# Age Estimation by Morphological Analysis of Third Molar Maturity on Orthopantomograph

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## Abstract

The present study was aimed to estimate the age of an individual by morphological analysis of third molar maturity on orthopantomograph. The study was undertaken at the Dept of Orthodontics, Rural Dental College, Loni, from 1st March 09 to 31st August 09, among students of Rural Dental College, Loni in the age group of 16 to 23 years. Assessment and fixing of age of a person in these age groups is necessary in issues pertaining to establishing criminal responsibility, dispensing judicial punishment, classification of an offence as rape and kidnapping, validity of marriage contract and attainment of majority. Orthopantomograph of 196 subjects were taken, of which half i.e. 98 were male and 98 were females. Developmental stages of 3rd molars in all four quadrants were evaluated using Demirjian 8 stage scoring scale. The predominant developmental stage in age 16 years in all quadrants was 'D'. In females it appeared in the range of 60-70%, while it was in the range of 71.4- 86 % in males. In age 18 years predominant development stage in females in upper jaw was 'F' in 60 % cases, while in lower jaw it was in the range of 20-40 %. Stage 'G' was seen in 20 % cases in all quadrants. Stage 'H' appeared in upper jaw in 20 % cases. In males predominant stages seen in upper jaw were 'F' and 'G' in 50 % cases each. In the lower jaw 'F' was the predominant stage followed by 'G' in 33.3 % cases. Our study results confirm the utility of morphological analysis of third molar maturity by Demirjian 8 stage classification on orthopantomograph as a means of estimating biological age of the subjects and can be practically implemented.

**Key words**: Dental age, Third molar, Demirjian's score scale, orthopantomograph

## Introduction

Age assessment of living has become increasingly important over the last few years, with the questions of criminal responsibility, rape, kidnapping etc, frequently confronting the medico-legal experts[1-4]. Age detection is a complicated procedure. Determining chronologic age in persons within the range of 15.5 to 23.5 years remains a problem. There are many ways of determining age in human. Morphological and radiological examination of skeletal features and examination of the development of third molars are useful for estimation of age in this juvenile age group. But, it is known that chronology of dental development is less variable than bone development and teeth, being the hardest calcified tissue in the body, tend to be intact even when other components of the skeleton have disintegrated. Hence the dental examination method applied for this particular period of life is a reliable indicator of age. The continuation of third molar development during adolescence makes the third molar most useful when there is a need to determine the juvenile or adult status of an individual.

The dental development has shown a good correlation with chronological age. A number of studies have proved the worth of dental age assessment. In fact the multidisciplinary study group on forensic age diagnostics has also recommended the use of evaluation of orthopantomograms for age assessment [5]. A very meticulous orientation of the various measures of age should be synchronized with reference to chronological age. The dental age has to be

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assessed with reference to the calcification of the crown and roots, the eruption period of teeth, attrition and exfoliation. Considering these associated characters, dental age can be predicted to near accurate calculation.

The development of third molar teeth shows remarkable diversity among different ethnic groups, and thereby the elaboration of maturity standards based on various populations has been suggested for forensic purposes. Up to now several studies have been undertaken in different populations to explore the usefulness of the third molar as a reliable age indicator. These studies show that dental development varies slightly between different populations, making population-specific studies necessary. Hence, it was considered worthwhile to determine third-molar developmental Demirjian 8 stage scoring scale in a sample of Maharashtrian population, to assess chronologic age.

## Material and Methods

The study was carried out in the Dept of Orthodontics, Rural Dental College, Loni. The subjects of the present study consisted of 98 males and 98 females in the age group of 16- 23 years.

The study subjects are bonafide residents of Maharashtra with known birth date and were apparently healthy at the time of study. The subjects were selected by random sampling. The Orthopantomograph were taken at Dept of Oral Radiology & Medicine, Rural Dental College, Loni.

The identification number, sex, date of birth and X-ray examination date of each subject were documented and the developmental stages of the 3rd molar were determined. The age of the subjects was calculated as the date of X-ray minus the date of birth.

The following scoring system was used for classification of 3rd molar eruption stages.

| S. No. | Classification | Characteristics |
|--------|----------------|-----------------|
| 1 | A | Cusp tips are mineralized but have not yet coalesced |
| 2 | B | Mineralized cusps are united so the mature coronal morphology is well defined |
| 3 | C | The crown is about half formed; the pulp chamber is evident and dentinal deposition is occurring |
| 4 | D | Crown formation is complete to the dentino enamel junction. The pulp chamber has a trapezoidal form. |
| 5 | E | Formation of the interradicular bifurcation has begun. Root length is less than the crown length. |
| 6 | F | Root length is at least as great as crown length. Root have funnel shaped endings |
| 7 | G | Root walls are parallel, but apices remain open. |
| 8 | H | Apical ends of the roots are completely closed, and the periodontal membrane has a uniform width around the root. |

**Scoring scale (Demirjian 8 stage classification)** [6]

Impacted wisdom teeth were excluded from analysis. Wisdom teeth with an unclear direction of emergence also were not included in the analysis. All staging was carried out by the same observer.

**Statistical analysis:** It was performed using SPSS software.

### Results

The results of the present study are given in table 1-2. A total of 196 subjects were evaluated of which 98 were males and 98 were females. The details of the same are highlighted in table no 1.

Table 2. shows the various stages of development of 3rd molar teeth in females and males as per the Demirjian classification.

The predominant developmental stage in age 16 years in all quadrants was 'D'. In females it appeared in the range of 60-70%, while it was in the range of 71.4- 86 % in males. The other stages

seen in age 16 were 'E' 10-30% and 'F' 10% in females and stage 'E' in 14.2% cases in males.

Predominant stage in females in age 17 years in upper jaw was 'E' in 57% cases followed by 'F' in 28.7 % cases, while in lower jaw it was 'D' in 57% cases followed by 'E' in 28.7 % cases and 'F' in 14.3 % cases. In males the predominant stage seen in all quadrants was 'E' in 50 % cases, followed by 'F' in 25 % cases. Stages 'G' appeared in this age group in 25 % cases in lower jaw only.

In age 18 years predominant development stage in females in upper jaw was 'F' in 60 % cases, while in lower jaw it was in the range of 20-40 %. Stage 'G' was seen in 20 % cases in all quadrants. Stage 'H' appeared in upper jaw in 20 % cases. In males predominant stages seen in upper jaw were 'F' and 'G' in 50 % cases each. In the lower jaw 'F' was the predominant stage followed by 'G' in 33.3 % cases.

Age 19 years in females showed predominance of stage 'G' in 50% cases along with appearance of stage 'H' in 25-37.5 % cases. Stage 'F' was seen in this subject group in 12.5 % cases, where as in males the stage 'G' was in the range of 42.9-57.1 % and 'H' in the range of 28.6-57.1 %.

The prevalence of stage 'H' in females increased to the range of 50-75 % in age 20 years with stage 'G' being in the range of 25-50 %. In males the stage 'H' predominated all quadrants in range of 57-100 %, when 14.3-28.7 % samples were excluded being absent or not assessable.

In age 21 yrs in females stage 'H' was seen in 100 % cases, and in males it was the only stage seen i.e. 71.4% to 85.7%. 14.3 % samples were excluded being third molar absent or in assessable. Similar findings were also seen in age 22 yrs.

In age 23 yrs 'H' was the predominant stage in females in the range of 62.5-75 %, with presence of stage 'G' in 12.5-25 % samples. In males the presence of stage 'H' was seen predominantly in the range of 71.4-100 %, with exception of Right upper quadrant where stage 'G' was present in 57.1 % samples with the rest 42.9 % either absent or not assessable

**Discussion**

Age assessment has always played a pivotal role in general and medico-legal practice. Be it issues of employment, retirement, marriage, child labor, or identification of the living or dead persons, evaluation of age has a paramount importance.

Various methods are available for assessment of age, namely assessment of cranial suture closure, radiological evaluation of developmental stages of permanent teeth, changes in symphysis pubis, changes in sternal end of ribs, secondary changes in the vertebrae etc. Of these radiological evaluation of developmental stages of permanent teeth gives a fairly accurate assessment of age of an individual.

The various stages of development of the 3rd molar shows a linear correlation with age in both sexes, as evident in other studies too [7-10].

Early maturity stages were predominant in age group 16-18 years as also seen in study by Introna F and colleagues [7].

There was a similarity of maturity stages in both sexes in age 16, 17 and 20 yrs. The predominant stages in these age groups were same i.e. stage 'D' in 16 yrs, 'E' in 17 yrs, 'H' in 20 yrs. Females showed presence of a delay in dental maturity, consistent with findings of other studies [6, 8-10] as were evident from presence/ predominance of early maturity stages as compared to males in the age group 16-20 yrs and 23 yrs. This corroborated the fact that unlike the other teeth which mature and erupt early in females, the third molars mature and erupt later in females.

Age 18 yrs showed distinct difference in the two sexes, as the predominant stage in females was 'F' while those in males were 'F' and 'G'. This corroborated the fact that unlike the other teeth which mature and erupt early, the third molars mature and erupt later in females.

Except for age 18 yrs, significant similarity in predominant stages was seen in all age groups. This finding was in slight variance with the other studies which found similarity in maturity stages in age above 18 yrs, whereas in our study similarity was seen in age less than 18 also. [7, 9, 11]

Stage 'D'-'F' were predominant in age 16-18 yrs, unlike stage D-G in Introna and colleagues study [7]. Predominant stages in age 18-19 were lagging in maturity by one stage, when

compared to by Introna and colleagues [7], which shows delayed dental maturation in Indians as compared to Europeans (Italians).

Contrary to the findings of Bolanos and colleagues [12] who used the 10 stages of Nolla classification, we found a significant correlation between age and development of third molar, and also presence of sexual dimorphism.

Consistent with the findings of Introna and colleagues [7] the maxillary third molars showed early maturity compared to that of mandibular third molars.

The probability of cases with stages 'F' and 'G' being above 18 yrs was significantly high, which is similar to the findings of Salvia AD and colleagues [8].

## Conclusion

In the Indian legal system age 16 yrs and 18 yrs have great medico-legal importance. Assessment and fixing of a person in these age groups is necessary in issues pertaining to establishing criminal responsibility, dispensing judicial punishment, classification of an offence as rape and kidnapping, validity of marriage contract and attainment of majority. Our study results confirm the utility of morphological analysis of third molar maturity by Demirjian's 8 stage classification on orthopantomograph as a means of estimating biological age of the subjects from 16 to 23 years and can be practically implemented in assessment of age of an individual with significant accuracy. Bisexual variations are seen hence one should keep the sex of the subject in mind while viewing the orthopantomograph.

**Table No 1. Age and sex wise distribution of the sample**

| S. No | Age (years) | Sex | | Total |
|-------|-------------|------|--------|-------|
| | | Male | Female | |
| 1 | 16 | 14 | 20 | 34 |
| 2 | 17 | 8 | 14 | 22 |
| 3 | 18 | 12 | 10 | 22 |
| 4 | 19 | 14 | 16 | 30 |
| 5 | 20 | 14 | 8 | 22 |
| 6 | 21 | 14 | 6 | 20 |
| 7 | 22 | 8 | 8 | 16 |
| 8 | 23 | 14 | 16 | 30 |
| Total | | 98 | 98 | 196 |

**Table No 2. Stages of development of 3rd molars on orthopantomograph in females and males**

| | | Age | 16 | | 17 | | 18 | | 19 | | 20 | | 21 | | 22 | | 23 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sex | F | M | F | M | F | M | F | M | F | M | F | M | F | M | F | M |
| | | N | 20 | 14 | 14 | 8 | 10 | 12 | 16 | 14 | 8 | 14 | 6 | 14 | 8 | 8 | 16 | 14 |
| S.no. | Tooth | Stage | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) | n(%) |
| 1. | URM | AB* | | 2(14.2) | | | | | | | 2(25) | | | | 2(25) | | 2(12.5) | 4(28.6) |
| | | NA** | | | | 2(25) | | | 2(12.5) | | | 2(14.3) | | 2(14.3) | | 2(25) | | 2(14.3) |
| | | A | | | | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | | | | |
| | | C | 2(10) | | | | | | | | | | | | | | | |
| | | D | 14(70) | 10(71.4) | 2(14.3) | | | | | | | | | | | | | |
| | | E | 2(10) | 2(14.2) | 8(57) | 4(50) | | | | | | | | | | | | |
| | | F | 2(10) | | 4(28.7) | 2(25) | 6(60) | 6(50) | 2(12.5) | | | | | | | | | |
| | | G | | | | | 2(20) | 6(50) | 8(50) | 6(42.9) | 2(25) | | | | | | 4(25) | |
| | | H | | | | | 2(20) | | 4(25) | 8(57.1) | 4(50) | 12(85.7) | 6(100) | 12(85.7) | 6(75) | 6(75) | 10(62.5) | 8(57.1) |
| 2. | ULM | AB* | | | | | 2(20) | | 2(12.5) | 2(14.3) | | | | 2(14.3) | | 2(25) | | |
| | | NA** | | | | 2(25) | | | 2(12.5) | | | | | 2(14.3) | | | 2(12.5) | 2(14.3) |
| | | A | | | | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | | | | |
| | | C | 2(10) | | | | | | | | | | | | | | | |
| | | D | 14(70) | 12(86) | 2(14.3) | | | | | | | | | | | | | |
| | | E | 2(10) | 2(14) | 8(57) | 4(50) | | | | | | | | | | | | |
| | | F | 2(10) | | 4(28.7) | 2(25) | 6(60) | 6(50) | 2(12.5) | | | | | | | | | |
| | | G | | | | | 2(20) | 6(50) | 4(25) | 4(28.6) | 2(25) | | | | | | 2(12.5) | 2(14.3) |
| | | H | | | | | | | 6(37.5) | 8(57.1) | 6(75) | 14(100) | 6(100) | 10(71.4) | 8(100) | 6(75) | 12(75) | 10(71.4) |
| 3. | LRM | AB* | | 2(14) | | | | | 2(12.5) | | | | | | 2(25) | | 2(12.5) | |
| | | NA** | | | | | | | | | | 4(28.7) | | 2(14.3) | | 2(25) | | |
| | | A | | | | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | | | | |
| | | C | 2(10) | | | | | | | | | | | | | | | |
| | | D | 12(60) | 12(86) | 8(57) | | | | | | | | | | | | | |
| | | E | 6(30) | | 4(28.7) | 4(50) | 4(40) | 2(16.7) | | | | | | | | | | |
| | | F | | | 2(14.3) | 2(25) | 4(40) | 6(50) | 2(12.5) | | | | | | | | | |
| | | G | | | | 2(25) | 2(20) | 4(33.3) | 8(50) | 8(57.1) | 4(50) | | | | | | | |
| | | H | | | | | | | 4(25) | 6(42.9) | 4(50) | 10(71.3) | 6(100) | 12(85.7) | 6(75) | 6(75) | 14(87.5) | 14(100) |
| 4. | LLM | AB* | | 2(14) | | | | | | | | 2(14.3) | | | | | 4(25) | 2(14.3) |
| | | NA** | | | | | | | | | | 4(28.7) | | 2(14.3) | 2(25) | 4(50) | | |
| | | A | | | | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | | | | |
| | | C | 2(10) | | | | | | | | | | | | | | | |
| | | D | 12(60) | 12(86) | 8(57) | | | | | | | | | | | | | |
| | | E | 6(30) | | 4(28.7) | 4(50) | 6(60) | 2(16.7) | | | | | | | | | | |
| | | F | | | 2(14.3) | 2(25) | 2(20) | 6(50) | 2(12.5) | | | | | | | | | |
| | | G | | | | 2(25) | 2(20) | 4(33.3) | 8(50) | 8(57.1) | 4(50) | | | | | | 2(12.5) | |
| | | H | | | | | | | 6(37.5) | 6(42.9) | 4(50) | 8(57) | 6(100) | 12(85.7) | 6(75) | 4(50) | 10(62.5) | 12(85.7) |

URM: Upper right molar, ULM: Upper left molar, LRM: Lower right molar, LLM: Lower left molar.* AB: absent. ** NA : not assessable. M: Male, F: Female

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