

Study of Elbow Prints and Its Correlation with Body Mass Index: A First-of-Its-Kind

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ABSTRACT

Background: This study aims to determine whether elbow prints can be useful in forensic analysis and whether they could potentially replace thumbprints in biometrics.

Objective: Our objective was to determine any similarities and differences between the elbow prints of different individuals and to correlate the elbow print with the individual's BMI (Body Mass Index).

Settings & Design: The study was cross-sectional, and the sample size was 100.

Material and Methods: Using an ink pad, the elbow region of the subject was smeared liberally with blue ink. The subject was told to flex the elbow completely and rest their elbow perpendicularly on the horizontally laid butter sheet paper. Additionally, height and weight of the subject were measured, and the BMI was calculated.

Results: In the study, no correlation was seen between the age, sex, or the BMI with the shape of the elbow prints.

Conclusion: Elbow prints could help in national registry maintenance and biometrics if future studies are done on the crease pattern. If different shapes of the elbow prints are available at a crime scene, then it might be decisive. However, in the presence of a single shape of elbow print, it might not be. Therefore, future studies on the elbow crease pattern need to be undertaken.

KEYWORDS: Elbow, Prints, Forensic, Classification, Legal.

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INTRODUCTION

Prints are the impressions left by the friction ridges on a surface. The study of fingerprints is called dermatoglyphics or dactylography, lip prints called cheiloscopy, prints of palatal rugae called palatal rugoscopy, etc.

These prints can be visible or patent three-

dimensional prints on soft surfaces like soap, wet paint, wax, oil, grease, blood, dirt, and ink. They could be latent or invisible prints on a wide variety of other surfaces [1].

Patent prints are easily seen, while latent prints need additional assessment methods. Some methods of viewing these latent prints

are using powders to see the print, alternate light sources, or chemical developers [2].

A lot of research has already been done on fingerprints, cheiloscopy, and palatal rugoscopy and these can be used to determine identity [3]. According to Oates, elbow prints with the friction ridges on the elbow skin, potentially have individual characteristics, making them a potential forensic identification tool [4].

In rare cases, suspects have left impressions of their elbows in the absence of fingerprints, just like in a case supervised by Kanable R. in the United States of America in 2000. The accused was arrested based on his elbow print left at the crime scene that resembled “a lizard’s mouth”[5].

In this study, we studied elbow prints, on which there is very little available data. The study concluded that latent elbow prints could help in biometrics and national registry maintenance, and could substitute for fingerprints in cases of thumb amputation, burns, etc. They can be used for law enforcement and forensic studies like in cases of a scuffle. Also, we tried to observe any relation between BMI (Body Mass Index) and the elbow prints.

Objective:

To determine any similarity and differences between the elbow prints of different individuals.

To correlate the elbow print with the BMI of the individual.

MATERIALS AND METHODS

Study Design: This cross-sectional study was done in Maharashtra, India. Before the study began, approval was obtained from the Institutional Ethics Committee. No. IESC/369/2025. Written informed consent was taken from all volunteers.

Selection Criteria:

Inclusion criteria: Males and females aged 17-20 years were included by random selection.

Exclusion criteria:

1. Fractures of the upper end of the radius and ulna and the lower end of the humerus.
2. Previous surgery in the lower end of the

humerus and the upper end of the radius and ulna.

3. Other illnesses that can disrupt the skin or bony structures of the elbow and could cause tenderness or injury to the elbow, e.g., olecranon bursitis, metastasis.

4. Deformity of the spine, e.g., kyphosis & scoliosis. Fractures of any other body part, such that can affect the height.

5. Transgender (self-declared)

Sample Size: Assuming that the elbow print of an obese individual will be bigger than a thin person’s and taking the proportion 50% at 95% Confidence Interval with the precision of 10%, the sample size calculated was 97. Further, we rounded up our sample size from 97 to 100. Sample size was calculated by Win Pepi version 11.6.5.

Materials required were an ink pad, butter-sheet paper, proforma and consent forms, ruler, weighing machine, measuring tape, and magnifying glass.

Methods:

Inclusion and exclusion criteria were checked first upon the recruitment of the volunteers. Consent was taken and confidentiality maintained. They were examined between 11:30 am to 1:00 pm to eliminate discrepancies due to diurnal variation.

Using an ink pad, the elbow region of the subject was smeared liberally with blue ink. The subject was told to flex the elbow completely and rest their elbow perpendicularly on the horizontally laid butter sheet



Fig. 1: Method used for obtaining elbow prints.

paper. It was then labelled with the name and the side of the upper limb, i.e., left or right. Additionally, subject height and weight were measured using a measuring tape and a weighing machine, respectively, and the BMI was calculated. (Figure 1)

To minimize methodological errors and inter-observer bias, a single observer conducted all measurements under consistent conditions in a well-lit room. The values were recorded in centimetres (cm) on the proforma sheet.

RESULTS

The results obtained are depicted in Table 1. On analysis of the various elbow prints received, the following categories of elbow print shapes were seen in approximate increasing order of area of print (Figure 2 and 3):

1. Small circular
2. Small oval
3. Large oval
4. Triangular
5. Quadrangular
6. Large circular

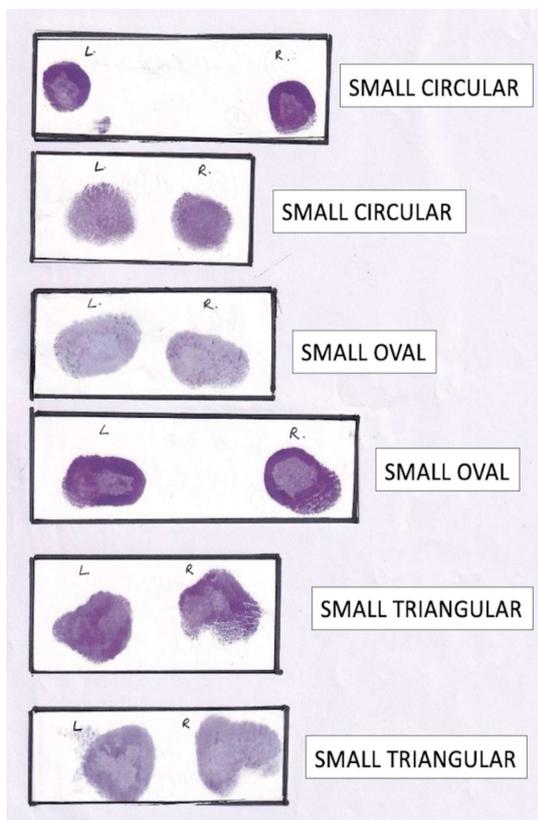


Fig. 2: Categories of elbow print shapes observed. (L-left elbow, R-right elbow)

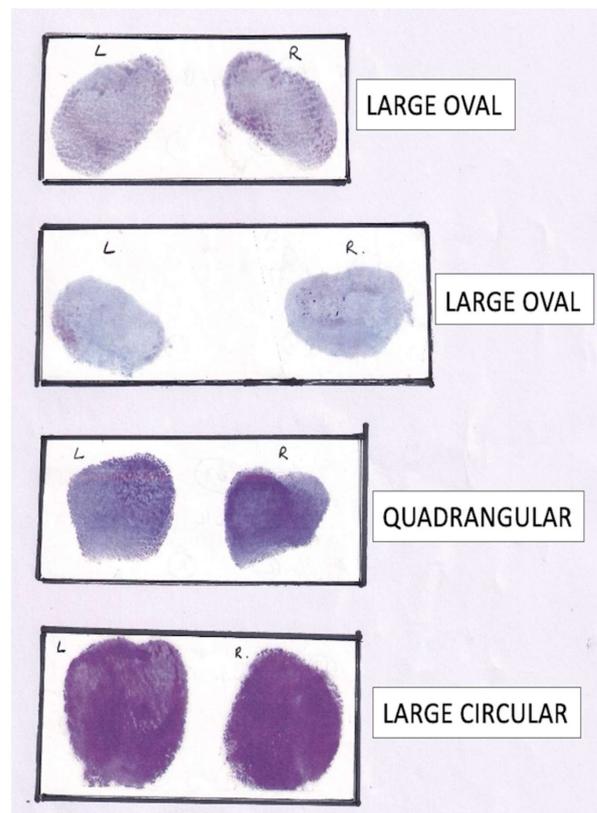


Fig. 3: Categories of elbow print shapes observed. (L-left elbow, R-right elbow)

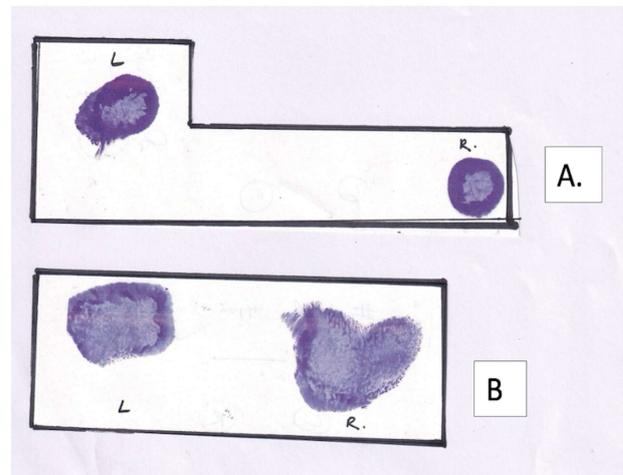


Fig. 4: Both different shapes of elbow prints. A) Left arm injury B) Fracture in the right upper limb.

Asian Body Mass Index categories have been chosen as follows: [6]

1. Underweight- <math><18.5 \text{ kg/ m}^2</math>
2. Normal weight- 18.5- 22.9 $\text{kg/ m}^2</math>$
3. Overweight- 23 – 24.9 $\text{kg/ m}^2</math>$
4. Obese - > 25 $\text{kg/ m}^2</math>$

In the study, no correlation was seen between the BMI or the gender of an individual with the shape of the elbow prints. The relationship between age and the size and shape of the elbow prints needs to be further studied,

Table 1: Results obtained.

Sex	BMI (kg/m ²)	Shapes of elbow prints					
		SMALL CIRCULAR	SMALL OVAL	LARGE OVAL	TRIANGULAR	QUADR-ANGULAR	LARGE CIRCULAR
Females	<18.5	5	2	0	0	0	0
	18.5- 22.9	20	3	0	1	0	0
	23– 24.9	3	2	0	0	1	1
	> 25	9	0	2	1	0	0
Total		37	7	2	2	1	1
Males	< 18.5	3	2	0	1	1	0
	18.5- 22.9	18	4	3	0	1	0
	23 – 24.9	2	2	2	0	0	1
	> 25	3	5	0	2	0	0
Total		26	13	5	3	2	1

as most volunteers in the above-mentioned age group showed a “small circular” pattern of elbow prints.

It was observed that the shapes of the elbow prints were bilaterally symmetrical and both the upper limbs usually left a similar shape. It was also noticed that if a patient had a previous fracture, injury or tenderness around the elbow, the left and right elbow prints of both sides differed. (Figure 4)

DISCUSSION

The first study to compare elbow prints was conducted by Oatess in 2000 [4]. In the same year, Kanable R. published an article on how a suspect was arrested based on his elbow print at the crime scene [5].

Oatess studied whether elbow prints could be used for the identification of an individual and concluded that they were a major potential criterion for forensic studies and individual characterisation [4].

In this study, there was considerable overlap in the different shapes of elbow print and the BMI categories. The elbow prints were not directly correlated with the BMI. Most elbow prints were “small-circular” in the age group that we studied and were thus, not unique based on their shape. Also, no relation was seen between the gender of the individual with the elbow print shape. More research is needed on the crease pattern of the elbow, as only shapes were compared in this study.

CONCLUSION

In this study, no correlation was seen between the age, sex or the BMI with the shape of the

elbow prints. Elbow prints of the upper limbs of an individual were bilaterally symmetrical, left the same shapes and were a more sanitary method for the study of individuals compared to fingerprints, which are more contaminating. In case of any injury to the elbow, the prints of both sides differed. These prints could help in national registry maintenance and biometrics if future studies are done on the crease pattern. The shape of the elbow print, together with the crease pattern, could replace fingerprints, but currently, it is still a dilemma. If different shapes of the elbow prints are available at a crime scene, then it might be conclusive and might help nab a criminal. However, in the presence of a single shape of elbow print, it might not be decisive.

The study was done with the hope that forensic medicine and biometrics would better from it. It is the harbinger of further studies on elbow prints

ABBREVIATIONS

BMI – Body Mass Index

L – Left elbow

R – Right elbow

Source of support: nil

Conflicts of Interests: None

Author Contributions

Data collection, Study concept and design: PS, KG, SG
 Definition of intellectual content & Drafting: PS, KG, SG

Literature search & data acquisition: SG, KG, PS

Manuscript preparation: PS, KG, SG

Approval of final version: PS, KG, SG

Agreement of accountability: KG, SG, PS

Endnotes:

Elbow prints show less uniqueness as derived by the shape. However, crease pattern could be studied in future. The skin creases are difficult to compare unlike fingerprints and would require specialized knowledge.

Ethical Policy and Institutional Review Board Statement: The study is conducted considering the ethical principles mentioned in the Declaration of Helsinki (2013) and has been approved by the Institutional Ethics Committee.

Data Availability Statement: The data set used in the current study is available on request to Dr Khushi Gupta.

REFERENCES

- [1]. Wikipedia Contributors. Fingerprint [Internet]. Wikipedia. Wikimedia Foundation; 2019 [cited 2025 Oct 30]. Available from: <https://en.wikipedia.org/wiki/Fingerprint>
- [2]. Global Forensic and Justice Center. Fingerprint Analysis: How It's Done [Internet]. www.forensicsciencesimplified.org. 2013 [cited 2025 Oct 30]. Available from: <https://www.forensicsciencesimplified.org/prints/how.html>
- [3]. Raj Y, Shylaja SS, Bhavani S. Role and Reliability of Cheiloscopy, Rugoscopy and Dactyloscopy in Gender Identification. *J Oral Maxillofac Pathol*. 2024;15:60-5.
- [4]. Oatess RT. Elbow Print Identification. *J Forensic Identif*. 2000;50:132-7.
- [5]. Kanable R. Smudge or elbow print. *Law Enforcement Technology*. 2000;27(5):94-8.
- [6]. https://iris.who.int/bitstream/handle/10665/206936/0957708211_eng.pdf [Internet]. iris.who.int. WHO; 2000 Feb [cited 2025 Oct 30]. Available from: https://iris.who.int/bitstream/handle/10665/206936/0957708211_eng.pdf

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