Original Article

Correlation of dental caries and dermatoglyphic patterns: A study in pediatric population

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Abstract

Introduction: Dental caries is the most prevalent chronic disease among children worldwide irrespective of the advancements in oral healthcare. The basis of considering dermatoglyphic patterns as marker for dental caries is that the epithelium of finger buds and enamel are both ectodermal in origin and develop during the same period of intrauterine life. **Aim and Objective:** To record and evaluate the dermatoglyphic patterns, its correlation with early childhood caries (ECC) and to predict its efficacy in assessing the caries risk. **Method:** The study was carried out on 100 school going children within the age group of 36–71 months. Study population was divided into two groups comprising of 50 individuals each on the basis of def score, experimental group (def ≥ 1) and control group (def score 0). Dermatoglyphic patterns of all ten palmar digits were recorded using Cummins and Midlo method and assessed using a magnifying glass (2×). **Results:** Statistically significant increase in number of whorls was found in ECC group, whereas higher number of loops was seen in control group. In ECC group, value of both, the mean axial t triradius angle and mean total ridge count was low as compared to the caries-free group. **Conclusion:** There is definite variation in dermatoglyphics between the ECC and caries-free group, indicating that dermatoglyphic patterns can be used as a non-invasive predictive tool for children with ECC.

Keywords: Caries susceptibility, dermatoglyphics, pediatric dentistry

Introduction

The study of the human hand has always been fascinating, and it has intrigued not only anthropologists and physicians, but also psychologists, writers, painters, sages and chiromancers.[1] 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. Dermatoglyphic analysis is now beginning to prove itself as an extremely useful tool for preliminary investigations into conditions with a suspected genetic basis.[2]

Harold Cummins hailed as the "Father of Dermatoglyphics," coined the term dermatoglyphics along with Midlo in the year 1926.[3,4] The term "dermatoglyphics" refers to study of intricate dermal ridge configurations on the skin covering the palmar and plantar surfaces of hand and feet.[5] Dermal patterns once formed remain constant throughout life.[6] The dermal ridges are largely genetically determined, but are also subjected to alteration when combined genetic and local environmental modifications exceed certain threshold level during the

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critical period of ridge differentiation. Dermatoglyphic patterns have also been used to predict genetically related disorders, such as Down's syndrome, Alzheimer's disease, multiple sclerosis, congenital spinal cord anomalies, cleft lip, cleft palate, periodontal diseases, bruxism, malocclusion and oral submucous fibrosis.[7-12]

Dental caries is an infectious disease of multifactorial origin, with genetic susceptibility being one of the influencing factors. The application of dermatoglyphic patterns for dental diseases, such as dental caries, is rationalized due to the similarities of environmental and genetic factors between teeth and skin during their development. During embryogenesis, the ridged skin and teeth develops from the same ectodermal layer between 6th and 7th week of intrauterine life. This may suggest that the genetic information contained in the genome is dissipated during this period, and any disturbance affecting tooth development and structure may be simultaneously reflected through changes in dermatoglyphic patterns or vice versa.[13]

Early childhood caries can be described as "the presence of one or more decayed (non-cavitated or cavitated lesions), missing teeth (due to caries), or filled tooth surfaces in any primary tooth in a child of 72 months age or younger."[14] This can be deemed as an international public health problem, the detrimental effect of which can have immediate and long-term effect. It can also have significant social and economic consequences on the child's and family's lives as the cost of treatment increases with the severity of disease.[14] Moreover, the progressive nature of this lesion can result in pain, difficulty in eating and speaking, thus affecting the general health of the child. Hence, prevention at the primary level can help in curbing this entity, thus resulting in betterment of the quality of life of children. Preventive measures like modification of infant diet and feeding habit by educating the parents and health givers can be of help.[15] In addition, visiting the dentists and intervention at this initial stage can be very useful.

The present study was hence designed to evaluate the correlation between dermatoglyphic patterns and dental caries by analyzing the fingerprint patterns of subjects with and without dental caries, which can be used as a cheap, non-invasive screening tool and thus be used in primary prevention.

Material and Methods

The present study was conducted on 100 school going children from Patna, Bihar. Procedure of the study was explained to the school authorities and consent was obtained prior to the commencement of the study. Institutional ethical clearance was also obtained.

Study population

Study population included children attending school during dental camps, belonging to the age group of 36–71 months.

Study design

The study sample comprised of 100 children aged between 36 and 71 months. Study population was divided into two groups comprising of 50 individuals each on the basis of def score, experimental group (def ≥1) and control group (def score 0).

Dermatoglyphic pattern recording and interpretation

Cummins and Midlo's ink method was used to record finger and hand prints.[1] Children's hands were cleaned with soap and water and then an antiseptic lotion was used to eradicate any dirt and oil from the ridged skin. Finally, hands were air dried in order to improve the quality of finger and palm prints.

Finger and palm prints

Black duplicating ink pad was used to record finger prints (both right and left hand) of all the subjects. The student's right palms were pressed against the ink pad, guided and pressed tightly against the white bond paper clipped on to a hard board which was kept firm, followed by pressing it firmly against the bond paper 2-3 times; because the second or third recording was satisfactory and readable. The same procedure was repeated for the left hand. Caries experience of children was measured using def index.

Method of reading handprints

The handprints obtained were checked for their clarity with a magnifying glass (×2×) and coded. The presence of core and the tri radii of the dermatoglyphic pattern were checked thoroughly to include the handprint in the study. A total of 1000 digital prints and 200 palmar prints were obtained.

Analysis of fingerprint patterns:[2,3,5,13]

Predominantly three dermatoglyphic patterns were observed in fingertips, arch pattern, loop pattern, and whorl pattern.[3] In addition, axial t triradius (ATD) angle and total ridge counts (TRC) were also calculated in the subjects.

1) **Arches:** These are characterized by succession of more or less parallel ridges, which traverse the pattern area and form a curve that is concave proximally and crosses the fingertip from one side to the other without recurving [Figure 1]. These patterns usually do not show the presence of triradii, except when the tented arch is present that will have a triradii point near its midline.
2) **Loops:** In this pattern, a series of ridges enter the pattern area on one side of the digit, recurve abruptly, and leave the pattern area on the same side. A loop has a single triradius or confluence point of ridges [Figure 1]. Loops may vary considerably in shape and size.
3) **Whorl:** A whorl has concentric arrangement of ridges, with two or more triradii [Figure 1]. Whorls may be spiral, symmetrical, double looped, central-pocketed, or accidental.
4) **"ATD" angle:** A feature of the palm that captures the relative position of three triradii-a and d, usually located on distal palm just inferior to the 2nd and 5th fingers, respectively and t whose location can vary on the proximal palm from just distal to the wrist, up to the center of the palm. ATD angles

were measured for each palm print by drawing two straight lines through the "a" and "t" triradii and the "d" and "t" triradii and measuring the resulting angle [Figure 2]. The atd angles were compared and assessed for increase or decrease in mean frequencies between the groups.

5) **Total ridge count:** Ridge count was done by drawing a line from the triradius to the center of the pattern and determining the number of intersected ridges between these two points [Figure 2]. Arches score zero because they have no triradii and thus there are no ridges to count. A loop has one triradius. In whorls, which have two triradii, counts are made from each triradii and the larger one is used. A TRC is the summation of the ridge count for all ten fingers. It was assessed for increase or decrease in mean frequencies between the groups.

Statistical analysis

Data were analyzed using SPSS (version 16). Chi-square test was used to test the association between dental status and dermatoglyphic pattern of right and left hand. "*P*" value of less than 0.05 was considered statistically significant.

Results

The evaluation and comparison of patterns in children with ECC and caries-free children in both right and left hands showed a statistically significant increase in number of whorls in ECC group when compared to control group, whereas higher number of loops was found in the control group as compared to ECC group in both hands [Figure 3]. The number of arches in control group was marginally higher as compared to ECC group in both hands. However, this was not statistically significant in right hand ($P = 0.0579$) but significant in left hand ($P = 0.0385$).

The mean ATD angle was found to be higher in control group when compared to ECC group in both hands, which was statistically significant [Figure 4]. Higher TRC of 151.90 ± 14.56 was found in the control group as compared to 130.90 ± 12.77 in the ECC group which was statistically significant [Figure 5].

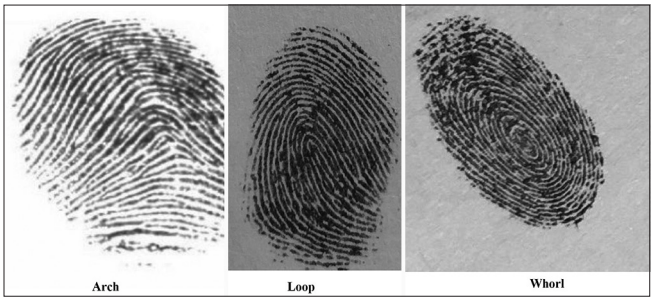

Figure 1: Figure depicting arch, loop, and whorl

Pattern	Group	Mean	Standard deviation	Standard error of Mean	Mean difference	Z	P value
Right Hand							
Whorls	ECC	3.80	1.43	0.20	3.12	-7.417	<0.0001*
	Control	0.68	1.30	0.18			
Arches	ECC	0.28	0.64	0.09	-0.34	-1.901	0.0579
	Control	0.62	1.01	0.14			
Loops	ECC	0.92	1.32	0.19	-2.78	-7.009	<0.0001*
	Control	3.70	1.47	0.21			
Left Hand							
Whorls	ECC	3.64	1.45	0.21	3.00	-7.615	<0.0001*
	Control	0.64	1.12	0.16			
Arches	ECC	0.30	0.65	0.09	-0.64	-2.073	0.0385*
	Control	0.94	1.52	0.21			
Loops	ECC	1.06	1.33	0.19	-2.36	-5.991	<0.0001*
	Control	3.42	1.73	0.24			
*Denotes significant difference							

Figure 3: Table showing evaluation and comparison of patterns in children with ECC and caries-free children

Discussion

Dental caries is a chronic, complex, multi factorial disease, the occurrence of which is influenced by a variety of factors including host and environmental interplay. Numerous host factors for dental caries have been proven to be genetically determined.[16] Similarity in the caries patterns among family members have been seen over several generations and hence, inheritance of this susceptibility is suspected. Genetic variations in the host factors may contribute to increased risk of dental caries. The dermatoglyphic patterns can be used as an early predictor for detection of caries in children, as these are unique, based on the genetic constitution of an individual and remain constant throughout.[17]

Dermatoglyphic interpretation of patterns in the digits of caries-free children in this study showed maximum loops followed by whorls and arches in both right and left hands, whereas the ECC group showed maximum occurrence of whorls followed by loops and arches. These findings were in accordance with studies done by Madan *et al.*, Atasu, Sharma and Somani, and Ahmed *et al.* who found an increased frequency of ulnar

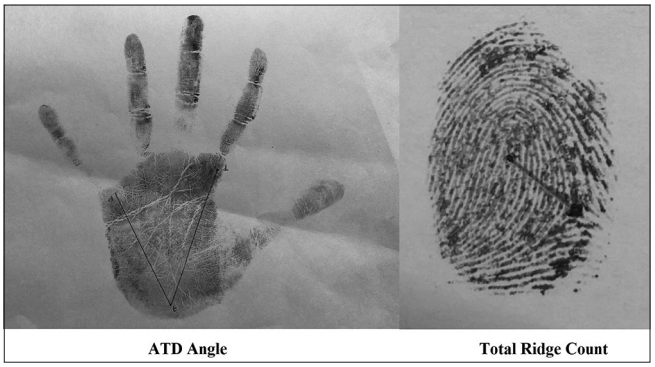

Figure 2: Figure showing ATD angle and total ridge count

Group	Mean	Standard deviation	Standard error of Mean	Mean difference	Z	P value
Right Hand						
ECC	48.42	3.42	0.48	-8.63	-7.346	<0.0001*
Control	57.05	3.33	0.47			
Left Hand						
ECC	49.82	3.89	0.55	-6.24	-6.645	<0.0001*
Control	56.06	3.10	0.44			
*Denotes significant difference.						

Figure 4: Table showing evaluation and comparison of ATD angle in children with ECC and caries-free children in both right and left hands

Group	Mean	Standard deviation	Standard error of Mean	Mean difference	Z	P value
ECC	130.90	12.77	1.81	-21.00	-6.509	<0.0001*
Control	151.90	14.56	2.06			
*Denotes significant difference.						

Figure 5: Table showing comparison of TRC (total ridge count)

loops in caries-free children and an increased frequency of whorls in children with dental caries.[3,17-19] The ATD was wider in the control group (>56°) than in ECC group (between 45° and 56°); this is in agreement with Atasu, where the caries-free children had more t triradii than that of the children with extensive caries.[17] Ahmed *et al.* studied the correlation between dermatoglyphics and dental caries and found that the ATD angle was >56° in the control group, whereas in the experimental group it was between 45° and 56°.[19] The ridge count for each finger of an individual was found and the total ridge was count obtained by adding the values for all ten fingers. The quantitative analysis of the TRC in caries-free was higher when compared to the ECC group. Similar findings were reported by Atasu, Madan *et al.* and Ahmed *et al.*[3,16,19]

In the present study, we found that the children with dental caries showed an increase in whorl patterns on the distal phalanges of the ten fingers, a decrease in the ATD angle and TRCs as compared to the normal children which indicates the degree of developmental instability of the study group. A definite correlation in the dermatoglyphic patterns between children with ECC and caries-free children was seen in this study. Thus, recording the dermatoglyphic patterns of children at an early age, during their first dental visit would prove to be handy in predicting whether the child belongs to the high-risk group or the low-risk group and thereby can aid in planning a definitive preventive and treatment strategy.

Moreover, there was highly statistically significant total finger ridge count of whorls in caries active children, whereas there was highly statistically significant total finger ridge count of loops in caries-free children. These results were in concordance with results obtained by Sengupta *et al.*[20]

Kaur *et al.* explored the unique relationship between dermatoglyphics and dental components to identify children at particular risk of dental decay in the 6-12 years of age group and reported subject group to have a decreased frequency of loops, whereas control group had increased frequency of loop pattern on palmer digits, a finding similar to our study.[21] Deepti *et al.* performed a study to check the role of dermatoglyphics in dental caries and reported an increased frequency of loops in right hand digit 3 and 5 (middle and little finger) in caries positive participants, a finding not in concordance with our study.[22] Reddy *et al.* evaluated and compared the correlation between dermatoglyphic peculiarities and caries experience in special children ranging in the 6–16 years age group and reported the frequency of whorls to be more in caries group than in the caries-free group, a finding similar to ours.[23] Similar results were also obtained by Sanghani *et al.*[24]

Similar studies have also been done in adult population. Chinmaya *et al.* assessed the relationship between fingerprint patterns and dental caries in 18–26 years age group of students and reported dental caries experience to be the highest among students with whorl pattern followed by the central pocket loop and least among students with loop pattern.[25] Veeresh *et al.* studied the correlation between dermatoglyphics, dental caries, and salivary pH and concluded that caries free people showed inflated frequency of loops, whereas subjects with high decay score had additional share of whorls. They also reported the total ridge count to be higher in individuals with high decayed missing filled teeth (DMFT) score.[26] Similar results were also reported by Shetty *et al.*[27] The results obtained by all of these studies are in accordance with our study.

Sharma *et al.* undertook a study to establish link between dental caries and dermatoglyphics. They reported whorl pattern to be more common in individuals with caries as compared to the caries-free individuals who exhibited more loop pattern, finding similar to our study. They also reported that as the number of loops increased, counts of both *Streptococcus mutans* and *Lactobacilli* decreased, whereas the whorls increased so did the counts of *Streptococcus mutans* and *Lactobacilli*.[28]

Conclusion

The present study shows a significant association between fingerprint patterns and ECC. This could prove to be a valuable, noninvasive anatomical tool which could be used for screening of ECC and hence in devising measures for prevention of the disease. Further extensive research and studies with larger sample size and varied parameters in the field of dermatoglyphic have to be done in order to evaluate the significance of these variations in the dermatoglyphic features of patients with ECC.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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