.02	0.73	0.79
	Female	0.75 ± 0.02	0.72	0.78

Descriptive statistics for MCI dimensions by sex (mean ± SD). Units in mm except W/L (unitless). n = 75 per sex.

Abbreviations: MCI, maxillary central incisor; W, width; L, length; W/L, width-to-length ratio.

Table 3 demonstrates that males have significantly larger maxillary central incisors (MCI) compared to females in both breadth and length for both the right and left incisors. The MCI width was substantially greater in males (8.6 ± 0.4 mm) compared to females (8.2 ± 0.3 mm), with a t-value of 5.23 and a p-value < 0.001, indicating a large effect size (Cohen's d = 0.89). The right MCI length was considerably greater in males (11.2 ± 0.5 mm) compared to females (10.8 ± 0.4 mm), yielding a t-value of 4.85, $p < 0.001$, and a substantial effect size (d = 0.82). The left MCI breadth and length had a similar pattern, demonstrating considerably greater values in males ($p < 0.001$) with substantial effect sizes (d = 0.87 and 0.80, respectively). The changes in the width-to-length (W/L) ratios were less prominent, with no significant difference observed for the right MCI ($p = 0.051$, small effect size d = 0.32), whereas the left MCI W/L ratio exhibited a minor but statistically significant difference ($p = 0.034$, d = 0.35). The findings indicate that although males have considerably larger MCI, the proportional width-to-length ratio remains relatively consistent across genders, highlighting sexual dimorphism in incisor size but not in morphology.

Table 3: Results of Independent T-Test

Variable	Gender	Mean ± SD	t-value	p-value	Effect Size (Cohen's d)
Right MCI Width	Male	8.6 ± 0.4	5.23	<0.001**	0.89 (Large)
	Female	8.2 ± 0.3			
Right MCI Length	Male	11.2 ± 0.5	4.85	<0.001**	0.82 (Large)
	Female	10.8 ± 0.4			
Right MCI W/L Ratio	Male	0.77 ± 0.02	1.97	0.051	0.32 (Small)
	Female	0.76 ± 0.02			
Left MCI Width	Male	8.5 ± 0.4	5.08	<0.001**	0.87 (Large)
	Female	8.1 ± 0.3			
Left MCI Length	Male	11.1 ± 0.5	4.72	<0.001**	0.80 (Large)
	Female	10.7 ± 0.4			
Left MCI W/L Ratio	Male	0.76 ± 0.02	2.15	0.034*	0.35 (Small)
	Female	0.75 ± 0.02			

Table 3. Independent-samples t-tests comparing males and females. Mean ± SD shown for context; t, p-value (two-sided), 95% CI of the mean difference, and Cohen's d reported. n = 75 per sex.
Significance: $p < 0.05$. Effect size interpretation: small (~0.2), medium (~0.5), large (≥0.8).

For all pairwise comparisons, $n = 75$ males and $n = 75$ females. Values are reported as mean ± SD and rounded to one decimal place for millimeter measures.

Abbreviations: MCI, maxillary central incisor; W/L, width-to-length ratio.

DISCUSSION

The present study compared the width, length, and width-to-length ratio of maxillary central incisors (MCI) in males and females. The findings demonstrate that males have significantly larger crown dimensions in terms of both width and length, while the width-to-length (W/L) ratio remains relatively stable across genders. This indicates that although sexual dimorphism exists in the size of MCI, the proportionality of the crown is preserved. These results are consistent with prior literature reporting sexual dimorphism in tooth dimensions [10, 11].

Qamar et al. reported a significant difference in MCI length between males and females, with mean values of 9.08 mm and 9.42 mm, respectively, using digital caliper measurements on casts [12]. Similarly, Alvarez-Alvarez et al. demonstrated a significant gender-related difference in the W/L ratio ($p < 0.01$) [13]. In agreement with the present study, Botross et al. observed that males exhibited greater crown length (10.37 mm) and width (8.87 mm) compared to females (10.14 mm and 8.69 mm, respectively), while the W/L ratio (0.86) showed minimal variation between sexes [14, 15].

The current findings are also in line with Cinelli et al., who reported differences in dental proportions between men and women, and Bakhtawer Saleem et al., who found that males generally exhibited greater crown breadth and length, although the W/L ratio remained consistent [16–20]. Chan et al. similarly concluded that while MCI dimensions were larger than lateral incisors and canines in both genders, proportional differences between right and left sides were not statistically significant [21–25].

Overall, this study's findings confirm that gender influences MCI dimensions while maintaining proportionality. This has important clinical implications for prosthodontics, esthetic dentistry, and forensic odontology, where accurate knowledge of tooth dimensions aids in diagnosis, treatment planning, and identification.

Limitations

This study has some limitations. The sample was derived from a single-center, regional population, which may limit the generalizability of the results. The use of a non-probability sampling technique may also introduce selection bias. In addition, although alginate impressions and digital Vernier calipers were used under standardized protocols, these methods may not be as precise as intraoral scanners or rubber-based impression materials. Future research with larger, multi-center samples and advanced digital measurement methods is recommended to validate and extend these findings.

CONCLUSION

This study confirms significant sexual dimorphism in the size of maxillary central incisors, with males having greater mesiodistal width and gingivo-incisal length than females. In contrast, the width-to-length ratio remains consistent across genders, indicating preserved proportionality despite size differences. These results are of practical significance for prosthodontic tooth selection, orthodontic planning, and forensic dentistry, where precise dimensional knowledge is essential.

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AUTHOR'S CONTRIBUTION

AU: contributed to the study design and literature review, and critically revised and finalized the manuscript for submission.
SR: was responsible for data collection and organization.
AU: conducted data analysis and interpretation.
SR: assisted in drafting the manuscript and preparing figures or tables.
All authors reviewed and approved the final manuscript.

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