Indian Journal of Forensic Medicine and Pathology
Volume 7 Number 1, January - March 2014

Original Article

Dermatoglyphics and Dental Caries: A Cross Sectional Study among 12 Year Old School Children in Mangalore, India

Vaibhav P. Thakkar*, Ashwini Rao, Prateek Rastogi***, Ramya Shenoy****, Rajesh G.****, Mithun Pai B.H.*******

Abstract

Aim: To determine if an association exists between dermatoglyphic patterns and occurrence of dental caries among 12 year old school children in Mangalore. **Settings and Design:** A cross sectional study conducted in school settings. **Methods and Material:** A total of 183, 12-year old school children were selected using simple random sampling. Dental caries experience was assessed using the Decayed, Missing and Filled Tooth index. Dermatoglyphic patterns of the fingers and the total ridge count were recorded using the ink stamp pad method and analysed using a 2x magnifying glass. **Statistical Analysis Used:** Chi-square test and one way ANOVA were used for statistical analysis of collected data. **Results:** The mean DMFT score of this population was 2.83 ± 2.53 whereas mean dmft score was 0.84 ± 1.64. Chi-square analysis showed a statistically significant frequency of whorls in the 2nd finger in children with a dental caries experience of more than 3 ($p<0.05$). The total ridge count also showed a statistically significant relation with dental caries experience, when the one way ANOVA test was used ($p<0.05$). In children with higher dental caries experience, the total ridge count was less and vice versa. **Conclusions:** Dermatoglyphic patterns and total ridge count could be a novel method to determine the population at risk for dental caries, thus providing a vital component in the search for an acceptable, accurate and cost-effective predictor for identifying high risk individuals.

Keywords: Caries risk assessment; Dermatoglyphics; Dental caries; School children.

Introduction

For ages, features of hands have fascinated scholars, sages, theologians, doctors and laymen alike. Dermatoglyphics, a terminology coined by Harold Cummins and Charles Mildo in 1926, is a science, which involves the study of fine patterned dermal ridges on digits, palms and soles.[1]

Authors affiliation: *Post Graduate Student, **Professor and Head, Dept. of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University, Mangalore, ***Associate Professor, Dept. of Forensic Medicine and Toxicology, Kasturba Medical College, Manipal University, Mangalore India, ****Associate Professor, *****Assistant Professor, Dept. of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University, Mangalore, Karnataka, India.

Reprints requests: Dr. Ashwini Rao, Professor and Head, Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University, Mangalore, Karnataka, India.

E-mail: ashwini.rao@manipal.edu

The pattern of ridges formed on the tips of human fingers has long been regarded as unique to each individual. These dermal patterns once formed, remains constant throughout the life of an individual.[2] Dermatoglyphic patterns have proved to be of diagnostic value in certain disorders like mongolism, Turner's syndrome, cardiovascular disease, diabetes, bronchial asthma and schizophrenia.[3-6]

Genetic contribution to the development of dental diseases has been an area of interest for many years. Dental caries is the major disease of dentistry and genetic factors play an appreciable part in determining individual resistance against dental caries. Studies have provided convincing evidence for a marked genetic component to dental status and dental caries experience.[7-15]

The basis of considering dermatoglyphic patterns as a marker for dental caries is that in the embryonic period, tooth formation and the formation of finger ridge patterns begins

and ends at about the same time. The dermal ridges of the hand take their origin from the foetal volar pads which appear in the 6th-7th week of embryonic life, at the same time as that of tooth formation in intraembryonic life. They occur as mound-shaped elevations of the mesenchymal tissue situated above the proximal end of the most distal metacarpal bone on each finger, in each interdigital area. The type of arrangement of ridge patterns on the fingers is determined by the size and position of these volar pads.[2]

The ridge patterns are completed by 12th-14th week of gestation, i.e. at the same time as that of tooth formation completion in the embryonic life.[6] Therefore it may be hypothesised that hereditary and environmental factors leading to dental caries may also cause peculiarities in fingerprint patterns.

This led to the conception of the present study with the aim of determining if dermatoglyphic patterns are associated with the occurrence of dental caries among 12 year old school children.

Materials and Methods

The present study was a cross sectional descriptive study conducted on 183, 12 year old school children of Mangalore, a coastal city of India, which has a high prevalence of dental caries.[16]

Ethical clearance to conduct the study was obtained from the Institutional Ethics Committee of Manipal College of Dental Sciences, Manipal University, Mangalore (Ref No: 11076 dated4 August 2012). Permission to conduct the study was acquired from the head of the institution and the principal of the selected schools and informed consent was taken from the parents of the participants.

The sampling frame consisted of all the schools in Mangalore out of which 5 schools were selected by simple random sampling technique (lottery method).

Calibration was done with an expert in forensic medicine, to assess the inter-examiner reliability in identification of dermatoglyphic patterns using the Kappa statistic.[17] The Kappa values obtained were 0.937 for fingerprint pattern identification and 0.784 for Total Ridge Count (TRC) calculation.

All the children aged 12 years of age as on their last birthday present in the selected schools on the day of examination, formed the sample. Children with special health care needs and those with genetic disorders (including cleft lip and palate syndromes) were excluded from the study.

The selected children were divided into three groups based on their highest Decayed, Missing and Filled Tooth Index[18] score for permanent (DMFT Index) and primary teeth (dmft Index).The division was done into following groups: Group A (Index score 0), Group B (Index score 1-3) and Group C (Index score more than 3).[19] Data collection was done over a period of 4 weeks in the month of September 2012.

An interview schedule was used to obtain information about dietary preferences and the oral hygiene practices followed by the children. These were elicited by face to face interview during the examination at school.

The caries experience of the children was recorded using the DMFT/dmft Index. The WHO criteria[20] was used for diagnosing dental caries. Examination was carried out beginning from the maxillary right quadrant and proceeding in a clockwise direction to the mandibular right quadrant. A trained recorder helped in recording the data.

Dermatoglyphic patterns of the digits of both hands were recorded using the Cummins and Mildo method.[21] Children's palms were scrubbed thoroughly with an antiseptic solution and were allowed to dry. The digits were then pressed firmly on an ink pad with the little finger first followed by the ring finger, middle finger, index finger and finally the thumb for each participant. Prints were obtained on bond paper by applying stable and adequate pressure. The same process was repeated for the left hand on a different sheet

of paper. Using this method three recordings were done to get acceptable and legible prints.

The dermatoglyphic patterns were then analysed to determine the loops, arches, whorls and the total ridge count.[22] The Total Ridge Count was determined by drawing a square of 5 mm X 5 mm on a thin transparent sheet which was placed on the recorded fingerprint (Figure 1). It was then observed under a magnifying glass and the number of ridges passing through the square drawn on the sheet is counted. The drawn box (25 mm^2) was placed on the same area of all the recorded digits to obtain standardised readings.[23-26]

The data was coded and analysed using the SPSS version 11.5. The level of statistical significance was kept at $p \leq 0.05$. Chi-square test and ANOVA were used for statistical analysis of collected data.[27]

Table I: Descriptive Statistics of the Study Population

Gender	
Male	97(53.1%)
Female	86(46.9%)
Brushing with toothpaste	
Once a day	92 (50.3%)
Twice a day	91(49.7%)
Diet	
Veg	37(20.2%)
Mixed	146(79.8%)

Results

The study was conducted on 183, 12 year old school children of Mangalore. Gender wise distribution of the population showed that the number of males and females in this study were 97 (53%) and 86 (47%) respectively. All the participants used toothbrush and toothpaste with half of the subjects brushing once a day and the other half brushing twice a day. Almost 80% of the subjects belonged to the mixed diet group and the remaining 20% were vegetarians (Table I).

The mean DMFT score of this population was 2.83 ± 2.53 whereas mean dmft score was 0.84 ± 1.64. The mean number of decayed teeth were 2.77 and the mean number of filled teeth were 0.05 in the permanent dentition and the mean number of decayed teeth and filled teeth were 0.81 and 0.02 in the deciduous dentition respectively. No subject had teeth missing due to caries. The prevalence of dental caries was found to be 84%.The study sample was divided into three groups based on their dental caries experience. A total of 29 children with no dental caries were categorized into group A, 77 children with a dental caries experience of 1-3 to the group B and 77 children with a dental caries experience of more than 3 to the

Table II: Gender-Wise Distribution Based on the Dental Caries Experience

Gender	Group A No dental caries	Group B Dental caries experience of 1 - 3	Group C Dental caries experience of >3	Total
Male	16	40	41	**97**
Female	13	37	36	**86**
Total	**29**	**77**	**77**	**183**
Not Statistically significant				

Table III: Dermatoglyphic Patterns and the Dental Caries Experience

GROUPS	LOOPS	ARCHES	WHORLS	Total
Group A (No dental caries)	149 (51.4%)	29 (10%)	112 (38.6%)	**290**
Group B (Dental caries experience of 1 – 3)	465 (60.4%)	35 (4.5%)	270 (35.1%)	**770**
Group C (Dental caries experience >3)	470 (61%)	41 (5.3%)	259 (33.7%)	**770**
Total	**1084**	**105**	**641**	**1830**
Not Statistically significant				

Table IV: Finger-wise Distribution of Dermatoglyphic Patterns and Dental Caries Experience in the Permanent Dentition

	Finger	Group A (No dental caries)	Group B (Dental caries experience of 1 – 3)	Group C (Dental caries experience of >3)
Right Hand	1	Loop	Loop	Loop
	2	Whorl	Whorl	Whorl
	3	Loop	Loop	Loop
	4	Whorl	Loop	Whorl
	5	Loop	Loop	Loop
Left hand	1	Loop	Loop	Loop
	2	Loop*	Whorl	Whorl
	3	Loop	Loop	Loop
	4	Whorl	Loop	Loop
	5	Loop	Loop	Loop
* Statistically significant at $p < 0.05$				

Table V: Finger-wise Distribution of Dermatoglyphic Patterns and Dental Caries Experience in the Deciduous Dentition

	Finger	Group A (No dental caries)	Group B (Dental caries experience of 1 – 3)	Group C (Dental caries experience of >3)
Right Hand	1	Loop	Loop	Loop
	2	Loop	Loop	Whorl*
	3	Loop	Loop	Loop
	4	Loop	Loop	Loop
	5	Loop	Loop	Loop
Left hand	1	Loop	Loop	Loop
	2	Loop	Loop	Whorl*
	3	Loop	Loop	Loop
	4	Whorl	Loop	Loop
	5	Loop	Loop	Loop
* Statistically significant at $p < 0.05$				

Table VI: Mean Total Ridge Count (TRC) Values among Groups

Groups	N (Total fingers)	Min	Max	Mean (SD)
Group A (No dental caries)	290	8	28	17.10* (3.27)
Group B (Dental caries experience of 1 – 3)	770	8	29	14.43*(2.92)
Group C (Dental caries experience >3)	770	7	25	14.12*(3.02)
*One way Anova between groups significant at 0.05 level				

group C (Table II).

When the 10 fingers of the183 children were analysed, we got a total of 1830 dermatoglyphic patterns, out of which, 1084 were loops, 641 were whorls and 105 were arches (Table III).When the patterns were compared between the three groups, we found that the frequency of loops was higher in the high caries group (Group C) whereas the frequency of arches and whorls were higher in the no caries group (Group A). However, this finding was not statistically significant

Table VII: Within Groups Analysis Using Post Hoc Tukey's Test		
Between	**Standard error**	**P value**
Group A & Group B	0.208	0.000*
Group A & Group C	0.208	0.000*
Group B & Group C	0.154	0.108*
***Significant at 0.001 level**		

(Table III).

Gender-wise analysis using the Chi-square test showed no statistically significant association between dermatoglyphic patterns and dental caries experience.

When the finger wise distribution of dermatoglyphic patterns were compared with the dental caries experience in the permanent dentition, we found that the presence of a loop in the second finger (ring finger) of the left hand was associated with no caries whereas whorls were more commonly associated with dental caries and this was found to be statistically significant (Table IV).

Table V shows the finger wise distribution of dermatoglyphic patterns when compared with the dental caries experience in the deciduous dentition. Here we found that the presence of whorls in the second finger (ring finger) of both the right as well as the left hand was associated with high dental caries experience and this was found to be statistically significant.

Table VI shows the mean Total Ridge Count (TRC) values of the population. The mean TRC values were higher (17.1) in the no caries group (Group A) when compared to the TRC values of 14.43 and 14.12 in Group B and Group C respectively. Analysis using the one way ANOVA found a statistically significant relation. The TRC value was found to decrease with an increase in the caries experience among the study participants (Table VI).

Within group analysis done using Post Hoc Tukey's test showed that there was a statistically significant difference in TRC values between Group A and B, Group A and C but not between Group B and C. These values indicate that high TRC values were associated with low caries experience and low TRC values with high caries experience (Table VII).

Discussion

Dermatoglyphics has been a useful guide and a powerful tool in understanding basic questions in biology, medicine, genetics and evolution, apart from being the best method for personal identification. In the same context, dermatoglyphics might be used as a valuable tool in determining the population at risk for dental caries. Host factors like the structure of dental enamel, immunologic response to cariogenic bacteria, or the composition of saliva are the factors that affect the development of dental caries in an individual. Genetic variations in the host may contribute to increased risks for dental caries.[9]

A total of 183 children aged 12 years participated in this study. The age group of 12 year olds was selected for this study as it is generally the age at which children leave primary school and the last age at which reliable sample may be obtained easily through the school system. This age group is also the global monitoring age for dental caries for international comparisons and monitoring of disease trends.[20]

The prevalence of dental caries was found to be 84% which was found to be very high compared to the study by Suprabha *et al.*[16] The children were divided into three groups based on their dental caries experience.[19] The number of children with highest DMFT/dmft scores in the three categories was 29, 77 and 77 respectively.

When the 1830 dermatoglyphic patterns of 183 children were analysed, we found an increased frequency of loops among this study

population. However, on individual finger analysis it was seen that whorls were seen with increased frequency in children with high dental caries experience and it was found to be statistically significant. Similar findings were reported by other studies.[1,5,28] Atasu [28]in his study stated that students with dental caries had more whorls on their fingertips whereas Madan *et al*[1] reported that although the maximum occurrence of whorls were seen in the dental caries group, the prevalence was found to be higher on the 3rd digit (ring finger) of the left hand in females and in the 3rd digit (ring finger) on the right hand in males. Abhilash *et al*[5] reported that dental caries susceptibility of an individual increases with an increase in the incidence of whorl pattern.Bhat *et al* [29] in their study also found the frequency of whorls to be more in the caries group and the frequency of loops to be more in the caries free group. The increased frequency of occurrence of whorl pattern on 2nd finger (ring finger) of children with high caries experience in our study was inaccordance with the results of the previous studies by Atasu[28], Madan *et al.*[1] and Abhilash *et al.*[5] This association was true for both primary and permanent dentition in our study. When the Total Ridge Count (TRC) was analysed, an inverse relation was observed between the Total Ridge Count (TRC) and dental caries experience. One way ANOVA was significant between mean TRC values and high caries experience in both primary and permanent dentition. Hence, the present study demonstrates that TRC values decreased significantly with an increase in caries experience. This finding was corroborated in other studies where it was shown that Total Ridge Count (TRC) values are inversely related to dental caries experience.[1,5,28]

Conclusions

Dental caries if not controlled in the early phase may lead to harmful consequences. In children it can be a major reason for the loss of school hours. The disability associated with advanced dental carious lesions is also severe. Establishing a basis for the genetic contribution to dental caries will improve our understanding of the complexity of dental caries pathogenesis and provide an opportunity to link patterns of inheritance with susceptibility to dental caries.

Further studies in this area, on well-characterized populations with clearly defined dental caries prevalence, taking into consideration all the confounding variables, will be required to analyse the relationship between dermatoglyphics and dental caries in depth.If the science of dermatoglyphics could be used for predicting dental caries risk, this would then provide a vital component in the search for an acceptable, accurate and cost-effective tool for predicting and preventing dental caries and for promoting oral health.

Key Message

The science of dermatoglyphics may be used to determine the population at risk for the development of dental caries.

References

1. Madan N, Rathnam A, Bajaj N. Palmistry: A tool for dental caries prediction! *Indian J Dent Res.* 2011; 22(2): 213-18.
2. Mathew L, Hegde AM, Rai K. Dermatoglyphic peculiarities in children with oral clefts. *J Indian Soc Pedod Prev Dent.* 2005; 23: 179-82.
3. Barthwal A. Digital dermatoglyphic and blood groups. *Journal of Anatomical Science.* 1986; 8: 42-45.
4. Mahajan A, Gour KK, Thakare AE. Dermatoglyphic patterns in patients of bronchial asthma - a qualitative study. *Int J Biol Med Res.* 2011; 2(3): 806-807.
5. Abhilash PR, Divyashree R, Patil SG, Gupta M, Chandrasekar T, Karthikeyan R. Dermatoglyphics in Patients with Dental Caries: A study on 1250 Individuals. *J Contemp Dent Pract.* 2012; 13(3): 266-274.
6. Okajima M. Development of dermal ridges in the fetus. *J Med Genet.* 1975; 12(3): 243-50.

7. Hassell TM, Harris EL. Genetic Influences In Caries and Periodontal Diseases. *Crit Rev Oral Biol Med.* 1995; 6(4): 319 – 42.
8. Kimura S. Embryologic development of flexion creases. *Birth Defects Orig Artic Ser.* 1991; 27(2): 113-29.
9. Niswander JD. Genetics of common dental disorders. *Dent Clin North Am.* 1975; 19(1): 197-206.
10. Shuler CF. Inherited risks for susceptibility to dental caries. *J Dent Educ.* 2001; 65(10): 1038-45.
11. Conry JP, Messer LB, Boraas JC, Aeppli DP, Bouchard TJ Jr. Dental caries and treatment characteristics in human twins reared apart. *Arch Oral Biol.* 1993; 38(11): 937-43.
12. Mandel ID. Nature vs nurture in dental caries. *J Am Dent Assoc.* 1994; 125(10): 1345-51.
13. Niswander JD. Effects of heredity and environment on development of dentition. *J Dent Res.* 1963; 42: 288-96.
14. Townsend GC, Aldred MJ, Bartold PM. Genetic aspects of dental disorders. *Aust Dent J.* 1998; 43(3): 269-86.
15. Boraas JC, Messer LB, Till MJ. A genetic contribution to dental caries, occlusion, and morphology as demonstrated by twins reared apart. *J Dent Res.* 1988; 67(9): 1150-5.
16. Suprabha BS, Rao A, Shenoy R and Khanal S. Utility of knowledge, attitude, and practice survey, and prevalence of dental caries among 11- to 13-year-old children in an urban community in India. *Glob Health Action.* 2013; 6: 20750.
17. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 1977; 33(1): 159-74.
18. Peter S. Indices in Dental Epidemiology. In, Peter S (Ed). Essentials of Preventive and Community Dentistry, 4th edition. New Delhi: Arya (Medi) Publishing House; 2009, 343-45.
19. Hegde PP, Ashok Kumar BR, Ankola VA. Dental caries experience and salivary levels of Streptococcus mutans and Lactobacilli in 13-15 years old children of Belgaum city, Karnataka. *J Indian Soc Pedod Prev Dent.* 2005; 23(1): 23-6.
20. Oral health surveys - Basic methods. 4th edition. Geneva: World Health Organization; 1997.
21. Cummins H, Keith HK, Midlo C, Montgomery RB, Wilder HH, Wilder IW. Revisedmethods of interpretation and formulation of palmar dermatoglyphics. *Am J Phys Anthr.* 1929; 12: 415-473.
22. Sharma A, Somani R. Dermatoglyphic interpretationof dental caries and its correlation to salivary bacteria interactions: an in vivo study. *J Indian Soc Pedod Prev Dent.* 2009; 27(1): 17-21.
23. Cummins H, Mildo C. Finger prints, Palms and soles. New York: Dover Publications; 1961.
24. Acree MA. Is there a gender difference in fingerprint ridge density? *Forensic Sci Int.* 1999; 102(1): 35-44.
25. Nayak VC, Rastogi P, Kanchan T, Lobo SW, Yoganarasimha K, Nayak S, Rao NG, Pradeep Kumar G, Suresh Kumar Shetty B, Menezes RG. Sex differences from fingerprint ridge density in the Indian population. *J Forensic Leg Med.* 2010; 17(2): 84-6.
26. Nayak VC, Rastogi P, Kanchan T, Yoganarasimha K, Kumar GP, Menezes RG. Sex differences from fingerprint ridge density in Chinese and Malaysian population. *Forensic Sci Int.* 2010; 197(1): 67-9.
27. Hassard TH. Understanding biostatistics. Mosby - year book. Inc. USA, 1991.
28. Atasu M. Dermatoglyphic findings in dental caries: a preliminary report. *J Clin Pediatr Dent.* 1998; 22(2): 147-9.
29. Bhat PK, Badiyani BK, Aruna CN, Chengappa S, Bhaskar NN. Dermatoglyphics-A New Diagnostic Tool in Detection of Dental Caries among Deaf and Mute Children. *IJCDS.* 2011; 2(4): 80-84.