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Original Research Article

Dermatoglyphics in infants with isolated, non-familial cleft lip palate- a case control study from Southern India

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ABSTRACT

Background: The role of genetic factors may be established by study of dermatoglyphics, therefore, any genetic abnormality during the formation of cleft lip and/or palate (CL/P) in the early trimester maybe reflected by altered dermatoglyphics. Aim: This study aims to assess altered dermatoglyphics in children with isolated, non-familial CL/P to understand the role of genetic factors in clefting.
Methods: Case control study in a cranio-facial centre comprising of 40 infants (6-9 months) with CL/P and age and gender matched controls. Finger printing was done using black duplicating ink. A p-value of 0.05 was considered significant.
Results: Majority (57.5%) had left sided clefting. Ulnar loops were the predominant digital pattern in the study group but there was no statistical difference with the controls, when all the finger patterns were considered together. There was significant difference in digital patterns in between the left thumb (p=0.033), ring (p=0.048) and little fingers (p=0.029) in the two groups. Comparison between the right and left hands within the study group showed significant difference in digital patterns in the thumb (p=0.047) and little finger (p<0.001). The study group also had a wider atd angle with significance (right hand p=0.038, left p=0.003) and a lower a-b ridge count with significance (right hand p= 0.045, left p=0.012).
Conclusions: There was a definite dermatoglyphic difference specifically in the left hand, which was also the major side of clefting, within subjects as well as between subjects and controls.

Keywords: Asymmetry, Dermatoglyphics, Oro facial clefting, Ulnar loops

INTRODUCTION

Orofacial clefts (OFC) impose a major social, financial and psychological burden for parents as well as high morbidity in affected children. The world-wide prevalence is approximately 1 in 500 to 700 births with significant geographic and ethnic variations.[1] Orofacial development is a complex process that involves interaction of several genes and signalling pathways that result in morphological heterogeneity. Around five weeks of gestation when there is a failure of progressive fusion of palate anterior to the incisive foramen with premaxilla, alveolus and lip, it results in cleft lip and/or primary palate (CL/P) which can be unilateral or bilateral. Isolated cleft palate however is anatomically and embryologically different from CL/P and occurs when the fusion that moves caudally is interrupted at seven weeks of gestation. Isolated or non-syndromic cleft lip palate (NSCLP) accounts for about 70% of CL/P.[2,3] The etiology of NSCLP is more complex and multifactorial,

involving endogenous genetic, exogenous environmental and/or a combination of the two.[4]

The role of genetic factors may be established by study of dermatoglyphics and especially in clinical genetics where it is used to describe and compare different biomedical events. Dermal ridges originate from fetal volar pads composed of mesenchymal tissue starting at 6th-7th week of development. They are a part of a phenotype influenced by genetics, intrauterine environment, nutrition, blood supply to the fingers, rate of growth of the fetus and no individual shares the same finger prints.[5]

As the skin is neurologically innervated by cervical spine segments, any genetic or environmental factors which disrupt the development of neuroectoderm can alter its formation.[6] Ridges become visible at about three and are completed by the sixth month of prenatal development. Any genetic abnormality in the formation of CL/P maybe reflected by altered dermatoglyphics.[7]

Hence, this study aims to assess the presence of altered dermatoglyphics in children with isolated, non-familial CL/P to understand the role of genetic factors in clefting.

METHODS

The study was done after obtaining Institutional Ethical Committee clearance. Written informed consent was obtained from either parent of the enrolled subject. Forty infants with isolated, non-familial CL/P aged between 6 and 9 months with equal age and gender matched healthy controls were studied over 18 months in a tertiary private hospital with a craniofacial centre.

The narrow age was selected so as to compare the atd angle and ab ridge count between subjects and controls, as these vary with age. The subjects were selected when they were due for cheiloplasty. Sample size was convenience sampling based on estimated new cases of CL/P during the study period.

Exclusion criteria included discernible syndrome, family history of CL/P in three generations, isolated cleft palate and atypical OFC, or any features suggestive of teratogenic exposure. Finger printing was done using black duplicating ink.[8] Dermatoglyphics studied included Fingerprints:

- Digital patterns: Whorls, Arches, Loops- ulnar and radial
- Palm prints: atd angle, a-b ridge counts and
- Symmetry.

The atd angle is the angle formed between tri radii a, t and d; where it is an axial triradius usually located near a point where the palm is connected to the wrist, whereas a and d is present at the base of the palm. The ab ridge count is the number of ridges between the triradii a and b.

Statistical Analysis

Statistical analysis was performed using software packages SPSS version 16.0 and Epi Info version 6. For continuous data like atd angle and ab ridge count, mean was calculated and expressed as ±standard error of mean. Significance between groups was established by independent sample t test. For categorical data, like digital patterns, proportions were calculated and Chi-square applied for significance. A p-value of <0.05 was considered significant in this study.

RESULTS

Demography

Both the study and control groups comprised of children between 6 and 9 months. All the children belonged to lower middle class society in the socioeconomic group. Each group comprised of 26 males (65%) and 14 females (35%). Left sided clefts constituted the largest group 23 subjects (57.5%), with left sided cleft lip with palate seen in 20 subjects (50%) and left sided cleft lip in 3 subjects (7.5%).

Bilateral clefting was seen in 7 (17.5%). Consanguinity was seen in 5 (12.5%) of study group and none in the control group, and was statistically significant (p= 0.05). The mean paternal age in the study and control groups were 30.18±0.80 and 30.58±0.37 years respectively. The maternal ages were as follows: 24.95±0.692 in the study and 25.88±0.291 years in the control. Parental ages were not statistically significant in both the groups.

Dermatoglyphics

The most common digital pattern seen in both study and control groups were ulnar loops which constituted more than 50% of all, followed by whorls, arches and radial loops.

The digital patterns when compared between the study and the control group were not found to be statistically significant, when all the finger patterns were considered together. When the digital patterns were compared between the groups in the individual fingers, significant difference was found in the left thumb, ring and little fingers (Table 1).

In left thumb, ulnar loops (n=30, 60%) predominated in the study group in contrast to whorls (n=17, 63%) in the control group. The difference was statistically significant with Chi-square 6.81 and p=0.033. Similarly, in the left ring finger, whorls (n=18, 64.3%) were the most common digital pattern studied in contrast to ulnar loops (n=25, 64.1%) in the control group (Chi-square 6.08; p=0.048).

No radial loops or arches were present in the left little finger of the controls in contrast to children with clefting. These differences in patterns between were statistically

significant with Chi-square 9.02 and p=0.029. No significance in the digital patterns were present in the other fingers studied (Table 2). Digital patterns when were compared between the right and left hand of children with CL/P also showed statistically significant difference in the thumb and little finger (Table 3).

Table 1: Comparison of significant digital patterns in infants with isolated cleft lip palate (study) and normal controls.

Digit	Pattern	Study *n* (%)	Control *n* (%)	Chi square, p- value
Left thumb	Ulnar Loop	30 (60)	20 (40)	6.81, 0.033
	Radial Loop	0	0	
	Whorl	10 (37)	17 (63)	
	Arches	0	3 (100)	
Left ring	Ulnar Loop	14 (35.9)	25 (64.1)	6.08, 0.048
	Radial Loop	0	0	
	Whorl	18 (64.3)	10 (35.7)	
	Arches	8 (61.5)	5 (38.5)	
Left little	Ulnar Loop	32 (50.8)	31 (49.2)	9.02, 0.03
	Radial Loop	5 (100)	0	
	Whorl	3 (33.3)	6 (66.7)	
	Arches	0	3 (100)	

Table 2: Frequency of digital patterns in study and controls, which was non-significant.

Digit	Pattern	Study n (%)	Control n (%)	Chi square, p- value
Left index	Ulnar Loop	20 (50)	20 (50)	3.59, 0.31
	Radial Loop	4 (57.1)	3 (42.9)	
	Whorl	14 (58.3)	10 (41.7)	
	Arches	2 (22.2)	7 (77.8)	
Left middle	Ulnar Loop	18 (40.9)	26 (59.1)	6.86, 0.07
	Radial Loop	0	2 (100)	
	Whorl	12 (70.6)	5 (29.4)	
	Arches	10 (58.8)	7 (41.2)	
Right Thumb	Ulnar Loop	23 (56.1)	18 (43.9)	3.89, 0.143
	Radial Loop	0	0	
	Whorl	12 (37.5)	20 (62.5)	
	Arches	5 (71.4)	2 (28.6)	
Right index	Ulnar Loop	14 (43.8)	18 (56.2)	2.65, 0.45
	Radial Loop	2 (66.7)	1 (33.3)	
	Whorl	19 (59.4)	13 (40.6)	
	Arches	5 (38.5)	8 (61.5)	
Right middle	Ulnar Loop	27 (48.2)	29 (51.8)	2.253, 0.522
	Radial Loop	2 (100)	0	
	Whorl	5 (45.5)	6 (54.5)	
	Arches	6 (54.5)	5 (45.5)	
Right ring	Ulnar Loop	13 (44.8)	16 (55.2)	0.735, 0.69
	Radial Loop	0	0	
	Whorl	21 (51.2)	20 (48.8)	
	Arches	6 (60)	4 (40)	
Right little	Ulnar Loop	23 (42.6)	31 (57.4)	3.66, 0.16
	Radial Loop	0	0	
	Whorl	8 (66.7)	4 (33.3)	
	Arches	9 (64.3)	5 (35.7)	

The left thumb had predominantly ulnar loops (n=30, 56.6%) compared to whorls and arches in the right hand (Chi-square 6.11; p=0.047). Similarly, the left little finger had a predominance of ulnar (n=32, 58.2%) and radial loops (n=5, 100%), while right little finger had a majority of whorls and arches with significance (Chi-square 17.75; p<0.001). The mean atd angle was compared between the study and the control group. This was statistically significant with p value of 0.038 on the right hand and p value of 0.003 on the left hand. The mean ridge count was similarly compared between the study and control groups, which was statistically significant with p value of 0.045 on the right hand and p value of 0.012 on the left hand. The same is presented in a Table 4. It was observed that two subjects had single palmar crease in the left hand, which was corresponding to the side of the cleft. No special character was noticed in the hands of the control group.

Table 3: Comparison of significant digital patterns between the hands in infants with isolated cleft lip palate.

Digit	Pattern	Right Hand *n* (%)	Left Hand *n* (%)	Chi square, *p* value
Thumb	Ulnar Loop	23 (43.4)	30 (56.6)	6.106, 0.047
	Whorl	12 (54.5)	10 (45.5)	
	Arches	5 (100)	0	
Little finger	Ulnar Loop	23 (41.8)	32 (58.2)	17.745, 0.001
	Radial Loop	0	5 (100)	
	Whorl	8 (72.7)	3 (27.3)	
	Arches	9 (100)	0	
Index finger	Ulnar Loop	14 (41.2)	20 (58.8)	3.769, 0.288
	Radial Loop	2 (33.3)	4 (66.7)	
	Whorl	19 (57.6)	14 (42.4)	
	Arches	5 (71.4)	2 (28.6)	
Middle finger	Ulnar Loop	27 (60)	18 (40)	7.682, 0.053
	Radial Loop	2 (100)	0	
	Whorl	5 (29.4)	12 (70.6)	
	Arches	6 (37.5)	10 (62.5)	
Ring finger	Ulnar Loop	13 (48.1)	14 (51.9)	0.554, 0.758
	Whorl	21 (53.8)	18 (46.2)	
	Arches	6 (42.9)	8 (57.1)	

Table 4: Comparison of atd angles and ab ridge counts in infants with isolated cleft lip palate (study) and normal controls.

Pattern	Hand	Mean±SEM		95% Confidence intervals	P- value
		Subjects	Controls		
Atd angle	Right	45.60°±1.26	42.78°±0.42	0.157 to 5.49	0.038
	Left	45.85°±0.96	42.55°±0.40	1.21 to 5.34	0.003
Ab ridge count	Right	34.95±1.23	37.78±0.62	-5.59 to -0.59	0.045
	Left	34.40±0.77	37.38±0.86	-5.27 to -0.67	0.012

DISCUSSION

Amongst birth defects, CL/P is ranked fifth after NTD, talipes, polydactyly and hydrocephalus in India with birth prevalence between 27000 and 33000 per year.[9] Children with isolated, non-familial clefts were evaluated in our study for presence of altered dermatoglyphics. Consanguinity appeared be a risk factor for clefting according to our study. However there was no association between parental ages and clefting. Left sided clefting constituted the majority.

Many studies have demonstrated a genetic-environmental interaction in causation of CL/P and the development of the face occurs around the same time of formation of finger and palm prints. Any genetic alteration in formation of CL/P will be demonstrated in altered dermatoglyphics. Balgir et al from India found increased frequency of ulnar loops in both boys (controls 51.4%, CL/P 55.8) and girls (controls 47%, CL/P 52.6%) and decreased whorls in both gender.[7] Mathew et al, in another Indian study, also reported a similar increase in frequency of ulnar loops (62%) while children in the

control group had whorls as a dominant configuration.[10] Scott et al describes a similar finding with study subjects having a significant increase in frequency in loops (63.5% versus 41.2% in controls) with decreased frequency of whorls (33.4% versus 57.6%).[11] Though ulnar loops were the predominant digital pattern in the study group, there was no statistical difference with the controls in the overall pattern in our observation. On comparison of digital patterns in individual fingers between the two groups, there was significant difference in digital patterns between the left thumb, ring and little fingers. Also, when the right and left hands of the study group was compared, there was significant difference in patterns mainly in the thumb and little fingers. Also, two subjects had single palmar crease on the left hand, corresponding to the same side of the cleft. Thus, the major findings in our study in relation to the digital and palmar patterns were predominantly noted in the left hand of the subjects. Left sided clefting was also a majority in our study. No other study has demonstrated such a finding. This perhaps can be explained by means of a developmental field defect. That is, a single or multiple disturbances in the intrauterine period during the same time may have caused different groups of the embryonic structures to respond like a single unit.[12]

On comparison of the atd angle between study group and controls, infants with CL/P had a wider angle in both hands as compared to controls, which was highly significant in our study. This was comparable to other Indian studies. Mathew et al, reported that subjects with clefts had a wider atd angle, between the ranges of 45-560(5%) and >560 (13%), in contrast to 77% of normal children having <450, with high significance.[10] Balgir similarly demonstrated a wider atd angle in both gender.[11] However, other studies were contradictory.[13,14] Saxena et al, found the mean atd angle in the study group and controls were similar.[15] Studies on a-b ridge count show contradicting results and as the count varies with sex chromosome, probably gender matching would be required.[13,14] The difference in the ab ridge count and the atd angle was also more striking in the left hand in our study group.

CONCLUSION

The present study showed that there was a definite dermatoglyphic difference specifically in the left hand, which was also the major side of clefting, within subjects as well as between subjects and controls. Though this study is limited by the sample size, the results may serve as a preliminary data to explore the probable role of a field defect during the embryonic phase in children with isolated, non-familial cleft lip and palate.

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