Age Estimation Using Radiographic Stages of Third Molar in Odisha Population
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Introduction
Age estimation plays an important role in forensic science. Teeth remain as a useful material for age estimation. The morphological and radiological examination of third molars make up a part of the dental treatment including orthodontic, pedodontic, and surgical treatments by providing valuable information for the clinicians. Late in adolescence, after formation of the premolars and canines, third molars are the only teeth that continue to develop. According to several studies, although the third molars are the most variable teeth in the dentition, still they remain to be the most reliable biological indicator for estimation of age during middle teens and early twenties.

Forensic age diagnosis is applicable in persons without valid identifying documents. Determining chronological age in persons within the range of 15.5-23.5 years is difficult as skeletal indicators, such as diaphysis-epiphysis fusion, hand-wrist examination, cervical vertebrae assessment, amino acid racemization, sternoclavicular bones, changes in the pubic symphysis, fusion of cranial sutures, or changes in secondary sex characteristics, have their advantages and limitations but are more or less indecisive, especially during these years. So, the radiographic assessment of the degree of third molar formation is a major part for forensic age estimation of adolescents and young adults. Several methods were used in the past to assess dental mineralization.

In the present study, we chose the eight-stage scheme (Figure 1) designed by Demirjian’s tooth mineralization stages (statistical analysis using Mann–Whitney U test was performed to compare the differences in the mineralization stages of males and females and between maxilla and mandible). Comparison of males and females with mean stages in maxilla and mandible were done using Mann–Whitney U test. Probabilities of individuals being older than 10, 12, 14, 16, 18, 20, 22, 24 years were also estimated.

Results: Males attained formation Stage H (the apical end of the root canal is completely closed) earlier than females, whereas females attained Stage G earlier than males. Maxillary left molar developed earlier than mandibular left molar in males. 100% probability was seen in Stage H for both maxilla and mandible.

Conclusion: The Demirjian method is most reliable for age assessment using third molar mineralization stages.

Materials and Methods
The retrospective study sample consisted of 510 digital orthopantomograms (OPG) of 227 (44.50%) females and 283 (55.49%) males aged between 9 and 25 years. The

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Abstract:
Background: Radiology plays an important role in human age estimation and dental radiography being the most simple, non-destructive technique. Dental age estimation has been widely used to determine the chronological age of adolescents and young adults.

Materials and Methods: A total of 510 digital orthopantomograms of 227 females and 283 males aged between 9 and 25 years were taken, and third molar development was evaluated by Demirjian’s tooth mineralization stages (statistical analysis using Mann–Whitney U test was performed to compare the differences in the mineralization stages of males and females and between maxilla and mandible). Comparison of male and females with mean stages in maxilla and mandible were done using Mann–Whitney U test. Probabilities of individuals being older than 10, 12, 14, 16, 18, 20, 22, 24 years were also estimated.

Results: Males attained formation Stage H (the apical end of the root canal is completely closed) earlier than females, whereas females attained Stage G earlier than males. Maxillary left molar developed earlier than mandibular left molar in males. 100% probability was seen in Stage H for both maxilla and mandible.

Conclusion: The Demirjian method is most reliable for age assessment using third molar mineralization stages.
The inclusion criteria were the adequate quality of OPG’s, people, who are native of Odisha, presence of all the four third molars, no history of medical or surgical disease that could affect the development of third molars. Exclusion criteria were OPG’s with poor image quality, any pathology affecting the development of third molars and OPG’s with any missing third molar. Statistical analysis was done using statistical package for social sciences 20.0.

Table 1 presents the age and sex distribution in detail. Mean age for all the eight developmental stages were calculated. Comparison of male and females with mean stages in maxilla and mandible were done using Mann–Whitney U test.

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**Figure 1:** Schematic drawings of the eight formation stages of tooth development (modified from Demirjian et al.) courtesy Szilvia Arany.
Results
Statistical analyses showed no significant inter or intra-observer differences on repeated scoring done on 150 subsamples after 1 month ($P > 0.05$). Means of all the eight different developmental Stages (A to H) of the third molars were examined in both males (Tables 2 and 3) and females (Tables 4 and 5). Males and females were compared for each stage of all third molars by Mann–Whitney U test (Table 6). A significant difference was observed in third molar development between males and females with respect to Stage A (18, 28); D (38); E (38); G (18, 28, 38, 48), and H (18, 38, 48). Males attained formation Stage “H” for 18; “D,” “H” for 38, and “H” for 48 earlier than females. Contrast results were observed for Stages “A,” “G” of 18, 28; “E,” “G” of 38; “G” of 48 where females showed development earlier than females. Third molar development was compared between maxilla and mandible in both genders by Mann–Whitney U test. Maxillary left molar developed earlier than mandibular left molar in males (Table 7). Probabilities of an individual being older than 10, 12, 14, 16, 18, 20, 22, 24 years were also estimated (Table 8).

Discussion
The importance of age estimation has increased over the years, especially of living persons for a legal perspective. 66 age estimates were executed to determine whether a suspect without legal identification documents has criminal liability or whether the general criminal law in force for adults is to be applied in a particular case. For children, age estimation can be carried out according to the mineralization stages of the seven permanent teeth starting from incisors to their second molars.13 Whereas for late adolescence and early adulthood, the third molar is the only tooth still being under developed and is the tooth to study for age estimation. Different classification systems were given by different authors, dividing mineralization
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A study by Meinl \textit{et al.}\textsuperscript{2} on Austrian population reported a significant difference between males and females in the development of mandibular third molars. Rai \textit{et al.}\textsuperscript{16} also reported a significant difference in third molar development between males and females regarding the calcification Stage D and Stage G which showed the genesis early in females than males, but in our study, we found that Stage D was early in males and G in females. Arany \textit{et al.} study on Japanese population revealed statistically significant differences in the Stages D, E, and G, which were faster in males compared to females. However, in our study, we found H and D stages to be early in males and A, G, E stages to be early in females. Regarding the difference in the development of maxillary and mandibular molars maxillary molars developed earlier than
mandibular molars in males which was in accordance with the studies done by Arany et al.\textsuperscript{17}

According to the study conducted by Hassan and Hamalia,\textsuperscript{18} on Egyptians to detect the chronological age of individuals based on the development of third molars showed that the mean ages of upper and lower right molar, lower left molar were significantly higher in females than in males where as in our study the mean age of mandibular left molars was greater in both females and males when compared to the other molars. Moreover, males showed an insignificant decrease of mean age of upper left molar tooth than females where as our study showed greater mean age for all the third molars in females when compared to males.

Mohammed et al.\textsuperscript{19} have conducted a study using the modified Demirjian method and concluded that there was a significant correlation between dental age and chronological age and the process of maturation was earlier in females when compared to males which is similar to our study. The Demirjian method was applied in most of the studies all around the world; most of them show the similar pattern of maturity and few with the difference in males and females or difference in maxilla and mandible. This could be the because of the difference in the populations which chosen were from different geographical areas. Still the Demirjian method remains to be the best in the age estimation using OPGs.

Conclusion
Age is one of the essential factors in establishing the identity of the person. Estimation of the human age is a procedure adopted by anthropologists, archaeologists, and forensic scientists. Age estimation of an individual by examination of the developmental stage of third molars using OPG can be a useful tool in the field of legal and forensic medicine. Our data provides references for third molar examination using the Demirjian method in Odisha population. However, studies with larger sample must be conducted which would be helpful in tracing some guidelines concerning the sex of the individual for each age group.

References