Dermatoglyphics and Cheiloscopy in the Inheritance of Cleft Lip and Palate: Unraveling the Mystery

Naveen Reddy Admala, Sharmila Arjunan, Gopinath Adusumilli, Jayaprakash Reddy Thirumala, Raghu Devanna, Saravanan Pichai

ABSTRACT

Introduction: Dermatoglyphic and cheilosscopic analysis have been useful in understanding basic questions in biology, medicine, genetics, evolution and forensics. They are now beginning to prove themselves as an extremely useful tool for preliminary investigations into conditions with a suspected genetic basis.

Materials and methods: Case-control type of study consisting of two groups of thirty parents each of cleft lip with/without palate, CL(P) affected children (Group A) and normal children (Group B). Study aims to determine the presence of any dermatoglyphic asymmetry and correlation between finger prints and lip pattern, among the two groups.

Prints of all ten fingers were taken by Ink method and recorded on white paper. Lip patterns were obtained by direct photography of the subjects in natural head position.

Results: Chi-square test was done to determine the significance of occurrence of different patterns among the two study groups.

Increased dermatoglyphic asymmetry with higher ulnar loop patterns was seen in Group A. Whorl patterns were increased in Group B.

An increase in type I (straight grooves) and II (branches) in Group A and type III (intersected lines) in Group B was seen in lip patterns.

Conclusion: A highly significant correlation was observed in finger prints and lip patterns in parents with CL(P) affected children and hence can prove to be an extremely useful screening tool for CL(P) and other associated genetic anomalies.

Keywords: CL (P), Finger prints, Lip patterns, Dermatoglyphics, Cheiloscopy.


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INTRODUCTION

Over the past 150 years, dermatoglyphics has been a useful tool in understanding basic questions in biology, medicine, genetics and evolution, in addition to being the best and most widely used method for personal identification. The last few decades have seen the development of the importance of lip prints as another skin impression, which may be useful in identification and diagnosis of congenital diseases and anomalies.

Cummins and Midlo (1926) were the first to coin the term ‘Dermatoglyphics’. It is the science and art of the study of surface markings/patterns of ridges on the skin of the fingers, palms, toes and soles. The main thrust of their research was on Down’s syndrome and the characteristic hand pattern formations. External surface of the lip has many elevations and depressions forming a characteristic pattern called lip prints, examination of which is referred to as cheiloscopy. This is unique for individuals like the finger prints.

In humans, the development of the primary palate and the lip is completed by the seventh week of intrauterine life and that of the secondary palate by the 12th week. The dermal ridges develop in relation to the volar pads, which are formed by the sixth week of gestation and reach maximum size between twelfth and thirteenth weeks. This means that the genetic message contained in the genome – normal or abnormal is deciphered during this period and is also reflected by dermatoglyphics.

The current state of medical dermatoglyphics is such, that the diagnosis of some illnesses can now be done on the basis of dermatoglyphic analysis alone and currently, several dermatoglyphic researches claim a very high degree of accuracy in their prognostic ability from the hand features.

The aim of our study:

1. To determine if parents of nonsyndromic cleft lip with or without cleft palate CL(P) children display more dermatoglyphic asymmetry than parents of normal unaffected children.

2. To study the various pattern types of lip prints in parents of CL(P) children to detect if any specific pattern can be considered as a genetic marker in the transmission of CL(P) deformity.

MATERIALS AND METHODS

The subjects examined in this study were divided into two groups—Group A and B.
Group A comprised of 30 parents (mother and father) who:
1. Had at least one child affected by nonsyndromic cleft lip alone, cleft palate or cleft lip and palate without any other systemic manifestations.
2. Were normal healthy individuals not affected themselves by CL(P).

The age range of mothers in Group A was between 17 and 29 years (mean age of 23.4 years).

The age range of fathers in Group A was between 24 and 35 years (mean age of 30.0 years). The distribution of children affected in Group A is given in Table 1.

Group B consisted of 30 parents (mother and father) who:
1. Had normal, healthy children without any medical or congenital anomalies.
2. Provided no history of relatives affected by CL(P).

The age range of mothers in Group B was between 18 and 30 years (mean age of 24.5 years).

The age range of fathers in Group B was between 28 and 35 years (mean age of 31.1 years).

**Method of Obtaining Finger Prints**
1. The subjects were asked to wash their hands with detergent and after thorough drying, their finger prints were recorded.
2. The finger prints were collected using standard ink method.
3. Blue duplicating ink was evenly spread over a clean glass slab using a brush.
4. The subjects distal phalanx of each finger was rolled gently from left to right on the glass slab and the procedure was repeated on a plain white paper to record the finger print (Fig. 1).
5. Similarly, the distal phalanx of all ten digits were recorded to analyse the symmetry in pattern between corresponding fingers on the right and left hand.

**Method of Recording Lip Pattern**
1. The subjects were made to stand upright in natural head position with lips relaxed without any strain.
2. Lip prints were recorded by direct photography under natural lighting using a D-SLR camera. The photographs included only the lower third of the face focusing on the upper and lower lips to conceal the identity of the subjects (Fig. 2).

Ethical clearance was obtained from the institutional review board for the conduction of this study and the subjects were duly informed about the purpose of the investigations made and consent was taken for the same.

**Analysis of Finger Prints**
1. The finger prints of all the ten digits of the samples (30 parents each of CL(P) patients and normal, healthy children) were collected using the method mentioned above.
2. Galton (1892) divided the ridge patterns on the distal phalanges of the fingertips into three groups namely Arches, Loops and Whorls (Fig. 3). Although numerous subclassifications have been subsequently offered, this simple classification is still recognized and used by majority of investigators today.

![Fig. 1: Method of recording finger prints](image1)

![Fig. 2: Method of recording lip patterns by photography](image2)

<table>
<thead>
<tr>
<th>Cleft lip</th>
<th>Cleft palate</th>
<th>Cleft lip and palate</th>
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<tr>
<td><strong>Left</strong></td>
<td><strong>Right</strong></td>
<td><strong>Left</strong></td>
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Table 1: The distribution of children affected by CL(P) whose parents were sampled in Group A to study dermatoglyphic and cheiloscopic peculiarities
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1. The lips are divided into 6 topographical areas as shown in (Fig. 4).
2. The pattern of lip prints given by Suzuki and Tsuchihashi in 1970 were used (Fig. 5).

3. The frequency of each type of lip print patterns in the 6 topographical areas was statistically correlated and its percentage was estimated. p-value was calculated for each one in comparison to control.

Three investigators who were blind to the subjects’ group, independently categorized the finger print and lip patterns into the corresponding classifications mentioned. Any dispute which arose among the three was decided based on consensus.

RESULTS

Data entry and analysis was performed using SPSS statistical software. The significance values were calculated using chi-square test.

Our study indicated that subjects of Group A had more dermatoglyphic asymmetry than subjects of Group B with the values being highly statistically significant (Table 2).

There was more inter digital asymmetry (with an increased score) seen in mothers and fathers of Group A, i.e. parents with children affected with CL(P) as compared to parents of Group B who had a lesser asymmetry score.

The individual comparison of ridge patterns of mothers and fathers of Groups A and B are as depicted in Graphs 1 and 2.

In the study of lip patterns, the lips which were divided into 6 topographical area were assigned pattern types I, II, III, IV or V based on nearest resemblance to the classified patterns by Suzuki and Tsuchihashi (1970).

It was observed that there was an increase in pattern types I and II in parents of CL(P) affected children (Group A) and a increased frequency of pattern type III in parents of normal children (Group B).
Similarly among the lip patterns, an increase in pattern I (straight grooves) and II (branched) were observed in genetically susceptible parents as opposed to increased pattern III (intersected) in parents of normal children.

Genes in their optimal state are nearly symmetrical. Asymmetry will be illustrated in various human bilateral structures like eyes, teeth, hands, etc. where genes have been damaged. Thus, dermatoglyphic analysis can be an extremely useful diagnostic tool for the preliminary investigation into conditions with suspected genetic base.

Dermal ridge differentiation takes place early in fetal development. The resulting ridge configurations are genetically determined and are influenced and modified by environmental factors.4

It is known that finger and palm prints are formed during the first 6 to 7 weeks of the embryonic period and are completed after 10 to 20 weeks of gestation. Abnormalities in these areas are influenced by a combination of hereditary and environmental forces, but only when the combined factors exceed a certain level, can these abnormalities be expected to appear.

### DISCUSSION

Our study concluded that there was a statistically significant correlation between increased dermatoglyphic asymmetry of ridges in parents of CL(P) children. An increased loop pattern in genetically susceptible individuals were observed whereas in parents of normal, healthy children, an increase in whorl count was recorded.

A comparison between the frequency of occurrence of different lip patterns among mothers and fathers of cases and controls are depicted in Graphs 3 and 4.

<table>
<thead>
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<th>Table 2: The asymmetry scores of subjects of Groups A and B</th>
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<tr>
<td><strong>Total scores</strong></td>
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p* value, significant  p < 0.001 (HS)  p < 0.001 (HS)
The epidermal ridges of the fingers and palms as well as the facial structures like the lip, alveolus and palate are formed from the same embryonic tissues (ectoderm) during the same embryonic period (6-9 weeks). Thus Nobaru et al (1986)\textsuperscript{11} stated that the genetic and environmental factors which are responsible for causing CLP may cause peculiarities in dermatoglyphic patterns.

According to Charles Woolf et al (1977)\textsuperscript{8} the asymmetry analysis found that probands in families with a positive family history of clefting had significantly more asymmetry in their pattern types than all other groups. They also saw an increase in mean dissimilarity scores among probands with a positive family history, compared either with probands without a family history or with controls. Thus, in families with multiple occurrences of clefting, unaffected relatives show the same degree of pattern asymmetry as controls, while affected probands show a higher degree of pattern asymmetry. The results were similar to our study were in increased asymmetry between dermal patterns were seen among the parents of affected children as compared to normal children.

The wrinkles and grooves on labial mucosa called as sulci labiorum form a characteristic pattern called ‘lip prints’ and the study of which is referred to as chieloscopy. Lip prints develop in the same first few weeks of embryological life as the lips. Lip prints, as one of the dermatoglyphics, have been used as genetic markers in many congenital and clinical diseases.\textsuperscript{13} In our present study, there are important statistically significant differences between the studied lip prints and the control ones.

Predilection of CL (P) as one of the congenital disorders is considered a major advance in prevention of its occurrence or lowering its incidence than surgical repair. This primary prevention may be aided by finding something in parents’ lips directly related embryologically, anatomically and/or genetically to the inheritance of the clefted lips of children, that is the lip prints.\textsuperscript{9,12} Lip prints develop in the same first few weeks of embryological life as the lips.\textsuperscript{12}

Wael M Saad et al (2005)\textsuperscript{2} concluded that there was an increased frequency of patterns I (straight lines) and II (branched grooves) in parents of CLP subjects with an increase in pattern III (intersected lines) in normal children’s parents which were similar to the results of our present study. They also came across a new pattern ‘O’ in the centre of the upper lip, which was never documented previously, among parents of case group.

Dermatoglyphic and cheiloscopy analysis is now beginning to prove itself as an extremely useful tool for preliminary investigations into conditions with a suspected genetic basis. In many respects, it has been used as an adjunct to other disciplines, serving as a vehicle to resolve broader biomedical problems. Thus in biology, anthropology, genetics and medicine, dermatoglyphics serves as a tool to describe, compare and contrast, and at times predict occurrences and risks for biomedical events studied by these major disciplinary areas.

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