

A comparative study of sagittal dental relationship using digital method of bite mark evaluation

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Abstract

Introduction: Intercuspation of teeth depends on position of teeth and jaws. Bite mark is the resultant of the intercuspation of teeth produced by an individual. **Aims and Objective:** Comparative evaluation of bite marks in Angle's Class I, II, and III sagittal occlusion. **Materials and Methods:** Three groups as per Angle's classification-Class I, Class II, and Class III relation were taken. Each group comprised 30 samples each. The dental casts were scanned to create digital images. "IC Measure" software was used to determine the angular and linear measurements on scanned images of study model after calibration. Internal angles of odontometric triangle, intercanine width, shape of the arch, size, and shape of the individual teeth was recorded and subjected to the statistical analysis. **Results:** All incisors had rectangular and canine had triangular shape. Bilateral maxillary lateral incisors and mandibular left central incisor were significantly small in size for Class III. Square arch form was found more commonly in Class III and ovoid arch form in Class I and Class II occlusion. Intercanine width was insignificant among all occlusions. All the angles of the odontometric triangle in the maxillary and mandibular arches were significant for Class III. **Conclusion:** Class III occlusion individuals were distinct for shape of the arch and angles of maxillary and mandibular odontometric triangle. The quantified values of odontometric triangle can be utilized for the identification of Class III individuals.

Key words: Dental arch, dentition, DNA, forensic dentistry, individuality, occlusion, odontometry, orthodontics, software

Introduction

Human identification is the need of the hour in the wake of the increased number of crimes and calamities all over the world. Wide spectrum of techniques for identification exists like finger prints and other biometric

techniques; ear prints, handwriting analysis, voice analysis, DNA fingerprinting, forensic odontology, etc., Forensic odontology deals with the study of dental applications

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in legal proceedings. Bite marks as a part of forensic odontology serves 2 purposes; medico-legal autopsy and as part of prosecution of a suspect.^[1] Bite marks are often found in criminal scenarios in victims of murder, rape, child abuse, etc., or a victim may inflict them on the perpetrator. Legally dental identification is considered as a valid method of matching and drawing comparison between the bite marks found on the skin or recorded in food items to the accused person's dentition.^[2] Wright and Dailey and Lessig *et al.* have suggested that the state of the dentition, the position of the teeth, the degree of breakdown and/or repair of the teeth, restorations, and prosthesis will create a bite mark with a high level of individuality termed as the uniqueness of human dentition (UHD).^[3,4] Bite marks as forensic evidence along with fingerprints and DNA played an adjunctive role in sealing the fate of four convicts on December 16, 2012 in the Supreme Court of India (Nirbhaya case).

Relationship of the teeth and/or occlusion is analyzed based on the intercuspation of maxillary and mandibular deciduous or permanent teeth in transverse, sagittal, and vertical dimension. First molars are the foremost permanent teeth to erupt in the oral cavity. Hence, bears an impact on the establishment of the final occlusion. EH. Angle-Father of modern orthodontics – classified sagittal relation of teeth into three types, namely Class I, Class II, and Class III occlusion.^[5] All the three occlusions are different and distinct in their dental arch characteristics. The literature was appraised for analyzing the distinctiveness of different sagittal dental relations with the overlays of incisors and canines most commonly found in the bite mark, a lacuna of evidence was observed in this pretext. Hence, there was a need to analyze the various parameters of the anterior dentition and compare them with different sagittal relation groups. Thus, the aim of this study was to assess and correlate bite marks to Class I, Class II, and Class III sagittal dental relation.

Materials and Methods

A retrospective cross-sectional study was planned. The study was conducted in the Department of Orthodontics. The sample for the study was collected from the orthodontic record archives present in the department. Keeping a confidence interval of 95%, the required sample size estimated for the study was 90. The estimated sample group was further divided into three groups, namely Class I, Class II, and Class III as per Angle's classification [Figure 1 and Table 1]. Hence, each group comprised 30 samples, respectively.^[6] Only good quality study models in permanent dentition with fully erupted teeth till the second permanent molars in the age range of 16–25 years without having any type of distortions were selected. The presence of grossly destructed teeth in the upper and lower arches, developmental anomaly, missing, fractured or



Figure 1: Angle's Class I, II, and III (right to left) sagittal dental relationships

Table 1: Angle's classification of occlusion

Angles classification	Definition
Class I molar relation	Mesiobuccal cusp tip of permanent first maxillary molar occludes with the buccal groove of permanent mandibular first molar
Class II molar relation	Distobuccal cusp tip of permanent first maxillary molar occludes with the buccal groove of permanent mandibular first molar
Class III molar relation	Mesiobuccal cusp tip of permanent first maxillary molar occludes with the interdental groove between permanent mandibular first and second molar

restored teeth, and transpositions of teeth and posttreatment models of orthodontically treated patients were excluded.

An indirect method of bite mark evaluation was utilized in our study. The dental casts were scanned to create digital images of the dental casts. Only the occlusal aspects of the maxillary and mandibular casts were scanned. The code for individual set of the scanned image was formulated and stored. A total of 20 scanned images were randomly selected on which the measurements were made by the two authors. Statistical test to assess interobserver agreement between two judges was carried out using Cohen's kappa. According to Cohen values between 0.81–1.00 suggest almost perfect agreement, we obtained a value of 0.85. The investigator who conducted the bite mark analysis on the scanned images was blinded for the code formulated for assorting the scanned models as Class I, Class II, and Class III.

The shape of the upper and lower arch was noted as ovoid, tapered, and square arch forms as suggested by McLaughlin *et al.* [Figure 2].^[7] 'IC Measure' Software - The Imaging Source, Bremen, Germany was used to determine the angular and linear measurements on scanned images of the study model. The images were calibrated in the ratio of 1:1 (actual cast: Digital image). Measurements were recorded to the level of two decimals. Mesiodistal widths of all six anterior teeth were measured individually in both upper and lower arches [Figure 3]. Odontometric triangle measurement method was used, in which a triangle was made on the incisal edges of the anteriors by marking three points, two on the outer most convex point of canines and one in the midline between the upper central incisors. The three internal angles of the triangles were measured and compared between groups [Figures 4-6].^[8-10] The length of the base of the odontometric triangle was taken as the

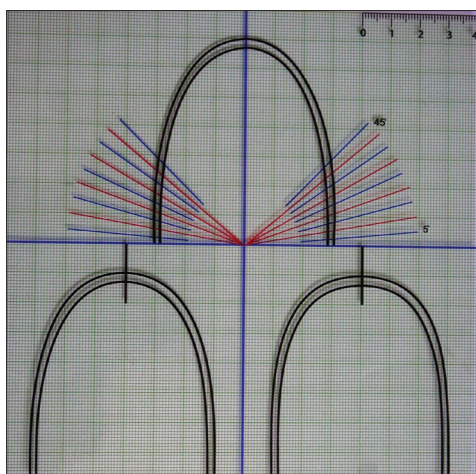


Figure 2: Arch forms. Upper – tapered arch form, lower left – ovoid arch form, lower right – square arch form

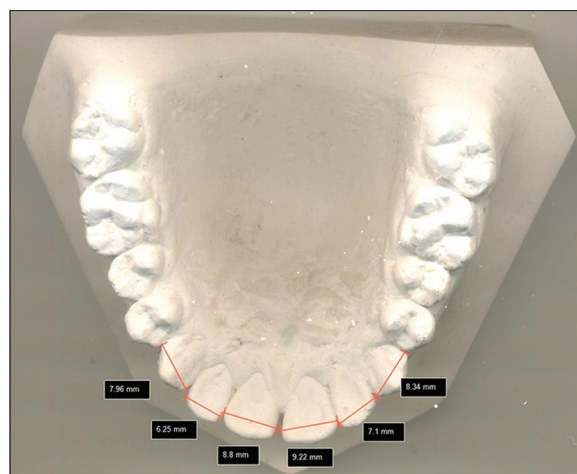


Figure 3: Measurement of mesiodistal width of teeth

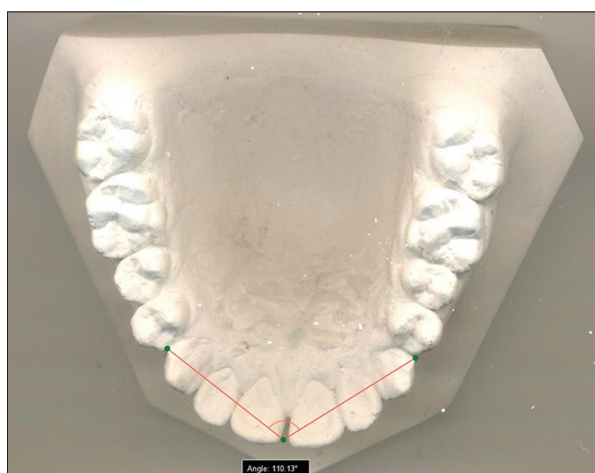


Figure 4: Odontometric triangle angle 1. The angle at the midline (13-M-23)

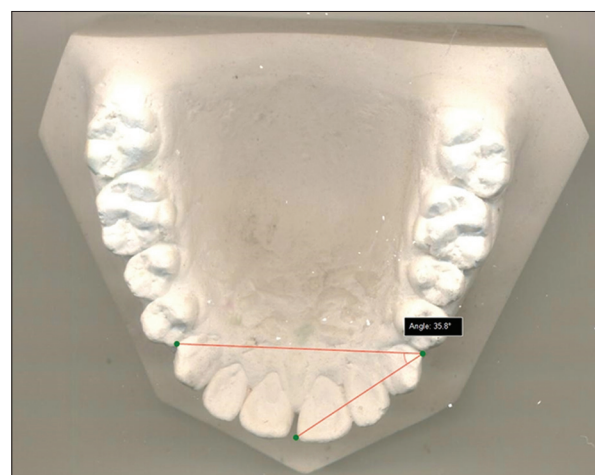


Figure 5: Odontometric triangle angle 2. The angle formed at the right canine (M-13-23)

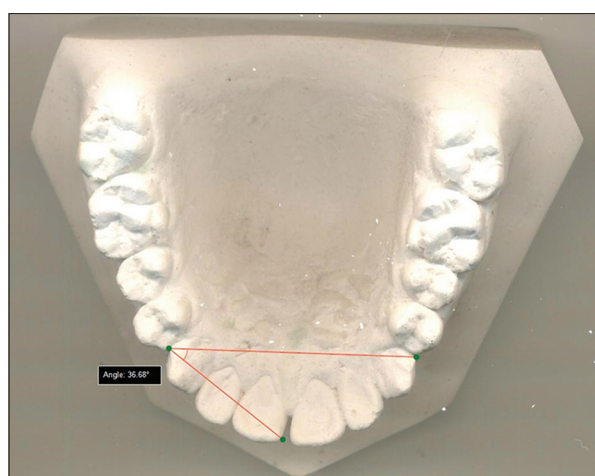


Figure 6: Odontometric triangle angle 3. The angle formed at the left canine (13-23-M)



Figure 7: Intercanine width same as the base of the odontometric triangle; that is from the outer most convex point of one canine to the opposite canine

intercanine width; that is the distance between the outer most convex points of both canines [Figure 7]. The shape of permanent maxillary and mandibular anterior teeth from

incisor to canine was also analyzed. All the measurements were measured and tabulated in Microsoft Excel sheet.

SPSS Software version 21 - The International Business Machines Corporation (IBM), New York, USA was utilized in the study to conduct the statistics. The confidence interval was set at a 95% interval. One-way analysis of variance analysis was conducted to determine the significance within and between the groups of Class I, Class II, and Class III dental relation. A multi comparison *post hoc* test was done to make a comparison of each group with every other group.

Results

Males showed a greater number of square arches (26) followed by ovoid arches (17). None of the males in the study had a tapered arch form. Whereas females showed a greater number of ovoid arch forms (27) followed by square arch forms (17) and tapered arch forms (3) in the given sample [Graph 1]. Both Class I and Class II occlusion individuals showed ovoid, square, and tapered arch forms in descending order. In Class III, occlusion individuals revealed the maximum number of square arch forms (25) followed by ovoid arch forms (5). None of the class III individuals had a tapered arch form [Graph 2]. All the central and lateral incisors had a rectangular shape when viewed from the occlusal aspect and all canines had a triangular shape.

Statistical significance for in-between group comparison ($P < 0.05$, confidence interval 95%) as per the ANOVA test was found for the following variables – mesiodistal width of the upper right and left lateral incisor and lower left central incisor and all the three internal angles of the odontometric triangle in the upper as well as the lower arch [Table 2]. A multi comparison *post hoc* test was performed to compare the three groups. All of the above parameters were statistically significant when the comparison was made between Class I–Class III and Class II–Class III. The mesio-distal width of the lower left central incisor was only significant between Class II and Class III [Tables 3-5]. The

mean values and standard deviation for all the parameters in Class I, Class II, and Class III samples are given in Table 6. The value of the odontometric triangle angles that were significant for Class III occlusion were 21.02 ± 7.37 , 20.85 ± 7.05 , and 138.52 ± 14.44 in the mandibular arch and 29.0 ± 1.32 , 30.72 ± 1.34 , and 118.43 ± 3.08 in the maxillary arch.

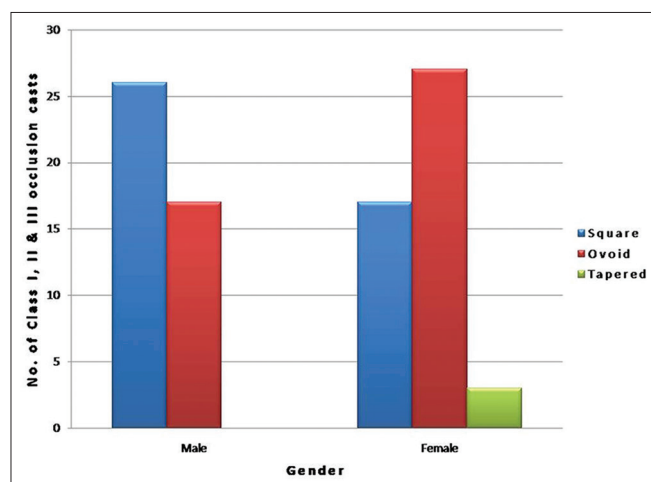
Discussion

Forensic odontology has developed great importance in the field of personal identification in the last few decades. At

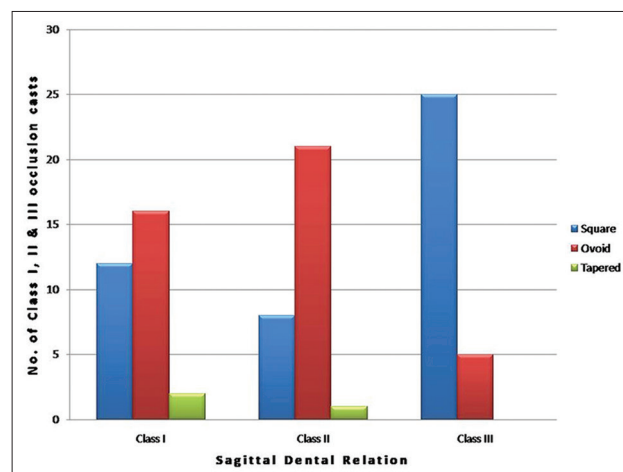
Table 2: Group comparison analysis of variance test

Parameter - between group comparison	Mean square	F	Significant
ICW13-23	3.9	0.49	0.614
MDW11	1.2	3.01	0.054
MDW12	3.4	10.34	0.000
MDW13	1.4	2.69	0.074
MDW21	0.1	0.13	0.875
MDW22	5.7	13.33	0.000
MDW23	1.2	3.05	0.052
13-M-23	1681.6	35.42	0.000
M-23-13	436.6	36.05	0.000
23-13-M	524.0	42.89	0.000
ICW33-43	2.5	8.90	0.000
MDW31	2.5	8.90	0.000
MDW32	0.5	1.40	0.251
MDW33	0.4	0.76	0.469
MDW41	0.6	2.29	0.107
MDW42	0.4	1.32	0.272
MDW43	0.9	1.33	0.269
43-M-33	4495.7	40.79	0.000
M-33-43	1083.9	41.72	0.000
33-43-M	1015.2	36.10	0.000

$P < 0.05$. 13, 23, 33, 43: FDI tooth number. ICW: Inter canine width, MDW: Mesiodistal width, M: Midline, FDI: Fédération Dentaire Internationale



Graph 1: Arch form distribution in males and females



Graph 2: Arch form distribution in Class I, II, and III sagittal dental relation

Table 3: Multi group comparison of intercanine width in the maxilla and mandible

Dependent variable	Mean difference (I-J)	SE	Significant	95% CI	
				Lower bound	Upper bound
ICW13-23					
Class I					
Class II	0.65	0.7236	0.642	-1.0744	2.3764
Class III	0.06	0.7236	0.996	-1.6604	1.7904
Class II					
Class III	-0.59	0.7236	0.698	-2.3114	1.1394
ICW33-43					
Class I					
Class II	-0.19	0.1366	0.337	-0.519	0.132
Class III	0.37	0.1366	0.021	0.048	0.699
Class II					
Class III	-2.40	0.76782	0.007	-4.2305	-0.5688

ICW: Inter canine width, SE: Standard error, CI: Confidence interval

the same time, digital technologies have enhanced precision and reliability in diagnosis. Bite mark analysis first entered as evidence in the judicial system in 1954 in the Texas case of Doyle versus state.^[11] Odontologists have often been called upon by prosecutors investigating a criminal case to generate information about the pattern of bite marks left in human skin or food items. This may help to establish the identification of the suspect. The basic premise of such a conviction, as literature describes it, is the uniqueness of the human dentition. Every person has a set of 32 teeth and 160 dental surfaces with deviations in positions, altered angulations, presence of restorations and crowns all of which result in a highly individualistic dentition.^[12] Rawson RD mathematically proved the unique nature of the human dentition.^[13] Sognnaes *et al.* and Franco *et al.* showed similar results supporting UHD.^[14,15] However, there is controversy in literature regarding this concept especially with respect to twins and orthodontically treated patients.^[16,17]

Direct and indirect techniques of bite mark registration are utilized to evaluate bite marks of an individual. The direct method of evaluation involves identifying the potential suspect and using his dental cast for direct comparison to the tooth indentations on the skin. Direct comparison can also be made on excised tissue, bitemark impression, and bitemark photograph.^[18] The indirect method of bite mark analysis normally comprises overlays which are used to compare the biting edges of a suspected biter's dentition to the bite mark photograph printed in 1:1 ratio.^[19,20] Various methods of comparison overlays have been mentioned in literature. Tai *et al.* and Pajnigara *et al.* compared the various methods and suggested the computer-assisted overlay generation method to be reliable and better than other methods such as xerographic, radiographic, and hand traced overlays, especially in terms of area and rotation of teeth.^[21,22] Pretty found digital overlay to be the most popular among odontologists in a web-based survey.^[23]

Table 4: Multi group comparison of odontometric triangle in the maxilla and mandible

Dependent variable	Mean difference (I-J)	SE	Significant	95% CI	
				Lower bound	Upper bound
13-M-23					
Class I					
Class II	1.760	1.7792	0.586	-2.4827	6.0020
Class III	-11.99800	1.7792*	0.000	-16.2404	-7.7556
Class II					
Class III	-13.75767	1.7792*	0.000	-18.0000	-9.5153
M-23-13					
Class I					
Class II	-0.579	0.8985	0.796	-2.7218	1.5631
Class III	6.29867	0.8985*	0.000	4.1562	8.4411
Class II					
Class III	6.87800	0.8985*	0.000	4.7356	9.0204
23-13-M					
Class I					
Class II	-0.555	0.9024	0.813	-2.7065	1.5972
Class III	6.94533	0.9024*	0.000	4.7935	9.0972
Class II					
Class III	7.50000	0.9024*	0.000	5.3481	9.6519
43-M-33					
Class I					
Class II	2.858	2.7108	0.545	-3.6055	9.3222
Class III	-19.62900	2.7108*	0.000	-26.0928	-13.1652
Class II					
Class III	-22.48733	2.7108*	0.000	-28.9512	-16.0235
M-33-43					
Class I					
Class II	-1.417	1.3160	0.531	-4.555	1.721
Class III	9.6300	1.3160*	0.000	6.492	12.768
Class II					
Class III	11.0467	1.3160*	0.000	7.909	14.185
33-43-M					
Class I					
Class II	-1.557	1.3692	0.494	-4.822	1.708
Class III	9.2067	1.3692*	0.000	5.942	12.472
Class II					
Class III	10.7633	1.3692*	0.000	7.498	14.028

*P<0.05. 13, 23, 33, 43: FDI tooth number. M: Midline, SE: Standard error, CI: Confidence interval, FDI: Fédération Dentaire Internationale

Hence, we chose to scan all the pretreatment dental casts and made measurements on the digitized images of the same. The computer-based measurement method had many advantages. Since the procedure is digital, it facilitates easy storage. It also allows securing evidence via multiple storage options. This technique involves scanning, hence avoids observer bias. Digitalization also provides better accessibility and makes it easier and uncomplicated for a third party to study the materials.^[18]

The size and shape of the teeth, dental arch form, intercanine width and odontometric triangle were appraised.

Table 5: Multi group comparison of mesiodistal widths of anteriors in the maxilla and mandible

Dependent variable	Mean difference (I-J)	SE	Significant	95% CI	
				Lower bound	Upper bound
MDW11					
Class I					
Class II	-0.043	0.1601	0.960	-0.425	0.338
Class III	0.317	0.1601	0.124	-0.065	0.698
Class II					
Class III	0.360	0.1601	0.069	-0.022	0.742
MDW12					
Class I					
Class II	-0.160	0.1489	0.533	-0.515	0.195
Class III	0.4900	0.1489*	0.004	0.135	0.845
Class II					
Class III	0.6500	0.1489*	0.000	0.295	1.005
MDW13					
Class I					
Class II	-0.113	0.1890	0.821	-0.564	0.337
Class III	0.310	0.1890	0.234	-0.141	0.761
Class II					
Class III	0.423	0.1890	0.070	-0.027	0.874
MDW21					
Class I					
Class II	-0.057	0.1876	0.951	-0.504	0.391
Class III	0.040	0.1876	0.975	-0.407	0.487
Class II					
Class III	0.097	0.1876	0.864	-0.351	0.544
MDW22					
Class I					
Class II	-0.217	0.1689	0.409	-0.619	0.186
Class III	0.6233	0.1689*	0.001	0.221	1.026
Class II					
Class III	0.8400	0.1689*	0.000	0.437	1.243
MDW23					
Class I					
Class II	0.010	0.1643	0.998	-0.382	0.402
Class III	0.357	0.1643	0.082	-0.035	0.749
Class II					
Class III	0.347	0.1643	0.094	-0.045	0.739
MDW31					
Class I					
Class II	-0.193	0.1366	0.337	-0.519	0.132
Class III	0.3733	0.1366*	0.021	0.048	0.699
Class II					
Class III	0.5667	0.1366*	0.000	0.241	0.892
MDW32					
Class I					
Class II	0.037	0.1589	0.971	-0.342	0.416
Class III	0.247	0.1589	0.272	-0.132	0.626
Class II					
Class III	0.210	0.1589	0.387	-0.169	0.589
MDW33					

Contd...

Table 5: Contd...

Dependent variable	Mean difference (I-J)	SE	Significant	95% CI	
				Lower bound	Upper bound
Class I					
Class II	-0.190	0.1823	0.552	-0.625	0.245
Class III	0.010	0.1823	0.998	-0.425	0.445
Class II					
Class III	0.200	0.1823	0.518	-0.235	0.635
MDW41					
Class I					
Class II	-0.157	0.1281	0.443	-0.462	0.149
Class III	0.117	0.1281	0.635	-0.189	0.422
Class II					
Class III	0.273	0.1281	0.089	-0.032	0.579
MDW42					
Class I					
Class II	-0.038	0.1378	0.960	-0.3663	0.2909
Class III	0.172	0.1378	0.427	-0.1563	0.5009
Class II					
Class III	0.210	0.1378	0.285	-0.1186	0.5386
MDW43					
Class I					
Class II	-0.028	0.2122	0.990	-0.5342	0.4775
Class III	0.285	0.2122	0.375	-0.2209	0.7909
Class II					
Class III	0.313	0.2122	0.307	-0.1925	0.8192

*P<0.05. MDW: Mesio-distal width, SE: Standard error, CI: Confidence interval

Measurements were made directly onto 1:1 calibrated occlusal scans of the maxillary and mandibular dentition using "IC Measure" software. In this study, both subjective and objective methods of bite mark evaluation were utilized. Subjective refers to something that is open to greater interpretation and relies on the individual's own particular traits, emotions, and viewpoints. Objective means something that can be observed by anybody, is not influenced by opinions or personal feelings and is quantifiable and measurable. The shape of teeth and arch forms of the upper and lower jaws were the parameters for the subjective method of evaluation. Mesio-distal width of teeth, intercanine width, and odontometric triangle method were the objective method of bite mark evaluation. A higher number of parameters were observed with the objective method of evaluation.

In this study, measurement of the intercanine width was taken from the base of the odontometric triangle since the outer most convex point of the canine is most easily identifiable on the bite mark. This method of evaluation of intercanine width differs from Tarvadi *et al.* who measured the intercanine width using cusp tips.^[24] He found that using intercanine width as a parameter for bite mark analysis is an unreliable method. This may be because the canine cusp tips are not as discernible in the bite mark as the outline of the canine is. Moreover, skin is poor registration material. Therefore, the base of the odontometric triangle,

Table 6: Descriptive statistics for Class I, II, and III occlusions

	Mean $\pm$ SD		
	Class I	Class II	Class III
ICW13-23	40.48 $\pm$ 2.90	39.83 $\pm$ 2.87	40.42 $\pm$ 2.63
MDW11	9.05 $\pm$ 0.55	9.09 $\pm$ 0.75	8.73 $\pm$ 0.54
MDW12	7.37 $\pm$ 0.53	7.53 $\pm$ 0.57	6.88 $\pm$ 0.63
MDW13	8.29 $\pm$ 0.53	8.41 $\pm$ 0.86	7.98 $\pm$ 0.76
MDW21	9.04 $\pm$ 0.65	9.10 $\pm$ 0.89	9.00 $\pm$ 0.61
MDW22	7.34 $\pm$ 0.57	7.56 $\pm$ 0.67	6.72 $\pm$ 0.71
MDW23	8.31 $\pm$ 0.53	8.30 $\pm$ 0.65	7.95 $\pm$ 0.72
13-M-23	106.44 $\pm$ 5.25	104.68 $\pm$ 10.27	118.43 $\pm$ 3.08
M-23-13	37.02 $\pm$ 3.18	37.60 $\pm$ 4.94	30.72 $\pm$ 1.34
23-13-M	36.85 $\pm$ 3.10	37.40 $\pm$ 5.03	29.90 $\pm$ 1.32
ICW33-43	31.94 $\pm$ 2.50	31.39 $\pm$ 3.24	33.79 $\pm$ 3.12
MDW31	5.77 $\pm$ 0.43	5.97 $\pm$ 0.56	5.40 $\pm$ 0.59
MDW32	6.41 $\pm$ 0.47	6.38 $\pm$ 0.50	6.17 $\pm$ 0.82
MDW33	7.16 $\pm$ 0.53	7.35 $\pm$ 0.70	7.15 $\pm$ 0.85
MDW41	5.80 $\pm$ 0.40	5.96 $\pm$ 0.56	5.68 $\pm$ 0.51
MDW42	6.41 $\pm$ 0.43	6.44 $\pm$ 0.46	6.23 $\pm$ 0.68
MDW43	7.25 $\pm$ 0.55	7.28 $\pm$ 0.67	6.97 $\pm$ 1.13
43-M-33	118.89 $\pm$ 7.56	116.03 $\pm$ 8.06	138.52 $\pm$ 14.44
M-33-43	30.48 $\pm$ 3.45	31.90 $\pm$ 4.04	20.85 $\pm$ 7.05
33-43-M	30.22 $\pm$ 3.58	31.78 $\pm$ 4.15	21.02 $\pm$ 7.37

13, 23, 33, 43 - FDI tooth number. ICW: Inter Canine Width, MDW: Mesiodistal width, M: Midline, SD: Standard deviation, FDI: Fédération Dentaire Internationale

i.e., the outermost convex point of the canines was used as a landmark for measuring the intercanine width.

No study so far has evaluated the relationship between sagittal dental relation and bite marks. Statistical significance was observed in Class III individuals for the angles of the odontometric triangle in both maxillary and mandibular arches. The mean values of the angles adjoining the base of the triangle at the canine region were lesser, and the mean value of the angle at the apex (midline) was larger in Class III suggesting shorter and broader maxillary and mandibular odontometric triangles in Class III compared to Class II and Class I. The angle at the apex of the odontometric triangle is affected by the anteroposterior position of incisors and the intercanine width. We found no significance in the linear measurement of intercanine width between all the classes. Our observations correlated to the observations made by Koo *et al.* who compared the arch widths between Class I and Class III and found that the arch width discrepancy in Class III revealed itself at the basal arch width level rather than the dental level.^[25] Thus, a larger angle at the apex of the odontometric triangle may have been observed due to the lingual inclination of the teeth; which often occurs in Class III dental compensation.

When the mesiodistal width of the teeth was appraised, the left and right maxillary lateral incisors of Class III occlusion were found to be significantly smaller compared to their Class I and Class II counterparts. Similarly, the left mandibular central incisor of Class III occlusion was

significantly smaller compared to the same tooth of Class II occlusion. This was in contrast to the observations made by Hussein *et al.* who found smaller maxillary laterals in Class I occlusion in Malay school children.^[26] The difference in results could be attributed to a variation in the size of teeth occurring due to different ethnic origins. Yang *et al.* found that Bolton's anterior and overall ratio for skeletal Class III are greater than for skeletal Class I and Class II occlusion.^[27] This will happen either when the mandibular teeth are large or maxillary teeth are small. The presence of small maxillary laterals observed in this study affirms the above. In relation to arch forms this study showed the maximum number of ovoid arches in Class I and Class II occlusions and square arches in Class III occlusions. The observation of this study correlated with the observations made by Omar *et al.*^[28] All the incisors and canines revealed rectangular and circular shapes, respectively, in cross-sectional view. This finding was similar to that made by Sandeep *et al.*^[19]

The results of this study can be useful during litigation to help rule out individuals in the search for suspects. Nonmatching individuals can be separated from the pool of suspects and this helps to narrow down the search process. However, this is only supplemental evidence and should not be used as primary evidence in conferring a criminal charge upon an individual as many factors contribute to the accurate production of the bite marks such as position, pressure, etc., Understanding the gravity of the implications bite mark analysis results can have on the life of an individual caught in the suspicious circle, the American Board of Forensic Odontology has introduced guidelines for the evaluation of bite marks.^[29] Despite the guidelines, wrongful convictions have occurred in the past.

From 2000 to 2010, there have been approximately 10 DNA exoneration cases involving bite mark evidence in the US.^[30] DNA profiling is the gold standard for criminal prosecutions but is expensive, labor intensive, and time consuming. Bite mark analysis only assist in limiting the number of individuals on whom DNA profiling is done to reach a proper conclusion –enough to convict someone. Newer methods using three-dimensional (3D) technologies are also being introduced for bite mark analysis. It is necessary to expand the scientific knowledge and further research is required to evaluate the existing digital and newer 3D techniques in bite mark analysis.

Conclusion

Class III occlusion individuals were distinct for the shape of the arch and angles of the maxillary and mandibular odontometric triangle. The quantified values of odontometric triangle can be utilized for the identification of Class III sagittal dental relation. There is a scope for another study to be done for evaluating the size of the teeth in relation to sagittal occlusions.

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Conflicts of interest

There are no conflicts of interest.

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