



ORIGINAL RESEARCH PAPER

Forensic Science

RECOGNITION AND ANALYSIS OF FINGERPRINTS AND PALM PRINTS PATTERNS OF IDENTICAL TWINS OF MALWA REGION, PUNJAB

KEY WORDS: Fingerprints, Palmprints, Identical twins, Verification, Personal Identification, Biometrics, Dermatoglyphics.

Komaljeet Kaur	Department of Forensic Science and Toxicology, Institute of Applied Health Sciences, Chandigarh University, Gharuan, Punjab, India.
Anita*	Department of Forensic Science and Toxicology, Institute of Applied Health Sciences, Chandigarh University, Gharuan, Punjab, India*Corresponding Author.
Dr. Priyanka Verma	assistant professor, Department of Forensic Science and Toxicology, Institute of Applied Health Sciences, Chandigarh University, Gharuan, Punjab, India*Corresponding Author.
Navjot Kaur	Research scholar ,Department of Forensic Science and Toxicology, Institute of Applied Health Sciences, Chandigarh University, Gharuan, Punjab, India

ABSTRACT

The closest genetic based relationship existing in identical twin makes fingerprints and palm prints recognition a challenging task. The impressions of the friction ridges of skin on the all parts of fingers are called the fingerprints and palm region of the hand are known as palm prints. The fingerprints and palm prints are unique characteristics and permanent to every person. The fingerprints and palmprints are used for verification and personal identification of individuals, even in cases of identical twins. The purpose of this study is to illustrate that further work should be done which will provide more information in other areas of dermatoglyphics to explore in future investigation of crime cases. The main focus of this study of fingerprints and palmprints of identical twins is to examine the similarities and dissimilarities of prints patterns in the pairs which are compared heterolaterally (the prints of right hand of one twin compared with the prints of left hand of other) and homolaterally (the prints of right hand of twin 1 compared with the prints of right hand of twin 2 and similarly, compare the prints of both left hands). The bilaterally (between the hand of one pair) found similarities and dissimilarities between the hands of each identical twin are then compared with the above similarities and dissimilarities

1. INTRODUCTION

Fingerprint identification have been used for personal identification for a long time where it means the comparison of friction ridge skin impressions of fingers, palms and sole of foot of humans to determine that these are from same individual. Another name for fingerprint identification is dactyloscopy, and hand print identification. The raised portion of epidermis skin on the digits, palm and sole of foot is particularly known as a friction ridge, also known as epidermal ridges. These friction ridges are helpful in having a grip on rough surfaces and improve contact to surface in wet conditions. The development of fingerprints and palmprints takes place in different stages as Finger Pad Development, Skin Layer Growth, Creation of Ridges, Ridge Pattern and Fingerprint Characteristics. A fingerprint is an impression of the friction ridges on all parts of the finger. A palmprint is an impression of the palm region of the hand.

There are mainly three types of fingerprints i.e. the latent prints or chance prints are the impressions left by friction ridge skin on a surface, whether it is visible or invisible at the time of deposition. These prints may be present on oils, paints, blood, ink, etc. Latent prints may exhibit only a small portion of the surface of the finger and may be smudged, distorted, overlapping, or any combination, depending on how they were deposited, the patent prints are impressions of friction ridges from the unknown origins which are visible to human eye and are caused by the transfer of any foreign material on the finger, onto a surface. They need no enhancement because they are already visible. This type of fingerprints can be deposited in materials like ink, dirt, or blood onto a surface. And the plastic prints are the friction ridge impressions from a finger or palm deposited in a material that retains the shape of the ridge detail. These prints may be commonly found on wax, grease deposits, and putty, etc. These prints need no enhancement.

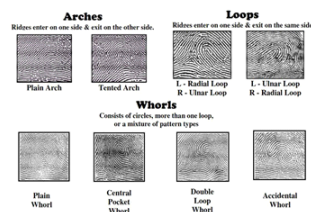
Henry's four types of pattern grouping are- arch (plain and tented), loop (radial and ulnar), whorl (plain whorl, central pocket whorl, double loop whorl and accidental whorl) and composite (twined loop, central pocket loop, lateral pockets loop and accidental loops). In the loop pattern there are two points - the core (center of the loop) and the delta. The palm region has three different regions- Thenar region, hypothenar region and interdigital region. The area covered by life line is known as thenar region. The area opposite to the thenar area is known as hypothenar region. The area below the fingers (covered by heart line) is known as interdigital region or tri-radiated region.



Fig.1 Showing fingerprint and palmprint

There are mainly three types of twins – monozygotic twins, dizygotic twins and polar body twins. Monozygotic twins are formed from the fertilization of one egg and one sperm. Dizygotic twins are formed from the fertilization of two eggs and two sperms. Polar body twins are formed from the fertilization of one egg and two sperms. The normal frequency of monozygotic twins is 1 in 250 pregnancies and of dizygotic twins are approximately one-third of all spontaneous twins.

Biometrics is the most important and automated way which is used to solve the crime cases by recognizing the physical and behavioral characteristics of an individual. A biometric system is a device which acquires physical and behavioural data from an individual and extract a set of special features from patterns from the data, compares the set of features to the set of features already stored in the database and gives the result. There are four modules of a biometric system – sensor module, quality assessment or feature extraction module, matching and decision making module and system database module.



Importance of fingerprints and palmprints in forensic investigation

3. MATERIALS AND METHODOLOGY

Materials Required

The materials required in this study were - Black ink paste, Glass plate, Roller, Standard fingerprint card, A sharp needle, Scale and Protractor.

Methodology

Collection of samples - Total 30 samples of identical twins of age 3 years to 17 years were collected from Malwa population, Punjab. Selection Criteria - The samples were collected with the oral consent of the twins and written consent of the parents. The information used in the identification of an individual, such as name, age, sex, address, and any disease was collected from the parents of the twins.

Exclusion Criteria - The standard methodology is used for collecting the samples of fingerprints and palmprints. The black ink paste is applied on a clean and dry glass plate. The paste should be evenly distributed on the whole plate with the help of a roller to make a fine layer. Complete the required information at the top of the paper or standard fingerprint card.

4. RESULT AND DISCUSSION

The main purpose of this study of fingerprints and palmprints of identical twins is to examine the similarities and dissimilarities of prints patterns in the pairs which are compared heterolaterally (the prints of right hand of one twin compared with the prints of left hand of other) and homolaterally (the prints of right hand of twin 1 compared with the prints of right hand of twin 2 and similarly, compare the prints of both left hands). The bilaterally (between the hand of one pair) found similarities and dissimilarities between the hands of each identical twin are then compared with the above similarities and dissimilarities.

In this study, the collected samples of identical twins are studied and data is analyzed to determine how much similarities and dissimilarities can be occurred between the identical twins. The results are shown in the tables 1-4.

Table 1 shows the results of the comparison of ATD angles in the palmprints of identical twins pairs. The comparison of ATD angles of palmprints determines that 11.11% similarity is there in the ATD angles of palmprints of identical twins. This would indicate that the ATD angle of palmprints of even identical twins have some similarity.

Table.1 Results of comparison of ATD Angles of pairs of identical twins.

Sr.no.	Hands	Matching Pairs	Non Matching Pairs
1	L1-L2, R1-R2	0	30
2	L1-R1	5	25
	L2-R2	4	26
3	L-L	2	28
4	R-R	4	26

Table.2 illustrates the result of patterns found in fingerprints of identical twins. The fingerprints pattern types found in collected samples of twins are ulnar loop, radial loop, whorl, tented arch, central pocket loop, central pocket whorl, double loop whorl, accidental whorl, accidental loop and twin loop. The collected data shows the result of comparison as 9.48% similarity in the occurrence of fingerprint patterns in the identical twins.

Table.2 Results of comparison of fingerprint pattern found in hands of twins.

Sr. no	Hands	Matching Pairs	Non Matching Pairs
1	L1-L2, R1-R2	0	30
2	L1-R1	4	26

	L2-R2	4	26
3	L-L	5	25
4	R-R	0	30

Table.3 shows the number of fingerprint patterns found in the each finger of the identical twins. The observation shows that the largely occurred pattern types are ulnar loop with a total of 314 and whorls with 164 occurrences in 600 samples (20 fingers of one pair of twins in 30 samples).

Other findings include the observation that other 8 pattern types occurs in fingerprints are tented arch with 42 occurrences, central pocket loop with 27 occurrences, central pocket whorl with 17 occurrences, double loop whorl with 22 occurrences and radial loop with 7 occurrences in 600 samples. The rare occurrence of 3 pattern types is found from the observation that are accidental whorl which occurs only 3 times in 600 samples, accidental loop and twin loop which occurs only twice in 600 samples. The result shows the similarity (in %) seen in the pattern type in the five finger, 15.16% in thumb, 11.66% in index finger, 14.16% in middle finger, 13.5% in ring finger and 14.16% in little finger.

Table.3 Result of comparison of fingerprint patterns on the basis of pattern of each finger of twins.

Sr. no.	Hands	Number of samples having similar patterns in each finger				
		Thumb	Index Finger	Middle Finger	Ring Finger	Little Finger
1	L1-L2, R1-R2	12	7	10	10	9
2	L1-R1	21	14	19	22	18
	L2-R2	21	17	20	15	23
3	L-L	18	16	19	17	19
4	R-R	19	16	17	17	16

Table.4 shows the result of ridge count difference calculated from the samples of identical twins. To calculate the ridge count difference, ANOVA test is applied on the collected data. The result of ANOVA test shows that null hypothesis is accepted and there is a significant difference between the ridge count of the pairs of even identical twins.

Table.4 Results of comparison of total ridge count of twins in four pairs.

Sr.no.	L1	L2	R1	R2	L1	R1	L2	R2
1	64	24	66	23	64	66	24	23
2	50	39	52	40	50	52	39	40
3	75	75	69	70	75	69	75	70
4	66	68	58	76	66	58	68	76
5	89	84	90	84	89	90	84	84
6	66	45	50	29	66	50	45	29
7	67	66	65	67	67	65	66	67
8	60	60	66	71	60	66	60	71
9	66	64	71	58	66	71	64	58
10	86	76	87	71	86	87	76	71
11	75	84	81	81	75	81	84	81
12	53	56	48	54	53	48	56	54
13	59	76	87	66	59	87	76	66
14	62	71	63	72	62	63	71	72
15	58	62	72	65	58	72	62	65
16	65	59	66	69	65	66	59	69
17	72	65	75	61	72	75	65	61
18	66	64	67	63	66	67	64	63
19	54	27	70	38	54	70	27	38
20	78	79	81	74	78	81	79	74
21	59	63	57	58	59	57	63	58
22	71	63	70	96	71	70	63	96
23	43	38	46	32	43	46	38	32
24	58	39	50	44	58	50	39	44

25	60	62	79	69	60	79	62	69
26	73	67	61	58	73	61	67	58
27	65	44	70	39	65	70	44	39
28	13	0	4	10	13	4	0	10
29	68	55	70	62	68	70	55	62
30	4	37	23	36	4	23	37	36

The other observation of pattern types found in the interdigital area of the palm prints results that the most commonly found pattern type in this area is loop with 5.84% occurrence and other pattern type is arch with 94.16% occurrence. The loop pattern is found in 7 samples out of total 60 samples (30 samples of twins = 60 samples).

The results of this study that there are varying degrees of similarities and dissimilarities in which can be observed by the ridge count difference, ATD angle and pattern types in the identical twins. A good outcome is the significant difference between the ridge count in fingerprints of pairs of identical twins.

Sir Boxwala M., et al, studied that the overall pattern type of fingerprints is different but there are some occurs in the ridge characteristics of twins fingerprints. The result of this study shows that there is least similarity found in the patterns occurred in the interdigital area of the palm of identical twins. The result of this study from different observations represents that the largely occurred pattern type is ulnar loop and the rarely occurred pattern types are accidental loop, accidental whorl and twin loop.

Sir Adams Wai-Kin Kong, et al, Sir Xiangqian Wu, et al. and Sir Agarwal S. and Dr.Gupta P.C. from their studies on palmprints demonstrated that the palmprints were used for the personal identification on the basis of the principal line, some weak lines, wrinkles, ridges and texture features present in the palmprints but in this study the ATD angles of the palmprints are measured and the results of this shows that the ATD angles of the twins are also different and can be involved in personal identification.

Sir Sargur N. et al. and Sir Vinoth A. and Saravanakumar S. from their studies demonstrated that the minutiae based matching algorithm was used to study the features of fingerprints of twins but the result of this study shows that along with minutiae, ridge count can also be used to study the features of fingerprint because there is a significant difference in ridge count of fingerprints patterns of the twins also.

The small number of samples provides a satisfactory representation of identical twins in an area. This study makes no observation and correlation about minutiae in the fingerprints and palmprints.

5. CONCLUSION

The result of the analysis of data in this study states that the ridge count and pattern types are dermatoglyphic phenotypic expressions. The statistical test applied on the ridge count to find the ridge count difference results that the hypothesis is accepted by randomly collecting and observing the 30 samples of identical twins from the population of a particular region.

This study is done by making different observations about ATD angle of the palm, pattern types found in fingerprints and in interdigital area of palm and ridge count of the identical twins to get more information about the similarities and dissimilarities between the fingerprints and palmprints of pairs of identical twins. The results of this study illustrates that further work should be done to explore more information in other areas of dermatoglyphics. A continue research in this area provide us more information about the dermatoglyphic expressions which is further used to separate the casual factors associated with the same. The results of this study will provide information to explore in future investigation of crime cases.

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