Lips and Fingertips tell it all -Cheiloscopy and Dermatoglyphics as Predictive Factors for Dental Caries and Periodontitis

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ABSTRACT:- Dental Caries and Periodontitis are two of the commonest oral ailments affecting millions of people worldwide. Though there are some known causative factors, mystery still revolves around the fact that some individuals are more susceptible to it compared to others, who are exposed to similar conditions. This can be partially explained by the fact that these diseases are genetically linked. And apart from the regular oral hygiene measures, the only way to prevent these diseases is by predicting its occurrence and taking necessary measures to limit its destruction potential. It is a known fact that the epithelium of finger buds, the lips, and the tooth develop at the same time of intrauterine life. So our study was an attempt to correlate the occurrence of Dental caries and/ or Periodontitis in an individual, with their lip print and thumbprint patterns, and to assess whether these investigation tools can be used to predict the occurrence of these diseases at an early age

Aim: To study the role of cheiloscopy and dermatoglyphics as predictive factors for dental caries and periodontal disease in an adult institutional population (age >12 years).

Materials and Methods: A cross-sectional study was carried out on 200 patients reporting to the OPD of Oral Medicine and Radiology department, NAIR HOSPITAL DENTAL COLLEGE, MUMBAI. They were screened based on the criteria laid down for the study and were divided into four groups(Group 1: DMFT(Decayed Missing Filled Teeth Index) score of 7 or more, Group 2: CPITN(Community Periodontal Index of Treatment Needs) score of 2 or more in more than 2 sextants, Group 3: DMFT score of 7 or more and CPITN score of 2 or more in more than 2 sextants, Group 4: Control Group), following which their lip print and thumbprint patterns were recorded and data was analyzed using SPSS version 16.0 and Mann-Whitney U test was used to compare types of lip pattern and thumbprints between the different experimental groups

Results: The prevalence of Reticular pattern was maximum in subjects with Dental Caries (50%) and the ones with both Caries and Periodontitis (50%). Also, a significant relation was found between the left thumbprint pattern and oral health status, with the left loop pattern (71.4%) being the commonest in subjects having both Dental Caries and Periodontal disease. On the other hand, Significant results weren't found with respect to the right thumbprint pattern.

Conclusion: Dermatoglyphics and Cheiloscopy can hence prove to be extremely useful, noninvasive and inexpensive tools for preliminary investigations and early detection of oral diseases.

Keywords:- Genetics, Forensic tools, Embyonic development, Early diagnosis

I. INTRODUCTION

The grooves and wrinkles present in the zone of transition of the lip, between the inner labial mucosa and outer skin produces a characteristic and unique pattern called lip prints, the study of which is known as cheiloscopy.[1] Lip prints are uniform throughout life and recover after undergoing alterations following trauma, inflammation, and other environmental conditions. Hence, they have the same forensic value as dactyloscopic traces.[2,3] In 1932, Edmond Locard, one of France's greatest criminologist, first recommended the use of lip prints for identification of a person.[2,4]Ever since then, Lip print studies have caught the attention of many scientists as a new tool for human identification.[2] Similarly, for centuries, the dermal ridge configuration of the hands has fascinated scholars.[5] After decades of scientific research, the hands have come to be recognized as a significant tool in the diagnosis of psychosocial, medical and genetic conditions.[5]

Dental caries is a major public health concern affecting millions of people worldwide.[6,7] It is a ''carbohydrate modified transmissible local infection with saliva as a critical regulator".[6]The Keyes Triad more or less

explains the multifactorial nature of etiology of caries, but still, there are some individuals who appear to be more susceptible to caries and some who are extremely resistant, regardless of the environmental risk.[7]

It is now said, that genetic influences may modify the expression of this disease,[7] which can be triggered by some regular environmental factor. Recent studies of twins reared together, adjusted according to age and gender, estimated the heritability for caries, as ranging from 45-64%.[7]

The second most common dental ailment is periodontitis, which again is associated with a myriad of factors, and for which several risks and susceptibility factors have been proposed. It is associated with multiple modifying genes but the search for the specific susceptibility genes is complicated, mainly because of etiological heterogeneity and genetic heterogeneity.[8] Early and aggressive periodontitis is a consistent feature of several genetic or inherited disorders. HLA-A9 and HLA-B15, these two human leukocyte antigens are associated with a 1.5 to 3.5 times greater risk of getting the disease.[8] Both, twin studies and association studies were done in order to confirm the role of genetics in the chronic form of the disease. The concordance rate was greater in monozygotic twins (23%) compared to dizygotic twins (8%), which supports the role of genetics.[8]

There is a very strong correlation between the occurrence of the above-mentioned dental ailments and the genetic makeup of the individual. And the only way to answer the unanswerable questions regarding the varied susceptibility of individuals to these diseases is by studying their genetic constitution. Extracting genetic information from chromosomes is not only expensive but is also an invasive procedure. [7, 8]

Till this technology reaches a stage where it is accessible to clinicians and researchers all over, there needs to be an alternative to solve this problem. It is known, that the dermal ridges begin to form during the 6th-7th week of embryonic life, [5] which is at the same time as that of the development of the facial skeleton, particularly the lips. [9] Interestingly, This is also the time when the tooth formation begins. Hence, the epithelium of finger buds, lips, and tooth, develop at the same time of intrauterine life. [3, 5]Also, The epithelium of finger buds and enamel of the tooth are both ectodermal in origin. Additionally,the interactions between epithelium and mesenchyme are responsible for development of different cells of periodontiumi.e Osteoblasts, cementoblasts and fibroblasts.It may be hypothesized that certain enamel proteins like ameloblastin and amelogenin may be responsible for maturation of dental follicle and transformation of the epithelial rooth sheath cells into cementoblasts, which indicates the importance of enamel organ in development of periodontium and hence shows an indirect relation to the development of dermal ridges during the embryonic life. [10]

This forms the basis of our study, which tries to bridge the gap between technology and us, by considering cheiloscopic and dermatoglyphic patterns as genetic markers for dental caries and periodontitis and studying their role in predicting an individual's susceptibility to these common oral diseases. Hence the aim of this study was to study the role of cheiloscopy and dermatoglyphics as predictive factors for dental caries and periodontal disease in an institutional population.

II. MATERIALS AND METHODS

A cross-sectional study was carried out on 200 patients reporting to the OPD of Oral Medicine and Radiology department, Nair hospital dental college, Mumbai, who were screened based on the criteria laid down for the study. Ethical Clearance was obtained from the Institutional review board on March 6th 2017 and study was completed in six months duration.

Materials used for collection of lip prints and thumb prints: Tissue wipes, Dark colored lipstick, Cotton swab, cellophane tape, scissors, magnifying glass(10x) ink pad and case record forms for transferring the recorded prints.

Inclusion criteria
- Patients reporting to the OPD of Oral Medicine and Radiology Department having more than 8 teeth per arch

Exclusion criteria
- Individuals having less than 8 teeth per arch or having any form of inflammation, trauma, surgical scars, congenital anomalies or active lesions of the lips or fingers

Oral examination was carried out using a Dental mirror, Straight probe, and Community Periodontal Index of Treatment Needs(CPITN) probe. The patients were then divided into four groups, based on the findings
- GROUP 1: Decayed Missing Filled Teeth(DMFT) score of 7 or more
- GROUP 2: CPITN score of 2 or more in 2 or more sextants
- GROUP 3: DMFT score of 7 or more and CPITN score of 2 or more in 2 or more sextants
- GROUP 4: Control group- Patients who did not fall into any of the above-mentioned categories

Prior information was given to all the patients participating in the study with the help of patient information sheets, printed in English and two other local languages, which was followed by taking an informed consent from them.

The sample size was calculated using *Epi Info sample size calculation software.*

$$N = \frac{z^2\, p\, (1- p)}{d^2}$$

Where, z=1.96 for 95% confidence interval, 1.645 for 90% confidence interval
　　　　p= Highest prevalence of dental caries among types of lip pattern i.e. 73%
　　　　d= acceptable margin of error i.e. 5%
The sample size was calculated to be 210.
Hence the Sample size can be rounded off to 200

Procedure for recording lip prints
After screening the patients and obtaining informed consent, they were prepared for the study. Their Lips were cleaned, after which a dark colored lip color was smeared on the lips with the help of a swab.
In a completely relaxed position of the lips, a cellophane tape was used to record the prints, which was subsequently transferred to the case record form, which also had the demographic details of the patient, DMFT and CPITN index scores.

Procedure for recording thumbprints
For recording the thumbprints, both the right and the left thumbs were first cleaned and were then lightly pressed upon the ink pad with uniform pressure. These prints were then transferred to the case record form. The thumb prints were stored for records and were not destroyed following documentation

After collection of the prints and recording the data, it was analyzed by two trained observers who were unaware of the group allocation to minimize the observer bias.

Analysis of the prints
The central 10 mm of the lower lip was analyzed as it remained intact, without much distortion, in most of the lip print collections.
In 1967, Suzuki made a detailed investigation of the measurement of the lips and the use of rouge for extraction of useful data from the lips for forensic application,[2] later in 1971, *Suzuki and Tsuchihashi*devised their own classification, which was used in this study.[2]

Suzuki and Tsuchihashi classification[1]
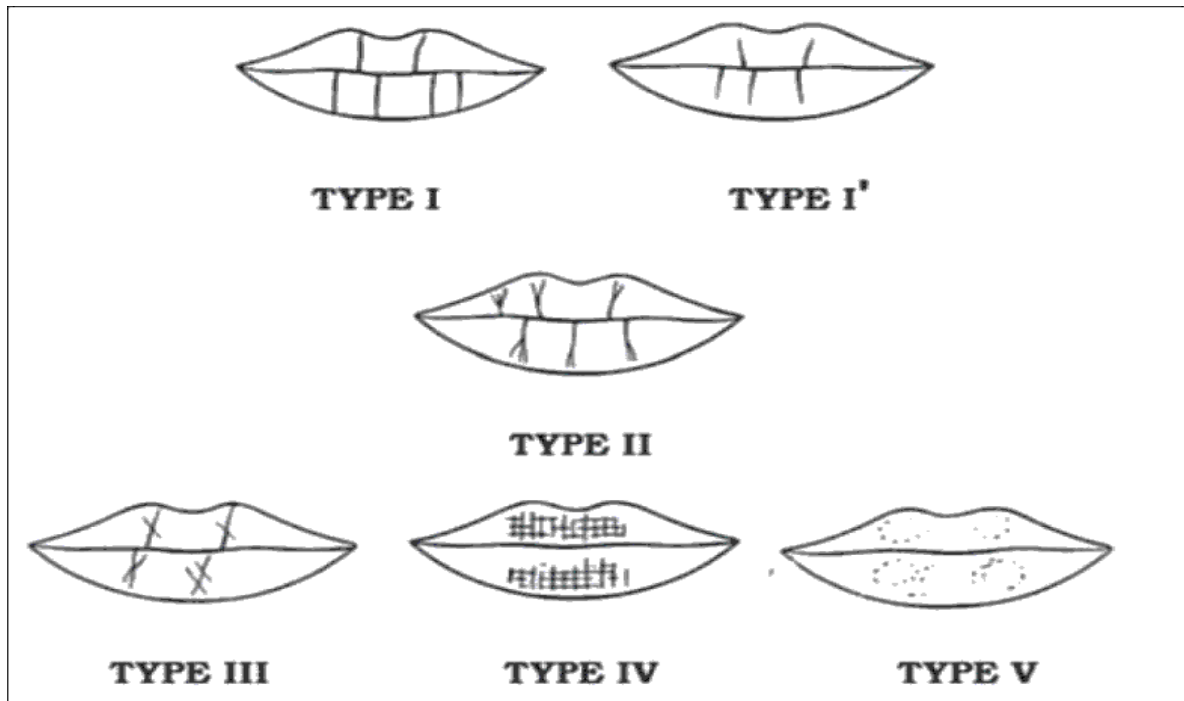*Type I: A clear-cut groove running vertically across the lip.*
Type I': Partial-length groove of Type I.
Type II: A Branched groove.
Type III: An intersected groove.
*Type IV: A Reticular pattern*
Type V: Other patterns.

[11]
Table/Fig 1: Diagrammatic representation of the lip print patterns

The very first attempt to study the groove pattern on the fingers was made by Sir Francis Galton in the year 1880 and his classification was later refined by Dr. Edward Henry about 10 years later, who introduced the concept of 'delta' and 'core' points.

Galton-Henry Classification [12]
- *Arch pattern*
- *Tented Arch pattern*
- *Loop pattern(Left loop ,Right loop ,Twin loop/Double loop)*
- *Whorl pattern*
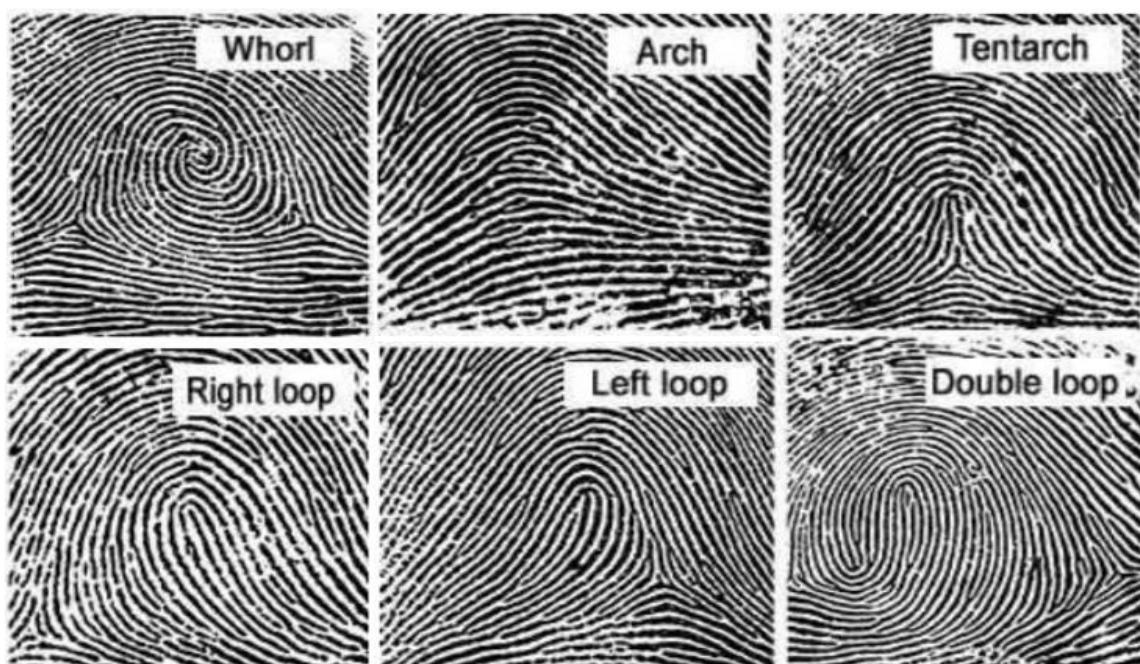
[13]
Table/Fig 2: Diagrammatic representation of the Thumb print patterns

Statistical analysis:

A training and calibration exercise was carried out before the analysis i.e., after explaining the standardized classification and rules, the examiners were made to examine a few cases and the results of both were compared to check for inter-observer variability.

SPSS version 16.0 was used for data analysis. Both descriptive & inferential statistics were computed. Frequency distribution and percentages were calculated for different types of lip patterns and thumbprints. Mann-Whitney U test was used to compare types of lip pattern and thumbprints between the different experimental groups. p-value less than 0.05 was considered statistically significant.

III.   RESULTS

Out of the 200 subjects that were included in the study, reticular lip print pattern(40.4%) was most commonly found in the study subjects(Table/Fig 3).Left loop pattern(48%) was most common for left thumbprint(Table/fig 4) and right loop pattern(53%) for right thumbprint(table/fig 5).

Table/Fig 3: Distribution of different types of lip patterns

Left Print	Frequency	Percentage
Vertical	30	15.0
Branched	61	30.5
Intersected	28	14.0
Reticular	81	40.5
Total	200	100.0

Table/Fig 4: Distribution of different types of left thumbprint patterns

Left Thumb Print Pattern	Frequency	Percentage
left loop	96	48.0
right loop	2	1.0
double loop	27	13.5
Whorl	56	28.0
Arch	14	7.0
tented arch	5	2.5
Total	200	100.0

Table/ fig 5: Distribution of different types of right thumbprint patterns

Right Thumb Print Pattern	Frequency	Percentage
left loop	2	1
right loop	106	53
double loop	17	8.5
Whorl	57	28.5
Arch	14	7
tented arch	4	2
Total	200	100.0

Table/fig 6: Relationship between lip print and oral health status

		Group				P Value
		Group 1	Group 2	Group 3	Group 4	
Lip print	Vertical	12	14	2	2	0.02 (S)
		17.1%	24.1%	14.3%	3.4%	
	Branched	12	19	2	28	
		17.1%	32.7%	14.3%	48.3%	
	Intersected	11	6	3	9	
		15.7%	10.3%	21.4%	15.5%	
	Reticular	35	19	7	19	
		50.0%	32.8%	50.0%	32.8%	
Total		70	58	14	58	200
		100.0%	100.0%	100.0%	100.0%	100.0%

Mann-Whitney U test

There was a significant association between types of lip print pattern and oral health status (Table/fig 6). Reticular lip print pattern was most common in Group 1 and 3(50%) which was significantly higher as compared to group 2 and 4 (33.9 & 32.8).

Table/fig 6: Relationship between left thumbprint and oral health status

		Groups				P Value
		Group 1	Group 2	Group 3	Group 4	
Left thumb	Left loop	28	27	10	30	0.02 (S)
		40.0%	46.5%	71.4%	51.7%	
	Right loop	0	0	0	2	
		.0%	.0%	.0%	3.4%	
	Double loop	18	7	0	4	
		25.7%	12.0%	.0%	6.9%	
	Whorl	20	17	3	16	
		28.6%	29.3%	21.4%	27.6%	
	Arch	3	4	0	6	
		4.3%	6.8%	.0%	10.3%	
	Tented arch	1	3	1	0	
		1.4%	5.1%	7.1%	.0%	
Total		70	58	14	58	200
		100.0%	100.0%	100.0%	100.0%	100.0%

Mann-Whitney U test

There was a significant association between types of left thumbprint pattern and oral health status (Table/fig 6). Left loop thumb pattern was most common in Group 3 (71.4%) which was significantly higher as compared to group 1, 2 and 4.

Table/fig 7: Relationship between right thumbprint and oral health status

		Groups				Total
		Group 1	Group 2	Group 3	Group 4	
Right thumb	Left loop	1	0	0	0	0.32 (NS)
		1.4%	.0%	.0%	.0%	
	Right loop	36	32	9	29	
		51.4%	55.1%	64.3%	50.0%	
	Double loop	11	4	0	2	
		15.7%	6.8%	.0%	3.4%	
	Whorl	18	14	3	22	
		25.7%	24.1%	21.4%	37.9%	
	Arch	3	4	2	5	
		4.3%	6.8%	14.3%	8.6%	
	Tented arch	1	4	0	0	
		1.4%	6.8%	.0%	.0%	
Total		70	58	14	58	200
		100.0%	100.0%	100.0%	100.0%	100.0%

Mann-Whitney U test

The Right loop pattern was most common in group 3 (64.3%) which was higher as compared to the distribution of right loop pattern in other groups (Table/fig 7). But, this difference was not found to be statistically significant.

IV.   DISCUSSION

Periodontal disease is one of the most prevalent infectious diseases, affecting thousands of people across the globe. It occurs due to a complex interaction between the host immune system and the plaque micro-organisms. This leads to an irreversible destruction of the tissues surrounding the tooth. Numerous risk factors have been implicated in the occurrence and progression of periodontitis. One of which is Genetics. The role of which, had been an enigma, till recent years, when it was found that genome plays a significant role in influencing the inflammatory and immune responses in periodontitis.[14] Dental Caries is said to be the most common bacterial disease in humans[15]. Several etiological and risk factors are associated with the manifestation of caries.Environmental factors, such as diet, quality of dental hygiene, fluoride exposure, microbiota and Host factors such as salivary flow rate, buffering capacity, the position of teeth, depth of occlusal pits and fissures and surface characteristics of enamel. Just like many other medical and oral diseases, Dental caries occurrence depends on a complex interaction between the genetic structure and environmental factors.[6]

The term Dermatoglyphics which was coined by Cummins et al in 1926 [4], refers to the study of the intricate dermal ridge configurations on the skin covering the palmar and plantar surfaces of hands and feet.[5] The dermal ridges originate from fetal volar pads that appear in the 6th-7th week of embryonic life. This is around the same time as that of tooth formation in intraembryonic life. This indicates that the genetic message contained in the genome is deciphered during this period and is also reflected by dermatoglyphics.[5]

Lip print pattern is unique to an individual and hence this anatomical character of the human lips may be useful in identification and diagnosis of congenital diseases and anomalies.[16] Various facial structures like the lip, alveolus, teeth ,and palate are formed from the same embryonic tissues and during the same time as that of epidermal ridges of fingers and palms.[3]Since the enamel of the tooth and epithelium of fingers both develop from ectoderm and because the enamel organ is found to play an important role in development of periodontal apparatus, any disturbance in the ectodermal layer may be reflected in the development of dermal ridges as well as the tooth.[12]

And this was the basis of co-relating two of the most prevalent oral diseases, i.e. dental caries and periodontal disease with the study of lip prints and dermatoglyphics, in our study.

Reticular lip print pattern(40.4%) was most commonly found in the study subjects. Moreover, left loop pattern(48%) was most common for the left thumbprint and right loop pattern(53%) for the right thumbprint. And out of these 200 subjects, the prevalence of Reticular pattern was maximum in subjects with Dental Caries (50%) and the ones with both Caries and Periodontitis(50%). Also, a significant relation was found between the left thumbprint pattern and oral health status, with the left loop pattern(71.4%) being the commonest in subjects having both Dental Caries and Periodontal disease. Though Right loop pattern was most common in patients with caries and periodontal ailment (64.3%) which was higher as compared to the distribution of right loop pattern in other groups but this difference was not statistically insignificant.

Madhusudan et al (2015),[3] carried out a study to assess the relationship between cheiloscopy, dermatoglyphics and dental caries and concluded that prevalence of caries is higher among subjects with Branched lip print pattern [male(42%) female(32.24%)]. On the contrary, In this study, the incidence of Caries and periodontitis was found to be higher in subjects with reticular pattern(40%). In thumbprint analysis, loop pattern was found to be the most prevalent thumbprint pattern in both the studies mentioned above, unlike the studies conducted by PR Abhilash et al(2012),[17] Madan et al (2011),[18] Padma K Bhat (2011),[19], Ekta et al,[5] where whorl pattern was found in most of the subjects. However, Smitha et al [20] concluded in their study that there was an increased incidence of loop and whorl in caries-active individuals, which is similar to the results obtained in this study.

Vaidya et al[12],concluded in their study, that individuals with periodontitis had increased incidence of whorl pattern on both the right and left hands.This is similar to the results obtained by Sowmya et al[21] and Atasu.M[22]. In contrast, no significant results were obtained with respect to a direct correlation with the disease in this study. However, statistically significant results were seen in subjects who suffered from both the ailments considered in the study, i.e. caries and periodontitis. : The differences in the results, compared to those of previous studies is possibly due to the difference in classification systems and analysis methods used.

Dermatoglyphics has been considered as a genetic marker in many congenital and clinical diseases such as Down's syndrome, Apert syndrome, and Diabetes.[13]The Role of dermatoglyphics as an indicator of precancerous and cancerous lesions of the oral cavity was studied by Ambika[23]. Similar studies have been carried out by Satish et al(2014),[24] and SNR Yaratha(2017),[25]co-relating dermatoglyphics and cheiloscopy with Oral Submucous Fibrosis and Cleft lip and palate respectively.

Limitations- Various limitations that were encountered during the study. The most important being difficulty in obtaining consent for this study. Several patients refused to have their lip prints and thumb prints recorded. One of the possible reasons was the lack of awareness amongst the general population about genetics being an

important etiological factor of oral ailments, and the importance of dermatoglyphics and cheiloscopy in determination of disease susceptibility. Secondly, several patients did fall into one of the criterias for the study, but had to excluded due to inflammation and or/infection of lips and abrasions/injuries on the fingers, which was fairly common in patients reporting to the out patient department. Additionally, inaccuracies while recording the prints, for example, insufficient coverage of epithelial surface with lip color/ink, improper positining of lips or fingers while recording the print including movement of the patient, reulted in difficulty in reading the prints. Lack of professional knowledge of the examiners analyzing the patterns may have also resulted in errors during classification.

V. CONCLUSION

Oral diseases and their occurrences have remained a partially unsolved mystery. There are several factors which modify the etiology and prevalence of even simple tooth decay. And anything which cannot be explained is usually answered by the core matter, DNA. Extracting genetic information from chromosomes involves heavy expenses. Dermatoglyphics and Cheiloscopy can prove to be extremely useful, noninvasive and inexpensive tools for preliminary investigations and early detection of oral diseases.

Patients may not agree to have their lip print and thumbprint samples recorded, for analysis and study of disease susceptibility. There is lack of knowledge and awareness amongst the general population regarding the basic causative factors of oral diseases, therefore it is a challenging task to explain the role of genetics as one of the plausible factors and the importance of having their prints recorded. This concept of using lip and thumbprints for checking the susceptibility is still at the stage of inception. Not only does it require extensive research in order to ascertain the significance of these variations in patterns,[5]but also attempts have to be made to increase public awareness regarding the various factors which can cause these oral diseases and how this method can be used to prevent or at least control it, by studying the patterns and categorizing into risk groups and taking sufficient precautionary measures right from an early age . This could take time, a decade even, but we must work towards it, as perseverance is the secret to all triumphs.

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