"Mapping the Correlation Between Fingerprint Pore Diameter and Chronological Age"

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ABSTRACT

Fingerprints are unique dermatoglyphic patterns found on the volar surfaces of the fingertips, characterized by ridges and furrows. Poroscopy, the systematic examination of sweat pores located along these ridges, is a significant technique in forensic identification due to the individual specificity of pore configurations. While previous research has established the uniqueness and consistency of pore patterns, the potential influence of aging on these characteristics remains insufficiently studied. Current literature offers limited insight into agerelated changes in pore size, morphology, or visibility, and there is a notable absence of longitudinal data and diverse age cohort studies to fully address this issue. This study aims to address this gap by systematically analysing pore features across four distinct age cohorts: adolescents and young adults (13–24 years), middleaged adults (25–48 years), older adults (49–60 years), and senior adults (60+ years). A total of 400 fingerprint samples were collected from these groups. Fingerprint impressions were obtained using an inkless ink pad on glossy paper, selected for its ability to produce high-resolution prints with clearly visible pores. Adequate pressure was applied to ensure optimal ridge and pore detail. The collection sequence commenced with the right thumb and concluded with the left little finger, with ten prints gathered per age cohort. A mirrorless camera equipped with a fixed focal length and zoom lens was employed for print documentation. The number of pores per ridge segment was manually quantified to calculate the average pore diameter. The results demonstrate the considerable potential of poroscopy in forensic age estimation, highlighting its utility as a supplementary tool for approximating the age of an individual from latent fingerprint evidence recovered at crime scenes.

Keywords: Fingerprint, Poroscopy, ridges, valleys, inkless ink pad, mirrorless camera

Data Statement

Sample of 40 individual from 4 different age groups:

1. Age group of 13-24

2. Age group of 25-48

3. Age group of 49-60

4. Age group of 60+.

Data collected manual through inkless pad on glossy paper surface.

Data is observed in 5x5mm square box.

Data observed; total pores, no. of pores on 1 ridge, pore shapes (elliptical, circular & others) and average pore diameter.

INTRODUCTION

Fingerprints are the unique identification feature for every individual. Even, identical twins with identical DNA can easily be identified independently through fingerprints. Sir Francis Galton known as the father of fingerprint.

Fingerprints are permanent throughout the life until and unless any permanent damage occurred to the fingertips like any severe injury, deep burn, acid burn, etc. There are different minutiae characters on the fingertips which helps in matching one print with other to know if those two are from same individual or different. Mainly minimum eight points should be matched in questioned and sample print to say them as identical or same prints. There are three levels of fingerprint analysis; Pattern, Minutiae and Poroscopy & Ridgeology.

Poroscopy is discovered and developed by Sir Edmond Locard in 1912. It is a study of sweat pores on the papillary ridges of the skin to identify the individual. Locard observed pores on the epidermal ridges are unique for each individual. Locard also found that like ridge characteristics the sweat pores are also permanent, immutable and individual. It may help in establishing identity of individuals when there is no sufficient minutiae characteristics are available in case of partial and unclear prints for identification purpose. A single pore appears like a dot on fingerprint. There are different shapes of seat pores on fingerprint like; Oval, Square, circle.

The study aims to develop an age-stratified fingerprint database that enables more precise and context-aware identification. By assigning each sample to its appropriate age group, the system reduces the search space and improves overall matching accuracy. Poroscopy lies under level 3 of FP analysis which means it is the best way to identify an individual through the sweat pores present on the print and by providing a data base we can also work on this domain as till now poroscopy is not used in the identification purpose commonly due to the lack of research and database on it.

AIM

The main purpose of this, is to study various sweat pores present on the fingertips of the different people on the basis of their age groups. As the pores are unique for every individual, through the study of pores we can make an easy approach in the field of fingerprint for comparison and identification through different age groups. Poroscopy is the study of sweat pores present on the ridges like the ridge characters it is also unique for each individual. Poroscopy comes under 'level three' under features of fingerprint scan. Through poroscopy we can also determine the gender. As per the studies with increasing age the density of the ridges decreases in humans. Males exhibit a lower density of pores in comparison of females. Through poroscopy, it is possible to identify a certain age group with accuracy. These pores of different age group make the identification and comparison of fingerprints easy which found on the crime scene, even if they do not have sufficient minutia character.

Significance

1. Help in identification purpose even after incomplete prints.

2. Can help in more precise results because of 3rd level detail.

3. Help in forensic investigation and studies.

4. Help in reducing the suspects by eliminating different factors like age, occupation, region, etc and find suspect easily.

Sample Collection

The samples were collected under a stratified method by using a glossy paper and an inkless pad. The samples collected are simple prints not rolled ones. During the collection process the glossy paper is turned as a ten-digit fingerprint data sheet and the prints are taken accordingly in a proper order. The prints are taken in a pattern started from right thumb and end by left little finger. All the ten fingers are simply pressed again the inkless pad

first and then pressed against the glossy paper with appropriate force as instructed. Samples are collected from 40 different people including all ten fingers which makes the count of total samples 400.

Samples collection is done in 4 different groups of the age;

1. Age group (13-24) :10 samples including both male and female

2. Age group (25-48) :10 samples including both male and female

3. Age group (49-60) :10 samples including both male and female

4. Age group (60+) :10 samples including both male and female

Examination Procedure

The sample of different people according to different age groups are collected and preserved properly for the further examination work. Samples of 40 people are collected within four different age group categorizes which includes 13-24, 25-48, 49-60 & 60+ ages. The fingerprint collection procedure is held manually with the help of glossy paper and inkless ink pad. The prints are collected age wise and proper instruction are given while collecting prints. Prints are started taking from Right Thumb and ends at Left Little. The examination part of the samples is started from the stereomicroscope which has limitation of instrumentation for the diameter calculation so to make it possible the whole examination part is done manually. For this study, each individual print was photographed using a mirrorless camera, with a measurement scale placed adjacent to the print to ensure accurate scaling and measurement. The photographs are then taken for the examination part. For the examination of pores in prints, a square of 5x5 mm is drawn on the print using measurement scale placed adjacent to the sample for accuracy. After that the counting of total no. of pores in square, total no. of pores on a single ridge, total no. of circular pores in square, total no. of elliptical pores in square, total no. of other shaped pores in square and the average diameter of the pores are taken. The average diameter of pores includes the mean of minimum 5-6 pores in the square. The diameter of each pore is taken from the paint in the pixels by using line and then converted the pixels into micrometres to get the diameter of each pore. After measuring diameter of each pore, mean value was calculated to obtain average pore diameter and finally average diameter of each sample is obtained through this process. All the measurements were compiled into a detailed table, and the results were plotted graphically to make the data easier to interpret.

Data Analysis and Interpretation

Table showing the values of analysis for sample 1(age 13-24) with graphical representation:

Age group 13-24

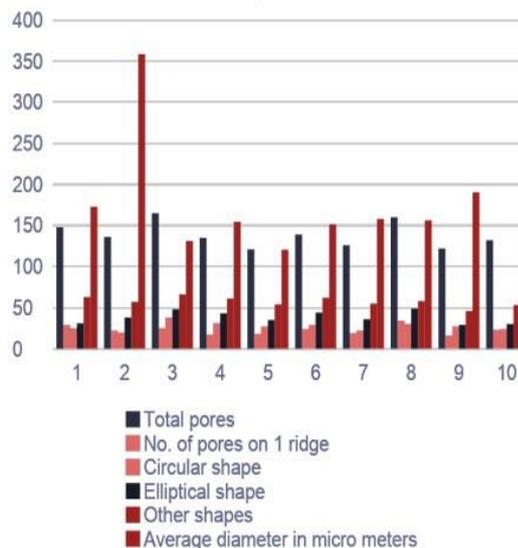| Sample no.	Finger name	Total pores	No. of pores on 1 ridge	Circular shape	Elliptical shape	Other shapes	Average diameter in micro meters
S1	RT	148	29	25	31	63	172.7273
	RI	136	22	20	38	57	358.4229
	RM	165	25	38	48	66	131.1475
	RR	135	17	31	43	61	154.4715
	RL	121	18	27	35	54	120.5674
	LT	139	24	29	44	62	151.5152
	LI	126	19	22	36	55	157.8947
	LM	160	34	30	49	58	156.25
	LR	122	16	27	29	46	190.0826
	LL	132	23	24	30	53	132.4503

Sample S1

Table showing the values of analysis for sample 11(age 25-48) with graphical representation:

Age group 25-48

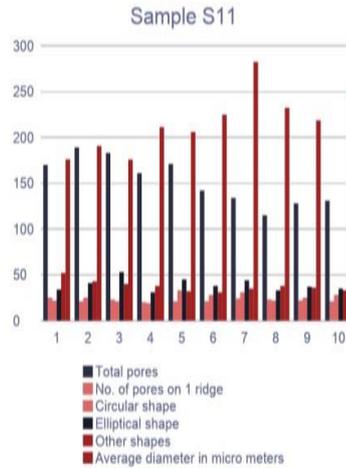| Sample no.	Finger name	Total pores	No. of pores on 1 ridge	Circular shape	Elliptical shape	Other shapes	Average diameter in micro meters
S11	RT	170	25	22	34	52	176
	RI	189	21	25	41	43	190.4762
	RM	183	23	21	53	40	175.6757
	RR	161	20	19	31	38	211.1801
	RL	171	21	33	45	32	205.8824
	LT	142	21	28	38	31	224.6377
	LI	134	24	31	44	35	282.2581
	LM	115	23	22	33	38	232.1429
	LR	128	22	25	37	36	218.4874
	LL	131	21	28	35	33	244.6043

Table showing the values of analysis for sample 26(age 49-60) with graphical representation:

Age group 49-60

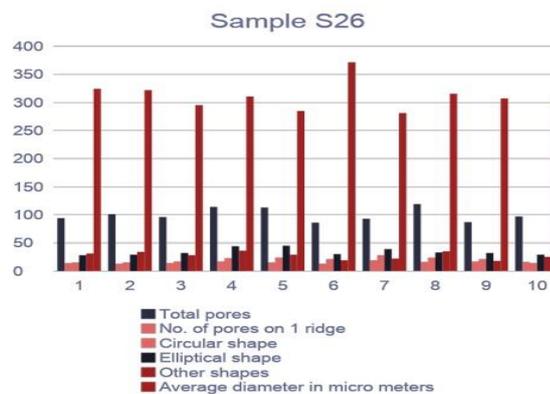| Sample no.	Finger name	Total pores	No. of pores on 1 ridge	Circular shape	Elliptical shape	Other shapes	Average diameter in micro meters
S26	RT	94	14	15	28	31	324.0741
	RI	101	13	15	29	34	321.7391
	RM	96	14	17	32	28	295.082
	RR	114	17	23	44	36	310.6061
	RL	113	15	24	45	29	284.6715
	LT	86	13	21	30	19	371.4286
	LI	93	19	28	39	22	281.0458
	LM	119	16	24	33	35	315.3846
	LR	87	17	21	32	18	307.0866
	LL	97	16	14	29	25	309.8592

Table showing the values of analysis for sample 11(age 60+) with graphical representation:

Age group 60+

Sample no.	Finger name	Total pores	No. of pores on 1 ridge	Circular shape	Elliptical shape	Other shapes	Average diameter in micro meters
S38	RT	61	11	7	15	11	481.4815
	RI	79	11	13	20	19	405.5944
	RM	71	13	12	29	18	419.8473
	RR	65	12	15	22	16	458.3333
	RL	78	9	15	14	15	402.8777
	LT	83	14	17	26	15	456.8966
	LI	90	13	15	33	22	428.5714
	LM	86	13	12	28	17	409.0909
	LR	89	17	14	26	21	401.4559
	LL	91	14	13	27	23	402.7778
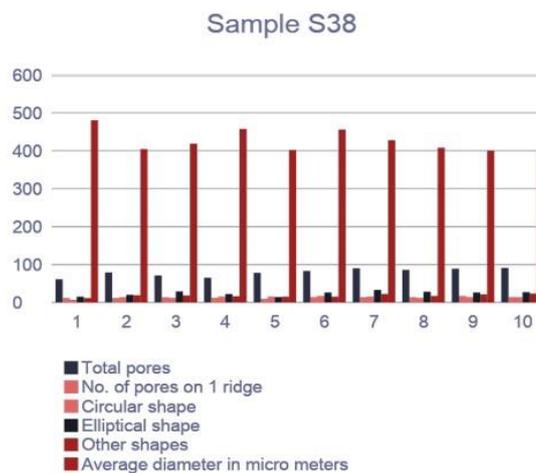
The collected samples are stored and a square of 5x5 mm is made on print for the sweat pore counting purpose. The sweat pores of all the fingers of all the participants are counted thoroughly. Average diameter for every print is also counted through the excel sheet.

For the collected data tables and graphs are prepare for each participant's fingerprint which contain each detail as shown above. The details are represented in the graphical form from the table which is prepared with the details for easy understanding. The table contain the name of sample and then the name of finger on which the examination is performed and further the total no. of pores on that particular finger, different shape pores on the finger as well as the average diameter of the pores. Single table for a single person's print is prepared and

according to different ages to give a required output. Above only few samples are provided as per the age groups and we can provide the whole content if it is needed.

Observation

1. Samples of 40 people are collected according to their age group. Four age groups are taken and samples of 10 people are collected in each group which involves all ten prints of an individual.

2. A 5x5 mm square is taken as per the process to count the sweat pores. The pores within the square of 5x5mm are counted as per the table shown above the total no. of pores in the square, no. of pores on single ridge, shapes of different sweat pores and then the average diameter of the pores present in the square.

3. Here we observed that the no. of pores in each age group differs not only no. of pores but diameter of pores also differs.

4. As per the study, no. of pores in the age group 13-24 is more and less in the 60+ age group which shows the no. of sweat pores decrease with respect to increasing age.

5. The sweat pores in the early age are dense in comparison of old age. When average diameter of the sweat pores is calculated it is observed that the diameter of pores increased with increasing age and the diameter of pores are small in the early age.

6. When the density of the ridges decreases the diameter of sweat pores increased. The no. of the pores on the ridges is less in 60+ and the diameter of the pores are larger as the age increases the density of the ridges decrease and the diameter of pores increased in both males and females.

7. The pores in early teenage shows the pores very clearly and densely with high density of ridges.

Future Scope

Through this study we can provide a type of data and further we can produce a proper data base of the sweat pores as these are also permanent and inevitable like fingerprints so this can give a more precise result for the identification purpose of an individual. As per the data in our hands at present there is not such specific data base prepared for the poroscopy which can help in finding the individual and that's why it is not used for the identification purpose. Once we get the data base for this, we can also prepare the instruments for the same and can get more precision to identify an individual through poroscopy.

CONCLUSION

The study shows the age of an individual can be find out by the no. of pores on a fingerprint. The no. of pores is more in the early age people while the no. of pores decreases with increasing age. When the age increases the diameter of pores also increase accordingly but in 13-24 age group the diameter of pores is lesser. The density of ridges is less in aged people while the ridge density in younger ones is higher. In early age the pores are close to each other while with increasing age the pores became far from each other. This study shows satisfactory results of establishing the age of the donor with the help of poroscopy. Prints found on SOC which lacks the sufficient minutiae points can be used for the further investigation by doing a poroscopy examination of them. This may help in categorizing the suspects in a specific age group so the range of suspects became narrow and easy to find the criminal as well.

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