Study and Comparison of Lip Print for Sex Determination and Permanency over a time period employing Three Methods: Lipstick, Latent, and Digital Photography in North Bihar Population

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ABSTRACT

Background: This study was conducted for Comparison of Lip Print for Sex Determination and Permanency over a time period employing Three Methods: Lipstick, Latent, and Digital Photography in North Bihar Population.

Material and Methods: An observational cross-sectional study was designed to include 50 males and 50 females in the age group of 10 – 60 years with healthy labial mucosa. Lip prints were recorded using the lipstick method, the latent lip print method, and the digital method from every study participant thrice at intervals of 6 months. The data was computed and compared using appropriate statistical analysis.

Results: There was no significant difference in the lip print recordings by the lipstick method, latent lip print method, and digital method at any point of time. Further, there was no difference in the lip prints over a period of one year, recorded thrice at intervals of 6 months, using any of the three recording methods.

Conclusion: Lip prints are permanent and do not change over time. Moreover, the threr methods of recording lip prints namely the lipstick method, latent lip print method, and digital method are equally efficient at recording lip prints and may be thereby used for sex determination.

Key words: Lip prints, cheiloscopy, lipstick method, digital method, latent lip prints, uniqueness of lip prints, permanency of lip prints

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INTRODUCTION

Forensic science has proven to be an exceptional tool for delivering justice, upholding the law, and protecting human rights. Nevertheless, the field of forensics currently finds itself at a pivotal juncture with medicolegal practices. On one side, forensic science necessitates the validation and accuracy assessment of its methodologies; on the other, legal practices have occasionally accepted or dismissed these methods based solely on historical precedents, often lacking reasonable and experimental validation.[1]

Long before standards for the admissibility of forensic evidence were established, the pattern analysis of fingerprints, bite marks, and bloodstains had significantly evolved. This evolution resulted in the establishment of precedents in cases where these patterns were deemed admissible within the judicial system, despite a lack of sufficient scientific validity.[1] The evidentiary crisis associated with such pattern analysis further raises concerns regarding the reliability of these analyses. A persistent conflict has been observed regarding the admissibility and reliability of bite mark analysis in

legal proceedings.[2] Indeed, a summary report indicates that bite marks are among the types of forensic evidence frequently cited as contributing factors to wrongful convictions.[3]

For an extended period, fingerprint analysis has been a trusted method for identifying both suspects and victims, owing to the permanence and uniqueness of the patterns. However, criminals have become increasingly aware of advancements in fingerprint detection techniques, prompting them to adopt measures such as wearing gloves to evade identification. Additionally, certain dermatological conditions can hinder accurate fingerprint recognition, leading to potential failures and jeopardizing the admissibility of evidence in legal proceedings.[4,5]

Similarly, lip prints are distinctive to each individual and can be easily documented. Given that lip prints are permanent and immutable, their patterns have garnered significant interest from forensic scientists, who advocate for their reliability and admissibility as forensic evidence in the pursuit of justice and individual identification.[6]

Lip prints are distinctive patterns of wrinkles and grooves found on the labial mucosa, unique to each individual; even monozygotic twins exhibit variations in their lip prints. These patterns emerge during the sixth week of intrauterine development and are believed to remain constant throughout a person's life, regardless of conditions that may affect the lips, such as herpes.[7,8] The examination of lip print patterns has established a significant role in forensic science, referred to as Cheiloscopy, which focuses on identifying individuals through their lip print patterns. Advancements in scientific understanding regarding lip prints aim to enhance their admissibility and reliability as forensic evidence, leading to various classification and recording methods documented in the literature.[9,10]

This study was attempted to compare three renowned methods of recording lip prints namely the lipstick method, latent lip print, and the photographic method for their accuracy. Further, the recorded lip prints were used to determine sex and eventually to propose their reliability in sex determination of individuals. Lastly, the study aimed to deduce the permanence of lip prints to further strengthen the scientific grounds of the concern of their admissibility or reliability as forensic evidence in the court of law.

This research aimed to compare three well-known techniques for recording lip prints: the lipstick method, latent lip print analysis, and the photographic method, focusing on their accuracy. Additionally, the recorded lip prints were utilized to ascertain sex and ultimately to evaluate their reliability in determining the sex of individuals. Finally, the study sought to analyze the permanence of lip prints to reinforce the scientific basis regarding their admissibility and reliability as forensic evidence in a court of law.

MATERIAL AND METHODS

RESULTS

The study comprised of 100 individuals, of which 50 individuals were males and 50 females, fulfilling the inclusion criteria for the study from the population of North Bihar.

Table 1: Lip print recordings by all the three methods in males and females at three different time intervals

			Time Interval		
			0 months (T1)	**6 months (T2)**	**12 months (T3)**
Latent Lip Print Method	**Males**	N	50	50	50
		∑X	101	108	106
		Mean	1.7281	1.9733	1.8544
		$\sum X^2$	324	355	334
		Std.Dev.	1.5410	1.5751	1.6813
		P value	**0.9021**		
	Females	N	50	50	50
		∑X	97	126	119
		Mean	1.6412	2.0567	1.7884
		$\sum X^2$	258	383	319
		Std.Dev.	1.5412	1.5907	1.5718
		P value	**0.4146**		
Lipstick Method	**Males**	N	50	50	50
		∑X	124	143	139
		Mean	2.4103	1.8483	2.0417
		$\sum X^2$	412	305	381
		Std.Dev.	1.2533	1.2799	1.6318
		P value	**0.7675**		
	Females	N	50	50	50
		∑X	119	107	97
		Mean	2.079	1.8123	1.6777
		$\sum X^2$	399	310	268
		Std.Dev.	1.6522	1.4744	1.3173
		P value	**0.5474**		
Digital Method	**Males**	N	50	50	50
		∑X	135	55	59
		Mean	2.2186	2.2656	2.2869
		$\sum X^2$	407	423	405

		Std.Dev.	1.4057	1.5035	1.4609
		P value	**0.6573**		
	Females	N	50	50	50
		∑X	120	118	114
		Mean	2.0519	2.0178	2
		$\sum X^2$	388	375	379
		Std.Dev.	1.5819	1.5827	1.5898
		P value	**0.4547**		

Table 2: Pairwise comparisons of the recordings produced by all the three methods among T1, T2, and T3 in both males and females

Latent Lip Print method	**Males**	**Pairwise comparisons**		**$HSD_{.05}$ = 0.7024 $HSD_{.01}$ = 0.8772**	**$Q_{.05}$ =3.3436 $Q_{.01}$ = 4.1759**
		T1:T2	M_1 = 1.77 M_2 = 1.89	0.11	Q = 0.58 (*p* = .91309)
		T1:T3	M_1 = 1.77 M_3 = 1.85	0.10	Q = 0.47 (*p* = .93531)
		T2:T3	M_2 = 1.89 M_3 = 1.87	0.03	Q = 0.07 (*p* = .99815)
	Females	Pairwise comparisons		$HSD_{.05}$ = 0.6945 $HSD_{.01}$ = 0.8762	$Q_{.05}$ =3.3238 $Q_{.01}$ = 4.1863
		T1:T2	M_1 = 1.66 M_2 = 2.04	0.39	Q = 1.83 (*p* = .39981)
		T1:T3	M_1 = 1.66 M_3 = 1.76	0.11	Q = 0.50 (*p* = .93382)
		T2:T3	M_2 = 2.04 M_3 = 1.76	0.27	Q = 1.32 (*p* = .61407)
Lipstick method	**Males**	Pairwise comparisons		$HSD_{.05}$ = 0.4865 $HSD_{.01}$ = 0.8352	$Q_{.05}$ =3.7436 $Q_{.01}$ = 4.2759
		T1:T2	M_1 = 2.31 M_2 = 1.95	0.37	Q = 2.08 (*p* = .31192)
		T1:T3	M_1 = 2	0.28	Q = 1.49 (*p* = .55004)

			$M_3 = 2.05$		
		T2:T3	$M_2 = 1.95$ $M_3 = 2.05$	0.10	Q = 0.61 (p = .90843)
	Females	Pairwise comparisons		$HSD_{.05}$ = 0.6385 $HSD_{.01}$ = 0.8791	$Q_{.05}$ =3.3416 $Q_{.01}$ = 4.1749
		T1:T2	$M_1 = 2.07$ $M_2 = 1.81$	0.27	Q = 1.31 (p = .61375)
		T1:T3	$M_1 = 2.07$ $M_3 = 1.69$	0.39	Q = 1.98 (p = .35210)
		T2:T3	$M_2 = 1.81$ $M_3 = 1.69$	0.11	Q = 0.63 (p = .89899)
Digital method	**Males**	Pairwise comparisons		$HSD_{.05}$ = 0.6415 $HSD_{.01}$ = 0.8019	$Q_{.05}$ =3.3418 $Q_{.01}$ = 4.1733
		T1:T2	$M_1 = 2.36$ $M_2 = 2.25$	0.01	Q = 0.07 (p = .99874)
		T1:T3	$M_1 = 2.36$ $M_3 = 2.20$	0.06	Q = 0.27 (p = .98021)
		T2:T3	$M_2 = 2.36$ $M_3 =$	0.04	Q = 0.19 (p = .98886)

			2.20		
	Females	Pairwise comparisons		$HSD_{.05}$ = 0.6978 $HSD_{.01}$ = 0.8653	$Q_{.05}$ =3.3136 $Q_{.01}$ = 4.1059
		T1:T2	$M_1 = 2.05$ $M_2 = 2.02$	0.04	Q = 0.17 (*p* = .99039)
		T1:T3	$M_1 = 2.05$ $M_3 = 2.00$	0.07	Q = 0.25 (*p* = .98899)
		T2:T3	$M_2 = 2.02$ $M_3 = 2.00$	0.03	Q = 0.08 (*p* = .91210)

On comparison of the efficacy of the three methods of recording lip prints in males and females, it was found that there was no significant difference in the recordings produced by the latent lip print method, lipstick method, and digital method, at T1, T2, and T3 in both males and females. However, in males, at T1, there was a significant difference in the readings produced by the latent lip print method and the lipstick method, and the latent lip print method and digital method, while the lipstick method and digital method yielded similar readings with no statistically significant difference (Table 3) .This indicated that all the three methods of recording lip prints employed in our study have similar efficacies.

Table 3: Comparison of the lip prints recorded by the three different methods: the latent lip print method, lipstick method, and digital method

MALES									
Method	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**
	T1			**T2**			**T3**		
Mean	2.32	1.67	2.36	2.06	1.85	2.26	1.96	2.06	2.23
SD	1.26	1.55	1.46	1.59	1.19	1.40	1.48	1.53	1.44
SEM	0.15	0.20	0.17	0.20	0.14	0.10	0.11	0.15	0.18
N	50	50	50	50	50	50	50	50	50
P value	**0.0158**			0.7569			0.5001		
		0.8260			0.2471			0.5745	
	0.0320			0.4579			0.2262		
FEMALES									
Method	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**	**Latent Lip Print Method**	**Lipstick Method**	**Digital Method**

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	T1			**T2**			**T3**		
Mean	1.78	2.08	2.06	1.89	1.87	2.05	1.71	1.68	2.04
SD	1.63	1.63	1.58	1.55	1.46	1.53	1.51	1.35	1.54
SEM	0.21	0.25	0.20	0.20	0.19	0.21	0.21	0.17	0.25
N	50	50	50	50	50	50	50	50	50
P value	0.3117			0.8058			0.7997		
		0.9540			0.4621			0.2561	
	0.3289			0.6371			0.4141		

DISCUSSION

Identity determination, or the process of individual identification, constitutes a crucial element in the investigation of crimes and disasters; the identification of victims, suspects, and offenders is fundamental to the administration of justice. Since the 19th century, fingerprints have been extensively utilized as a means of establishing identity within legal proceedings. The two primary justifications for the effectiveness of fingerprints as evidence are their uniqueness and permanence. Nevertheless, the presence of fingerprints at crime scenes or disaster sites can sometimes be uncertain. The rapid advancement of criminal investigation techniques has prompted criminals to adopt measures to avoid leaving fingerprints as identifying evidence.

Additionally, there are instances where fingerprints may be absent due to factors such as injuries, illnesses, or random occurrences. In such cases, investigators may need to explore alternative patterns that possess the qualities of being both unique and permanent, skin to fingerprints. Lip prints have been proposed as such patterns, characterized by their uniqueness and permanence, and are currently the subject of extensive research in the context of individual and sex determination. Various techniques have been developed, examined, and compared for the purpose of recording lip prints for individual and sex identification. We conducted a comparison of the effectiveness of three emerging methods for recording lip prints: the lipstick method, the latent lip print method, and the digital method. Each of these techniques offers comparable ease of application, thus allowing for a comparative analysis of their effectiveness in determining sex.[11]

We carried out a research study involving 50 males and 50 females from the North Bihar population. In their comparative analysis of the latent lip print method versus the lipstick method for recording lip prints, Dwivedi N et al (2013) included 50 males and 50 females from Lucknow (Uttar Pradesh).[12] Similarly, Ranjan V et al (2014) attempted to utilize lip prints for sex determination, conducting their study in Modinagar (Uttar Pradesh) with 54 participants.[13] Furthermore, Sangam M et al (2024)[14] assessed gender differences and the uniqueness of lip prints, focusing on the population of Guwahati. Although there have been studies with comparable objectives conducted worldwide, the majority of research in India has centered on populations from the northern regions of the country.

We employed black fingerprint powder to gather the latent lip prints. Various studies have utilized alternative materials such as indigo dyes, Sudan III dyes, aluminum, and magnetic powders, each demonstrating varying levels of effectiveness. Additionally, the diverse surfaces on which latent lip prints are discovered and require collection influence the quality of the recorded lip prints.

In our study involving the population of Bihar, sex determination with the help of any of the three methods of recording lip prints was not possible due to statistically insignificant differences in the patterns in males and females. This was although supported by a systematic review and meta-analysis performed by Franco A et al (2021)[15], who commented that sexual dimorphism reflected through the study of lip print patterns showed very high uncertainty. 65 However, on the other hand, Mishra P et al (2022)[16] concluded in their study that lip prints are significantly different in males and females in the population of Bihar as well and thus be used for sex determination.

CONCLUSION

Lip prints are permanent and do not change over time. Moreover, the threr methods of recording lip prints namely the lipstick method, latent lip print method, and digital method are equally efficient at recording lip prints and may be thereby used for sex determination.

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