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Correlation between Dental Calcification Stage 5 and CVM Stage 3 in Class II Malocclusion Patients

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Abstract

Introduction: Growth modification treatment using functional appliances is recommended for growing patients. For the best outcome, it is necessary to use the functional appliance at the peak puberty. The goal of our study was to determine whether a correlation exists between calcification stage 5 of the mandibular 2nd molar and maxillary canine and the CVM stage 3 to assess the timing of skeletal maturation from an Orthopantomogram (OPG) radiograph.

Material and Methods: The sample size comprised 100 patients, 71 females and 29 males aged 11 to 15 years. The maxillary canine and the mandibular 2nd molar teeth calcification stage (stage 5) were determined by the modified Gleiser and Hunt method on Panoramic radiographs. The peak pubertal growth stage (CVM 3) was assessed by the CVM method on Lateral cephalometric radiographs.

Results: CVM stage 3 and canine calcification stage 5 were not correlated whereas canine calcification stage 5 and molar stage 5 were significantly correlated with p-value <0.05. Moreover, CVM stage 3 and molar stage 5 were also not correlated.

Conclusions: Assessment of dental calcification stage five of the maxillary canine and mandibular 2nd molar on the panoramic radiograph can not be used to assess the timing of skeletal maturation. A larger sample size is required to verify the reliability of this method.

Keywords: Cervical vertebral maturation, Dental calcification, Skeletal maturation

Introduction

Dento-facial deformities can be of dental or skeletal origin.[1] Skeletal Dysplasia is defined as an irregular jaw arrangement in at-least one of the three special planes. Sagital skeletal dysplasia is classified as Skeletal Class I, II and III. Skeletal Class II has different treatment options for different age groups.[2-3] Treatment modalities varies from growing age (jaw orthopedics to functional appliances) and in adults from camouflage to surgical orthodontics.[3]

In orthodontics treatment timing thus has considerable influence on planning the orthodontic treatment, and its outcomes. For example, for patients with skeletal class II malocclusion, the growth modification using functional appliance treatment to enhance mandibular growth results is better when it is done during the peak-pubertal growth spurt stage. One of the most commonly used method to assess skeletal age is the cervical vertebral maturation (CVM) method. [4] It has been accurate and repeatable. [5]

Dental panoramic radiographs are routinely used as a part of orthodontic diagnosis to see

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the root development stages of different teeth. Therefore, the ability to assess the peak-pubertal growth phase by stages of dental calcification would offer an advantage over the conventional lateral cephalogram. The modified Gleiser and Hunt method was used for the assessment of the dental calcification stage. In a study done by Trakiniene G. significant association between maxillary canine stage 5 (r=0.812), mandibular second molar stage 5 with P<0.01, and CVM stage 3 was found. [6]

However, a study on the correlation of teeth calcification using the modified Gleiser and Hunt method with peak pubertal growth spurt stage is not available in Pakistan. The finding from this study will help use dental calcification as an estimate of a peak-pubertal growth on the panoramic radiograph as a substitute to the CVM method, thus eliminating additional radiographic exposure.

Material and Methods

A cross-sectional study with IRB numbers 5/ERC/CMHLMC and LMDC/FD/125/24 respectively, was undertaken at two centers in Lahore, following ethical approval. The investigation lasted six months and a sample size of 100 was estimated with a 95% confidence level through WHO Sample size calculator. The expected correlation is, r = 0.82.

The study comprised patients of both genders, aged between 11-15 years having class II malocclusion, with normal growth and development, and absence of congenital anomalies, such as hypodontia as per medical history and clinical examination. The patients with permanent teeth extracted, abnormal dental conditions such as dilaceration and fusion, and serious medical illness were excluded.

After approval of the hospital's ethical review committee, calculated sample was included in the study. Informed consent from each patient's parents/guardian was obtained and demographic details were also recorded. Digital OPG and lateral cephalogram exposures were done as a part of routine orthodontic treatment.

In this study, the (right) maxillary canine and mandibular 2nd molar teeth were used as indicators. We choose maxillary canine because after its eruption transition to permanent dentition is completed in the maxillary arch. Mandibular second molars were selected because of the ease of evaluation of their roots on Panoramic radiographs. The teeth calcification stage (stage 5) was measured by the modified Gleiser and Hunt method [6] on Panoramic radiographs (Figures 2 and 3). The maxillary canine was considered to be at dental calcification stage 5 by completely closed root apex and even periodontal width around the root and its apex. The mandibular 2nd molar was considered to be at dental calcification stage 5 by partly open root apex and parallel root walls.

The peak pubertal growth stage (CVM 3) was estimated by the CVM method [7] on Lateral cephalometric radiographs. Confounding variables were controlled during the data analysis stage through stratification.

Statistical Analysis

Data were assessed in SPSS version 21. Quantitative variables were explained as mean and standard deviation while qualitative variables such as gender, dental stages, and skeletal stages were presented in the form of frequency and percentages. Spearman's rank correlation test was carried out to see the correlation between the peak-pubertal growth stage (CVM stage 3) and dental calcification stage 5 of maxillary canines and mandibular 2nd molars. P-value ≤ 0.05 was considered statistically significant. Data were stratified for age and gender.

Result

The study group consisted of 100 patients; 71 were females and 29 were males. The mean patient age for males was 14.31±1.168 and females 14.52±1.026 respectively.

The correlation found between CVM stage 3 and canine calcification stage 5 with a p-

value>0.05 was insignificant. An insignificant correlation was found between CVM stage 3 and second molar calcification stage 5 with a p-value>0.05. however, the second molar calcification stage 5 and canine calcification stage 5 were significantly correlated with a p-value <0.05 (Table I)

Table I: Correlation between Cervical vertebral maturation stage 3, Maxillary canine calcification stage 5, and Mandibular molar calcification stage 5

	CVM Stage 3 and Maxillary canine calcification stage 5	CVM stage 3 and Mandibular molar calcification stage 5	Canine stage 5 and Molar stage 5
Spearman's Correlation	0.004	0.035	0.433
p-value	>0.05	>0.05	<0.0005
No. of cases	100	100	100

Discussion

Treatment time is the key variable in determining the outcome of the orthodontic treatment. In growing patients having deficient mandibles, growth modification is the recommended treatment. This treatment is most successful when started during the adolescent growth spurt. To determine the stage of the adolescent growth spurt, various methods have been proposed in the literature, for example, hand and wrist skeletal maturation method, cervical vertebrae maturation method, and dental mineralization method. Most of the studies show inconsistent outcomes while examining the correlation between dental mineralization and the skeletal maturity stages.[8-9]

In our study of Class II malocclusion patients, we found a negative correlation between dental calcification stage 5 of maxillary canine and the mandibular second molar with peak-pubertal growth CVM stage 3. This is similar to the findings of Perinetti which reported a low diagnostic value of lower teeth for the determination of peak-pubertal growth spurt. They examined three hundred and fifty-four subjects comprising 208 girls and 146 with a mean age of 11 years, ranging from 6 years to 17 years. They assessed the dental maturation through the calcification stages of the permanent lower cuspid, first and second bicuspids, and second molar from the dental panoramic radiograph using the Demirjian method. [10]

In our study, an insignificant correlation was found between cervical vertebral maturation stage 3 and maxillary canine calcification stage 5. Our result is in accordance with the findings of Şahin Sağlam who reported the lowest correlation for the first lower bicuspid and upper canine. The study was carried out on 422 children (276 females, 146 males) with ages from 91 to 168 months on pre-treatment left hand and wrist, orthopantomogram, and periapical radiograph. They suggested that the relationship between teeth mineralization and skeletal maturity is not strong for teeth mineralization to be utilized as a method of assessment for skeletal maturation.[11]

This was also in agreement with the result of Sachan who found a negative correlation between the development of canine teeth and skeletal maturity (r= 0.49) in the Greek population. [12]

However, our results were in disagreement with the findings by Rasool G, which reported that the correlation between cervical vertebrae maturation and dental calcification is highly significant (r=0.871 p=0.000). They conducted a study on dental panoramic and lateral cephalograms of 100 patients in a Pakistani population and dental calcification of mandibular canine and skeletal maturation was determined with Demirjian method and cervical vertebrae maturation respectively. [13]

This was supported by results from the study by Trakinienė G that reported correlations between the cervical vertebrae maturation and teeth mineralization stages highest between the upper cuspid (r = 0.812) and the lower second molar having P < 0.01. CVM stage 3 corresponds to maxillary canine calcification stage 5, and mandibular second molar calcification stage 5. Their sample consisted of 274 patients (age 7-19 years) and upper right cuspid, lower 2nd, and 3rd molar

were used as a marker. Dental calcification was determined using the modified Gleiser and Hunt method and skeletal age was determined through CVM method. [14]

Our results agree with the result of Perinetti G who studied lower second molar maturation diagnostic ability to determine the peak mandibular growth stage and concluded the same. Their sample consisted of forty subjects from Burlington and Oregon growth studies with twenty males and twenty females with lateral cephalograms taken from nine to sixteen years annually. Lower second permanent molar maturation was determined by the Demirjian method and yearly increments of Co-Gn distance defined the growth of the mandible.[14] However, recent studies by Mollabashi and others reported that the correlation between dental, CVM and chronological age was significant.[15-18]

A possible explanation for the differences between our study and the findings of other studies may be partially due to different assessment methods used and partially from variations in age bracket, and ethnicity of the examined patients that were affected by ethnicity, nutrition, and socio-economic status.

Our study had limitations which were mainly the small sample size and uneven representation of gender categories. The distribution value was very high in the groups, so it was difficult to assess additional parameters.

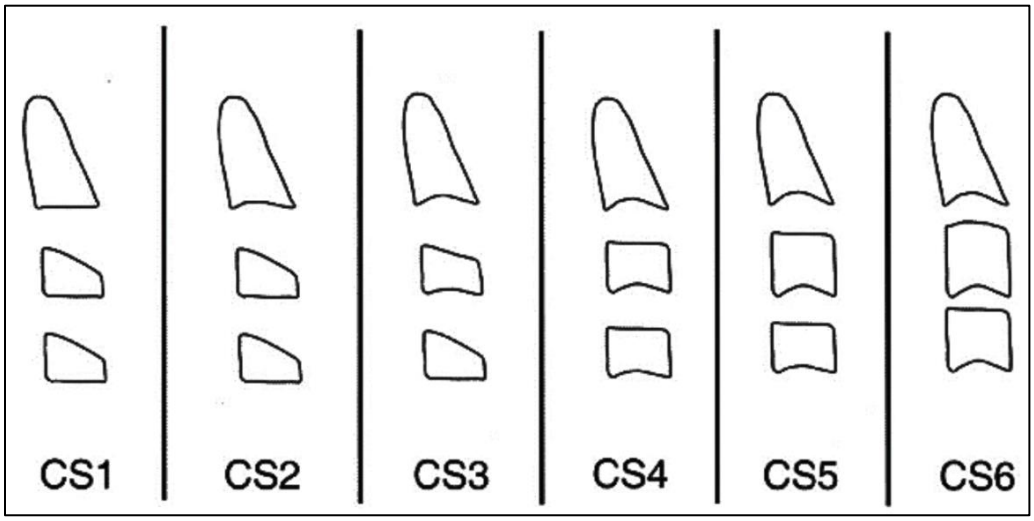

Figure 1: Diagrammatic representation of modified six-stage cervical vertebral maturation index. (Adapted from Baccetti et al.(4))

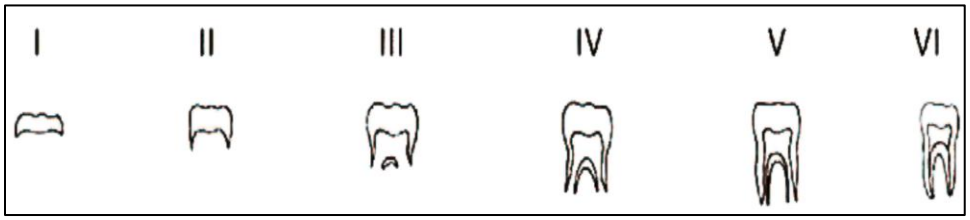

Figure 2: Diagrammatic representation of calcification stages for the mandibular second molar from the modified Gleiser and Hunt method. (Adapted from Trakinienė G.(6))

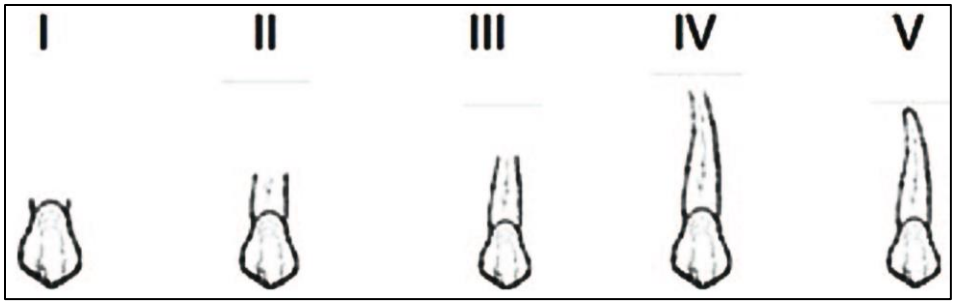

Figure 3: Diagrammatic representation of calcification stages for maxillary canine from the modified Gleiser and Hunt method. (Adapted from Trakinienė G.(6))

Conclusion

Determination of dental calcification stage 5 according to the modified Gleiser and Hunt method of maxillary canine and the mandibular 2nd molar on the dental panoramic radiograph could not be used to assess the timing of skeletal maturation. It is not possible to predict the reliability of this method until a larger sample size is used. The dental maturation method is to be used cautiously in combination with other methods e.g., Hand and wrist radiographic skeletal assessment methods to determine the skeletal maturation status of the subjects.

Ethical Approval

This study was approved by ethical review committee of CMH Lahore Medical & Institute of Dentistry, Lahore (IRB numbers 5/ERC/CMHLMC and LMDC/FD/125/24).

Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

AN: Conceptualization, data curation writing, original draft preparation, Data Collection.
SS: Data Collection, Data Entry, and Literature Search.
MQS: Writing review, editing, visualization supervision, formal analysis.
JIAK: Project administration, resources, software validation, data interpretation.
HMZM: Methodology, investigation, data interpretation.
TK: Methodology, investigation, data interpretation.

References

1. Angle E. Classification of malocclusion. Dental Cosmos. 1899;41(3):248-64.
2. Mitchell L. An introduction to orthodontics: Oxford University Press; 2019.
3. Khan SQ, Ashraf B, Khan AQ, H. M. Prevalence of malocclusion and its relation with crowding and spacing. Pak Oral Dental J. 2014;34(3):472-76.
4. Baccetti T, Franchi L, McNamara JA, Jr. An improved version of the cervical vertebral maturation (CVM) method for the assessment of mandibular growth. The Angle orthodontist. 2002;72(4):316-23.
5. Perinetti G, Franchi L, Contardo L. Determination of timing of functional and interceptive orthodontic treatment: a critical approach to growth indicators. J World Fed Orthod. 2017;6(3):93-7.
6. Trakiniene G, Smailiene D, Kuciauskiene A. Evaluation of skeletal maturity using maxillary canine, mandibular second and third molar calcification stages. European journal of orthodontics. 2016;38(4):398-403.
7. Baccetti T, Franchi L, McNamara Jr JA. The cervical vertebral maturation (CVM) method for the assessment of optimal treatment timing in dentofacial orthopedics. Semin Orthod. 2005;11(3):119-29.
8. Demirjian A, Buschang PH, Tanguay R, Patterson DK. Interrelationships among measures of somatic, skeletal, dental, and sexual maturity. Am J Orthod. 1985;88(5):433-8.
9. Sierra AM. Assessment of dental and skeletal maturity. A new approach. The Angle orthodontist. 1987;57(3):194-208.
10. Perinetti G, Contardo L, Gabrieli P, Baccetti T, Di Lenarda R. Diagnostic performance of dental maturity for identification of skeletal maturation phase. European journal of orthodontics. 2012;34(4):487-92.
11. Sahin Saglam AM, Gazilerli U. The relationship between dental and skeletal maturity. Journal of orofacial orthopedics = Fortschritte der

Kieferorthopadie: Organ/official journal Deutsche Gesellschaft fur Kieferorthopadie. 2002;63(6):454-62.
12. Sachan K, Sharma VP, Tandon P. A correlative study of dental age and skeletal maturation. Indian Journal of Dental Research: official publication of Indian Society for Dental Research. 2011;22(6):882.
13. Rasool G, Hussain U, Shah SS. Evaluation of the skeletal maturation using lower canine mineralization. Pak Oral Dental J. 2014;34(4):629-34.
14. Perinetti G, Sossi R, Primozic J, Ierardo G, Contardo L. Diagnostic reliability of mandibular second molar maturation in the identification of the mandibular growth peak: A longitudinal study. The Angle orthodontist. 2017;87(5):665-71.
15. Mollabashi V, Yousefi F, Gharebabaei L, Amini PJIO. The relation between dental age and cervical vertebral maturation in orthodontic patients aged 8 to 16 years: a cross-sectional study. 2019;17(4):710-8.
16. Qureshi T, Duggal R, Chaudhari PKJIO. Correlation between chronological age and skeletal maturity in different malocclusions: a retrospective study. 2021;19(3):453-61.
17. Magat G, Ozcan SJISiD. Assessment of maturation stages and the accuracy of age estimation methods in a Turkish population: A comparative study. 2022;52(1):83.
18. Barreto BCT, Marañón-Vásquez GA, da Costa Barreto LS, Masterson D, de Souza MMG, Maia LC. Is there a correlation between dental and cervical vertebrae maturation stages in growing subjects? A systematic review with meta-analysis. Clinical oral investigations. 2022;26(5):3823-42.