Research Article

Assessment of Mesiodistal Angulations of Mandibular Canine and Posterior Teeth using Orthopantomogram

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ABSTRACT

Background: Appropriate mesiodistal angulation of teeth is necessary for the stability of the stomatognathic system, so achieving proper angulation should be included in the orthodontic treatment objectives. The commonly used panoramic radiograph can be utilized for the assessment of mesiodistal angulation of teeth.

Aims and Objective: To evaluate and compare mesiodistal angulations of mandibular canine and posterior teeth with and without a third molar. To compare mesiodistal angulation between the sides with and without a third molar.

Material and Methods: This is a cross-sectional comparative study using an orthopantomogram (OPG) of 66 subjects aged 17-29 years. The sample was divided into: with third molar and without third molar groups. A reference line was used to determine the angulations of teeth that passed through the mental foramen. The kappa statistic test was done to determine the intra-observer variability. Student's t-test was performed to compare the mesiodistal angulations of mandibular canine and posterior teeth with and without a third molar.

Result: There was a significant difference in mesiodistal angulations between the second molar ($p < 0.001$), and first molar ($p < 0.001$) on the right side, and second molar ($p < 0.001$), first molar ($p = 0.005$), second premolar ($p = 0.01$) and first premolar ($p = 0.04$) on the left side. There was also a difference in mesiodistal angulation for the first molar ($p = 0.05$) between the right and left side when the third molar was present. Likewise, there was a difference in mesiodistal angulation for the second molar ($p = 0.016$) between the right and left side when the third molar was absent.

Conclusion: The presence of a third molar was significantly associated with mesiodistal angulation of molars and premolars while angulation of canine was not affected.

KEYWORDS: Mandibular Canine, Mandibular Posterior teeth, Mental foramen, Mesiodistal angulation, Orthopantomogram

INTRODUCTION

Appropriate mesiodistal angulation of teeth is essential for the stability of the stomatognathic system. Achieving proper axial angulation should be a key objective of orthodontic treatment, as it directly influences dental alignment.

Holdaway proposed that one of the ways to obtain proper angulation is by incorporating artistic bends in the wire.[1] Andrews developed an appliance that used standard brackets to obtain correct angulation, which is necessary for obtaining six keys of normal occlusion.[2]

The panoramic radiograph is an important diagnostic aid used in orthodontics, allowing visualization of broad anatomic structures. Graber and Phillips highlighted that a panoramic radiograph is a commonly used diagnostic aids in orthodontics because of its simplicity, patient comfort, wide appraisal, and minimal radiographic exposure.[3,4] The reliability of the panoramic radiograph for angular measurement had been demonstrated by mathematical calculation and confirmed experimentally by Frykholm et al., and Phillip and Hurst.[5,6] One of the anatomic structures visible in OPG is the mental foramen, which is the small foramen on the anterior surface of the mandible typically adjacent to the roots of premolars.

The presence of third molars has been suggested as one of the causes of lower anterior crowding. Sheneman concluded that patients with congenitally missing third molars exhibited greater dental stability.[7] Erupting third molars exert a mesial driving force, which may cause the molars, premolars, and canine crowns to incline mesially, potentially leading to crowding and misalignment. However, the exact role of third molars in altering the alignment of other teeth remains unclear, and more research is needed to fully understand their impact on dental occlusion.

Despite numerous studies involving the measurement of dental angulations, there are many uncertainties regarding appropriate treatment and the role of the third molars in causing alterations in the positioning of other teeth in the arch.[8] However, some studies suggest that third molars contribute to lower anterior crowding by exerting a mesial driving force causing molars, premolars and canines to incline mesially, the exact impact of third molars on tooth alignment is still unclear.[7]

The objectives of this research were to evaluate and compare the mesiodistal angulations of the mandibular canines and posterior teeth in patients with and without third molars. Additionally, this study aimed to compare the mesiodistal angulation between the sides with and without third molars in the same individuals.

MATERIAL AND METHODS

This study was a cross-sectional comparative study using orthopantomograms of patients visiting the Department of Orthodontics, Kantipur Dental College, Kathmandu, Nepal. The inclusion criteria were OPG records of the patients of the aged 17-29 years, OPG clearly showing mental foramen, and the presence or absence of third molars (used for group division). For Group I, third molars must have a root length equal to or greater than the crown length.[9] Exclusion criteria were impacted or missing canines, premolars, first and second molars, and presence of supernumerary teeth. The sample was divided into two groups: Group I (with third molars) and Group II (without third molars). The study period was from November to mid-December 2022. Ethical clearance was obtained from the Institutional Review Committee, Kantipur Dental College (IRC Ref No: 33/022).

The sample size was calculated using the data from the study by Cuoghi et al.[10] using the formula:

$$N = \frac{f(\alpha, \beta) \times 2SD^2}{D^2}$$

Where, ƒ (α, β) =7.85, Standard deviation (SD) =4.5, Mean difference (D) = 2.2, $N = \frac{7.85 \times 2 \times (4.5)^2}{(2.2)^2}$

N=65.68 ~ 66

Therefore, the sample size was 66.

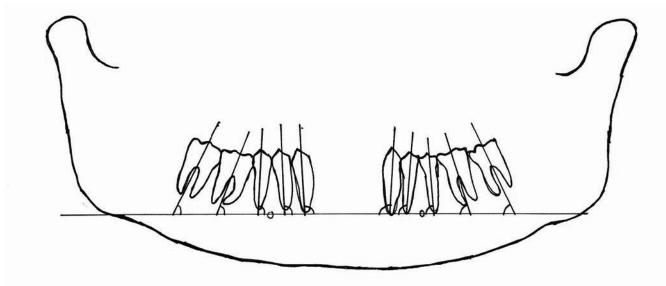

Figure 1: line drawn through long axis of teeth: A33 and A43—intersection of the long axes of the mandibular left and right canines; A34 and A44—intersection of the long axes of the mandibular left and right first premolars; A35 and A45—intersection of the long axes of the mandibular left and right second premolars; A36 and A46—intersection of the long axes of the mandibular left and right first molars; and A37 and A47—intersection of the long axes of the mandibular left and right second molars.

Data were obtained from the departmental records. The reference line was used to determine the angular measurement of the tooth, which was constructed using the center of right and left mental foramen and drawing a line through the foramen (Fig. 1).[11] The dentoalveolar and skeletal structures drawn from the radiographs were the external outline of the mandible, the mental foramen and the contours of the canines, premolars and mandibular molars. The image of the root canal at its longest aspect was taken for a single-rooted tooth (canine, first and second premolars), while the average image of the mesial and distal root canals was taken for double-rooted teeth (first and second molars) as shown by Tavano et al. (Fig. 1).[11]

Manual tracing and measurement were performed and the angles A43, A33, A44, A34, A45, A35, A46, A36, A47 and A37 formed by the intersection of the long axes of the teeth with the reference line were measured manually by one investigator. Ten percent of the sample was assessed after ten days and the Kappa statistic test was performed to determine the intra-observer variability.

SPSS V20 was used to compare the means of mesiodistal angulation of canine, premolars, first and second molars with and without third molars, SPSS V20 was used. Student's t-test was used to compare the means of mesiodistal angulations of canines and mandibular posterior teeth with and without third molar.

RESULT

The mesiodistal angulations of the mandibular canines, premolars, and first and second molars with and without third molars are shown in Table 1. The mesiodistal angulations of the right second molar ($p < 0.001$) and right first molar ($p < 0.001$), left second molar ($p < 0.001$), left first molar ($p = 0.005$), left second premolar ($p = 0.01$) and left first premolar ($p = 0.04$) were statistically significant. Mesiodistal angulations of the right canine ($p = 0.927$) and left canine ($p = 0.237$) were not significant. Likewise, the second molar ($p = 0.016$) showed a significant difference between the right and left sides when the third molar was absent and the first molar ($p = 0.005$) showed a significant difference between the right and left sides when the third molar was present as shown in Tables 2 and 3.

Table 1: Comparison of the mesiodistal angulations between Group I (with third molars), Group II (without third molars)

Angle	Group I (N = 33) Mean ± SD (degrees)	Group II (N = 33) Mean ± SD (degrees)	p-value
A47	59.91 ± 4.996	65.55 ± 4.963	0.000*
A46	65.03 ± 5.892	69.76 ± 5.196	0.001*
A45	73.36 ± 6.163	75.79 ± 6.163	0.115
A44	82.48 ± 7.058	83.39 ± 6.093	0.577
A43	88.33 ± 5.091	88.45 ± 5.646	0.927
A37	63.73 ± 6.140	69.70 ± 5.133	0.000*
A36	70.42 ± 4.330	74.21 ± 6.204	0.005*
A35	74.79 ± 5.721	78.73 ± 6.251	0.01*
A34	81.39 ± 6.159	84.67 ± 6.508	0.04*
A33	86.61 ± 5.648	88.61 ± 5.889	0.237

*Statistically significant at $p < 0.05$

Table 2: Comparison of the mesiodistal angulations on right and left sides without third molar

Teeth	Right (Mean ± SD, degrees)	Left (Mean ± SD, degrees)	p-value
Canine	88.45 ± 5.646	88.61 ± 5.889	0.736
1st premolar	83.39 ± 6.093	84.67 ± 6.508	0.137
2nd premolar	75.70 ± 6.163	78.73 ± 6.251	0.055
1st molar	69.76 ± 5.196	74.21 ± 6.204	0.061
2nd molar	65.55 ± 4.963	69.70 ± 5.133	0.016*

*Statistically significant at $p < 0.05$

Table 3: Comparison of mesiodistal angulations on right and left sides with third molar

Teeth	Right (Mean ± SD, degrees)	Left (Mean ± SD, degrees)	p-value
Canine	88.33 ± 5.091	86.91 ± 5.648	0.444
1st premolar	82.48 ± 7.058	81.39 ± 6.159	0.07
2nd premolar	73.36 ± 6.163	74.79 ± 5.721	0.114
1st molar	65.03 ± 5.892	70.42 ± 4.330	0.005*
2nd molar	59.91 ± 4.996	63.73 ± 6.140	0.062

*Statistically significant at $p < 0.05$

DISCUSSION

This study showed that the presence of third molars had a significant effect on the mesiodistal angulation of mandibular second molars, first molars, and premolars, but the mesiodistal angulation of the mandibular canine was not affected. The mesiodistal angulations of mandibular molars and premolars were reduced or more angulated mesially when the third molar was present.

The significant reduction in the angulation of molars and premolars in Group I can be attributed to the mesial pressure exerted by the third molars during their eruption and development which is similar to the studies by Bergstrom and Jensen[12] and Vego.[13] However, in contrast to our study, Weinstein and Ades et al.observed that third molars had no role in affecting the mesiodistal angulation of adjacent teeth.[14,15]

The angulation of the right and left mandibular canines and premolars on the right side were not affected by the presence of the third molar, which suggests that mesial pressure exerted by the third molar does not influence the anterior segments which is also similar to a study done by Cuoghi et al.[10] Our study showed no significant difference in right-sided premolars but the significant difference on the left-sided premolar, this difference could be due to individual variation on eruption pattern, occlusal force, and relationship of lower dentition with upper.

While third molars influence the angulation of posterior teeth, their effect on the anterior region, including canines, is limited. This supports the conclusion that third molars do not contribute to anterior crowding. Studies by Ades et al. further emphasize that anterior crowding is primarily due to natural mesial drift rather than the presence of third molars. You et al.[16] concluded that mesiodistal angulations were more acute mesially in patients with third molars, similar to our study.[15]

The significant difference in the angulation of the second molar without third molars and the significant difference for first molar with third molars could be attributed to the natural asymmetry between the right and left sides, additionally influence of occlusal forces and anatomical positioning of certain teeth.[17]

One limitation of this study is the moderate sample size, which may impact the generalizability of the findings. This study was conducted by a single examiner which inter-examiner reliability. Further research incorporating mesiodistal dimension, arch perimeter, and angulation of the anterior teeth could help clarify the potential role of third molars in the development of anterior crowding. Further exploration can be done using digital applications for more accuracy.[18] Furthermore, CBCT studies offer a better chance to explore this topic further as they provide a detailed three-dimensional evaluation.

CONCLUSION

The presence of third molar was significantly associated with the angulations of the mandibular first molars, mandibular second molars, and mandibular premolars on left side, but no association was found with mesiodistal angulations of the mandibular canine and premolars on right side. When third molars were present there is significant result for mandibular first molar and when third molar was absent there is significant difference for mandibular second molar.

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Conflict of Interest

None.

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REFERENCES

1. Holdaway RA. Bracket angulation as applied to the edgewise appliance. Angle Orthod 1952;22(4):227–36.
2. Andrews LF. The diagnostic system: occlusal analysis. Dent Clin North Am 1976;20(4):671–90.
3. Graber TM. Panoramic radiography. Angle Orthod 1966;36(4):293–311.
4. Phillips JE. Principles and function of the orthopantomograph. Oral Surg Oral Med Oral Pathol 1967;24(1):41–9.
5. Frykholm A, Malmgren O, Sämfors KA, Welander U. Angular measurements in orthopantomography. Dentomaxillofac Radiol 1977;6(2):77–81.
6. Philipp RG, HURST RV. The cant of the occlusal plane and distortion in the panoramic radiograph. The Angle Orthod 1978;48(4):317-23.
7. Sheneman J. Third molar teeth and their effect upon the lower anterior teeth; a study of forty-nine orthodontic cases 5 years after band removal. Am J Orthod Dentofacial Orthop 1969;55(2):196.
8. Zawawi KH, Melis M. The role of mandibular third molars on lower anterior teeth crowding and relapse after orthodontic treatment: a systematic review. Sci World J 2014;2014(1):615429.
9. Liversidge HM. The assessment and interpretation of Demirjian, Goldstein and Tanner's dental maturity. Ann Hum Biol 2012;39(5):412–31.

10. Cuoghi OA, Sella RC, de Mendonça MR. Mesiodistal angulations of the mandibular canines, premolars and molars with or without the presence of third molars. Eur J Orthod 2010;32(4):472–6.
11. Tavano O, Ursi WJ, Almeida RR, Henriques JF. Determination of reference lines for angular measurements in orthopantomographic radiographs. Odontol mod 1989;16(1):22–5.
12. Bergstom K. Responsibility of the third molar for secondary crowding. InDent Abstr 1961;6(1):544.
13. Vego L. A longitudinal study of mandibular arch perimeter. The Angle Orthod 1962 ;32(3):187-92.
14. Weinstein S. 8 third molar implications in orthodontics. J Am Dent Assoc 1971;82(4):819–23.
15. Ades AG, Joondeph DR, Little RM, Chapko MK. A long-term study of the relationship of third molars to changes in the mandibular dental arch. Am J Orthod Dentofacial Orthop 1990;97(4):323-35.
16. You T-M, Ban BH, Jeong J-S, Huh J, Doh R-M, Park W. Effect of premolar extraction and presence of the lower third molar on lower second molar angulation in orthodontic treatment. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014;118(3):278–83.
17. Nishiura A, Matoba H, Inami K, Yasui K, Azumi E, Hosoyama Y, Matsumoto N. Comparative evaluation of the change in angulation between erupted and impacted third molars at the same root development stage, in non-extraction orthodontic treatment. J Osaka Dent Univ 2018;52(1):45-50.
18. Mohan A, Sivakumar A, Nalabothu P. Evaluation of accuracy and reliability of OneCeph digital cephalometric analysis in comparison with manual cephalometric analysis—a cross-sectional study. BDJ open. 2021;7(1):22.