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CHEILOSCOPY AND DERMATOGLYPHICS AS GENETIC MARKERS FOR TRANSMISSION OF CLEFT LIP AND PALATE (CLCP): A CROSS-SECTIONAL STUDY.

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ABSTRACT

AIM: To compare lip print and finger print patterns of parents with and without non-syndromic CLCP children.

MATERIALS AND METHODS: 124 parents of children with non-syndromic CLCP as a study group and parents of unaffected children as control group were included. Lip prints and finger prints were collected from all subjects and analysis was carried out using Chi-square test.

RESULTS: Among the males and females of the study group, loops were the most common pattern followed by the arches whereas, in the male control group whorl patterns were more common. Among the female controls loops followed by arches were found to be common patterns. The atd angle asymmetry was found to be more in cases as compare to controls. For the lip patterns in cases type IIa, IIb and type O was common while in controls type I and I' was common.

CONCLUSION: Types IIa and IIb lip patterns, asymmetry of Atd angles can be considered as genetic markers for the transmission of CLCP deformity to off springs.

KEYWORDS : cleft lip, cleft palate, dermatoglyphics, cheiloscopy.

INTRODUCTION: The lip print and finger print pattern is unique for each individual .The study of patterns of lines on the vermilion borders of the lips is called as Cheiloscopy. It can be defined as "a method of identification of a person based on characteristic arrangements of lines appearing on the red part of lips or as a science dealing with lines appearing on the red part of the lips" (Prabhu RV, 2012). Study of the patterns of the epidermal ridges of the finger, palms, and soles is known as Dermatoglyphics; a word coined by the anatomist Harold Cummins. It can serve as an aid for the diagnosis of many diseases due to chromosomal aberrations and also mark other diseases that are both genetically and non-genetically determined (Verbov J, 1970). The development of primary palate and lip is competed by the 7th week of intra-uterine life and that of secondary palate by the 12th week. The dermal ridges also reach maximum sizes between the 12th and 13th weeks. This means that the genetic message contained in the genome whether normal or abnormal; is deciphered during this period and is also reflected by Dermatoglyphics (Matthew L, 2005)

The epidermal ridges of fingers and palms as well as facial structures such as lips, alveolus, and palate form from the same embryonic tissues (ectoderm) during the same embryonic period; thus these features may serve as a proxy markers in altering early development in cleft lip and palate. However, despite the high prevalence of cleft lip and palate and the known relationship between congenital malformations and abnormal Dermatoglyphics, reports investigating the relationship between cleft lip and palate and Dermatoglyphic deviations are relatively sparse (Matthew L, 2005). Cleft lip and palate are associated with Dermatoglyphic deviations and the genetic material which codes for cleft lip and palate is inherited by parents. So it is interesting to understand the influence of the parental genome on their lip and finger patterns.

Off late, studies have identified new patterns on the lips of the parents to be associated with the occurrence of cleft lip and palate in their children. The results of the studies are contradictory and the literature available is also very scare. Also, very few studies have compared lip print patterns and finger print patterns of parents with and without non-syndromic cleft lip and palate children. Hence the present cross sectional study was planned to compare lip print patterns and finger print patterns of parents with and without non-syndromic cleft lip and palate children in Davangere city.

MATERIALS AND METHODS: The present cross sectional study was conducted among parents of patients registered under the Smile Train Program in SSIMS hospital in Davangere city. A convenient sample of parents of the children having non-syndromic cleft lip and palate registered under the Smile Train Program constituted the case group and general population was the control group. The sample size was decided Sample size (n) in each group was determined based on the formula(Charan J, 2013).

$$n = (Z_\alpha + Z_\beta)^2 2p(1-p) / d^2$$

where Z was the standard normal variate, at 5% type 1 error Zα = 1.96

p was the prevalence; p = 0.1 (based on the prevalence observed in a study by Mossey P et al.) (Mossey P, 2009)

d was the absolute error or the precision; d = 0.05

Sample size in each group was estimated to be 62 in each group. The final sample size was **124**.

Inclusion criteria for study group:

1. Biological parents aged 20-40 years of children having non-syndromic cleft lip and palate of any degree.
2. Subjects who gave voluntary informed written consent for recording lip and finger print patterns.

Exclusion criteria for study group:

1. Parents of children with congenital malformations other than cleft lip and palate.
2. Parents of children with only cleft lip or palate.
3. Parents allergic to the ink.
4. Known allergy to the lipstick used.
5. Parents with trauma/ulcers/infections/swelling or any such conditions on lips and fingers which do not permit proper examination of patterns.
6. Children with non-syndromic cleft lip and palate not having biological parents.

Inclusion criteria for control group:

1. Biological parents aged 20-40 years of children not having any congenital malformations.
2. Subjects who gave voluntary informed written consent for recording lip and finger print patterns.

Exclusion criteria for control group:

1. Parents of children with congenital malformations
2. Parents allergic to the ink.
3. Known allergy to the lipstick used.
4. Parents with trauma/ulcers/infections/swelling or any such conditions on lips and fingers which do not permit proper examination of patterns.
5. Non-biological parents of the study subjects.

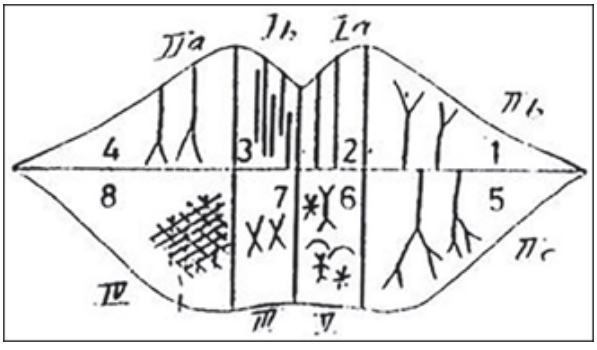
Ethical clearance was obtained from the Institutional Review Board of Bapuji Dental College and Hospital, Davangere. Voluntary informed consent was be obtained from the study participants prior to the start of the study after informing about the research details through a participant information form.

Armamentarium required for lip prints and finger prints:

1. Dark Shaded lipstick
2. Ear buds
3. Cellophane tape
4. Scissors
5. Sanitary tissues (to wipe the lipstick)
6. Metal ruler and pencil
7. Protractor
8. Inkpad with ink
9. Bond sheet for recording impression
10. Magnifying lens to examine the prints

Collection and analysis of lip prints:

Lip prints were recorded of both the mothers and fathers of children with CLCP and without CLCP. On one end of the ear bud, lipstick was applied in a single motion on the upper lip. Similarly, other end of the ear bud was used to apply lipstick on the lower lip after which the ear bud will be discarded using aseptic conditions. Lip impressions were made on the sticky side of the cellophane applying uniform pressure and the tape was removed using a single jerk. It was pasted on a white paper (Amith HV, 2011). Visual examination was done of the lip prints using magnifying lens. Later each lip was divided into six topographical areas given by Hassan and Fahmy (1977) and analysis of each area was done by Afaf's modification (addition of type "O") of the classification given by Suzuki and Tsuchihashi (1970). (Saad WM, 2005)



Afaf's modification of Suzuki and Tsuchihashi classification of lip prints.

Collection and analysis of palm prints:

The palm and finger prints were individually taken from each participant using ink method; in which the digits will be inked by rolling them across the ink pad one by one followed by printing onto a strip of paper. The finger prints were labelled according to the sides of the hand (right and left) and each digit was identified by using roman numerals (thumb= 1, index finger=2, middle finger=3, ring finger=4 and little finger=5). The finger print patterns were then classified into arches, whorls, loops with the help of magnifying glass and the total ridge count was calculated. 'atd' angle was measured for each palm and compared with the other hand. All the measures were assessed by a trained rater who was blinded to the subject's group status.

Statistical Analyses: The data obtained was compiled systematically in Microsoft Excel sheet and subjected to statistical analysis using SPSS version 20. Descriptive statistics was generated in terms of frequencies and percentages. Statistical analysis for comparing lip prints and finger print patterns and its association with cleft lip and palate were carried out using Chi-square test.

RESULTS:

Comparison of the finger print patterns of **male subjects** showed that except for finger print patterns on ring finger there was statistically significant difference in prints patterns of thumb, index finger and middle finger between case group and the control group ($p < 0.05$) and statistically high significant difference was observed between print patterns of little fingers ($p < 0.01$). Loops were the most common patterns in the cases followed by arches (loops>arches>whorls) while in the control group, whorls were more common (whorls>arches>loops) (Table 1). Among **females** no significant difference was observed in prints patterns of all the fingers on right and left hand between case group and the control group ($p > 0.05$). Loops were the most common pattern in the cases followed by arches and whorls (loops>arches>whorls) while in the control group, loops were more common (loops> arches> whorls). (Table 2)

Quadrant wise comparison of **upper lip print patterns** between the cases and controls showed statistically significant difference in patterns of upper right quadrant (URQ p-value = 0.01) and upper middle quadrant (UMQ p-value = 0.003) (Table 3). When quadrant wise comparison of the **lower lip print patterns** was done, a high statistically significant difference was observed between cases and control group in the lower right quadrant (LRQ p-value = 0.0001) and lower middle quadrant (LMQ p-value = 0.0001). (Table 4)

Among cases type IIa, IIb and type O was predominantly observed while in controls type I and I' was predominant (Table 3 and 4). On comparison of the 'atd angle' of the right hand and left hand in cases and controls, asymmetry of atd angle was more common in case group as compared to the control group which was statistically highly significant. (p = 0.0001) (Table 5)

Table 1: Comparison of finger print patterns between Male cases and controls

Digit	Side	Study group			Control group			P -value
		arches	Loops	whorls	Arches	Loops	whorls	
thumb	right	10 (50%)	15 (71.4%)	6 (30%)	10 (50%)	6 (28.6%)	14 (70%)	0.030*
	left	8 (42.1%)	18 (78.3%)	5 (26.3%)	11 (57.9%)	5 (21.7%)	14 (73.7%)	0.002*
Index finger	right	13 (68.4%)	14 (53.8%)	4 (25%)	6 (31.6%)	12 (46.2%)	12 (75%)	0.035*
	left	13 (76.5%)	14 (50%)	4 (25%)	4 (23.5%)	14 (50%)	12 (75%)	0.013*
Middle finger	right	16 (66.7%)	10 (52.6%)	5 (27.8%)	8 (33.3%)	9 (47.4%)	13 (72.2%)	0.044*
	left	17 (68%)	10 (50%)	2 (10%)	8 (32%)	10 (50%)	12 (75%)	0.027*
Ring finger	right	9 (50%)	13 (65%)	9 (39.1%)	9 (32%)	7 (35%)	14 (60.9%)	0.238
	left	12 (54.5%)	13 (65%)	6 (31.6%)	10 (45.5%)	7 (35%)	13 (68.4%)	0.103
Little finger	right	14 (56%)	13 (81.2%)	4 (20%)	11 (44%)	3 (18.8%)	16 (80%)	0.001*
	left	16 (64%)	15 (83.3%)	0 (0%)	9 (36%)	3 (16.7%)	18(100%)	0.0001**

Table 2: Comparison of finger print patterns between female cases and controls

Digit	Side	Study group			Control group			P -value
		arches	Loops	whorls	Arches	Loops	whorls	
thumb	right	13 (52%)	13 (50%)	6 (50%)	12 (48%)	13 (50%)	6 (50%)	0.988
	left	12 (44.4%)	16 (51.6%)	4 (80%)	15 (55.6%)	15 (48.4%)	1 (20%)	0.341
Index finger	right	11 (45.8%)	21 (60%)	0 (0%)	13 (54.2%)	14 (40%)	4 (100%)	0.062

	left	12 (44.4%)	20 (57.1%)	0 (0%)	15 (55.6%)	15 (42.9%)	1 (100%)	0.362
Middle finger	right	20 (62.5%)	9 (39.1%)	3 (37.5%)	12 (37.5%)	14 (60.9%)	5 (62.5%)	0.168
	left	18 (64.3%)	8 (30.8%)	6 (66.7%)	10 (35.7%)	18 (69.2%)	3 (33.3%)	0.02*
Ring finger	right	17 (56.7%)	13 (43.3%)	2 (66.7%)	13 (43.3%)	17 (56.7%)	1 (33.3%)	0.500
	left	15 (51.7%)	13 (44.8%)	4 (80%)	14 (48.3%)	16 (55.2%)	1 (20%)	0.345
Little finger	right	9 (37.5%)	19 (57.6%)	4 (66.7%)	15 (62.5%)	14 (42.4%)	2 (33.3%)	0.234
	left	9 (37.5%)	17 (54.8%)	6 (75%)	15 (62.5%)	14 (45.2%)	2 (25%)	0.151

Table 3: Comparison of upper lip print patterns between cases and controls

Type of lip print pattern	URQ			UMQ			ULQ		
	Cases	controls	p-value	Cases	controls	p-value	Cases	controls	p-value
Type I	6 (9.5%)	12 (19.7%)		3 (4.8%)	3 (4.9%)		2 (3.2%)	3 (4.9%)	
Type I'	7 (11.1%)	5 (8.2%)		4 (6.3%)	12 (19.7%)		10 (15.9%)	7 (11.5%)	
Type II a	19 (30.2%)	8 (13.1%)		19 (30.2%)	11 (18%)		11 (17.5%)	8 (13.1%)	
Type II b	9 (14.3%)	7 (11.5%)		14 (22.2%)	11 (18%)		21 (33.3%)	13 (21.3%)	
Type II c	7 (11.1%)	3 (4.9%)	0.01*	1 (1.6%)	6 (9.8%)	0.003**	6 (9.5%)	3 (4.9%)	0.162
Type III	2 (3.2%)	11 (18.0%)		1 (1.6%)	8 (13%)		6 (9.5%)	11 (18%)	
Type IV	8 (12.7%)	3 (4.9%)		6 (9.5%)	5 (8.2%)		5 (7.9%)	5 (8.2%)	
Type V	3 (4.8%)	6 (9.8%)		1 (1.6%)	2 (3.3%)		1 (1.6%)	6 (9.8%)	
Type O	2 (3.2%)	6 (9.8%)		12 (25.5%)	3 (4.9%)		1 (1.6%)	5 (8.2%)	

Table 4: Comparison of lower lip print patterns between cases and controls

Type of lip print pattern	LRQ			LMQ			LLQ		
	Cases	controls	p-value	Cases	controls	p-value	Cases	controls	p-value
Type I	4 (6.3%)	5 (8.2%)	0.0001*	1 (1.6%)	3 (4.9%)	0.0001**	3 (4.8%)	4 (6.6%)	0.062
Type I'	12 (19%)	7 (11.5%)		3 (4.8%)	5 (8.2%)		11 (17.5%)	14 (23%)	
Type II a	19 (30.2%)	5 (8.2%)		13 (20.6%)	9 (14.8%)		18 (28.6%)	4 (6.6%)	
Type II b	20 (31.7%)	10 (16.4%)		17 (27%)	12 (19.7%)		13 (20.6%)	14 (23%)	
Type II c	1 (1.6%)	7 (11.5%)		4 (6.3%)	5 (8.2%)		4 (6.3%)	2 (3.3%)	
Type III	0 (0.0%)	8 (13.1%)		1 (1.6%)	9 (14.8%)		4 (6.3%)	6 (9.8%)	
Type IV	0 (0.0%)	8 (13.1%)		2 (3.2%)	7 (11.5%)		8 (12.7%)	9 (14.8%)	
Type V	5 (7.9%)	5 (8.2%)		0 (0%)	6 (9.8%)		0 (0%)	3 (4.9%)	
Type O	2 (3.2%)	6 (9.8%)		22 (34.9%)	5 (8.2%)		2 (3.2%)	5 (8.2%)	

Table 5: Comparison of atd angels of right and left hand between cases and controls

SI No	Atd angle	cases	controls	p- value
1.	Asymmetry	52 (84.1%)	27 (43.5%)	0.0001**
2.	Symmetry	10 (15.9%)	35 (56.4%)	

DISCUSSION:

Cleft lip with or without cleft palate is a common birth defect with complex etiology and a prevalence that varies between 1:500 to 1:2000 in the population (Scott NM, 2005). Cleft lip and palate are associated with dermatoglyphic deviations and the genetic material which codes for cleft lip and palate is inherited by parents. So it is interesting to understand the influence of the parental genome on their lip and finger patterns. The present cross-sectional study was done among 20-40 year old parents with and without non-syndromic cleft lip and palate children who were registered under the Smile Train program. The age group was standardised because a study done by Randhawa K et al showed that the finger and lip print patterns can change over a period of time. (Randhawa K, 2011)

The method of collection of lip prints was done by lipstick method (Williams 1991) as it is most commonly followed method for collecting lip prints and also is economically feasible. For collection of finger and palm prints, Ink method was followed (Durham, Plato 1990) which is the widely accepted method and most commonly followed for recording finger and palm prints. After collecting the lip prints, the lips were divided into six topographical areas as given by Hassan and Fahmy (1977) and the patterns were classified according to the Afaf's modification of Suzuki and Tsuchihashi classification (1970) for the analysis. Various authors have used different criteria to assess the lip print patterns. The use of varying criteria with lack of clear definitions led us to select Afaf's modification of Suzuki and Tsuchihashi classification (1970) for evaluation of lip prints, which is relatively simple to follow.

Comparison of finger print patterns between male cases and controls showed that loops were the most common patterns in the cases followed by arches (loops>arches>whorls) while in the control group, whorls were more common (whorls>arches>loops). These findings were similar to the studies done by Saxena RS et al., Woolf and Gianas where loops and arches were found to be more common in the parents of the children having cleft lip and palate. (Saxena RS, 2013; Woolf and Gianas 1976, 1977). Other studies done by (Jahanbin A, 2010) and (Neiswanger K, 2002) showed no significant difference between the finger print patterns in the parents of the children with and without cleft lip and palate.

On comparison, there was no significant difference observed in the patterns of females cases and controls (loops>arches>whorls). These findings were similar to the study done by (Neiswanger K, 2009) and (Scott NM, 2005) where he found that there was increased frequency of loops and decreased frequency of whorls in female cases and controls which were not statistically significant. There was more asymmetry between the mean atd angles in cases as compared to the controls in the present study. These findings were similar to the studies done by (Gianas, 1977; Jahanbin A, 2010 and Neiswanger K, 2002) where asymmetry was significantly different between cases and controls with cases having more asymmetry. A study done among Chinese population by Neiswanger et al in 2002 showed that there was no significant differences in asymmetry for 'atd angles'.

There was significant difference in patterns of upper right quadrant and upper middle quadrant between cases and controls. Type IIa was the predominant pattern found in cases in upper right quadrant and for controls type I was predominant. For the upper middle quadrant type IIa was common in cases and type I' for controls while there was no significant difference between the lip print patterns among cases and controls in the upper left quadrant. These findings were in accordance with the results of the study done by Saad et al in which type II and type O pattern was predominant in the upper lip of

cases (Saad W, 2005) and Annie J et al where they found type II pattern predominant among the upper lip of the parents of the children having cleft lip and palate.(Annie J, 2011) Studies done by Annie J et al in kerala population showed contradictory results in which type IV was the predominant pattern in middle portion of the upper lip of the cases. (Annie J, 2010)

When quadrant wise comparison of the lower lip print patterns was done, significant difference was observed between cases and control group in the lower right quadrant and lower middle quadrant. Type IIb was found to be common in cases and controls in the lower right quadrant whereas type O was common in cases and type IIb was common in controls in lower middle quadrant. (Saad W, 2005) These findings were similar by a study done by Vahanwala et al in 2000 where type I pattern was predominant among the lower lip in the cases. (Vahanwala SP, 2000)

CONCLUSIONS: Among males loop was the most common pattern in the cases followed by arches (loops>arches>whorls) while in the control group, whorl was more common (whorls>arches>loops). Among mothers no significant difference was observed in finger print patterns on right and left hand between case group and the control group. Type IIa and type IIb and type O lip print patterns was common among cases while type I and I' was common among controls. Asymmetry of atd angels was found to be more common among cases as compared to the controls. Types IIa and IIb lip patterns, asymmetry of atd angles can be considered as genetic markers for the transmission of CLCP deformity to off springs.

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