

Original Research Paper

Correlation between Skeletal Age and Dental Age in Living Individuals

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Abstract

The age determination of living individuals of unknown chronological age, has assumed a very strong role in juvenile crimes in India. Many cases are being referred by courts for age determination of such 'juveniles in conflict with law', in which the most important cut off age is 18 years. Age estimation of unknown chronological age is a big challenge for law enforcement agents which have become more important due to ever increasing incidences of heinous crimes committed by juveniles. We present a review of correlation of skeletal age measured by X-rays of various joints and dental age measured by OPG (Orthopantograms) of a population of 150 cases of age estimation cases sent to our hospital by various courts of law at Delhi, capital city of India. The result was subjected to statistical analysis by using Pairwise Pearson's correlation (0.885) which suggests highly significant correlation. The result shows statistically highly significant correlation between the said parameters.

Key Words: skeletal age, dental age, Pearson correlation coefficient

Introduction:

The age determination of living individuals of unknown chronological age, has assumed a very strong role in juvenile crimes in India as well as internationally. Many cases are being referred by courts for age determination of such 'juveniles in conflict with law', in which the most important cut off age is 18 years.

The most frequent methods involved in age determination of living individuals in India are skeletal age and dental age. Skeletal age is determined by series of radiographs of hand-wrist, pelvis, shoulder etc., whereas dental age is determined by eruption pattern of teeth and formative stages as depicted on OPG radiograph. Both dental and skeletal ages are affected by various factors like genetic, environmental, diet, and race.

Most common method used for dental age determination is based on maturity score developed by Chaillet and Demirjian in 2004 in French population. [1] India-specific regression formulas were developed by Asith Acharya (2011), which gave better age estimates for Indian population (mean absolute error, MAE=0.87 years) than the original formulas (MAE=1.29 years). [2]

The study done by Garamendi et al found that when either of skeletal age or dental age is used alone to estimate age, then neither of them provides optimal accuracy. But combination of these methods represented a significant increase in the efficacy of the prediction that a subject was under the 18-year-old age limit or not. [3] When a combination of two methods is used, it is important to find out the correlation between the two methods. The accuracy of age estimation will not be optimal if the results of two methods are not closely related to each other.

Till date, to best of author's knowledge, the correlation between dental age based on India-specific regression formulas and skeletal age has not been examined.

The present study aims to examine the correlation between Dental ages based on India specific regression formulas of Demirjian's method and skeletal ages as derived from radiographs of various bones.

Materials and Methods:

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Retrospective records of age estimation cases were retrieved from Department of Forensic Medicine & Toxicology, VMMC & Safdarjung Hospital New Delhi. This department received cases for age determination which is referred by various courts commonly Juvenile Justice Boards & other trial courts.

The skeletal ages in these cases was based on the radiographs of various joints reported by Department of Radio diagnosis. OPG x-rays of all the cases were taken and examined by Dental specialist. Dental age was based on Demirjian's and Chaillet method, calculated on basis of India-specific regression formulas developed by Acharya. [2]

Initially, records of 150 cases were retrieved. Out of 150, the cases in which third molars were absent were excluded from present study. Finally 132 cases were considered for finding the correlation. The reports of skeletal age, which were given in form of range, were converted into mean skeletal age.

Results:

Skeletal age from x-ray examination and dental age from OPG x-rays were recorded for all 150 cases. The result (Table I) was subjected to statistical analysis by using Pairwise Pearson's correlation using software STATA Version 12.0. The Pearson correlation efficient of this study was 0.885, suggest highly significant correlation.

Discussion and Conclusion:

The estimation of age in living individuals of unknown chronological age has implicit legal importance in view of increasing juvenile crimes. Juvenile Justice (Care and Protection of Children) Act, 2000, has made it mandatory that age estimation boards should include Dentist and Radiologist, which further underlines the importance of finding the correlation between skeletal and dental ages.

Photo 1: OPG of a 16 year old boy

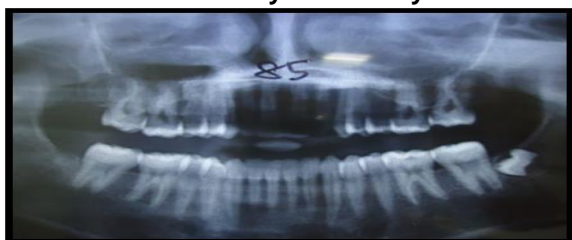


Photo 2: OPG of a 15 year old boy



Photo 3: OPG of an 11-12 year old boy

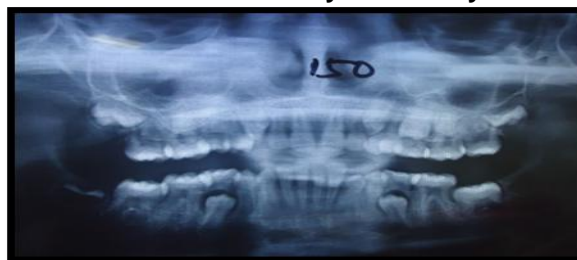


Photo 4: OPG of a 16 year old boy



Various studies have examined the correlation between dental age and skeletal age. Sukhia and Fida [4] determined the correlation among chronologic age, skeletal maturity, and dental age, and concluded that skeletal maturity and dental age are significantly correlated.

Another study investigated the relationships between the stages of calcification of various teeth and skeletal maturity stages among Turkish subjects based on hand wrist radiographs. [5] This study also established a high correlation between the two.

But these studies were done in other countries and the correlation data in Indian population is not available. So the present study attempts to establish the correlation between dental age based on India-specific regression formulas and skeletal age in mixed Indian population. The accuracy of India specific regression formulas based on Chaillet and Demirjian 8-teeth method in prediction of age has been evaluated by some investigators.

These India specific regression formulas were developed by Acharya, and he concluded that it gave better age estimates for Indian population (mean absolute error, MAE=0.87 years) than the original formulas (MAE=1.29 years). [2] Kumar and Gopal also tested the reliability of India specific formulae and concluded that age estimation using this method narrows down the error rate to just over one year making this method reliable. [6]

In our study the correlation is highly significant. This indicates that age as estimated by Demirjian's method is closely related to the skeletal age as estimated on basis of various radiographs. As this study was done on living

individuals of unknown chronological age, it was not possible to establish the correlation with chronologic age. Based on the results of this study, we can suggest that combination of these two methods should be used for more accurate estimation of age in living individuals.

References:

1. Chaillet N, Demirjian A. Dental maturity in South France: A comparison between Demirjian's method and polynomial functions. *J Forensic Sci.* 2004; 49:1059-66.
2. Acharya AB. Age estimation in Indians using Demirjian's 8-teeth method. *J Forensic Sci.* 2011; 56:124-7

3. Garamendi PM, Landa MI, Ballesteros J, Solano MA. Reliability of the methods applied to assess age minority in living subjects around 18 years old. A survey on a Moroccan origin population. *Forensic Sci Int.* 2005; 154: 3-12
4. Sukhia RH1, Fida M. Correlation among chronologic age, skeletal maturity, and dental age. *World J Orthod.* 2010;11:78-84
5. Uysal T, Sari Z, Ramoglu SI, Basciftci FA. Relationships between dental and skeletal maturity in Turkish subjects. *Angle Orthod.* 2004; 74: 657-64.
6. Kumar VJ1, Gopal KS. Reliability of age estimation using Demirjian's 8 teeth method and India specific formula. *J Forensic Dent Sci.* 2011; 3: 19-22.

Table 1: Correlation between Skeletal and Dental Age of Subjects 1-50

S.N.	Skeletal age (mean)	Dental Age (mean)
1	17.5	17
2	18.5	18
3	>20	> 19.5
4	>20	> 19.5
5	>20	> 19.5
6	15	15
7	15	15
8	>20	18.6
9	15	16
10	20	NA
11	17.5	NA
12	21	17.5
13	18	>19.5
14	18.5	17.5
15	17	16.8
16	>20	18
17	13	16
18	17	16.5
19	21	>19.5
20	19	18
21	19	18.5
22	17	17.5
23	10	10.5
24	17	18
25	19	19
26	19	17
27	17	17.5
28	20	21
29	15	16.5
30	15	16
31	30	>21
32	10	9.5
33	30	>19.5
34	21	>19.5
35	17	18
36	10	10
37	21	18
38	19	18.5
39	19	>20.5
40	17	17
41	19	>19.5
42	>20	>19.5
43	17	19
44	21	>19.5
45	15	17
46	21	>19.5
47	21	21
48	19	NA
49	17.5	17
50	19.5	19

Table 2: Correlation between Skeletal and Dental Age of Subjects 51-98

S.N	Skeletal age (mean)	Dental Age (mean)
51	17.5	NA
52	17.5	17
53	17.5	17.5
54	17.5	18
55	17.5	NA
56	17.5	18
57	13	13
58	13	15
59	13	11
60	12.5	11
61	14.5	15
62	17.5	17
63	19	19
64	17	NA
65	16.5	16
66	15.5	NA
67	13	16
68	15	NA
69	13	16
70	7.5	9
71	16.5	15
72	15	15
73	16	17
74	15	16
75	21	19
76	13	15
77	15	17
78	7.5	10
79	7.5	10
80	15	16
81	15	17
82	17	NA
83	17.5	19
84	7.5	11
85	15	16
86	20	>19.5
87	19	>20
88	21	18
89	12.5	14.5
90	13	14
91	12.5	15
92	19	18
93	18.5	>20
94	17.5	17.5
95	13	14.5
96	21	18
97	21	19.5
98	19	18.5

Table 3: Correlation between Skeletal and Dental Age of Subjects 99-150

S.N	Skeletal age (mean)	Dental Age (mean)
99	21	>21
100	15	NA
111	17.5	17
112	20	>21
113	17	16.5
114	10.5	14.5
115	17	17.5
116	7	10
117	13	15.5
118	13	15.5
119	15	15.5
120	13	15.5
121	15.5	17.5
122	13	15.5
123	19	18
124	20.5	NA
125	17.5	18.5
126	13	15.5
127	17.5	NA
128	15.5	16.5
129	13	16.5
130	15.5	17.5
131	18.5	19.5
132	17.5	17.5
133	21	>19.5
134	16	16-17
135	10	11-12
136	6	8-9
137	15.5	15-16
138	15.5	NA
139	7.5	8-9
140	10	9-11
141	12.5	11-12
142	17	NA
143	15	17
144	17	17-18
145	17	17-18
146	17	17-18
147	18	19-20
148	17	16-17
149	17	NA
150	13	11-12