



## “DETERMINATION OF BILATERAL DIFFERENCES IN FINGERPRINTS”

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### Abstract

Determination of the bilateral variances in the fingerprints is also a crucial area of conducting the study in the field of forensic science as it is one of the best methods of identifying the suspects as well as it also helps in establishing the complete involvement of the victims in the crime. This study is completely based on the evaluation of the bilateral differences in a fingerprint while utilizing statistical analysis. The samples are collected from females and males which are 69 in number. The samples comprise the whorl patterns which need to be conducted. The analysis in detail is conducted for identifying the variances among the right and left thumbprints. This complete study also revealed several significant factors as well as differences in ridge density, ridge counts as well as other types of characteristics among the right and left handprints of every sample. Moreover, the complete findings of this research also represented that the differences between the right and left fingerprints actually varied in large numbers among the individuals while providing the spotlight on the importance of analysing the bilateral differences while analysing the fingerprints.

**Keywords:** Determination, Fingerprints patterns, Bilateral differences, Forensic

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## INTRODUCTION

The fingerprints are the unique things in nature, the fingerprints which can be found on the Crime Scene can also be utilized for evidence. Fingerprint comprises 3 basic types which are whorl, loop, and arch as well as other types of fingerprints are also characterized such as the tinted arch or the plain arch. The bilateral differences determination by the fingerprints are also the individual and it can be utilized for conducting an identification. The fingerprint bilateral differences also refer to as the variances among the fingerprints in the right hand and left hands of a person. Moreover, these fingerprints are also unique in their way, it comprises the differences among the minutiae, and ridge patterns as well as among both the right- and left-hand fingerprints which are also not the same for one person. It may also differ and the main important term for the forensic field in which fingerprints are utilized for identifying the victims or the suspects. For the determination of the bilateral differences among the fingerprints, the experts of the forensic field typically compare as well as examine the right and left hands fingerprints of the person while utilizing the process called the analysis of fingerprints. It also includes the identification of unique features like characteristics as well as the type of patterns. Moreover, determining the fingerprint's bilateral differences requires accurate analysis as well as the comparison of both hand fingerprints of a person. It can also be conducted by manual comparison or while utilizing the system of automated identification of fingerprints.

## MATERIALS AND METHODS

The materials and methods which are utilized in this research also depend on getting permission from the committee of the institute which usually works on the ethical allowance. This complete research is based on the quantitative methodology which is used in this research for framing the analysed data. Collection of the samples research is conducted on the basis of collecting samples of the fingerprints from the subjects 69 people by taking the Impressions of their fingerprints of right and left hands of around 36 females and 33 males following the age group of 18 to 25 years (Adetona, 2018). All the subjects belong to the Hindi and Punjabi population study at Chandigarh University which is situated in Mohali, gharuan, India. The main purpose of conducting this research is also explained as well as the stated, informed consent is also obtained from every subject. For the collection of the fingerprints, the samples need to be analysed while taking the

Impressions on the A4 sheet with the black ink as well as the black ink pad is also needed for taking the Impressions. The ridge counting is also conducted on the basis of using the magnifying glass for every subject of the whorl patterns. The fingerprint determination of the bilateral differences is also the technique utilized by forensic experts for analysing in identifying the suspects. It can be the necessary method for the identification of bilateral differences while conducting the comparison of the fingerprints of both the hands of a person (Akhlaghi et. al., 2016).

Various types of methods and methodologies are also utilized for determining the fingerprint's bilateral differences. It involves minutiae analysis, Delta analysis, ridge count analysis, automated comparison, and visual comparison.

- Minutiae analysis- It comprises the ridge characteristics like the endings or the bifurcations which are also unique in every fingerprint through the comparison of the minutiae from the left as well as the right fingerprints, it can be possible for identifying any kind of differences (Algani, 2022).
- Delta analysis- It includes the identification of the location of the Delta points of both the right and left fingerprints any kind of differences among the location of the delta point can also indicate the bilateral difference
- Ridge count analysis- It can be stated as the technique which can be utilized for counting the sequence of the ridges among the specific points in fingerprints by comparing ridge counts on the right and left fingerprints. It is also possible in identifying any kind of differences (Petrova et. al., 2020).
- Automated comparison- It can be conducted by the use of software that can be utilized by computer algorithms for doing the comparison among the left and right hands' fingerprints. Such type of method is also less prone to human error and it can also provide a greater number of objective results (Romphothong&Traithepchanapai, 2019).
- Visual comparison- It includes the comparing of right- and left-hand fingerprints by analysing them visually for identifying the similarities or differences in the fingerprints. This type of method is also subjective and it is possible that a human error may occur (Baragi, et. al., 2022).

## RESULTS

There are several types of research and studies conducted on the basis of determining the

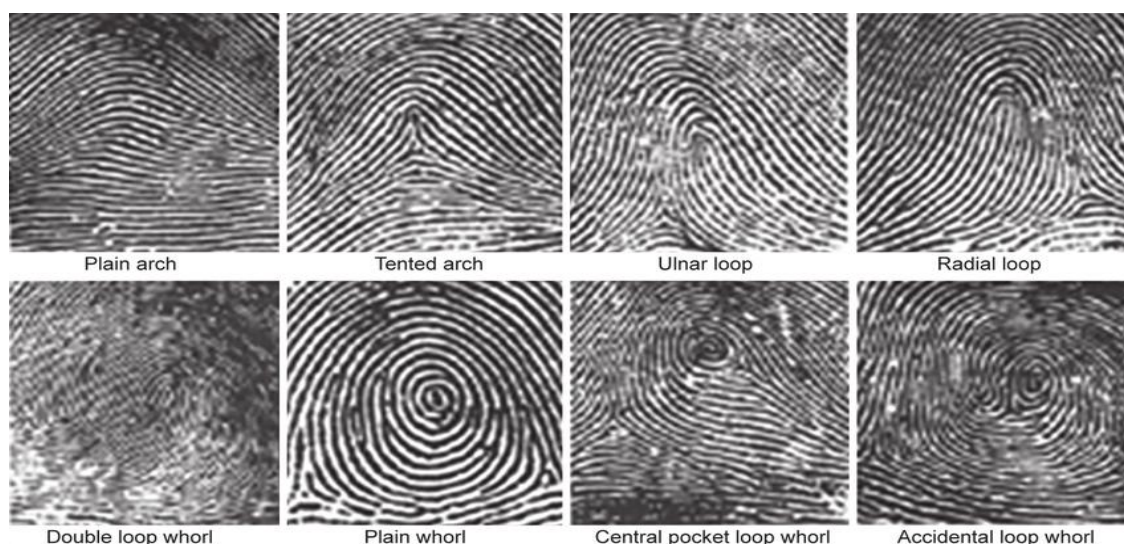
fingerprint's bilateral differences. Some of the main findings are presented below: -

**Bilateral differences persistence-** This type of study represented that the fingerprints bilateral differences usually persist over time in other words, we can say that the differences between the right-hand fingerprints and left-hand fingerprints remain relatively and deliberately constant in the entire life of a person (Petrova & Andreenko, 2018).

**Detailed level-** The details of the fingerprints may also vary among the right hands as well as the left hands. The detail level in the fingerprints can also be determined by the arrangements and density of the ridges. The research also represented the various types of detailed levels which may also be very crucially among the right hand and left hand (Petry- Schmelzer et. al., 2021).

**Various types of ridge counts-** The fingerprints are having unique counts of Ridge which may also vary from the right hand to the left hand of a person. The counts of the ridge can also be determined by counting the sequence of the ridges within the specific portion of the fingerprint. The researchers also represented that the count of the ridge can also differ between the right hand and left hand (MOORTHY & ZULKIFLY, 2016).

**Asymmetric bilateral-** The studies also represented that the fingerprints of a person cannot be identical to both hands of a person. It can be different significantly as well asymmetric on the levels of bilateral. In other words, we can say that the pattern of the Ridge of the right hand may be slightly different or asymmetrical as compared to the left hand. The image which is presented below represents the various types of fingerprint patterns (LD & IP, 2021).



**Various pattern of fingerprints**

(Source: [www.researchgate.net](http://www.researchgate.net), 2023)

The complete research represents that there are the significant fingerprints bilateral differences which includes the differences among the ridge counts, ridge patterns as well as the detail level. All these

differences can be also effective and useful in the investigation of the forensic field as well as it also provides support in identifying the suspects as well as matching the fingerprints within the individuals (Kaur, 2019).

**Table 1. Sample collected from females of left hand**

Female left pattern	Index	Middle	Ring	Little	Thumb
1					

**Table 2. Sample collected from females of right hand**

Female right pattern	Index	Middle	Ring	Little	Thumb
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**Table 3. Sample collected from Males of left hand**

Male left pattern	Index	Middle	Ring	Little	Thumb
1					

**Table 4. Sample collected from Males of right hand**

Male right pattern	Index	Middle	Ring	Little	Thumb
1					

**Table 5. Sequence of female left pattern presented in the table below.**

Female pattern	left	Index	Middle	Ring	Little	Thumb
1		Double loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop
2		Double loop	Whorl	Ulnar loop	Double loop	Whorl
3		Radial loop	Ulnar loop	Plain whorl	Ulnar loop	Twin loop
4		Radial loop	Radial loop	Radial loop	Ulnar loop	Ulnar loop
5		Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Central pocket loop
6		Whorl	Radial loop	whorl	Radial loop	Radial loop
7		Ulnar loop	Whorl	Ulnar loop	Whorl	Ulnar loop
8		Central pocket loop	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
9		Ulnar loop	Ulnar loop	Whorl	Radial loop	Radial loop
10		Radial loop	Radial loop	Whorl	Radial loop	Whorl
11		Whorl	Whorl	Whorl	Radial loop	Radial loop
12		Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
13		Twin loop	Ulnar loop	Whorl	Whorl	Whorl
14		Arch	Whorl	Whorl	Whorl	Ulnar loop
15		Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Radial loop
16		Radial loop	Double loop	Double loop	Double loop	Whorl
17		Central pocket loop	Ulnar loop	Radial loop	Central pocket loop	Twin loop
18		Double loop	Radial loop	Whorl	Whorl	Whorl
19		Whorl	Radial loop	Radial loop	Radial loop	Whorl
20		Whorl	Whorl	Whorl	Radial loop	Whorl
21		Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
22		Radial loop	Radial loop	Whorl	Radial loop	Plain arch
23		Whorl	Whorl	Whorl	Whorl	Ulnar loop
24		Arch	Radial loop	Radial loop	Radial loop	Arch
25		Radial loop	Radial loop	Radial loop	Radial loop	Radial loop
26		Radial loop	Radial loop	Whorl	Whorl	Whorl
27		Radial loop	Radial loop	Radial loop	Radial loop	Ulnar loop
28		Whorl	Radial loop	Whorl	Radial loop	Whorl
29		Radial loop	Radial loop	Whorl	Radial loop	Double loop
30		Ulnar loop	Ulnar loop	Central pocket loop	Radial loop	Ulnar loop
31		Whorl	Whorl	Central pocket loop	Tented arch	Whorl
32		Whorl	Whorl	Whorl	Whorl	Whorl
33		Arch	Arch	Ulnar loop	Ulnar loop	Whorl
34		Radial loop	Radial loop	Radial loop	Radial loop	Radial loop
35		Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
36		Tented arch	Radial loop	Whorl	Ulnar loop	Ulnar loop

**Table 6. Percentage of female left pattern presented in the table below.**

Patterns	Left Index	left middle	left ring	left little	left thumb
Double loop	3	1	1	2	1
Radial loop	10	14	7	14	6
Ulnar loop	7	12	7	10	10
Whorl	5	5	11	4	13
Central pocket loop	2	0	2	0	1
Twin loop	1	0	0	0	1
Arch	1	1	0	0	1
<b>Percentage</b>	<b>80.555556</b>	<b>91.666667</b>	<b>77.777778</b>	<b>83.333333</b>	<b>91.666667</b>

**Table 7. Sequence of female right pattern presented in the table below.**

Female right pattern	Index	Middle	Ring	Little	Thumb
1	Whorl	Radial loop	Whorl	Ulnar loop	Radial loop
2	Whorl	Whorl	Whorl	Whorl	Whorl
3	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Twin loop
4	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Twin loop
5	Ulnar loop	Ulnar loop	Whorl	Whorl	Ulnar loop
6	Whorl	Radial loop	Whorl	Whorl	Twin loop
7	Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
8	Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Whorl
9	Ulnar loop	Ulnar loop	Central pocket loop	Ulnar loop	Ulnar loop
10	Whorl	Ulnar loop	Ulnar loop	Ulnar loop	Central pocket loop
11	Twin loop	Ulnar loop	Whorl	Ulnar loop	Twin loop
12	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop
13	Ulnar loop	Ulnar loop	Whorl	Whorl	Whorl
14	Radial loop	Radial loop	Radial loop	Radial loop	Radial loop
15	Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
16	Whorl	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
17	Twin loop	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
18	Whorl	Whorl	Ulnar loop	Ulnar loop	Whorl
19	Whorl	Ulnar loop	Whorl	Whorl	Whorl
20	Whorl	Whorl	Ulnar loop	Ulnar loop	Whorl
21	Ulnar loop	Whorl	Ulnar loop	Whorl	Ulnar loop
22	Radial loop	Radial loop	Whorl	Radial loop	Arch
23	Whorl	Whorl	Whorl	Whorl	Whorl
24	Radial loop	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
25	Whorl	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop
26	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop
27	Arch	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
28	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Whorl
29	Double loop	Whorl	Whorl	Ulnar loop	Twin loop
30	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
31	Radial loop	Whorl	Central pocket loop	Whorl	Whorl
32	Whorl	Whorl	Whorl	Whorl	Whorl
33	Ulnar loop	Arch	Ulnar loop	Ulnar loop	Ulnar loop
34	Radial loop	Radial loop	Whorl	Radial loop	Radial loop
35	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
36	Whorl	Ulnar loop	Whorl	Ulnar loop	Double loop

**Table 8. Percentage of female right pattern presented in the table below.**

Patterns	Right index	Right Middle	Right Ring	Right little	Right Thumb
Double loop	1	0	0	0	1
Radial loop	5	5	1	3	3
Ulnar loop	15	22	16	19	13
Whorl	12	8	16	13	12
Central pocket loop	0	0	2	0	1
Twin loop	2	0	0	0	5
Arch	1	1	0	0	1
<b>Percentage</b>	<b>100</b>	<b>100</b>	<b>97.222222</b>	<b>97.222222</b>	<b>100</b>

**Table 9. Sequence of Male left pattern presented in the table below.**

Male left pattern	Index	Middle	Ring	Little	Thumb
1	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
2	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Double whorl
3	Ulnar loop	Radial loop	Whorl	Radial loop	Twin loop
4	Twin loop	Central pocket loop	Radial loop	Central pocket loop	Radial loop
5	Plain whorl	Plain whorl	Whorl	Ulnar loop	Plain whorl
6	Whorl	Ulnar loop	Double whorl	Ulnar loop	Ulnar loop
7	Twin loop	Twin loop	Radial loop	Arch	Radial loop
8	Ulnar loop	Central pocket loop	Ulnar loop	Central pocket loop	Ulnar loop
9	Plain whorl	Plain whorl	Plain whorl	Radial loop	Plain whorl
10	Whorl	Radial loop	Whorl	Radial loop	Radial loop
11	Whorl	Double whorl	Radial loop	Whorl	Radial loop
12	Twin loop	Radial loop	Plain whorl	Radial loop	Twin loop
13	Ulnar loop	Radial loop	Central pocket loop	Radial loop	Radial loop
14	Plain whorl	Ulnar loop	Whorl	Whorl	Plain whorl
15	Whorl	Whorl	Whorl	Ulnar loop	Whorl
16	Double loop	Whorl	Whorl	Ulnar loop	Double loop
17	Whorl	Ulnar loop	Ulnar loop	Ulnar loop	Twin loop
18	Radial loop	Radial loop	Central pocket loop	Radial loop	Whorl
19	Whorl	Whorl	Whorl	Whorl	Ulnar loop
20	Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Whorl
21	Radial loop	Whorl	Radial loop	Whorl	Ulnar loop
22	Whorl	Radial loop	Radial loop	Radial loop	Radial loop
23	Whorl	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
24	Whorl	Whorl	Whorl	Radial loop	Whorl
25	Whorl	Radial loop	Whorl	Double loop	Ulnar loop
26	Radial loop	Whorl	Radial loop	Double loop	Radial loop
27	Whorl	Whorl	Whorl	Whorl	Whorl
28	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop
29	Whorl	Whorl	Whorl	Whorl	Whorl
30	Radial loop	Ulnar loop	Radial loop	Radial loop	Radial loop
31	Whorl	Ulnar loop	Central pocket loop	Ulnar loop	Whorl
32	Double loop	Double loop	Radial loop	Radial loop	Radial loop
33	Radial loop	Radial loop	Radial loop	Radial loop	Radial loop

**Table 10. Percentage of Male left pattern presented in the table below.**

Patterns	left index	left middle	left ring	left little	left thumb
Double loop	2	1	0	2	1
Radial loop	5	8	9	11	10
Ulnar loop	7	10	5	9	8
Whorl	13	8	13	8	7
Central pocket loop	0	2	3	2	0
Twin loop	3	1	0	0	3
Arch	0	0	0	1	0
<b>Percentage</b>	<b>90.909091</b>	<b>90.909091</b>	<b>90.909091</b>	<b>100</b>	<b>87.878788</b>

**Table 11. Sequence of Male Right pattern presented in the table below.**

Male pattern right	Index	Middle	Ring	Little	Thumb
1	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
2	Whorl	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
3	Whorl	Whorl	Whorl	Ulnar loop	Whorl
4	Whorl	Central pocket loop	Ulnar loop	Ulnar loop	Whorl
5	Whorl	Whorl	Whorl	Ulnar loop	Whorl
6	Ulnar loop	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
7	Twin loop	Whorl	Radial loop	Whorl	Whorl
8	Radial loop	Radial loop	Whorl	Radial loop	Radial loop
9	Radial loop	Radial loop	Radial loop	Radial loop	Central pocket loop
10	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop

11	Whorl	Ulnar loop	Whorl	Ulnar loop	Twin loop
12	Whorl	Ulnar loop	Ulnar loop	Ulnar loop	Twin loop
13	Arch	Ulnar loop	Radial loop	Ulnar loop	Ulnar loop
14	Whorl	Ulnar loop	Whorl	Whorl	Whorl
15	Whorl	Whorl	Whorl	Radial loop	Radial loop
16	Double loop	Whorl	Whorl	Ulnar loop	Double loop
17	Whorl	Whorl	Whorl	Ulnar loop	Twin loop
18	Whorl	Radial loop	Whorl	Radial loop	Whorl
19	Whorl	Whorl	Whorl	Whorl	Radial loop
20	Whorl	Ulnar loop	Ulnar loop	Whorl	Whorl
21	Ulnar loop	Ulnar loop	Ulnar loop	whorl	Radial loop
22	Central pocket loop	Whorl	Ulnar loop	Whorl	Whorl
23	Whorl	Radial loop	Radial loop	Radial loop	Radial loop
24	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Whorl
25	Whorl	Ulnar loop	Whorl	Ulnar loop	Whorl
26	Ulnar loop	Ulnar loop	Ulnar loop	Whorl	Ulnar loop
27	Whorl	Whorl	Whorl	Whorl	Whorl
28	Whorl	Ulnar loop	Whorl	Ulnar loop	Ulnar loop
29	Whorl	Whorl	Whorl	Whorl	Whorl
30	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Double loop
31	Ulnar loop	Whorl	Whorl	Whorl	Whorl
32	Double loop	Whorl	Ulnar loop	Ulnar loop	Ulnar loop
33	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop	Ulnar loop

**Table 12. Percentage of Male right pattern presented in the table below.**

Patterns	left index	left middle	left ring	left little	left thumb
Double loop	2	0	0	0	2
Radial loop	2	4	4	5	5
Ulnar loop	9	16	12	18	8
Whorl	17	12	17	10	14
Central pocket loop	1	1	0	0	1
Twin loop	1	0	0	0	3
Arch	1	0	0	0	0
<b>Percentage</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Table 13. Ridge density of females left pattern are presented in the table below.**

Female left pattern	Index	Middle	Ring	Little	Thumb
1	18	14	18	15	21
2	21	20	22	14	18
3	13	9	14	15	10
4	16	15	13	13	13
5	17	19	18	12	17
6	11	15	15	15	12
7	21	16	20	19	19
8	14	16	10	18	13
9	11	12	16	11	10
10	14	9	12	10	12
11	12	13	15	18	19
12	18	14	13	16	12
13	9	10	14	10	18
14	0	11	12	10	10
15	11	12	14	21	10
16	17	20	20	18	10
17	21	10	18	21	19
18	24	21	20	19	19
19	16	14	16	15	20
20	18	20	22	18	16
21	17	19	17	13	21
22	15	23	19	10	15
23	13	18	17	17	19
24	0	6	18	10	0
25	11	9	10	15	18

26	15	13	15	15	0
27	5	12	12	11	12
28	18	16	16	13	18
29	14	17	20	17	25
30	7	12	11	10	12
31	19	22	20	19	22
32	18	21	20	14	17
33	0	0	11	7	15
34	7	13	18	15	11
35	18	14	20	21	15
36	0	0	11	14	19

**Table 14. Mean, mode and median of female left pattern.**

Hand	Mean	Mode	Median
Index	13.31	18	14.5
Middle	14.03	14	14
Ring	16.03	20	16
Little	14.69	15	15
Thumb	14.92	19	15.5

**Table 15. Ridge density of female's right pattern are presented in the table below.**

Female right pattern	Index	Middle	Ring	Little	Thumb
1	21	21	22	24	16
2	17	17	24	17	28
3	13	14	17	13	16
4	11	12	6	14	10
5	15	14	19	15	20
6	11	11	14	17	12
7	21	15	17	21	19
8	13	11	12	12	26
9	13	10	14	13	11
10	15	19	6	12	14
11	17	18	19	12	12
12	21	15	12	22	12
13	14	11	20	12	16
14	12	15	16	0	10
15	16	14	18	20	9
16	20	14	16	23	18
17	21	18	15	24	20
18	24	28	21	28	24
19	16	14	13	15	20
20	22	19	19	23	22
21	18	24	15	20	17
22	15	24	25	20	24
23	18	22	19	14	16
24	11	8	14	7	7
25	12	16	15	14	21
26	10	14	14	16	15
27	0	13	17	13	8
28	12	13	19	17	19
29	14	18	19	16	15
30	11	17	14	14	11
31	20	20	16	19	30
32	21	16	21	21	21
33	5	0	14	7	18
34	14	13	20	15	18
35	13	13	19	17	18
36	15	12	13	11	24



**Table 16. Mean, mode and median of female right pattern.**

Hand	Mean	Mode	Median
Index	15.06	21	15
Middle	15.36	14	14.5
Ring	16.5	19	16.5
Little	16.06	17	15.5
Thumb	17.14	16	17.5

**Table 17. Ridge density of Male's left pattern are presented in the table below.**

Male left pattern	Index	Middle	Ring	Little	Thumb
1	13	9	10	9	18
2	0	15	10	9	15
3	22	20	21	18	21
4	15	14	13	16	12
5	18	17	18	19	8
6	14	17	11	17	18
7	17	8	21	0	26
8	19	27	15	17	17
9	9	12	10	11	16
10	13	13	6	9	17
11	14	15	19	15	14
12	15	3	0	19	18
13	9	12	10	20	16
14	16	10	15	12	11
15	17	14	18	27	16
16	15	19	13	19	23
17	16	14	18	20	11
18	10	10	14	14	13
19	18	18	15	14	15
20	15	17	19	19	16
21	17	14	22	24	19
22	10	13	12	7	16
23	12	14	12	16	14
24	11	11	10	2	18
25	12	11	15	11	17
26	23	19	17	8	19
27	19	16	17	7	24
28	15	11	19	14	16
29	17	11	16	18	21
30	6	11	15	7	7
31	12	16	15	10	18
32	18	19	15	16	16
33	9	9	14	12	15

**Table 18. Mean, mode and median of Male left pattern.**

Hand	Mean	Mode	Median
Index	14.12	15	15
Middle	13.91	14	14
Ring	14.39	15	15
Little	13.82	19	14
Thumb	16.39	16	16

**Table 19. Ridge density of Male's right pattern are presented in the table below.**

Male right pattern	Index	Middle	Ring	Little	Thumb
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1	16	13	15	10	24
2	9	15	16	14	19
3	19	22	19	18	24
4	14	16	17	25	22
5	19	17	22	17	22
6	18	18	23	18	21
7	14	13	24	12	18
8	13	13	23	33	19
9	8	12	10	11	16
10	14	6	11	4	17
11	17	11	15	12	21
12	17	12	12	14	23
13	0	14	16	12	17
14	17	11	14	12	20
15	13	14	21	20	16
16	21	22	19	10	26
17	12	11	19	16	19
18	9	13	12	11	20
19	13	15	13	18	12
20	22	19	18	20	13
21	22	14	20	15	21
22	18	11	10	13	11
23	12	10	14	14	15
24	7	14	14	10	16
25	12	11	15	19	15
26	22	15	20	6	15
27	22	16	13	11	27
28	13	12	13	17	18
29	13	15	18	28	22
30	10	12	17	4	13
31	15	15	17	15	20
32	12	7	3	3	19
33	11	11	11	11	18

**Table 20. Mean, mode and median of Male right pattern.**

Hand	Mean	Mode	Median
Index	14.36	13	14
Middle	13.64	11	13
Ring	15.88	15	16
Little	14.33	12	14
Thumb	18.76	19	19

**Table 21. The table which is presented below based on the bilateral differences of females and males.**

S.no	Positively/negatively in hand	Male	Female
1)	Left hand positive	66%	79%
2)	Right hand Negative	50%	73%
3)	Left hand positive	33%	20%
4)	Right hand Negative	50%	50%

According to the bilateral differences the positive of males represent 66% of the left hand and females 79% of the left hand positively, 50% of the negative right hand of males and 73% of the negative right hand of females, 33% of the positive left hand of males and 20% of the

positive left hand of females, 50% of the negative right hand of males and 50% of negative right hand of females.

**DISCUSSION**

One of the studies which is published in the forensic science journals in the year 2015 also explored the utilisation of the advance methods called the "imprint overlay techniques" for the identification and determination of the fingerprint's bilateral differences. This type of technique includes the creating of the mould of a finger while utilising the dental putty as well as overlaying a mould among the end fingerprints for determining any kind of differences. Researchers also explored that this type of method is the effective in the identification of the fingerprints of bilateral differences (Basman et. al., 2019). Moreover, in the cases where the traditional methods like the comparing of the Delta points or the minutiae points were also not so effective and other research also elaborated in the forensic science Journal in the year 2021, examined that the utilization of these statistical methods named as "binomial test" for the determination as well as identification of the fingerprint's bilateral differences. Such type of method also includes the analyzing the characteristics of the ridge numbers of every finger as well as comparing it with the Right and left hands. Researchers also explored that this type of method is the effective one in the identification of the fingerprints of bilateral differences. Moreover, in the cases where the traditional methods like the comparing of the Delta points or the minutiae points were also not so effective (De Mesa et. al., 2021). Although the studies which are conducted demonstrate that the various types of techniques and methods which can be utilized for determining the fingerprints bilateral differences and it can also be utilized for the determination of the fingerprint's bilateral differences, as well as the methods, can be useful in the identification of the differences among the right- and left-hand fingers. Moreover, further study is required for determining the best reliable and effective method for the analysis of the fingerprint's bilateral differences in various types of forensic terms (Chavan & Kumar, 2020).

## CONCLUSION

It is concluded that bilateral differences determination by the fingerprints are also the individual and it can be utilized for conducting an identification. The fingerprint bilateral differences also refer to as the variances among the fingerprints in the right hand and left hands of a person. Moreover, these fingerprints are also unique in its own way, it comprises of the differences among the minutiae, ridge patterns as well as among both the right- and left-hand fingerprints which are also not the same for one individual person. It also includes the

identification of unique features like characteristics as well as the type of patterns. Moreover, determining the fingerprint's bilateral differences, requires accurate analysis as well as the comparison of both hand fingerprints of a person. It can also be conducted by manual comparison or while utilising the system of automated identification of fingerprints. According to the bilateral differences the positive of male represent 66% of left hand and in females 79% of the left hand positively, 50% of negative right hand of males and 73% of the negative right hand of female, 33% of positive left hand of males and 20% of the positive left hand of females, 50% of negative right hand of males and 50% of negative right hand of females.

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