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A Comparative Study to Assess the Inter-Relationship of Lip Prints with Facial Index and Cephalic Index

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Abstract
Introduction: *Forensics plays an important role in personal identification. Lip prints, facial index and cephalic index are of utmost importance in the field of forensics. However there is scarcity of studies which try to find a correlation between these three parameters.*
Aim: *To compare pattern of lip prints with facial index and cephalic index*
Materials and Methods: *In vivo study conducted on 30 healthy individuals in the age group of 17-21 years. Facial index and cephalic index were calculated based on measurements taken and lip prints were recorded for each individual*
Result and Conclusion: *The most common facial index observed was mesoprosopic, most common cephalic index was mesocephalic and the most common lip print was Type I whereas the least common type of lip print was Type 4 and Type I.*
Keywords: *Lip Prints, Facial Index, cephalic index.*

Introduction

Since ancient times description of human body plays a major role in crime investigation which nevertheless has been quiet challenging.[1] Personal identification is of at most importance in natural mass disaster like floods, earth quakes or man-made disaster like bomb blast, terrorist attack etc.[2] Traditionally personal identification comprises of determination of age, gender, stature and ethnicity.[3] The commonly used personal identification methods from a long time has been finger prints with retinal scans whereas identification of dead individuals may face numerous challenges especially when its decomposed or dismembered.[2]

Cheiloscopy is a forensic investigation technique that deals with identification of humans based on lips traces.[3] In the past decades, lip-print studies

attracted the attention of many scientists as a new tool for human identification in both civil and criminal issues. Lip prints are typical lines and fissures present in the form of wrinkles and grooves on the human lip between inner labial mucosa and outer skin.[4] They are unique to each individual and do not change during the life of a person.[5] Lip prints are considered one of the most important forms of personal identification in forensics.[6] Recognition of lip print has some advantages such as small data requirement and quick pattern matching; furthermore, being unique to an individual the same as fingerprints.[6] They recover even after minor trauma, inflammation and diseases like herpes. Visible lip prints are easy to obtain and analyze from crime scenes. Hence they can be used for individual identification.

Facial index represents measurement of facial parameters which is useful in various fields like forensic, reconstruction, orthodontics, anatomists etc.[1] It is used in anthropometrics where facial proportions are represented by prosopic index to identify the ethnic variation among population.[7] Cephalic index is an important parameter in forensic medicine, anthropology and genetics to identify the sex and racial differences between individuals.[1] Cephalic index is affected by geographical area, gender, age, racial and ethnic factors.[8]

The field of lip prints has been extensively explored in terms of its correlation to various parameters like age, sex, race, facial pattern, facial profile, blood group etc. This current study is a unique attempt to verify whether there is if any, correlation between facial index and cephalic index with lip prints.

Materials and Methods

This was an in vivo study conducted over a month comprising of 30 healthy individuals between 17-21 years of age. This randomly selected study group included both males and females. Individuals with facial asymmetry, traumatic lesions or anomalies on lips, skull related anomalies and individual who had undergone orthodontic and maxillofacial surgical treatments were excluded. Facial index and cephalic index for each subject of the study group along with lip prints were recorded in the Dept of Oral and Maxillofacial Pathology. All measurements were recorded in a relaxed sitting position with head in the neutral anatomical position.

For facial index the nasion to gnathion was measured using a caliper whereas the inter zygomatic distance was measured using 3 metalic scales (figure 1a and 1b). The values obtained were recorded in centimeters and calculated using the below mentioned formula

$$\text{Facial Index} = \frac{\text{Nasion to Gnathion} \times 100}{\text{Inter zygomatic width}}$$

Based on the value obtained from the above formula the Facial index was classified as

Table 1: Showing types of facial patterns based on facial index value

Facial patterns	Cephalic index value
Euryproscopic (Broad face type)	80-84.9
Mesoproscopic (Average face type)	85-89.9
Leptoproscopic (Tall Narrow face type)	90-94.9

Figure 1a   Figure 1b

Cephalic index was measured using 3 metal scales, the head length was measured as the distance from the glabella to the inion using one scale and head breadth was measured as distance between euryon using two scales (figure 2a and 2b). The numerical values were recorded as centimeters and the cephalic index was calculated using the formula

$$\text{Cephalic index} = \frac{\text{Maximum width of head} \times 100}{\text{Maximum length of head}}$$

Based on the cephalic index value the head types were categorized as

Table 2: Showing types of head based on cephalic index value

| Head types	Cephalic index value
Brachcephalic (Broad head type)	>80
Mesocephalic (Medium head type)	75-80
Dolicocephalic (Long head type)	<70

Figure 2a   **Figure 2b**

We used visible lip print method to record the lip prints in this study. All the participants were informed about the study. Initially lips were cleaned using wet cotton and a uniform layer of lipstick was applied and spread out evenly (figure 3a). Lip impression was transferred on self-adhesive tapes immediately by applying pressure evenly and later to a white bond paper (figure 3b & 3c). Each pattern of lip prints were tabulated and each were categorized based on lip prints pattern suggested by SUZUKI and TSUCHIHASHI 1940 (Table c). Results were tabulated and statistically analyzed using purposive sampling method.

Table 3: Lip print pattern given by Suzuki and Tsuchihashi 1970

Type I	A clear cut line of groove running vertically across the lip
Type I'	Straight grooves that disappear half way into the lip instead of covering the entire breadth of the lip or partial length groove of Type I
Type II	Grooves that fork in their course or a branched groove
Type III	An intersected groove
Type IV	A reticular groove
Type V	Grooves that do not fall into any of the above categories and cannot be differentiated morphologically
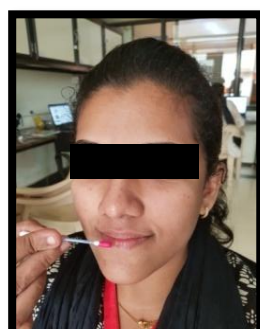
Figure 3a   **Figure 3b**   **Figure 3c**

The data obtained for facial index, cephalic index and lip print were entered into excel sheets and submitted for statistical analysis.

Results

The result of the current study is represented as cumulative percentage. In the present study the most common facial index observed was mesoprosopic (50%) followed by leptoprosopic (40%) and euryprosopic (10%). We found that Type I (38.46%) was the most common lip print seen in mesoprosopic facial pattern whereas type III and type V were the least common type of lip print (7.69%). Type II lip print was the most common type (40%) seen leptoprosopic facial pattern whereas type 4 lip print was the least common type (0%). Type I lip pattern was the most common type (33.33%) of lip print noted in europrosopic facial type whereas type I' was the least common type (0%) [Table 4].

Table 4: Showing occurrence of type of lip print in facial type pattern represented as cumulative percentage

Type	Euryproscopic	Leptoproscopic	Mesoproscopic	Total
Type I	1	2	5	8
Row %	12.50 %	25.00 %	62.50 %	100.00 %
Column %	33.33 %	20.00 %	38.46 %	30.77 %
Type I'	0	2	2	4
Row %	0.00 %	50.00 %	50.00 %	100.00 %
Column %	0.00 %	22.40 %	8.86 %	15.40 %
TYPE II	0	4	4	8
Row %	0.00 %	50.00 %	50.00 %	100.00 %
Column %	0.00 %	40.00 %	30.77 %	30.77 %
TYPE III	1	2	1	4
Row %	25.00 %	50.00 %	25.00 %	100.00 %
Column %	33.33 %	20.00 %	7.69 %	15.38 %
TYPE IV	1	0	2	3
Row %	33.33 %	0.00 %	66.67 %	100.00 %
Column %	33.33 %	0.00 %	15.38 %	11.54 %
TYPE V	0	2	1	3
Row %	0.00 %	66.67 %	33.33 %	100.00 %
Column %	0.00 %	20.00 %	7.69 %	11.54 %
TOTAL	3	12	15	30
Row %	11.54 %	38.48 %	50.00 %	100 %
Column %	100.00 %	100.00 %	100.00 %	100.00 %

The most common head type noted in the current study was mesocephalic (43.3%), followed by brachycephalic (40%) and the least common type was dolicocephalic (16.7%) head type. Type II lip print was the most common (45.45%) type of lip print seen in mesocephalic head type whereas type V was the least common type (0%). Type I lip print was the most common (41.67%) type of lip print in brachycephalic head type and type I' was the least common (0%) type of lip print. Type I' lip print was the most common (18.63%) type seen in dolicocephalic head type whereas Type 1 lip pattern was the least common type (0%) [Table 5].

Table 5: Showing occurrence of type of lip print in head type represented as cumulative percentage

Type	Brachycephalic	Dolicocephalic	Mesocephalic	Total
Type I	5	0	3	8
Row %	62.50 %	00.00 %	37.50 %	100.00 %
Column %	41.67 %	00.00 %	27.27 %	30.77 %
Type I'	0	2	2	4
Row %	00.00 %	50.00 %	50.00 %	100.00 %
Column %	00.00 %	18.63 %	16.57 %	14.54 %
TYPE II	3	0	5	8
Row %	37.50 %	00.00 %		100.00 %
Column %	25.00 %	00.00 %	45.45 %	30.77 %
TYPE III	1	2	1	4
Row %	25.00 %	50.00 %	25.00 %	100.00 %
Column %	8.33 %	66.67 %	9.09 %	15.38 %
TYPE IV	1	0	2	3
Row %	33.33 %	00.00 %		100.00 %
Column %	8.33 %	00.00 %	18.18 %	11.54 %
TYPE V	2	1	0	3
Row %	66.67 %	33.33 %	00.00 %	100.00 %
Column %	16.67 %	33.33 %	00.00 %	11.54 %
TOTAL	12	5	13	30
Row %	46.15 %	11.54 %	42.31 %	100.00 %
Column %	100.00 %	100.00 %	100.00 %	100.00 %

Discussion

The pattern of wrinkles and grooves on the lips give rise to a characteristic pattern known as lip prints and was first noted by R Fischer in 1902. Cheiloscopy is an upcoming tool for the identification of a person's lip print. It is one of the most interesting and emerging methods of human identification, and originates from criminal and forensic practice.[3] Lip prints are unique and reliable and are constant during the life of a person. These can be obtained at the crime scene from clothing, cups, cigarettes, windows and doors.[5]

Lip prints are extensively studied for its reliable constant appearance among genders and races. It has been found that lip print patterns are also inherited. Facial index is a general tool for identification of ethnicity of population where as cephalic index is helpful in identifying the gender. Thus there are numerous attempts to correlate the pattern of lip print with various other constant parameters like gender, race, ethnicity, blood group etc so as to ramify its usefulness in forensics. Though there are numerous studies in this regards there are limited studies correlating the lip prints with facial index and cephalic index hence this current study was a novel approach to throw more light in this regards.

The most common type of facial pattern noted in our study was mesoprosopic and is similar to the findings of Praveen Kumar etal 2013 but contrast to the findings of Priyadarshini etal 2018.[9]

The most common type of lip prints in mesoprosopic and europrosopic face type was Type I and Type II lip prints was most common in leptoprosopic face type. The most common type of lip print was type II in mesocephalic head type, type I lip print in brachycephalic head type and type I' lip print was common for dolicocephalic head type.

In the current study we found that Type I and Type II lip prints were the most common patter noted in facial and cephalic index. This finding of our study is consistent with previous studies of Vahanwala Ragab et al, Sandhu et al and Sayed Wali et al conducted in Mumbai, Egypt, Punjab, and Libya respectively. [10-12]

Conclusion

This exclusive but limited study indicates that lip prints hold promise as a supplementary tool to recognize the Facial and Cephalic indices of an individual. Confirmation of these results to form firm facts will need wider and more inclusive population studies

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