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GENDER DETERMINATION FROM RIDGE DENSITY OF PALM PRINTS

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Abstract:

Forensic science is the application of science for those criminal and civil laws which are enforced by police agencies in the criminal justice system. A fingerprint is an impression left by the friction ridges of a human finger. The recovery of fingerprints from a crime scene is an important method of forensic science. Fingerprints are easily deposited on suitable surfaces by the natural secretions of sweat from the eccrine gland that are present in epidermal ridges. A palm print refers to an image acquired of the palm region of the hand. Palm prints can be used for criminal, forensic, or commercial applications. This study is to determine the sex of individual from the palm print ridge density. Palm is divided into four quadrants as p1, p2, p3 and p4. Palm prints of 50 males and 50 females were taken on the plain paper with the help of ink. Observation shows that males have less ridge count as compared to females. Palm prints prove important role in directing the search to the particular gender and therefore the investigating officer can save time in capturing suspect.

Key Words: Forensic Science, Fingerprints, Palm Prints, Ridge Density & Gender Determination

Introduction:

Finger Prints:

A fingerprint is an impression left by the friction ridges of a human finger. The recovery of fingerprints from a crime scene is an important method of forensic science. Fingerprints are easily deposited on suitable surfaces (such as glass or metal or polished stone) by the natural secretions of sweat from the eccrine gland that are present in epidermal ridges. [1] Human fingerprints are detailed, unique, difficult to alter, and durable over the life of an individual making them suitable as long-term markers of human identity and may be employed by police or other authorities to identify individuals who wish to conceal their identity. Study of fingerprints is known as 'Dactyloscopy'.

Fundamental Principles of Fingerprints:

- ✓ **First Principle:** "A fingerprint is an individual characteristic, no two fingers have yet been found to possess identical ridge characteristics."
- ✓ **Second Principle:** "A fingerprint will remain unchanged during lifetime."
- ✓ **Third Principle:** "Fingerprints have general ridge pattern that permit them to be systematically classified."

Core:

It is the centre of fingerprint. In whorl pattern, the core point is found in the middle of the spiral/circle. In a loop pattern, the core point is found in the top region of the innermost loop.

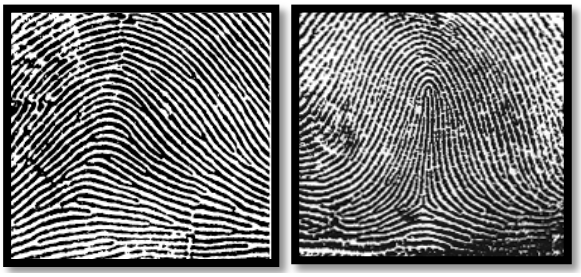
Delta:

It is the point on a friction ridge at or nearest to the point of divergence of two type lines, and located at or directly in front of the point of divergence.

Fingerprint Patterns:

1. Arch: In an arch pattern, ridges flow in one side and flow out the opposite side. There are no deltas in an arch pattern. There are two types of arch patterns:

1. Plain arch 2. Tented arch



2. Loop Patterns: In a Loop pattern, the ridges will flow in one side, recurve, (loop around) touch or pass through an imaginary line drawn from the delta to the core, and exit the pattern on the same side from which it entered. A loop pattern has only one delta. There are two types of loop patterns:

1. Ulnar Loop 2. Radial Loop

3. Whorl Pattern: A whorl pattern consists of a series of almost concentric circles. A whorl pattern has two deltas. There are four types of whorl patterns:

1. Plain Whorl 2. Central Pocket Loop Whorl

3. Double Loop Whorl 4. Accidental Whorl

Palm Print:

A palm print refers to an image acquired of the palm region of the hand. It can be either an online image or offline image where the image is taken with ink and paper. [2] The palm itself consists of principal lines, wrinkles (secondary lines), and epidermal ridges. It differs to a fingerprintin that it also contains other information such as texture, indents and marks which can be used when comparing one palm to another. Palm prints can be used for criminal, forensic, or commercial applications. Palm prints, typically from the butt of the palm, are often found at crime scenes as the result of the offender's gloves slipping during the commission of the crime, and thus exposing part of the unprotected hand.

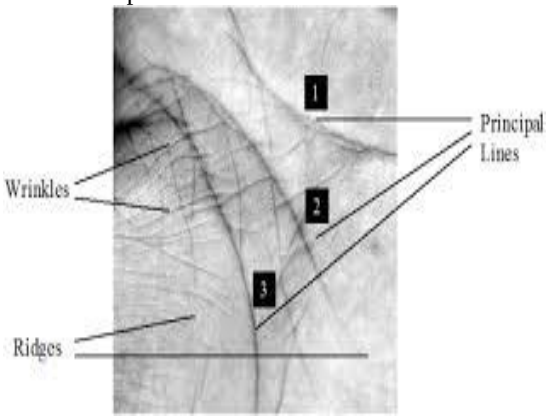


Figure 1: Human Palm

Palm is divided into four quadrants as p1, p2, p3 and p4.

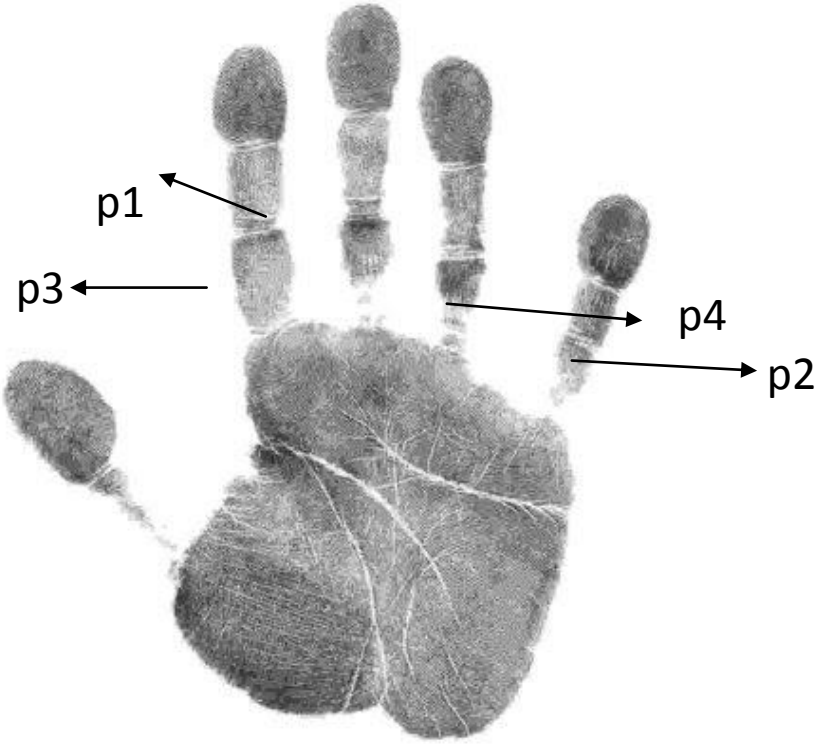


Figure 2: Palm Print

Sample Collection:

- ✓ Palm prints were obtained from 50 males and 50 females in the age group of 18 to 60 years old of healthy individual.
- ✓ The samples were collected from Anand district of Gujarat. It includes samples of both males and females of students, staff members, puns of the institute and residential areas.
- ✓ Material required:
  - Fingerprint slab – its surface is smooth as, the ink spreads evenly on the slab.
  - Roller – It is used to spread the ink on the fingerprint slab.
  - Thumb impression ink – It is specialized ink used for the impression purpose. Gives less smudging.
  - Cotton wool
  - Acetone
- ✓ Both hands of the subject were wiped with cotton wool socked in acetone.
- ✓ The subjects were first asked to place his /her right palm on the slab and then take print of the palm on the plain paper (A4), same method used for left hand.
- ✓ After taking the prints, the palms were cleaned with cotton wool soaked in acetone.
- ✓ The Subjects were advised to wash it again with soap and water.
- ✓ After whole procedure done, the samples were labeled in proper manner for observation.

Methodology:

- ✓ Palm prints of 50 males and 50 females were taken on the plain paper with the help of ink.
- ✓ The collected sample was then analyzed using the Linen tester (Waltex 8X magnifier) and 5mm^2 transparent glass block.

Figure 3: Linen Tester

The palm is divided into four quadrants as p1, p2, p3 and p4.

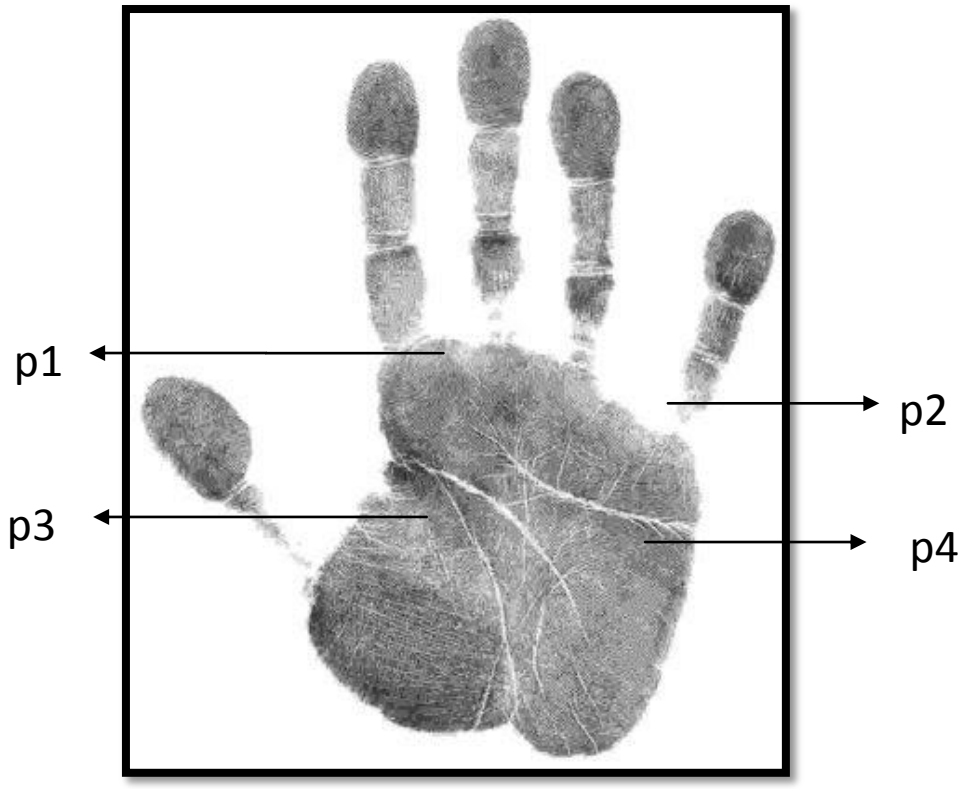


Figure 4: Palm Prints

Put a block of 5mm^2 on p1 and count the ridge come under the area of block using linen tester and note it down on the sample paper, the same is used for other quadrants of both hands.

Find out the mean of four quadrants of both hands.

Observation Table:

Table 1

Number of Ridges		**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Male Right Hand	P1	0	2	5	15	16	5	3	0	0	0
	P2	0	14	19	8	3	0	1	0	0	0
	P3	1	6	22	11	6	3	0	0	0	0
	P4	1	11	13	11	2	4	0	0	0	0

Table 2

Number of Ridges		**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Male Left Hand	P1	8	12	20	6	7	0	0	0	0	0
	P2	4	4	3	9	17	7	5	1	0	0
	P3	0	8	10	15	14	4	1	0	0	0
	P4	1	0	18	18	6	4	0	0	0	0

Table 3

Number of Ridges		6	7	8	9	10	11	12	13	14	15
Female Right Hand	P1	0	0	0	2	9	18	11	7	0	0
	P2	0	1	9	13	16	4	3	0	0	0
	P3	0	1	7	15	13	7	6	2	0	0
	P4	0	0	4	19	10	7	3	4	1	0

Table 4

Number of Ridges		6	7	8	9	10	11	12	13	14	15
Female Left Hand	P1	0	4	6	13	8	7	8	2	0	0
	P2	0	0	1	1	11	13	13	5	1	0
	P3	0	0	4	9	15	10	6	5	0	0
	P4	0	1	5	9	18	9	7	0	0	0

Table 5

Serial Number	Number of Ridges	Number of Male Cases				Number of Female Cases			
		RH	%	LH	%	RH	%	LH	%
1	6	0	0	0	0	0	0	0	0
2	7	6	12	3	6	0	0	0	0
3	8	27	54	17	34	2	4	1	2
4	9	12	24	18	36	18	36	11	22
5	10	5	10	11	22	17	34	21	42
6	11	0	0	0	0	10	20	10	20
7	12	0	0	0	0	2	4	3	6
8	13	0	0	0	0	0	0	0	0
9	14	0	0	0	0	0	0	0	0
10	15	0	0	0	0	0	0	0	0
Total No. of Cases: 50									

RH - Right hand
LH - Left hand
% - Percentage

Result:

Observation shows that males have less ridge count as compared to females. 54% of male cases are having 8 ridge count. Males decreases rapidly beyond 9 ridge count. No males are found above 10 ridge count. 42% of female cases are having 10 ridge count. Females decreases rapidly beyond 11 ridge count. No females are found below 8 and above 12 ridge count.p3 and p4 regions of palm print proves significant for determining gender of the individual. Ridge count of left hand and right hand were found different of same individual and even the ridge count of the four regions(p1, p2, p3, p4) of palm prints were also not same for the same hand.

Conclusion:

From my work I came to conclude that, palm prints prove important role in directing the search to the particular gender and therefore the investigating officer can save time in capturing suspect. The present study was conducted to determine the ridge densities of palm print and it has been successful to hypothesize that, female tend to have greater ridge density as compared to male. The ridge count between 8 to 10 per $5mm^2$ belongs to male and the ridge count between 10 to 12 per 5 mm^2 belongs to female. This study would be helpful in gender determination in most of the cases where palm prints are found and other evidences are destroyed or not enough for identification.

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