

An Anthropometric Assessment Method for Facial Profile Determination in Forensics

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ABSTRACT

Background: It was extremely difficult for the forensics to identify the individuals, especially in the mass disasters and natural calamities like earthquakes etc. In most of the cases the facial profile is completely destroyed and dentition is the only source of tool which helps in identifying the individuals and their gender.

Aim and Objective: To evaluate and correlate inner inter-canthal distance, outer inter-canthal distance, inter-alar distance and bizygomatic width to the maxillary inter-canine distance to determine facial profile and gender.

Materials and Methods: The study was carried out by consent and involved 100 subjects who satisfied the inclusion criteria. Five parameters were measured : inner inter-canthal distance(IICD), outer inter-canthal distance(OICD), inter-alar distance(IAD), bizygomatic width(BZW) and maxillary inter-canine distance(MICD) using digital vernier calliper. The data was summarized in table form, and were statistically analysed using pearson correlation.

Results: Significant correlation was observed between IICD and BZW($r = 0.224$, $p = 0.014$), IICD and IAD ($r = 0.411$, $p = 0.001$), BZW and MICD ($r = 0.229$, $p = 0.022$), IAD and MICD ($r = 0.247$, $p = 0.013$); negative correlation was observed between OICD and MICD ($r = -0.023$, $p = 0.818$). OICD is more in females, MICD is more in males.

Conclusion: Maxillary inter-canine distance can be used as a the tool for the determination of the facial profile and gender, although a larger sample size is required for further study.

Keywords: 2D facial reconstruction, Maxillary inter-canine distance, inner and outer inter-canthal distance, inter-alar distance, bizygomatic width.

INTRODUCTION

Human face plays an important role in highlighting human individuality and identity. Human identification becomes complicated especially when mass disasters be fall. In most of the disasters like tsunamis, earth quakes, floods, fire accidents, train and road accidents, bomb blasts, air plane crashes etc. the finger prints, facial features and other evidences are destroyed this makes the human identification complicated procedure. In such circumstances dental evidence will be the valuable tool of identification. Because dental structures are the hardest among other body parts and are well preserved in the closed oral cavity. These generally can resist environmental conditions like fire, decomposition, desiccation and are among the last ones to disintegrate after death. The basic of dental identification lies in the principal fact that no two oral cavities look alike¹.

Dental features like morphology of each tooth, arrangement of teeth in respective arches, shape and size of teeth, crowdings, spacings, rotations, missing teeth, restorations, prosthesis and other dental anomalies are unique to an individual¹.

Hence dental evidence can be used as tool for the 2-dimensional facial reconstruction. The parameters that are necessary for 2 – dimensional facial reconstruction are inner inter-canthal distance, outer inter-canthal distance, inter-alar distance, bizygomatic width.

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In our study we have considered the maxillary inter-canine distance as a dental tool for the 2- dimensional facial construction using the above parameters.

MATERIALS AND METHODS

This study was conducted among the 100 individuals along with informed consent. The subjects contain 67 females and 33 males ranging from 18 to 28 years age group.

These subjects were selected based on the inclusion and exclusion criteria.

Inclusion criteria includes: a) individuals between 18 to 28 years because facial growth is completed at the end of this period. b) individuals with absence of morphological and developmental anomalies. c) individuals who had complete permanent dentition. d) individuals with ideal arch form and alignment.

Exclusion criteria includes: a) Presence of missing teeth, crowdings, rotations, spacings, midline diastema, excessive overjet, retained deciduous teeth, supernumerary teeth in maxillary anterior teeth region b) individuals undergoing orthodontic treatment.

Armamentarium used for the study are: Digital vernier callipers, divider, metal scale, spirit and cotton.

Table 1: Means of different facial parameters

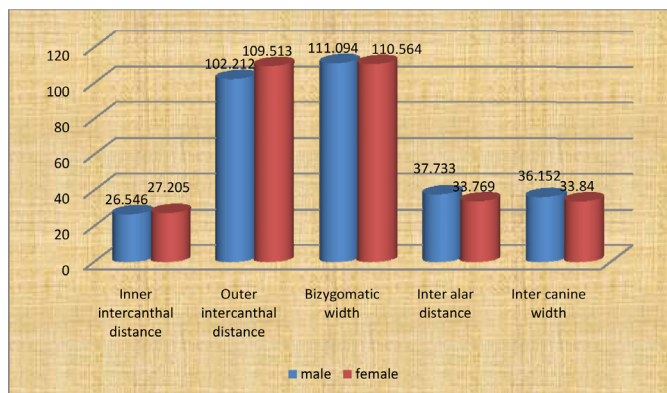
	Gender	Mean	SD	Mean difference	t-value	p-value
Inner intercanthal distance	Male	26.546	6.2040	-0.6590	-0.606	0.546
	Female	27.205	4.4957			
Outer intercanthal distance	Male	102.212	5.5121	-7.3013	-3.89	0.698
	Female	109.513	107.6136			
Bizygomatic width	Male	111.094	17.9862	0.5298	0.206	0.837
	Female	110.564	7.7076			
Inter alar distance	Male	37.733	4.2138	3.9647	4.958	0.001*
	Female	33.769	3.5190			
Inter canine width	Male	36.152	4.0009	2.3112	3.410	0.001*
	Female	33.840	2.7050			

Unpaired t test, *statistical significant.

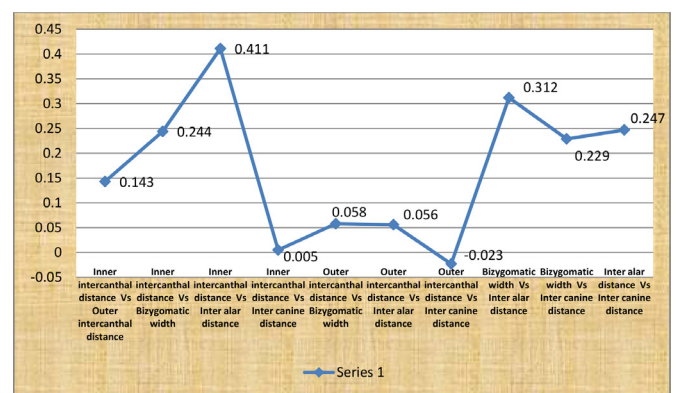
Table 2: Pearson correlation between various parameters measured

	r-value	p-value
Inner intercanthal distance Vs Outer intercanthal distance	0.143	0.157
Inner intercanthal distance Vs Bizygomatic width	0.244	0.014*
Inner intercanthal distance Vs Inter alar distance	0.411	0.001*
Inner intercanthal distance Vs Inter canine distance	0.005	0.962
Outer intercanthal distance Vs Bizygomatic width	0.058	0.565
Outer intercanthal distance Vs Inter alar distance	0.056	0.578
Outer intercanthal distance Vs Inter canine distance	-0.023	0.818
Bizygomatic width Vs Inter alar distance	0.312	0.002*
Bizygomatic width Vs Inter canine distance	0.229	0.022*
Inter alar distance Vs Inter canine distance	0.247	0.013*

Pearson correlation, *statistically significant



Graph 1: Graphical representations of means of different facial parameters



Graph 2: Graphical representation of facial parameters using pearson correlation



Vernier callipers was used for measuring the facial parameters, divider and metal scale are used to measure the maxillary inter-canine distance, cotton and spirit are used to sterilise divider after every use.

Subjects were seated comfortably on dental chair in relaxed state and upright position with head resting against the head rest. And were instructed to close the eyes while measuring the outer and inner inter-canthal distance to avoid any injury to eyes¹.

Inner inter-canthal distance was measured from medial canthus of one eye to medial canthus of the other eye without applying pressure. Outer inter-canthal distance was measured from lateral canthus of one eye to lateral canthus of the other eye without applying any pressure. Inter-alar distance was determined by measuring the distance between the widest points on the ala of nose. While measuring subjects were instructed to stop breathing momentarily – to avoid changes in the shape of nose. Bizygomatic width was determined by measuring the distance between the lateral prominences of zygomatic arch. Maxillary inter-canine distance was determined by measuring the distance between the tips of the maxillary canines using the divider and then measured it on the metal scale¹. (Figure 1)

RESULTS

The mean of different facial parameters i.e, inner inter-canthal distance, outer inter-canthal distance, inter-alar distance, bizygomatic width, maxillary inter-canine distance in both genders are shown in table 1, graph 1. Most of the facial parameters are comparatively more in males than in females except inner inter-canthal distance and outer inter-canthal distance. (Table 1, Graph 1)

Pearson correlation shown in table 2, graph 2. There was a highly significant correlation between the inner inter-canthal and bizygomatic width ($r = 0.224$, $p = 0.014$), Inner inter-canthal distance and inter-alar distance ($r = 0.411$, $p = 0.001$), bizygomatic width and maxillary inter-canine distance ($r = 0.229$, $p = 0.022$), inter-alar distance and inter-canine distance ($r = 0.247$, $p = 0.013$). There was a negative correlation between the maxillary inter-canine distance and the outer inter-canthal distance. (Table 2, Graph 2)

DISCUSSION

This study was based on the anthropometric measurements, where facial reference points are utilised to estimate the maxillary inter-canine width for the purpose of human identification. The current study included 100 participants (33



Fig 1: (A) Inner intercanthal distance (B) Outer intercanthal distance (C) Interalar distance (D) Bizygomatic width (E) Intermaxillary distance

males and 67 females) to assess relation between maxillary inter-canine width and 2D facial parameters. The respondents were split into two groups as male and female, for the current investigation in order to measure the dimensions of each sex. We aimed to see whether maxillary inter-canine width can be used to determine various reference points¹. We observed substantial correlation between maxillary inter-canine width and facial reference points like inner inter-canthal distance, inter-alar distance and bizygomatic width; negative correlation was observed between the maxillary inter -canine width and outer inter-canthal distance. Also observed that maxillary inter-canine width was more in males when compared to females.

Our study showed correlation between MICD and other facial parameters, as Shivhare et al. in their study². Meena KM et al. conducted a study on 85 Aryans and 85 Mongoloids subjects, analysed using Pearson's correlation which showed highly significant but weak correlation between MICD and IAD, inter papillary distance (IPD), and inter commissural width (ICOW) in Aryans; a highly significant but weak correlation only between MICD and IPD in Mongoloids³. Vanderlei G et al. conducted a study on standard digital images of 81 Brazilian subjects, Spearman rank correlation was conducted which showed the highest probability of correlation of inner inter- canthal distance, inter-pupillary distance (IPD), inter commissural width (ICOW) with maxillary inter-canine width⁴. In the study by Banu R et al. it was observed that in females, there was a significant correlation between IAD, IICD, IPD, and MICD⁵. Pisulkar S et al. in their study which was conducted on 200 subjects, MICD and IICD showed a strong positive correlation, IAD and MICD showed a moderately positive correlation⁶. Strajnic L et al. conducted a study on 89 subjects, in which it was observed that a moderate correlation was established between the IAD and MICD, low correlation was established between the IICD and MICD⁷. Arun Kumar KV et al. examined 800 subjects and found a consistent ratio of 1.61 between IICD and MICD⁸. Tripathi S et al. conducted a study on 500 young individuals and analysed using ANOVA which showed a highly significant correlation between IAD and MICD. Ahmed N et al. conducted a study on 230 subjects and observed the interpupillary, inner inter-canthal, and bizygomatic distance should not be directly used to determine maxillary anterior teeth width, While maxillary anterior teeth width can be determined by modifying the inner inter-canthal distance with golden percentage and interpupillary distance with golden proportion⁹.

The soft tissue resilience was the study's main flaw. This study was done in an institutional setting and evaluation of

respondents in the 18–28 age range provide another restriction. As a result, only a tiny population in the relevant age range may find the results useful. Inter papillary distance (IPD) and inter commissural distance (ICOW) are not measured, which was also limitation of the study. Therefore, more research is needed where bony landmarks of large population can also be used as reference points as this might make the results more accurate.

CONCLUSION

The present study showed a statistical significance where the maxillary inter-canine distance can be used as a the tool for the reconstruction of the 2-D facial profile and gender determination although a larger sample size is required for further study.

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