Original Research Paper

Cephalometry Compliments Dactylography

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Abstract

Forensic identification either strives to achieve or claim's to achieve conclusions of 'individualization'. Acceptable methods include Anthropometry, Dactylography, DNA analysis, Forensic Odontology. Among which Fingerprints is a well- known field used widely for personal identification and preferred in data bases and Cephalic index in distinguishing Sex, ethnicity, geographical identification, and Forensic reconstructions. As both Finger prints and Head shapes develop genetically, as unique characteristics of individuals, we intended to study the relation between these two methods of individualization. Finger prints and cephalic index of 100 volunteering students, in the age group of 19-23 yrs were recorded and categorized. The data was subjected to statistical analysis and it was found that, the mean cephalic index among all participants was mesocephalic predominant while the females were predominantly Brachiocephalic. The finger print pattern revealed a predominance of Loop (72%), followed by whorl and arch as a whole, where the Loop pattern predominated in the Mesocephalics, and the whorl in Brachiocephalics. Of interest was the presence of the Arch pattern, seen only in brachiocephalic female. The findings of our study does point to a correlation between Finger print patterns and Cephalic indices of the individuals.

Key Words: Forensic identification, Anthropometry, Cephalometry, Dactylography

Introduction:

In this new millennium, society is faced with fresh challenges in every conceivable area. Despite advancements in modern technology, medical breakthroughs and the geographical changes, that the past have brought, crime still persists in all areas of our livelihood. The apprehension and subsequent prosecution of the perpetrator(s) is essential to maintain law and order. Experts use forensic science to help the Court of Law to punish the culprit.

Forensic identification either strives to achieve or claim's to achieve conclusions of 'individualization' e.g., personal identification, or narrow the pool to specific population e.g., race, region and sex. To obtain individualization many methods are followed in Forensic Medicine.

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Most accepted and applicable branches are Anthropometry, Dactylography, DNA analysis; Forensic Odontology.Living beings are highly organized that have evolved according to their needs. Human body no less is of a higher order with a near perfect form and function.

Any disruption in this form of human body could lead to pathologies. Every unit of human body is unique to it-self and is synchronous with the other parts, to function normally resulting in a distinctive pattern of that individual. Being so unique, we are able to identify one-self using various parameters for various reasons.

Dactylographic/Fingerprints are widely used for individualization, and Cephalometrics a branch of Anthropology can determine the Race/ region/ sex of the individuals [1, 2] narrowing down the probability.Dermatoglyphics is a well-known field used widely for personal identification and preferred in data bases the world over. The term Dermatoglyphics is derived from the Greek words "derma" meaning skin and "glyphic" meaning carvings. [3]

These are very unique from individual to individual which are widely used for Individualization and also have a value in diagnosing genetic disorders during embryogenesis. Many studies clearly stated the genetic basis for epidermal ridge patterns.

The dermal ridges develop on Volar pads which are formed in 6th week of intrauterine life, the patterns of these dermal ridges are formed according to the size and shape of these Volar pads. [4] Various studies have shown that the measurement of the cephalic index which measures dimensions of head in cadaveric, living or radiologic specimen, is helpful in distinguishing Sex, ethnicity, geographical identification, forensic reconstructions, surgical corrections etc. [5]

Each method having its own pros and cons we propose to use a combination of different parameters that would make identification even more fool proof.

Thus, a thought was conceived to study the relationship between Dactylography and Cephalometrics, if at all one existed. What were the chances of a certain facial form having a particular fingerprint pattern?

This pilot study was undertaken to record fingerprints and cephalic index of individuals and to correlate both the parameters.

Materials and Methods:

For this study 100 volunteering students (50 male & 50 female) in the age group of 19-23 yrs, who were apparently healthy without any congenital abnormalities or trauma/previous surgeries related to arms and craniofacial regions were selected.Subjects with obstructive hair styles were avoided, and all the participants were native to Andhra Pradesh state, India.

Cephalic measurements and Finger print pattern were recorded individually.

Cephalic Index Measurements:

The measurements were recorded with the subjects sitting on chair with head in anatomical position and nearest to 1 mm.

To obtain cephalic index three anatomical landmarks were considered, the Glabella, Inion, and Euryon.

The head length was measured using a spreading calliper from Glabella to Inion, and head breadth was measured as the maximum transverse diameter between the two euryons using spreading calliper.

Cephalic index (C.I) was calculated based on the formula given by Soames: [6]

C.I. = Head width / Head length X 100

Head shape of the subjects was determined according to the score of Cephalic Index obtained as:

- Dolicocephalic   C.I. > 70 but < 74.9
- Mesocephalic   C.I.> 75 but < 79.9
- Brachiocephalic   C.I > 80 but < 84.9
- Hyperbrachiocephalic C.I. > 85 but < 89.9

Fingerprint Pattern Analysis:

Ink prints of fingers were obtained according to method of Cummins. This was done first by cleaning the hands to avoid dirt from hands. The rolled fingerprints were obtained by placing the digits on an inked plate and then rolling them on to a white sheet (record sheet) which had specific spaces allotted for the respective fingers and hands. These were later screened with the aid of magnifying hand lens to reveal the patterns. [7]

Fingerprint patterns were classified under three main types' i.e. Arches/curve, Loops, and Whorls. This classification was based on the number of triradii (Lines meet) present, Arches have no triradii, Loops have one and Whorls have two. [8, 9]

The pattern that is predominant among ten fingers was considered as the type of fingerprint pattern for that individual.

Data obtained was subjected to statistical analysis, using IBM SPSS V.20.0 software and obtained cross-tabulations, Chi-Square test, Spearman correlation, and Pearson's relation.

Observations and Results:

The mean cephalic index among all participants was 79.89, being mesocephalic predominant. Male participants showed a similar mean of 78.45, mesocephalic followed by Brachio, Dolico, and Hyperbrachiocephalic's while in females a mean of 81.32 was recorded, being predominantly Brachiocephalic followed by Meso and Hyperbrachiocephalic with no Dolicocephalics (Table 1)

The finger print pattern revealed a predominance of Loop (72%), followed by whorl and arch pattern, with no significant difference of distribution among the genders. (Table 2) An interesting finding was of an arch/curve pattern noted only in Brachocephalic Females.

Correlating the finger print pattern and the cephalic index, the Loop pattern predominated among the mesocephalic individuals, while the whorl pattern predominates the Brachiocepahlic's. (Table 3)

Discussion:

Human identification is a decisive event in Forensic medicine, for which various branches of medicine work with different methods to achieve individualization of the person.

Among which some are used for identification of age, gender, ethnicity and region while some are useful in identification of the person accordingly to the need of circumstances. Some forums insist for an

adjunctive parameter to a principle method of individualization to enhance the authenticity.

Taking this cue our study utilizes, Dermatoglyphics and Cephalic index which are two established parameters helpful in personal identification of an individual.

The present study showed a mean cephalic index of 79.89 in the complete sample, which was similar to a study by Bhargava & Kher, on Berelas of Central India [10] and Gujarat region population [11]. While many other studies done on different populations were not in agreement with our results which can be credited to the complex interactions between genetics and environmental factors. [12]

In the present study the mean cephalic index type for Males was predominantly Mesocephalic (C.I=78.45), in Females it was Brachiocephalic (C.I=81.32) showing a statistical significant difference among both genders(Table 4, 5) which was an important inference from the previous studies, suggesting that cephalometric analysis will determine the gender and communal differences. [12, 13, 14]

The rare types of head shapes observed in this study were Dolicocephalic present only in males and Hyperbrachiocephalic present in both the genders. Dolicocephalic was the common and predominant type in males in most of other Indian studies as against our mesocephalic, while Hyperbrachiocephalic was a rare type [12], a common observation with our study.

In our study, the Loop patterns predominated in 65% of the individuals followed by the whorl pattern in 25%, Arch/ Curve pattern in 7% and composite in 2-3% individuals. This was in accordance to the normal range of distribution found among world population. [15]

Literature stated that the formation of different types of finger print patterns might not be directly determined by genes, but is the indirect consequence of the size and shape of the finger pads of hand at the time of dermal ridge development. [4]

As the finger pads develop and regress in size, a series of dermal ridges are formed at dermal and epidermal junction by twelfth and thirteenth week where the surface remains smooth. These become reflected by identical configurations on the skin surface as epidermal ridges with a definite pattern by nineteenth week of intrauterine life. [4]

The final pattern type may be interpreted as the result of height and contour of finger pad, where a low pad with little disruption of parallel lines results in an Arch, a high pad giving a Whorl, and an intermediate height pad marks a loop. The Shape and Size of the individual with basis of genetics in the gestation time will influence the finger print pattern, which even dictates the future head shape and size.[4]Many studies have previously correlated between Finger print patterns and blood groups, adult hypertension, gender determination, cleft lip/palate, PMD's, Caries, periodontitis, malocclusions [12, 16, 17] and many other parameters where they have shown the common genetic basis for their results, where dermatoglyphics has played a diagnostic role in a number of diseases having a hereditary basis.

Our study showed the Loop pattern to predominate in Mesocephalic's, where the loop is said to be a result of an intermediate height pad, similar to the mesocephalic's which are intermediate, while the Whorl pattern predominated in Brachiocephalic and Arch pattern was restricted only to Brachiocephalic female individuals. This can be explained as the whorl pattern develops from a high bulbous finger pad and likewise the Arch pattern with a Flat pad which is seen more in Brachiocephalics where head is also flat and broad.

Conclusion:

This study suggests a correlation between Finger print patterns and Cephalic indices of the individuals, so also is the Arch/Curve pattern found only in Brachiocephalic and Female individuals. Though a pattern of relationship has evolved, further repeated studies on a larger population are necessary, to establish that the findings of this study were not merely a coincidence but do have a scientific basis. If this correlation exists it would act as an adjunctive parameter for identification of individuals.

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Table 4: Chi-Square test (P<0.05)

	Value	Df	p-value
Pearson Chi Square	12.153[a]	3	.007 Significant
Likelihood Ratio	15.293	2	.002
Linear by Linear association	8.718	1	.003

Table 1: Gender Based Cross Tabulation of the Cephalic Index

			Dolicocephalics	Mesocephalic	Brachiocephalic	Hyperbrachio	Total
Gender	**Males**	Count	8	24	15	3	50
		% Within Sex	16.0%	48.0%	30.0%	6.0%	100 %
		%Within Index Type	100.0%	55.8%	35.7%	42.9%	50%
		% of Total	8%	24.8%	15%	3%	50%
	Females	Count	0	19	27	4	50
		% Within Sex	0.0%	38.0%	54.0%	8%	100%
		%Within Index Type	0.0%	44.2%	64.3%	57.1%	50%
		% of Total	0.0%	19%	27%	4%	50%
Total	Total	Count	8	43	42	7	100
		% Within Sex	8%	43%	42%	7%	100%
		%Within Index Type	100%	100%	100%	100%	100%
		% Of Total	8%	43%	42%	7%	100%

Table 2: Gender Wise Finger Print Predominance

			Finger print Types			Total
			Loop	Whorl	Curve	
Gender	Males	Count (%)	35(35)	15(15)	0(0)	50(50)
	Females	Count (%)	37(37)	11(11)	2(2)	50(50)
Total		Count (%)	72(72)	26(26)	2(2)	100 (100)
		% of Total	72%	26%	2%	100%

Table 3: Correlation of Finger Prints with Cepahlic Indices

Cephalic Index Type			Finger Print Predominant Type			Total
			Loop	Whorl	Arch / Curve	
Dolicocephalic	Gender	Males	6	2	0	8
	Total		**6**	**2**	**0**	**8**
Mesocephalic	Gender	Males	17	7	0	24
		Females	16	3	0	19
	Total		**33**	**10**	**0**	**43**
Brachiocephalics	Gender	Males	9	6	0	15
		Females	19	6	2	27
	Total		**28**	**12**	**2**	**42**
Hyperbrachio	Gender	Males	3	0	0	3
		Females	2	2	0	4
	Total		**5**	**2**	**0**	**7**
Total	Gender	Males	35	15	0	50
		Females	37	11	2	50
	Total		**72**	**26**	**2**	**100**