Indian Journal of Forensic Odontology
Volume 4 Number 3-4, July - December 2011

Dermatoglyphics and dental caries: A review

Vineet Gupta, Puneet Kumar*, Roshni Dupare*, Sonia Sood Datta***

**Senior Lecturer, Krishna Dental College, Department of Oral and Maxillofacial Pathology, Mohannagar, Ghaziabad, UP, India.

*Post Graduate Student, ITS Dental College, Muradnagar, UP, India.

Abstract

Multifactorial etiology works as a processing unit in the causation of dental caries in mineralized portions of human teeth. In the present review, one important parameter is *considered*, the genetic component, *dermatoglyphics*.

The epidermal ridges of the fingers and palms as well as the facial structures like the lip, alveolus, teeth and palate are formed from the same embryonic tissues (ectoderm) during the same embryonic period (6-9 weeks). Thus, the genetic and environmental factors which are responsible for causing dental caries may also cause peculiarities in the dermatoglyphic patterns.

Keywords: Dermatoglyphics, dermal ridges, dental caries.

Introduction

The word *dermatoglyphics* was coined by Cummins and Midlo in 1926 *meaning dermi = skin and glyphe = curve* [1,2,3,4,5] In humans, the development of primary palate and the lip is completed by the seventh week of intrauterine life and that of secondary palate by twelfth week. The dermal ridges develop in relation to volar pads, which are formed by the sixth week of gestation and reach maximum size between 12-13th week [6,7]. This means that genetic message contained in the genome, normal or abnormal, is deciphered during this period and is also reflected by dermatoglyphics [8,9,10]. Moreover, tooth enamel is an ectodermal structure same as that of palate and alveolar ridges and is most susceptible to caries. Dermal ridge differentiation takes place early in fetal development.

The resulting ridge configurations are genetically determined [11,12,13,14] and are influenced or modified by environmental forces [15,16,17,18]. It is known that finger and palm prints are formed during the 6-7 th week [19,20,21,22,23] of the embryonic period and are completed after 10-20 weeks of gestation.[24,25,26,27,28] 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. [29, 30]

Classification

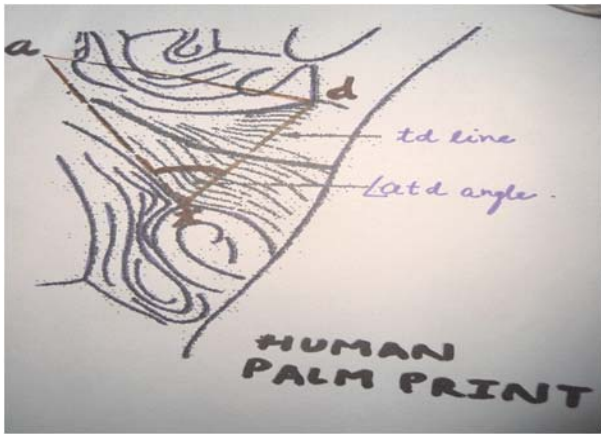
Dermatoglyphic patterns are broadly classified [31, 32] into three major types: whorl, loops, and arches, which have been subdivided into various subtypes. These patterns are present on finger tips/buds, whereas whole of human palm show certain other features such as atd angle [This angle is formed by lines drawn from the digital triradius (a) to the axial triradius (t) and from this triradius to the digital triradius (d)], H-loop, IV loop, and t-triradius.

A loop [Figure 1] is recognized as a series of ridges that enter the pattern area on one side of digit, recurves abruptly and leaves the pattern area on the same side. A single triradius is present, which is located laterally on the fingertip, where the loop is closed. If the ridge opens on ulnar side (away from thumb), it is called as ulnar loop, and if it opens

Corresponding author: Dr. Vineet Gupta, C-40, East Krishna Nagar, Delhi - 110 051.

E mail: ving.30@gmail.com

toward the radial side (toward thumb), it is called as radial loop. A whorl [Figure 2] differs



from the loop in the aspect of concentric arrangement of ridges, with two or more triradii in the latter.

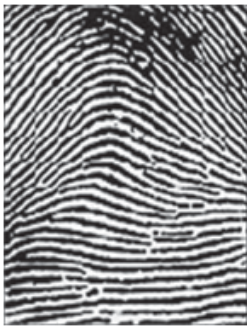
In all the dermatoglyphic patterns seen, arches [Figure 3] show the simplest ridge pattern, which is formed by the succession of one or more parallel ridges which cross the finger from one side to the other without recurving. These patterns usually do not show the presence of triradii, except when the tented arch is present that will have a triradii point near its midline.

Fig. 1. Dermatoglyphic pattern: Loops

Fig. 2. Dermatoglyphic pattern: Whorls

In all the dermatoglyphic patterns seen, arches [Figure 3] show the simplest ridge pattern, which is formed by the succession of one or more parallel ridges which cross the finger from one side to the other without recurving. 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.

Fig. 3. Dermatoglyphic pattern: Arches



Materials and Methods for Recording and Evaluating Dermatoglyphics: [31, 33]

- Basic diagnostic instruments
- Gauze pads
- Duplicating printing ink
- Chart paper (white)
- Magnifying glass (2× power)
- Soap

Loops are compared between subjects and controls (Nidhi et al) and correlated to salivary pH and bacteria [31,33]. Dermatoglyphics has been linked to salivary pH and bacteria; thus, polygenic nature as well genetic susceptibilty to dental caries is revisited.[34,35]

Mostly, children are selected between 3-6 years of age [31,33] because of following reasons. Firstly, by three years of age whole set of deciduous dentition must have erupted. Secondly, by this period window of infectivity would have been completed so that *S*. mutans [35] levels can be measured much confidently. Thirdly, we know that incipient enamel lesions transform into cavitation by 2-5 years , in case of deciduous dentition rate being faster. So, by this time if any lesion would have developed it must have started progressing

and this may add up to number of carious teeth; keeping these factors in my mind it can be well assured that it is genetically susceptibility that determines cariogenic potential of enamel at this point of time, since as the age advances other factors may also become much significant in causation of dental caries. There is a significant role of genetic and environmental factors in causation of dental caries. Control group, that is, caries-free children, have an increased frequency of loops and a higher salivary pH toward normal, whereas subjects, that is, children with caries in e"5 teeth, have decreased frequency of loops and a lower salivary pH toward normal . This means that if a child has carious teeth his/her salivary pH would be lowered owing to more demineralization activity caused by microorganisms. Controls (caries-free students) in various studies have found to be showing decreased S. mutans levels as compared to subject group. Therefore, it indicates that caries-free students have increased loops and there is a high significant difference in controls and subjects in terms of frequency of loops [8]. This difference in dermatoglyphic patterns indicates that it's no wonder if dermatoglyphic pattern recording of a child may be carried out as it is done in a medical examination in some nations[9].

Since this may be a genetic indicator for dental caries acquisition, as we have *S. mutans* levels for early childhood caries.

Recording of handprints

• The hands of the patient are scrubbed thoroughly and blot dried.

• The duplicating ink is dispensed in a pea-sized amount for each hand and spread to the entire area of palm and fingers with the help of a gauze pack. It is important that a very minimal amount of dye is taken as this helped in getting clear handprints. The more the amount of dye, darker are the prints and thus unreadable. Various dyes are tried before settling for black duplicating printing ink.

• Once even spread of the dye is ensured, the patient is asked to place his/her hand with all fingers apart on a sheet of paper. Light pressure is applied over all the fingers to ensure proper recording of prints.

• The handprints obtained are checked for their clarity through a magnifying glass (2×) and a number was given to it. The presence of core and the triradii of the pattern are noted to include the handprint in the study. If these landmarks cannot be demarcated clearly, then taking another handprint is recommended. The handprints taken are preserved with caution.

• Often, it is noted that the thumb does not provide proper prints, which is due to its spatial orientation as compared to the rest of the fingers. So, a separate impression of the thumb is taken.

Method of reading handprints

The handprints are observed in a sequential manner (Mathew et al):

The handprints are observed from the left hand 4 th digit till the thumb.

• Then, they are observed from the thumb of right hand till the 4 th digit. It is done under a magnifying glass with 2× power. Only the occurrence of type of pattern on the finger tips of 10 digits is noted for each digit. The total ridge count (TRC) is done.

Type of dermatoglyphic pattern

The frequency of true patterns of loops, whorls and arches is counted on the finger tips of all the 10 digits.

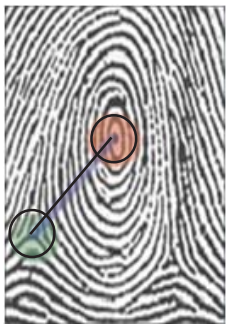
Total ridge counting

Mark the two landmarks as "core" (as circle in centre [Figure 4]) and "triradii" (as circle in left corner below in [Figure 4]) of the pattern.

- A line (is drawn joining these two landmarks (this line should be as nearly as possible at right angles to the ridge area).
- All the ridges that cross this line are counted, whereas ridges terminating before touching the line are not counted.

- Ridge containing the point of core and triradii is not included in the count.
- If a ridge bifurcates before reaching the line, it is counted as two ridges.

Fig. 4. Method of ridge counting



Handprints of caries-free children , especially females, shows maximum ulnar loops , followed by whorls and arches and the least present are radial loops. Caries-free males shows more occurrences of arches. The caries group shows maximum occurrence of whorls than caries-free group and they are found to be more prevalent in females on their left hand 3 rddigit than in males, who shows more whorls on their right-hand 3 rd digit.

This is a nascent science requiring more research work. Earlier research work by M. Atasu on the dermatoglyphic patterns observed in Ellis-van Creveld syndrome (EVC) [10] and in dental caries [11] and by Kargul *et al* [12] on the dermatoglyphic patterns observed in hypohydrotic ectodermal dysplasia patients are the landmark studies. These patterns have been, since time immemorial, a basis of personal identity.

Limitations of the Dermatoglyphics[31]

• Monozygotic twins or parents/children are still a challenge.

• There is no way of finding out whether genetics or environmental factors play a dominating role in the occurrence of dental caries.

• Dental caries, being a multifactorial disease, cannot be controlled in children just by knowing their genetic susceptibility to the disease. If such patients do not have any complaint regarding their dental problem, then motivating parents and the child in such circumstances is unconvincing and difficult.

Conclusion

Dermatoglyphics is considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine anomalies.

The dermatoglyphic patterns have been used as an oral health marker, which can determine the genetic predisposition of children to dental caries. The children and their parents are observed to show similar pattern of occurrence of dental caries. This can be attributed to the genetic inheritance of salivary pH, enzymes, salivary flow and tooth morphology.

References

1. Holt SB. The hypothenar radial arch-A genetically determined epidermal ridge configuration. *Am J Phy Anthrop* 1975; 42: 229-32.
2. Uchida JA, Solton HC. Evaluation of Dermatoglyphics in medical genetics. *Pediatr Clin North Am* 1963; 10: 409.
3. Edward D Campbell. Fingerprints and palmer. Dermatoglyphics. *E-fingerprints.net* 1998.
4. www.odc.co.in- History of Dermatoglyphics.
5. Nariyama M. Identification of chromosomes associated with dental caries using quantitative trait locus analysis in mice. *Caries Res* 2004; 38(2):79-84.
6. Dermatoglyphics in Schizophrenia. *Br J Psychiatry* 1968; 114: 1387-97.
7. Glanville EV. Heredity and line of palmar dermatoglyphics. *Am J Hum Genet* 1965; 17: 420-4.
8. Blanka Schaumann and Mitton Alter. *Dermatoglyphics in medical disorders*. Berlin; Newyork Springer Verlag, 1976: 27-87.
9. John J Mulvihill and David W Smith. The Genesis of Dermatoglyphics. *J Pediatrics* 1969; 75 (4): 579-589.
10. Gregory A Popich and David W Smith. The Genesis and significance of digital and palmar hand creases, Preliminary report. *J Pediatrics* 1970; 77 (6): 1017-1023.

11. Marilyn Preus. Dermatoglyphics and Syndromes. *Amer J Dis Child* 1972; 124: 933-943.
12. Rajangam S, Janakiram S, Thomas IM Dermatoglyphics in Down's syndrome. *J Indian Med Assoc* 1995; 93(1):10-3.
13. Fogle, T. Using dermatoglyphics from Down syndrome and class populations to study the genetics of a complex trait. *Association for Biology Laboratory Education (ABLE)* 1990; 11: 129-150.
14. Sardool Singh. Dermatoglyphics of schizophrenics, patients with Down's syndrome and mentally retarded males as compared with Australian Europeans using multivariate statistics. *Amer J Physiol Anthropol* 42(2): 237–240.
15. Matsuyama N, Ito Y. The frequency of fingerprint type in parents of children with Trisomy 21 in Japan. *J Physiol Anthropol* 2006; 25(1):15-21.
16. Kobyliansky E. Relationship between genetic anomalies of different levels and deviations in dermatoglyphic traits. Part 2: Dermatoglyphic peculiarities of females with Turner's syndrome. *Anthropol Anz* 1997; 55(3-4):315-48.
17. W.A.Bretz. Longitudinal analysis of heritability for dental caries traits. *J Dent Res* 2005; 84(11): 1047-1051.
18. Huang CM, Mi MP. Digital dermal patterns in breast cancer. *Proc Natl Sci Counc Repub China B* 1987; 11(2):133-6.
19. Bierman HR, Faith MR, Stewart ME. Digital dermatoglyphics in mammary cancer. *Cancer Invest* 1988; 6(1):15-27.
20. Seltzer MH, Plato CC, Fox KM Dermatoglyphics in the identification of women either with or at risk for breast cancer. *Am J Med Genet* 1990; 37(4): 482-8.
21. Chintamani. Qualitative and quantitative dermatoglyphic traits in patients with breast cancer: a prospective clinical study. *BMC Cancer* 2007; 13 (7): 44.
22.. Bets LV, Dzhanibekova IV, Lebedev NB .Kuraeva TL. Constitutional and dermatoglyphic characteristics of children with diabetes mellitus. *Probl Endokrinol (Mosk)* 1994; 40(1): 6-9.
23. Ravindranath R, Thomas IM. Finger ridge count and finger print pattern in maturity onset diabetes mellitus. *Indian J Med Sci* 1995; 49(7): 153-6.
24. Vera M, Cabrera E, Guell R. Dermatoglyphics in insulin-dependent diabetic patients with limited joint mobility. *Acta Diabetol* 1995; 32(2): 78-81.
25. G. Eswaraiah, R. S. Bali. Palmar flexion creases and dermatoglyphics among diabetic patients. *Ameri J Physiol Anthropol* 47; (1): 11–13.
26. Barta L, Regöly-Mérei A, Kammerer L Dermatoglyphic features in diabetes mellitus. *PMID*: 665221.
27. Scott NM. Dermatoglyphic fingerprint heterogeneity among individuals with nonsyndromic cleft lip with or without cleft palate and their unaffected relatives in China and the Philippines. *Hum Biol* 2005; 77(2): 257-66.
28. Mathew l et al. Dermatoglyphic peculiarities in children with oral clefts. *J Indian Soc pedod prev dent* 2005: 179-182.
29. Rodewald A, Zahn-Messow K. Dermatoglyphics findings in families with Xlinked hypohidrotic (or anhidrotic) ectodermal dysplasia (HED). *Prog Clin Biol Res* 1982; 84: 451-8.
30. Hypohidrotic ectodermal dysplasia: dental clinical, genetic and dermatoglyphic findings of three cases. *J Clin Pediatr Dent* 2001; 26(1): 5-12.
31. Nidhi Madan, Arun Rathnam, Neeti Bajaj Palmistry: A tool for dental caries prediction! *Indian Journal of Dental Research* 2011; 22 (2): 213-218.
32. Pratibha Ramani ,Dr.Abhilash PR , Herald J Sherlin . Anuja N, Priya Premkumar, Chandrasekar T ,G.Sentamilselvi, VR Janaki. Conventional Dermatoglyphics –Revived concept: A Review. *International Journal of Pharma and Bio Sciences* 2011; 2(3): 446- 458.
33. L Mathew, AM Hegde, K Rai. Dermatoglyphic peculiarities in children with oral clefts. *Journal of Indian Society Of Pedodontics and Preventive Dentistry* 2005; 23 (4): 179-182.
34. Hegde SK. Estimation of salivary capable of inhibiting and stimulating streptococcus mutans, and its correlation to dental caries and untreated carious teeth. *J Indian Soc Pedod Prev Dent* 2005;23: 126-30.
35. Loesche WJ. Role of Streptococcus mutans in human dental decay. *Microbiol Rev* 1986; 50: 353-80.