The versatile use of free-to-download and open access computer software in forensic odontology casework

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ABSTRACT

Development of new computer hardware and software in the last 15 years has radically altered the way dentists approach to forensic odontology casework. However, many of these developments are still out of reach of most dentists in emerging economies owing to economic factors. This oral presentation details how a free-to-download and open source software application named GIMP ('GNU Image Manipulation Program') can assist dentists in diverse forensic odontological analyses, including child and adult age estimation, bite mark investigation, and sex assessment. The author has no vested/financial interest in this software. The intention is not to recommend this software in particular, but to highlight the techniques and steps involved (which may be similar to other free software applications) but are hitherto unexplained in detail. At approx. 75 MB, GIMP is easy to download and install in basic desktop/laptop computers. Using just one tool available in GIMP (viz., the 'Measure Tool'), the open apex method can be used on radiographs of children to measure the width of the developing apical portion of the tooth, the tooth height, calculate their ratio and estimate the age. Similarly, the 'Measure Tool' may also be used to assess the mesiodistal and buccolingual dimensions of teeth on two-dimensionally (2D) scanned skull specimens for sex assessment. Another use of the 'Measure Tool' is calculating the length of root dentinal translucency on 2D scanned images of 250 microns thick tooth sections for adult age estimation. In addition, using tools such as the 'Fuzzy Select Tool', root dentinal translucency can be delineated to calculate translucency area for estimating age on similar scanned tooth sections. On dental radiographs imported to the software, the 'Free Select Tool' can be used to select the outline of the tooth and outline of the pulp/root canal. The number of pixels within these selections can be viewed on the Histogram dialog and their ratio calculated to estimate age in adults using the pulp-to-tooth area ratio. Lastly, the software program can also be applied to 2D bite mark analysis. This includes proper orientation of the close-up bite mark photograph using the 'Measure Tool' and 'Rotate Tool', correcting it for minor photographic distortion using the 'Perspective Tool', confirming that distortion is corrected using the 'Ellipse Select Tool' and Stroke Selection, and life-sizing the photograph using Scale Image; once these steps in processing the bite mark image is completed, the incisal surface/bite edges on the 2D scanned casts of the suspect's dentition are outlined with the

'Free Select Tool' and stroked on a new layer. The stroked bite edges (the so-called "hollow volume overlay") can be copied and pasted (as a New Layer) on the life-sized bite mark image and then superimposed on the bite mark using the 'Move Tool' and 'Rotate Tool'. Thus, GIMP has the potential to serve as an excellent tool in the armamentarium of dentists involved in routine or occasional forensic odontology casework.