

# Comparison between Maxillary Canines Mandibular Second Molar and Skeletal Maturity Indicators for Assessment of Pubertal Growth Status – A Radiograph Study

Baha ul Haq Khan

Department of orthodontics, Jaipur Dental College, India

## Abstract

**Objective:** Our objective was to assess the developmental stages of maxillary canine and mandibular second molar in different age groups and to find the correlation with skeletal maturity using maxillary canine and mandibular second molar calcification stages

**Material and methods:** In this cross sectional study samples were derived from OPG and Hand-wrist radiographs of 120 patients whose age ranged from 8-16 yrs (60 males and 60 females). Demirjian method was used to estimate the dental age through assessment of different calcification stages of maxillary canine and Mandibular second molar. Skeletal stage was determined using Julian singer method by using hand-wrist radiographs.

**Results:** On comparing both genders, more number of females were showing advanced stages at an earlier age than males. Values showed gradually increasing stages of maxillary canine and mandibular second molar root development with age in both genders. On comparing both genders, more number of females showed advanced stages at an earlier age than males. Paired T-test revealed no significant difference between mean dental and skeletal age. Tendency toward late skeletal maturation and early dental maturation was observed. Spearman rank order test showed high correlation between skeletal maturity markers and dental maturity markers of maxillary canine and mandibular second molar.

**Conclusion:** Calcification stages of Maxillary canine and Mandibular second molar showed that females had more chances to be within peak stages than males because of the maximum growth spurt in females.

**Keyword:** calcification stages, growth, skeletal maturity

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## I. Introduction

Growth and development of children is considered to be most important factor for orthodontist for age prediction for treatment planning. It is however known to vary between populations and can alter treatment planning. In growing individual, orthodontic treatment depends on skeletal growth rather than physiologic or chronological age.<sup>2</sup> To detect skeletal growth, routinely hand-wrist radiograph is taken which is a supplemental diagnostic aid apart from essential diagnostic radiographs such intra oral periapical radiographs, OPG, and lateral cephalogram

The ability to assess skeletal maturity by the developmental stage of the dentition through the examination of an OPG offers several advantages over the conventional hand-wrist radiographic method. In Orthodontic treatment most commonly used is Orthopantomography than hand wrist radiograph. To reduce radiation exposer with children and skeletal maturity identification, several investigators have evaluated the association between dental maturity and chronological age in different populations.

There's a little data available about relationship between skeletal maturity and the calcification of teeth for Indian children. Also the detection of skeletal growth of an individual through calcification stages of maxillary canine and mandibular second molar needs more investigation. There is limited information in literature regarding skeletal growth assessment by using OPG. Hence in this study an attempt was made to fill the lacunae regarding the skeletal growth assessment by using OPG in children from Jaipur city.

## II. Material And Methods

Pre-treatment OPG and Hand-wrist radiographs of 120 subjects [60 girls and 60 boys] were obtained from the records of patients who were seeking orthodontic treatment in Jaipur Dental College.

OPG and Hand-wrist radiographs were graded according the Demirjian's tooth calcification stage and Julian Singer Hand- wrist radiograph stage. Radiographic assessments of dental and skeletal maturity was performed simultaneously using an illuminated viewing box in a dark room by trained oral radiologist The Inclusion criteria constitute: children with normal growth and development within the age group of 8 to 16 years, children with intermediate or late mixed, or early permanent phases of dentition. Children suffering from serious illness and systemic diseases were excluded from the study.

OPG and Hand-wrist radiograph were taken in single panoramic X ray a machine at the same time for each subject by keeping all the exposure parameters constant.

The research objectives were explained to the patients and / or their parents before starting treatment.

The study protocol was reviewed and approved by the institutional ethical committee.

### **III. Methods**

OPG and Hand -wrist radiograph of each individual was taken with a universal counter balancing type of cephalostat at Jaipur Dental College. Hand wrist radiograph were taken with fingers slightly separated.

#### **Assessment of individual dental maturity**

Assessment of dental maturity was carried out through the calcification stages, according to Demirjian method(Stages D to H), in the OPG of the maxillary canine and mandibular second molar:

Stage D: Crown formation is complete down to the cemento- enamel junction and the beginning of root formation is seen, in the form of a spicule.

Stage E: Larger than that in the previous stage and the root length is less than the crown height.

Stage F: The root length is equal to or greater than the crown height.

Stage G: Apical end is still partially open.

Stage H: The apical end of the root canal is completely closed.

After assignment of a calcification stage for maxillary canine and mandibular second molar, stages were converted to scores through a conversion table, and then a score was calculated for each subject.

#### **Assessment of individual skeletal maturity**

Julian Singer method for skeletal maturity identification was used in Hand-wrist radiograph. These stages are defined as:

Stage 1 (Early): Epiphysis of proximal phalanx of second finger being narrower than its diaphysis.

Stage 2 (prepubertal): Epiphysis of proximal phalanx of second finger is equal to its diaphysis in width.

Stage 3 (pubertal onset): Increased width of epiphysis of proximal phalanx of the second finger.

Stage 4 (pubertal): Capping of the diaphysis of the middle phalanx of third finger by its epiphysis.

Stage 5 (pubertal deceleration): Fusion of epiphysis of distal phalanx of third finger with its shaft. Epiphyses of radius and ulna not fully fused with respective shafts.

Stage 6: Fusion of epiphysis of radius and ulna with respective shafts.

#### **Statistical analysis**

In this study we have to use Spearman rank correlation because it is a non-parametric test that is used to measure the degree of association between two variables. Spearman rank correlation test does not assume any assumptions about the distribution of the data and is the appropriate correlation analysis when the variables are measured on a scale that is at least ordinal and scores on one variable must be monotonically related to the other variable.

### **IV. Results**

Assessment of dental maturity was carried out through the calcification stages, according to Demirjian. Out of 60 boys, majority 42% of subjects shows stage E (Root formation has begun) at the age of 12 years, while in 60 girls, majority 34.2% of girl's shows stage G (Parallel root walls with open apices) at the age of 11 years. The date of calcification is same for two teeth for particular period of growth and calcification stage advances in girl then boy at age between 11-12 years.

Table 1 and 2 Shows skeletal maturity according to Julian Singer Hand-wrist method in boys and girls. Correlation of maxillary canine root formation stage with hand wrist radiograph

Max. canine root formation	Hand wrist radiograph				
boys	Skeletal maturity staging				total
	2	3	4	5	
D	1	0	0	0	1
E	31	3	0	0	34
F	0	1	0	0	1
G	4	13	0	1.7	18
H	0	3	1.7	0	3

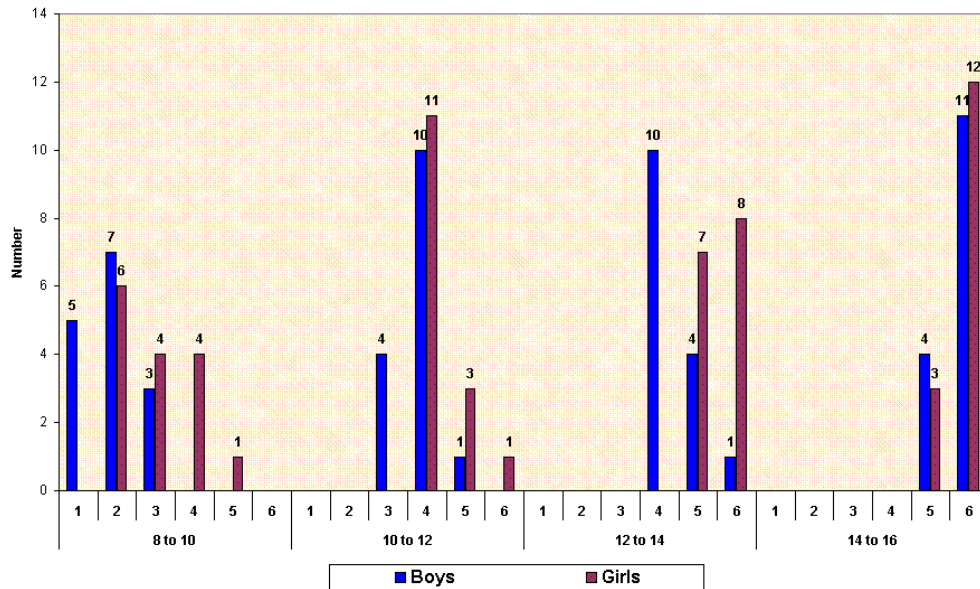
**Table 1: Julian singer hand wrist method for boys**

Max. canine root formation	Hand wrist radiograph				
girls	Skeletal maturity staging				total
	2	3	4	5	
D	1	2	3	7	13
E	5	7	1	1	14
F	1	2	0	0	3
G	1	13	6	6	26
H	1	2	3	7	13

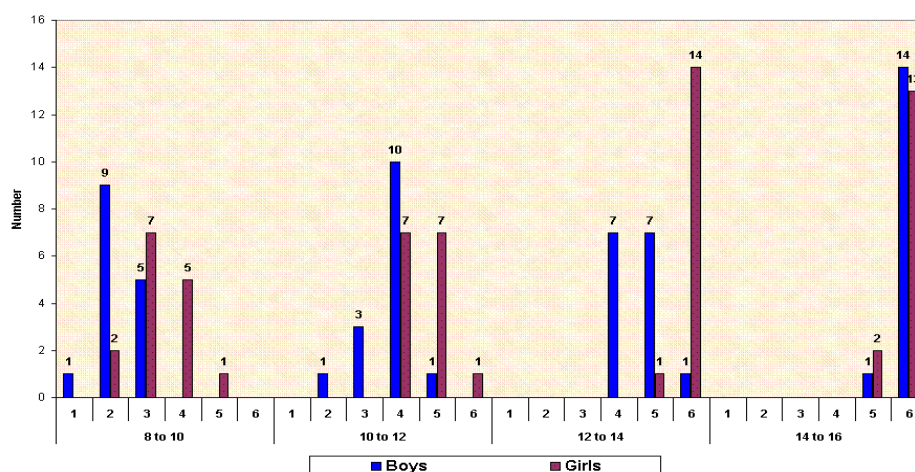
**Table 2: Julian Singer wist method for girls**

54.38% of boys shows stage E (Root formation has begun) of maxillary canine same time, hand wrist radiograph shows stage 2 (prepubertal), while 22.80% of girls shows stage G (Parallel root walls with open apices) of maxillary canine same time Hand wrist radiograph shows stage 3 (pubertal onset), so we conclude that in boys stage E and in girls stage G shows peak stage of growth.

**Number of subjects in Maxillary Canine Grades by Age and Sex**



**Number of subjects in Mandibular Second Molar by Age and Sex**



## V. Discussion

The present study represents a basic investigation to establish the relationship of maxillary canine and mandibular second molar root formation to growth status. Chronologic age conveys only a rough approximation of the maturational status of a person, hence dental and skeletal ages have been explored as maturity indicators since decades. Assessing maturational status, can have a considerable influence on diagnosis, treatment planning, and the eventual outcome of orthodontic treatment. Growth modulation procedures which bring about changes in the skeletal base such as use of extra oral orthopaedic forces or functional appliances are based on active growth periods.<sup>6</sup>

This study help to determine growth potential in the adolescent patient with help of orthodontist and pedodontist. Because of individual variations on timing, duration and velocity of growth, skeletal age assessment is essential in formulating viable orthodontic treatment plans. Hand wrist radiograph most commonly used for skeletal maturity identification. To avoid taking an additional X-ray, however, some researchers have sought to relate maturation with dental and skeletal features.<sup>7</sup> Very few studies have shown that there is an association between bone development and dental calcification therefore, the stages of dental calcification can be used as the first tool for diagnosis. Dental maturity assessment offers the advantage (over skeletal maturity indicator) of being a simple procedure that can be carried out on panoramic and intraoral radiographs that provide minimal irradiation to the patient and easy determination of the calcification stages of teeth. On this basis, few researchers have proposed dental maturation to be a clinically useful diagnostic aid for the identification of individual skeletal maturation stages.<sup>8</sup>

The Julian Singer method and Demirjian method seems to be highly practical for clinical use in skeletal age assessment and tooth calcification assessment.

Mappes et al indicated that the predominant ethnic origin of the population, climate, nutrition, socioeconomic levels, and urbanization are causative factors of these racial variations. In normal child, the apex closure of Maxillary canine is completed by the age of 15 years, while Mandibular second molar extend up to 16 years.<sup>9</sup>

This makes the tooth more reliable as a maturity indicator since most children exhibit a period of active growth up to the age of 16-17 years, this is in agreement with the findings of Al- Bustani.<sup>5,10</sup>

No significant difference between chronological age and skeletal age assessed by SMI, similar findings were reported by Ha'gg.<sup>11</sup> But This is also not in accordance with some of the previous studies by Divyashree et al and Sahin Salam et al.<sup>12,13,7</sup> On comparing developmental stages of maxillary canine and mandibular 2<sup>nd</sup> molar in males and females, significant differences were found. Similar findings were reported by Hegde et al.<sup>14,12</sup>

Male patients shows stage E at the age of 12 years, while many of female patient's shows stage G at the age of 11 years.

Calcification stage of Mandibular second molar there will be more chance for males than females to be within peak stages, this is because the maximum growth spurt in female occurs at earlier age than male, which turn to affect the skeletal maturation more than the dental development. Our study also shows same results.<sup>15</sup>

On comparing developmental stages of maxillary canine, In Female stage G of maxillary canine coincides with stage 3 of Hand wrist radiograph, while in Male stage E coincides with stage 2 of SMI (Table 1 and 2). These stages represent the peak of the pubertal growth spurt. This finding supports the suggestions of previous studies.

The present study revealed a highly significant association between the developmental stages of mandibular 2<sup>nd</sup> molar and SMI, stage E coincides with stage 3 of SMI in females and stage 2 in Males (Table 3 and 4).

In panoramic radiographs, tooth calcification stages clinically useful for skeletal maturity indicator at the period of pubertal growth.

The ability to accurately appraise skeletal maturity from maxillary canine and mandibular second molar calcification, without the need for additional radiographs, has the potential to improve orthodontic diagnostic and therapeutic decisions. The hand wrist radiograph should be seen as a complement, rather than a replacement, to other valid methods to evaluate a child's physical condition. The techniques simplicity and ease of use should encourage these methods as first level diagnostic tool to assess skeletal maturity. Therefore, it is practical to consider the relationship between dental and skeletal maturity when assessing age of an individual in the age group of 8-16 years. There are remarkable differences in the distribution of tooth calcification and mineralization phases between sexes. Girls usually begin and end their dental development earlier than boys. Clinically, these differences suggest the need to start orthodontic treatment earlier in girls than in boys.

## VI. Conclusion

Calcification stages of maxillary canine and mandibular second molar can give a guide for the puberty period, in stage D all males and females are in pre peak stage, in stage E and F they are within pre-peak and peak stages with more male(54.38%) than female maturity. In stage G, males in peak stage, whereas about one third of females (22.80%) passed to post peak, in stage H, less than 10% of males passed to post peak, while 80% of females are within post peak stage.

The apex closure of Maxillary canine is completed by the age of 15 years, while Mandibular second molar extend up to 16 years.<sup>9</sup> Calcification stages of this two teeth, there will be more chance for males than females to be with in peak stages, this is because the maximum growth spurt in female occurs at earlier age than male.

The findings of this study indicate that tooth calcification stages might be clinically used as skeletal maturity indicator at the period of pubertal growth.

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