DIGITAL MEASUREMENT OF DENTINAL TRANSLUCENCY IN CORRELATION WITH AGE MATURITY - A FACT OR FICTION?

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ABSTRACT

Background

Age estimation has been a dentist's cup of tea with regard to forensic dentistry. It is easy, widely adapted and reliable procedure during mass disasters. Traditionally, dentinal translucency has been measured using vernier calipers and technology is seldom used.

Objectives

This study aimed at integrating the computer based digitalization to measure dentinal translucency on sectioned teeth translucency measurements.

Materials and Methods

Thirty extracted permanent teeth were collected and were sectioned to 250 μm. They were then mounted on the scanner and scanned. The scanned images were then measured using American Board of Forensic Odontology Scale (ABFO) Scale No. 2 scale. The length of translucency using Adobe Photoshop

Results

Correlation coefficients of translucency measurements of the estimated age showed a high degree of correlation with the actual age with a mean difference of ± 10. The relation is linear with translucency as a better indicator with advancing age

Conclusions

The translucency measurements obtained by the digital methods can be recommended to save time in comparison with the manual method.

KEYWORDS: Age Assessment, Dentinal Translucency, Computer, Adobe Photoshop, Forensic Dentistry.
INTRODUCTION

Dentist had played a pivotal role since 1776 when Paul Revere identified his friend Dr. Joseph Warren, due to the presence of a small denture that Paul Revere had fabricated for Dr Warren. The uniqueness of forensic science has always played a pivotal role during the identification of victims in a mass disaster or natural calamity where the information of the deceased is unavailable. It is also used in crime scene investigation for the identification of the identity of the criminal or deceased.

Estimation of post-mortem remains is a challengeable task and even more difficult is age estimation. The fact that teeth can withstand significant amount of destruction, they tend to play a major role in reconstructive and comparative evidence. A lot of methods are available to estimate the age of individuals based on the dentition. Atlas method, Moorrees et al, and Anderson et al have all estimated the age of the children. In adults Gustafson’s technique, Demerijians technique, Johanson’s technique, and Willem’s techniques have been used in the 19th century of which noted popularity was the Gustafson’s morpho-histologic approach has occupied a prime place in age estimation. The next preferred technique was Johanson’s technique. All these techniques used the dentinal translucency as a key factor in age estimation. Age estimation based on dentinal translucency is a widely accepted method.

Traditionally measuring the age based on dentin translucency was done with an aid of Vernier Caliper. As with advancements in technology this seems to be rather outdated approach that involves wasteful expenditure of time and energy. Hence in order to provide a better solution to save time and the ease of storage, digitilisation seems to be a better alternative. Hence this study is aimed to describe a new digitally simple method for age estimation by analysing dentinal translucency as an in forensic identification.

MATERIALS AND METHODS

Twenty permanent teeth from individuals in the age group 25 to 55 years, extracted for valid clinical reasons such as malocclusion/orthodontic treatment, periodontal disease and caries, were obtained from the Department of Oral and Maxillofacial Surgery, SRM Dental College. The extracted teeth were thoroughly cleaned and soft tissue remnants removed from the root surface with a scalpel. Teeth were kept in 10% formalin and, following fixation, manual sectioning was done using Arkansas stone in the buccolingual plane as close as possible to the central axis of the tooth.

Each tooth section was placed next to an American Board of Forensic Odontology Scale (ABFO) No. 2 scale (Figure 1) on the scanner platen.
The long axis of the section was aligned parallel to the y-axis of the scale. Prior to scanning, the scanner setting was verified to be 100% of the original to ensure life-size scanned images. Subsequently an image of 600 dpi resolution of the section with scale was obtained. The scanner lid was kept open while scanning and ambient light conditions kept to a minimum (note: keeping the lid closed obstructs passage of the optical scanning light through the translucent zone, rendering the entire tooth section opaque). Scanned images were imported to Adobe Photoshop image-editing software for viewing and measuring the extent of translucency. The different dental tissues are generally appreciable on the image and dentinal translucency, in particular, appears as a dark region on the section (Figure 2).

Translucency was measured using a number of tools available on Adobe Photoshop. The method for measuring translucency that follows has been adapted from different steps described by Johansen and Bowers for digital analysis of bite mark evidence. For convenience of measuring apical and coronal extent of translucency, “guides” were placed on the image (Figure 3).

These guides can be activated by inserting Photoshop’s in-built “rulers” along the edges of the image (on the Menu Bar choose View > Rulers, or Ctrl R, or Command R for Macintosh systems). Once the rulers are activated, guides are placed by clicking the cursor within the x-axis (horizontal part) of the ruler and dragging onto the image. Click and drag as many guides as may be required onto the image but it is anticipated that two should suffice. To move a guide, the Move Tool is used; alternatively, the Ctrl key is held down (Command key for Macintosh systems) and the guide
moved to the desired location. Once the respective guide has been placed at the apical and coronal extent of root dentin translucency, the distance between them can be obtained using the Measure Tool on the Toolbox (Figure 3). Using this tool, a line is drawn between the guides; the distance (D1) is displayed in the Options Bar. If the Options Bar is not displayed, it can be activated by choosing Window > options. Measurements obtained using the Measure Tool is sensitive to 0.1 mm. The measuring line drawn can be kept vertical by holding down the Shift key. The units were ensured to be in mm by comparing with the reference ABFO No. 2 scale. In the event units are not in mm, choose Edit > preferences > units and rulers and select "mm" under units and click OK.

Statistical Analysis

Age was estimated by using the translucency length obtained for each case using the formula

\[
\text{Age} = 40.0391 + (2.1063 \times \text{translucency length})
\]

Correlation between age and dentin translucency length was done using Pearson's correlation.

RESULTS

It could be inferred from the present study that around thirteen samples show a discrepancy from the actual age to the calculated age based on translucency of -3 to +9 and seven samples show a discrepancy from -3 to +9. Considering \pm 10 as positive result and < \pm 10 as negative. Positive results with minor discrepancy were seen in 65% of the study population (i.e from -3 to +9, 13 samples) and negative result was seen in 35% of the population.

Table 1: The Actual Age and Estimated Age of the Study Patients

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Actual Age</th>
<th>Length</th>
<th>Calculated age</th>
<th>Rounded off age</th>
<th>Discrepancy</th>
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<td>4.8</td>
<td>50.14934</td>
<td>50</td>
<td>3</td>
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<tr>
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<td>25</td>
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<td>42.1454</td>
<td>42</td>
<td>17</td>
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<tr>
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<td>13</td>
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<tr>
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<td>46</td>
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</tr>
</tbody>
</table>

Figure 4: Correlation between Age and Length of Translucency: Figure 4 depicts, This picture depicts the correlation coefficient between the age and length measurement. A strong positive correlation exists (R=0.9299). This means that as the age increases, the length between the apical and coronal extent of root dentin translucency increases and vice versa. The value of R², the coefficient of determination, is 0.8647
DISCUSSIONS

Dentinal translucency was extensively studied by Tomes\(^8\) and it was first applied in the field of forensic sciences by Bang and Ramm\(^9\). Difference in refractive indices between intratubular organic and extra tubular inorganic material is equalized, resulting in increased translucency of the affected dentin that has been the key principle in age estimation using dentinal translucency. The apex of the tooth seems to be the most reliable source for age estimation\(^8\). This was first observed by Miles et al\(^10\). The present study has used the apex of the tooth for age estimation. As the age advances, the translucency progresses from the apex towards the crown portion of the tooth. This suggests a linear relationship and the present study also adheres to this fact. It was also observed by Johnson et al\(^6\). The present study used digitalization of the sample, it was observed that a good linear relationship was stabilized. It proves the fact that digitalization can be used over manual methods. This is in correlation with the studies done by Acharya et al\(^11\) and contradictory to the study done by Drusini et al\(^12\) and Valenzuela et al\(^11\). The present study show that age was estimated within a range of ± 10 suggesting that about 65% of the study population falls under this category. This is in agreement with the studies done by Simranjit Singh et al\(^14\) but it is in contrast with the studies done by Acharya et al\(^11\) who estimated the age within ±5 years. This difference needs to be validated further with studies done on a large scale and involving a wider age category of patients.

ADVANTAGE OF THIS METHOD

- Software program that is used is commercially available and a widely used image-editing digital aid.
- Accuracy of age estimation using present digital method is much higher to that of conventional method.
- Images can be stored and conveniently retrieved for future use, irrespective of the condition of the actual tooth section.
- This method is least affected by environmental factors and the pathological process\(^15\).
- It can also be used on intact teeth and not necessarily on extracted teeth although tooth sections provide better detail\(^16\).
- This method does not require a great level of expertise.
- As the teeth are symmetrical in their position, any tooth from any relative position can be included for measuring purpose\(^16,17,18\).
DISADVANTAGE OF THIS METHOD

- Wider variations seen.\(^{19}\)

- There is no global accepted definition of the upper and the lower limits of root dentin translucency.\(^{20}\)

LIMITATION OF THE PRESENT STUDY

- In order to validate this study a larger sample size needs to be taken.

- Ideally the formula that we had used for the age estimation was derived based on earlier study digital translucency measurements.

- This study has adapted a 2D computer based Adobe Photoshop image editing software which is less precise when compared to 3D view. (Dentin translucency in buccolingual plane is only viewed and is considered.)

REFERENCES


