A Forensic Approach Between Chance and Complete Fingerprints

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ABSTRACT *According to the Locard's Principle of exchange "Every contact leaves a trace". When fingers of a victim or culprit come in contact with any object then it leaves their impression on it. This impression some time visibly appears and sometime is doesn't. These invisible or visible fingerprints have plethora of information which is forensically utilized for the identification and individualization of victim and culprit. In this paper we present statistical assessment for differentiation and individualization of chance and complete prints. Both chance and complete fingerprints of Left Right Thumb and Index finger of male and female (50 each) are respectively developed by black powder/ ink method and recorded digitally by photography. It has been observed the male complete and chance print show similarity with an average of 77.6% and female with an average of 74.4%.*

INTRODUCTION

The epidermal ridges on our fingers, palms and soles are characterized by parallel ridges that form distinguishable configuration. These configurations make everybody's fingerprints unique and do not change in life [5]. Thousands of years before the birth of Christ, Chinese monarchs used fingerprint impressions for the official purpose of sealing important state documents. Chance and latent fingerprints are marks left at the crime scene which are not immediately visible to the naked eye. To expose these types of marks, fingerprint examiner use fingerprints powder, fuming and other techniques. **Kumari et. al.[4]** analyzed the new visualizing agents for latent fingerprints on synthetic food and festival colors and has concluded the new powdering method (gulal) for the development of latent fingerprints on different substrates. **Chauhan and Chattopadhyay** [1] suggested the development of latent dermal ridges present on fruits and vegetables and has concluded that the dermal ridges was successfully developed which was clear, identical and carrying enough information about an individual. In the present study, the initial attempt has been made to develop the chance print of the suspect and then compare, match and evaluate that print with the visible print of the same individuals by digitally imaging process or photography with digital camera (canon-10.0 mega pixel). This type of work can provide the enough information of an individual to the investigators.

MATERIALS AND METHODS

Fifty samples of Chance and Complete prints were collected from fifty males and fifty females respectively of Left Index, Left Thumb, Right Index and Right Thumb fingers. All the samples were collected from various departments of Bundelkhand University, Jhansi.

Complete Print- Ink tube, glass slab, roller, white sheets.
Chance Print- Dry black powder ink, spraying brush (very light feather).
Techniques- Digital camera (canon-10.0 mega pixel), measuring scale, magnifying lens and laptop/PC, Adobe Photoshop, MS- word 2010, MS Excel 2010, IBM SPSS Statistics software 20.

The comparison and matching of fingerprints for the purpose of identification focuses on different level i.e. level one and level two.

In the level one details (fig. 1), the central area of fingerprint provides the general type of information such as loop, arch whorl and composites. This type of details are identical and cannot provide enough information to make an identification of fingers. Thus, the level two details (fig. 2) focus on the characteristics of ridge path and can provide a great deal of details.
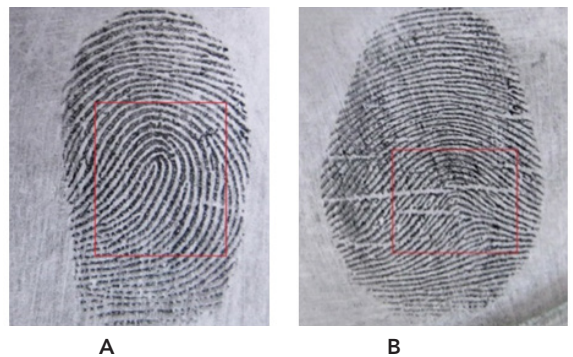

A B

Fig-1: Shows the "level one" details provide information of central area of fingerprint i.e. loop and arch.
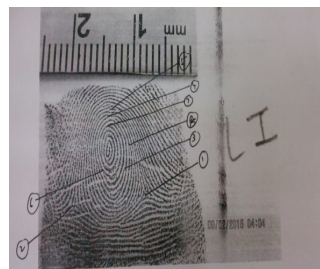

Fig-2: Shows the "level two" details provide information of ridged details i.e. minutiae's.

1. Delta.
2. Delta.
3. Lake.
4. Convergence.
5. Fragment.
6. Convergence.
7. Bifurcation.
8. Bifurcation.

As the FBI uses and adopted the standard methods, the examiner use the four step process **ACE-V** (*analysis, comparison, evaluation* and *verification)* for determining the each print that focuses on level one and level two details. The first phase is **analysis** (fig. 3), in which the "level one" and "level two" details of fingerprints were observed.
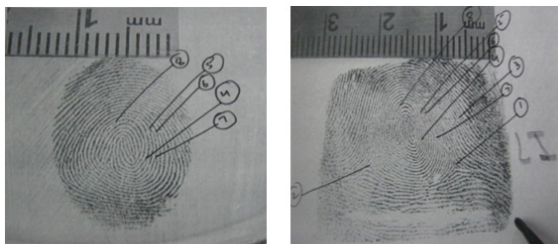
Chance Print   **Complete Print**

Fig-3: Analysis of Chance and Complete Print.

Once the thorough analysis of prints were completed, the second phase is **comparison** (fig. 4), in this we concentrate primarily on the chance print and match the minutiae's present at the same place and on the same location as on the visible print.
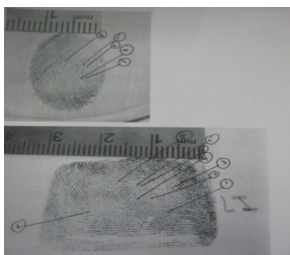

Fig-4: Showing of Comparison of Chance over Complete Print having ridge detail.

The third phase is the **evaluation** (table- 1), the two prints are identified by placing them together side by side and decides whether the print are of same source or different source.

Table-1: Evaluation of chance print over complete print

S.No	Characteristics	Chance Print	Complete Print
1.	**Delta**	Absent	Present
2.	**Delta**	Absent	Present
3.	**Ridge Crossing**	Absent	Present
4.	**Lake**	Present	Present
5.	**Convergence**	Present	Present
6.	**Convergence**	Present	Present
7.	**Convergence**	Present	Present
8.	**Lake**	Present	Present

The final process is the **verification,** another expert will repeat the entire process that has made the positive identification.

RESULTS

In the present study, the detail present in both the prints are compared, and an evaluation of that prints take place to determine the maximum and minimum number of pattern found in male (table-2) and female (table-3), average percentage (table-4) (chart-1), maximum and minimum number of characteristics (table-5) (chart-2), and assessment of ridge characteristics in chance print over the complete print (table- 6a,6b), (table-7a,7b), (table-8a,8b) and (table-9a,9b).

Table-2: Maximum and minimum number of pattern found in male (50 sample).

Total number of sample of male of each finger= 50			
S.No	Sample Name	Pattern /Max. no.	Pattern/Min. no.
1.	**Left Index (LI)**	Ulnar loop (24)	Arch (1)
2	**Left Thumb (LT)**	Ulnar loop (24)	Arch (3)
3.	**Right Index (RI)**	Ulnar loop (23)	Arch (1)
4.	**Right Thumb (RT)**	Whorl (18)	Central pocket loop (3)

Table-3: Maximum and Minimum number of pattern found in female (50 sample).

Total number of sample of male of each finger= 50			
S.No	Sample Name	Pattern /Max. no.	Pattern/Min. no.
1.	**Left Index (LI)**	Whorl (19)	Central pocket loop (1)
2	**Left Thumb (LT)**	Ulnar loop (25)	Central pocket loop (1)
3.	**Right Index (RI)**	Whorl (23)	Radial loop (1)
4.	**Right Thumb (RT)**	Ulnar loop, Whorl (18)	Central pocket loop (4)

Table 2 and table 3 represents the maximum and minimum number of pattern found in LI, LT, RI and RT.

Table-4: Average of Percentage of male and female.

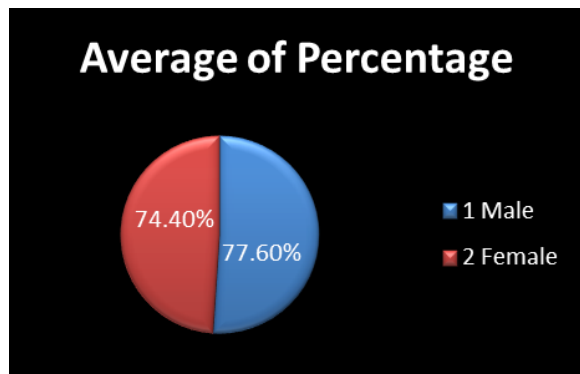| S.No	Sample	Average of Percentage
1.	Male	77.6%
2.	Female	74.4%

Chart-1: Represents the Average of percentage of chance

over complete print among 50 samples of male and female are found to be 77.6% and 74.4% respectively.

Table-5: Maximum and minimum ridge characteristics found in male and females.

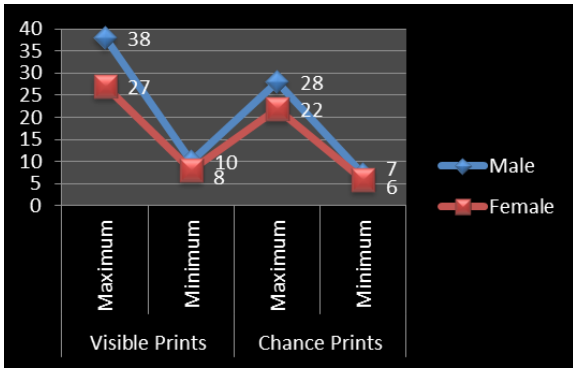| Sample	Complete Prints		Chance Prints	
	Maximum	Minimum	Maximum	Minimum
Male	38	10	28	07
Female	27	08	22	06

Chart 2: The chart represents the maximum and minimum ridge characteristics found in chance over complete prints of male and females is (28, 38); (07, 10) and (22, 27) and (06, 08) respectively.

Table 6a: Assessment of ridge characteristics of chance over complete print of left index (LI) finger of male of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		LI	LI
1.	Delta	36	45
2.	Lake	25	27
3.	Enclosure	10	11
4.	Bifurcation	34	36
5.	Convergence	23	24
6.	Fragment	03	04
7.	Dot	00	00
8.	Trifurcation	02	02
9.	Ridge Ending	00	01
10.	Divergence	01	01
11.	Intersection	00	02

It represents the data for the assessment of chance over complete print of ridge characteristics of left index (LI) finger among 50 male samples. It has been observed that the delta (36, 45) and bifurcation (34, 36) respectively are the characteristic which shows the highest level of matching and the divergence (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the dot or point is the only characteristic, which is not present in both the sample of the print.

Table 6 b: Assessment of ridge characteristics of chance over complete print of right index (RI) finger of male of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		RI	RI
1.	Delta	31	47
2.	Lake	24	28
3.	Enclosure	13	14
4.	Bifurcation	36	38
5.	Convergence	23	24
6.	Fragment	08	11
7.	Dot	00	00
8.	Trifurcation	01	01
9.	Ridge Ending	00	00
10.	Divergence	01	01
11.	Intersection	02	02

It represents the data for the assessment of chance over complete print of ridge characteristics of right index (RI) finger among 50 male samples. It has been observed that the delta (31, 47) and bifurcation (36, 38) respectively are the characteristics which show the highest level of matching and the divergence (1, 1) and trifurcation (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the dot or point and ridge ending are the characteristics, which is not present in both the sample of the print.

Table 7a: Assessment of ridge characteristics of chance over complete print of left thumb (LT) finger of male of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		LT	LT
1.	Delta	28	47
2.	Lake	21	24
3.	Enclosure	14	15
4.	Bifurcation	38	42
5.	Convergence	14	15
6.	Fragment	01	02
7.	Dot	00	00
8.	Trifurcation	00	00
9.	Ridge Ending	01	02
10.	Divergence	01	01
11.	Intersection	00	00

It represents the data for the assessment of chance over complete print of ridge characteristics of left thumb (LT) finger among 50 male samples. It has been observed that the delta (28, 47) and bifurcation (38, 42) respectively are the characteristics which show the highest level of matching and the divergence (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the dot or point, trifurcation and intersection are the characteristics, which are not present in both the sample of the print.

Table 7 b: Assessment of ridge characteristics of chance over complete print of right thumb (RT) finger of male of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		RT	RT
1.	Delta	18	46
2.	Lake	24	28
3.	Enclosure	16	19
4.	Bifurcation	33	35
5.	Convergence	22	28
6.	Fragment	03	03
7.	Dot	01	01
8.	Trifurcation	01	01
9.	Ridge Ending	01	01
10.	Divergence	01	01
11.	Intersection	05	05

It represents the data for the assessment of chance over complete print of ridge characteristics of right thumb (RT) finger among 50 male samples. It has been observed that the delta (18, 46) and bifurcation (33, 35) respectively are the characteristics which show the highest level of matching and the dot (1, 1), trifurcation (1, 1), ridge ending (1, 1) and divergence (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that in this finger there are no characteristic, which is not present in both the sample of the print.

Table 8a: Assessment of ridge characteristics of chance over complete print of left index (LI) finger of female of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		LI	LI
1.	Delta	31	44
2.	Lake	15	16
3.	Enclosure	01	01
4.	Bifurcation	36	39
5.	Convergence	16	16
6.	Fragment	01	01
7.	Dot	00	00
8.	Trifurcation	00	00
9.	Ridge Ending	01	01
10.	Divergence	00	00
11	Intersection	01	01

It represents the data for the assessment of chance over complete print of ridge characteristics of left index (LI) finger among 50 female samples. It has been observed that the delta (31, 44) and bifurcation (36, 39) respectively are the characteristics which show the highest level of matching and enclosure (1, 1), fragment (1, 1), ridge ending (1, 1) and intersection (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the dot or point, trifurcation and divergence are the characteristics, which is not present in both the sample of the print.

Table 8b- Assessment of ridge characteristics of chance over complete print of right index (RI) finger of female of 50 samples.

S.No	Characteristics	Chance Print	Visible Print
		RI	RI
1.	Delta	24	46
2.	Lake	18	20
3.	Enclosure	00	00
4.	Bifurcation	42	44
5.	Convergence	15	19
6.	Fragment	01	01
7.	Dot	00	00
8.	Trifurcation	00	01
9.	Ridge Ending	01	01
10.	Divergence	00	00
11	Intersection	01	01

It represents the data for the assessment of chance over complete print of ridge characteristics of right index (RI) finger among 50 female samples. It has been observed that the delta (24, 46) and bifurcation (42, 44) respectively are the characteristics which show the highest level of matching and the fragment (1, 1), ridge ending (1, 1) and intersection (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the enclosure, dot or point and divergence are the only characteristics, which is not present in both the sample of the print.

Table 9a: Assessment of ridge characteristics of chance over complete print of left thumb (LT) finger of female of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		LT	LT
1.	Delta	30	48
2.	Lake	16	19
3.	Enclosure	00	00
4.	Bifurcation	40	41
5.	Convergence	12	12
6.	Fragment	00	00
7.	Dot	00	00
8.	Trifurcation	00	00
9.	Ridge Ending	00	00
10.	Divergence	00	00
11	Intersection	01	01

It represents the data for the assessment of chance over complete print of ridge characteristics of left thumb (LT) finger among 50 female samples. It has been observed that the delta (30, 48) and bifurcation (40, 41) respectively are the characteristics which show the highest level of matching and the intersection (1, 1) shows the lowest level of matching sample of chance over complete print. The present table further reveals that the enclosure, fragment, dot or point, trifurcation, ridge ending and divergence are the characteristics which is not present in both the sample of the print.

Table 9b: Assessment of ridge characteristics of chance over complete print of right thumb (RT) finger of female of 50 samples.

S.No	Characteristics	Chance Print	Complete Print
		RT	RT
1.	Delta	17	46
2.	Lake	20	21
3.	Enclosure	02	02
4.	Bifurcation	44	44
5.	Convergence	15	16
6.	Fragment	03	03
7.	Dot	00	00
8.	Trifurcation	00	00
9.	Ridge Ending	00	00
10.	Divergence	00	00
11	Intersection	00	00

It represents the data for the assessment of chance over complete print of ridge characteristics of right thumb (RT) finger among 50 female samples. It has been observed that the delta (17, 46) and bifurcation (44, 44) respectively are the characteristics which show the highest level of matching and enclosure (2, 2) shows the lowest level of matching sample of chance over complete print. The present table further reveals that dot, trifurcation, ridge ending, divergence and intersection are the characteristic, which is not present in both the sample of the print.

DISCUSSION

The present study helps in personal identification of an individual from the chance print which was compared with complete print of the same individual in LI, LT, RI and RT finger of male and female. It have been observed that ulnar loop is the patterns found in maximum number and arch, central pocket loop and radial loop are the patterns found minimum in number among 100 samples containing 50 male and female each. Similarly Chauhan and Chattopadhyay [1] reported the recovery and enhancement of lateral dermal ridges have been successfully done by using a battery of powder on fruits and vegetables. Only one accidental print was found in LI finger of male and it has been clear that accidentals prints are also recovered from crime scene. Similarly Harish.et.al [4] concluded that latent fingerprint development in writing surface of CD i.e. glossy and smooth texture has not been examined by common agents (food colors and holi colors). David. M. Bierie [2] data shows approximately 2 million warrants are active on any given day. Warrant features vary significantly across states (per capita), and fugitive demographics. Extradition varies as a function of legal (e.g., crime seriousness) and extra-legal factors (e.g., race of fugitive).The latent ridges details present on any surface were successfully developed and having an enough information about the personal identification of an individuals.

SUMMARY

In the present study, the chance print of an individual is analyzed and compared with the complete print of the same individual in left index, left thumb, right index and right thumb fingers of male and female. It has been observed that the ulnar loop is the pattern found maximum and arch, central pocket loop and radial loop found minimum in number among both the samples. The result also shows the highest and lowest level of ridge details present in LI, LT, RI and RT fingers of the sample. One accidental was also found in the LI finger of the male which reveals the recovery of the accidental print was possible as it was left behind by criminal at scene of crime.

CONCLUSIONS

Based on the findings of the study, the following conclusions were established:

- The chance print helps in personal identification through comparison with the suspect sample.
- It provides an idea about the full fingerprint of the suspected person.
- Provide information about the number of suspect involved in case.
- A collaborated full fingerprint can be obtained from fragmented chance print found at different location.
- Manner of propagation of fingers at the surface can be identifying by keenly observing the chance print.
- Individualization can be performed on the basis of minutiae present at the chance print.
- The average of the male samples will be found more in comparison with the female samples i.e. 77.6% and 74.4% respectively.

The dermal ridges developed were clear, identifiable and having enough information for nabbing the suspects.

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