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Inter-operator reliability of overlay generation techniques in bite mark analysis

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Introduction

Overlays are representative of incisal edges of the teeth produced over transparent sheet. They are used most commonly for comparison of bite mark pattern of a suspect with that found on an animate or inanimate object. It is the most common technique of comparing the bite marks. With time many techniques of overlay generation have evolved like the manual, photocopying and computer assisted technique.

Objectives

1) To evaluate various overlay generation techniques.
2) To evaluate the inter-operator reliability in comparing the overlays generated.

Material and Methods

Twenty-five individuals participated in the study. Impressions of maxillary and mandibular arches of these individuals were made and dental study models prepared in dental stone. Overlay production was done by manual, photocopying and computer assisted technique. In manual technique a sheet of transparency film and a fine tipped pen were used to mark the perimeter of the biting surface. In the photocopying technique an accurate image of the dental model was made. Then the image placed upside down on a radiographic view box and the tooth edge outlines were traced. These outlines were then photocopied on a transparent sheet. In the computer assisted technique first the study models were scanned and then a gradual selection of biting edges of the teeth was done using magic wand selection tool resident in the Photoshop software version 7. The image obtained was printed on transparent sheet. Finally the overlays obtained by each method were compared amongst themselves by two operators.

Results

In our study the inter-operator reliability was found to be highest in computer generated overlay method with kappa coefficient of 0.5614 having a moderate degree of agreement. The values for manual and photocopying generated overlays were 0.3772 and 0.4231 respectively:

Manual Method (Matching)

Fig. 1: Biting edges being traced

Fig. 2: Manual overlay

Observer I	**Observer II**				**Total**
	No	Slight	Moderate	Excellent	
No	0	0	0	0	0
Slight	0	5	4	0	9
Moderate	0	3	13	0	16
Excellent	0	0	0	0	0
Total	0	8	17	0	25

Test Statistics: Kappa Coefficient: 0.3772 (agreement)

Photocopying Method (Matching)

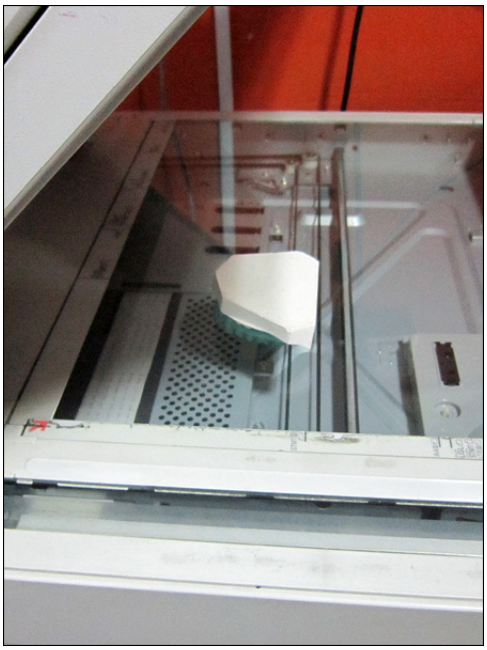

Fig. 3: Dental model being photocopied

Fig. 4: Photocopied dental model

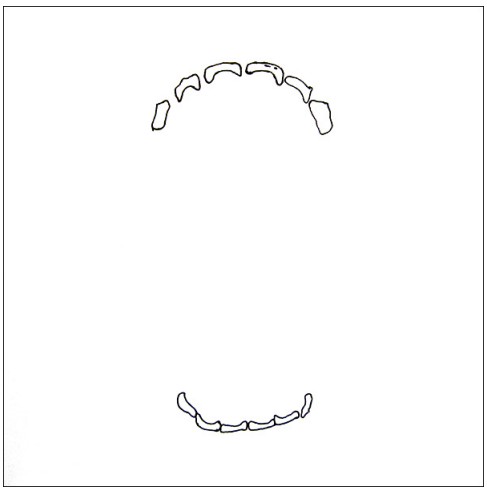

Fig. 5: Traced biting edges

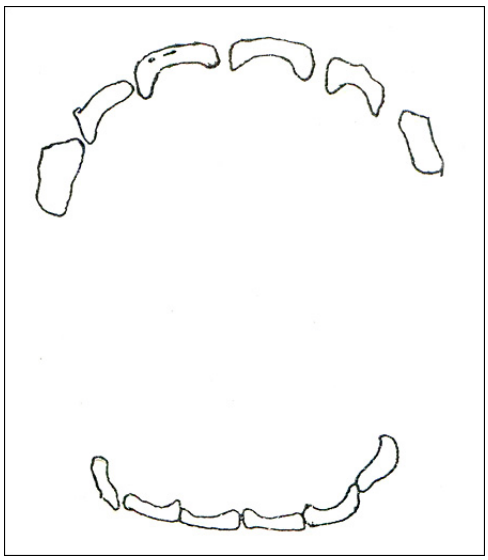

Fig. 6: Photocopied overlay

Observer I	**Observer II**				**Total**
	No	Slight	Moderate	Excellent	
No	0	0	0	0	0
Slight	0	3	0	0	3
Moderate	0	2	10	7	19
Excellent	0	0	0	3	3
Total	0	5	10	10	25

Test Statistics: Kappa Coefficient: 0.4231 (agreement)

Computer Generated Method (Matching)

Fig. 7: Dental model being scanned

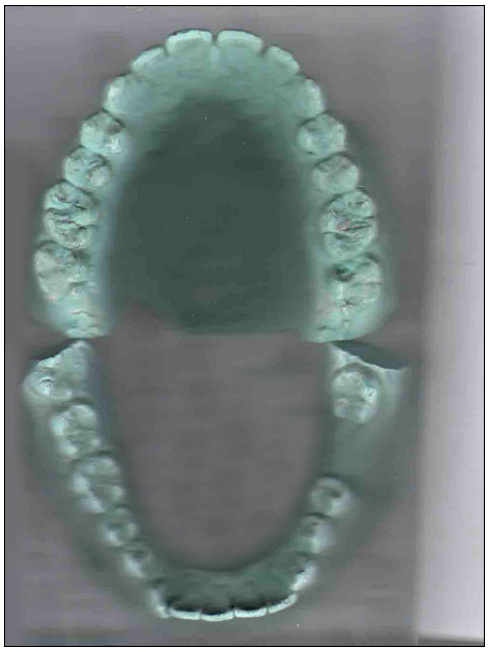

Fig. 8: Scanned dental model

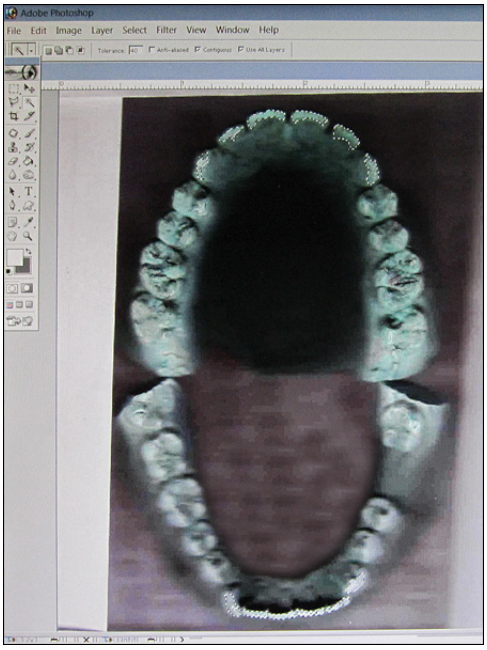

Fig. 9: Biting edges selected by magical wand selection tool

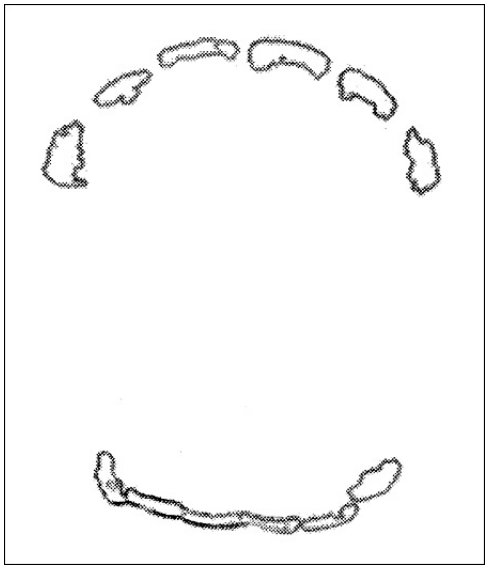

Fig. 10: Computer assisted overlay

Observer I	**Observer II**				**Total**
	No	Slight	Moderate	Excellent	
No	0	0	0	0	0
Slight	0	1	0	0	1
Moderate	0	0	10	1	11
Excellent	0	0	5	8	13
Total	0	1	15	9	25

Test Statistics: Kappa Coefficient: 0.5614 (agreement)

Conclusions

The principle of bite mark analysis is based on the premise that no two people have similar teeth and hence the bite marks made are dissimilar. Historically, manual technique was the only technique known for generating overlays and was used in about 1966, but now improved techniques like photocopying and computer aided overlay generation techniques is available. One of the limitations of the overlays is that they are two dimensional representatives of three dimensional bite marks. To the best of our knowledge, our study is the first of its kind measuring the inter-operator reliability of the various overlay generation techniques. Past studies have studied the various overlay generation techniques with the intent of finding the best technique of overlay generation, with matching done by a single examiner. As two examiners conducted the observation in our study, we were able to find the inter-operator reliability of the overlays generated. The computer assisted overlays were found to give reliable results when matched by more than one examiner.

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