Submitted: Nov 25, 2025 | Accepted: Dec 23, 2025
Vol. 8/No. 2/July-December, 2025 Original Article

Comparative Study to Evaluate the Width of Maxillary Anterior Teeth and Skull Circumference among Male and Female Visiting College of Dental Surgery, BPKIHS

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ABSTRACT

Introduction: Restoring maxillary anterior teeth in edentulous patient without pre-extraction records is often challenging. Skull circumference has been proposed as a guide for selecting maxillary anterior teeth; however, its relationship appears to differ across gender and population. The objective of this study is to compare the width of maxillary six anterior teeth and skull circumference among males and female visiting College of Dental Surgery, BPKIHS, in eastern Nepal.

Methods: Maxillary anterior teeth width and skull circumference of 470 participants (235 males and 235 females) above 18 years were measured using digital Vernier caliper and measuring tape, respectively. Mann-Whitney U test, Kruskal-Wallis test and Spearman's correlation test were applied to assess gender and ethnic differences and correlations, respectively.

Results: Significant gender difference was found in the width of six maxillary anterior teeth ($p<0.001$) and skull circumference ($p<0.001$). Across ethnic/caste group, only skull circumference differed significantly ($p=0.011$). Tooth width correlated with skull circumference in the total population ($r=0.26$, $p<0.001$) and in females ($r=0.18$, $p=0.005$).

Conclusion: Maxillary anterior teeth width and skull circumference vary with gender and ethnicity. Skull circumference can be used as a reliable guide for selecting anterior teeth in edentulous Nepalese populations.

Keywords: Esthetics; Skull circumference; Width; Maxillary anterior teeth.

INTRODUCTION

In prosthodontics, achieving optimal esthetics and function relies heavily on understanding craniofacial anatomy and its influence on dental structures.[1] The maxillary anterior teeth are particularly important as they significantly affect smile, speech, and overall facial harmony.[2,3] Various studies have explored association between tooth and cranial measurements, proposing anthropometric guidelines for artificial teeth selection.[4-7] However, skull circumference remains a relatively underexplored parameter in relation to maxillary anterior teeth size. Notably, sexual

Conflict of Interest: None

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dimorphism in craniofacial anatomy can influence teeth proportions, thereby impacting denture fabrication, esthetic restoration and rehabilitation.[8,9] Thus, establishing population- and gender- specific reference are necessary to ensure predictable outcomes.[10,11]

Sears (1941)[12] suggested that the maxillary anterior teeth width could be estimated using head circumference, yet evidence supporting this relationship remains limited, particularly among Nepalese population. This study compares the relationship between two genders and secondarily explores ethnic variation to provide a potential guide for prosthodontic treatment planning.

METHODS

An observational comparative study was conducted at the College of Dental Surgery, BPKIHS, Dharan, including 470 participants (235 males and 235 females) selected through non-probability purposive sampling. Ethical approval was obtained from the IRC (Ref. No. 245/077/078-IRC) and Thesis Protocol Evaluation Committee (Ref. No. Acd/596/077/078) of BPKIHS, and written informed consent was obtained from all participants.

Participants selected were above 18 years of age and had intact bilateral maxillary central and lateral incisors and canines, Class I canine occlusion, fully erupted and healthy periodontium, and caries-free, non-attrited teeth. Exclusion criteria included diastema, developmental facial or cranial abnormalities, fractured or restored anterior teeth, microdontia, peg-shaped lateral incisors, anterior spacing, or unwillingness to provide consent.

Sample size was calculated based on data from Deogade et al.[14] at a 95% confidence level and 80% power, with an additional 10% to account for non-response. Ethnicity and caste were recorded by self-report and verified against the Central Bureau of Statistics classification[15] (Table 1); any discrepancies were resolved through investigators consensus.

Maxillary anterior teeth width was measured intraorally with a calibrated digital Vernier caliper (Insize 1112-2000, with a precision 0.01 mm) as the greatest mesiodistal crown width of each central incisor, lateral incisor, and canine, with the six measurements summed for total width (Figure 1). Skull circumference was recorded with a non-stretchable measuring tape placed over the supraorbital ridge and glabella anteriorly and occipital prominence posteriorly, ensuring skin contact (Figure 2). All measurements were taken twice by a single examiner, and mean values were used.

All collected data were tabulated in Microsoft Excel software (2013) and statistical analysis was done using 11.5 version of Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL). The assumption of normality was tested using Shapiro-Wilk and Kolmogorov-Smirnov tests. The tests indicated that the data did not follow a normal distribution ($p<0.05$).

The analysis done were Mann–Whitney U test for gender comparisons, Kruskal–Wallis test for ethnic group comparisons, chi-square test for left–right differences, and Spearman's rank-order correlation for assessing relationships between teeth width and skull circumference, with a significance level of $p \leq 0.05$.

RESULTS

The enrolled participants consisted of 235 males, 235 females with a mean age 31.50 ± 12.42 years with no significant age difference between genders ($p>0.05$). Most participants belonged to Hill Adibasi/Janajati (41.7%) and Hill caste-origin groups (38.5%), with no participants from the Madhesi low caste group (socio-economic level 3) (Figure 3).

Intra-examiner reliability was excellent, with Intraclass Correlation Coefficient (ICC) values >0.98 for all measurements.

The median width of the six maxillary anterior teeth was significantly greater in males (49.00 mm, interquartile range (IQR) 46.38–51.00) than in females (47.00 mm, IQR 45.04–49.00) ($p < 0.001$). Similarly, median skull circumference was larger in males (562.00 mm, IQR 554–570) than in females (545.00 mm, IQR 531–555) ($p < 0.001$). However, the ratio of skull circumference to anterior teeth width showed no significant gender difference ($p = 0.655$). (Table 2).

Ethnic group comparisons (Table 3) revealed no significant differences in anterior teeth width ($p = 0.430$) or the skull-to-tooth ratio ($p = 0.680$), but skull circumference differed significantly across ethnicities ($p = 0.011$). No significant left–right differences (Table 4) were observed for central incisors ($p = 0.107$), lateral incisors ($p = 0.572$), or canines ($p=0.903$) in either gender.

In the total population, a weak but statistically significant positive correlation was found between anterior teeth width and skull circumference ($r = 0.257$, $p < 0.001$). In females, this correlation remained significant ($r = 0.182$, $p = 0.005$), whereas in males it was not statistically significant ($r = 0.096$, $p = 0.143$) (Table 5).

Table 1: Ethnic/Caste groups of Nepal based on nine broad cultural categories

S. No.	Broad cultural groups
1.	Caste – Origin:Hill groups
2.	Hill Adibasi/Janajati groups
3.	Hill Low caste or Dalits
4.	Madhesi caste origin groups (socio-economic level 1)
5.	Madhesi caste-origin groups (socio-economic level 2)
6.	Madhesi low caste groups (socio-economic level 3)
7.	Madhesi (Tarai) Adibasi/Janajati groups
8.	Musalman (Muslim)
9.	Other cultural groups
10.	Unidentified (noted within these broad cultural categories)

Table 2: Comparison of Maxillary Six Anterior Teeth Width, Skull Circumference, and Their Ratio Between Males and Females:

Variable	Male		Female		*p*-value	Remark
	Median (mm)	IQR (mm)	Median (mm)	IQR (mm)		
Width of maxillary six anterior teeth	49.00	46.38 – 51.00	47.00	45.04 – 49.00	<0.001*	S
Skull circumference	562.00	554.00 – 570.00	545.00	531.00 – 555.00	<0.001*	S
Ratio of skull circumference to width of six maxillary anterior teeth	11.49	10.94 – 12.10	11.51	11.01 – 12.13	0.655	NS

*Statistically significant difference found ($p<0.05$).
Mann–Whitney U-Test applied.
S = Significant; NS = Not significant.

Table 3: Comparison of Maxillary Six Anterior Teeth Width, Skull Circumference, and their Ratio between nine different ethnic/caste groups.

Ethnic/caste groups	Width of maxillary anterior teeth (mm)	Skull circumference (mm)	Ratio skull circumference to width of six maxillary anterior teeth
Caste – Origin: Hill groups	47.74	555.00	11.62
Hill Adibasi/Janajati groups	48.52	557.00	11.38
Hill Low caste or Dalits	47.74	549.00	11.87
Madhesi caste origin groups (socio-economic level 1)	47.89	540.50	11.41
Madhesi caste-origin groups (socio-economic level 2)	48.00	546.00	11.44
Madhesi (Tarai) Adibasi/ Janajati groups	47.54	539.00	11.53
Musalman (Muslim)	47.00	534.00	11.68
Other cultural groups	49.55	548.50	11.52
***p*-value**	0.430	0.011*	>0.05

*Statistically significant difference found ($p<0.05$).
Kruskal- Wallis Test

Table 4: Difference in tooth width in left and right sides in relation to gender.

Variables		Male	Female	Total	*p*-value	Remark
Difference in width of left and right central incisors	Present	26	38	64	0.107	NS
	Not Present	209	197	406		
Difference in width of left and right lateral incisors	Present	47	52	99	0.572	NS
	Not Present	188	183	371		
Difference in width of left and right Canine	Present	41	40	81	0.903	NS
	Not Present	194	195	389		

NS = Not significant
Statistically significant difference, p-value<0.05

Table 5: Correlation between variables in aspect of gender and total population.

		Skull circumference		
		Total population	Female	Male
Total width of maxillary anterior teeth	Spearman's Rank-Order Correlation (r)	0.257**	0.182**	0.096
	Sig. (2-tailed)	<0.001	0.005	0.143
	N	470	235	235

**Correlation is significant at the 0.01 level (2-tailed).

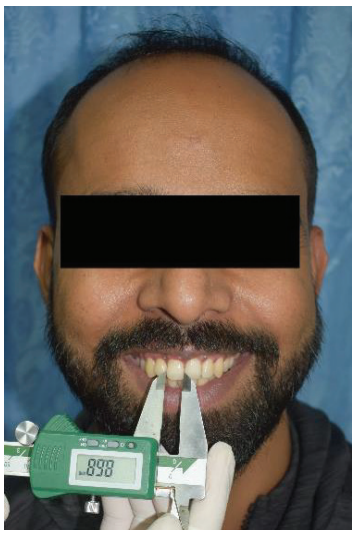

Figure 1: *Measurement of anterior teeth by digital vernier caliper.*

Figure 2: *Measurement of skull circumference with the help of non-stretchable measuring tape.*

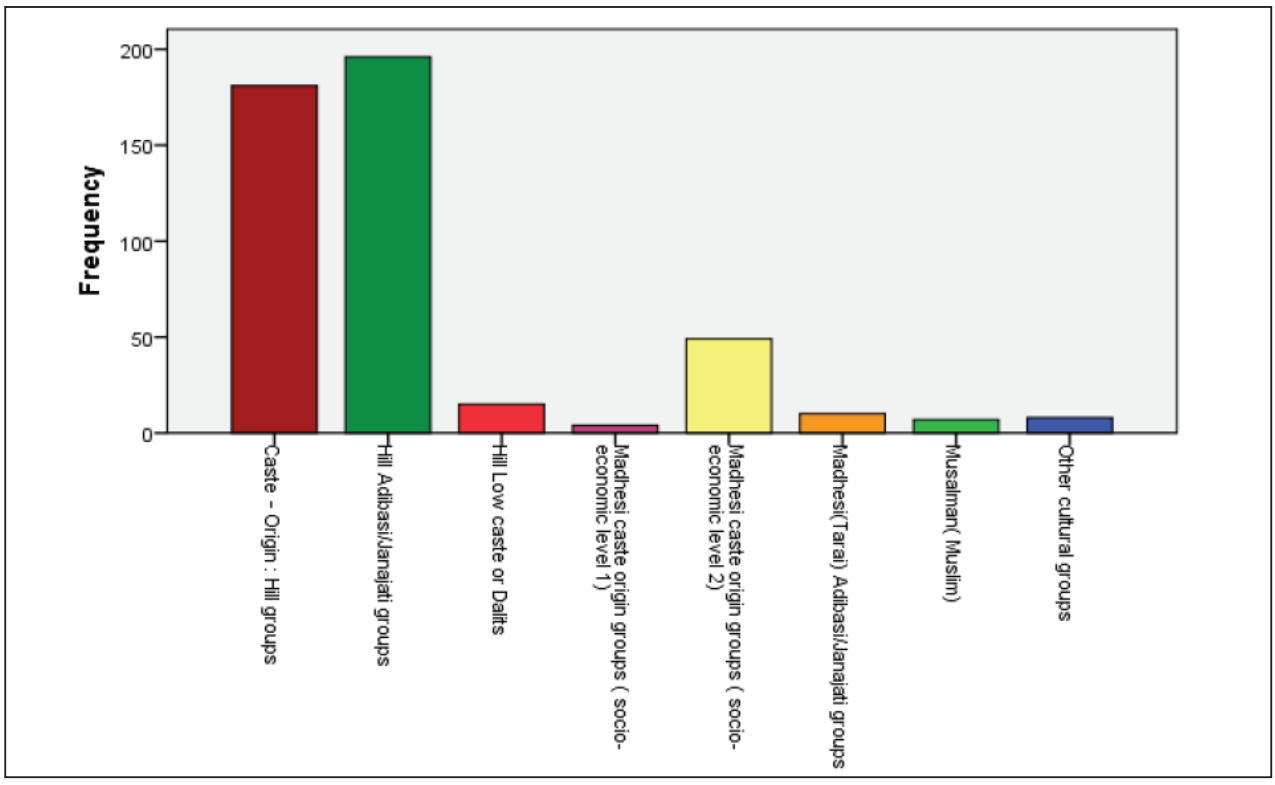

Figure 3: *Participants belonging to different ethnic/caste groups.*

DISCUSSION

This study aimed to compare the width of six maxillary anterior teeth and skull circumference among male and female Nepalese subjects, in line with Sears' (1941) assertion that larger teeth develop in larger heads. Sears proposed a formula dividing horizontal skull circumference by 13 to estimate upper anterior teeth width, highlighting its relevance in selecting teeth for edentulous patients. He also noted that male upper anterior teeth are broader than female teeth.[12]

Our findings support the rejection of the null hypothesis, indicating a relationship between maxillary anterior teeth width and skull circumference. The study included 470

participants (235 males, 235 females), aged 18–73 years, with mean ages of 31.84 ± 12.42 years (males) and 31.17 ± 12.43 years (females). Skull circumference was measured at the level of greatest curvature, following methods similar to Sears'[12] and Banerjee et al.[16] Maxillary anterior teeth were measured with a digital Vernier caliper (0.01 mm precision), consistent with previous studies.[16-18]

The median width of six maxillary anterior teeth was 48 mm (range: 35.92–55.50 mm). This is comparable to the findings of Mishra et al.[19] in the Nepalese population (46.24 mm), and Al Wazzan et al.[20] in Saudi Arabia (37–52 mm). However, it was smaller than values reported in Brazilian[21] (53.67 mm) and larger than some Indian populations (41.73 mm)[22], reflecting ethnic and population differences. Males had significantly greater anterior tooth width than females ($p<0.05$), consistent with previous studies.[16-17,20-24] The differences among caste groups were not statistically significant ($p>0.05$). The median skull circumference was 562 mm (range: 505–628 mm), significantly larger in males than females ($p<0.05$), aligning with studies by Banerjee R et al.[16], Evereklioglu et al.[25], Zhuang et al.[26], and Kumari S et al.[24] Differences across ethnic/caste groups were statistically significant ($p<0.05$), with Hill-origin groups showing the largest skull circumferences. The median ratio of skull circumference to six anterior teeth width in this study was 11.51, slightly lower than Sears'[12] proposed ratio of 13 and slightly greater than that of Indian population found by Banerjee R et al.[16] which was 10. No significant gender ($p>0.05$) or caste differences ($p>0.05$) were observed in this ratio.

No significant differences were found between left and right anterior teeth widths, consistent with Kaisy et al.[27] and Alqahtahi et al.[28] Minor discrepancies in one of the study[29] may be attributed to measurement technique or examiner variability. This study showed a significant positive correlation between maxillary anterior teeth width and skull circumference in the total population ($r=0.257$, $p<0.05$) and among females ($r=0.182$, $p<0.05$), but not in males ($r=0.096$, $p>0.05$). Likewise, Kumar S et al. found a weak positive correlation in combined population and in female whereas a weak negative correlation among male.[24] Alqahtani HM et al. conducted a correlation study between maxillary central incisor and head circumference and found significant similar difference among Saudi and South Asian populations ($p<0.05$) whereas, a statistically insignificant result among Arab/African population ($p>0.05$).[13]

These findings indicate that maxillary anterior teeth width and skull circumference vary by gender and ethnicity. While Sears'[12] anthropometric cephalic index method remains relevant, our data suggest the need for population-specific correlations to improve the selection of artificial anterior teeth in Nepalese edentulous patients. To our knowledge, this is the first study to evaluate the relationship between maxillary anterior teeth width and skull circumference among male and female Nepalese. The results can guide clinicians for selecting proper size and manufacturers in developing tooth molds suitable for the Nepalese population.

LIMITATIONS

This study has certain limitations. First, participants were recruited solely from the College of Dental Surgery, BPKIHS, which may not represent the entire Nepalese population. Second, the sample distribution across the ethnic/caste groups in the applied classification was not uniform, potentially affecting comparative analysis. Finally, skull circumference measurements may have been influenced by hair volume and thickness, particularly in female participants, which could introduce minor measurement error.

CONCLUSION

This study concludes that there is significant gender-based differences in both the width of the six maxillary anterior teeth and skull circumference among Nepalese individuals. Specifically, males have larger measurements in both areas compared to females. The relationship between skull circumference and the width of maxillary anterior teeth is notable in females but not in males. The findings suggest that skull circumference could serve as a useful guideline for selecting the width of upper anterior teeth. However, the lack of significant differences in the skull-to-teeth ratio across different genders and ethnic/caste groups indicates that this factor only may not be sufficient in tooth selection across populations.

The study highlights the need for further research at the community level, including diverse ethnic and caste groups in Nepal, to ensure more robust and reliable conclusions.

ACKNOWLEDGEMENT

Authors would like to express their humble gratitude to Professor Dr. R. K. Singh for his immense guidance and support to complete this study.

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