

## Dermatoglyphics: An Indicator of Dental Caries in Humans

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### Abstract

**Background:** We all know that fingerprints are found in human and some animals and they are unique to all individuals and remain unchanged over the life time. Today the study of the fingerprints has crossed its traditional realms and is being widely used as an adjunct in medical and dental fields to diagnose conditions with a suspected genetic base.

**Aim & Objective:** 1. To record and evaluate the Dermatoglyphics pattern in subjects attending OPD of Buddha Institute of Dental Sciences & Hospital, Patna, Bihar. 2. To identify and compare the type of Dermatoglyphics pattern associated with dental caries. 3. To find association (if any) between different Dermatoglyphics patterns and Dental caries.

**Methodology:** A descriptive cross sectional study was conducted in OPD of Buddha Institute of Dental Sciences & Hospital, Patna among simple random sample of 76 OPD Patient in the age group of 18-40 years after satisfying the inclusion & exclusion criteria. The data was collected using a proforma consisting of demographic details, oral hygiene practices, Sugar consumption, fingerprints format and WHO ORAL HEALTH ASSESSMENT FORM (2013) was used to assess the Dentition status of the individual. Dermatoglyphic (Fingerprints) of the study subject were recorded using the **Ink Method** described by *Cummin and Midlo & dermatoglyphic* patterns were analyzed with the help of a magnifying glass (10×) under guidance of fingerprint expert. Data were collected, compiled & tabulated using Microsoft excel & analyzed by Chi-square test & independent sample T test with  $p < 0.05$  as statistically significant.

**Result:** Prevalence of dental caries was highest among subjects with whorl pattern (3.59±2.18) followed by Loop pattern (2.73±1.56) whereas the subjects with Arch pattern shows lowest prevalence of dental caries (1.39±1.28) & this result came out to be statistically significant ( $P < 0.05$ ).

**Conclusion:** From this study it is clear that Dental caries susceptibility of an individual increases in the subject having Whorl pattern & thus there is a definite correlation between fingerprint patterns and dental caries.

**Keywords:** Dental caries; Dermatoglyphics; whorl pattern

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## Introduction

We all know that fingerprints are found in human and some animals and they are unique to all individuals and remain unchanged over the lifetime.<sup>1</sup> Today the study of the fingerprints has crossed its traditional realms and is being widely used as an adjunct in medical and dental fields to diagnose conditions with a suspected genetic base.<sup>2</sup> Dental caries is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth. It is the second most common cause of tooth loss and is found universally, irrespective of age, sex, caste, creed or geographic location.<sup>3</sup> Multifactorial etiology defines the causation of dental caries in mineralized tissues of teeth such as host, microbes, time and substrate etc. One of such causation factors is genetic predisposition which can be studied using *Dermatoglyphic* variations in individuals suggesting that dermatoglyphic patterns has both genetic and diagnostic role in Dental caries and thus can serve as genetic marker for dental caries in humans.<sup>4</sup> Recognition of irregular fingerprints among the patients of periodontitis, dental caries and other genetic anomalies like cleft lip and palate has been the recent interest of authors and academicians.<sup>5</sup> Based on the fact that development of teeth, alveolus and palate occurs at the same time as the development of dermal patterns it is evident that some correlation exists between dermal patterns and oral structures since they are both genetically governed structures.<sup>6</sup> Thus Dermatoglyphics can prove to be an extremely useful tool for preliminary investigations in conditions with a suspected genetic base especially in a developing country like India, it might prove to be non-invasive, inexpensive and effective tool for screening. Since caries is a multifactorial disease with the influence of genetic pattern, early prediction for high-risk individual can help in using effective and efficient caries preventive measures.<sup>7</sup> Thus this study was conducted with the aim to assess Dermatoglyphics as indicator of dental caries in human.

## Objectives

1. To record and evaluate the Dermatoglyphics pattern in subjects attending OPD of Buddha

Institute of Dental Sciences & Hospital, Patna, Bihar.

2. To identify and compare the type of Dermatoglyphics pattern associated with dental caries.
3. To find association (if any) between different Dermatoglyphics patterns and Dental caries.

## Methodology

A descriptive cross sectional study was conducted in OPD of Buddha Institute of Dental Sciences & Hospital, Patna for 2 month, January & February, 2020. Ethical approval for the study was obtained from the Institutional Review Board, Patna and Informed Consent was obtained from the participants.

The study population comprises of 76 Patients in the age group of 18-40 years attending OPD of Buddha Institute of Dental Sciences & Hospital, Patna Study subjects were selected by simple random sampling method after satisfying the inclusion and exclusion criteria.

### Inclusion Criteria

- Patients willing to consent to be a part of the study.

### Exclusion Criteria

- Subjects with skin disorder or having any developmental anomaly or any trauma to fingertips.
- Subject who are not willing to participate.

All the study subjects were pre informed and explained about the procedure. The data was collected using a proforma consisting of demographic details, oral hygiene practices, Sugar consumption, fingerprints format and WHO ORAL HEALTH ASSESSMENT FORM (2013)<sup>8</sup> was used to assess the Dentition status of the individual.

### Recording of Dermatoglyphic (Fingerprint) Pattern:

Considering the ethical issue and confidentiality of fingerprints of patients, the procedure was explained to the study subjects and permission was obtained through written consent forms before recording the fingerprints.

- After taking brief case history and clinical examination of the study subject, first the subject's hands were cleaned with soap and water and then scrubbed thoroughly with antiseptic lotion (Savlon) and allowed to dry. This was done to enhance the quality of the dermatoglyphic prints, by removing sweat, oil, or dirt from the skin surface before imprinting.
- Then Fingerprints of the study subject were recorded using the **Ink Method** described by *Cummin and Midlo*.<sup>9</sup>
- Based on the above method, the fingers of the subject's right hand were guided and pressed lightly on the ink pad and then guided by the examiner and pressed firmly on the A4 sheets which were kept on a firm surface. The subjects were made to do this repeatedly 2 to 3 times till clear prints were obtained.
- The same procedure was repeated for the left hand and Prints were dried. Care was taken while recording the prints to apply the stamp ink material in adequate amounts.
- Likewise fingerprints of the entire
- 76 subject were recorded.
- After taking the imprints of all fingers, ink was removed properly from the subject hand by using oil, soap and water.

#### Method of Reading Fingerprints

- The fingerprints were observed in a sequential manner and were analyzed from the fourth digit of the left hand moving in a clockwise direction till the thumb and then were analyzed from the thumb of the right hand moving in a clockwise direction till the

fourth finger.

- These dermatoglyphic patterns were analyzed with the help of a magnifying glass (10×) under guidance of fingerprint expert.

#### Dermatoglyphic Pattern Analysis

- The various patterns of fingerprints were analyzed according to the standard guidelines for classification of patterns.
- The ridge patterns on the distal phalanges of the fingertips observed were divided into three groups: arches, loops, and whorls.<sup>10</sup>

##### (i) Arches

These are the simplest patterns found on fingertips. These are formed by succession of more or less parallel ridges, which traverse the pattern area and form a curve that is concave proximally. Sometimes, the curve is gentle; at other times, it swings more sharply, so that it may also be designated as a low or high arch, respectively.

##### (ii) Loops

These are the most common patterns on fingertips. 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. Loops may vary considerably in shape and size. They may be large or small, tailor short, and vertically or horizontally oriented.

##### (iii) Whorls

These are any ridge configurations with two or more tri-radii. One tri-radius is on the radial side and the other on the ulnar side of the pattern. Tri-radii are formed by the confluence of three ridge systems that form angles of approximately 120° with one another.

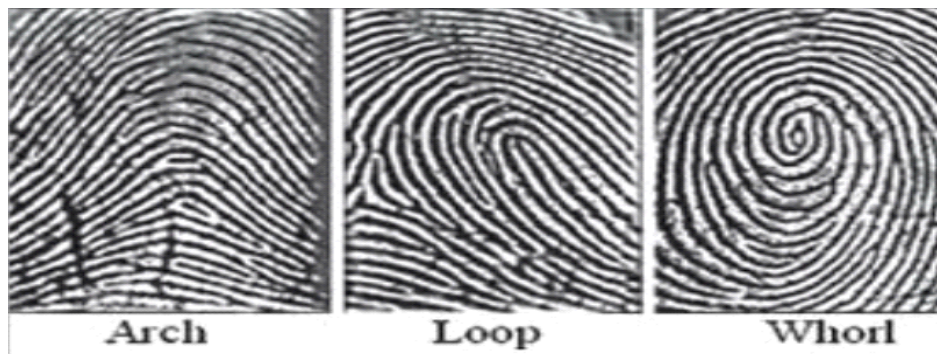
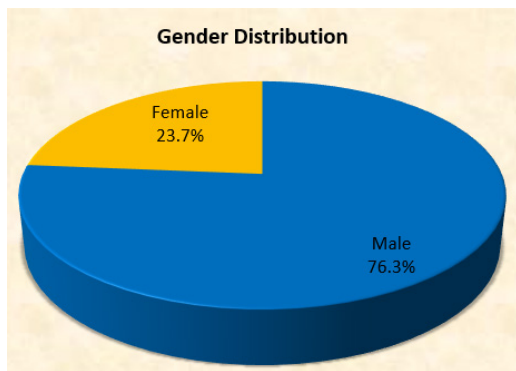


Figure Showing Type of Dermatoglyphic Patterns

The collected data were organized, tabulated and statistically analyze using SPSS software statistical computer package, version 22. The qualitative data was presented as frequencies and compared by Chi square test; the quantitative data was presented as mean and standard deviation (SD) and compared by independent sample t test. One Way ANOVA test was used for mean comparisons among different fingerprint pattern. Karl Pearson’s correlation Analysis was used for correlating Dermatoglyphics pattern with dental caries. The differences between the two groups were considered significant at  $P \leq 0.05$ .

### Results

In the present study of the out of the total (76) subjects examined, majority of the study subjects 58(76.3%) were males and rest 18(23.7%) were females.( Figure 1). The mean age of the total 76 study subjects was  $30.25 \pm 6.63$  years.



**Fig 1: Distribution of study subject according to their Gender**

Among all the 76 subjects, The Whorl pattern was found among majority of subjects 44.7% followed by Arch pattern among 40.8% subject and only 14.5% subjects having Loop pattern.(Table 1)

**Table 1: Distribution of subjects based on their fingerprint patterns**

Type of fingerprint pattern	No of subject	Percentage
Arch	31	40.8
Loop	11	14.5
Whorl	34	44.7
Total	76	100.0

Prevalence of dental caries was highest among subjects with whorl pattern ( $3.59 \pm 2.18$ ) followed by Loop pattern ( $2.73 \pm 1.56$ ) whereas the subjects with Arch pattern shows lowest prevalence of dental caries ( $1.39 \pm 1.28$ ) & this result came out to be statistically significant ( $P < 0.05$ ). ( Table 2)

When the mean comparison of different fingerprint pattern was done between male and female then all these results were found to be statistically insignificant with p value 0.467, 0.274 & 0.105 respectively. (Table 3)

**Table 2: Comparison of study subject according to their Caries experience & Dermatoglyphics pattern**

Type of finger	N	Decayed		Missing		Filled		DMFT	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arch	31	1.00	1.06	0.19	0.54	0.19	0.48	1.39	1.28
Loop	11	1.36	1.36	0.36	0.67	1.00	0.77	2.73	1.56
Whorl	34	2.24	1.37	0.91	1.06	0.44	0.93	3.59	2.18
Overall	76	1.61	1.37	0.54	0.89	0.42	0.79	2.57	2.03
Statistical Analysis:									
Arch Vs Loop Vs Whorl		P=0.001 S		P=0.003 S		P=0.012 S		P=0.000 S	
Arch Vs Loop	Mean Difference	0.36		0.17		0.81		1.34	
	P value	P=0.688 NS		P=0.829 NS		P=0.009 S		P=0.086 NS	
Arch Vs Whorl	Mean Difference	1.24		0.72		0.25		2.20	
	P value	P=0.000 NS		P=0.002 S		P=0.385 NS		P=0.000 S	
Loop Vs Whorl	Mean Difference	0.88		0.55		0.56		0.86	
	P value	P=0.118 NS		P=0.144 NS		P=0.088 NS		P=0.347 NS	

**Statistical Analysis:**

*ANOVA one way test for mean comparisons among Arch Vs Loop Vs Whorl.*

*Tukey's Post Hoc test for multiple comparisons (mean difference comparisons between two groups).*

**Table 3: Mean comparison of Finger print types between males and females**

Finger print type	Gender	N	Mean	SD	Mean difference	P value
Arch	Male	58	3.86	2.65	0.53	0.467
	Female	18	4.39	2.73		NS
Loop	Male	58	2.55	1.48	0.45	0.274
	Female	18	3.00	1.61		NS
Whorl	Male	58	3.60	2.61	1.16	0.105
	Female	18	2.44	2.64		NS

Statistical Analysis: Independent sample t test. Statistically significant if  $P < 0.05$

**Table 4: Correlation between caries experience and fingerprint patterns**

Finger print type Vs DMFT	No of pairs	Correlation coefficient (r)	P value	Result
Arch & DMFT	76	-0.465	0.000	Significant
Loop & DMFT	76	-0.088	0.448	Not Significant
Whorl & DMFT	76	0.482	0.000	Significant

Statistical Analysis: Karl Pearson's correlation Analysis.

In the present study Dental caries experience was assessed by correlating the DMFT Score with different fingerprint pattern (Arch, Loop and Whorl pattern) and it was found that the DMFT Score is in negative correlation with Arch pattern ( $r = -0.465$ ) and this result was found to be statistically significant with  $p$  value  $< 0.001$ . Similarly, the DMFT Score is in negative correlation with Loop pattern also ( $r = -0.088$ ) but this result was found to be statistically insignificant with  $p$  value 0.448. Alternatively, the DMFT score is in positive correlation with Whorl pattern ( $r = 0.482$ ) and this result was found to be statistically significant with  $p$  value  $< 0.001$  (Table 4). This means prevalence of dental caries increases with whorl fingerprint pattern and decreases with Loop and Arch pattern. In other words, it means that with an increase in the whorl pattern, the patient had an increased susceptibility to dental caries and with an increase in the Loop or Arch pattern the patient had decreased susceptibility to dental caries and vice versa. Thus our study shows significant relationship between Whorl fingerprint pattern and Dental caries.

## Discussion

When Dermatoglyphics pattern was analyzed in our study it was found that Whorl pattern was seen in majority of study subject (44.7%) followed by Arch pattern (40.8%) while Loop pattern was seen in only 14.5% study subject and all these findings are in contrast with the study done by Saumya Navit et al<sup>11</sup> where the frequency of loops pattern was highest (71%) followed by whorls (25.1%) and arches (3.9%). This may be due to the fact that our study sample consisted of OPD patients of dental college who were having some or the other dental problems especially dental caries and thus the frequency of whorl pattern was seen in majority of the study subjects.

In the present study the whorl pattern of fingerprint was found to be more prevalent in subjects having the highest mean of dental caries (2.57) and this findings are found to be similar to the studies conducted by B. R. Chinmaya et al<sup>12</sup>, Vijender et al.<sup>13</sup>, and Madan et al.<sup>14</sup> (2.82, 2.65, & 2.86) & contrast with the study conducted by Sengupta et al (2013)<sup>15</sup>, where participants with caries mainly had loop pattern.

On the other hand the Arch pattern of fingerprint was found to be more prevalent in subjects having the lowest mean of dental caries (1.39) and these findings are found to be similar to the studies conducted by S Ekta et al (1.23)<sup>16</sup> & contrast with the study conducted by B. R. Chinmaya et al<sup>12</sup> where Loop pattern was found to be more prevalent in subjects having the lowest mean of dental caries (1.58).

As per our study, there exists a statistically significant relationship between whorl pattern and dental caries. The whorl pattern and dental caries were positively correlated ( $r = 0.482$ ) ( $P = 0.000$ ). Thus, with an increase in the whorl pattern, there was an increase in dental caries. This is highly significant so, we analyze the possible reason for this significance. Dermal ridge differentiation takes place early in the fetal development. It is known that finger and palm prints are formed during the first 6 to 7 weeks of the embryonic period and are completed after 10 to 20 weeks of gestation. Abnormalities in these areas are influenced by combination of hereditary and environmental factors. These abnormalities are expected to appear only when the combined factors exceed a certain level. This threshold theory is now generally accepted and has been extrapolated by the studies of Carter (1969) & Mastunga (1977).<sup>17</sup> Basically, the pattern of the skin lines on the finger is formed in the second trimester of the fetus and it does not change for each individual during the life. The dermal ridges develop in relation to the volar pads, which are formed by the 6th week of gestation and reach maximum size between 12 and 13th week. The epidermal ridges of the fingers and the palms as well as facial structures like lip, alveolus, palate and tooth bud are also formed from the same embryonic tissue (ectomesenchyme) during the same embryonic period (6-9 weeks). The genetic message in the genome whether normal or abnormal is deciphered during this period and is reflected by Dermatoglyphics.<sup>18</sup>

However, a negative correlation was observed for arch pattern ( $r = - 0.465$ ) and dental caries. Thus, in the subjects with the Arch pattern, Dental caries susceptibility was very less. The results obtained were similar to the study conducted by Abhilash *et al.*<sup>19</sup>

Hence, with genetic information, the susceptibility for caries due to abnormality in the tooth structures like alterations in dental hard tissues like structure of dental enamel, tooth eruption and development may be reflected in the Dermatoglyphics pattern namely whorl , Arch and loop patterns. Hence, Dermatoglyphics could be an indicator of genetic susceptibility of an individual to dental caries.<sup>20</sup>

The strength of this study lies in the fact that this is the first study in Patna regarding Dermatoglyphics & dental caries. Apart from that a single examiner carried out the reading of all the handprints to decrease inter-examiner variability.

However, Limitation of the study is that selection of the age group in this study is 18-40 years and here dental caries can be due to other factors such as environmental factors etc and Dermatoglyphics mainly deals with genetic factor so lower age group selection would be able to reduce the bias to prove Dermatoglyphics as potential genetic marker of dental caries. Apart from that the study sample size was small, institutional based and of short duration so further longitudinal study can be done on large sample size for better generalizability of results.

Despite the limitations, the findings of this study provide further insight in the role of various Dermatoglyphics pattern proving as potential indicator of dental caries in humans.

## Conclusion

From this study it is clear that Dental caries susceptibility of an individual increases in the subject having Whorl pattern & thus there is a definite correlation between fingerprint patterns and dental caries.

Thus, Dermatoglyphics gives a hope in the prediction of dental caries much before its initiation giving a sufficient time to implement preventive measures. In a developing country like India, it might prove to be a non invasive, inexpensive, and effective indicator for dental caries.<sup>21</sup> These patterns may represent the genetic makeup of an individual and therefore his/her predisposition to certain diseases.

Given the expenses involved in conducting the analysis of the chromosomes themselves, Dermatoglyphics can prove to be an extremely useful tool for preliminary investigations. The pattern seems to be appearing wherein a definite approach in the form of 'Dermatoglyphics' might play a significant role in the near future not only for the purpose of screening but also for studying the behavior of dental caries.<sup>22</sup>

Since, Dermatoglyphics is still an inexact science at the present time, further extensive research and studies in this field have to be done in order to determine, ascertain and to evaluate the significance of these variations in dermatoglyphic features of patients with dental caries.<sup>9</sup> Hence, it's not the end but an opening to a new arena, where in near future detecting oral diseases at an early stage will be possible using Dermatoglyphics as a diagnostic tool.<sup>14</sup>

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