Forensic Corner

Original Article

Analysis of lip print and fingerprint patterns in patients with type II diabetes mellitus

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Abstract

Background and Objectives: Globally, the prevalence of diabetes is soaring high in the recent times. There is an ardent search in the scientific community for a reliable and cheap early predictor which can serve the purpose of mass screening of a genetically vulnerable population. Hence, the present study was conducted to assess the predictive role of cheiloscopy on type II diabetes mellitus (T2DM). Several studies have established the association of dermatoglyphics with diabetes. However, results are still far from satisfaction. Thus, we also evaluated fingerprint analysis along with cheiloscopy.

Materials and Methods: The study was conducted on 100 uncontrolled T2DM patients and 50 healthy controls. Lip prints were obtained using lipstick and cellophane paper analyzed and classified using Suzuki and Tsuchihashi's classification. Fingerprints were obtained using kajal stick, analyzed and classified using Henry's system of classification.

Results: Type IV pattern of lip prints was found significantly more in the diabetic patients. Howbeit, fingerprint analysis did not reveal any significant association with diabetes.

Conclusion: The present study showed a ray of hope for application of cheiloscopy as a potential biomarker in the early diagnosis of T2DM which can be used in mass screening. Further studies are warranted to confirm the findings.

Keywords: Cheiloscopy, dermatoglyphics, lip prints, type II diabetes mellitus

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INTRODUCTION

Every human being is distinct and discernible in that they exhibit their own pattern of characteristics. There are many well-known implanted methods of human identification based on these characteristics, and one of the most interesting emerging methods of human identification is human lips recognition. Normal lines and fissures in the form of wrinkles and grooves are present in the zone of transition of the human lip between the inner labial mucosa and outer skin.[1] These form a characteristic pattern, and the imprint produced by these are called lip prints. The study of lip prints is referred to as cheiloscopy. The word Cheiloscopy is derived from the Greek words, "cheilo" meaning lips and "skopein" meaning to see.[2]

Lip prints are analogous to fingerprints and can be used for personal identification since they are unique for individuals

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and do not change during the life of a person.[3] It has been verified that lip prints recover after undergoing alterations such as minor trauma, inflammation and herpes and that the disposition and form of furrows does not vary with environmental factors.[1] The biological phenomenon of system of furrows on the red part of human lips was first noted by anthropologist, R. Fischer in 1902. However, it was only in 1932 that Edmond Locard, one of France's greatest criminologists, recommended the use of lip prints in personal identification and criminalization.[4] Since then several studies have established the uniqueness of cheiloscopy.

Dermatoglyphics is a Greek word which is derived from "derma" meaning skin and "glyphae" meaning carving.[5] It is the science and art of the study of surface markings/patterns of ridges on the skin of the fingers, palm, toes and soles. Abnormalities in the ridge patterns may occur due to genetic alteration during organogenesis period, i.e., between 13th–60th day after fertilization of the ovum.[6] During development, once the epidermal ridges are formed they are age and environment stable becoming a reliable indicator of genetic composition of the individual. Since many genes take part in the formation of dermatoglyphic characters, it is possible that genes which predispose to familial disease may, by pleiotropy, also influence the ridge pattern so that particular constellation of dermatoglyphic features may be characteristic of a particular disease.[7] Abnormal dermatoglyphic patterns have been observed in several nonchromosomal genetic disorders and other diseases whose etiology may be influenced directly or indirectly, by genetic inheritance. Dermatoglyphics as a diagnostic aid and supportive evidence in the diagnosis of several diseases such as diabetes, mongolism, schizophrenia and leprosy has been reported in recent literature.[8]

Diabetes mellitus (DM) is a global disease, and the prevalence is increasing particularly in developing countries. It represents a major threat of the public health condition worldwide. Recent estimates indicate that there were 171 million people in the world with diabetes in the year 2000 and this is projected to increase to 366 million by 2030.[9] The vast majority of cases of diabetes fall into two broad etiopathogenetic categories – type I DM (T1DM) and T2DM. Clearly, T2DM has become an epidemic in the 21st century where India leads the world with the largest number of diabetic patients.[6] Converging points of evidence from population-based studies suggest that Indians are apparently genetically more prone to diabetes and insulin resistance.[10]

T2DM is a complex disorder of general metabolism and is currently thought to occur in genetically predisposed individuals who are exposed to a series of environmental influences that precipitates the onset of disease. It accounts for approximately 90%–95% of all diabetes. The clinical symptoms of T2DM are varied, and there are fewer efforts among individuals to assess their biochemical levels of blood or urine for glucose. Furthermore, the cost involved in these assessments is high. It is estimated that in about 50% of affected people the disease is undiagnosed.[8] Individuals with undiagnosed T2DM are at increased risk of developing coronary artery disease, stroke and peripheral vascular disease. With the increase in the prevalence of diabetes in the recent times there is a keen search in the field of medicine for potential early biomarkers of the disease. Lip prints and fingerprints being genetically determined may serve as one of such biomarkers. The analysis of lip prints and fingerprints are simple and noninvasive methods when compared with biochemical tests for T2DM. An unusual dermatoglyphics have already been reported as disease marker to DM in other parts of the world.[11-13] Recently, Sharma and Sharma also have shown the importance of fingerprints in T2DM.[14]

There is a paucity of good case–control studies, and literature search showed a single study emphasizing on the association of lip prints and T2DM.[15] The differences in the pattern of fingerprints among type II diabetics and nondiabetic individuals and the analogy of lip prints with fingerprints persuaded us to take up this study so that preventive measures can be initiated among prospective diabetics. We also believe that the difference of fingerprint patterns observed in type II diabetics needs confirmation in a different set of population. Hence, the present study attempts to ascertain whether there is any association of fingerprint patterns and lip print patterns with DM.

MATERIALS AND METHODS

Study sample

The study sample included 100 patients with uncontrolled type II diabetes in the age group 20–60 who attended Diabetic Clinic, Department of General Medicine, Government Medical College, Kozhikode, Kerala. The patients were on a regular follow-up and the last three consecutive fasting blood sugar values >140 mg/100 ml or last three postprandial blood sugar value >200 mg/100 ml or hemoglobin A1C value >7% was set as the criteria to proffer the uncontrolled state of the disease. Fifty healthy individuals without diabetes and without any family history of diabetes were taken as controls. While selecting cases and controls, individuals with any inflammation, trauma,

congenital deformity or any other disease of the lips and fingers, those with known hypersensitivity to lipstick and kajal sticks and those with other systemic diseases were excluded. All the participants signed consent forms; approval of the ethics committee was obtained. Data were collected by principal investigator (MP).

Lip print analysis

Procedure

The lips were first cleaned thoroughly and then outlined using a sharp lip liner pencil (Dazzler). On one end of an ear bud (Johnson and Johnson), lipstick (Dazzler) enough for upper lip was taken and applied uniformly, starting at the midline and moving laterally. The same procedure was repeated for the lower lip. The ear bud was discarded maintaining strict aseptic conditions. The individuals were asked to gently rub his/her lips together to spread the lipstick evenly. The lipstick was allowed to dry for about a minute. The individuals were asked to retain a relaxed lip position and impression was taken on the glued portion of the cellophane tape. Lip prints were obtained by dabbing in the center first and then pressing it comfortably toward the corner of the lips. The tape was carefully lifted from the lip, from one end to the other, avoiding any smudging of the print. The impression was then stuck on plain paper. Minimal pressure was maintained while taking the impression [Figure 1]. Cotton and Vaseline were used to remove the lipstick. After acquiring the patterns of the individuals, each of them was assigned a definite number and studied carefully with a magnifying lens. The lip prints were divided into four quadrants and patterns were assessed.[15]

The classification of patterns of the lines on the lips proposed by Suzuki and Tsuchihashi was followed,[16] since it gives a clear description of nearly all of the commonly encountered lip patterns and is interpreted as follows:

- Type I: Clear-cut vertical grooves that run across the entire lips
- Type I': Similar to type I, but do not cover the entire lip
- Type II: Branched grooves
- Type III: Intersected grooves
- Type IV: Reticular grooves
- Type V: Grooves do not fall into any of Type I–IV and cannot be differentiated morphologically (undetermined).

Figure 1: (a) Materials used in lip print and fingerprint analysis; (b) lipstick application using ear bud; (c) obtaining lip print using cellophane sheet; (d) final lip print

Fingerprint analysis

Procedure

Patients' hands were cleaned and dried before printing. A thin layer of black kajal material was applied to the fingers using Shingar Kajal stick. Imprints of five fingertips were recorded in specified boxes on an A4 sheet. The same procedure was repeated in relation to the other hand. After taking the fingerprints of all fingers, ink was removed initially using gauze pieces and Microshield hand rub following which soap and water was used. Prints were dried and studied using a magnifying lens to identify the fingerprints.

On each hand, the fingers were numbered from "I" through "V" starting from the thumb to little finger. The patterns of fingers were analyzed according to Henry's system of classification of fingertip patterns which classifies fingertip patterns into loops, whorls and arches [Figure 2].[17]

Scoring and statistical analysis

The collected data were analyzed blindly by two of the authors (SPM and DP). All data collected were presented as frequencies and percentages. Since the data were presented in terms of attributes and we intended to ascertain if the difference in the distribution of these attributes was due to sampling variation or not, Chi-square test was employed.

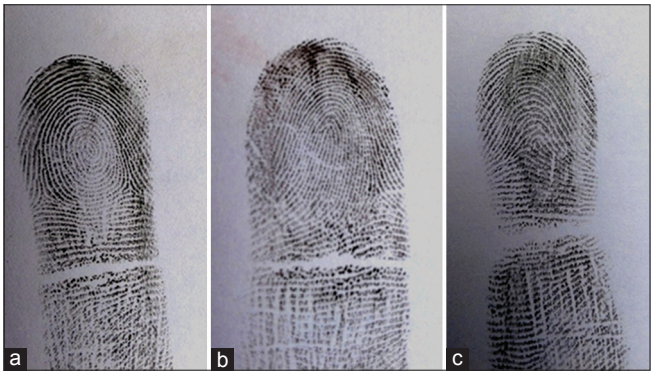

Figure 2: Various types of fingertip patterns: (a) whorl, (b) loop, (c) arch

$P < 0.05$ was considered statistically significant for all analysis. IBM SPSS software (IBM Analytics) was used for the statistical analysis.

RESULTS

The study group consisted of 100 cases of uncontrolled diabetic patients aged between 20–60 years and 50 healthy controls. The lip prints and fingerprints were obtained after getting informed consent. The prints were analyzed and categorized according to Suzuki and Tsuchihashi's classification. In addition, we also compared fingerprint pattern between diabetic (cases) and nondiabetic (controls) patients.

Lip print pattern

The lip print patterns in cases and controls were classified into Types I, I', II, III, IV and V. The percent distribution of each lip print pattern in cases were 8% Type I, 6% Type I', 4% Type II, 20% Type III, 57% Type IV and 5% Type V patterns. The percentage distribution of lip print patterns in controls was 30% Type I, 2% Type I', 32% Type II, 16% Type III, 18% Type IV and 2% Type V patterns. Figure 3 shows a comparison of lip print pattern between cases and controls (Chi-square value: 48.823, degree of freedom: 5). The difference in lip print patterns between cases and controls were statistically significant ($P = <0.001$). The difference was also compared in both sexes [Figures 4 and 5]. Results were statistically significant in females (Chi-square value: 30.826, degree of freedom: 5, $P = <0.001$) but insignificant in males (Chi-square value: 8.647, degree of freedom: 5, $P = 0.124$).

Fingerprint pattern

The fingerprint patterns were assessed for both hands starting from thumb to little finger (I through V). We analyzed the patterns of fingers according to Henry's system of classification (1900), which classifies fingertip patterns into three main types, namely, loops, whorls and arches. The percent distribution of these patterns was calculated for both the hands and the difference in fingerprint patterns between cases and controls was assessed [Figures 6 and 7]. In addition, the difference in fingerprint patterns for each finger was also assessed. The differences were not found to be statistically significant (for right hand Chi-square value: 2.181, degree of freedom: 2, $P = 0.336$ and for left hand Chi-square value: 3.590, degree of freedom: 2, $P = 0.166$).

DISCUSSION

The prevalence of DM is rising at a deplorable rate worldwide. Diabetes was once considered to be a mild malady of the elderly, howbeit presently, it is one of the prime causes of morbidity and mortality affecting the youth also. The WHO projects that diabetes will be the 7th leading cause of death in 2030.[18] The majority of diabetes (~90%) is T2DM caused by the amalgamation of impaired insulin secretion from pancreatic beta cells and insulin resistance of the peripheral target tissues, particularly muscle and liver.[19]

India holds the top position globally with the largest number of diabetic patients (31.7 million in 2000; 79.4 million in 2030) followed by China and the US.[20] Preliminary results from a large community study conducted by the

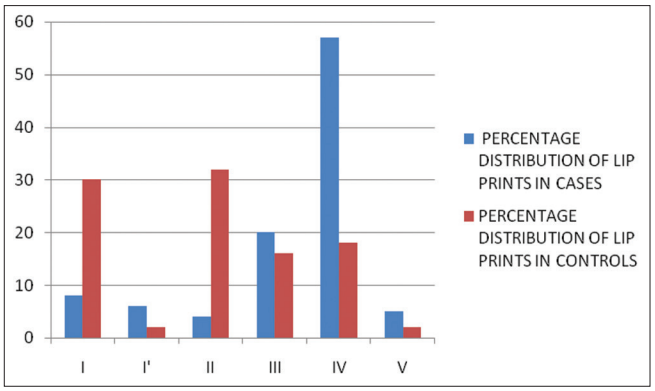

Figure 3: Comparison of lip print patterns in cases and controls

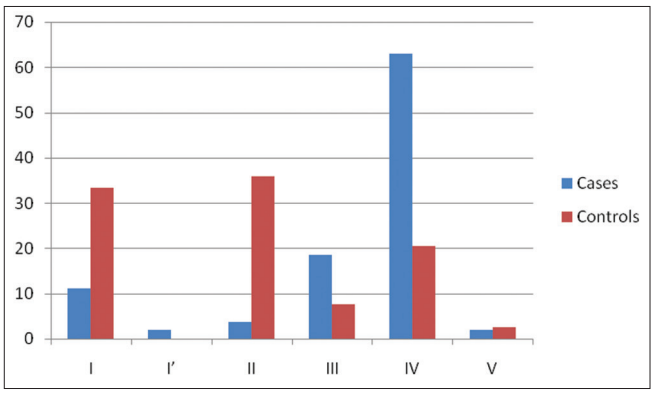

Figure 4: Comparison of lip print patterns in females

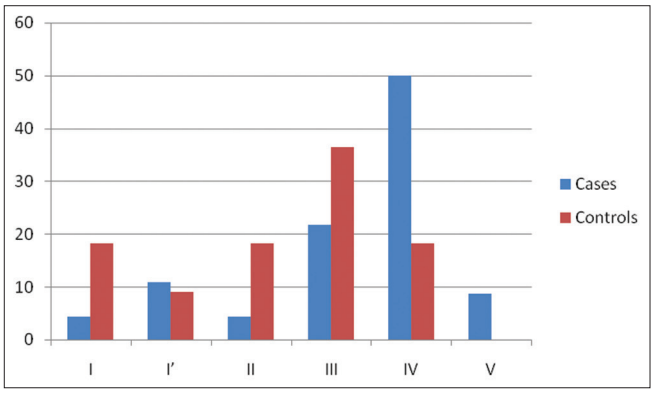

Figure 5: Comparison of lip print patterns in males

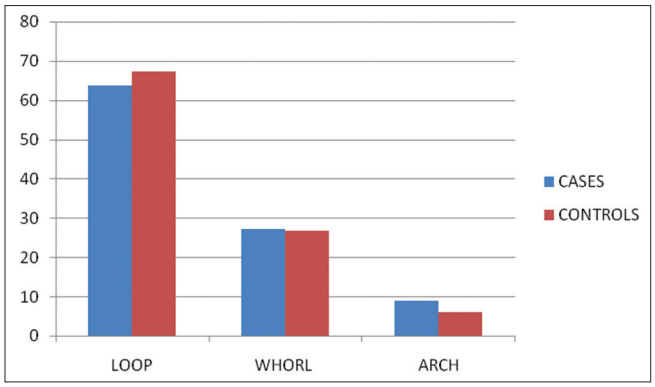

Figure 6: Distribution of fingerprint patterns in right hand

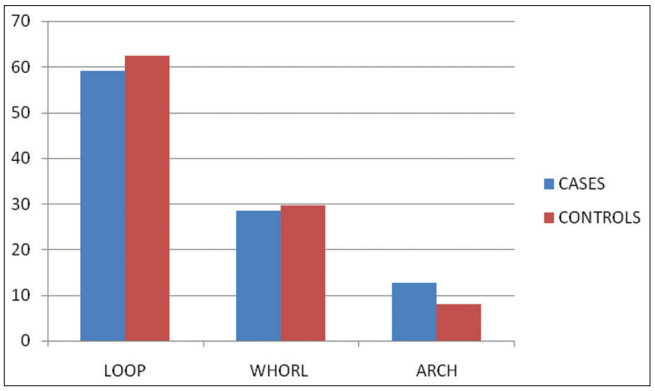

Figure 7: Distribution of fingerprint patterns in left hand

Indian Council of Medical Research (ICMR) revealed that a higher proportion of the population is affected in Southern India (13.5% in Chennai, 16.6% in Hyderabad and 12.4% in Bengaluru) as compared to Northern India (Chandigarh 0.12 million, Jharkhand 0.96 million).[21] In the state of Kerala, Raman Kutty *et al*. reported a prevalence of 16.3% in the capital city Trivandrum; a higher prevalence of 19.5% was reported by Menon *et al*. in Ernakulam.[22,23] This alarming proportion in the prevalence of DM may impose a potential burden on the socioeconomic status of a developing nation like India.

Although diabetes confirmation by blood test is the most widely accepted and validated method, this provides a stressful situation for the patient and requires more time and resources. Hence, the situation warrants a reliable early biomarker which can be used for mass screening of a genetically vulnerable population like that in our country, while imposing lesser financial liability and providing greater patient comfort.

Lip prints and fingerprints are genetically determined and form a pattern that is unique for each individual. T2DM, having a strong genetic background, can be influenced by these dermatoglyphic features. Furthermore, lip print and fingerprint analysis is simple and noninvasive methods, when compared with biochemical tests for T2DM. Footprints can also be used for similar anatomization. Record on the comparative study of lip print and fingerprint analysis with T2DM is exiguous in literature.

In the present study, it was found that 57.0% of the cases showed a Type IV (reticular) pattern, followed by Type III (20.0%), Type I (8.0%), Type I' (6.0%), Type V (5.0%) and Type II (4.0%). However, in controls, the maximum percentage was found for Type II and Type I which was 32.0% and 30.0%, respectively. Type I' and V were the least prevailing type of patterns in controls (2.0% each). Reticular type of lip print pattern was significantly higher in diabetics (57.0%) than normal healthy controls (18%). In normal controls, clear-cut vertical groves (30.0%) and branched pattern (32.0%) were significantly higher than diabetics (8.0% and 4%, respectively). These findings indicate the people with reticular type of lip pattern are at higher risk of developing T2DM, however, the group of people with clear-cut vertical groves and branched pattern are less likely to develop this disease. In a study from Nigeria, Umana *et al*. found that people with reticular and undifferentiated patterns had a higher probability of developing diabetes and those with branched and intersected pattern were at low risk.[15]

Akin to Nigerian population, we found that people of Malabar region with reticular pattern are at high risk of developing diabetes whereas people with branched pattern have less likelihood to develop the disease. Despite the fact that our study population of North Kerala (Malabar) is distinct ethnically and geographically from Nigerian population, the similar finding needs consideration. Thus, it can be validated that the people with reticular type of lip pattern have more chances to develop T2DM.

A comparison of lip print pattern between normal female individuals and female diabetic patients showed that 63.0% of female patients had reticular pattern which was significantly higher than female controls (20.5%). The normal female subjects showed branched and vertical pattern significantly more than diabetic females. These findings were similar to the study by Umana *et al*.[15] In the present study, the same trend as in female patients was seen with male patients also, however, the results were not statistically significant. This can be attributed to less number of male patients in the study (46% of cases and 22% of controls).

Published literature shows no study from India showing the association of lip prints and diabetes. A number of studies are however available on the prevalence of prominent type of lip print pattern in Indian population without any ailment.[24-27] Sandhu *et al*. orchestrated a study on lip print pattern in Punjabi population from North India and found Type I and II were the most common types similar to the patterns obtained in controls in the present Malabari population.[28] Other studies showed variegated results.[29-31] Verghese *et al*. in their study from Kerala found Type IV (reticular) pattern to be the predominant in both males and females.[32]

According to ICMR northern Indian population are less likely to develop DM than South Indian population. Arora *et al*. suggested that this difference could be due to the fact that the North Indians are migrant Asian populations and South Indians are the host populations, however, this possible cause-and-effect has not been corroborated through further research.[33] It is thus warranted that more elaborated studies on lip print and its association with DM are required to validate the results of the present study from other parts of the country and globally.

We also analyzed the fingertip patterns in all the digits of both hands in diabetics and controls. It was found that when seen individually each digit showed the highest percentage of loop pattern in both cases and controls. However, the results were not significant statistically.

When the pattern of right hands of cases were compared with the pattern of right hand of controls it was seen that the percentage of loop pattern was higher in controls when compared to diabetics while the percentage of whorl and arch patterns was higher in diabetics. For the left-hand, loop and whorl were in higher percentage in normal subjects and arch pattern was more in diabetics. However, the results were not significant statistically. These findings are in agreement with the study of Hossein and Nasser, however, their study was restricted to type 1 diabetes only.[34] Umana *et al*. in their study on Nigerian T2DM population also found loop and whorl were the predominant pattern in normal individuals while diabetics showed predominance of arch pattern.[15] However, the results were not statistically significant. Burute *et al*. also found preponderance of arch pattern in T2DM.[35]

In a sample of 75 T2DM Maharashtrian population from India, Nilesh *et al*. observed an increase in the number of whorls of both hands in males and females when compared with control group, while the frequency of ulnar loop was more in control group than diabetic patients.[36] Sant *et al*. reported an increased number of whorls and decreased number of ulnar loops in T2DM patients.[37] Aforementioned studies concentrating on the association of fingertip pattern with diabetes including the present study have so far yielded results which still are far from satisfaction. The results of different papers are also contradictory to each other.

We speculate that this variation may be attributed to several factors. First factor could be inclusion of insufficient amount of subjects in the study. Abhilash *et al*. in a sample size of 1250 found that the susceptibility of an individual to dental caries significantly increases with an increase in the whorl type of pattern.[38] They concluded that the dermatoglyphic patterns may be utilized to study the genetic basis of dental caries. Akin to dental caries DM is a multifactorial disease in which genetic and environmental factors play in unison. Thus, there is still scope for further study on a larger sample size. Other factors include the difference in the genetic make-up of individual belonging to different geographical areas and variegated methodology used in various studies.

The significant results of lip print pattern in the present study shows a ray of hope for application of cheiloscopy as a potential biomarker in the early diagnosis of T2DM which can be used in mass screening. We found a positive correlation between reticular lip print pattern and female diabetic patients and overall diabetics. The insignificant results of dermatoglyphics in T2DM call for further research on larger sample size.

CONCLUSION

Our results showed that type IV lip print patterns were significantly more in diabetics than non diabetics. This study indicates that people with type IV pattern of lip print may have a greater predilection for developing T2DM.

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Conflicts of interest
There are no conflicts of interest.

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