Original Article

Cheiloscopy: Association of lip prints in different skeletal malocclusions

ABSTRACT

Aim: The aim of this study was to assess the association between lip print pattern and different types of skeletal malocclusion.

Materials and Methods: A sample of 60 individuals (18–30 years old) with skeletal Class I, Class II Division 1, Class II Division 2, and Class III malocclusion as confirmed by Angle between point A and point B. angle were taken for the study and were named as Groups I, II, III, and IV, respectively. Lip print was recorded by lipstick-paper method and was classified according to Tsuchihashi classification as Type I, Type I', Type II, Type III, Type IV, Type V.

Results: It was seen that partial vertical groove (PVG) lip pattern was most prevalent for all the groups. In skeletal Class I, PVG lip pattern was most prevalent, whereas in skeletal Class II Division 1, intersecting groove, in skeletal Class II Division 2, PVG, and in skeletal Class III, complete vertical groove were prevalent. The difference between the four malocclusion groups of each type of lip print was significant except for Type II.

Conclusion: Lip print will help in sorting out participants in more reliable manner in cases of mass disaster or criminal investigations. Furthermore, they help in predicting type of malocclusion beforehand for the successful execution of preventive and interceptive orthodontic procedures.

Keywords: Cheiloscopy, lip prints, skeletal malocclusion

INTRODUCTION

Fingerprints had been found to be distinct for each individual and were used for personal identification and criminal investigation in forensic sciences. Lip prints consist of lines and furrows seen in the form of grooves in vermillion border of human lip, which is a zone of transition between oral mucosa and outer skin. Lip prints remain the same throughout the life and are uninfluenced by injuries, diseases, or environmental changes and can be used to identify person based on their characteristic arrangement of grooves. Several research studies had established that fingerprints can be used as evidence in forensic dentistry.

The study of lip prints is referred to as cheiloscopy. Investigators have tried to find the association between the type of lip print pattern and skeletal malocclusion (Class I, Class II, and Class III), types of lip prints and dental caries or prevalence of malocclusion, etc., None of these studies included Class II Division 2 as a separate group. The consideration of Class II malocclusion as Class II Division 1 and Class II Division 2 malocclusion will be a step ahead in forensic dentistry for sorting out participants in mass disaster or in criminal investigations.

There are different methods of recording lip prints such as lipstick-paper-cardboard method, photography, lipstick-paper

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method, lipstick-cellophane method, or using dental impression materials to make three-dimensional casts of the lips. The lipstick-paper method was used in this study as it provided good clarity and accuracy.

Considering this, the aim of this study was to assess the association between lip print pattern and different types of skeletal malocclusion.

MATERIALS AND METHODS

Sample
Sixty patients with an age range of 18–30 years who reported to the Department of Orthodontics and Dentofacial Orthopedics, BBDCODS, for fixed orthodontic treatment were included in the study. All the patients were from Lucknow population and were not differentiated on the basis of their gender.

Distribution of sample
The sample was divided into four groups based on the type of skeletal malocclusion. Participants with skeletal Class I, Class II Division 1, Class II Division 2, and Class III malocclusion were named as Groups I, II, III, and IV, respectively.

Exclusion criteria
The participants having lesions on the lips or any congenital facial defects were excluded from the study. Individuals with known hypersensitivity to lipsticks were also excluded from the study.

Materials used in the study
A. Digital lateral cephalograms with cephalostat machine of Planmeca Proline XC cephalostat (Finland) machine
B. Tracing armamentarium includes lead acetate paper, HB pencil, marker, scale, and protractor
C. Bard-Parker knife (No. 15)
D. Maybelline New York SuperStay 14 h (Red-510) lipstick
E. Lip brush
F. Photo (glossy) paper
G. Magnifying lens
H. Sellotape.

The approval was taken from the ethical committee of BBDCODS, Lucknow. Informed consent was taken from all the participants.

Methods
1. Digital soft copies of the lateral cephalograms of all the participants were obtained
2. For classification, lip prints for all the participants were recorded on white-colored photo (glossy) papers with their name, age, sex, and type of skeletal pattern using lipstick-paper method.

Classification of subjects in different types of skeletal malocclusion
The sample was divided into four groups (15 in each group) on the basis of their ANB angle.

Figure 1 shows the landmarks and planes used to measure the ANB angle.

Table 1 shows the landmarks and planes used to measure the ANB angle.

Table 2 gives the range of ANB angle to be considered for different malocclusion groups.

Class II Division 1 and Division 2 were identified based on their dental features which are listed below:

Class II Division 1
- Class II molar and canine relation
- Proclined maxillary incisors with increased overjet.

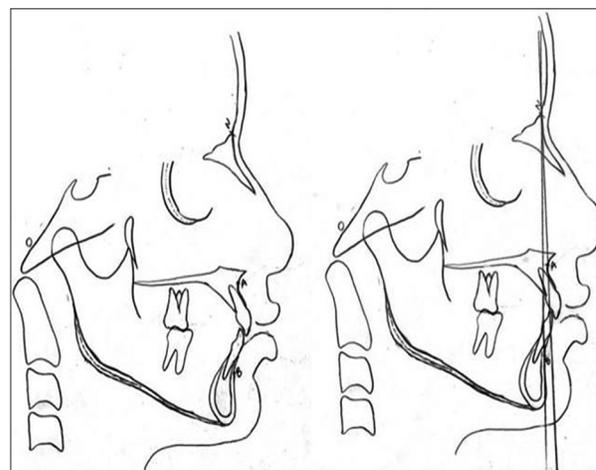### Class II Division 2
- Class II molar and canine relation

Figure 1: Landmarks and planes used to measure the ANB angle

Table 1: Landmarks and planes to measure the ANB angle

Landmarks for measurement of ANB angle	Planes for measurement of ANB angle
Point N (most anterior point on the frontonasal suture in mid-sagittal plane)	N-A plane
Point A (subspinale)	N-B plane
Point B (supramentale)	

Table 2: Range of ANB angle to be considered for different malocclusion groups

n=60	Skeletal Class I	Skeletal Class II	Skeletal Class III
ANB range	2–3	>4	<2

- Retroclined maxillary central incisors and labially tipped maxillary lateral incisors/retroclined maxillary central and lateral incisors and labially tipped maxillary canines
- Deep bite
- Decreased overjet
- Retroclined lower incisors.

Table 3 shows the mean value of ANB angle for different participants in the study. The participants who had borderline or contradictory values were excluded from the study.

Method to record lip print

a. The participants were asked to sit in relaxed position on a dental chair
b. The lips of the participants were cleaned with the help of wet cotton
c. A portion of red-colored lipstick was cut with the help of Bard-Parker (No. 15) knife which was put into the dappen dish
d. It was applied on the lips with the help of lip brush
e. The participants were asked to rub both the lips together to spread the lipstick
f. The photo paper strip (glossy) was placed over the lips, and lip impression was taken by pressing the photo paper strip first at the center of the lips followed by uniformly pressing it toward corner of the lips
g. Figure 2 shows the method to record lip prints.

Table 3: Mean value of ANB angle for different participants in the study

n=60	Skeletal Class I		Skeletal Class II Division 1/Division 2		Skeletal Class III	
	Mean	SD	Mean	SD	Mean	SD
ANB range	2.7	1.2	5.3	2.1	−2.1	1.8

SD: Standard deviation

Figure 2: Method to record lip prints

Every measure was taken to prevent any cross-contamination. To prevent the smudging of the lip prints taken on the photo paper (glossy), lip print was secured by placing the cellotape.

Analysis of lip prints

The lip impressions were then visualized with the use of a magnifying lens in the Department of Oral Pathology, BBDCODS.

For classification, the middle part of the lower lip, 10 mm wide, was taken as study area as suggested by Sivapathasundharam *et al*.[1]

Lip print pattern was classified according to Tsuchihashi classification into different types for each sample:
- Type I – Complete vertical groove (CVG)
- Type I' – Partial vertical groove (PVG)
- Type II – Forked groove (FG)
- Type III – Intersecting groove (IG)
- Type IV – Reticular groove (RG)
- Type V – Undetermined groove (XG).

To reduce the errors, lip prints were recorded thrice for each patient. Lip print pattern seen majority of times were documented.

Figure 3 shows the sample of different types of lip print pattern observed in the study.

Statistical analysis

The obtained data were tabulated and subjected to statistical analysis. Chi-square test was considered for statistical comparisons.

RESULTS

Table 4 shows the prevalence of type of lip print pattern in different malocclusion groups. Table 5 shows the comparison between different groups of each type of lip print pattern.

DISCUSSION

Lip patterns, being analogous to the fingerprints found in the palms and digits, gained popularity for personal identification in the field of forensic medicines. The development of lip, alveolus, and palate occurs at the same period, i.e., the 24th week of intrauterine life and also from the same embryonic origin. Any factor that tends to affect the development of a particular structure will ultimately affect all the other structures that develop along with it. Hence, there is a possibility for the developmental changes that occur in relation to alveolus to be reflected in the cheiloscopic

Table 4: Prevalence of type of lip print pattern in different malocclusion groups (*n*=15)
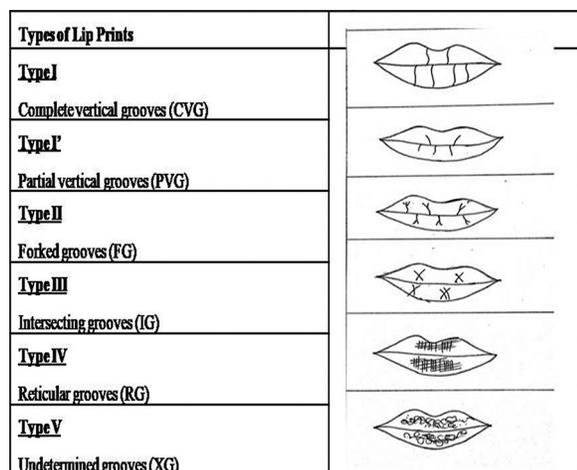
Lip prints pattern	Groups on the basis of skeletal malocclusion				
	Group I (skeletal Class I)	Group II (skeletal Class II Division 1)	Group III (skeletal Class II Division 2)	Group IV (skeletal Class III)	Mean
Type I (CVG) (%)	-	-	26.6	66.6	23.3
Type I' (PVG) (%)	53.3	33.3	73.3	20	45
Type II (FG) (%)	-	-	-	6.6	1.6
Type III (IG) (%)	6.6	66.6	-	-	18.3
Type IV (RG) (%)	40	-	-	6.6	11.66
Type V (XG) (%)	-	-	-	-	-

*CVG: Complete vertical groove, PVG: Partial vertical groove, FG: Fork groove, IG: Intersecting groove, RG: Reticular groove, XG: Undetermined

Table 5: Comparison between different groups of each type of lip print pattern

	Group I (skeletal Class I)	Group II (skeletal Class II Division 1)	Group III (skeletal Class II Division 2)	Group IV (skeletal Class III	Total	*P*
Type I (%)	0 (0.0)	0 (0.0)	4 (26.7)	10 (66.6)	14 (23.3)	<0.0001 S
Type I' (%)	8 (53.3)	5 (33.3)	11 (73.3)	3 (20.0)	27 (45)	0.019 S
Type II (%)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.7)	1 (1.6)	0.384 NS
Type III (%)	1 (6.7)	10 (66.7)	0 (0.0)	0 (0.0)	11 (18.3)	<0.0001 S
Type IV (%)	6 (40.0)	0 (0.0)	0 (0.0)	1 (6.7)	7 (11.66)	0.001 S
Type V (%)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	NA

S: Significant, NS: Not significant, NA: Not available

Types of Lip Prints	
Type I	
Complete vertical grooves (CVG)	
Type I'	
Partial vertical grooves (PVG)	
Type II	
Forked grooves (FG)	
Type III	
Intersecting grooves (IG)	
Type IV	
Reticular grooves (RG)	
Type V	
Undetermined grooves (XG)	

Figure 3: Different types of lip print pattern observed in the study

patterns. This was the basis of analyzing the association between lip print pattern and skeletal malocclusions. In a study done by Vignesh *et al*.,[2] the most prevalent lip print pattern observed was RG and XG pattern for mesial step, RG pattern for distal step, and CVG pattern for flush terminal plane.

Earlier studies included evaluation of the prevalence of different lip patterns in different population groups. Tsuchihashi[3] found that intersected lip pattern was most frequent in the Japanese population. Sivapathasundharam *et al*.[1] noted that intersected lip pattern was predominant in Indo-Dravidian population. Verghese *et al*. (2010)[4] found that reticular lip pattern showed the highest incidence in Kerala population.

These studies did not involve the division of population in different skeletal malocclusion groups; hence, further studies were conducted by different authors to evaluate the association of lip print pattern in different malocclusion groups. They found variability in the types of lip print pattern in different groups. However, none of the studies have divided Class II malocclusion as Division 1 and Division 2; hence, we included Class II Division 1 and Division 2 as separate groups in our study.

The overall result of the present study showed that PVG lip pattern (44.97%) was most prevalent for all the groups followed by Type I, i.e., CVG, and the least prevalent was Type II, i.e., FG. It was also seen that the PVG lip pattern was the most prevalent type in skeletal Class I (53.3%) and skeletal Class II Division 2 malocclusion (73.3%). IGs were most prevalent in skeletal Class II Division 1 cases (66.6%).CVG lip pattern was most common in Class III malocclusions (66.6%). XG lip pattern was not seen in any of the participants. The difference between the four malocclusion groups for each type of lip print pattern was significant except for Type II (forked groove [FG]).

Graph 1 shows the comparison of different lip patterns between participants having different skeletal malocclusions.

In a study by Raghav *et al*.[5] and Sujatha *et al*.,[6] FG lip pattern was most prevalent in Class I malocclusion followed by RG lip pattern, whereas in our study PVG was most prevalent followed by RG lip pattern for skeletal Class I malocclusion.
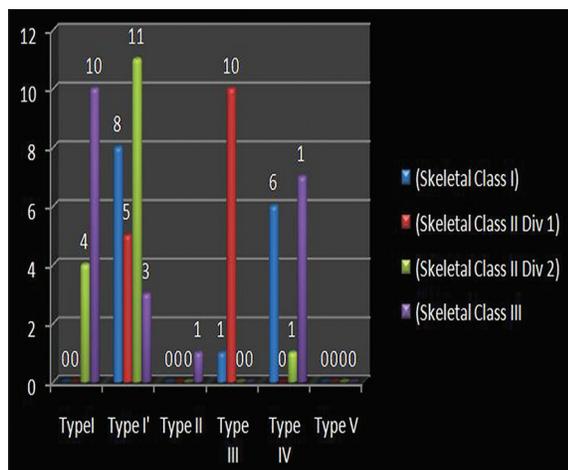
Graph 1: Comparison of different lip patterns between participants having different skeletal malocclusions

For Class II malocclusion, the most prevalent was FG followed by IG lip pattern, and for Class III malocclusion, the most prevalent was VG followed by FG lip pattern in a study by Raghav *et al*.[5] They did not consider Class II Division 1 and Division 2 separately. It was seen in the present study that the trend was different for Class II Division 1 (IG, 66.6% > PVG, 33.3%) and Class II Division 2 malocclusion (PVG, 73.3% > CVG, 26.6%). Sujatha *et al*.[6] showed a contrary trend (CVG > RG) for Class II malocclusion. Similar to a study done by Raghav *et al*., PVG (66.6%) was the most common lip pattern in Class III malocclusion in our study as well.

Shivani *et al*.[7] found that CVG + RG, PVG + RG, and IG + RG types of lip pattern were most prevalent in skeletal Class III malocclusion. Prashant *et al*.[8] divided Class I into different subtypes and found that RG (24.6%) was most prevalent in crowding, CVG (8%) in spacing, and XG (10.8%) in crossbites. For Class II malocclusion, XG (21.6%) was the most prevalent lip pattern followed by RG (15.4%), and for Class III malocclusion, RG (4.6%) was the most prevalent type followed by IG (2.7%).

Within the limitation of this study (small sample size), it can be stated that the prevalence of type of lip pattern was different in different groups of skeletal malocclusion. The consideration of skeletal malocclusion as Division 1 and Division 2 will help in sorting out participants in more reliable manner in cases of mass disaster or criminal investigations. Lip print pattern or fingerprint pattern profiling can also be recorded for each patient and saved in his personal database for personal identification. As lip print pattern develops early in our life, the type of malocclusion can also be predicted beforehand for the successful execution of Preventive and interceptive orthodontic procedures.

CONCLUSION

1. Type I' PVG was most prevalent for all the groups and Type II forked groove (FG) was least prevalent for all the groups
2. Type I' PVG was most prevalent in skeletal Class I malocclusion and Class II Division 2 malocclusion
3. Type III IG was most prevalent in skeletal Class II Division 1 malocclusion
4. Type I CVG was most prevalent in skeletal Class III malocclusion.

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Conflicts of interest
There are no conflicts of interest.

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