ORIGINAL ARTICLE

Utility of cheiloscopy, rugoscopy, and dactyloscopy for human identification in a defined cohort

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Abstract

Background: Identification is of paramount importance in any forensic investigation. Positive identification of living or deceased using distinctive traits is a cornerstone of forensic science. The uniqueness of these patterns and subtle distinction between traits has offered worthy supplemental tools in establishing the true nature of facts. **Aim:** The first aim of our study was to determine the most common pattern of lip prints, palatal rugae, and finger prints in the study subjects. Secondly, to determine if any specific pattern of lip print, palatal rugae, or the finger print concurs in individuals, and thereby establish a database of these prototypes for human identification from a defined cohort. **Materials and Methods:** The sample size comprised 100 female students of a dental college staying together in the hostel. Lip prints were recorded on a white bond sheet using lipstick, palatal rugae on dental casts, and finger prints using printer's blue ink. **Results:** Our observation suggested that the reticular pattern of lip print, the wavy pattern of palatal rugae, and the loop pattern of finger prints were the predominant patterns. Correlation of the three parameters did not reveal significant differences. **Conclusions:** This approach of human identification utilizing conventional techniques and relevant parameters is pertinent in defined groups. However, larger representative sample with robust analytical tools may provide a necessary blueprint of human identification.

Key words: Cheiloscopy, dactyloscopy, rugoscopy

Introduction

Human identification is of paramount importance and it is indeed challenging considering the fact that every individual has distinctive trait. This requires a combination of different procedures to individualize a person or an object. "Identity" is a set of physical characteristics, functional or psychic, normal or pathological, that define an individual.[1] Although DNA comparisons and finger print analysis are common techniques employed to ensure fast and secure identification, there are certain crime scenarios where other supplemental aids become essential.[2] Moreover, with tremendous demand placed upon law enforcement to provide justice, it is logical to use any type of physical characteristic to identify a suspect. Coincidently, the mouth allows for a myriad of possibilities which aids in identification of subjects in a defined cohort. The data obtained can be compared to real-life scenarios serving in small population groups with varying ethnic and racial backgrounds.

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Materials and Methods

Our study sample comprised 100 female students, aged from 17 to 22 years, with different ethnic backgrounds, but

staying together in the university campus. An informed consent was taken from all the study subjects, along with the institutional ethical committee approval (No. IEC 315/2011). Out of these subjects, only 91 were considered for analysis because of the unavailability of appropriate prints and impressions.

For the analysis of lip prints, the materials used were lipstick (Elle 18, 026 maroon iris), lipstick applicator, cellophane tape, white bond paper (Royal Executive Bond, 85 gsm, Premium White A4 sheets), and magnifying glass. Only subjects with full complement of teeth were included, and those who were hypersensitive to cosmetics or presented with any pathology like ulcer or trauma to the lips were excluded. For recording the lip prints, lips were initially wiped clean using tissue paper following which the lipstick was applied gently using a lipstick applicator from the central to the lateral portion of the upper lip with a single stroke. The subjects were then asked to clutch both the lips to ensure that the lipstick application was uniform. Following 2 min of waiting, the glue portion of the cellophane tape was used to obtain the impression of the lip. This record was immediately transferred on to a white bond paper by gently sticking the cellophane tape. This method, besides serving as patient's permanent lip record could also be safely preserved for subsequent analysis. For analysis, each lip print was topographically divided into six areas, and only the central portion of the lower lip was considered.[3] The analysis of the prints was based on the numerical superiority of the patterns of the line visible in the area of study.[4] If two patterns predominated, then the lip print was regarded as undetermined. For further categorization of lip prints, the method proposed by Suzuki and Tsuchihashi was followed, which is as follows. Type 1 presented with distinct vertical grooves that run across the entire lip; type 1′ was similar to type 1, but did not extend the entire lip surface; type 2 were the branched grooves; type 3 showed intersected grooves; type 4 presented with reticular grooves; and type 5 includes grooves that cannot be determined morphologically.

For analysis of palatal rugae, the materials used were the upper impression trays, alginate impression material (Zelgen Plus, Dentsply), dental stone (Denstone), graphite lead black pencil, and magnifying glass. Besides fulfilling the criteria of having the full complement of teeth, abnormalities like severe malocclusion, palatal pathologies, denture wearers, and tobacco-associated and parafunctional habits were excluded. To record palatal rugae, alginate impression of the maxillary arch was obtained and the cast made with dental stone. A plaster base was positioned for each cast for preservation of cast model and easier tracing for interpretation. The outline of rugae was traced on these casts using a sharp graphite pencil under adequate light. The palatal rugae pattern was then analyzed on these casts using the magnifying glass. As studying the pattern was our objective than assessing the number, unification, and direction of rugae, the analysis was performed using modified Lysell classification in which the rugae was divided into four types based on their shape. It was classified as curved if the rugae pattern was crescent shaped and curved gently, wavy if it was slightly curved at the origin and termination, straight if the course of rugae was straight from origin to termination, circular if the rugae formed a definite continuous ring, and undetermined if the rugae pattern did not fall into any of the above types.

The record of finger print impressions was obtained using printer's black ink, white bond paper (Royal Executive Bond, 85 gsm, Premium White A4 sheets), and magnifying glass. The subjects included were all healthy, and individuals with physical disability, systemic illness, or syndromes were excluded. The imprint obtained from the left thumb using printer's black ink was transferred on to a white bond paper and analyzed using magnification lens. Analysis of finger print was carried out using the most widely accepted Michael and Kucken classification, which classifies finger print pattern as the loop, whorl, arch-like, and composite patterns. All the above values were subjected to Chi-square test to examine the correlation of lip prints, palatal prints, and finger prints.

Results

Our observation revealed that the most common pattern of lip print was the reticular (type 4 pattern, 30 out of 91 subjects, 33.3%), followed by branched (type 2, 26 out of 91 subjects, 28.5%), complete vertical (type 1 pattern, 21 out of 91, 23.07%), incomplete vertical (type 1′, 8 out of 91, 8.79%), and undetermined (type 5, 1 out of 91, 1%). There was no intersected (type 3) pattern noted [Figures 1 and 2]. The most common pattern of palatal rugae observed was wavy (48 out of 91 cases, 52%), followed by curved (17 out of 91 cases, 18.6%), straight (10 out of 91 cases, 10.9%), and undetermined (5 out of 91 cases, 5.4%). There were no circular types of rugae pattern in any of the study subjects [Figures 3 and 4]. With regard to finger print, the loop pattern was most common (44 out of 91 cases, 48.3), followed by whorl pattern (20 out of 91 cases, 21.9%), arch pattern 13 out of 91 cases, 14.28%), and the composite pattern (9 out of 91 cases, 9.89%) [Figure 5].

The correlation of lip prints, palatal prints, and finger prints by Chi-square test showed no statistical significance. Correlation of reticular pattern (lip prints) and wavy pattern (palatal rugae) accounted for 47% of the cases ($P = 0.3$). Incidentally, the reticular pattern (lip prints) and loop type (finger print) showed a remarkable 59%, accounting for the highest percentage as compared to the other combinations ($P = 0.4$). Lastly, correlation of loop type (finger prints) and wavy type (palatal rugae) accounted for 55% of the cases ($P = 0.5$).

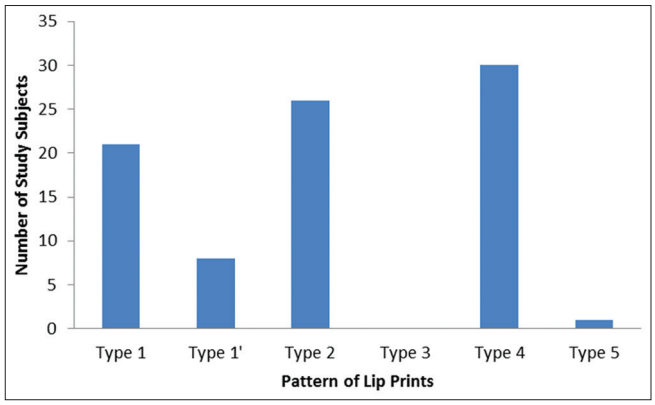

Figure 1: Distribution of pattern of lip prints in study subjects

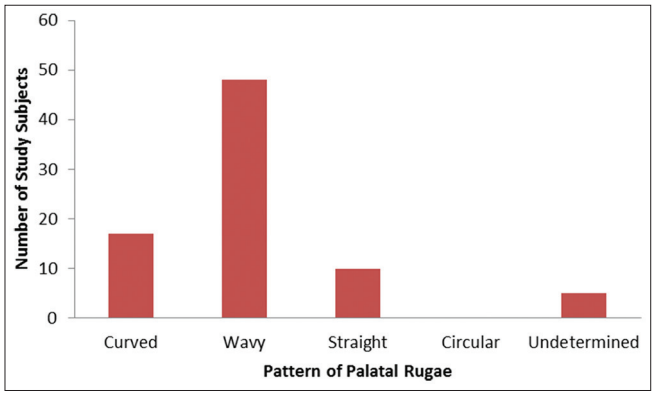

Figure 3: Distribution of pattern of palatal rugae in study subjects

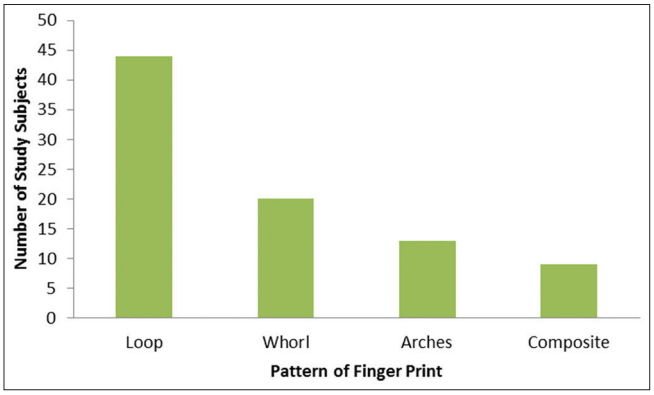

Figure 5: Distribution of pattern of finger prints in study subjects

Discussion

In the absence of antemortem data, identification is usually established by the testimony of eye witness. In view of forensic jurisprudence, detecting and identifying lip print at a site of calamity of any nature may prove to provide key evidence. External surface of the lip has many elevations and depressions forming a characteristic pattern called lip prints.[1] As it is genotypically determined, the importance of using it for forensic investigations is justified as the pattern never undergoes changes from birth until the body undergoes decomposition.[2] Moreover, it also gives an intuition into the type of the event, number of

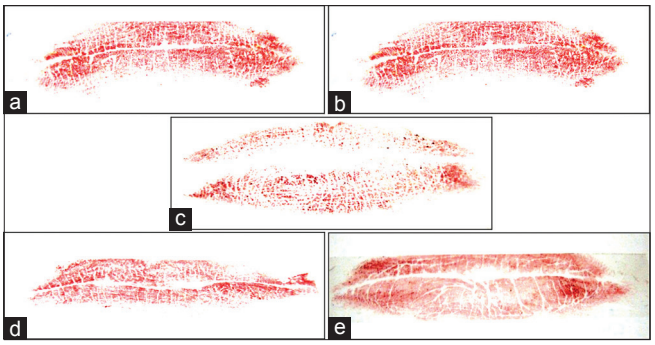

Figure 2: Patterns of lip prints: (a) complete vertical, (b) incomplete vertical, (c) reticular, (d) branched, (e) undetermined

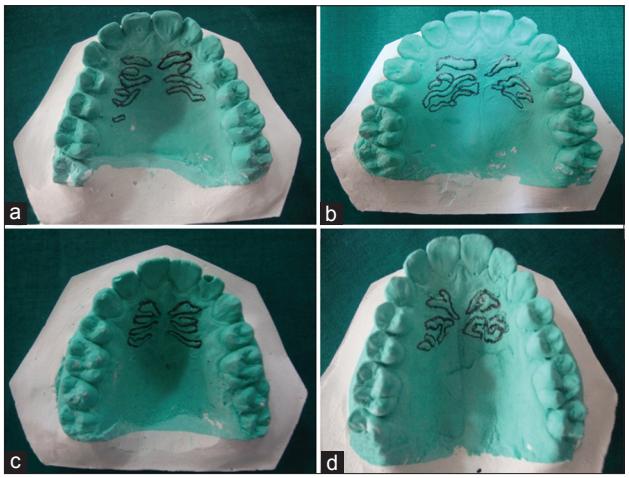

Figure 4: Patterns of palatal rugae: (a) curved, (b) wavy, (c) straight, (d) undetermined

people involved, gender, cosmetics used, any habits, and pathological states associated with the lips.[2]

With regard to the type of lip print from studies in Indian female population, a great degree of inconsistency is evident based on the previous study reports. The presence of complete vertical (type 1) and incomplete vertical (type 1′) patterns has been reported.[4,5] Contrary to these observations, Gondivkar *et al*. found a prevalence of branched pattern (type 2),[6] while intersected and branched pattern (types 3 and 2, respectively) were the most predominant in a study reported by Saraswathi *et al*.[7] Similar distribution pattern is available in reports of Gopichand *et al*. and Domiaty *et al*., in which the intersected (type 2) and the branched (type 3) were the most frequent patterns, respectively.[1,2] Interestingly, our observation suggested that the reticular pattern was the most predominant (type 4 patterns, 30 out of 91 subjects, 33.3%) and none of the subjects presented with intersected pattern (type 3). The varied presentation of lip prints is perhaps due to difference in sampling methods and inclusion of diverse population groups with varied ethnicity. Nevertheless, this unpredictability in outcome may prove to be ideal for forensic investigation as the likelihood of uniqueness of pattern in individual is higher.

Similar to presentation of lip prints, the palatal rugae has much to offer as a useful forensic tool. It was first discovered as a method of identification by Harrison Allen in 1889.[8] The rugae are protected from trauma, insulated by heat of the tongue, and hence survive postmortem insults. Although a slight alteration in the relationship of the rugae to the teeth occurs during orthodontic tooth movement, no major alteration in shape of rugae is noted.[8] Taking this into account, analysis of palatal rugae was carried out by only taking the shape or pattern of rugae into consideration. The rugae also provide sufficient information to validate identity beyond reasonable doubt and would serve in any forensic investigation. The most predominant pattern in our study was wavy, followed by curved pattern, which is in accordance with the other studies.[6,9-13] Incidentally, a predominance of wavy pattern has also been noted in Australian aborigines (Kapali *et al*.) and the Nepalese population (Shreenivas *et al*.).[11,13] In contrast, Saraf *et al*. noted that the converging pattern was predominant, which was not taken into consideration in our study.[14] These variable results could be attributable to variation in ethnicities and geographic background. As our study comprised random selection of subjects with varying background, it would be inappropriate to conclude the most common palatal rugae pattern. It is important to assess the population difference by assessing discrete variables like rugae shape than the continuous variables like rugae length.

The analysis of finger prints as a form of identification has been used since time immemorial. No two finger prints even in a given individual have been found to have the same ridge pattern and this remains unchanged throughout life. This uniqueness in its presentation is the very fact that the analysis of finger print offers an excellent means of forensic investigations. Today, automated finger print identification has been employed among law enforcement agencies throughout the world. Our observation of loop pattern being the most common, followed by whorl pattern, arch pattern, and the composite pattern is consistent with the universal observation.

The comparison and correlation of the lip prints, palatal prints, and finger prints did not yield any significant statistical significance. However, one study has drawn a significant correlation between vertical type of lip prints and arch-type finger prints.[15] As the sampling in our case was purposive with the sole objective of identification of individuals in a setup which comprises heterogeneous mix of population, we could not draw any correlation. However, continuation of this work including more subjects and further validation of results may provide some clues of any correlation of these three unique patterns of identification.

Although the science of forensics revolves around the four pillars of age, sex, race, and stature, we have made an attempt to study the pattern of three commonly used parameters for forensic identification in a small, yet diverse group, with a purpose of preparing a blueprint of individuals. This attempt is important as we would be establishing the forensic signature using this Combination Approach for human identification. Correlation of all three parameters is the first of its kind and has not been reported so far for reasons unknown. This preliminary observation of obtaining the indelible identification mark is the first step in generating a database which is practiced worldwide. As for instance, the palatoscopy has been used for necroidentification, and the Brazilian aeronautic ministry has made it mandatory to provide rugoscopy of pilots for victim identification in the event of disaster. Likewise, in Poland, an archive of lip print records is initiated and these records have been included in the casework of crime investigation department as an evidence for justice in court.[16] The world's first ever finger print bureau was established due to the pioneering work of Sir William Herschel in Kolkata, India. The importance of establishing the database of all the three essential elements of human identification is the need of the hour.

Conclusion

Although an extensive scientific research on the study of the lip prints, palatal rugae, and finger prints is available, the study comparing and correlating all these three variables is minimal. A forensic bank has to be developed worldwide in order to store all these evidences, thereby developing a cohesive system. Our attempt was to initiate the process at the regional level, which if continued further will allow secure and faster identification with these supplemental evidences. This is the first study which has tried to correlate all the three parameters, but the interpretations derived from this study are precluded by limited sample size which definitely calls for a more extensive and detailed research in a more logical manner to authenticate our findings. Therefore, PATTERNS definitely act as aids in population subtyping because lip prints speak the untold, rugae see the unseen, and finger prints solves the entire mystery.

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