Accuracy and Reliability of Age Estimation from Physiological Changes of Third Molars

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Abstract:
Aim: Our study aimed to verify the relation between physiological changes of third molar and age of an individual.
Material and Method: Our study evaluated 42 ground sections of third molars according to Gustafson´ s six criteria method. Patient´s age was registered at time of extraction of third molar. We recorded level of attrition, secondary dentine deposition in pulp, changes in periodontium, cementum apposition, root resorption and root translucency. Each factor was alloted a score regarding degree of changes in the tooth. Total score was calculated and transferred to the estimated age according to Gustafson´s formula. A regression line was drawn from known age and the total score to create a new regression formula. A standard error of 5.38 and 5.33 years was obtained with Gustafson's formula and newly derived formula, respectively.
Conclusion: Third molars are considered the most variable teeth in dentition. Although Gustafson suggested the usefulness of this method ideally in single rooted teeth, we found a singnificant correlation between physiological changes of third molars and age of an individual. In conclusion, despite of its variability third molar can be used for forensic purposes of age estimation in cases with no other tooth available.
Keywords: Dental age; Third molar; Forensic odontology; Gustafson´s formula; Ground section

I. Introduction

Age estimation of unknown individual remains a challenging task for anthropologists, archaeologists and forensic physicians. Teeth offer resistence to mechanical, thermal and chemical iritations and generally belong to the most resilient substances of human skeleton. Therefore, forensic age estimation derives benefit of dental tissues as indicators of aging because they may be preserved for a long time after death.

Most authors dealing with age estimastion issue commonly exclude third molars from their studies. The reason is obvious. Third molars are the most variable teeth in the permanent dentition and therefore their variability can cause alternation of results. Nevertheless, in last years third molars have been found very usefull in age estimation of adolescents as they are the only developing teeth after fourteenth year of age. [1] Some authors hold the view, that third molars are less influenced by external factors thank to their specific position at the end of dentogingival lamina. [2]

Gustafson´s method is internationally used for forensic age estimation purposes. It belongs to morphological methods of classification. Gustafson proved that we can evaluate six secondary changes in teeth with advanced age. These are attrition, periodontal disease, deposition of secondary dentine, root translucency, cementum apposition and root resorption. [3]

The aim of this study was to compare chronological age with estimated dental age by evaluating physiological parameters in third molars.

II. Material And Methods

The present study was carried out in the Institute of Dentistry and Oral Sciences, Faculty of Medicine and Dentistry, Palacký University, Olomouc, Czech Republic.

A total of 42 third molars were extracted at the Department of Oral and Maxillofacial Surgery, University Hospital Olomouc, Czech Republic. Age of the patient, gender and number of tooth was recorded at time of extraction **(Table 1).** The known age was ranging from 17 to 63 years with average age 26.2 years.

After the extraction, the teeth were cleaned under the running water, disinfected in the 3% H_2O_2 and dried at the room temperature. Every tooth was embedded in alabaster plaster type II. Further processing was carried out with dental saw (Trystom Olomouc) and then with rough carborundum stone until a section of 1 mm was obtained. At this thickness, the root translucency was noted. Finally, cleaned and dried section was viewed under microscope. The following six dental parameters were evaluated in each case as follows: [3] **(Figure 1)**

Attrition (A):
A0 - No attrition
A1 - Attrition limited to enamel level
A2 - Attrition limited to dentine level
A3 - Attrition up to pulp cavity
Periodontal disease (P):
P0 - No obvious periodontal disease
P1 - Beginning of periodontal disease but no bone loss
P2 - Peridontal disease more than 1/3rd of the root
P3 - Peridontal disease more than 2/3rd of the root
Secondary dentine (S):
S0 - No secondary dentine formation
S1 - Secondary dentine up to upper part of pulp cavity
S2 - Secondary dentin up to 2/3rd of the pulp cavity
S3 - Diffuse calcification of entire pulp cavity
Root translucency (T):
T0 - No translucency
T1 - Beginning of translucency
T2 - Translucency more than 1/3rd of the apical root
T3 - Translucency more than 2/3rd of the apical root
Cementum apposition (C):
C0 - Normal cementum
C1 - Thickness of cementum more normal
C2 - Abnormal thickness of cementum near the apex of the root
C3 - Generalized abnormal thickness of cementum throughout the apex of the root
Root resorption (R):
R0 - No resorption
R1 - Spotted resorption
R2 - Resorption limited to cementum
R3 - Extensive resorption of the cementum and dentin both

Table 1 Distribution of gender and type of tooth

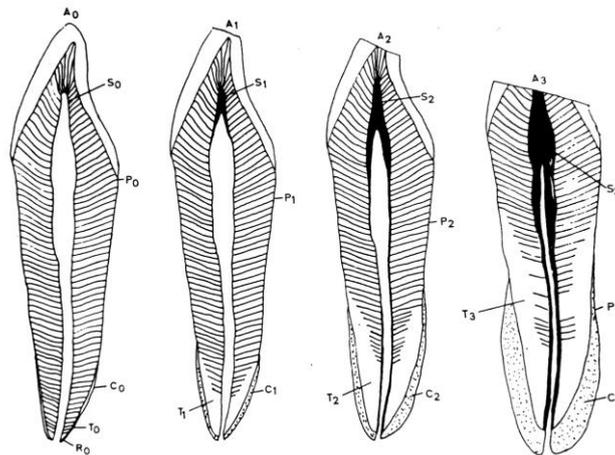|	18	28	38	48	TOTAL NUMBER
FEMALES	3	9	6	15	33
MALES	1	2	1	4	9
TOTAL NUMBER OF CASES	4	11	7	19	42

Figure 1 Schematic drawing of Gustafson´s four point system **[3]**

III.   Results

After collecting the data and calculating the total score, estimated age was calculated using the formula devised by Gustafson: $Y = 4.56X + 11.43$, where X = total score, Y = estimated age. A graph was plotted with actual age on one side, the score calculated on the other **(Figure 2).** Regression line for correlation between age and points was obtained in order to offer a derived formula for age estimation of the Czech individuals. We offered new regression formula: $4,237X + 12,769$, where X is total score and Y is estimated age. Standard error of 5.38 years with Gustafson's formula and 5.33 years with newly derived formula was achieved **(Table 2).**
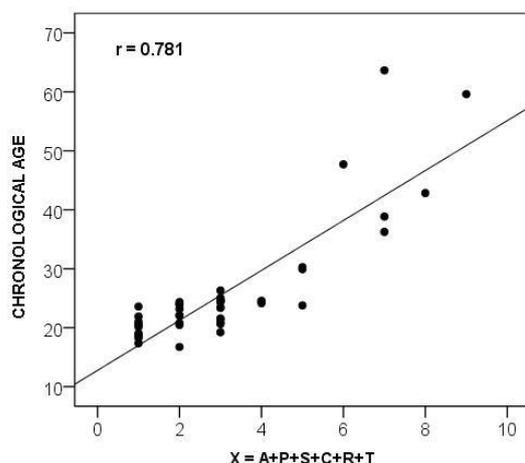
Figure 2 Correlation between total score and chronological age

Table 2 Comparison of total score, actual age and calculated age

Case No.	Total score	Actual Age	Age calculated by Gustafson´s formula	Age calculated by newly derived formula
1	1	18	16	17
2	4	24	30	30
3	3	21	25	25
4	2	24	21	21
5	2	17	21	21
6	1	24	16	17
7	3	25	25	25
8	2	22	21	21
9	3	25	25	25
10	3	25	25	25
11	1	21	16	17
12	3	21	25	25
13	3	22	25	25
14	3	23	25	25
15	2	22	21	21
16	3	23	25	25
17	1	19	16	17
18	1	17	16	17
19	1	20	16	17
20	1	21	16	17
21	3	25	25	25
22	1	22	16	17
23	2	24	21	21
24	2	20	21	21
25	3	21	25	25
26	2	24	21	21
27	4	25	30	30
28	3	19	25	25
29	3	24	25	25
30	2	23	21	21
31	1	19	16	17
32	5	24	34	34
33	2	21	21	21
34	7	36	43	42
35	8	43	48	47
36	7	39	43	42
37	5	30	34	34
38	6	48	39	38
39	7	64	43	42
40	5	30	34	34
41	9	60	52	51
42	3	26	25	25

IV.   Discussion

Morphological changes on teeth have become object of interest of many investigators. In 1950, Gustafson [3] presented an age estimation method evaluating six criteria according to four point system. His method can be considered as the main guideline for age estimation used up to these days in forensic medicine. This method has been reexamined and modified by number of researchers for the improvement of accuracy. **[4-11]** Gustafson in his own study mentioned possibility of using the same scoring system in case of third molars,

but advise to be aware of infidelity at the same time. One of the reasons is that third molars ale not influenced the same way as the rest of the dentition. Attrition seems to be the most involved factor. Although attrition itself is associated with aging when the tooth is in normal occlusion **[12]**, it has issues as an age marker beacuse of possible parafunctions, patient´s diet or missing antagonist **[13]**.

Johanson **[14]** modified Gustafson's method by evaluating seven different stages instead of four. His study proposed a more accurate formula for age estimation with a standard error of 5.16 years by using multiple regression analysis. He proposed that the ideal thickness of ground section should be 0,2 mm. Nevertheless, it has been proved that the conception of using less thick section up to 0.25 mm does not yield better results. **[15]**

The standard error of calculated age by Gustafson´s method was in our study 5.38 years, which was contrary to the original finding of Gustafson who found age difference of 4.5 years. The standard error of calculated age by newly derived formula was 5.33 years This results indicate higher error of estimated age in cases of third molars. This inaccuracy might be caused by the above mentioned variability of third molars. Nevertheless, there is still significant correlation between age and morphological changes of wisdom teeth. Therefore, the third molars can be used for purposes of forensic dentistry.

V.   Conclusion

In the present study we found a significant correlation between physiological changes of third molars and age of an individual. In conclusion, despite of its variability third molar can be used for forensic purposes of age estimation in cases with no other tooth available.

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