SECONDARY DENTIN AS A PARAMETER FOR AGE ESTIMATION- AN IN VITRO STUDY

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ABSTRACT
In many mass disasters, age estimation is a widely used method for personnel identification. Several methods of age estimation have been studied including bone, which changes as an individual grows. A particular problem for age estimation is that premortem modification may vary from subject to subject and in addition, post-mortem changes and taphonomy are influenced by many factors. Of the various parts of the body used in age estimation, teeth are least affected by the taphonomic process. Previous studies have shown that with advancing age the size of the dental pulp cavity is reduced as a result of secondary dentin deposition, so that the measurement of this secondary dentin deposition can be used as an indicator of age.

Method: The study included 200 extracted teeth, 100 were single rooted teeth and 100 were multirooted teeth. Patient information’s like chronological age, sex and place of the tooth in dentition was noted down at the time of extraction of tooth. Teeth were then reduced grossly in the mesio-distal direction on a lathe machine with a constant supply of water. These sections were grounded manually on the rough surface of the Arkansas stone first and then on the finer surface with a constant supply of the water until the enamel rods and dentinal tubules were visible clearly under the microscope. Thicknesses of all the ground sections were between 0.4 to 0.8 mm which was measured by Vernier caliper.

Results and conclusion: Secondary dentin deposition can be effectively used as an indicator of age. Statistical analysis showed that it is reliable method for age estimation.

KEY WORDS: Forensic Dentistry, Secondary dentin, Ground section, Age, Parameter.

INTRODUCTION:
Forensic age estimation of unidentified human bodies and human remains for the purpose of identification has been traditional feature of forensic science. It may be many times necessary to determine the age of living persons particularly in cases when the individual is either unwilling or unable to reveal his identity.¹ Age estimation is of broader importance in forensic medicine, not only for identification purposes of deceased victims, but also in connection with crimes and accidents.²

Dental tissues are among the most durable tissues of the human body resistant to different external influence, as well as to mechanical, thermal and chemical irritations. Their specific position and shapes are source of many different hereditary and acquired characteristics. They are useful in anthropological, laeodontologic, palaeoanthropological and forensic investigations as biomarkers of aging because they may be preserved for a long time even after death.³, ⁴

The tooth is the hardest structure in the human body, and contains enamel and dentin. Enamel is harder than bone and consists of more or less dead material while, Dentin is similar to bone in composition and has a consistency similar to cartilage, lies inside of the enamel surface and constitutes the entire tooth root.⁵ Three types of dentin have been identified in human teeth: Primary dentin, Secondary dentin and Tertiary dentin. Secondary dentin is the dentin formed continuously throughout life after the crown is fully formed. Formation of secondary dentin starts at the side of the pulp where the antagonist meets the tooth during mastication, and seems to be mainly related to age. ⁶, ⁷, ⁸

Gottlieb was the first one to correlate the secondary dentin changes with an age.⁹ In 1950 Gustafson has included secondary dentin as a one of the parameter along with four other parameters and gave his formula for estimation of an age.¹ Maple in 1978 reported improved technique of using dental histology for estimation of adult age by using in multiple regression analysis based on Gustafson’s parameters.⁶ In 1992 Solheim has studied 1000 teeth by making ground sections and he gave the
The aim of this study is to evaluate the deposition of secondary dentin occurring in teeth with age.

**MATERIAL AND METHOD:**

The present study was conducted in the department of oral pathology and microbiology at K.M. Shah Dental College & Hospital, Vadodara. The study included 200 extracted teeth, 100 were single rooted teeth and 100 were multirooted teeth. Patient information’s like chronological age, sex and place of the tooth in dentition was noted down at the time of extraction of tooth. Teeth were then reduced grossly in the mesio-distal direction on a lathe machine with a constant supply of water. These sections were grounded manually on the rough surface of the Arkansas stone first and then on the finer surface with a constant supply of the water until the enamel rods and dentinal tubules were visible clearly under the microscope. Thicknesses of all the ground sections were between 0.4 to 0.8 mm which was measured by Vernier caliper. The freshly prepared ground section was mounted on a slide using DPX and coverslip. Then the mounted slides were marked with identifying number and left for drying.

- **Inclusion criteria:**
  1) Intact permanent teeth extracted for certain clinical reasons e.g. to facilitate denture fabrication, periodontitis.

- **Exclusion criteria:**
  1) Teeth which are affected by root caries, abrasion, erosion and dilacerations.
  3) Retained deciduous teeth
  4) Fractured root/teeth
  5) Teeth with periodontitis resulting in resorption
  6) Any pathology involving teeth

The prepared slides were viewed under the routine binocular microscope at magnification of 40x. Secondary dentin deposition from each section was examined on the monitor.

Secondary Dentin was denoted by ‘S’
S₀ – No Secondary dentin
S₁ – Secondary dentin has begun to form in the upper part of pulp cavity
S₂ – Pulp cavity was half filled with secondary dentin
S₃ – Pulp cavity was nearly or wholly filled with secondary dentin

All the ground sections was viewed together and measurement of secondary dentin was noted down by the investigator and two independent observers separately to minimize the interobserver bias. The averages of measurements of all the three observers, and investigator + three observers was also be recorded for each tooth. These readings were subjected to statistical analysis.

**RESULT AND OBSERVATIONS:**

**Table 1** shows age group wise distribution of tooth. Out of 200(100%) tooth in group I (25-30 year) 52 (26%), group II (31-35year) 44 (22%), group III (36-40year) 28(14%) tooth, group IV (41-45year) 12 (6%), group V (46- 50year) 12 (6%), group VI (51-55year) 16 (8%), group VII (56-60 year) 32 (16%), group VIII (above 60 year) 04(2%) tooth distributed.

**Table 2** shows distribution of sex. Out of 200 (100%) tooth, 108(54%) tooth were collected form male and 92 (46%) tooth were collected form female.

**Table 3** shows actual age and calculated age using regression equation physiological factor: Secondary dentin deposition (Formula: \( Y = 14.11x + 20.19 \)). Actual age range was between 25 to 65 year and mean age was 40.30 ± 12.04 year while, Calculated age range was 22.43 to 55.99 year and mean age was 40.79 ± 9.87year (p=0.002).

**Table 1:** Table showing various age group and number of case in each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Age Group</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25 - 30</td>
<td>52</td>
</tr>
<tr>
<td>2</td>
<td>31 - 35</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>36 - 40</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>41 - 45</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>46 - 50</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>51 - 55</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>56 - 60</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>Above 60</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>200</td>
</tr>
</tbody>
</table>

**Table 2:** Table showing the sex distribution of the cases in the study.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>108</td>
</tr>
<tr>
<td>Female</td>
<td>92</td>
</tr>
</tbody>
</table>
Table 3: Table showing comparison of age calculated by formula and actual age

<table>
<thead>
<tr>
<th>Age</th>
<th>Range</th>
<th>Mean±S.D.</th>
<th>t</th>
<th>p</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>25 – 65</td>
<td>40.3±12.04</td>
<td>-1.256</td>
<td>0.002</td>
<td>NS</td>
</tr>
<tr>
<td>Calculate</td>
<td>22.43 – 55.99</td>
<td>40.79±9.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Ground section of tooth shows different age estimation parameters

Figure 2: Ground sections of teeth mounted on microscopic slide

Figure 3: Secondary dentin deposition scores

DISCUSSION:
Age estimation is a sub-discipline of the forensic sciences and should be an important part of every identification process, especially when information relating to the deceased is unavailable. The estimation should be as accurate as possible since it narrows down the search within the police missing persons files and enables a more efficient and time-saving approach.

The present study is undertaken to measure the deposition of the secondary dentin deposition in dried ground sections of teeth and correlate this with the known age of the individual.

A total of 200 cases were taken in this study and secondary dentin deposition was recorded. The teeth selected in this study were single and double root tooth.

Cases were divided into different age groups and maximum number of cases in the study belonged to age group of 25 to 30 years, next being 35 to 40 years. This age group was largest as this is the most active age group and most of the postmortem done in the hospital are from this age group.

In our study, 108 were males and 92 females. We found that mean total score in males were slightly higher than that in females but statistically this difference was non-significant. This finding was consistent with the finding of Pillai and Bhaskar (1974).11
The comparison of the mean actual age and mean calculated age, using the formula for Secondary dentin deposition was found that mean calculated age (40.79 ± 9.87) was slightly higher as compared to the mean actual age (40.30 ± 12.04) but statistically this difference was non-significant.

Maximum and Minimum deviation was calculated (-15.79 to +11.21 years) which was not similar to that calculate using Gustafson’s (-3.53 to + 4.67 years) as well as Maple and Rice’s formula (-4.69 to + 5.49).

Thus in our study we found that secondary dentin deposition gave the comparable result for an age estimation.

CONCLUSION:
In conclusion this method do not estimate direct relationship with age in years but they allow us to class individuals into a set of broad age categories, as did also other methods of age estimation. Naturally, because of the lengthy process of preparing the ground sections and especially because of the small amount of accessible material, not all questions could be answered and not all problems of evaluation could be dealt with in full. Evidently, the issue of the estimation of age of an individual’s from the teeth will remain a subject of further research.

REFERENCES: