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Estimation of Innercanthal Distance(ICD) of An Individual Using The Incisal width of Maxillary Central Incisor -A Pilot Study

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Abstract
Introduction: *Dental evidence is a valuable tool in identifying inividuals. This study is based on the fact that the ICD is attained by the age of 1 year, after which the growth in this area is slow in contrast to outer orbital dimension.*
Objectives: *To ascertain whether the incisal width of the maxillary central incisor can be used to detect the inner canthal distance. To derive at an equation ICD=CIWX2/0.618 from the previously proven FORMULA CCIW=ICDX0.618/2. This study attempts to emphasize the practicality of applying Inner-canthal Distance as an adjuvant to support and aid in sketching of an individual.*
Materials and Methods: *30 subjects between 18 and 35 years of age, free from facial and dental deformities were examined; Inner Canthal Distance (ICD) and Incisal width of Central Incisor measured from Wax bite (IWWB) were recorded and ICD was calculated using the formula ICD=CIWX2/0.618. Pearson's Correlation Coefficient test was used to evaluate the ICD and the IWWB.*
Results: *The ICD and Incisal width of Central Incisor measured from Wax bite was found to be highly correlated (r=0.54).*
Conclusion: *Based on these results we propose the use of incisal width of maxillary central incisor to calculate the ICD and vice-versa as, to supplement the evidence provided for individual identification/sketch and increase its value as a forensic tool.*
Keywords: *Inner Canthal Distance (ICD), Central Incisor Width (CIW), Bite Marks, maxillary central incisor, south Indian population.*

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I. Introuction

Identification of an individual plays a very important role in cracking crime cases.Suspect's sketches drawn on the basis of description given by victim or eyewitness plays very important role in cracking crime cases but still they are not effectively used due to some deficiencies in current system[1].Sketches used in forensic investigations are either drawn by forensic artists (forensic sketches) or created with computer software (composite sketches) following the verbal description provided by an eyewitness or the victim [2]. Practitioners in this field take help from soft- tissue prediction guidelines that have been published. However, many of these guidelines are subjective and have not been systematically evaluated using empirical methods [3,4].Teeth are the hardest and chemically the most stable tissues in the body. They are known to resist post- mortem, mechanical, chemical, physical and thermal types of destruction [5]. The inner canthal distance (Fig.1) is defined as the distance between the medial angles of the palpebral fissures [6]. Abdullah in 2002 has proposed a formula to calculate the width of the central incisor from the inner canthal distance. The ICD was found to be greater than the combined width of maxillary central incisors. Thus the ICD was multiplied by 0.618. the resultant product was then divided by 2 to obtain the width of a single central incisor. FCIW = ICD/2 x 0.618[7].In a study conducted in south India, as in the European population, the ICD and the golden proportion are reliable predictors for determining the width of the maxillary central incisors in the south Indian population also. Reference points in faciomaxillary region such as interpupillary distance, intercanthal distance, interalar distance and bizygomatic width can significantly contribute toward reconstruction of two- dimensional (2D) facial profiles [8]. The study has been conducted with the aim to ascertain whether the incisal width of the maxillary central incisor can be used to detect the inner canthal distance, and to emphasize the practicality of applying Inner-canthal Distance as an adjuvant to support and aid in sketching of an individual.

II. Materials And Methods

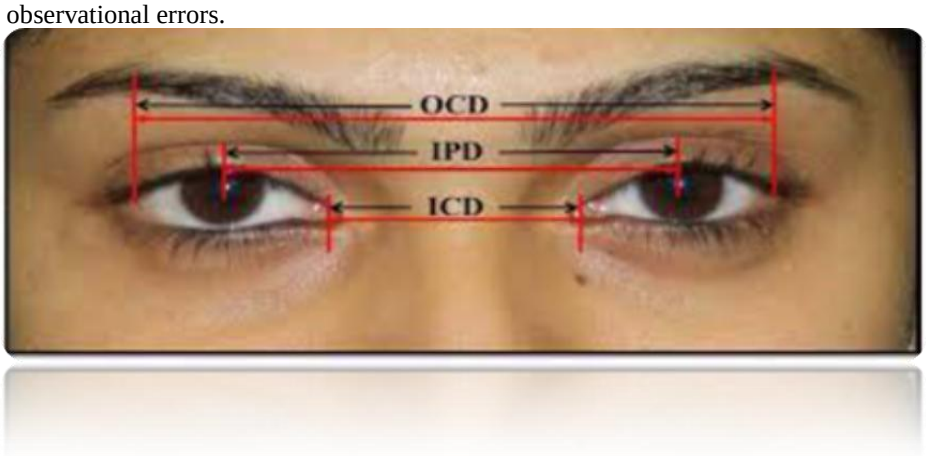
The study was conducted among 30 students, 15 males and 15 females, between the age of 18 and 35 years, with no facial or dental deformity were selected. The purpose and procedures regarding the study were explained to all participants and an informed consent was obtained from them. All the subjects had full complement of teeth with no history of orthodontic treatment, crowding, diastema, morphological deformity or any form of restorations. The subject was seated in a relaxed, upright position during examination to ensure selection criteria mentioned above.

Central incisor width(CIW):

The maxillary central incisors were measured at the contact point area with the help of a vernier caliper.

Inner canthal distance measurement:

Subjects were seated with their heads supported in an upright position and they looked straight. The sterilized caliper was placed against the forehead and lowered toward the eyes. The arms of the calipers were adjusted so that they were in gentle contact with the medial angle of the palpebral fissures of the eyes. Care was taken not to compress the soft tissues. The distance between these two anatomical landmarks was recorded as ICD, ICD was measured two times for each subject by the same operator. Average value was taken to avoid intraoperator observational errors.



The common ratio of geometric progression are 0.618 and 1.618.Any decreasing function is multiplied by 0.618 and increasing function by 1.618 to get the next result. As the inner canthal distance was greater than the combined widths of the maxillary central incisors, it was multiplied by 0.618. The resultant product was divided by 2 to obtain the width of a single central incisor. The formula can be expressed as follows: FCIW=ICD/2x0.618, where FCIW is the calculated width of a maxillary central incisor. The calculated width

was compared with the calculated central width from the wax bite measurement for each subject. Intra-observer error validation was done.

Inner canthal distance from central incisor width:

ICD was calculated using the formula ICD=CIWX2/0.618.

The data obtained was tabulated and analyzed using Statistical Package for Social Sciences, Version 16 (SPSS). Based on these values, the mean and standard deviation (SD) were calculated. The P value of 0.05 or less was considered as statically significant.

Agreement between measured from wax bite and calculated widths of central incisor from innercanthal distance was evaluated with Pearson's Correlation Coefficient (Pearson r).ICD and correlations were derived from the Pearson's Correlation Coefficient.

A t-test was used to find the statistical significance between measured and calculated values of CIW for male and female subjects separately.

III. Results

Table 1 shows the mean values and SD for the inner canthal distance, Incisal width of Central Incisor measured from vernier caliper, for all patients were 31.90 ±3.13, 8.32±1.29.

Table 2 depicts the Innercanthal Distance of male as 31.6±3.18 and for female as 32.1±3.16. Incisal width of Central Incisor measured from vernier caliper for male and female are 8.61±1.14 and 8.03±1.39 respectively.

Table 3 illustrates the observations and statistical calculations done for Pearson's Correlation Coefficient (r) the Incisal width of Central Incisor measured from vernier caliper and the Inner Canthal Distance in all patients.

From the Table 3 and figure 1, the correlation between Incisal width of Central Incisor measured from vernier caliper and the Inner Canthal Distance in all patients was inferred to have a good positive correlation with a Pearson correlation coefficient of 0.544^{**} and 1.000^{**} respectively. The results are highly statistically significant.

Table 4 and figure 2 and 3 shows the correlation between the Incisal width of Central Incisor measured from vernier caliper and the Innercanthal distance in males and females separately.

The result showed a good positive correlation between Incisal width of Central Incisor measured from vernier caliper and the Innercanthal distance in both male and female patient, with greater correlation between Incisal width of Central Incisor measured from vernier caliper and the inner canthal distance in male patient (r = .752**) compared with female patient (r = .443) [figure 3].

From the table 5 the results show a perfect positive correlation between the Innercanthal Distance derived from the Central incisor Width. From the Table 6, Innercanthal Distance derived from the Central incisor Width for males showed a perfect positive correlation but females showed negative correlation but the results are not statistically significant. Table 1: The mean values and standard deviation for the upper incisal width measured using vernier caliper and calculated from ICD and Measured ICD.

	N	Mean	Std. Deviation
Innercanthal Distance (ICD)	30	31.90	±3.13
Measured Incisal width of Central Incisor (MCI)	30	8.32	±1.29
Innercanthal Distance derived from the Central incisor Width.	30	26.93	±4.16

Table 2: Mean values and standard deviation for the width of upper central incisors and Inner Canthal distance for both male and female patients.

Gender	N	Mean	Standard Deviation
Inner canthal distance			
Male	15	31.6	±3.18
Female	15	32.1	±3.16
Measured Incisal width of Central Incisor (MCI)			
Male	15	8.61	±1.14
Female	15	8.03	±1.39
Innercanthal Distance derived from the Central incisor Width.			
Male	15	27.87	±3.68
Female	15	25.97	±4.52

Table 3: Observations and statistical calculations done for pearson's correlation coefficient (r) between the measured Incisal width of Central Incisor, and the Inner Canthal Distance in all patients.

Pearson Correlation		
	Innercanthal distance	p value Sig. (2-tailed)
Measured Incisal width of Central Incisor	0.544**	.002

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4: Correlation Coefficient (r) between the measured Incisal width of Central Incisor and the Innercanthal distance in males and females separately

Sex	Innercanthal Distance	p value Sig. (2-tailed)
Female		
Incisal width of Central Incisor measured from Wax bite	.443	.098
Male		
Incisal width of Central Incisor measured from Wax bite	.752**	.001

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Observations and statistical calculations done for pearson's correlation coefficient (r) between the measured Incisal width of Central Incisor and Innercanthal Distance derived from the Central incisor Width in all patients.

Pearson Correlation		
	Innercanthal Distance derived from the Central incisor Width	p value Sig. (2-tailed)
Incisal width of Central Incisor measured from Wax bite	1.000**	.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6: Correlation Coefficient (r) between the measured Incisal width of Central Incisor and Innercanthal Distance derived from the Central incisor Width in males and females separately.

Sex	Innercanthal Distance derived from the Central incisor Width	p value Sig. (2-tailed)
Female		
Measured Incisal width of Central Incisor	-.170	.545
Male		
Measured Incisal width of Central Incisor	1.000**	.000

Figure1: Graphical representation of the measured Incisal width of Central Incisor and the Innercanthal Distance of the study population

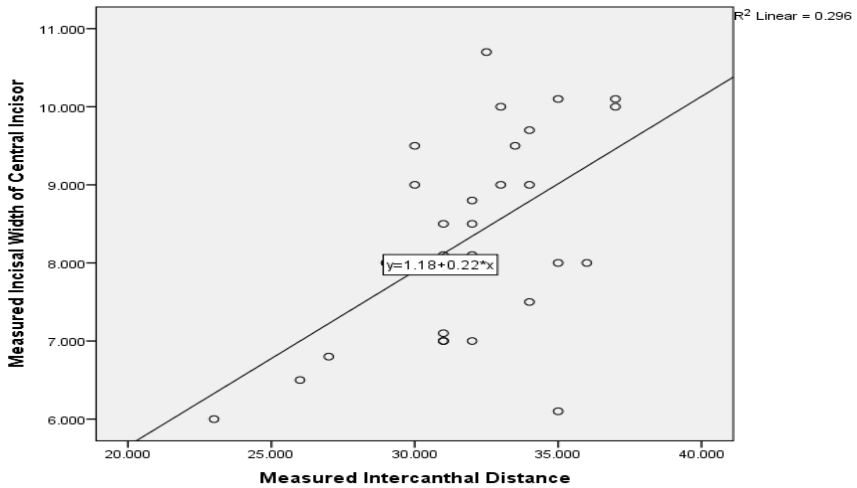


Figure2: The correlation between the Incisal width of Central Incisor measured from vernier caliper and the Innercanthal Distance in both males and females in the study population (Scatterplot)

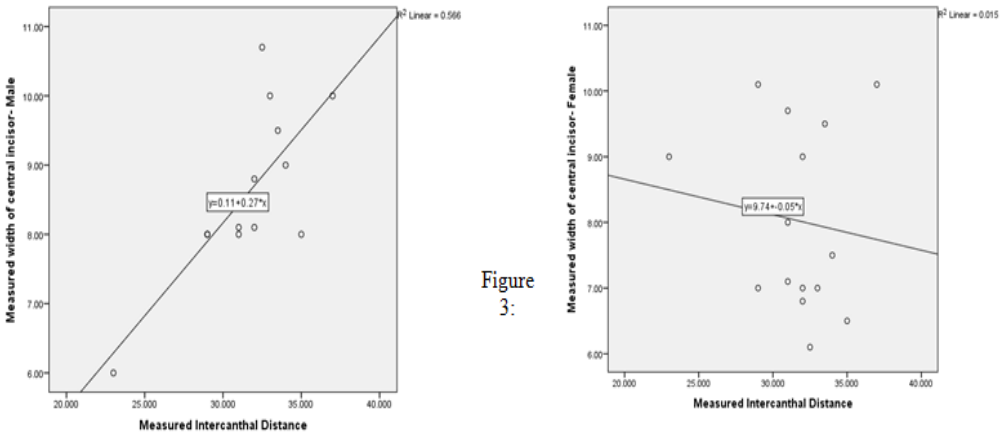


Figure 3:

Figure 3: Pearson's correlation coefficient (r) between the Incisal width of Central Incisor measured from vernier caliper and Calculated the Inner Canthal Distance in all patients. (Scatterplot)

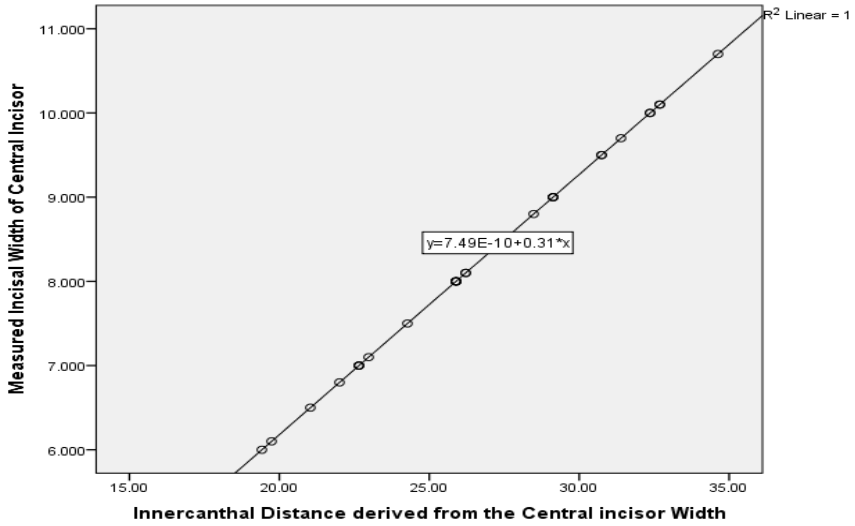
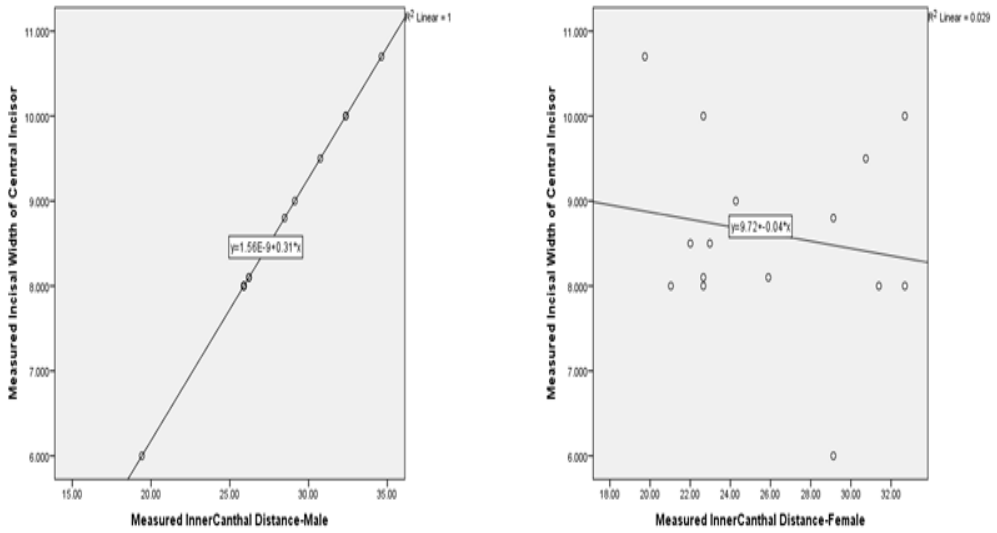


Figure4: Correlation Coefficient (r) between the Incisal width of Central Incisor measured from vernier caliper and Innercanthal Distance derived from the Central incisor Width in males and females separately,



IV. Discussion

This study is based on the fact that Laestadius reported that in 78% of adults, the ICD is attained by the age of 1 year, after which the growth in this area is slow in contrast to outer orbital dimension. According to Epker and Fish, these values are established by 6–8 years of age and do not change significantly after this time.[9] This stable landmark can be identified, located and measured accurately.[7] This study attempts to showcase the usefulness of deriving innercanthal distance by using incisal width of maxillary central incisor which can be used as an adjuvant to support and aid in sketch analysis for person identification. Study conducted by Md. Abdullah proved that ICD is a reliable guideline for selecting width of maxillary central incisor but in Arab population.[7] Study conducted by the George et al the ICD and the golden proportion are reliable predictors for determining the width of the maxillary central incisors in the south Indian population also.[10] Our study reinforces the findings that and incisal width of maxillary central incisors measured by vernier caliper is a reliable predictor for calculating Inner canthal distance.

In our study mean values and SD for the inner canthal distance, Incisal width of Central Incisor measured from vernier caliper from all subjects were 31.90 ±3.13 and 8.32±1.29 respectively. A similar result was seen in George et al study which reported ICD to be 32.59±2.19, 30.77±2.16 for Males and females and also width of central incisor 10.08±0.67 & 9.51±0.66 respectively.[20]Bali et al reported the mean inner canthal distance of male and female subjects was 29.85±1.47mm and 27.46±2.1mm, respectively. The mean maxillary central incisor width of male and female subjects was 9.18±0.51mm and 8.42±0.40mm, respectively [11].Gender based difference in mesiodistal width of central incisor was reported by previous investigators like Cesario et al.,[12] Lavellea,[13] and Md. Abdullah.[7]The correlation between Incisal width of Central Incisor measured from vernier caliper, and the Inner Canthal Distance in all patients was inferred to have a good positive correlation with a Pearson correlation coefficient of 0.544^{**} and 1.000^{**} respectively. This means that ICD can be utilized as an adjunct in the victim identification. Pearson correlation of inner canthal distance and central incisor width, showed a highly significant significance ($p<0.000$).when comparing the males and females males had significant results.One of the limitations of study is ethnic differences exist between different populations,[14,15] universal application of the previous research work is possible only when it is studied in all populations.[15,16]

V. Conclusion

Pearson correlation of measured and calculated inner canthal distance using central incisor width , showed a highly significant significance ($p<0.000$).when comparing the males and females males had significant results. Based on these results we propose the use of Central Incisor Width to calculate Innercanthal distance, can increase its value as a forensic tool. This is the first study of its kind. Hence further research should necessarily be done on different ethnic groups to confirm the empirical observations.

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