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Lip Prints as an Early Indicator of Different Malocclusions

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ABSTRACT

Introduction: The goal of the current investigation was to see if there was any correlation between skeletal malocclusions and lip print patterns.

Settings and Design: Hospital based, prospective, observational, cross-sectional study.

Materials and Method: The study was conducted on 120 subjects, divided into 3 groups Skeletal Class I, Class II, and Class III based on ANB angle, Beta angle, and Wits. For the assessment of lip print patterns, they were classified according to the Tsuchihashi classification system.

Statistical analysis: The chi-square test was used to study differences in the groups.

Results: It was noted that the most prevalent lip pattern was Type I while; the least was the Type V pattern. A Type III lip pattern was absent. There was a significant correlation between Type I lip pattern and Skeletal Class III malocclusion. Also, there were significant gender differences in lip print patterns in skeletal class I malocclusion with no differences in skeletal class II and class III malocclusion.

Conclusion: Lip prints can be a useful aid in predicting the type of skeletal malocclusion as they develop early in life, therefore, can be successfully used for preventative and interceptive orthodontic procedures. Hence, lip prints can be used as early detectors of skeletal malocclusions.

Keywords: Lip prints; Skeletal malocclusion; Forensics.

Key message: Since the craniofacial skeleton and lips print both develop at the same embryonic stage, developmental variables that result in malocclusions may also be reflected in the lip print patterns.

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INTRODUCTION

The cornerstone of forensic science is the accurate identification of live or deceased people using their distinctive qualities and characteristics. The mouth is considered a multiplicity of options for forensic identification. In addition to teeth, soft oral and peri-oral tissue impressions can provide information.[1] The study of lip prints is termed cheiloscopy.[2] Every individual has a distinctive lip print that remains constant from the sixth week of fetal development until death. This implies

that the pattern of lip wrinkles (also known as "lip prints") is comparable to that of thumbprints. According to several studies, lip prints can be used in forensic dentistry, similar to thumbprints.[3] A strong genetic predisposition has been observed by many authors.[4,5] The first 6–12 weeks of pregnancy are crucial for the entire development of the lip, alveolus, and palate. It is well established that any factor present throughout genetic expression will inevitably have an impact on all structures that grow during that time.[5] Hence, environmental elements that result in malocclusion during development should have an impact on the pattern of lip prints. This could imply a connection between skeletal malocclusion and lip-printed patterns.

Lip prints are established at a very early period[6]; hence, doctors would benefit by being able to forecast the type of malocclusion at a young age and gain more insight into the identity of the individual.

AIM AND OBJECTIVES

The aim of the present study was to find out whether there exists a relationship between lip prints and sagittal skeletal jaw relation in adults of age 18-25 years. The objectives of the study were to record and study the lip prints and lateral cephalograms of each sample in the study group, to correlate the recorded lip print patterns with the respective sagittal skeletal jaw relation and to determine if there exists any association between them.

MATERIALS AND METHOD

Study type and design

This is a prospective, observational, cross-sectional study was conducted in the Department of Orthodontics.

Sample size calculation

The sample size was calculated using G power software version 3.2.9. In this study, it was recommended that at a significance level of 0.05, and a power of 90%, the study should include 99 samples. Therefore, 120 participants were included in the study.

Participants

Convenient method of sampling was used for the study. The subjects who came to the Department for their treatment were included and Lateral Cephalograms were obtained as a pre-treatment record of the subjects, which were used in our study for classifying them into Skeletal Class I, II and III.

After screening 600 subjects from Jan 2022 to November 2022, based on the selection criteria, a total of 120 subjects were included in this study. The inclusion criteria were as follows: Subjects having normal lip mucosa with no developmental anomalies or lip trauma, presence of all the teeth up to second molars, subjects with Skeletal Class I, II and III sagittal jaw relationship, and normal growth pattern (FMA=25±50), were included in the study.

The subjects with known hypersensitivity to lipsticks, pathologies of lips, subjects who did not give the informed consents, previous history of orthodontic treatment, scarring of lips and congenitally missing or extracted teeth except third molars, were excluded from the study.

Ethical committee approval was obtained from the institutional committee (SDCRI/IEC/22/08), and Clinical Trials were registered at the Clinical Trials Registry of India (REF/2022/08/057070). Written informed consents were obtained from all the subjects before the start of the study.

The study sample was categorized into Class I, Class II, and Class III skeletal patterns based on ANB angle, beta angle, and Wits.[7] The study sample was divided into three groups:

Group A: Skeletal Class I malocclusion-If ANB angle is between 2 to 4 degrees, Wits appraisal (AO=BO in females & BO is ahead of AO by 1mm in males) and Beta angle is between 27 to 35 degrees (39 subjects; mean age-20.75±3.74 years; 22 males and 17 females).

Group B: Skeletal Class II malocclusion-If ANB angle is greater than 4 degrees, Wits appraisal (AO is ahead of BO) and Beta angle is less than 27 degrees (48 subjects; mean age - 20.32±2.44 years; 16 males and 32 females).

Group C: Skeletal Class III malocclusion-If ANB angle is less than 2 degrees, Wits appraisal (BO is ahead of AO) and Beta angle is more than 35 degrees[7] (33 subjects; mean age-21.32±2.65 years; 18 males and 15 females).

Method

Digital lateral cephalograms of all subjects were obtained in the natural head position (NHP) using a KODAK 8000 Digital Panoramic and Cephalometric X-ray system.

For each subject, lip prints were captured on

white bond paper. The participants were instructed to rest on a dentist's chair while being examined for lip prints, and their lips were then cleansed with a moist cloth. Then, using a Bard-Parker knife, a piece of red lipstick was divided and placed in a dapper dish, from which a lip brush was applied. The participants were asked to rub both lips together to spread the lipstick. The bonded portion of the cellophane tape strip was placed over the lipstick, and a lip impression was created by first dabbing it in the centre and then uniformly pressing it toward the corners of the lips. For a lasting record, the cellophane strip has adhered to the white bond paper. A magnifying glass was then used to view the lip impressions.[8] Each measurement was performed to prevent cross-contamination.

The lip print designs were categorized according to Tsuchihashi's nine suggestions.[8] Similar to the work by Sivapathasundharam *et al*[2], the central portion of the lower lip (10 mm wide) was chosen as the study area for classification. By counting most lines in this area that resembled the Tsuchihashi classification, the lip print pattern was identified.

To reduce bias in the study

To reduce the methodology bias, all lip impressions were evaluated twice for their validity, once by the principal investigator and again by an orthodontist. The lip patterns, confirmed by both of them to be proper, were utilized in the study. Both investigators were blinded to the type of skeletal pattern in the subjects at the time of lip pattern analysis. To reduce measurement bias and increase the reliability of the study, 20 subjects were recalled 2 weeks apart by the principal investigator, and lip prints were retaken. Intraobserver reliability was calculated using the intraclass correlation coefficient, and it showed high reliability (97).

STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS version 22.0, IBM, corp. Shapiro-Wilk test was used to assess the normality of the data. As the data was found to be normal, non-parametric test was used. The chi-square test was used for assessing the association of lip print pattern with gender, and comparing different lip print patterns in subjects having skeletal class I and class II malocclusion, skeletal class I and class III malocclusion, and skeletal class II and class III malocclusions. The frequency distribution for various lip print patterns with respect to different malocclusions was expressed in terms of number and percentage. Statistical significance was set at $p \leq 0.05$.

RESULTS

Table 1 shows the prevalence of the lip print pattern in the subjects. Type I was the most common (41.7%) and Type V (0.8%) was the least common. Lip patterns were evaluated in different skeletal malocclusions, that is, skeletal class I, class II, and class III. In the skeletal class I group, the Type II lip pattern was the most prevalent (48.7%) (Table 2). In the skeletal class II group, Type II was the most prevalent (41.7%), and Type I lip pattern (10.4%) was the least (Table 3). In the skeletal class III group, the Type I lip pattern was the most prevalent (60.6%), whereas the Type V lip pattern was completely absent (Table 4).

Table 1: Prevalence of lip print patterns among the subjects

Patterns	Frequency	Percent
Type I	50	41.7
Type I	5	4.2
Type III	0	0
Type II	45	37.5
Type IV	19	15.8
Type V	1	.8
Total	120	100.0

Table 2: Distribution of lip print patterns in Skeletal Class I subjects

Pattern	Frequency	Percent
Type I	15	38.5
Type II	19	48.7
Type III	0	0
Type IV	4	10.3
Type V	1	2.6
Total	39	100.0

Table 3: Distribution of lip print patterns in Skeletal Class II subjects

Pattern	Frequency	Percent
Type I	15	31.3
Type I	5	10.4
Type II	20	41.7
Type III	0	0
Type IV	8	16.7
Total	48	100.0

Table 4: Distribution of lip print patterns in Skeletal Class III subjects

Pattern	Frequency	Percent
Type I	20	60.6
Type II	6	18.2
Type IV	7	21.2
Total	33	100.0

On evaluating the gender differences, it was noticed that subjects with skeletal class I showed significant Type II lip patterns (77.3%) in males and Type I (64.7%) lip patterns in females ($p<0.05$), while skeletal class II and Skeletal Class III showed non-significant gender differences in lip pattern ($p\geq0.05$) (Table 5).

Table 5: Gender wise distribution of lip print patterns among Skeletal class I, II & III subjects

Skeletal relation	Gender	Pattern of lip prints	Frequency	Percent	p-value
Class I	Female	Type I	11	64.7	
		Type II	2	11.8	
		Type IV	3	17.6	
		Type V	1	5.9	0.0013
	Male	Type I	4	18.2	
		Type II	17	77.3	
		Type IV	1	4.5	
Class II	Female	Type I	8	25.0	
		Type I'	4	12.5	
		Type II	14	43.8	
		Type IV	6	18.8	0.5828
	Male	Type I	7	43.8	
		Type I'	1	6.3	
		Type II	6	37.5	
		Type IV	2	12.5	
Class III	Female	Type I	9	60.0	
		Type II	2	13.3	
		Type IV	4	26.7	0.6897
	Male	Type I	11	61.1	
		Type II	4	22.2	
		Type IV	3	16.7	

p≤0.05- significant

The chi-square test showed no significant difference in lip patterns in all subjects with skeletal classes I and II ($p>0.05$) (Table 6).

Table 6: Comparison of lip print patterns among Skeletal class I and Class II subjects

Pattern	Class I		Class II	
	Frequency	Percent	Frequency	Percent
Type I	15	38.5	15	31.3
Type I	0	0.0	5	10.4
Type II	19	48.7	20	41.7
Type IV	4	10.3	8	16.7
Type V	1	2.6	0	0.0
Chi-Square value	6.49			
p-value	0.16			

p≤0.05- significant

Skeletal classes I and III showed a significantly higher ($p < 0.05$) proportion of Type I lip pattern in subjects with skeletal class III than in those with skeletal class I, while the proportion of Type II lip pattern was significantly higher ($p <0.05$) in subjects with skeletal class I than in those with skeletal class III (Table 7).

Table 7: Comparison of lip print patterns among Skeletal class I and Class III subjects

Pattern	Class I		Class III	
	Frequency	Percent	Frequency	Percent
Type I	15	38.5	20	60.6
Type I	0	0.0	0	0
Type II	19	48.7	6	18.2
Type IV	4	10.3	7	21.2
Type V	1	2.6	0	0.0
Chi-Square value	8.85			
p-value	0.03*			

* p ≤0.05 - Statistically significant

On comparing skeletal class II and class III, it was found that the proportion of Type I lip patterns was significantly higher ($p < 0.05$) in subjects with skeletal class III than in those with skeletal class II (Table 8).

Table 8: Comparison of lip print patterns among class II and Class III subjects

Pattern	Class II		Class III	
	Frequency	Percent	Frequency	Percent
Type I	15	31.3	20	60.6
Type I	5	10.4	0	0
Type II	20	41.7	6	18.2
Type IV	8	16.7	7	21.2
Type V	0	0.0	0	0.0
Chi-Square value	10.91			
p-value	0.012*			

* p≤0.05- Statistically significant

DISCUSSION

Development of the lip and alveolus occurs during early intrauterine life. Hence, any environmental or genetic factor affecting one structure will influence other structures too.[5] Our study was based on the assumption that since they have the same time and same embryonic origin[5], there should be some association between lip print patterns and skeletal malocclusions found in an individual.

There are different methods of recording lip prints in the literature[9] but in the present study, we used the most common method (lipstick cellophane technique), which provided good clarity and accuracy.

Regarding the prevalence of lip patterns in different skeletal malocclusions, our study showed that Type I and Type II were the most prevalent, and Type V was the least common lip pattern. Similar results were reported by Raghav P *et al.*[10] and Kaushal B *et al.*[11] However, our findings contradict those of Verghese *et al.*[12] and Tsuchihashi.[8] Type III lip pattern was not observed in the present study. This contradicts the results of many previous studies.[8,12] The most probable reason for these differences could be regional variations.

On assessing the gender differences in the pattern of lip prints, it was observed in our study that there was no significant gender difference in skeletal class II and class III malocclusion, which supports the fact that there might be no sexual dimorphism in lip patterns. Our findings were following those of Tsuchihashi[8] and Verghese *et al.*[12] However, there was a significant sex difference in skeletal class I malocclusion; Type II malocclusion was more common in males, and Type I malocclusion was more common in females. This was following the studies by Vahanwal *et al.*[1], Babu *et al.*[13], and Gondivkar *et al.*[14] These contradictory findings suggest that cheiloscopy should be used as a supplement to other techniques to determine sex (not as the sole method).

Both skeletal class I and class II subjects predominantly had Type I and Type II lip patterns, with no discernible difference between the groups when lip print patterns in various skeletal malocclusions were compared. Skeletal class III subjects, however, displayed Type I lip patterns that were significantly different from skeletal classes I and II. This finding shows that both lip prints and skeletal class III malocclusions exhibit strong inheritable tendencies. These results are in accordance with those of Raghav P *et al.*[10] and Jain S *et al.*[15] Our results contradict those of Aditi *et al.*[16] and Sindura A *et al.*[17] The reason for the conflicting results might be due to differences in the methodology and system of classification of lip prints used in the studies. Due to conflicting results on the use of lip prints for personal identification and their relationship to skeletal malocclusions, further extensive research is required in this direction.

LIMITATIONS

Due to the small sample size of our study, more research encompassing more ethnic groups and larger sample size is necessary to confirm the relationship between lip patterns and skeletal malocclusions. Another drawback of the study is that the etiology of malocclusion, which is determined by genetic, environmental, and local variables, has not been considered.

CONCLUSIONS

Our analysis led us to conclude that Type I lip patterns were the most common. Each patient's lip print pattern was noted and maintained in an individual database for personal identification. Skeletal classes I and II predominantly showed Type I and II lip patterns, respectively. Skeletal class III malocclusion and Type I lip patterns were significantly correlated. Lip prints can be a useful aid in predicting the type of skeletal malocclusion that develops early in life; therefore, they can be successfully used for preventative and interceptive orthodontic procedures. Hence, lip prints can be used as early detectors of skeletal malocclusions.

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