CHAPTER I
INTRODUCTION

A palm print is concerned with inner surface of a hand. Palm print mainly consist of three lines or ridges and they are principal line, secondary line (wrinkles) and epidermal ridges. Palm prints are unique for each individuals. Palm print differs to a fingerprint in that it also contains information such as texture, indents and marks which can be used when comparing one palm to another.

The main important feature of palm print identification are geometrical feature, principal features, wrinkle feature, delta point features and minutiae features. Geometry feature like width length and area can easily get by analyzing the palm print. The principal line location and form of principal lines are very important physiological characteristics for identifying individual. Wrinkles which are differ from principal lines and they are thinner and more irregular. Delta point is defined as the center of a delta-like region in the palm print.[15]

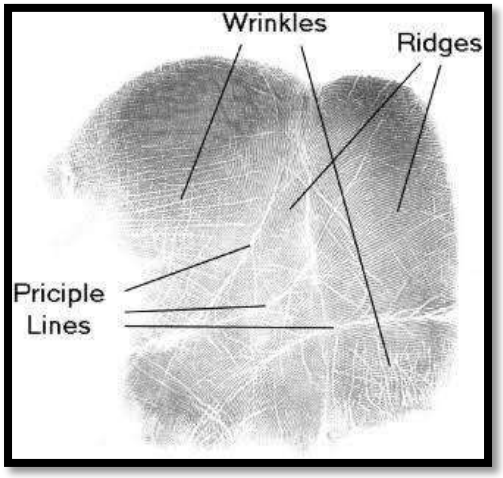


Figure 1: shows the main lines or ridges in the palm print [19]

The palm have four prominent areas, that included central prominent part of the thenar eminence, hypothenar region; inner to the proximal axial triradius , medial mount; proximal to the triradius of the second digit and lateral mount; proximal to the triradius of the fifth digit.

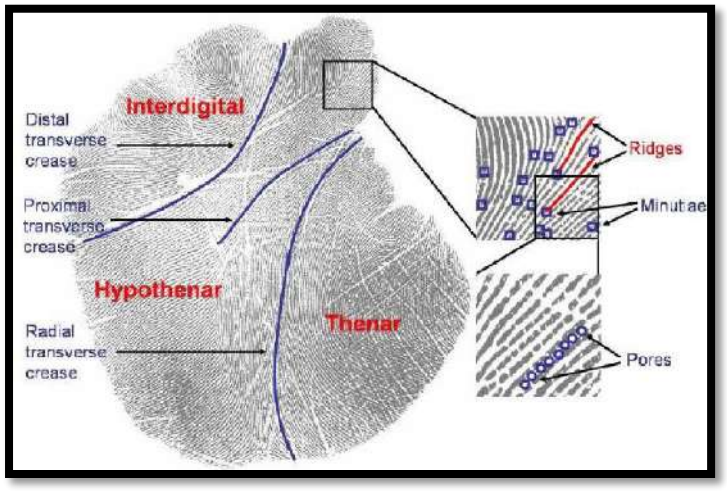


Figure 2: shows the sections in the palm prints[20]

Identification of sex plays an important role in forensic. Palm print analysis help to prove the identity of the culprit. Palm print, typically from the butt of the palm, are often found at crime scenes as the result of the offender's loves slipping during the commission of the crime, and thus exposing part of the unprotected hand. Palm print are crucial evidences. Palm prints are produced almost every surface e.g. document, wall, table, bottle, glass, etc. in latent form. In case of sexual assault, palm prints can be recovered from the many part of the body. Even during the designing of (Aadhar card), retina and fingerprints were recorded while palm prints were left un- notifiable, therefore the utilization of this national identity of an individual can't be centralized for the aspect of investigation. Detailed analysis of fingerprints and palm prints at the crime scene hence, becomes vital to identify the suspect and establish a crime. Often the prints collected from crime scenes, weapons of offence (knife, hilts, gun, grips) steering wheels and window panes are of palms and fingers. Fingerprints are usually recovered from the crime scenes. The prints obtained

from the crime scene are matched with the suspects to confirm their involvement in crime. If the sex of the perpetrator is established from the prints available at the crime scene, the burden of the investigating officer is reduced as their search of potential suspects will be restricted to a particular sex. The sex differences in palm print ridge density can even be valuable in identification of a dismembered hand during medico legal investigations to establish the identity of an individual in cases of mass disasters/mass homicides. [11]

CHAPTER II
LITERATURE REVIEW

Richard L Jantz, Kenneth R Parham (1978), observes that average dermal ridge breadth in the second inter digital area was found to be significantly greater in an African Black sample than in the known Caucasian samples. Between races differences are roughly equal to within population sex differences, and are great or greater than many of the differences observed between Caucasian controls and patients exhibiting sex chromosome aneuploidies. These race differences cannot be explained by differences in hand size or body size, so they apparently reflect developmental differences during the process of ridge formation.[1]

Mark A Acree (1999), determined if women have significantly higher ridge density, hence finer epidermal ridge detail, than men by counting ridges that occur within a well-defined space. If significant gender differences do exist then the likelihood of inferring gender from given ridge densities will be explored. This study focused on 400 randomly picked ten-print cards representing 400 subjects. The demographic composition of this sample population represents 100 Caucasian males, 100 African American males, 100 Caucasian females and 100 African American females all within the age range of 18–67. Results show that women tend to have a significantly higher ridge density than men and that this trend is upheld in subjects of both Caucasian and African American descent ($F=81.96$, $P<0.001$). Application of Bayes' theorem suggests that a given fingerprint possessing a ridge density of 11 ridges/25 mm2 or less is most likely to be of male origin. Likewise a fingerprint having a ridge density of 12 ridges/25 mm2 or greater is most likely to be of female origin, regardless of race.[2]

Esperanza Gutiérrez (2001), determined whether such differences exist in a sample of the Spanish population by counting epidermal ridges within three well-defined fingerprint areas. If significant gender differences do exist, then the likelihood of inferring gender from given ridge densities will be explored. The data used in this study was obtained from all 10 fingerprints of 200 individuals of the Spanish Caucasian population (100 males and 100 females) between the ages of 20 and 30. Results show that women tend to have a significantly higher ridge density

than men in the distal region of all 10 fingers (radial and ulnar count areas), but not in the proximal region (lower count area).[4]

Sudesh Gungadin (2007), was conducted the study with an aim to establish a relationship between sex and fingerprint ridge density. The fingerprints were taken from 500 subjects (250 males and 250 females) in the age group of 18-60 years. After taking fingerprints, the ridges were counted in the upper portion of the radial border of each print for all ten fingers and mean value was calculated. The results have shown that a finger print ridge of [less than or equal to] 13 ridges/25 [mm. sup. 2] is more likely of male origin and finger print ridge of [greater than or equal to] 14 ridges/25 [mm. sup. 2] is more likely of female origin. It has been successful to support the hypothesis that women tend to have a statistically significant greater ridge density than men.[3]

Vinod C Nayak, Prateek Rastogi, Tanuj Kanchan, K Yoganarasimha, G Pradeep Kumar,RiteshG Menezes(2010),was studied the gender differences in fingerprint ridge density in Chinese and Malaysian population. The study done on 200 subjects (100 males and 100 females) of Chinese origin and 100 subjects (50 males and 50 females) of Malaysian origin revealed that significant gender differences occur in the finger ridge density. Fingerprint mean ridge density of 12 ridges/25 mm2 or less is found to be more likely to be of males and a mean ridge count of more the 13 ridges/25 mm2 is more likely of female origin in Chinese subjects. Fingerprint mean ridge density of 11 ridges/25 mm2 or less is found to be more likely to be of males and a mean ridge count of more the 13 ridges/25 mm2 is more likely of female origin in Malaysian subjects.[7]

Vinod C. Nayak, Prateek Rastogi, Tanuj Kanchan, Stany W Lobo, K Yoganarasimha, Smitha Nayak, Nageshkumar G Rao, G Pradeep Kumar, B Suresh Kumar Shetty, Ritesh G Menezes (2010), studied the sex differences in fingerprint ridge density in the Indian population. The study done on 100 males and 100 females revealed that significant sex differences occur in the fingerprint ridge density. The present study shows a statistically significant difference in fingerprint ridge densities of male and female fingerprints in people of Indian origin. A mean

fingerprint ridge density of 12 ridges/25 mm2 or less is found to be more likely to be of males and a mean ridge count of more the 12 ridges/25 mm2 is more likely to be of female origin.[6]

Kaur Ramanjit, Rakesh K Garg (2011), examined ridge density differences in two Northern Indian populations (Sikh Jat and Bania). The authors are not aware of any research on differences in ridge density among the Sikh Jat and Bania populations of Punjab, except anthropological studies. In the present study it has been found that 92% of Sikh Jat females have a mean ridge density above 13, whereas 76% of Sikh Jat males have (a mean ridge density) below 13, while in Bania, 100% of females have mean ridge density above 14 and 80% of males–below 14. The study suggests that there are significant differences in epidermal ridge density between males and females within each of the two populations, and also significant differences between the two populations. This study will provide additional information for the finger print examiner in analysing finger impressions and narrowing down an investigation involving a large number of samples.

Tanuj Kanchan, Kewal Krishan, KR Aparna, S Shyamsunder (2012), observes that sex differences exist in footprint ridge density among humans. Maximum sex differences were observed for ridge density in medial ball area, followed by great toe, lateral ball and minimum sex differences were observed in the heel region. It is observed that sex can be estimated from footprint ridge density with reasonable accuracy. The sexing potential of total footprint ridge density was 82.6% from the right and 83.6% from the left footprints respectively. [9]

Neeti Kapoor, Ashish Badiye (2015), determined any significant difference in the thumbprint ridge density of males and females in a central Indian (Marathi) population to enable the determination of gender. The results showed that females tend to have a higher thumbprint ridge density in both the areas examined, individually and combined. Applying the t-test, the differences in the ridge densities of males and females at LoC (Left of Centre), RoC (Right of Centre) and Combined (LoC + RoC) were found to be statistically significant at $p < 0.01$ levels, proving the association between gender and fingerprint ridge density. Probability densities for men and women derived from the frequency distribution (at LoC, RoC and Combined) were used

to calculate the likelihood ratio and posterior probabilities of gender designation for the given ridge count for subjects using Baye's theorem.[12]

Amit Chauhan (2015), focused on determination of gender in which 400 samples (including 200 males and 200 female) were collected from an age group of 15-50 years from the population of western Uttar Pradesh. The ridge densities of intensified palm prints were studied by following an international procedure (25mm2). As a denouement, the procured mean ridge density, if≤ 12 ridges/25 mm2 or less then is likely to be male origin, and 14≥ ridges/25 mm2 or more then that is likely to be from female origin. The obtained results of this study can be helpful to minimize the number of suspects list and nab them behind the bars.[13]

SF Abdullah, AFNA Rahman, ZA Abas, WHM Saad (2016), this study is meant to enhance the forensic manual method by proposing a new algorithm for fingerprint global feature extraction for gender classification. The result shows that the new algorithm gives higher acceptable readings which is above 70% of classification rate when it is compared to the manual method. This algorithm is highly recommended in extracting a fingerprint global feature for gender classification process.[12]

Lawan Hassan Adamu, Samuel Adeniyi Ojo, Barnabas Danborno, Samuel Sunday Adebisi, Magaji Garba Taura (2017), predicted the facial height (FH), facial width, and ratios from thumbprints ridge count and its possible applications. This was a cross-sectional study. A total of 457 participants were recruited. A fingerprint live scanner was used to capture the plain thumbprint. The facial photograph was captured using a digital camera. Pearson's correlation analysis was used for the relationship between thumbprint ridge density and facial linear dimensions. Step-wise linear multiple regression analysis was used to predict facial distances from thumbprint ridge density. The result showed that in males the right ulnar ridge count correlates negatively with lower facial width (LFW), upper facial width/upper FH (UFW/UFH), lower FH/FH (LFH/FH), and positively with UFH and UFW/LFW. The right and left proximal ridge counts correlate with LFW and UFH, respectively. In males, the right ulnar ridge count predicts LFW, UFW/LFW, UFW/UFH, and LFH/FH. Special upper face height I, LFW, height of lower third of the face, UFW/LFW was predicted by right radial ridge counts. LFH, height of

lower third of the face, and LFH/FH were predicted from left ulnar ridge count whereas left proximal ridge count predicted LFW. In females only, the special upper face height I was predicted by right ulnar ridge count. In conclusion, thumbprint ridge counts can be used to predict FH, width, ratios among Hausa population.[13]

CHAPTER III

AIM AND OBJECTIVES

AIM

To Study Is To Determine The Sex From Palm Print Ridge Density In Kerala Population.

OBJECTIVES

- To analyze the sex from the palm print by analyzingthe variation in ridge density in different areas of the palm prints among men and women.
- To analyze the four prominent areas on the palm prints for study.
- Determine the sex by counting the ridge number of the four prominent area.

CHAPTER IV
MATERIALS AND METHODOLOGY

This study was conducted in the Department of Forensic Science, Aditya Degree College Andhra Pradesh. The participants included in the study from Kerala population. Healthy individuals aged between 18 to 20 years were included in the study after taking informed consent. A total of 150 individuals (75 men and 75 women) voluntarily participated in the study.

MATERIALS REQUIRED

1. A plain glass plate of size 15cm×15 cm
2. Black duplicating ink (Kores India make)
3. Roller
4. Magnifying lens
5. White bond paper
6. Transparent sheet
7. A total of 150 palm prints (right and left hand)
8. Ruler and magnifying lens

METHODOLOGY

A clean plain glass plate was uniformly smeared with black duplicating ink with the help of a roller. The subjects were asked to apply their hand on the smeared plate and then transfer them on to a white paper. Regular pressure was applied to obtain the palm prints. Palm prints were obtained from both right and left hands. Total 150 palm prints were taken in the paper then analyze the sample by using the hand lens and 5mm ×5mm (0.5cm) marked transparent sheet.

The transparent film was placed on the palm print sample in the defined area to be analyzed. The count was carried out diagonally on a square for measure ridge density or the number of given ridges. The ridges were counted with the help of a hand lens. This value represents the number of ridges in 25 mm square area and reflects the ridge density value. Then record the ridge density of defined area (P1, P2, P3, P4).

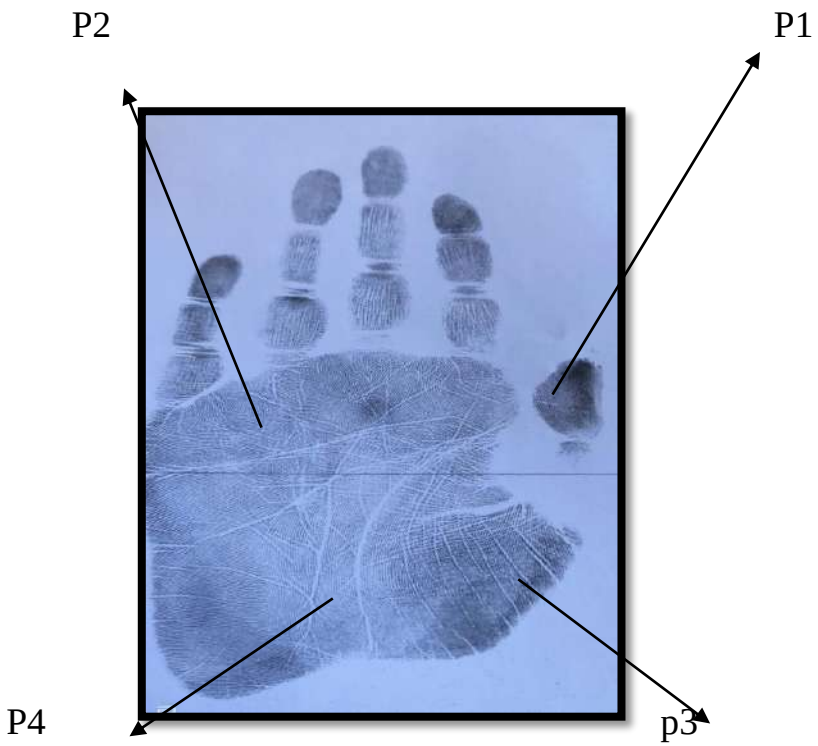


Figure: 3 Shows the defined area of palm print to count ridge density

CHAPTER 5

OBSERVATION

Table 1: Observation table for right hand of male:-

No of ridges		5	6	7	8	9	10	11	12	13
Male Right Hand	P1	0	0	0	2	14	25	26	5	3
	P2	0	0	0	24	29	14	7	0	1
	P3	0	0	0	32	26	14	3	0	0
	P4	0	0	0	21	23	21	4	6	0

Table 2: Observation table for left hand of male:-

No of ridges		5	6	7	8	9	10	11	12	13
Male Left Hand	P1	0	0	0	30	18	27	0	0	0
	P2	0	0	0	19	16	17	12	10	1
	P3	0	0	0	20	25	24	4	2	0
	P4	0	0	0	28	28	10	9	0	0

Table 3.Observation table for right hand of female:

No of ridges		5	6	7	8	9	10	11	12	13
female Right Hand	P1	0	0	0	0	0	9	16	28	22
	P2	0	0	0	1	9	23	26	14	2
	P3	0	0	0	1	5	24	20	14	11
	P4	0	0	0	0	6	29	20	17	3

Table 4: Observation table for left hand of female:

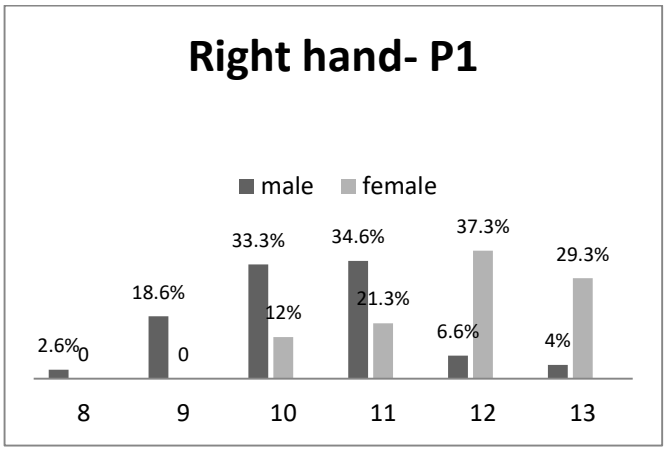
No of ridges		5	6	7	8	9	10	11	12	13
female left Hand	P1	0	0	0	6	23	18	17	9	2
	P2	0	0	0	1	1	21	23	23	6
	P3	0	0	0	6	10	25	20	8	6
	P4	0	0	0	7	12	28	15	13	0

P1: Medial mount

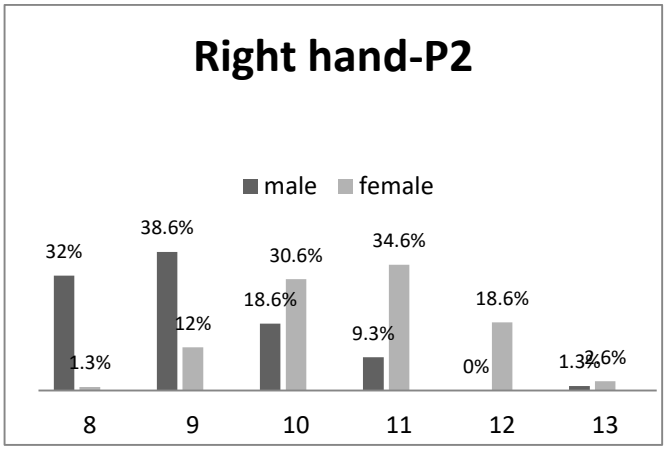
P2: Lateral mount

P3:Thenar Eminence

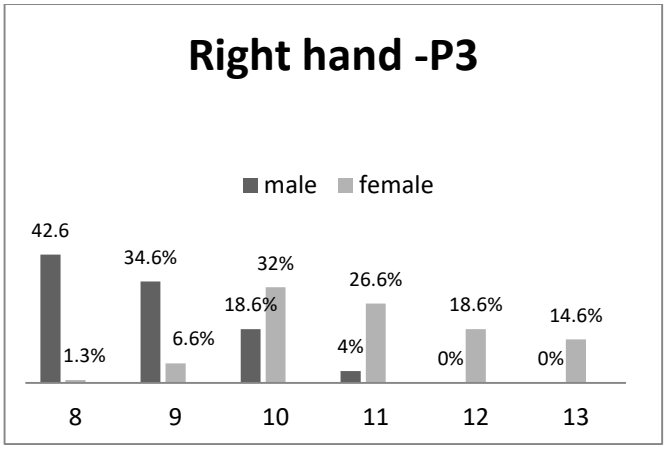
P4: Hypothenar Region



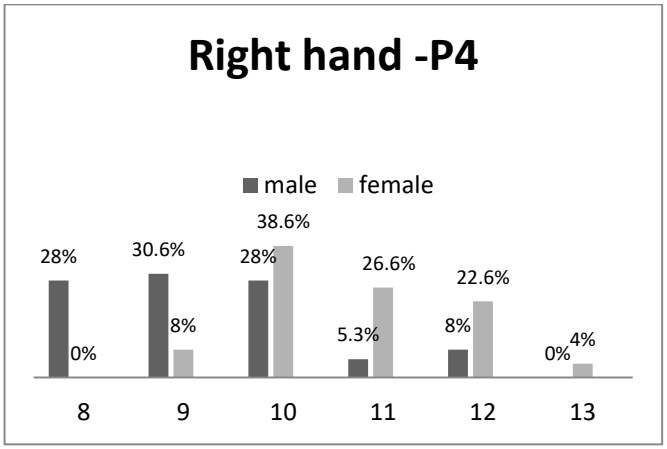
Bar graph: 1 Shows frequency distribution of palm print ridge densities in the P1 areas of the palm prints among men and women in the right hand.



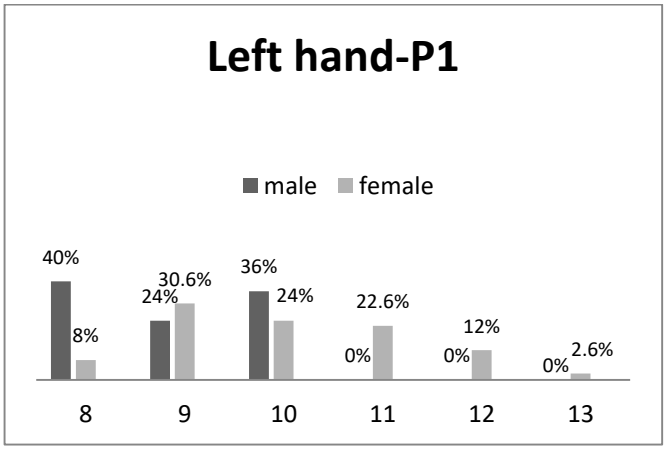
Bar graph 2. Shows frequency distribution of palm print ridge densities in the P2 areas of the palm prints among men and women in the right hand.



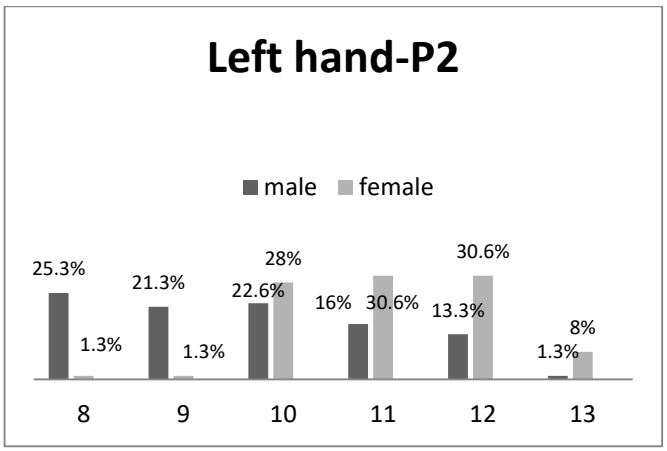
Bar graph 3. Shows frequency distribution of palm print ridge densities in the P3 areas of the palm prints among men and women in the right hand.



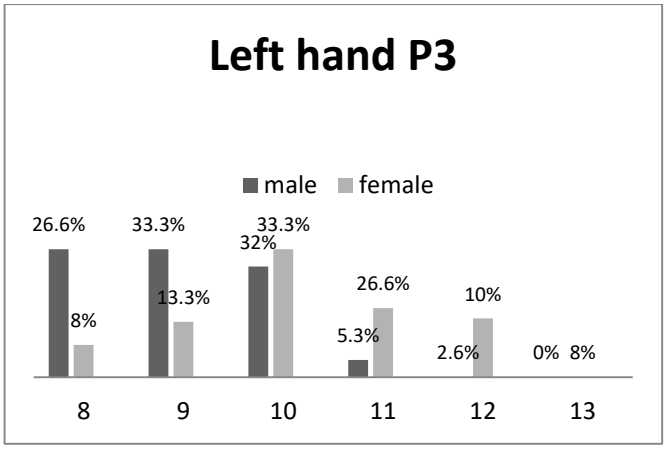
Bar graph 4. Shows frequency distribution of palm print ridge densities in the P4 areas of the palm prints among men and women in the right hand.



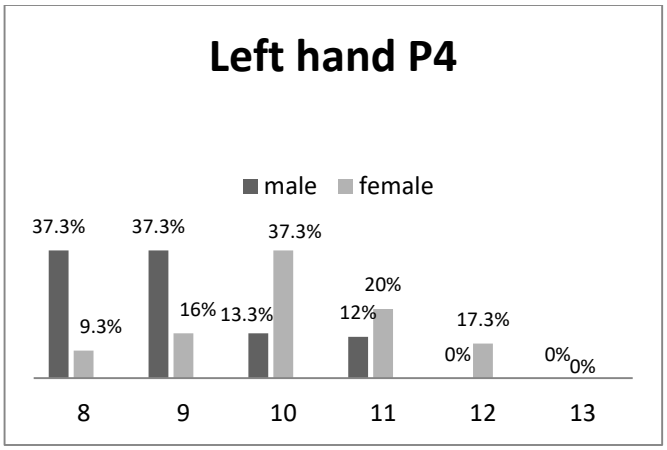
Bar chart 5. Shows frequency distribution of palm print ridge densities in the P1 areas of the palm prints among men and women in the left hand.



Bar chart 6. Shows frequency distribution of palm print ridge densities in the P2 areas of the palm prints among men and women in the left hand.



Bar chart 7. Shows frequency distribution of palm print ridge densities in the P3 areas of the palm prints among men and women in the left hand.



Bar chart 8. Shows frequency distribution of palm print ridge densities in the P4 areas of the palm prints among men and women in the left hand.

CHAPTER VI

RESULT AND CONCLUSION

RESULT:

The results of the observation indicates that sex difference exist in the palm print ridge density. Higher palm print ridge density is observe in women than in men in all expect Medial mount in the right hand. Ridge count in male decreases above 10. The ridges in females varies from 10 to 13. The P3 and P4 regions of palm print are significant for determining the gender of the individual. Ridge counts of the left hand and right hand are different for same individual and also the ridge count of the four region (P1,P2, P3, P4) of palm prints are not same for the same hand.

CONCLUSION:

Palm prints are important role in determining the particular gender. The study was conducted to determine the sex from the ridge densities of palm print and it has been successful to determine gender that, female tend to have greater ridge density than male. Female have higher ridge density in both right and left hand except P1 area. It is evident that statistically significant difference exist in the palm print ridge density among the different areas in men and women in the right and left hand. 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.

CHAPTER VII
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