# Original Research Paper

# Age Estimation by Clinico-Radiological Examination of Third Molar Teeth: A Study from Delhi

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## Abstract

The aim of present study was to estimate the age by studying various stages of eruption and development of third molar teeth of different quadrant in age group of 15-25 years. A total 100 patients including equal number of males and females were examined clinically as well as radiologically (orthopantomograms). Demirjian's staging (A-H) was used for chronological evaluation of the maxillary and mandibular third molars. The study showed that the eruption of the third molar tooth was earlier in males as compared to the females and statistically significant difference in left upper, left lower and right lower quadrants. Using the regression analysis it was concluded that for all four quadrants chronological age had a positive linear relationship with dental stage. The right maxillary molar had the strongest relation than other quadrants. However, values in this study were not found to be statistically significant which may be due to the less number of subjects examined and the higher age taken for the Demirjian's staging.

**Key Words:** Third molar; Chronological age; Orthopantomograms; Demirjian's staging

## Introduction:

Age constitute an important factor in relation to assessment of crimes of varied nature, civil purposes and identity of a person. [1] Age of a person can be determined by physical, radiological and dental examination.

Dental age is usually estimated by clinical examination of the teeth and by radiographic methods. These two methods depend upon the order of eruption and development of the teeth. Teeth erupt in two sets i.e. temporary and permanent teeth.

Temporary teeth may guide for determination of age from six months to thirty-three months while the permanent teeth help from six years to twenty two years. [2] Estimation of age by only clinical examination of teeth is not suitable. By radiographic methods it is possible to follow the formation of crowns and roots of teeth and their calcification.

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In this study we have estimated the age clinically as well as radiologically by studying various stages of eruption and development of third molar teeth and also studied the order of eruption of third molar in different quadrants in both sexes in the age group of 15-25 years.

## Materials and Methods:

The study was conducted on a total of 100 cases of either sex between 15-25 years of age. (Table 1) A written informed consent from the person/guardian was obtained. Birth certificate or any other valid documents were considered for age proof.

Persons with malnutrition, any disease affecting the skeletal growth and general development, any congenital anomalies of teeth and impacted or extracted third molar tooth were excluded from the study.

The persons were examined clinically and radiologically (orthopantograms) and the staging were done as follows:

## Clinical Staging:

**Stage 1:** Not erupted tooth (NE) - tooth yet not perforated the oral mucosa
**Stage 2:** Partially erupted tooth (PE) – occlusal surface partially visible
**Stage 3:** Completely erupted tooth (CE) - complete emergence in occlusal plane

## Radiological Staging:

After clinical examination and staging, OPG was done for each subject. Based on those radiological findings of third molar teeth,

Demirjian's Staging [3] was done in which the development of teeth was divided in following eight stages:

**Stage A:** Cusps tips mineralized but not coalesced

**Stage B:** Mineralized cusps united with well-defined morphology

**Stage C:** Crown half formed, pulp chamber evident, dentinal deposition occurring

**Stage D:** Crown formation complete to dentino-enamel junction

**Stage E:** Beginnings of formation of inter-radicular bifurcation, root length is less than crown length.

**Stage F**: Root length is at least as great as crown length, roots have funnel-shape ending

**Stage G:** Root walls are parallel but apices remain open

**Stage H**: Apical ends of root completely closed and the periodontal membrane has uniform width around the root

The data was analyzed by the statistical software SPSS version 15.0. Mean and 95% confidence intervals was determined using the descriptive statistics. Unpaired students t-test was used to compare the mean age in males and females for each quadrant in not erupted, partially erupted and erupted subjects.

The comparison among male and female with regards to third molar development was done by Mann-Whitney test. Wilcoxon signed rank test was used to compare between the right and left and lower and upper teeth, such as 18 vs. 38 and 28 vs. 48 in males and females separately. Chi-square test was used to compare the proportion of absent teeth in males and females for each quadrant.

To estimate the dental age based on the Demirjian's staging for each quadrant, simple linear regression and then multiple linear regression tests were applied.

## Observations and Results:

**A. Based on Clinical Staging:** (Table 2 & 3)

1. The total numbers of unerupted third molar teeth were more in case of females as compared to males, and more common in age less than 18 years.
2. The total numbers of unerupted third molar teeth were more in mandibular arch, while total number of partially and completely erupted teeth were more in maxillary arch.
3. The percentage for unerupted third molar teeth was more for right side as compared to left, and more for right lower quadrant (55%) as compared to other quadrants.
4. The percentage for partially and completely erupted teeth was more for right as compared to left and for maxillary arch as compared to mandibular arch.

**The Mean Age for Partially Erupted Teeth:** For right and left maxillary teeth, the mean age was 16.835 years for males and 15.0 years for females, but it was not statistically significant. (P value: 0.08) For left and right mandibular, it was 17.40 years for males and 17.0 years for female. (P value: 0.576)

**The Mean Age for Completely Erupted Teeth:** For right maxillary teeth, it was 21.57 year males and 21.67 for females. (P value: 0.864) For left maxillary, it was 21.29 years for males and 21.73 years for females. (P value: 0.475)

For left mandibular, it was 21.27 years for males and 21.84 years for females. (P value: 0.304) For right mandibular, it was 21.36 years for males and 21.64 years for females. (P value: 0.669) There was no significant difference in mean age in males and females for each quadrant in partially erupted and completely erupted stages.

**B. Based on Radiological Study:** (Table 4-6)

• **Stage Wise Distribution of Third Molar Teeth for Males:**

Stage D and E observed equally in all quadrants and in both arches. Stage F and H observed more commonly in maxillary arch and no left- right asymmetry seen. Stage G was more common in mandibular arch and no left-right asymmetry seen.

• **Stage wise Distribution of Third Molar Teeth for Females:**

Stage C was more common in mandibular arch and on right side. Stage D was present more commonly in mandibular arch and no left- right asymmetry seen.

Stage E was more commonly present in maxillary arch and on right side. Stage F was present more commonly in mandibular arch and on left side.

Stage G was present more commonly in maxillary arch and on left side. Stage H was present more commonly in mandibular arch and on right side.

• **Quadrant wise Distribution of Third Molar Teeth:**

The percentage of third molar teeth eruption was more on left side (88%) for males and for females, it was more for right side (84%).

• **Arch wise Distribution of Third Molar Teeth:**

The percentage of third molar teeth eruption was more in lower arch (mandibular) in both males and females.

- **Sex wise Comparison of Present and Absent Third Molars in Different Quadrants:**

No significant difference found in proportion of absent third molar teeth between males and females. The percentage of missing maxillary and mandibular third molars was found to be 20.0% and 16.0% respectively. In Males this percentage was 19.0% and 13.0% and in females 21.0% and 19.0% respectively.

- **The Estimated Dental Age for Males: (Based on Demirjian's staging)**

The mean age for Stage D was 15 years for all quadrants. The mean age for Stage E in right maxilla was 16years, for left maxilla was 17 years and for left & right mandible was 21 years.

The mean age for Stage F in right maxilla was 18 years, 18.67 years for left maxilla, 17.60 years for left mandible and 18.17 years for right mandible.

For Stage G, the mean age in right maxilla was 18.55 years, 18.70 years for left maxilla, 18.17 years for left mandible and 18.00 years for right mandible. For Stage H, the mean age in right maxilla was 21.76 years, 21.35 years for left maxilla, 21.81years for left mandible and 21.73 years for right mandible.

Thus the earliest mean age for the eruption of third molar for males was 15 years and can range up to 21 years.

- **The Estimated Dental Age for Females: (based on Demirjian's staging)**

The mean age for STAGE C was 18 years for right maxilla, 16 years for both mandibular quadrants. For Stage D it was 15.75 years for right maxilla, 15.67 years for left maxilla, 16.88 years for left mandible and 17.14 years for right mandible.

The mean age for Stage E in right maxilla was 19.22years, for left maxilla is 19.13 years and for left & right mandible are 18 and 19 years respectively.

The mean age for Stage F in right maxilla was 19.5 years, 19.17years for left maxilla, 20.44 years for left mandible and 20.17 years for right mandible.

For Stage G, the mean age in right maxilla was 20.38 years, 20.31 years for left maxilla, 20.55 years for left mandible and 20.83 years for right mandible.

For Stage H, the mean age in right maxilla was 21.78years, 21.43 years for left maxilla, 21.63years for left mandible and 22.00years for right mandible.

Thus, the earliest mean age for third molar eruption for females was 15.67 years and can range up to 22 years.

**The Mann Whitney test:**

There was significant difference in eruption of third molar in left upper, left lower and right lower quadrants between males and females. Whereas, right upper quadrant this Stage was not statistically significant. In all the cases, mean for the formation of stages was higher in males as compare to the females.

**Wilcoxon signed rank test (arch-wise):**

No significant difference was observed in the eruption of teeth in upper and in lower arches for males and females. (Table 7)

**Wilcoxon signed rank test (right-left symmetry):**

No significant difference was observed in the eruption of teeth in Right and in left for males and females. (Table 8)

**Univariate and Multiple Regression Analysis:**

For all the four quadrants chronological age had a positive linear relationship with the dental stage, strongest being for the right maxilla. If the subject moves from one stage to next stage there was a proportionate change in the chronological age, of approximately 0.354 year for the 18 quadrant. (Table 9)Stepwise multiple regressions found that only the 18 quadrant was statistically significant while the others were statistically insignificant.

## Discussion:

In the present study, the clinical emergence of mandibular third molar was in the range of 15-18 years with no statistically significant sex difference in males and females. Levesque et al (1981) recorded that the clinical emergence of mandibular third molar was between 15 and 19 years of age, bilateral agenesis was seen in about 9% without significant sexual difference and no right-left asymmetry recorded. [4]

This is not in concordance with our study in which right left asymmetry noted. The percentage for unerupted third molar teeth was more for right lower quadrant (55%) as compared to other quadrants. But the percentage for partially and completely erupted teeth was more for right upper quadrant.

Chhokar, Aggarwal and Bhardwaj recorded that in females eruption of third molar was present in 80% cases by 18 years of age. [5] In present study, the total numbers of unerupted third molar teeth were more in case of females as compared to males, and more common in age less than 18 years. This is similar to the results of Chhokar et al. [5]

Levesque et al found that the root development course was faster in males than in females by six months. [4] The study conducted

on American whites by Mincer et al concluded that the root formation was earlier in males than females. [6] Willershausen B et al studied a total of 1202 orthopantograms and concluded that root development was more advanced among boys than among girls of the same age, with no apparent differences in growth patterns based on national/ethnic background. [7]

Also there was a sudden increase in the percentage of completely erupted teeth from 18-21 years in their study. Mesotten et al studied the people of Caucasian origin found that there was earlier development of 3rd molar in males when compared to females. [8] According to Sisman et al the third molar generation was earlier in males than females. [9] Bai et al also in their study concluded that the third molar was earlier formed in males than in females. [10]

In our present study also we found that the eruption of the third molar teeth was earlier in males as compared to females. This is in concordance with the studies of Levesque, Willershausen, Mincer, Sisman and Yuming Bai. [4, 6, 7, 9, 10]

According to Mincer et al the stages A to D showed that the individual in question was less than 18 years while stage H confirmed him to be over 18 years leaving stages E, F and G as ambiguous. [6]

He did not comment on the sex differences in the stage development. Francesco Introna et al showed a prevalence of stages D to G in the age 16-18 years and a clear predominance of stage H in individuals over 18 years of age. [11]

Finally, an intermediate stage between G & H was demonstrated in subjects aged between 17-21 years. He also did not comment on the sex differences, if any, in the stage development.

In the present study, for the males the Stage D was observed in 14-15 years while stages E, F, G, and H were observed in age group 16-22 years. While for the females, the stages C and D were found in the age group of 15-18 years and stage E, F, G and H were found above 18 years.

This is in accordance with the studies of Mincer and Introna for the Stage H, showing that the Stage H appears in individuals above 18 years of age, and for stage D which appears before 18 years of age. However the stages C, E, F and G show a wide variation. [6, 11]

## Conclusion:

The conclusion drawn from the study is that the eruption of the third molar tooth is earlier in males as compared to the females when examined clinically and radiologically.

There is statistically significant difference in eruption of third molar in left upper, left lower and right lower quadrants between males and females.

Using the regression analysis it is concluded that for all four quadrants chronological age has a positive linear relationship with dental stage such as if the subject moves from one stage to next stage.

There is a proportionate change in the chronological age of approximately 0.354 year for the right upper quadrant.

The right maxillary molar has the strongest relation than other quadrants. Also for the males the Stage D was observed in 14-15 years while stages E, F, G and H were observed in age group 16-22 years.

While for the females, the stages C and D were found in the age group of 15-18 years and stage E, F, G and H were found above 18 years. Though these values were not found to be statistically significant it may be due to the less number of subjects examined and the higher age taken for the Demirjian's staging.

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**Table 1: Cases According to Age and Sex**

| Age grps(Yrs) | Male | Female | Total |
|---|---|---|---|
| 15-16 | 5 | 5 | 10 |
| 16.1-17 | 5 | 5 | 10 |
| 17.1-18 | 5 | 5 | 10 |
| 18.1-19 | 5 | 5 | 10 |
| 19.1-20 | 5 | 5 | 10 |
| 20.1-21 | 5 | 5 | 10 |
| 21.1-22 | 5 | 5 | 10 |
| 22.1-23 | 5 | 5 | 10 |
| 23.1-24 | 5 | 5 | 10 |
| 24.1-25 | 5 | 5 | 10 |

**Table 6: Comparison between Males and Females Ordinal Formation Stage for Each Quadrant**

| Quadrant | Males | Females | Z-value | P-value |
|---|---|---|---|---|
| Right upper | 5.50±3.02 | 5.26±2.65 | -1.246 | 0.213 |
| Left upper | 5.64±2.89 | 4.70±3.01 | -2.045 | 0.041 |
| Left lower | 6.12±2.52 | 5.00±2.72 | -2.714 | 0.007 |
| Right lower | 5.94±2.65 | 4.84±2.77 | -2.580 | 0.010 |

**Table 2: Sex Wise Distribution of Eruption Third Molar**

| Age grps (Yrs) | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | NE | PE | CE | NE | PE | CE |
| 15-16 | 18 | 2 | 0 | 16 | 4 | 0 |
| 16.1-17 | 16 | 4 | 0 | 20 | 0 | 0 |
| 17.1-18 | 14 | 6 | 0 | 17 | 3 | 0 |
| 18.1-19 | 8 | 10 | 2 | 16 | 0 | 4 |
| 19.1-20 | 2 | 0 | 18 | 15 | 0 | 5 |
| 20.1-21 | 9 | 0 | 11 | 9 | 0 | 11 |
| 21.1-22 | 5 | 0 | 15 | 14 | 0 | 6 |
| 22.1-23 | 4 | 0 | 16 | 4 | 0 | 16 |
| 23.1-24 | 4 | 0 | 16 | 8 | 0 | 12 |
| 24.1-25 | 7 | 0 | 13 | 6 | 0 | 14 |
| Total | 87 | 22 | 91 | 125 | 7 | 68 |

**Table 7: Arch Wise Findings of Wilcoxon Signed Rank Test**

| Upper jaw | | | Lower jaw | |
|---|---|---|---|---|
| Quadrant | 18 | 28 | 38 | 48 |
| Males | 5.50±3.02 | 5.64±2.89 | 5.64±2.89 | 5.94±2.65 |
| Z-value | -0.463 | | -1.342 | |
| P-value | 0.643 | | 0.180 | |
| Females | 5.26±2.65 | 5.00±2.72 | 5.00±2.72 | 4.84±2.77 |
| Z-value | -1.682 | | -1.254 | |
| P-value | 0.092 | | 0.210 | |

**Table 8: Wilcoxon Signed Rank Test (Right-Left Symmetry)**

| | Right | | Left | |
|---|---|---|---|---|
| Quadrant | Upper | Lower | Upper | lower |
| Males | 5.50±3.02 | 6.12±2.52 | 6.12±2.52 | 5.94±2.65 |
| Z-value | -1.837 | | -0.797 | |
| P-value | 0.066 | | 0.426 | |
| Females | 5.26±2.65 | 4.70±3.01 | 4.70±3.01 | 4.84±2.77 |
| Z-value | -1.132 | | -0.071 | |
| P-value | 0.258 | | 0.944 | |

**Table 9: Univariate and Multiple Regression Analysis**

| Univariate Regression | Intercept | Regression coefficients | F-ratio | R-square |
|---|---|---|---|---|
| Maxillary Right | 17.595 | 0.354 | 13.441 | 0.121 |
| Maxillary Left | 18.435 | 0.206 | 4.626 | 0.045 |
| Mandibular Left | 18.119 | 0.248 | 5.540 | 0.053 |
| Mandibular right | 18.254 | 0.237 | 5.241 | 0.051 |
| Multivariate Regression | | | | |
| Maxillary Right | 17.466 | 0.120 | 3.406 | 0.127 |
| Maxillary Left | | 0.356 | | |
| Mandibular Left | | -0.074 | | |
| Mandibular right | | -0.021 | | |

**Table 3**
**Sex Distribution of Eruption of Third Molar**

| | | Right upper | Left upper | Left lower | Right lower |
|---|---|---|---|---|---|
| **Partially Erupted** | | | | | |
| F | N | 2 | 2 | 1 | 2 |
| | M + S. D. | 15.00±0.00 | 15.00±0.00 | 17.0±0.0 | 17.0±0.0 |
| M | N | 6 | 6 | 5 | 5 |
| | M +S.D. | 16.83±1.17 | 16.83±1.17 | 17.40±0.894 | 17.40±0.894 |
| | P value | 0.080 | 0.080 | - | 0.576 |
| **Completely Erupted** | | | | | |
| F | N | 23 | 15 | 19 | 16 |
| | M +S.D. | 21.67±1.81 | 21.73±1.98 | 21.84±1.74 | 21.63±1.93 |
| M | N | 18 | 24 | 22 | 22 |
| | M + S. D. | 21.57±1.90 | 21.29±1.78 | 21.27±1.75 | 21.36±1.79 |
| | P value | 0.864 | 0.475 | 0.304 | 0.669 |

**Table 4**
**Sex Wise Distribution of Total Number of Third Molar Teeth according To Demirjian's staging**

| Stage | Right upper | | Left upper | | Left lower | | Right lower | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| ABSENT | 10 | 8 | 9 | 13 | 6 | 9 | 7 | 10 |
| C | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| D | 3 | 4 | 3 | 3 | 3 | 8 | 3 | 7 |
| E | 1 | 9 | 2 | 8 | 2 | 4 | 2 | 7 |
| F | 7 | 6 | 9 | 6 | 5 | 9 | 6 | 6 |
| G | 11 | 13 | 10 | 13 | 18 | 11 | 17 | 6 |
| H | 17 | 9 | 17 | 7 | 16 | 8 | 15 | 12 |
| TOTAL | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

**Table 5**
**The Mean Age (95% Confidence Intervals) For Both Sexes**

| Stage | Right upper mean(95% CI) | | Left upper mean(95% CI) | | Left lower mean(95% CI) | | Right lower mean(95% CI) | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| C | 24(-)* | 18 | | | | 16 | | |
| D | 15(-)# | 15.75 (15.5-16.0) | 15(-)# | 15.67 (15.33-16.00) | 15(-)# | 16.88 (16.21-17.54) | 15(-)# | 16 |
| E | 16(-)* | 19.22 (18.12-20.33) | 17.00 (16.00-18.00) | 19.13 (17.88-20.37) | 21 (18.00-24.00) | 18.00 (16.71-19.29) | 21.00 (18.0-24.0) | 17.14 (16.44-17.85) |
| F | 18.00 (16.87-19.13) | 19.5 (18.88 -20.62) | 18.67 (17.46-19.87) | 19.17 (18.06-20.27) | 17.60 (15.97-19.23) | 20.44 (19.63-21.26) | 18.17 (16.72-19.61) | 19.00 (17.93-20.07) |
| G | 18.55 (17.81-19.27) | 20.38 (19.64-21.14) | 18.70 (18.02-19.38) | 20.31 (19.57-21.04) | 18.17 (17.74-18.60) | 20.55 (19.66-21.43) | 18.00 (17.58-18.42) | 20.17 (18.63-21.70) |
| H | 21.76 (21.29-22.24) | 21.78 (21.21-22.35) | 21.35 (20.88-21.82) | 21.43 (20.74-22.11) | 21.81 (21.00-22.25) | 21.63 (21.31-22.31) | 21.73 (21.20-22.26) | 20.83 (20.17-21.49) |