Journal of Institute of Medicine Nepal
Institute of Medicine, Kathmandu, Nepal

OPEN ACCESS

Original Article

JIOM Nepal. 2025 Aug;47(2):88-92.

Prevalence of Variants of Mandibular Second Premolar in Medical Students: A Descriptive Cross-sectional Study

Prem Kumar Mehta[1], Kabir Shrestha[1], Prashuv Nepal[1], Archana Kumari Singh[1], Samarika Dahal[2], Anju Khapung[3], Radha Baral[2]

Author(s) affiliation

[1]*Maharajgunj Medical Campus, Institute of Medicine, Kathmandu, Nepal*

[2]*Department of Oral Pathology and Forensic Dentistry, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Institute of Medicine, Kathmandu, Nepal*

[3]*Department of Community Dentistry, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Institute of Medicine, Kathmandu, Nepal*

Corresponding author

Radha Baral, BDS, MDS
drradha@iom.edu.np

DOI
10.59779/jiomnepal.1363

Submitted
Feb 12, 2025

Accepted
Jun 23, 2025

ABSTRACT

Introduction
The mandibular premolars have shown diversity in cusp morphology, although they are included under the bicuspid. This has been useful in anthropology and forensic odontology as supporting evidence. This study aimed to determine the prevalence of different types of mandibular second premolars among medical students.

Methods
A descriptive cross-sectional study was conducted among 255 medical students after obtaining ethical approval. The number of cusps and the groove pattern present on the mandibular second premolar were examined and recorded using a sterile mouth mirror and explorer. The data was entered in a Microsoft Excel sheet and analyzed by the Statistical Package for Social Sciences (SPSS) version 27.0.

Results
The prevalence of the two-cusp variant 319 (62.5%) was more than the three-cusp variant 191 (37.5%). The most common groove type was H type 198 (38.8%), followed by Y type 191 (37.5%) and U type 121(23.7%). The present study showed that the Y-shaped groove pattern was more common in the right premolar 40% (102), and the H-shaped groove pattern was more common on the left side 42.4% (108). The study showed that two cusp-type premolars are more common on the right and left sides of both genders. This study also revealed that two cusp variants are more common than other variants in different ethnic groups examined on both sides.

Conclusion
The most prevalent variant of the mandibular second premolar was the two-cusps type. H-shaped grooves were most common, followed by Y and U-shaped grooves. H-shaped grooves were more prevalent compared to other types in both males and females.

Keywords
Anthropology; bicuspids; cross-sectional studies; prevalence

INTRODUCTION

Identification of a person based on gender and origin can be successfully carried out by evaluating anatomic features of the teeth known as non-metric dental traits.[1] Tooth morphology can provide information on the evolutionary relationship between species as well as variances and diversities within a population, making it useful in forensic odontology and anthropology.[2] Every single tooth possesses a collection of distinctive characteristics known as 'tooth category characteristics' that give the idea of identification.[3]

A cusp is an elevation or mound on the crown region of the tooth that makes up a divisional part of the occlusal surface.[4] There are two types of mandibular second premolars: two cusps and three cusps.[4] The two-cusp type has one buccal cusp and one lingual cusp, whereas the three-cusp form has one buccal cusp and two lingual cusps, the mesiolingual cusp and the distolingual cusp.[5,6] There are also similar variations in groove patterns in the tooth as the Y-shaped pattern is associated with three cusp type variants, and U, H groove patterns are associated with two cusp types.[5,6] The three-cusp type premolar is considered a modified or specialized form that came to evolution to compensate for the reduced size of the lingual cusp of the first premolar.[7]

The study of dental morphological features is important in anthropological research for population identification.[8] The tooth morphology can provide options for narrowing down the identification procedure in forensic circumstances.[9] Knowledge of morphological features can also aid in the classification and characterization of different ethnic groups.[5] Our study aims to investigate the Prevalence of various cusp types and groove patterns in mandibular second premolars among medical students at Maharajgunj Medical Campus.

METHODS

A descriptive cross-sectional study was conducted from December 2023 to August 2024 among the medical and dental students of Maharajgunj Medical Campus, Kathmandu. Ethical approval was obtained from the Institutional Review Committee of the Institute of Medicine [Reference number: 351, 080/081].

Inclusion criteria were Subjects with well-erupted permanent mandibular second premolars. Exclusion criteria were carious mandibular second premolar or with restorations, any pathologies involving teeth, traumatic injuries of the jaws, severely attritted teeth and participants having cross-ethnicity.

The convenience sampling method was used. The sample size was calculated using the following formula.

$n = Z^2 \times p \times q / e^2$

$= (1.96)^2 \times 0.67 \times (1-0.670) / (0.05)^2$

$= 339.75$

Where,

n= minimum required sample size for an infinite population

Z= 1.96 at 95% Confidence Interval (CI)

p= 0.67 prevalence variant of cusp in Selected Nepalese Population[5]

q= 1-p

e= margin of error, 5%

The calculated minimum sample size for an infinite population is 340. We have 700 total undergraduate medical students in the Maharajgunj Medical Campus. The sample size for the finite population is calculated as:

Sample size for finite population

$= n / [1+(n-1)/Population]$

$= 340/(1+339/700)$

$= 230$

Where,

n'= adjusted sample size

N= finite population

n= calculated sample size

The calculated minimum sample size was 230. A total of 255 medical students were included in the study.

For the collection of data, informed consent was initially obtained. After obtaining informed consent from the participants, mandibular second premolars were examined using a mouth mirror and explorer on both quadrants of the mandibular arch under proper illumination. The ethnic group was classified according to the Nepal Demographic and Health Survey, 2022.[10] The number of cusps and the groove pattern were examined and recorded on the Performa sheet. The data were entered into Microsoft Excel 365 and analyzed using IBM SPSS Statistics version 27.0. For descriptive statistics, frequency and percentages were used.

RESULTS

A total of 255 study participants; 510 premolars were examined in the study, of which the majority, 174(68.2%), were males and 123 (48.2%) were Brahmin, as shown in Table 1.

The mean age of the study participants was 22.2±1.9 years. This predominance of two-cusped forms was consistent on both sides of the mandibular arch: 153(60.0%) in the right quadrant and 166(65.1%) in the left. (Figure 1).

Table 1. Socio-demographic characteristics of the study participants (n=255)

Variables		No.
Gender	Male	174 (68.2)
	Female	81 (31.8)
Ethnicity	Brahmin	123 (48.2)
	Chhetri	28 (11.0)
	Dalit	4 (1.6)
	Janajati	30 (11.8)
	Madhesi	62 (24.3)
	Muslim	8 (3.1)

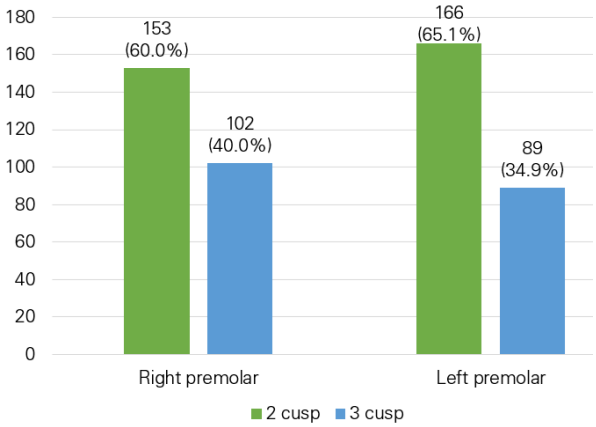

Figure 1. Distribution of the number of cusps in right and left premolars (n=255)

The most common groove type was H 198 (38.8%), followed by Y type 191 (37.5%) and U type 121(23.7%) (Table 2).

H-shaped grooves were more prevalent in males and females in two-cusp-type premolars. Only

Table 2. Distribution of the number of cusps and types of grooves according to gender (n=510)

No cusps and grooves	Male	Female	Total
Two cusps n (%)	222 (63.8)	97 (59.9)	319 (62.5)
H type n (%)	134 (38.5)	64 (39.5)	198 (38.8)
U type n (%)	88 (25.3)	33 (20.4)	121 (23.7)
Three cusps n (%)	126 (36.2)	65 (40.1)	191 (37.5)
Y type n (%)	126 (36.2)	65 (40.1)	191 (37.5)

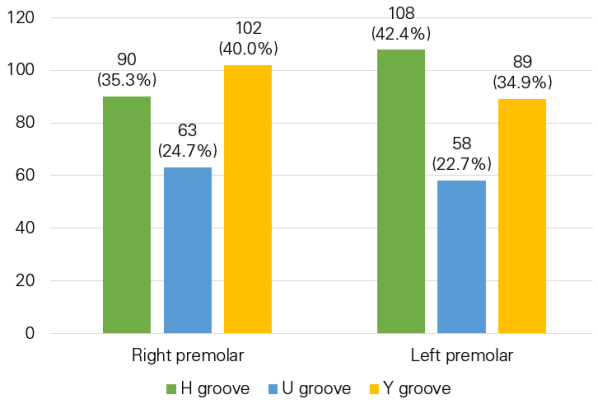

Figure 2. Distribution of types of grooves in right and left premolars

Y-shaped grooves were found in three cusp-type premolars in both males and females (Table 2).

The present study showed that the Y-shaped groove pattern was more common in the right premolar 102 (40%) and the H-shaped groove pattern was more common on the left side 108 (42.4%) (Figure 2).

The study showed that two cusp-type premolars are more common than three cusp-type premolars on the right and left sides of both genders. This study also showed two cusp variants are more common than other variants in different ethnic groups examined on both sides. (Table 3)

Y-shaped grooves were more common on the right side while H-shaped grooves were more common on the left side in males both males and females. (Table 4). The frequency of different groove patterns according to different ethnic groups is given in Table 4.

DISCUSSION

In the present study, the prevalence of two cusp variants was higher 319(62.5%), than three cusp 191(37.5%) types in mandibular second premolar. These findings are similar to the study conducted in the Kerala population, which showed two cusp varieties (52.8%) as the most frequent cusp pattern compared to three cusp forms (44.4%).[4] In another study in the Pakistani population, the prevalence of two-cusp type premolar was 61.55% compared to three-cusp type 38.45%.[11] Another study conducted among the South Indian population revealed that the predominant cusp pattern was two cusp types (82%).[12] Another study by Priyadarshini and Don also revealed that the predominant cusp type was the two-cusp type (55.5%).[2] Similarly, the study conducted in a similar setting in Nepalese subjects by Poudel et al. revealed that 67% of the participants had two cusp types and 33% had three cusp types of mandibular second premolar.[5] The two cuspal variant of mandibular second premolar

Table 3. Distribution of the number of cusps in the right and left premolars according to sociodemographic characteristics (n=255)

Variables		Right premolar		Left premolar	
		2 cusp n (%)	3 cusp n (%)	2 cusp n (%)	3 cusp n (%)
Gender	Male	108 (62.1)	66 (37.9)	114 (65.5)	60 (34.5)
	Female	45 (55.6)	36 (44.4)	52 (64.2)	29 (35.8)
Ethnicity	Brahmin	68 (55.3)	55 (44.7)	71 (57.7)	52 (42.3)
	Chhetri	20 (71.4)	8 (28.6)	19 (67.9)	9 (32.1)
	Dalit	3 (75.0)	1 (25.0)	3 (75.0)	1 (25.0)
	Janajati	18 (60.0)	12 (40.0)	22 (73.3)	8 (26.7)
	Madhesi	39 (62.9)	23 (37.1)	46 (74.2)	16 (25.8)
	Muslim	5 (62.5)	3 (37.5)	5 (62.5)	3 (37.5)

Table 4. Distribution of types of grooves in right and left premolars according to sociodemographic characteristics

Variables		Right premolar			Left premolar		
		H groove n (%)	U groove n (%)	Y groove n (%)	H groove n (%)	U groove n (%)	Y groove n (%)
Gender	Male	64 (36.8)	44 (25.3)	66 (37.9)	70 (40.2)	44 (25.3)	60 (34.5)
	Female	26 (32.1)	19 (23.5)	36 (44.4)	38 (46.9)	14 (17.3)	29 (35.8)
Ethnicity	Brahmin	40 (32.5)	28 (22.8)	55 (44.7)	49 (39.8)	22 (17.9)	52 (42.3)
	Chhetri	12 (42.8)	8 (28.6)	8 (28.6)	12 (42.9)	7 (25.0)	9 (32.1)
	Dalit	3 (75.0)	-	1 (25.0)	3 (75.0)	-	1 (25.0)
	Janajati	9 (30.0)	9 (30.0)	12 (40.0)	14 (46.6)	8 (26.7)	8 (26.7)
	Madhesi	25 (40.3)	14 (22.6)	23 (37.1)	28 (45.2)	18 (29.0)	16 (25.8)
	Muslim	1 (12.5)	4 (50.0)	3 (37.5)	2 (25.0)	3 (37.5)	3 (37.5)

was also reported in the Korean population.[13] However, three cusp types of mandibular second premolars are considered to occur more often.[6] These findings indicate considerable variation in the type pattern of mandibular premolars in different populations. The present study also showed that the prevalence of two-cusp premolars is higher in the right 153(60%) and left 166(65.1%) sides of the mandibular arch. These findings are again similar to the study conducted by Poudel et al.[5]

Our study showed that two cusp variants were more prevalent in males and females in both the right and left mandibular arches. This finding was consistent with other studies.[3-5] Similarly, no sex predilection was found for two or three cusp types in the study Singaporean Chinese population.[14] In contrast to these findings, a slight female predilection was seen for the two-cusp variety of second premolars and male predilection for the three-cusp variety in another study.[2]In our study, the most common groove type was H-shaped followed by Y-shaped and U-shaped. These findings are consistent with the study conducted by Gokul and Don[12] However, the study conducted by Ali et al in Pakistan among the patients visiting the tertiary health care center reported U-shaped groove patterns to be more prevalent than Y, and H.[15] Priyadharsani and Don reported Y groove as the most prevalent groove, followed by U and H groove.[2] In the Korean population, however, Y groove were most prevalent, followed by H and U-shaped grooves.[13]

Our study also showed Y-shaped groove patterns were more prevalent on the right side and H-shaped groove patterns were more common on the left side of the arch. These findings contrast with the study of Poudel et al[5], which showed that H-shaped grooves are more frequent on the right and Y-shaped grooves are common on the left side. However, another study revealed U U-shaped groove as the most prevalent groove on both sides of the jaw.[15]

In our study, the H type of groove was most prevalent in both male and female subjects. Similar to this study Gokul and Don also found H-type cusp prevalent in both genders.[12] Other studies are also in concurrence with the present findings.[5] In contrast, U-shaped grooves were most prevalent in males and H-shaped grooves were most prevalent in female Pakistani subjects.[15]

Our study also aimed at navigating the variation of cusp type in different ethnic groups. The study showed that two-cusp types are more common than three cusps in both sides of all ethnic groups recorded during the examination. It has been seen that there are variations in premolar morphology in different ethnic groups and this differing frequency can be used for ethnic affinity.[15,16] However, we couldn't find any study comparing the variation of cusp types and groove patterns of mandibular premolar with ethnicity in the Nepalese population using search engines like Google scholar and PubMed. This study was conducted in only one center with limited sample size so this study may not be representative of the larger population. Further studies with larger populations are required to predict the gender and ethnic variation of the mandibular second premolar.

CONCLUSION

The most common variant of the mandibular first molar was the two-cusp type with H-shaped groove. The two cusp patterns were common on both sides in males and females. H-shaped grooves were most prevalent in both males and females. Y-shaped grooves were more common on the right side while H-shaped grooves were more common on the left side.

ACKNOWLEDGEMENT

We would like to acknowledge Dr Sirjana Dahal for her constant help during the study.

FINANCIAL SUPPORT

The author(s) did not receive any financial support for the research and/or publication of this article.

CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

Study concept and design PKM, RB, SD Data collection KS, PN, AKS. Data analysis and interpretation AK Manuscript draft RB, SD, PKM

REFERENCES

1. Sah SK, Kandel S, Shrestha R, et al. Prevalence of selected non-metric dental traits in Indo-Nepalese and Tibeto-Nepalese ethnic groups of Western Hilly Region. JNMA J Nepal Med Assoc. 2019;57(219):323–6. doi:10.31729/jnma.4603
2. Priyadharshini M, Don KR. Prevalence of two variants of permanent mandibular second premolars. Int J Curr Adv Res. 2017;6(4):3541–4. doi:10.24327/ijcar.2017.3544.0311
3. Jain S, Chaurasia M, Jain D. Occlusal morphological variants of the permanent mandibular second premolar. Int J Med Sci Clin Res. 2022;5(4):346–50.
4. Sunil S, Gopakumar D. Prevalence of the two variants of mandibular second premolars in Kerala population. Int J Odontostomat. 2012;6(3):375–7. doi:10.4067/S0718-381X2012000300022
5. Poudel P, Adhikari BR, Bali H. Prevalence of two variants of mandibular second premolar at a tertiary care center of Nepal. J Chitwan Med Coll. 2023;13(44):79–81. doi:10.54530/jcmc.1267
6. Ash MM, Nelson SJ. Wheeler's Dental Anatomy, Physiology, and Occlusion. 9th ed. St. Louis: Saunders; 2003. p. 165–70.
7. Sharma JC. Dental morphology and odontometry of the Tibetan immigrants. Am J Phys Anthropol. 1983;61(4):495–505. doi:10.1002/ajpa.1330610412
8. Medhat A, Elzeiny M, Fathy I. A survey on the occlusal morphology of premolars in a sample of Egyptian population. Egypt Dent J. 2023;69(1):157–66. doi:10.21608/edj.2022.162826.2272
9. Patel PM, Pillai JP, Shah KH, et al. Cusp number traits and dental crown metric traits of mandibular premolars and maxillary second molar in sex determination: a cross-sectional dental model-based observational study. Int J Forensic Odontol. 2021;6:99–105. doi:10.4103/ijfo.ijfo_20_21
10. Ministry of Health and Population. Nepal Demographic and Health Survey 2022. Kathmandu: MoHP; 2022.
11. Khan DB, Khan F, Khan H. Frequency of bicuspid and tricuspid form of mandibular second premolar at Khyber College of Dentistry Peshawar. J Med Sci. 2013;21(3):118–20.
12. Gokul GI, Don KR. Occlusal morphological variants of permanent mandibular second premolar: a cross-sectional study. Ann RSCB. 2021;25(3):5780–93.
13. Yoo HI, Park HY, Kim SH. Occlusal surface analysis of mandibular premolars in Koreans. Korean J Phys Anthropol. 2015;28(3):145–53.
14. Loh HS. Coronal morphology of the mandibular second premolar in the Singaporean Chinese. Aust Dent J. 1993;38(4):283–6. doi:10.1111/j.1834-7819.1993.tb05498.x
15. Ali MA, Niazi M, Saqib S, Younas A, et al. Frequency of different groove patterns on the occlusal surface of mandibular second premolars. J Islamabad Med Dent Coll. 2019;8(2):84–7. doi:10.35787/jimdc.v8i2.327
16. Ludwig FJ. The mandibular second premolars: morphologic variation and inheritance. J Dent Res. 1957;36(2):263–73. doi:10.1177/00220345570360021701