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Role of Dermatoglyphics as a Diagnostic Tool in Medical Disorders

Research Article

M.P. Santhosh Kumar*

Reader, Department of Oral and Maxillofacial Surgery, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University 162, Poonamallee High Road, Velappanchavadi, Chennai 600077, Tamil Nadu, India.

Abstract

Dermatoglyphics is the art and science of the study of surface markings and patterns of ridges on the skin of the fingers, palm, toes and soles. It is a useful tool for investigations into conditions with a suspected genetic basis. Over the past centuries, dermatoglyphics has evolved as a useful tool in the field of genetics, anthropology, biology, medicine and dentistry. Current scenario of medical dermatoglyphics is such that the association between fingerprint patterns and various systemic conditions such as diabetes mellitus, kidney diseases, hypertension, psychosis, breast cancer, alcohol embryopathy, epilepsy, congenital heart diseases, bronchial asthma, auto-immune diseases and many others has been established. This article discusses the advanced and recent applications of dermatoglyphics in diagnosing several dental, oral and systemic disorders. It also highlights the usefulness of dermatoglyphics as a diagnostic tool for many systemic conditions in the field of medicine. Dermatoglyphics is an accessible, inexpensive, useful, reliable and noninvasive method of exploring the genetic associations of oral, craniofacial and systemic disorders. Thus, apart from personal identification, dermatoglyphics serves as an excellent tool in screening population for several medical and dental disorders.

Keywords: Dermatoglyphics; Finger Prints; Palm Prints; Dentistry; Diabetes Mellitus; Hypertension; Systemic Conditions; Genetics; Anthropology; Medicine; Disorders; Cancer.

Introduction

The term dermatoglyphicsis derived from two Greek words: derma (skin) and glyphe (carve). Dermatoglyphics is the science and art of the study of surface markings /patterns of ridges on the skin of the fingers, palm, toes and soles [1]. These dermal ridges over the palms and soles of an individual are unique, universal, inimitable and classifiable. These friction ridge formations which appear on the finger, palms of the hands and soles of the feet are formed by genetic regulation and control during early intrauterine life. Thus, fingerprints are unique to each person and they are not altered during life time due to disease, age or any other reason [2].

The development of dermal ridges starts from 12th-13th week of gestation and by around 20th week, well differentiated recognizable dermal ridges are formed. Fingerprints are classified into three basic types: whorls, loops and arches. As genetic or chromosomal abnormalities might be reflected as alterations in dermal ridges, they can be used as an easily accessible tool in the study of genetically influenced diseases [3]. Apart from their use in forensics,it has many applications in the field of medicine and dentistry to predict several systemic, oral, dental and maxillofacial disorders. This is due to the presence of established association between fingerprint patterns and various systemic conditions such as diabetes mellitus, kidney diseases, hypertension, psychosis, breast cancer, alcohol embryopathy, epilepsy, congenital heart diseases [4].

Dermatoglyphics As A Diagnostic Tool in Medical Disorders

Diabetes Mellitus

According to the study by Verbov [5], female diabetics showed a decreased frequency of finger whorls and an increased frequen-

***Corresponding Author**:
Dr. M.P. Santhosh kumar M.D.S,
Reader, Department of Oral and Maxillofacial Surgery, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University 162, Poonamallee High Road, Velappanchavadi, Chennai 600077, Tamil Nadu, India.
Tel: 9994892022
Email Id: santhoshsurgeon@gmail.com

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cy of arches, whereas male diabetics showed a high frequency of patterns in the fourth interdigital area.Jeddy et al [6] in their study, evaluated the efficacy of cheiloscopy and dermatoglyphics in screening diabetic patients. Type II and IV lip print patterns were predominant in diabetic patients and Type I lip print patterns in controls which was statistically significant. However, there was no significant difference in fingerprint patterns between both the groups. They concluded that cheiloscopy but not dermatoglyphics can be considered as a screening tool in type 2 diabetes mellitus.A similar study conducted by Manjusha et al [7], revealed predominantly Type IV pattern of lip prints in the diabetic patients. They concluded that cheiloscopy can be used as a potential biomarker in the early diagnosis of type 2 diabetes mellitus.

Morris et al [8] assessed if the fingerprint patterns can be used as an early indicator of diabetes mellitus. They concluded thata diagnostic tool based on fluctuating asymmetry in the fingerprints of finger pair IV, measured using a wavelet analysis could be developed for predicting risk prior to associated health problems for both type 1 and type 2 diabetes mellitus. Taiwo et al [9] evaluated the association between dermatoglyphics and type 2 diabetes mellitus. Total finger ridge count (TFRC) was significantly higher in diabetic subjects than in non-diabetics and the dermatoglyphic patterns were associated with type-2 diabetes. They stated that dermatoglyphics can be used for early identification of risk group individuals for surveillance purposes.Platilova et al., [10] in their study concluded that the abnormality of the qualitative sign of the C line (lacking or reduced) could be considered as another early predictive factor: in the off-springs of diabetics for both types of diabetes.

In the study by Ravindranath et al [11] among diabetes mellitus patients, males exhibited increase in radial and ulnar loops and arches; decrease in whorls whereas females demonstrated increase in ulnar loops; and decrease in whorls in the left hand.

A study on Russian children with diabetes mellitus revealed pattern asymmetry, reduced incidence of loop patterns and increased incidence of double-delta patterns. Boys hadincreased frequency of arches, coils and decreased frequency of loops. Girls had no arches and decreased frequency of radial and ulnar loops [12]. According to the study by Zeigler et al [13], Type 1 diabetic patients showed a lower third finger ridge count, a-b ridge count, higher transversality of the main lines, higher frequency of palmar axial t' and t" tri-radii and a lower frequency of 'true' patterns in the fourth interdigital and thenar area. It was concluded that dermatoglyphics can be used as a screening tool for Type 1 diabetes.In another study, patients with diabetes mellitus had frequent WD on the fingers and low pattern intensity. High TRC value was present in both girls and boyswith diabetes mellitus [14]. In the study by Eswaraiah et al [15], the palmar flexion creases, main line formulae, C-line types, and Axial tri-radii showed significant differences between the diabetic patients and the control group. The patterns in the interdigital areas IV and II were significantly lower among male and female patients compared to their controls.

Hypertension

In the study by Palyzova et al [16], characteristic dermatoglyphic features in patients with essential hypertension were: decrease in ulnar loops, increase in whorls and papillary lines, higher "atd" values, increased frequency of distal positions of the axial triradius, deviations in the number of lines between triradii a and b, and less marked patterns in the interdigital spaces, on the hypothenar and thenar areas.Significant dermatoglyphic findings observed in both sexes of hypertensive cases as compared to controls in the study by Pursnani et al [17] were: Increased Total finger Ridge count; Decreased frequency of Axial triradius t (in right palm female) and Axial Triradius t' and t" in right palm (male); Decreased atd angle; and Absence of Axial triradi in both the palms of individual.

In another study [18], hypertensive patients had decreased ulnar loops, increased whorls, higher total finger ridge count, higher mean atd angle, increased frequency of distal position of the axial triradius (mostly in t' position) and more missing axial tri-radii compared to their controls. Chakravathy et al [19] found a significant increase in whorls, and increase in Mean "atd" angle in hypertensives when compared with their controls. Thus, it was stated that fingerprint patterns can be used to identify individuals at risk of developing hypertension and preventive measures can be initiated.In the study by Wijierathne et al [20], increased frequency of whorl patterns, and higher mean total ridge count was present in hypertensive patients than the control group.

Diabetes Mellitus and Hypertension

In the study [21] conducted on diabetic and hypertensive patients, whorls were absent in hypertensive patients and in men with diabetes and hypertension; and increase in frequency of ulnar loops in women with hypertension was present.There was a decrease in frequency of whorls in women with both diabetes and hypertension than in women with hypertension alone. The TFRC differentiated healthy subjectsfrom hypertensive men and women; and the a-b ridge count differentiated diabetic and hypertensive men and women. The pattern intensity index and atd angle were higher in patients than in healthy subjects.

Patil et al [22] investigated the fingerprint patterns of patients with lifestyle-based diseases like hypertension, type2-diabetes and arthritis and found statistically significant difference in dermatoglyphic patterns of patients with systemic diseases when compared to the healthy controls.

Coronary Artery Disease

According to the study by Rashad et al [23], individuals with myocardial infarction had higher frequency of true whorls, higher total and absolute ridge counts, and lower frequency of ulnar loops than the control group. Patients with hypertension and angina pectoris were not significantly different inmost dermatoglyphic traits from the controls. In the study by Rashad et al [24], myocardial infarction patients had significantly higher frequency of true whorls, double loops; less ulnar loops and tented arches; higher total and absolute ridge counts in all digits. Similar trends were observed in analyses by digit and by hand, thus suggesting an antenatal origin of certain types of coronary disease.

An association reported between dermatoglyphic features and myocardial infarction (MI) in Japanese males was investigated on Caucasian males byAnderson et al [25]. They revealed that no significant differences in dermatoglyphic patterns existed between the myocardial infarction patients and the control group. In the

study conducted in north china [26], Patients with coronary artery disease hadabnormally high A-B ridge count, mean ATD angles and increased frequency of whorls and ulnar loops when compared to the healthy people. Thus, dermatoglyphics may play an important role in early diagnosis of coronary artery disease.

Congenital Heart Disease

In the study by Brijendra et al [27], there was increase in whorls with decrease in loop pattern, difference in the mean total finger ridge count (TFRC), widened mean atd angle, and higher mean ab, mean bc ridge, mean cd ridge, mean ad ridge counts in the various type of congenital cardiac diseasepatients as compared to that of controls.Ahuja et al [28] in their study reported that there was a considerable decrease in the t-d ridge count in all the categories of congenital heart disease studied, showing a distal displacement of the axial triradius to the t' position.

Rheumatic Heart Disease

According to Annapurna et al [29], patients with rheumatic heart disease had distinctive dermatoglyphic traits compared to that of the controls. It includes reduced frequency of arches on the finger tips in males and increased frequency of whorls in females; increased frequency of patterns in the III interdigital area in males; decreased d-t ridge count in females, and higher incidence of multiple axial triradii in females.In a study [30] on dermatoglyphics in patients with rheumatism, differences in dermatoglyphic indices in clinical types of rheumatic fever were mainly associated with a type of phenotypical pattern on the fingers, the presence or absence of a pattern on thenar and hypothenar, a pattern type on the fourth and fifth fingers. The authors concluded that it was possible to predict, the development of disease as well as its outcome.

Bronchial Asthma

A study conducted among bronchial asthma patients showedsignificantly different dermatoglyphic traits compared to that of controls. It included decrease in number of arches, increase in AFRC, increased ulnar loops in male patients and increased Whorls and radial loops in female patients [31]. In another study [32], a significant decrease in the mean value of the arches and increase in the mean value of the ulnar loops were observed in bronchial asthma patients compared to the control group. The mean values of TFRC, AFRC, and whorls were similar in both groups.Xue et al [33] revealed the presence of distinctive palm patterns in patients with bronchial asthma.

Kidney Diseases

Characteristic dermatoglyphic traits of kidney diseases such as Wilms tumor (WT) and adult polycystic kidney disease (APCD) include fewer whorl pattern frequency and lower mean total ridge count (TRC) [34]. The fluctuating asymmetry [FA] of the ridge count, A-B ridge count, total ridge count was found significant in patients with chronic kidney disease of unknown origin. The FA of pattern discordance (right vs left hands) between CKDu cases and control group were significant in several digits and the triradii a1 variable was less evident in palms of CKDu cases in both genders. The authors proposed a diagnostic tool based on FA could be developed for predicting risk prior to the development of CKDu [35].

Obesity

Alberti et al [36] reported a greater number of lines in left hand finger two (Mesql2) and a higher frequency of the whorl pattern in healthy weight group.The overweight group had a higher frequency of the radial loop pattern and the obese group had a higher frequency of the ulnar loop pattern.

Anaemia

Dogramaci et al [37] stated that the frequency of loops on the fifth finger of left hand, andmean c-d ridge count was significantly higher in female patients with beta-thalassemia major.However, it is not useful to detect thalassemia carriers. The findings of the study by Solhi et al [38] showed that the number of whorl fingerprint patterns in thalassemic patients was greater than that of normal individuals, while the number of loop fingerprint patterns being smaller and the frequency of arch fingerprint pattern in patients with major thalassemia was lower than that of minor thalassemic patients. In the study by Gualdi Russo et al [39], biological distances for dermatoglyphic qualitative and quantitative traits have been obtained from a group of beta-thalassemic heterozygotes and normal controls. The results indicated that the digital patterns have been the most efficient dermatoglyphic characters that differentiated between the two groups.

The dermatoglyphic analysis of Italian patients with Cooley's anemia and Cooley's trait showedthat Cooley's anemia patients had increase of loops and atd angles, decrease of whorls and total ridge count andminor changes in pattern distribution in the thenar and hypothenar areas. The Cooley's trait patients had increase in loops [40]. In the study by Mutalimova et al, the patients with beta-thalassemia major had increase in whorls, "atd" angle, ridge counts, and their parents had an increase in whorls. The changes of the dermatoglyphics in parents of children affected with beta-thalassemia major were suggested to be phenotypic feature of heterozygous carrier of the mutant gene [41]. In patients with sickle cell anaemia, the ulnar loop pattern had the highest frequency in both sexes of HB AS and HB AA individuals, TFRC and atd angles increased in frequency, whorls and Sydney creases were increased in males. Thus, dermatoglyphic traits could be considered as a marker for patients with sickle cell anemia [42].

Tuberculosis

Study by Sidhu et al [43] showed that tuberculosis patients and controls showed deviation from each other with respect to biological concordancedis-concordance in line C and hypothenar patterns; bilateral and left-homolateral (not right) differences in Plato's modal types of line C and; occurrence of hypothenar (R + L only) and III interdigital patterns (L-homolateral only).

Leprosy

In the study by Bumb et al [44], there was increase in frequency of loopson right hand, whorls on left hand and the distance between distal wrist crease and axial triradius was significantly decreased in LL patients. Decrease in frequency of whorls and a-b ridge count

was noted in TT patients.Gupta et alreported an increase in frequency of palmar pattern in thenar/1st interdigital area, increase in frequency of distal axial triradii (t' and t''), high frequency of Single Radial Base Crease (SRBC), low frequency of Double Radial Base Crease (DRBC), and high frequency of Simian Crease on palm of multibacillary leprosy patients [45].

A higher incidence of acquired ridge atrophy and congenital ridge dissociation on the palms was found in multibacillary leprosypatients compared to other types of leprosy [46]. Ghei et al [47] reported that a statistically significant association was noted with finger patterns (loop ulnar, loop radial, loop twin and loop central pocket) in the lepromatous type, whereas no such association was observed with the finger patterns in the tuberculoid type.

Alzheimer's Disease

Patients with senile dementia of the Alzheimer type [SDAT] showed a significantly increased frequency of ulnar loops on their fingertips, decreased frequency of whorls and arches and increased frequency of radial loops on the fourth and fifth digits. The fingerprint patterns observed in patients with SDAT weresimilar to patterns found in Down's syndrome [48]. According to the study by Weinreb et al, Alzheimer's disease[AD] patients had a significantly increased frequency of ulnar loops on the fingertips, Simian creases on the palms, palmar hypothenar patterns; and large distal loops in the hallucal region, increased frequency of radial loops on the fourth and fifth digits, Sydney lines on the palms, and small distal loops on the soles. The authors stated that the presence of eight or more ulnar loops or bilateral hypothenar patterns helps in identification of asymptomatic persons at increased risk for AD by dermatoglyphic criteria [49].

Cerebral Palsy

Dermatoglyphic traits of the digito-palmar complex revealed statistically significant differences between the fathers and their children suffering from cerebral palsywith a greater number of variables involved in male children with cerebral palsy [50]. In children with cerebral palsy, the arch, radial loop, whorl printsincreased; and ulnar printsand a-b ridge count decreased in boys. The total ridge counts decreasedand atd angle increased in boys and girls. Patterns in hypothenar, thenar/I, II, III and IV interdigital areas in case group were different from control group [51].

Epilepsy

In the study by Kharitonov et al [52], epileptic patients had increased frequency of the transversal sulcus, and less symmetricity on digital patterns compared to control groups. Schaumann et al [53] demonstrated that epileptic patients had significant dermatoglyphic features like an increased main line index on the right palm and decreased a-b ridge counts on both left and right palms. Kharitonov et al [54] concluded that dermatoglyphic characteristics were significant in the different groups of epileptic patients and accurate computer-aided diagnosis on the basis of dermatoglyphic examination can be made in 70% of the epileptic patients.

Von Recklinghausen's Disease [Neurofibromatosis]

Dermatoglyphic features in patients with generalized neurofibromatosis revealed increased frequency of digital central pocket patterns, monocentric whorls, secondary creases, higher quantitative values on digit II of both hands, reduction of main line C with decreased frequencies of patterns in the 3rd and 4th interdigital area of the left hand, lower ab ridge count,decreased frequency of high endings (5' or 5'') of line A in males and increased frequency of Sfl (Sydney line) in female patients [55]. According to Pallotta et al [56], patients with neurofibromatosis type I (NF-1) had increase in digital central pockets [quantitative fingertip pattern values], total finger ridge count (TFRC), atd angle, a-b ridge count in females, frequency of high endings (5' or 5'') of line A secondary creases, and decrease in both the ulnar index A'-d and the a-t' ridge counts.

Schizophrenia

Total finger ridge count and total A-B ridge count were low in patients with schizophrenia and they can serve as reliable dermatoglyphic indicatorsto identify individuals with and without schizophrenia [57]. Bramon et al [58] confirmed the presence of significant yet mild ABRC reductions in patients with schizophrenia which can be used as a sensitive indicator of the condition. Ahmed-Popova et alconcluded that the usefulness of dermatoglyphics as biological markers in mental disorders is contradictory and further research is needed [59].

The schizophrenics showed higher degree of discordance in the fingerprint patterns and ridge counts on homologous fingers. Thus, fluctuating asymmetry appears as a promising method for study of schizophrenia [60]. Dermatoglyphic analysis revealed significant differences in the proximal interphalangeal joint, eponychium of the middle digit and fingernails among cases and control groups. Dermatoglyphics can be used as a biomarker in clinical practice and could constitute an additional tool for the psychiatrist in diagnosing various mental disorders [61].

Mental Retardation

A dermatoglyphic study on mentally retarded patients revealed more intense and higher incidence of Patterns and TRC in the mentally retarded subjects compared to the controls. Total TRC of right hand in the mentally retarded persons were slightly higher than that of left hand [62].

Psychosis

Berecz et al [63] stated that the increased prevalence of minor physical anomalies (MPAs) and the abnormalities of dermatoglyphic patterns may be physical manifestations of neurodevelopmental disruption in affective disorders. The relative contribution of neurodevelopmental retardation to the aetiology of affective disorders remains undetermined.Ultrahigh risk (UHR) group for psychosis in the study by Russak et al [64] showed greater fluctuating dermatoglyphic asymmetry compared to controls. The

results of this study provided an important perspective on potential biomarkers and support neurodevelopmental conceptions of psychosis.

In the study by Rosa et al, the risk of either dermatoglyphic ridge dissociation [RD] or abnormal palmar flexion creases [APFC] was 44 percent in affected twins and 20 percent in nonaffected twins. In the group of MZ twins discordant for psychosis, discordance for RD or APFC always paralleled discordance for psychosis suggesting the operation of nongenetic factors [65]. In the study on patients with psychotic disorder, the presence of either ridge dissociations or abnormal palmar flexion creases was higher in the combined group of affected concordant and discordant twins than in the nonaffected discordant twins. In the discordant pairs, the presence of either abnormality was strongly associated with psychotic disorder [66].

Autism

In the study by de Bruin et al [67], finger print patterns, atd-angles, and palmar flexion crease patterns (PFCs) were analysedamong autism and healthy individuals. Boys with Autism Spectrum Disorders [ASD] had a higher rate of discordance in their finger print patterns than typically developing adolescent teenage [TD] boys. A study conducted in Iran revealed that autistic people had higher count of loops and decrease in ridge counts for the right and left thumbs and the index fingers. Thus, dermatoglyphics can be used in the screening of children with autism [68]. In a study done in Serbia, autistic boys had increased frequency of archesespecially on the fourth and fifth finger of both hands, decreased frequency of loops, lower TRC and ab-RC and wider atd angle [69].

Blindness

A study evaluated the hereditary characteristics of enzyme deficiency and dermatoglyphics in congenital colour blindness (CCB) patients. The rise in the frequency of eight or more whorls, the low value of atd angle and the presenting rate of real palmar patterns of the thenar, hypothenar and I, areas represented the hereditary traits of congenital colour blindness [70]. On comparison with a sample of normal Bulgarian children aged 3 to 18 years, children with visual, auditory and mental insufficiency differed in the relative frequency of pattern types on the digits especially on the second and fourth digits [71].

Genodermatosis

Minor differences in palmar and fingerprints were observed in patients with Darier's disease and normal controls [72]. Dermatoglyphic findings of a female with Ellis-van Creveld syndrome (EVC) showed remarkable dermatoglyphics when compared to the controls [73]. Cusumano et al revealed that greater number of digits with linear grooves, although associated with hand dermatitis were more commonly found in patients with atopic hand dermatitis. These patients also had significant increase in the whorl pattern especially in females [74]. A patient with Incontinentiapigmenti had remarkable dermatoglyphic findings such as hypothenar loops associated with distally displaced axial triradii on both palms, reduced total finger and summed palmar a-b ridge-counts, decreasing plantar pattern intensity on the left sole. The other family members had similar dermatoglyphic characteristics [75].

Patients with hypohidrotic ectodermal dysplasia (HED) demonstrated a distinctly abnormal longitudinal grooving along the entire length of each hair; desquamation of the surface cuticles and significant dermatoglyphic characteristics [76]. Research was done to investigate if the new Dermalog system could be used in conjunction with dermatoglyphics to identify patients with atopic dermatitis and the study revealed positive results [77]. The patients with X-linked hypohidrotic ectodermal dysplasia [HED] and the carrier females had higher incidence of arches on the fingertips, of t" triradii, of hypothenar patterns (especially ulnar loops), ridge flattening and hypoplasia, and of transversal direction of the main lines on the palms than the controls [78]. Dermatoglyphic investigations performed in a mother and her daughter, who were both suffering from hypomelanosis of Ito (incontinentiapigmentiachromians; HI) revealed single transverse creases, a high number of secondary creases and a longitudinal alignment of the main line A bilaterally, and a tricentric fingertip pattern on the right digit III of mother [79].

Breast Cancer

Results of the study by Metovic et al [80] indicated that the quantitative palmar parameter, ATD-angle, can play a role in identifying women with increased risk of breast cancer.According to the study by Seltzer et al [81], a pattern of 6 or more digital whorls was identified more frequently in women with breast cancer than in those without the disease. The positive predictive value of 6 or more digital whorls was comparable to that of mammography and that of breast biopsy. Thus, dermatoglyphics can be used to identify women either with or at risk for breast cancer.Sridevi et al [82] in their study demonstrated statistically significant changes in finger ridge count and fingertip pattern in cases of carcinoma breast.Palmar dermatoglyphics can be used as a reliable indicator for screening of high-risk population of developing breast cancer. No significant difference was found in the dermatoglyphic characteristics of women with and without breast cancer in the study by Sariri et al [83]. In the study by Chintamani et al [84], patients with breast cancer exhibited increased whorls in the right ring finger and right little finger with upto six or more whorls in the finger print pattern. Mean pattern intensity index was also significantly different among breast cancer patients compared to the control groups.According to Raizada et al [85], Breast cancer patients had increase in the arch pattern, decrease in the radial loops in the right and left thumb, the left index finger and the left middle finger, and decreased Total Finger Ridge Count (TFRC) and the Absolute Finger Ridge Count (AFRC).

Cervical and Endometrial Carcinoma

A study was conducted on Israeli-Jewish women with endometrial and cervical carcinoma to assess variations in their dermatoglyphic traits and indices of intraindividual diversity (Div), fluctuating asymmetry (FIA) and directional asymmetry (DA). Significant differences were found for some of the studied traits between cancer patients and their healthy control groups. The indices of diversity and asymmetry proved more suitable for discrimination, yielding the highest discrimination level between women with cancer and control females [86].

Duodenal Ulcer

The dermatoglyphic patterns which were significantly different in patients with duodenal ulcer compared to controls were: increased frequency of whorls; reduced frequency of loops on fingertips, and increased frequency of patterns in the thenar I and IV interdigital area [87].

Cancer

Dermatoglyphics of a group of cancer patients were different from those of groups of people suffering from certain other diseases and were more marked in males than in females. It was suggested that the genes which produce these differences may predispose the cancer patients to their malignancy [88].

Multiple Sclerosis

In both hands of the patients with MS, there was an increase in the a-b ridge count, ridge count in all fingers increased, and the dat angle [89].

Systemic Lupus Erythematosus

On dermatoglyphic analysis, eleven parameters were statistically significant, four separating the Mexican-American systemic lupus erythematosus [SLE] group from their controls and seven separating the Caucasian SLE group from their controls, thus suggesting a genetic abnormality associated with SLE [90]. In a study done in Austria, systemic lupus erythematosus [SLE] patients had a significantly higher frequency of low endings of line A on both hands, and-on the left hand-significantly more patterns in the fourth and fewer patterns in the third interdigitum. There was no association between these dermatoglyphic features and the HLA antigens (B8 an DRw3) [91]. Schur demonstrated significant differences of the palmar patterns of the right hand and right medial and left lateral triradius displacements between systemic lupus erythematosus patients, relatives, and healthy persons [92].

Ankylosing Spondylitis

Gomor et al in their study on ankylosing spondylitis patients concluded that HLA B27 did not contribute to the development of dermatoglyphic abnormalities [93]. Dermatoglyphic analysis in ankylosing spondylitis patients revealed that the atd angle was reduced on both palms, Ridge count was decreased between the b-c triradius on the left palm and increased on the third fingertip bilaterally [94]. Dermatoglyphic analysis of Ankylosing spondylitis patients revealed increased frequency of whorls and arches, Distal position of triradius, as well as more frequent occurrence of t', t", decreased frequency of loops and palmar patterns, and Main lines D, C, B, A ending in areas of lower numbers (9,7,5,4) [95].

Rheumatoid Arthritis

Analysis of dermatoglyphic patterns in rheumatoid arthritis patients revealed certain significant features. In male patients, with hands together, arches were increased, loops/ whorls were decreased and partial Simian crease was significantly increased. In the right hand, patterns were increased in the 3rd interdigital area. In female patients there was a significant increase in whorls and decrease in loops on the first finger on both the hands, increase in arches on the 3rd finger; both arches and whorls on the 4th finger of left hand [96]. Cvjeticanin et al described increased ridge count on the first and fifth finger bilaterally, on the fourth right fingertip, and their sum on each, and both fists among male patients with rheumatoid arthritis [97]. Cvjeticanin et al described increased ridge count on the third, fourth and fifth finger bilaterally, and consequentially in the total ridge count on the fingers of the two hands and of both hands taken together among female patients with rheumatoid arthritis [98].

Auto-Immune Diseases

In a study by Vormittag et al [99], Dermatoglyphics of patients-with systemic lupus erythematosus, scleroderma and Sjögren's syndrome were very different from the striking findings in Hashimoto's thyroiditis. Hence, it was concluded that thecharacteristic dermatoglyphic pattern of Hashimoto's thyroiditis is specific for this autoimmune disease, but not the expression of a general genetic predisposition to autoimmunity.

Noonan's Syndrome

In patients with Noonan's syndrome no deviation from the general population values was found with respect to individual quantitative value, A line termination, absence of C line, a-b ridge count, hypothenar patterns, and presence of p proximal triradius on soles. Whorls were however increased on fingertips and the axial triradius t [100].

Blood Groups

According to a Nepalese study, in both sexes, incidence of loops was highest in ABO blood group and Rh +ve blood types, followed by whorls and arches, while the incidence of whorls was highest followed by loops and arches in Rh -ve blood types. Loops were higher in all blood groups except "A -ve" and "B -ve" where whorls were predominant. Only the fingerprint pattern in Rh blood types of blood group "A" was statistically significant. In middle and little finger, loops were higher whereas in ring finger whorls were higher in all blood groups. Whorls were higher in thumb and index finger except in blood group "O" where loops were predominant. It was concluded that distribution of primary pattern of fingerprint is not related to gender and blood group, but is related to individual digits [101]. In a study conducted in Manipal, the mean comparison of different fingerprints with ABO and Rh blood groups showed no significant statistical association, thus concluding fingerprints cannot be used for blood grouping [102]. A study conducted among Libyan medical students to assess the relationship between fingerprints and different blood groups revealed that the majority of fingerprint pattern were Loops [50.5%] followed by whorls [35.1%] and arches [14.4%]. In Rh+ve casesof blood group A and O, loops incidences were the highest (52% and 54.3% respectively) then whorls (33.4% and 30.6% respectively), while in blood group B whorls were predominant in both Rh+ve and Rh-ve cases. In all blood groups there were high frequency of loops in thumb, index and little fingers [103].

Dermatoglyphic features are distinct to each and every person and is notidentical even in monozygotic twins. Thus, dermato-

glyphics may be in a position to become the primary means of assessing complex genetic traits, and also useful for the evaluation of children with suspected genetic disorders and diseases with long latency, slow progression, and late onset.

Now-a-days many dermatoglyphic studies are adopted by researchers for oral and systemic conditions and syndromes. This may lead to major breakthrough in the future and will aid in early diagnosis, treatment and better prevention of many genetically related disorders.

With a rich case bank established over the last decades we have been able to publish extensively in our domain [104-107]. Further large scale multi-centric trials are required to strongly establish the association between dermatoglyphics and systemic disorders pertaining to our study population. Extensive studies of ridge pattern have to be undertaken with several groups according to their racial and ethnic backgrounds [108].

Conclusion

Recently, several advances have taken place in the recording of dermatoglyphics. Dermatoglyphics have been correlated with skin patterns and external body features that can be used to construct diagnostic models for the purpose of personality identification as well as in diagnosis of phenotypic appearances. Dermatoglyphics do have a sure scientific basis for their role as a genetic marker in various diseases. By understanding the relationship between medical disorders and dermatoglyphic variations, it can serve as an excellent,non-invasivetool in the diagnosis of several systemic conditions.Dermatoglyphics is an accessible, inexpensive, useful, reliable and noninvasive method of exploring the genetic associations of oral and craniofacial disorders.Thus, apart from personal identification, dermatoglyphics serves as an excellent tool in screening population for several medical and dental disorders.

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