

Assessment Of Growth Status By Correlating The Maturation Stages Of Middle Phalanx Of Third Finger And Calcification Stages Of Mandibular Third Molar In An Institutional Set Up

Research Article

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Abstract

The aim of this study was to assess the correlation between maturation stages of the middle phalanx of third finger and calcification stages mandibular of third molar in 9-16 year old children in the South Indian population. A total of 39 subjects between the age group of 9-16 years were selected for this study. Their pretreatment digital panoramic and hand-wrist radiographs were retrieved from the DIAS software provided by Saveetha Dental College and Hospital, Chennai, Tamil Nadu, India. These records were analyzed using the Demirjian index for mandibular third molar maturation stage and Modified MP3 method for Middle phalanx maturation stage. Pearson's Chi-Square tests were done to analyse the association between Mp3 stages and mandibular third molar calcification stages. The statistical tests were performed in SPSS software. The results of this study showed that there is statistically significant association between Demirjian stages of mandibular molar and modified MP3 stages in both males ($p < 0.000$) and females ($p < 0.002$). Within the limitations of this study, it was concluded that calcification stages of mandibular third molar should be used as an adjunctive tool to assess growth. As third molars are known to have many variations, individual variation could be taken under consideration.

Keywords: Growth Spurt; Modified MP3 Method; Demirjian Index; Mandibular Third Molar.

Introduction

Measurements of growth are commonly interpreted in reference to levels of maturity in some parts of the skeleton, which can influence further clinical management. The changes seen with maturation are evident in many parts of the body including the craniofacial skeleton and dentition, during the process of growth and development of any somatic structures. Time plays a crucial role in determining the final morphological and dimensional results [1]. In growing individuals, the orthodontic treatment depends on skeletal growth. Orthodontic diagnosis and treatment planning for the growing children must involve growth prediction, especially in treatment of skeletal problems [14]. The knowledge of a patient's stage of growth and development plays a vital role

in diagnosis, treatment planning, results, and stability of the outcome of the treatment [24].

Chronologic age conveys only a rough approximation of the maturational status of an individual. Hence, dental and skeletal ages had been explored as maturity indicators in many studies [30].

Growth modulation procedures, which bring about changes in skeletal base such as the use of extra oral orthopedic force or functional appliances are suggested to be initiated during active growth periods [25]. These active growth periods have to be assessed objectively for both the timing and amount of active growth vector or direction of growth. Maturation status of an individual can be best evaluated relative to different stages of

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physiologic maturity rather than evaluating it with chronologic age. In some studies, gonial angle is widely used in orthodontic cephalogram tracing. It is considered as a valuable indicator to diagnose the growth pattern of patients.

Hand-wrist radiographs were made as a supplemental diagnostic aid to other essential diagnostic radiographs such as intraoral periapical (IOPA), orthopantomogram (OPG) and lateral cephalogram in order to measure skeletal growth. The validity of hand-wrist radiographic analysis has been confirmed by numerous studies [11, 13, 15, 27]. The orthopantomogram is a radiographic examination extremely useful in all dental specialities, especially orthodontics (Baskaran, no date). Cephalometrics is an important diagnostic tool in the field of orthodontics [17]. It is used to assess the relationship of the jaws in all three spatial planes, namely, anteroposterior, vertical and transverse. CBCT is considered as an ideal advanced diagnostic imaging modality in the field of modern dental practice. But radiation exposure is high compared to other radiographic modalities. Hence, for this study the use of CBCT was excluded.

Many studies [14, 27] have shown that there is a strong association between skeletal maturation and dental calcification stages. Generally, dental development can be assessed by either the phase of tooth eruption or stage of tooth calcification. The ability to assess skeletal maturity by stages of mandibular third molar calcification from an OPG would offer an advantage over conventional hand-wrist radiographic methods as no additional exposure to radiation would be necessary for the assessment of skeletal maturity. This allows us to follow the "As Low As Reasonably Achievable" (ALARA) principle [22].

The most common problem in any diagnostic system is to establish a range of normality. Hence, this study was done to provide a simple and practical method for assessing skeletal maturity using OPG by comparing the eight developmental stages of the third molar using the Demirjian index with that of six developmental stages of modified MP3 of the left hand and finding correlation between them. The data obtained from the study was tabulated.

Materials and Methods

This retrospective cross-sectional study was carried out at

Saveetha Dental College, Chennai, Tamil Nadu, India. A total of 39 subjects between the age group of 9-16 years were selected for this study. Their respective OPG and hand-wrist radiographs were obtained from the patient record provided by the institution. The radiographs of the subjects with muscular dystrophy, congenital abnormalities affecting growth and development, traumatic lesions of the jaw or hand-wrist, and other systemic conditions were excluded. Evaluation of the dental maturity of the mandibular third molar was done with the Demirjian Index on OPG. The evaluation of skeletal maturity was done on hand-wrist radiographs by modified MP3 method.

All statistical analysis and data management were performed using SPSS software for Windows and Google Excel Spreadsheet, respectively. Analyses were done in both males and females of the sample group. Pearson's Chi-square tests were done to estimate the association between maturation stages of MP3 and mandibular third molar.

Results and Discussion

In the present study a statistically significant association was found between Demirjian Index and modified MP3 in males ($p < 0.000$) (Fig.1) and females ($p < 0.002$) (Fig.2).

Among males, there is a statistically significant association between Demirjian index stage 4 and MP3 index stage 2 (Figure.1). Among females, the stage 4 of the Demirjian index has a significant association with stage 3 and 4 of the Modified MP3 index (Figure.2).

Previously our team had conducted numerous clinical trials [18, 21, 36, 31, 8, 29, 35], lab animal studies [26, 16, 28, 7, 20] and in-vitro studies [10, 5, 9] over the past 5 years. Now we are focussing on epidemiological surveys. The idea for this survey stemmed from the current interest in our community.

In this study, the results showed statistically significant positive correlation between dental maturity (DI) and skeletal maturity (MP3) which is consistent with findings of Mehta et al [23], Suma et al [32], Sun-Mi et al [4] and Engstrom et al [6]. The correlation between the calcification stages of mandibular third molar and MP3 of left hand was found to be significantly high ($P < 0.002$) for

Figure 1. The bar chart represents the association between the Demirjian Index for mandibular third molar maturation and MP3 for skeletal maturation among male population. The X-axis represents the Demirjian Index of the mandibular third molar and Y-axis represents the Modified MP3 method. There is a statistically significant association between Demirjian index stage 4 and Modified MP3 index stage 2. (Pearson's Chi-Square value - 38.57, $p < 0.000$).

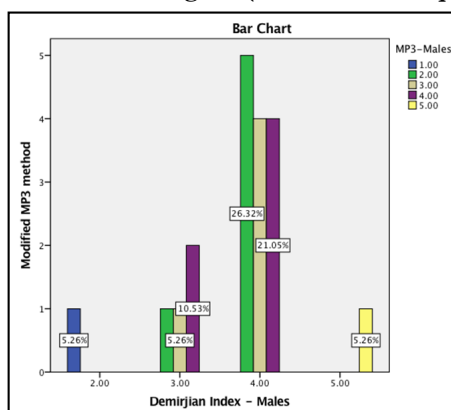
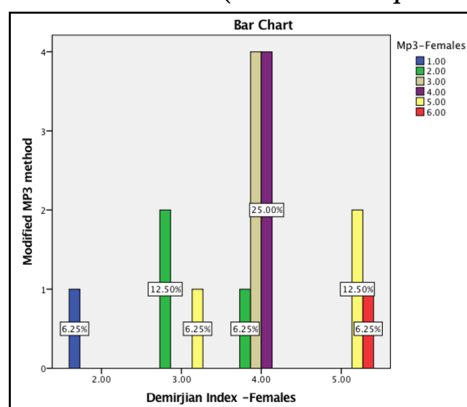


Figure 2. Bar chart represents the association between the Demirjian Index for mandibular third molar maturation and MP3 for skeletal maturation among the female population. The X-axis represents the Demirjian Index of the mandibular third molar and Y-axis represents the Modified MP3 method. The stage 4 of the Demirjian index has a significant association with stage 3 and 4 of the Modified MP3 index. (Pearson Chi square value-36.15, P value=.002, $P < 0.05$).



both genders. A variety of cephalometric analyses have been described for different applications by ascertaining the dimensions of lines, angles and planes between anthropometric landmarks established by physical anthropologists and points selected by orthodontists. Their primary use is to provide a means of comparison for individual dentofacial characteristics with a population average in order to identify areas of specific deviation, as well as describe the spatial relationship between various parts of the craniofacial structures.

In the study done by Sun-Mi et al, the relationship between mandibular third molar calcification and skeletal maturity was investigated using Demirjian index, skeletal maturation, and CVM indicators. Upon examination of the intercorrelations, each showed a statistically significant correlation, with a slightly higher correlation existing between skeletal maturation and Demirjian index than cervical maturation and Demirjian index. Authors pointed out the end of growth spurt coincides with formation of the pulp chamber, root length being equal to or greater than the crown height of the third molar [4]. Such findings correspond to those of Chertkow and Fatti [3], and Engstrom et al [6] also reporting strong correlation between third molar formation and skeletal maturity.

Assessment of a patient's puberty and development events is one of the most basic and important elements in orthodontic treatment. Information regarding pubertal growth spurt of the patients plays a significant role in diagnosis objectives and selection of treatment modalities [19]. The use of hand-wrist radiographs has been advocated in order to assess the skeletal age of the individuals. Several studies [11, 15, 34] have shown that the timing of pubertal growth of craniofacial region is closely related to specific ossification of events and stages observed in the hand-wrist area of the skeleton. Hence, hand-wrist radiographs have been considered to be a valuable diagnostic tool in Orthodontics. However, these radiographs can cause unnecessary radiation exposure to the patient. The ALARA principle is important especially for children and young adults. The ease of distinguishing the stages of dental development and availability of OPG are the practical reasons for attempting to assess the physiologic maturity as an alternative to hand-wrist radiographs.

In contrast to the findings of this study, the studies done by

Krailassiri et al [19] and Uysal et al [34] showed that the third molar demonstrated the poorest correlation. Garn et al [12] and Tanner [33] have reported low or insignificant correlations between the level of skeletal and dental maturation. The lack of concordance among the results of previous studies may be attributed to the different methods used for assessing skeletal and dental maturity.

This study in its entirety is a theoretical one and is based on well-known mathematical and physical formulae. It is important to take into account that different samples may influence the results of the correlation between the teeth and bone maturity, especially in the third molars, as they are known for their many variations based on previous studies. The concordance between teeth development and skeletal maturity could allow practitioners to use mandibular third molars as an auxiliary to evaluate skeletal maturity stage in the growing patients from the panoramic radiographs. The present study is limited to a certain population. It has a small sample size.

Conclusion

Within the limitations of the present study, it can be concluded that mandibular third molar calcification stages are as reliable as skeletal indicators, which can be used to predict growth status to determine optimal treatment time. As third molars are known to have many variations, individual variations should be taken under consideration.

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