Research Article

A COMPARATIVE STUDY TO CORRELATE LATENT LIP PRINTS VISIBLE LIP PRINT AND FACIAL PROFILE

Meenakshi Pal., Ranjitkumar Patil., Anurag Tripathi*., Vikram Khanna and Vandana Singh

Department of Oral Medicine & Radiology, KGMU Lucknow, U.P

A R T I C L E   I N F O

A B S T R A C T

Aim: we conducted study to compare latent lip prints & visible lip prints and to correlate Lip prints with facial profile of an individual as individual identification tool.

Materials & Methods: 90 individuals (45 males and 45 females) were taken. Latent lip prints were recorded and developed using black graphite powder. Facial profile of the individuals was recorded using skeletal sagittal jaw relations, Dento-alveolar relation and Soft tissue relations. Results obtained were statistically analyzed.

Results: All developed lip prints matched with their visible counterparts. Pearson correlation test was done to assess the correlation between skeletal profile & dental profile determinants with lip prints pattern. Type 1 and type 4 lip prints pattern showed significant correlation with skeletal and dental parameters (p value < 0.05). Correlation between lip prints and soft tissue facial profile was analyzed using Fischer exact test and found that association between soft tissue profile and lip print type was statistically significant with the value of Fischer exact test17.107 (P= 0.016).

Conclusion: Visible lip prints showed resemblance to their latent lip prints pattern. Lip pattern showed a positive correlation with facial profile. Type I and type 4 lip prints showed significant correlation with interincisal angles and ANB angles.

INTRODUCTION

The lip prints are normal lines and fissures which angles present in the form of wrinkles and grooves at the zone of transition of human lip between the inner labial mucosa and outer skin2. These lip prints are unique and do not change during the life of a person[18,26]. Each racial group have a specified pattern of lip prints however not even identical twins having identical lip prints[22]. It has been verified that they recover after undergoing alterations like minor trauma, inflammation and diseases like herpes[14]. But few pathosis, major trauma or surgical treatment of lips may lead to scarring or altered pattern and morphology of these grooves1. Therefore these lip prints can be used as individual identification.

Edmond Locard was one of the France's greatest criminologists who first recommended the use of lip prints in personal identification and criminalization[25]. Suzuki, in 1967, made detailed investigations of the measurement of the lips and the method for its extraction to obtain useful data for practical forensic application. Later in 1970, Suzuki and Tsuchihashi, classified these lip prints in to six distinct groups[19, 20, 27].

Corresponding author: **Anurag Tripathi**
Department of Oral Medicine & Radiology, KGMU
Lucknow, U.P

Type I: a clear cut groove vertically across the lips
Type I': a partial-length groove of type I,
Type II: a branched groove,
Type III: an intersected groove
Type IV: a reticular pattern
Type V: other types.

The above Lip prints patterns can be obtained at crime place in two forms i.e. visible or latent form. Visible lip prints are easy to obtain & analyze while latent lip prints are tough to recover at crime site. Development of latent lip print, their preservation and analysis is a time taking procedure but it provides an approach to forensic science for victim identification4.

The oily and moist secretions from sebaceous glands located at the vermillion border and subsequent moisture from the tongue enables the formation of a latent lip prints. There are different types of dye agents marketed under various trade names to develop finger prints and other staining purposes; which are also effective in development of latent lip prints. Few commonly used dye agents are Aluminium powder, Silver metallic powder, Plumb carbonate powder, Fat black aniline dyer, Lysochrome dyes and Fluorescent dyes etc.

Numerous research papers have been published worldwide to assess the correlation of lip prints with other parameters like age, sex, races and blood group of individuals, but the correlation of lip print with facial profile of an individual is not

much emphasized till date. Facial profile of an individual can be evaluated by use of either photograph or radiograph. Radiographic assessment shows both skeletal and soft tissue parameters of facial profile; which is more accurate and reliable method than profile photograph alone.

In case of victim identification, the information about facial profile cannot be obtain at the site of incident; but if we have a correlation between lip print and facial profile then by the use of this correlation an approximate facial profile of victim can be established. Therefore, we planned a study to compare the reliability of latent lip prints to the visible lips prints using black finger print powder and also to compare facial profile with lip prints.

MATERIALS & METHODS

An observational, cross-sectional, single-blind, hospital-based study was conducted in the Department of Oral Medicine and Radiology. The study group consisted of 90 volunteers with 45 males and 45 females, from the outpatient department. The sample size was calculated on the basis of statistical analysis.

Inclusion criteria: Individuals of 18 to 80 years and willing to participate in the study were taken as subjects.

Exclusion criteria: Patients having any developmental anomaly related to skull, any pathology involving the lips, allergy to cosmetics, subjects undergone orthodontic treatment or any maxillofacial surgery.

Method for lip prints recording

Visible lip prints: The lips of the subjects were first cleaned thoroughly using cotton wet with cleanser. A dark-colored lipstick was applied uniformly with one stroke on upper and lower lips. Their lip impression was transferred on a transparent self-adhesive tape having width of 2 inches. This lip impression was immediately pasted on a white bond paper. After removal of lip stick patient was asked to relax on dental chair for 10- 15 minutes; then latent lip prints were recorded.

Latent lip prints: The lips of the subjects were first cleaned thoroughly using cotton wet with cleanser. The lips gently pressed together against a Glass ionomer mixing transparent pad for 3-4 seconds. The lip prints formed on the mixing pad were developed by sprinkling the black graphite fingerprint powder, gently dusting using a feather brush loaded with fingerprint powder. The excess powder was removed to visualize the hidden print.

Comparison of latent lip prints to visible lip prints was carried out with the help of magnifying glass lens to analyse lip prints patterns. The field of observation was restricted to 10 mm on each side of the quadrant. Collected samples were coded blindly on the basis of lip prints pattern suggested by Suzuki and Tsuchihashi, 1970.

Establishment of Facial Profile

The digital cephalograms of all the participants were recorded with Carestream CS 9300 machine. All the digital cephalograms were then analyzed by Carestream CS 9300 machine's inbuilt software programme (using stenier's cephalometric analysis).The skeletal sagittal jaw relation was determined by measurment of ANB angle as given in stenier's cephalometric analysis. The dento-alveolar profile of subject was assessed by interincisal angle formed between long axis of maxillary and mandibular central incisors. Soft tissue

characteristics of subjects were evaluated by joining following reference lines in cephalogram; a line joining the soft tissue glabella and the soft tissue point A (deepest point in curvature of upper lip) and a line joining point A and the soft tissue pogonion (most anterior point of chin).

Statistical Analysis

The statistical software namely SPSS version 20.0 was used to calculate descriptive data and to perform Fischer exact test and Pearson's correlation test for the analysis of data.

RESULTS

Reliability of black finger print powder to reveal the latent lip prints

Black graphite finger print powder was used to develop latent lip prints of all the 90 subjects. All the latent lip prints were coded blindly and then compared with their visible counter parts. All the developed latent lip prints matched with the visible lips print pattern as. Sensitivity of test for lip prints developed by black graphite finger print powder was 71.11 %.

Assessment of lip prints as individual identification tool and correlation of visible and latent lip prints

These lip prints were further categorized according to Suzuki and Tsuchihashi (1970) classification for the purpose of individual identification. All the lip print samples were coded blindly and on the basis of above mentioned classification and results were analyzed. The result is showed in table 1. In all the 90 subjects unique distribution of lip prints patterns were found and proved it as an individual identification tool.

Table 1 Distribution of lip prints

Lip prints classification	No of subjects	Percentage
Type 1	24	26.7
Type 1'	25	27.8
Type 2	20	22.2
Type 3	15	16.7
Type 4	6	6.7
Type 5	0	0
Total	90	100.0

Assessment of the facial profile with lip prints

For assessment of individual facial profile three parameters were taken into consideration i.e. skeletal sagittal jaw relations, Dento-alveolar relation and soft tissue relation.

Skeletal Profile Determinants

The skeletal sagittal jaw relation was determined by measurement of ANB angle (SNA - SNB) as given in stenier's cephalometric analysis. The results of the study revealed mean value of SNA, SNB, ANB (Table 2).

Table 2 Mean values of skeletal profile determinants corresponding to various lip prints

Lip prints pattern	Mean SNA angle (degree)	Mean SNB angle(degree)	Mean ANB angle(degree)
Type 1	85.94	83.40	2.54
Type 1'	85.82	83.29	2.55
Type 2	85.34	80.19	5.17
Type 3	83.39	79.93	3.47
Type 4	84.07	81.30	2.80

Highest mean value of SNA angle (85.94) and SNB angle (83.40) were found with class Type I lip print whereas lowest mean value of SNA angle (83.39) and SNB angle (79.93) were

found with 3 lip print. Highest mean value of ANB angle (5.17) were found with Type 2 lip print while lowest mean value was found with Type I lip print.

Dento-Alveolar Profile Determinants

The dento-alveolar profile of subjects was assessed by interincisal angle formed between long axis of maxillary and mandibular central incisors.

Mean values of Dento-alveolar profile determinants corresponding to various lip prints

The results of the study revealed mean value of inter incisal angle (table-3).The mean values of inter incisal angles in type 1, 1', 2, 3, and type 4 lip print pattern were 122.88^0, 120.04^0, 122.40^0, 134.20^0 and 84.07^0 respectively. Highest mean value (134.20) of inter-incisal angles were found with type 3 lip print and lowest (84.07) with type 4 lip print.

Table 3 Mean values of Inter incisal angle (degree) corresponding to various lip prints

Lip prints pattern	Mean inter incisal angle (degree)
Type 1	122.88
Type 1'	128.04
Type 2	122.40
Type 3	134.20
Type 4	84.07

Soft Tissue Profile

The resultant facial profiles were categorised in to convex, concave and straight types. Out of total 90 subjects 54 (60.0%) had convex profile, 23 (25.6%) straight and 13 (14.4%) had concave facial profile (table 4)

Table 4 Subjects distribution according to facial profile for various lip prints

Lip prints pattern	Soft tissue profile					
	Convex		Straight		Concave	
	No.	(%)	No.	(%)	No.	(%)
Type 1	14	58.3%	3	12.5%	7	29.2%
Type 1'	10	40.0%	9	36.0%	6	24.0%
Type 2	16	80.0%	4	20.0%	0	0.0%
Type 3	10	66.7%	5	33.3%	0	0.0%
Type 4	4	66.7%	2	33.3%	0	0.0%
Total	54	60.0%	23	25.6%	13	14.4%
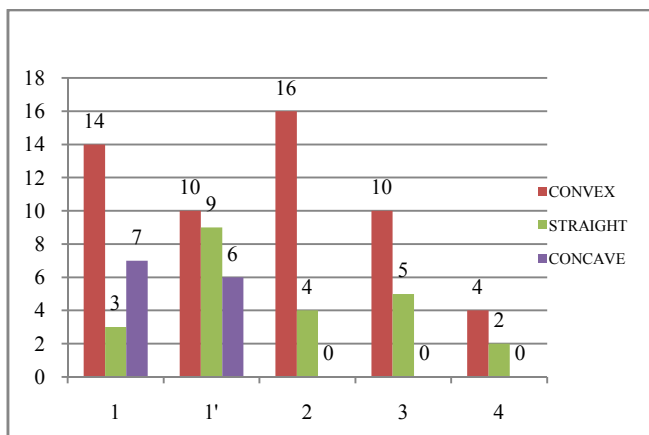
Fig 1 Subject facial profile in different lip print pattern

Correlation between Lip Prints and Skeletal and Dental Cephalometric Variables

Pearson correlation test was used to assess the correlation of type of lip prints pattern with skeletal and dental cephalometric variables. The value of correlation coefficient range from -1 to +1 and zero value showed no correlation.

The correlation between SNA & SNB; SNA & ANB; SNB & ANB and interincisal angle & ANB were evaluated under different types of lip prints pattern. In type 1 and type 4 lip prints pattern the value of correlation coefficient for all skeletal and dental parameters shows strong positive correlation with p value < 0.05.

In type I' lip print pattern strong correlation found between SNA & SNB and SNB & ANB angle but no relationship was found between SNA & ANB and ANB & interincisal angle. In type 2 lip print pattern strong correlation found between SNA & SNB and SNA & ANB but no relationship found between SNB & ANB angle and ANB & interincisal angle. In type 3 lip print pattern strong correlation found between SNA & SNB and SNB & ANB but no relationship found between SNA & ANB angle and ANB & interincisal angle.

Correlation between Lip Prints and Soft Tissue Facial Profile

On using Fischer exact test the results showed that the association between soft tissue facial profile and lip print type was statistically significant with the value of Fischer exact test17.107 (P value 0.016).

DISCUSSION

The science of study of lip prints is as cheiloscopy. Cheiloscopy is being used in forensic science for victim identification. The lip prints pattern develops at the six month of intra uterine life and remains unchanged even after death[15]. The correlation of lip prints with several other parameters like finger prints[5], palatal prints[17], sagittal jaw relation[7] and skeletal malocclusion[12] were studied previously but its correlation with facial profile is not well documented till date.

The correlation of the facial profile of subjects to their type of lip prints was analyzed in the present study. All the 90 subjects of studied population, showed unique distribution of lip print patterns and proved it as an efficient tool for individual identification. In various studies, a particular lip prints pattern was predominant in a specified population. In our study Type I and I' lip prints pattern were most prevalent which was congruent with the studies done by Vahanwala[23], Ragab *et al.*[13], Sandhu *et al.*[16] and Sayed Wali *et al.*[21] in Mumbai, Egypt, Punjab and Libya respectively.

Nidhi (2013)[10] found type II lip prints as most common pattern in their studied population a similar finding was reported by Nagasupriya[8].. Tsuchihashi[22] in his study in Japanese population found that type 3 lip print pattern as predominant pattern and similar findings were reported by Sivapathasundharam[2] (2001) *et al.* in Indo-Dravidian population. Verghese[24] in Kerala obtained type 4 lip print pattern as most prevalent type. No subject with type 5 lip print pattern was found in our study whereas Rachana V[11] found type 5 as a predominant lip print pattern in Goa population.

Considering the gender based distribution of lip pattern the analysis showed type 1 lip prints in both genders which were congruent with *Sandhu*[16]. The racial and regional differences could be attributed to the different distribution of lip prints pattern.

The present showed similar distribution of latent lip prints patterns when compared with their visible counter parts. These findings were consistent with the results of Madhusudan Astekar *et al*. (2015)[7]. The extent of reproducibility of latent lip prints depends upon the technique of recording lip print, the surface over which lip print were recorded and the reagent used for developing lip prints[9]. In present study all the three criteria were fulfilled at their best for recording latent lip prints and Suzuki and Tsuchihashi (1970) classification was used for the analysis of lip prints. Black graphite finger print powder was used to develop latent lip prints which had sensitivity of 71.1%.

In the present study subjects facial profile was determined by several skeletal, dental and soft tissue parameters instead of profile photographs used in previous studies and an attempt was made to correlate facial profile to the type of lip prints patterns.

ANB angle was used as determinant of skeletal anterio-posterior jaw relation as it indirectly indicates the skeletal profile of individuals. In the present study the correlation between SNA, SNB & ANB angles were evaluated under different types of lip prints pattern. There was significant correlation between lip prints and ANB angle in our study which was congruent with kulkarni *et al*.[6] and Raghav[12] study. In our study Type 1 and type 4 lip prints pattern showed strong correlation with ANB angle as compared to type 1', 2 and 3 lip prints type whereas kulkarni *et al*. and Pradeep Raghwa's study found significant correlation between ANB angle and type 3 lip prints pattern.

Inter incisal angle was used as determinant of dento-alveolar jaw relation because incisor retroclination or proclination may produce significant changes in the facial profile. The correlation between inter incisal angle & ANB were evaluated for different types of lip prints pattern. Type 1 and type 4 lip prints pattern showed significant correlation with inter incisal angle as compared to type 1', 2 and 3 lip prints type.

The soft tissue profile was considered as third and most important parameter for establishment of facial profile. In present study significant correlation found between soft tissue facial profile and type of lip prints pattern. In all the studied samples of 90 subjects convex facial profile was predominant followed by straight and concave profile.

Inheritable tendencies of lip prints were studied in various researches[3]. The growth and development of skeletal and dental profile determinants are also genetically governed. A significant correlation between inter incisal angle and ANB angle in subjects of type 1 and 4 lip prints pattern may be explained by their genetic basis.

The present study was conducted in a single centre including the small sample size from particular population. Multicentric studies with wide population area are required to establish more comprehensive correlation.

Our study showed significant correlation between lip prints and facial profile and unique distribution of different type of lip print pattern among different individuals. Thus the correlation between lip prints and facial profile could be used as a valuable tool in the forensic science for victim identification.

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