International Journal of Otorhinolaryngology and Head and Neck Surgery
Antil A et al. Int J Otorhinolaryngol Head Neck Surg. 2026 Oct;12(5):749-753
https://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937
DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20263382

Original Research Article

Dental compensations with changes in skeletal transverse dimensions: myth or reality

Amit Antil*, Prasanna Kumar, Saugat Ray, Amrit Thapa, Baljinder S. Walia, Indranil D. Roy

Department of Orthodontics and Dentofacial Orthopedics, Armed Forces Medical College, Pune, Maharashtra, India

Received: 03 February 2026
Revised: 01 September 2026
Accepted: 07 September 2026

***Correspondence:**
Dr. Amit Antil,
E-mail: akkiantil@gmail.com

ABSTRACT

Background: Orthodontic treatment aims to harmonize functional and aesthetic aspects of the dentofacial complex, with emphasis on molar inclinations and maxillary transverse dimensions. These parameters, evaluated across sagittal, vertical, and transverse planes, are essential for accurate diagnosis and treatment planning to achieve stable occlusion. This study assessed the correlation between maxillary and mandibular molar inclinations and skeletal transverse dimensions in a mixed Indian population using cone beam computed tomography (CBCT) analysis.
Methods: A retrospective, cross-sectional study was conducted on 50 pre-treatment CBCT scans (27 males, 23 females; mean age 19.8 years). Molar inclinations and transverse skeletal dimensions were measured using NNT software. Pearson's correlation coefficient was applied to evaluate relationships between variables.
Results: The mean mandibular transverse dimension (62.00±6.94 mm) exceeded the maxillary transverse dimension (60.61±4.29 mm). Mean inclinations of the right and left maxillary first molars with the occlusal plane were 79.49°±4.69° and 81.44°±5.71°, respectively, while mandibular first molars showed 106.47°±16.08° (right) and 103.26°±6.20° (left). A significant positive correlation existed between maxillary and mandibular transverse dimensions (r=0.40, p=0.003). The mandibular transverse dimension showed significant negative correlations with right (r=-0.53, p=0.00) and left (r=-0.42, p=0.02) maxillary molar inclinations. Other correlations were non-significant.
Conclusions: Findings indicate a significant relationship between mandibular transverse dimension and maxillary molar inclination. While maxillary molar inclination showed weak correlation with skeletal transverse dimensions, the results highlight the importance of considering transverse skeletal parameters in orthodontic diagnosis and treatment planning.

Keywords: Transverse dimensions, Molar inclinations, Corelations, Transverse discrepancy, Treatment planning

INTRODUCTION

Orthodontic treatment strives to balance both functional and aesthetic aspects of the dentofacial complex, with diagnosis and planning based on parameters like molar inclinations and maxillary transverse dimensions. Bjork has emphasized that these factors are assessed across three spatial planes—sagittal, vertical, and transverse, which provide essential information on craniofacial growth and development.[1] Understanding the correlation between molar inclinations and maxillary transverse dimensions is critical for achieving stable occlusion, as both influence occlusal relationships and arch form. According to Yang et al the maxillary transverse dimension, in particular, plays a key role in the alignment and positioning of teeth.[2]

Earlier studies such as, Albalawi et al identified a significant correlation between skeletal transverse discrepancy and dental compensations within a Saudi Arabian population, indicating that variations in maxillary transverse dimensions may influence molar inclinations.[3] Similarly, Papagiannis et al examined the relationship

between maxillary transverse dimensions and canine inclinations in a white population, finding a weak yet statistically significant correlation.[4] This suggests that while maxillary width may affect tooth inclination, additional factors likely contribute to these variations. Research on this topic within the Indian population remains limited. However, a study by Prasad et al in a South Indian population demonstrated a significant correlation between maxillary transverse dimension and arch form, emphasizing its importance in determining dental alignment.[5]

The present study aims to investigate the correlation between maxillary and mandibular molars inclinations and maxillary and mandibular skeletal transverse dimensions in a mixed Indian population through radiographic analysis.

METHODS

Study design and sample

This cross-sectional radiographic study was conducted at a tertiary care government hospital using archived records of 50 patients. The sample was selected from the orthodontic departmental archives, ensuring all patients had complete pre-treatment records, including cone beam computed tomography (CBCT) scans.

Study period

This cross-sectional radiographic study was conducted from December 2021 to March 2024 using archived records of 50 patients.

Sample size calculation

To estimate the sample size molar inclinations and transverse dimensions of the maxilla and mandible with 95% confidence and specified margins of error, a sample size of 50 was determined based on prior literature and Z-score estimation.

Inclusion and exclusion criteria

The study included patients over 18 years of age with complete pre-treatment records including informed consent from patients for taking and utilization of records for research and publication, full permanent dentition (excluding third molars), and no missing teeth, representing both genders, while excluding those with craniofacial anomalies, pathologically migrated molars or canines, a history of orthodontic treatment, or incomplete/poor-quality records.

Methodology

The study utilized pre-treatment CBCT images. All scans were taken using a standardized protocol (Cefla Dental Group's NewTom Giano CBCT machine). The scans were analysed using NNT software version 10.1 to measure molar inclinations and maxillary/mandibular transverse dimensions.

Parameters measured

The measurements of various linear and angular parameters made were as follows as given in Table 1 – maxillary transverse dimension: transverse dimension of maxilla from Mx to xM, mandibular transverse dimension: transverse dimension of mandible from MGJ to JGM, inclination of 1st upper right maxillary molar with occlusal plane (16Ocip): the buccolingual inclination of upper right 1st molar with the occlusal plane in coronal section, inclination of 1st upper left maxillary molar with oclusal plane (26Ocip): the buccolingual inclination of upper left 1st molar with the occlusal plane in coronal section, inclination of 1st lower right mandibular molar with occlusal plane (46Ocip): the buccolingual inclination of lower right 1st molar with the occlusal plane in coronal section, inclination of 1st lower left mandibular molar with occlusal plane (36Ocip): buccolingual inclination of lower left 1st molar with the occlusal plane in coronal section, and occlusal plane: occlusal plane is taken parallel to orbital plane and passing through contact surface made by cusp tips of right and left upper and lower 1st permanent molars (Figure 1).

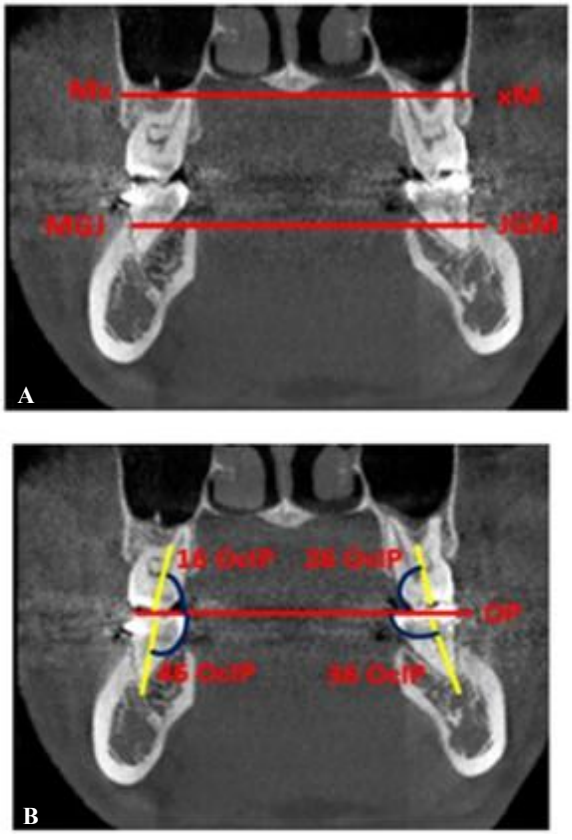

Figure 1 (A and B): CBCT method for evaluation of molar inclination with occlusal plane. Reproduced from Vasquez JM, Escobar AFPC, Loyo IF, Cano PAS.

Statistical evaluation

CBCT measurements have been recorded (Table 1) and analysed using statistical package for the social sciences (SPSS) (version 23.0). Pearson's correlation coefficient was applied to determine the relationships between skeletal and dental parameters (Table 2).

RESULTS

50 CBCT scanned images have been included in the sample. The study sample population comprised of 27 males and 23 females, with mean age of 19.8 years (Table 1 and Figure 2). The mean mandibular transverse dimension was 62.00±6.94 mm which was greater than the mean maxillary transverse dimension which was 60.61±4.29 (Table 2). The mean Inclination of right maxillary first molar with occlusal plane is 79.49±4.69. The mean Inclination of left maxillary first molar with occlusal plane are 81.440±5.71 (Table 2). The mean Inclination of right mandibular first molar with occlusal plane is 106.47±16.08. The mean Inclination of left mandibular first molar with occlusal plane is 103.26±6.20 (Table 1).

The Pearson correlation analysis revealed significant positive correlation between mandibular transverse dimension and the right mandibular first molar (r=0.425, p=0.002), though this may lack clinical relevance due to the typically bilateral nature of transverse discrepancies. Maxillary and mandibular transverse dimensions showed a moderately positive correlation (r=0.40, p=0.003). Negative correlations were observed between maxillary transverse dimensions and mandibular molar inclinations (r=-0.23, -0.10; p=0.98, 0.48) and between maxillary first molars and transverse dimensions (r=-0.008, -0.0425; p=0.95, 0.75), all statistically insignificant. Negative correlations between mandibular transverse dimensions and maxillary first molars (r=-0.53, -0.42; p=0.00, 0.02) were statistically significant (Table 2).

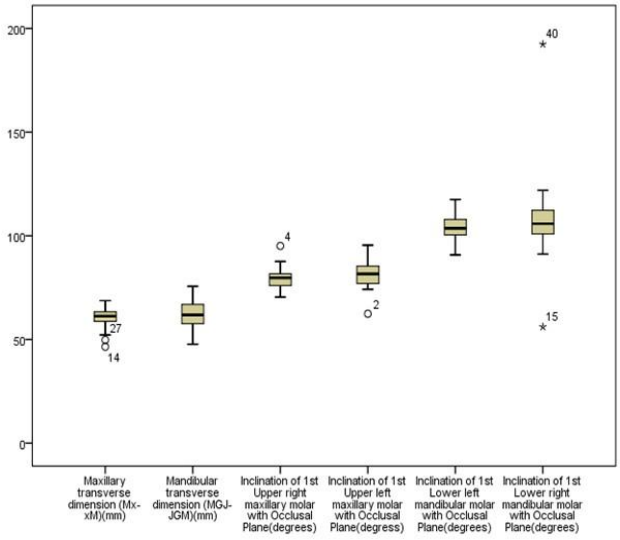

Figure 2: Frequency distribution of sample population as per parameters evaluated in the study.

Table 1: Various descriptives evaluated in the study as per original study design.

Variables	N	Minimum	Maximum	Mean	Std. deviation
Maxillary transverse dimension (Mx-xM) (mm)	50	46.5	68.7	60.610	4.2919
Mandibular transverse dimension (MGJ-JGM) (mm)	50	47.7	75.6	62.008	6.9489
Inclination of 1st upper right maxillary molar with occlusal plane (degrees)	50	70.4	95.1	79.492	4.6931
Inclination of 1st upper left maxillary molar with occlusal plane (degress)	50	62.4	95.5	81.444	5.7177
Inclination of 1st lower left mandibular molar with occlusal plane (degrees)	50	90.8	117.5	103.262	6.2077
Inclination of 1st lower right mandibular molar with occlusal plane (degrees)	50	56.1	192.4	106.474	16.0870
Transverse maxillomandibular discrepancy	50	-12.60	12.00	-1.3980	6.50900
Valid N (list-wise)	50				

Table 2: Pearson's correlation coefficient in between descriptives and transverse maxillomandibular dimensions measured in the study.

Correlations		Mx-xM	MGJ-JGM	16Ocip	26Ocip	36Ocip	46Ocip	Discrepency
Mx-xM	Pearson correlation	1	0.408**	-0.008	-0.045	-0.237	-0.101	0.224
	Sig. (2-tailed)		0.003	0.957	0.756	0.098	0.484	0.118
	N	50	50	50	50	50	50	50
MGJ-JGM	Pearson correlation	0.408**	1	-0.537**	-0.423**	0.176	0.424**	-0.799**
	Sig. (2-tailed)	0.003		0.000	0.002	0.221	0.002	0.000
	N	50	50	50	50	50	50	50
	Sig. (2-tailed)	0.118	0.000	0.000	0.002	0.014	0.000	
	N	50	50	50	50	50	50	50

**Correlation is significant at the 0.01 level (2-tailed), *correlation is significant at the 0.05 level (2-tailed), **highly significant, and *moderately significant.

DISCUSSION

Transverse dimensions, though less explored than sagittal and vertical dimensions in orthodontics, are crucial for diagnosing and managing malocclusions. In this study, the mean mandibular transverse dimension was found to be 62.00±6.94 mm, which was greater than the mean maxillary transverse dimension of 60.61±4.29 mm. This difference is consistent with the findings of Sawchuk et al and Vasquez et al, though the absolute values were lower due to differences in population demographics and measurement landmarks.[6,7] These findings highlight the need for population-specific standards in evaluating transverse dimensions, as ethnicity and other demographic factors can significantly impact the observed values.

The molar inclinations measured in this study provide insights into the relationship between transverse dimensions and dental alignment. The mean inclination of the right maxillary first molar to the occlusal plane was 79.49°±4.69°, and for the left maxillary first molar, it was 81.44°±5.71°. Similarly, the mandibular first molar inclinations were 106.47°±16.08° on the right and 103.26°±6.20° on the left. These values align with previous studies by Vasquez et al and Grosso et al, though slight variations can be attributed to landmark and measurement differences.[7,8] Notably, these findings provide a baseline for understanding the buccolingual inclinations of molars in relation to occlusal planes in young adults.

The Pearson correlation analysis revealed interesting patterns in transverse dimensions and molar inclinations. A significant positive correlation was observed between mandibular transverse dimension and the right mandibular first molar inclination (r=0.425, p=0.002). This indicates that as the mandibular transverse dimension increases, the inclination of the right mandibular molar also tends to increase. However, this correlation may lack clinical significance as transverse discrepancies typically manifest bilaterally. A moderately positive correlation (r=0.40, p=0.003) was also found between maxillary and mandibular transverse dimensions, suggesting a proportional relationship between the two arches.

Interestingly, negative correlations were found between mandibular transverse dimensions and the inclinations of the maxillary first molars (r=-0.53 and -0.42 for right and left molars, p=0.00 and 0.02, respectively), which were statistically significant. Similarly, weak negative correlations were noted between maxillary transverse dimensions and mandibular molar inclinations (r=-0.23 and -0.10, p=0.98 and 0.48, respectively), though these were not statistically significant. These findings suggest that as transverse discrepancies increase, maxillary molar inclinations become more buccal, while mandibular molar inclinations become more lingual. These patterns are consistent with Vasquez et al, Grosso et al and Kohakura et al who noted similar trends.[7-9]

The transverse maxillomandibular discrepancy ranged from -12.6 mm to 12 mm, with a mean of -1.40±6.51 mm, suggesting a mild overall discrepancy. Pearson correlation analysis showed a significant moderate positive correlation (r=0.40, p=0.003) between maxillary and mandibular transverse dimensions. However, the mandibular transverse dimension demonstrated strong negative correlations with the inclinations of the right and left maxillary molars (r=-0.53, p=0.00; r=-0.42, p=0.002, respectively), and a highly significant inverse relationship with transverse maxillomandibular discrepancy (r=-0.79, p=0.00).

Significant positive correlations between mandibular transverse dimensions and molar inclinations suggest functional interdependence, while negative correlations between transverse discrepancies and molar inclinations emphasize compensatory changes in dental alignment. The results align with previous studies of Sayania et al and Proffit et al, but also highlights the importance of considering demographic variations and methodological differences.[10,11]

Limitations

The study was limited by its relatively small sample size and single centre, cross-sectional design, which may restrict the generalizability of the findings. The use of archived CBCT records may have introduced limitations related to image quality and landmark identification. Further multicentric studies with larger and more diverse samples and longitudinal assessment are recommended.

CONCLUSION

Within the scope of the present study the following conclusions may be drawn. Changes in mandibular skeletal dimension strongly correlated with maxillary and mandibular molar inclination. However, maxillary molars were found to have weak correlation with maxillary and mandibular transverse skeletal dimensions.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bjork A. Cranial base development: A follow-up x-ray study of the individual variation in growth occurring between the ages of 12 and 20 years and its relation to brain case and face development. Am J Orthodont. 1955;41:198-225.
2. Yang B, Chung CH. Buccolingual inclination of molars in untreated children and adults: A cone beam computed tomography study. Angle Orthod. 2019;89(1):87-92.
3. Albalawi F, Alwakeel R, Alfuriji S, Alqahtani ND, Barakeh RM, AlGhaihab A, et al. A Correlation

Analysis between Arch Width and Molar Inclination Using Cone-Beam Computed Tomography Transverse Measurements: A Cross-Sectional Study. Diagnostics (Basel). 2023;13(11):1875.
4. Papagiannis A, Halazonetis DJ. Shape variation and covariation of upper and lower dental arches of an orthodontic population. Eur J Orthod. 2016;38(2):202-11.
5. Prasad M, Kannampallil ST, Talapaneni AK, George SA, Shetty SK. Evaluation of arch width variations among different skeletal patterns in South Indian population. J Nat Sci Biol Med. 2013;4(1):94-102.
6. Sawchuk D, Currie K, Vich ML, Palomo JM, Flores-Mir C. Diagnostic methods for assessing maxillary skeletal and dental transverse deficiencies: A systematic review. Korean J Orthod. 2016;46(5):331-42.
7. Vasquez JM, Escobar AF, Andres Felipe FL, Isabela SC. Correlation between transverse maxillary discrepancy and the inclination of first permanent molars: A pilot study. Rev Fac Odontol Univ Antioq. 2017;28(2):354-73.
8. Grosso LE, Rutledge M, Rinchuse D, Smith D. Buccolingual inclinations of maxillary and mandibular first molars in relation to facial pattern. Orthodont Pract. 2014;5(2):43-8.
9. Kohakura S, Kasai K, Ohno I, Kanazawa E. Relationship between maxillofacial morphology and morphological characteristics of vertical sections of the mandible obtained by CT scanning. J Nihon Univ Sch Dent. 1997;39(2):71-7.
10. Sayania B, Merchant M, Josephs P, Chung CH. Changes in the buccolingual inclination of first molars with growth in untreated subjects: A longitudinal study. Angle Orthod. 2017;87(5):681-7.
11. Proffit WR, Fields HW. Treatment of skeletal transverse and Class III problems. Contemporary Orthodontics. 6th edition. St. Louis: Mosby; 2019:440-54.

Cite this article as: Antil A, Kumar P, Ray S, Thapa A, Walia BS, Roy ID. Dental compensations with changes in skeletal transverse dimensions: myth or reality. Int J Otorhinolaryngol Head Neck Surg 2026;12:749-53.