Dermatoglyphic peculiarities in children with oral clefts

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Abstract

In humans, the development of the primary palate and the lip is completed by the 7th week of intra uterine life and that of secondary palate by 12th week. The dermal ridges develop in relation to the volar pads, which are formed by the 6th week of gestation and reach maximum size between 12th and 13th 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. Hence this study was done in order to observe the differences in dermatoglyphic patterns between the children with oral clefts and normal children and to determine the usefulness of dermatoglyphics in studying the genetic etiology of oral clefts. Dermatoglyphic data from 50 oral cleft children and 50 normal children were collected using the ink method and comparison was done between them. In the present study, we found an increase in the ulnar loop patterns on the distal phalanges of the ten fingers, an increase in the atd angle and an increase in the fluctuating asymmetry of the atd angle in the oral cleft children which indicates the degree of developmental instability of the oral cleft individual.

Key words: Dermatoglyphics, Fluctuating asymmetry, Oral cleft

For centuries the features of the hands have fascinated scholars, sages, theologians, doctors and laymen alike. The modern study of the hand is far removed from the popular image of the soothsaying hand reader uttering mysterious incantations in an arcane language. Rather, through decades of scientific research, the hand has come to be recognized as a powerful tool in the diagnosis of psychological, medical and genetic conditions. It was in 1926 that Cummins introduced the term “Dermatoglyphics”. It is the term applied to the study of the naturally occurring patterns of the surface of the hands and feet.1

The dermal patterns once formed remain constant throughout life.1 Dermatoglyphics is considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine anomalies.1

The importance of these markings to the genecist was not realized until recent years. They have proved to be a helpful adjunct to other diagnostic methods in identifying specific syndromes of genetic origin.2

The current status of dermatoglyphics is such that the diagnosis of some illness can now be done on the basis of dermatoglyphic analysis alone and currently several dermatoglyphic researches claim a high degree of accuracy in their prognostic ability from the hand features.2

Cleft lip with or without cleft palate CL(CP) and cleft palates (CP) are inherited defects having a broad phenotypic gamut. The frequency of CL(CP) is 1/1000 births and that of CP is 1/2000 births.3,4 The study of congenital cleft lip and cleft palate anomalies has been the subject of controversy regarding the etiology and mode of transmission.5 While most of the cases of this malformation have a polygenic mode of inheritance, a certain proportion results from rare mutant genes (Gorlin and Pindberg 1964),6 chromosomal aberration (Lubs et al 1961)7,8 and unknown exogenous factors. However, the exact etiology and mechanism of transmission of these malformations are still obscure.

In humans, the development of the primary palate and the lip is completed by the 7th week of intra uterine life and that of secondary palate by 12th week. The dermal ridges develop in relation to the volar pads, which are formed by the 6th week of gestation and reach maximum size between 12th and 13th 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.8

Hence, this study was done in order to observe the differences in the dermatoglyphic patterns between the oral cleft and normal children and to determine the usefulness of dermatoglyphics in studying the genetic etiology of cleft lip with and without cleft palate and cleft palate anomalies.

Materials and Methods

Data was collected from hundred children between the ages of 5-15 years with no difference between the sexes of which fifty consisted of the study group and the remaining fifty consisted of the control group. The study group consisted of non syndromic children with oral clefts without any other external manifestations who were registered at the Nitte...
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Meenakshi Institute & Craniofacial Center, Mangalore.
The control group consisted of normal, healthy children without any medical or congenital anomalies who came to the Department of Pedodontics and Preventive Dentistry at A.B Shetty Memorial Institute of Dental Sciences, Mangalore for their dental check up.

Dermatoglyphic data was collected using the ink method[1] with the black duplicating ink manufactured by Kores (India) Limited.

Data collected included the fingerprints and the palm prints [Figure 1].

1. Fingerprints

The bilateral fingerprints of all the 100 children from the study and the control group were collected using stamp pads and then they were classified into the arch, loop or whorl pattern[1]. The frequency of different fingerprint patterns of arches, loops and whorls on the distal phalanges of the ten fingers of the oral cleft children were then compared with that of the normal children.

2. Palm Prints

The bilateral palm prints were collected using black duplicating ink which was smeared on the palms and pressed on a sheet of paper which was kept firm. In order to eliminate any interpretations of the epidermal ridge patterns, where the hollow of the palms had not come in contact with the paper, a sponge was placed under the paper on which the inked palm was pressed.[1] Interpretation of the patterns were carried out according to Cummins and Mildo (1963)[9,1] and Penrose (1968).[10,1]

The frequency of true patterns of arches, loops and whorls in the interdigital area of I₂, I₃, I₄ was then observed in the children with oral clefts and the controls.

The atd angle was measured on the palms of the oral cleft and normal children and classified into three groups i.e. <45°, 45°-56° and >56°. Statistical analysis was done using the Gaussian test.

The fluctuating asymmetry of the atd angle between the hands were seen in each individual (oral cleft and normal) and classified into four groups -0, between 1-5°, between 6-9° and >10°.

Results

1. On comparison of the fingerprint patterns on the distal phalanges of the ten fingers of the fifty oral cleft children with that of fifty normal children, it was observed that the oral cleft individuals had an increased frequency of ulnar loops (310) as the ridge configuration as compared to the normal children who had a higher frequency of whorl patterns (208) which was found to be very highly significant [Graph 1].

2. On comparison of dermatoglyphic patterns of arches, loops and whorls at the interdigital areas I₂, I₃, I₄, no significant differences were seen between the oral cleft and normal children [Table 1].

3. An increased frequency of oral cleft individuals were observed to have an atd angle between the ranges of 45°-56° (51%) and >56° (13%) which was very highly significant. A higher frequency of normal children had the atd angle <45° (77%) which was also very highly significant. (Graph 2) The mean atd angle in the cleft children was 47.44° which is greater than 45° and the mean atd angle of the normal children was 41.82° which is less than 45°.

4. The fluctuating asymmetry of the atd angle of the oral cleft children were found to be increased in the higher ranges of 6-9°(14%) and >10° (12 %) when compared to the normal children which was statistically significant. [Graph 3].

Discussion

Dermal ridge differentiation takes place early in fetal development. The resulting ridge configurations are genetically determined and are influenced or modified by environmental forces.[1]
It is known that the finger and palm prints are formed during the 1st 6-7 weeks of the embryonic period and are completed after 10-20 weeks of gestation. Abnormalities in these areas are influenced by a combination of hereditary and environmental factors, but only when the combined factors exceed a certain level, can these abnormalities be expected to appear. This threshold theory has been advanced by the studies of Carter (1969) and Matsunaga (1977) is now generally accepted.

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 stated that the genetic and environmental factors which are responsible for causing cleft lip and palate may also cause peculiarities in the dermatoglyphic patterns.

Yamagata (1973) had compared the appearance of finger and palm prints of 196 children with cleft lip, alveolus and palate without any other external malformations with those of the normal persons, and observed a lower frequency of whorl patterns and a higher frequency of ulnar loop patterns in the fingers of the children with clefts. He also observed a higher percentage of patterns in the third interdigital and hypothenar areas and wider atd angles in the palm patterns in the patients. The findings of the present study also reveal statistically significant differences between the dermatoglyphic patterns of oral cleft children and the controls. As the dermatoglyphics are genetically controlled characteristics, any deviation in the dermatoglyphic features indicate a genetic difference between the controls and the abnormal population.

In this study, we observed that the children with oral clefts...
had an increased frequency of ulnar loops (310/500) on the
distal phalanges of the ten fingers whereas in the normal
children increased frequencies of whorls (208/500) were
seen. On comparison of the atd angles between the chil-
dren with oral clefts and the normal children, the oral cleft
children were found to have an atd angle in the higher ranges
above 45°(64%) whereas that of the normal children was in
the ranges less than 45° (77%). In a similar study done by
Balgir (1986) on a mixed group of CL(P) and CP children, he
found in them a higher percentage of loops, a small percent-
age of whorls and a higher percentage of Simian line and
Sydney line among the oral cleft children.

The fluctuating asymmetry of the atd angle was also found
to be in the higher ranges in the oral cleft children. Fluctu-
ating asymmetry is defined as the random differences be-
tween two sides of quantitative traits in an individual which
may increase in parallel to the decreasing buffering ability of an
organ and hence inability to maintain developmental
homeostasis. In the case of dermatoglyphics, it is the de-
gree of asymmetry, which will already be present during the
early fetal stages, and the magnitude of fluctuating asym-
metry will express the level of developmental homeostasis
of the individual.

Adams and Niswander, Woof and Gianas, Sofae and
Crawford, had also found enhanced fluctuating asymme-
try of the maximal atd angle in CL(P) individuals who showed
a familial history of the defect.

Genes in their optimal state are nearly symmetrical. Asym-
metry will be illustrated in various human bilateral struc-
tures like eyes, teeth, hands etc were genes have been dam-
aged. Thus, as the genetic damage can also be reflected
in the hands through the dermatoglyphic patterns, der-
matoglyphic analysis can be an extremely useful diagnostic
tool for the preliminary investigation into conditions with
a suspected genetic base. In the present study in the children
with oral clefts, we found an increase in the ulnar loop pat-
terns on the distal phalanges of the ten fingers whereas in the normal
children increased frequencies of whorls (208/500) were
seen. On comparison of the atd angles between the chil-
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age of whorls and a higher percentage of Simian line and
Sydney line among the oral cleft children.

Thus, we found a definite correlation between the der-
mattoglyphic patterns and the cleft deformity. Given the ex-
enses involved in conducting analysis of the chromosomes
themselves, dermatoglyphics can prove to be an extremely
useful tool for preliminary investigations into conditions with
a suspected genetic base. But further studies have to be
done with a larger sample size in order to evaluate the sig-
nificance of these variations in the dermatoglyphic features
in the oral cleft individuals.

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