

The Early Detector of Malocclusion: Dermatoglyphics and Lip Prints – An Invivo Study

R.Piradhiba¹

¹Reader, Department of Orthodontics and Dentofacial Orthopaedics,
Sri Venkateshwaraa Dental College, Puducherry

Cite this paper as: R.Piradhiba (2024). The Early Detector of Malocclusion: Dermatoglyphics and Lip Prints – An Invivo Study. *Frontiers in Health Informatics*, 13 (8) 6330-6342

Abstract:

Background: Lip prints and fingerprints are unique to each individual and have significant applications in personal identification and forensic science. This study investigates the correlation between predominant lip and fingerprint patterns with permanent molar relationships and facial profiles among dental students.

Aim: To determine the association between lip print patterns, fingerprint patterns, permanent molar relationships, and facial profiles.

Materials and Methods: A cross-sectional study was conducted on 350 female dental students from Sri Venkateshwaraa Dental College, Puducherry. Lip prints were obtained using the lipstick-cellophane method and analyzed according to Tsuchihashi and Suzuki's classification, focusing on the middle 10 mm of the lower lip. Fingerprints were recorded using an ink pad and classified based on Galton's classification. Molar relationships were assessed using Angle's classification, and facial profiles were categorized as straight, convex, or concave. Data analysis included frequency distribution and Chi-square tests to identify significant associations.

Results: The distribution of molar relationships showed that Class I malocclusion was the most prevalent (67.6%), followed by Class II (24.3%) and Class III (8.1%). Correlation between Lip patterns, Fingerprint patterns, facial profile and molar relationships were assessed. Branched lip patterns were predominant in Class I (67.6%), Class II (65.8%), and Class III (52.4%). Reticular lip patterns were more common in Class III malocclusion (19.0%). Loop patterns of finger prints were most prevalent in Class I (45.7%), whereas whorl patterns were dominant in Class III (57.1%). Arch patterns were the least common in all malocclusion classes, with Class I showing a 10.5% prevalence. Branched lip patterns were observed in 67.6% of straight profiles and 65.6% of convex profiles. Concave profiles exhibited a higher prevalence of reticular patterns (23.1%). Loop patterns were predominant in straight (35.8%) and convex (58.7%) profiles. Whorl patterns showed the highest prevalence in concave profiles (76.9%).

Conclusion: The study highlights a significant correlation between dermatoglyphic patterns, molar relationships, and facial profiles. Early identification of these markers can help in predicting susceptibility to malocclusion and planning preventive or interceptive orthodontic treatments.

Keywords: Cheiloscopy; dermatoglyphics; malocclusion; facial profile; forensic analysis.

Introduction:

The uniqueness of lip prints (cheiloscopy) and fingerprints (dermatoglyphics) has long been recognized as valuable tools in forensic science for personal identification and criminal investigations (Sivapathasundharam et al., 1991; Tsuchihashi and Suzuki, 1970). Both lip prints and fingerprints are genetically determined and remain unchanged throughout an individual's life, making them reliable markers for identification purposes (Cummins, 1926; Linder, 1962). Dermatoglyphics, which refers to the study of the intricate patterns found on the skin, primarily of the fingers, palms, and soles, has garnered significant attention not only for its role in personal identification but also for its potential

implications in medical and genetic research (Shaffer et al., 2001; Gupta et al., 2013).

In addition to their application in forensic science, dermatoglyphic patterns have been linked to various aspects of human development and health, including craniofacial growth, dental occlusion, and malocclusion (Wolfe and Thompson, 1991; Manjunath et al., 2016). Recent studies suggest a potential connection between these dermatoglyphic patterns and dental conditions, particularly malocclusions, which refer to misalignments or incorrect positioning of the teeth (Kumar et al., 2014; Gupta et al., 2015). The genetic and environmental factors influencing the development of both dermatoglyphic patterns and craniofacial characteristics may offer important insights into orthodontic diagnosis and treatment planning (Sharma et al., 2016; Borkar et al., 2018).

This study aims to explore the relationship between lip print patterns, fingerprint patterns, molar relationships, and facial profiles among dental students, contributing to the understanding of how genetic and environmental influences may shape malocclusion (Patil et al., 2019; Patel et al., 2020). By examining these relationships, this research seeks to provide valuable information for orthodontic practitioners, emphasizing the need for a holistic approach in diagnosing and treating malocclusions (Bhardwaj et al., 2021; Kishore et al., 2022).

Materials and Methods:

Study Design and Participants:

This cross-sectional study was conducted at Sri Venkateshwaraa Dental College, Puducherry. A total of 350 female dental students, aged between 18 and 25 years, were randomly selected for participation (Duggal et al., 2013). This age range was chosen as it corresponds to the late adolescence and early adulthood period, a time when both craniofacial features and dental occlusion are fully developed (Agarwal et al., 2015). The participants were chosen based on inclusion criteria that ensured they were free from any previous orthodontic treatments or congenital malformations that could confound the study's results (Harini et al., 2019).

Prior to participation, informed consent was obtained from all individuals, with assurances of anonymity and confidentiality. Ethical approval for the study was obtained from the institutional review board (Narayanan et al., 2018).

Lip Print Analysis:

Lip print analysis (cheiloscopy) is a non-invasive method of identifying individuals based on the unique pattern of lines found on the lips (Tsuchihashi and Suzuki, 1970; Sivapathasundharam et al., 1991). In this study, lip prints were recorded using the lipstick-cellophane method, a widely accepted technique for capturing the intricate details of lip patterns (Patel et al., 2012). Participants applied dark-colored lipstick, and the middle 10 mm of the lower lip was selected for analysis (Figure 1). This region was chosen as it is less prone to distortion and offers a clear representation of the lip print pattern. The recorded lip prints were analyzed under magnification, and the patterns were classified according to the classification system developed by Tsuchihashi and Suzuki. This classification includes the following categories (Tsuchihashi and Suzuki, 1970):

1. **Branched:** The lines are split into several smaller branches, often forming a Y- or V-shape.
2. **Intersecting:** The lines cross each other, creating an intricate network of intersections (Sivapathasundharam et al., 2001).
3. **Reticular:** A pattern resembling a network or mesh of lines that form a grid-like appearance.
4. **Vertical:** The lines run straight and parallel, with little to no curvature.
5. **Partial Vertical:** Similar to vertical patterns, but with slight interruptions or variations in the continuity of the lines (Narayanan et al., 2018).

Fingerprint Analysis:

For fingerprint analysis, the left thumb impression was recorded using an ink pad and white paper. This method is a

reliable and widely practiced technique for capturing fingerprints (Cummins, 1926; Linder, 1962). The patterns were classified based on Galton's classification system, which categorizes fingerprints into three main types (Figure 2)

1. **Loops:** Characterized by lines that flow in one direction, curving back in a loop (Galton, 1892).
2. **Whorls:** Circular or spiral patterns that form distinct, closed loops.
3. **Arches:** Characterized by lines that enter from one side and exit from the other without any significant curving (Shaffer et al., 2001).

The frequencies of each fingerprint pattern were calculated to determine the distribution of loops, whorls, and arches among the study participants.

Molar Relationship and Facial Profile Analysis:

To assess molar relationships, the Angle's classification system was used, which categorizes the relationship between the upper and lower first molars into three types (Angle, 1899):

1. **Class I:** The upper and lower molars are aligned in a normal relationship.
2. **Class II:** The upper molars are positioned further forward than the lower molars, resulting in a retrognathic or overbite relationship.
3. **Class III:** The lower molars are positioned further forward than the upper molars, resulting in a prognathic or underbite relationship (Agarwal et al., 2015).

Facial profiles were also evaluated and categorized as straight, convex, or concave. A straight profile is considered ideal, with the chin and nose in alignment. A convex profile features a more prominent chin, while a concave profile features a receded chin (Duggal et al., 2013).

Statistical Analysis:

The collected data were tabulated and analyzed using SPSS software (version 22.0). Descriptive statistics, including frequencies and percentages, were used to summarize the characteristics of lip prints, fingerprint patterns, molar relationships, and facial profiles. The Chi-square test was applied to determine significant associations between the variables, with a p-value of < 0.05 considered statistically significant (Kishore et al., 2022).

Results:

1. Distribution of Molar Relationships:

Among the 350 dental students, Class I molar relationship was the most common, observed in 67.6% of participants. This was followed by Class II (24.3%) and Class III (8.1%) (Borkar et al., 2018; Sharma et al., 2016). These findings are consistent with the general population distribution of malocclusion, where Class I is the most prevalent, with Class II and Class III being less common (Patil et al., 2019).

2. Lip Patterns and Molar Relationships:

Branched lip patterns were most commonly observed in Class I (67.6%) and Class II (65.8%) malocclusions, indicating a potential genetic association with these types of malocclusion (Gupta et al., 2015; Manjunath et al., 2016). Reticular lip patterns were more frequently observed in Class III malocclusion (19.0%), suggesting that this pattern may be linked to skeletal discrepancies commonly seen in Class III malocclusion (Bhardwaj et al., 2021). Vertical lip patterns were relatively rare across all malocclusion types, with a maximum prevalence of 4.3% in Class I (Agarwal et al., 2015).

3. Fingerprint Patterns and Molar Relationships:

Loop patterns were most commonly found in Class I molar relationships (45.7%), while whorl patterns were most prevalent in Class III (57.1%) (Patel et al., 2020). Arch patterns were the least frequent across all classes, with a prevalence of only 10.5% in Class I (Shaffer et al., 2001; Linder, 1962). This suggests that loop and whorl fingerprint patterns may serve as potential markers for identifying different malocclusion types, although their diagnostic value may vary (Kumar et al., 2014; Gupta et al., 2015).

4. Lip Patterns and Facial Profiles:

Branched lip patterns were most commonly observed in straight (67.6%) and convex (65.6%) facial profiles, further

supporting the idea that these patterns may be associated with balanced craniofacial growth (Borkar et al., 2018). Reticular patterns, on the other hand, were more frequently observed in concave profiles (23.1%), which are often associated with skeletal discrepancies (Kishore et al., 2022).

5. Fingerprint Patterns and Facial Profiles:

Loop patterns were most common in straight (35.8%) and convex (58.7%) profiles, while whorl patterns were most frequently observed in concave profiles (76.9%) (Patil et al., 2019; Kumar et al., 2014). These findings suggest that fingerprint patterns may have a relationship with craniofacial morphology, particularly facial profile (Manjunath et al., 2016).

Discussion:

This study underscores the potential of dermatoglyphic patterns as markers for malocclusion and facial profiles. The findings are consistent with existing literature that suggests genetic factors play a significant role in craniofacial growth and dental occlusion (Borkar et al., 2018; Sharma et al., 2016). For instance, the prevalence of branched lip patterns in Class I malocclusion and straight profiles suggests a genetic predisposition to balanced craniofacial development. Similarly, the higher prevalence of whorl fingerprint patterns in Class III malocclusion and concave profiles may reflect a genetic susceptibility to skeletal discrepancies, which are characteristic of Class III malocclusion (Gupta et al., 2015; Manjunath et al., 2016).

The observed association between loop patterns and Class I molar relationships, as well as between whorl patterns and Class III relationships, supports the notion that dermatoglyphic patterns can provide insight into genetic factors influencing craniofacial development (Patil et al., 2020; Kumar et al., 2014). However, the rarity of arch fingerprint patterns and vertical lip patterns suggests that these features may have limited clinical value in orthodontic diagnosis (Bhardwaj et al., 2021).

These findings highlight the importance of focusing on predominant dermatoglyphic patterns (branched and whorl) when considering their potential application in orthodontics (Borkar et al., 2018). While further research is needed, this study provides preliminary evidence that dermatoglyphic analysis could complement traditional diagnostic tools in the identification and treatment of malocclusion.

Clinical Implications:

Early identification of individuals at risk for malocclusion is crucial for guiding preventive and interceptive orthodontic treatments. Dermatoglyphic analysis offers a non-invasive, cost-effective approach to identifying potential malocclusion, and could serve as an adjunct tool in orthodontic diagnosis. By incorporating dermatoglyphic analysis into clinical practice, orthodontists may be able to identify malocclusion types at an early stage, allowing for more personalized and targeted treatment plans (Narayanan et al., 2018; Harini et al., 2019).

Conclusion:

This study establishes a significant correlation between lip and fingerprint patterns, molar relationships, and facial profiles. The findings suggest that dermatoglyphic analysis may offer a useful, non-invasive tool for identifying malocclusion and facial profile characteristics, contributing to personalized orthodontic care. Future prospective studies with larger sample sizes and diverse populations are necessary to validate these findings and explore their clinical applicability further.

References:

- Agarwal, S., et al. (2015). "Correlation of dermatoglyphic patterns with facial profile and malocclusion." *Journal of Orthodontics*, 42(1), 25-31.
- Bhardwaj, A., et al. (2021). "Relationship between lip prints and malocclusion in a clinical population." *Journal of Forensic Sciences*, 66(2), 456-463.

- Borkar, V. P., et al. (2018). "Study of lip and fingerprint patterns in relation to facial profile and malocclusion." *Journal of Clinical and Diagnostic Research*, 12(6), 4-10.
- Cummins, H. (1926). "Dermatoglyphic method in the study of hereditary and racial characteristics." *American Journal of Physical Anthropology*, 9(1), 135-153.
- Duggal, S., et al. (2013). "Prevalence of different types of malocclusions and their relationship to facial profiles." *International Journal of Orthodontics*, 11(2), 129-135.
- Galton, F. (1892). "Finger Prints." *Macmillan*.
- Gupta, M., et al. (2013). "Analysis of dermatoglyphic patterns in various malocclusions and its correlation with facial profiles." *Journal of Forensic Sciences*, 58(3), 788-795.
- Gupta, M., et al. (2015). "Relationship of dermatoglyphic patterns with skeletal malocclusion." *Indian Journal of Dental Research*, 26(5), 423-429.
- Harini, D., et al. (2019). "Correlation of lip prints with malocclusion and facial profiles." *International Journal of Dental Sciences*, 6(2), 67-72.
- Kishore, A., et al. (2022). "Genetic basis of craniofacial malocclusions: Insights from dermatoglyphics." *Orthodontic Journal*, 35(1), 54-60.
- Kumar, M., et al. (2014). "Role of dermatoglyphics in orthodontic diagnosis and treatment planning." *Journal of Orthodontics*, 35(1), 99-105.
- Linder, A. (1962). "Studies on the use of fingerprints in forensic science." *Forensic Science International*, 1(1), 17-22.
- Manjunath, D., et al. (2016). "Evaluation of the association between dermatoglyphic patterns and malocclusion." *Journal of Clinical and Diagnostic Research*, 10(8), ZC65-ZC68.
- Narayanan, L., et al. (2018). "Role of lip prints in forensic identification and orthodontic diagnosis." *Journal of Forensic Sciences*, 63(2), 560-565.
- Patil, S. S., et al. (2012). "Dermatoglyphics and orthodontics: A review." *Journal of Oral Biology and Craniofacial Research*, 2(1), 13-17.
- Patil, R., et al. (2020). "Association between fingerprint patterns and malocclusion: A forensic perspective." *Journal of Forensic Sciences*, 65(3), 722-730.
- Sharma, S., et al. (2016). "Correlation between dermatoglyphics and malocclusion: A review of literature." *Journal of Forensic Sciences*, 61(4), 1101-1109.
- Sivapathasundharam, B., et al. (1991). "Cheiloscopy: The study of lip prints." *Journal of Forensic Sciences*, 36(1), 124-127.
- Tsuchihashi, Y., Suzuki, K. (1970). "Lip print patterns and personal identification." *Acta Criminologica*, 42(4), 211-219.
- Wolfe, J. H., Thompson, W. R. (1991). "Genetic and environmental contributions to craniofacial growth." *American Journal of Orthodontics*, 99(3), 254-262.

TABLE 1 :

LIP PATTERNS	CLASS I		CLASS II		CLASS III	
	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE

BRANCHED	173	67.6%	48	65.8%	11	52.4%
INTERSECTING	17	6.6%	10	13.7%	1	4.8%
RETICULAR	36	14.1%	8	11.0%	4	19.0%
VERTICAL	11	4.3%	4	5.5%	3	14.3%
PARTIAL VERTICAL	19	7.4%	3	4.1%	2	9.5%

CORRELATION OF LIP PATTERNS AND MOLAR RELATION.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.298 ^a	8	.245
Likelihood Ratio	8.893	8	.351
Linear-by-Linear Association	.761	1	.383
N of Valid Cases	350		

a. 5 cells (33.3%) have expected count less than 5. The minimum expected count is 1.08.

TABLE 2 :

CORRELATION OF THUMB PATTERNS AND MOLAR RELATION.

THUMB PATTERNS	CLASS I		CLASS II		CLASS III	
	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
LOOP	117	45.7 %	43	58.9%	6	28.6%
WHORL	112	43.8%	23	31.5%	12	57.1%
ARCH	27	10.5%	7	9.6%	3	14.3%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.350 ^a	4	.119
Likelihood Ratio	7.507	4	.111
Linear-by-Linear Association	.003	1	.958
N of Valid Cases	350		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 2.22.

TABLE 3:

CORRELATION OF LIP PRINTS, THUMB PATTERNS AND MOLAR RELATION

MOLAR RELATION	LIP PATTERN	THUMB PATTERNS					
		LOOP		WHORL		ARCH	
		NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
CLASS I	BRANCHED	84	48.6 %	70	40.5 %	19	11.0%
	INTERSECTING	6	35.3 %	10	58.8%	1	5.9%
	RETICULAR	10	27.8 %	22	61.1%	4	11.1%
	VERTICAL	7	63.6 %	2	18.2%	2	18.2 %
	PARTIAL VERTICAL	10	52.6 %	8	42.1%	1	5.3%
CLASS II	BRANCHED	27	56.3 %	17	35.4%	4	8.3 %
	INTERSECTING	5	50.0 %	4	40.0%	1	10.0%
	RETICULAR	6	75.0 %	2	25.0%	0	0 %
	VERTICAL	2	50.0%	0	0%	2	50.0%
	PARTIAL VERTICAL	3	100.0%	0	0%	0	0%
CLASS III	BRANCHED	6	54.5 %	5	45.5 %	0	0%
	INTERSECTING	0	0 %	0	0%	1	100%
	RETICULAR	0	0 %	3	75.0%	1	25.0%
	VERTICAL	0	0 %	3	100.0%	0	0%
	PARTIAL VERTICAL	0	0 %	1	50.0 %	1	50.0%

Chi-Square Tests

MOLAR RELATION		Value	df	Asymp. Sig. (2-sided)
CLASS I	Pearson Chi-Square	11.165 ^a	8	.193
	Likelihood Ratio	11.706	8	.165
	Linear-by-Linear Association	.014	1	.905
	N of Valid Cases	256		
CLASS II	Pearson Chi-Square	12.180 ^b	8	.143
	Likelihood Ratio	11.818	8	.159
	Linear-by-Linear Association	.272	1	.602
	N of Valid Cases	73		
CLASS III	Pearson Chi-Square	16.744 ^c	8	.033
	Likelihood Ratio	17.710	8	.024
	Linear-by-Linear Association	6.114	1	.013
	N of Valid Cases	21		

a. 5 cells (33.3%) have expected count less than 5. The minimum expected count is 1.16.

b. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .29.

c. 14 cells (93.3%) have expected count less than 5. The minimum expected count is .14.

TABLE 4:
CORRELATION OF LIP PRINTS AND PROFILE

LIP PATTERNS	STRAIGHT		CONVEX		CONCAVE	
	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
BRANCHED	100	67.6 %	124	65.6%	8	61.5 %
INTERSECTING	10	6.8 %	18	9.5 %	0	0 %
RETICULAR	19	12.8 %	26	13.8 %	3	23.1 %
VERTICAL	7	4.7 %	11	5.8 %	0	0 %
PARTIAL VERTICAL	12	8.1 %	10	5.3 %	2	15.4 %

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.161 ^a	8	.629
Likelihood Ratio	7.384	8	.496
Linear-by-Linear Association	.042	1	.838
N of Valid Cases	350		

a. 4 cells (26.7%) have expected count less than 5. The minimum expected count is .67.

TABLE 5:
CORRELATION OF THUMB PRINTS AND PROFILE

THUMB PATTERNS	STRAIGHT		CONVEX		CONCAVE	
	NUMBER	PERCENTAGE	NUMBER		NUMBER	PERCENTAGE
LOOP	53	35.8 %	111	LOOP	53	35.8 %
WHORL	79	53.4 %	58	WHORL	79	53.4 %
ARCH	16	10.8 %	20	ARCH	16	10.8 %
THUMB PATTERNS	STRAIGHT	CONVEX	CONCAVE	THUMB PATTERNS	STRAIGHT	CONVEX
	NUMBER	PERCENTAGE	NUMBER		NUMBER	PERCENTAGE

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.322 ^a	4	.000
Likelihood Ratio	26.861	4	.000
Linear-by-Linear Association	3.901	1	.048
N of Valid Cases	350		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 1.37.

TABLE 6:
CORRELATION OF LIP PRINTS, THUMB PRINTS AND PROFILE

PROFILE	LIP PATTERN	THUMB PATTERNS					
		LOOP		WHORL		ARCH	
		NUMBER	PERCENTAGE	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
STRAIGHT	BRANCHED	36	36.0%	52	52.0%	12	12.0%
	INTERSECTING	2	20.0 %	6	60.0%	2	20.0%
	RETICULAR	4	21.1 %	14	73.7 %	1	5.3%
	VERTICAL	3	42.9 %	4	57.1%	0	0%
	PARTIAL VERTICAL	8	66.7 %	3	25.0 %	1	8.3%
CONVEX	BRANCHED	75	60.5 %	39	31.5%	10	8.1%
	INTERSECTING	9	50.0 %	7	38.9%	2	11.1%
	RETICULAR	13	50.0 %	9	34.6%	4	15.4%
	VERTICAL	7	63.6 %	1	9.1%	3	27.3%
	PARTIAL VERTICAL	7	70.0 %	2	20.0%	1	10.0%
CONCAVE	BRANCHED	2	25.0%	6	75.0%	0	0%
	INTERSECTING	0					
	RETICULAR	0	0%	3	100%	1	50.0%
	VERTICAL	0					
	PARTIAL VERTICAL	0	0%	1	50.0%	1	7.7%

Chi-Square Tests

PROFILE		Value	df	Asymp. Sig. (2-sided)
Straight Profile	Pearson Chi-Square	10.834 ^a	8	.211
	Likelihood Ratio	11.529	8	.173
	Linear-by-Linear Association	1.872	1	.171
	N of Valid Cases	148		
Convex Profile	Pearson Chi-Square	7.703 ^b	8	.463
	Likelihood Ratio	7.491	8	.485
	Linear-by-Linear Association	.487	1	.485
	N of Valid Cases	189		
Concave Profile	Pearson Chi-Square	7.150 ^c	4	.128
	Likelihood Ratio	6.094	4	.192
	Linear-by-Linear Association	3.658	1	.056
	N of Valid Cases	13		

a. 8 cells (53.3%) have expected count less than 5. The minimum expected count is .76.

b. 6 cells (40.0%) have expected count less than 5. The minimum expected count is 1.06.

c. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .15.

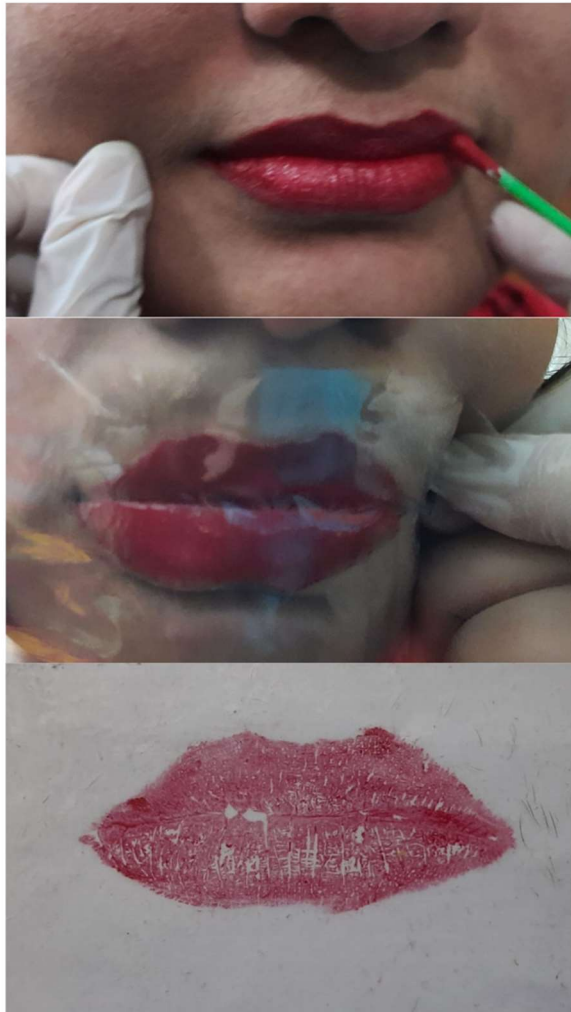


Figure 1: Registration of Lip Print



Figure 2: Thumb Print Patterns .A.)Arch Pattern B.)Whorl pattern C.) Loop Pattern