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Original Article

Causes of adermatoglyphia: A hurdle to biometric authentication

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Abstract

Objective To determine the causes of adermatoglyphia in patients presenting to Services Hospital, Lahore.

Methods This cross-sectional survey was carried out in the Department of Dermatology, Services Hospital, Lahore. All patients were referred by National Database and Registration Authority (NADRA) through Medical Examination Department (MED) of Services Hospital for verification of adermatoglyphia. Detailed history, physical and cutaneous examination was done. Skin of fingers and inkpad prints taken on white paper were evaluated. Causes of adermatoglyphia were assessed and data was recorded.

Results A total of 152 patients of adermatoglyphia were enrolled over a period of two years. Out of them, 96 (63.2%) were males while 56 (36.8%) were females. Mean age of the patients was 41.89 ± 23.72 years. Among our study population 20 (13.2%) patients had Isolated congenital (idiopathic) adermatoglyphia, 52 (34.2%) patients suffered from Congenital adermatoglyphia associated with a syndrome, while 80 (52.6%) patients presented with acquired causes of adermatoglyphia.

Conclusion It is concluded that adermatoglyphia is a challenge to biometric identification and authentication and is much more common than anticipated. With advancing technologies, other standardized alternative biometric modalities should be made available where fingerprinting is not conclusive.

Key words
Adermatoglyphia, biometric authentication, fingerprinting.

Introduction

Dermatoglyphics (or fingerprints) is a Greek word meaning skin (*derma) and carvings (glyphe).* These ridges are unique carvings of nature especially prominent over palmar surface of hands and plantar surface of feet. Their importance was first highlighted in the diagnosis of mongolism by Harold Cummins in 1936.[1,2] These naturally occurring patterns are unique to an individual and remain unchanged from birth to death.[3]Fingerprints are not similar even in monozygotic twins. Fingerprinting, also called Dactylography, is the single most widely utilized method for Biometric Identification and Authentication (I&A).[4,5] The variations in an individual's ridge pattern is partly determined by genetics (between 7th and 21st weeks of gestation) and partly by changes, trauma and diseases acquired during life.[6,7] Adermatoglyphia is defined as the congenital or an acquired loss of the epidermal ridge pattern.[4] It can be complete or partial, reversible or irreversible. It is also referred to as "Immigration Delay Disease".[8]

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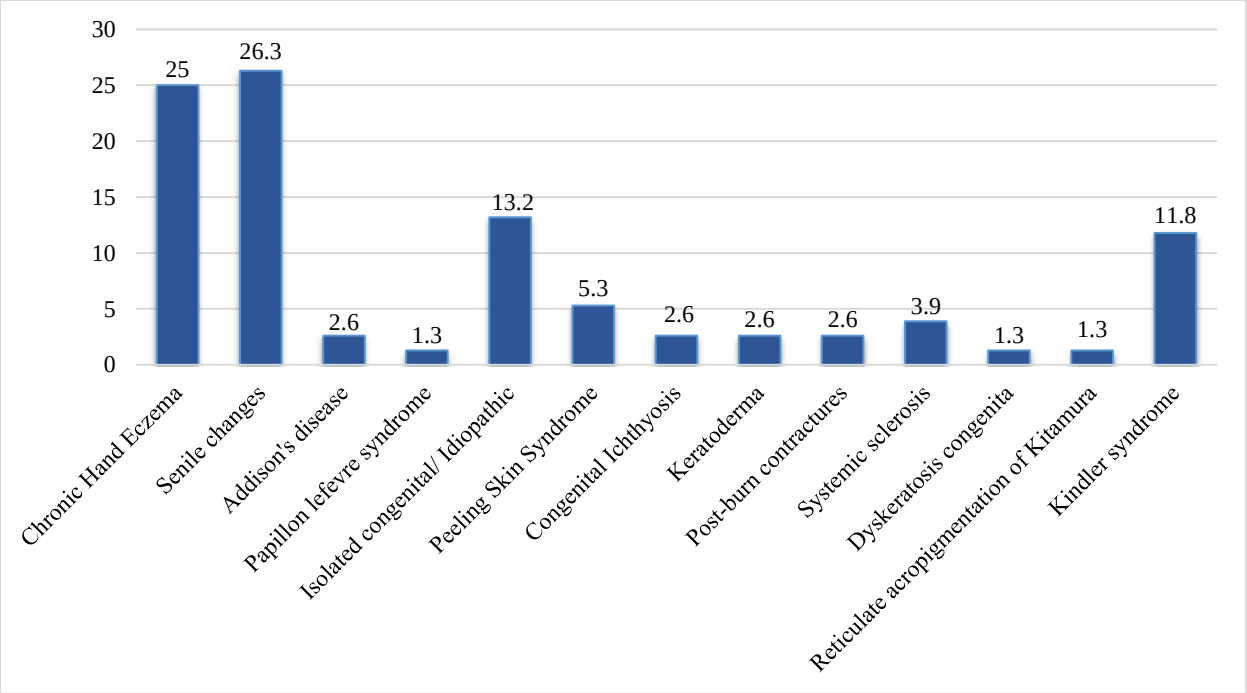

Figure 1 Causes of adermatoglyphia.

Most of the biometric methods of identification used these days are complex, however, the use of fingerprints is less complex, cheaper, readily available and therefore, widely used compared to other modalities. However, numerous hereditary and acquired causes of adermatoglyphia pose a huge hurdle in individual identification. There is a dearth of data regarding causes of adermatoglyphia in our population. This study was therefore planned to assess the demographics and etiology of adermatoglyphia. Patients with this condition have difficulties when undergoing biometric verification and this can be burdensome and depressing for patients especially when it is irreversible and if alternate methods of identification are not readily available.

Methods

This Cross-sectional survey was carried out in the Department of Dermatology, Services Hospital, Lahore. After taking approval from Ethical Review Board, patients presenting to Services hospital Lahore over a period of two years (July 2019 to June 2021) were enrolled after written informed consent. The patients were referred by National Database and Registration Authority (NADRA) and reported to Medical Examination Department (MED) for verification and certification of Adermatoglyphia. Detailed history, physical and cutaneous examination was done to analyze the cause of reduced or absent fingerprints. Fingerprints were taken on white paper and inkpad prints were evaluated. Clinical and demographic details of patients were recorded. Patients of reversible and treatable causes were treated with moisturizers or topical steroids for 6 to 8 weeks. They were called for follow up, if still their dermatoglyphics were reduced or absent, they were diagnosed as having irreversible adermatoglyphia and were advised alternate mode of identification. Data was entered and analyzed in SPSS 27. Numerical variables like age were presented as mean ± standard deviation. Qualitative variables like gender, profession and causes of adermatoglyphia were presented as frequency and percentage.

Table 1 Descriptive demographic data of patients.

Variable	*Categories*	*No. of Patients (n = 125)* *n*	*%*
Gender	Male	96	63.2
	Female	56	36.8
Age	10-30years	74	48.7
	31-50 years	28	18.4
	51-70 years	20	13.2
	71 years and above	30	19.7
Profession	Housewife	34	22.4
	Laborer	16	10.5
	Student	50	32.9
	Government employee	6	3.9
	Retired Government employee	8	5.3
	Business	8	5.3
	Landlord	6	3.9
	Banker	8	5.3
	Private employee	6	3.9
	Doctor	4	2.6
	Unemployed	6	3.9
Reason for Biometric Verification	Issuance of ID card	42	27.6
	Renewal of ID card	24	15.8
	Visa application	28	18.4
	Transfer of property	28	18.4
	Requirement for pension	4	2.6
	Entrance in exam hall	6	3.9
	Requirement at Bank	16	10.5
	Requirement for Passport	4	2.6
Causes of Adermatoglyphia (Treatable/Untreatable)	Treatable	36	23.7
	Untreatable	116	76.3
Causes of Adermatoglyphia (Congenital/Acquired)	Isolated Congenital	20	13.2
	Congenital associated with a syndrome	52	34.2
	Acquired	80	52.6

Results

A total of 152 patients of Adermatoglyphia were enrolled. Out of them, 96 (63.2%) were males while 56 (36.8%) were females. Mean age of the patients was 41.89±23.72 years. Age range was 17-87 years. Among our study population 20 (13.2%) patients had Isolated congenital (idiopathic) adermatoglyphia, 52 (34.2%) patients suffered from Congenital adermatoglyphia associated with a syndrome, while 80 (52.6%) patients presented with acquired causes of adermatoglyphia. Demographic details of the patients regarding their professions, reason for biometric verification and causes of adermatoplyphia are given in **Table 1** and **Figure 1**.

Most of the causes of adermatoglyphia were irreversible or untreatable (76.3%). Majority of the congenital causes of adermatoglyphia and eczemas were seen in younger patients usually

Table 2 Age-wise Distribution of Causes of adermatoglyphia.

Cause of Adermatoglyphia	*Age group of patients (years)*			
	10-30	*31-50*	*51-70*	*71 and above*
Chronic Hand Eczema	16	12	8	2
Senile changes	-	-	12	28
Addison's disease	4	-	-	-
papillon lefevre syndrome	2	-	-	-
Kindler syndrome	18	-	-	-
Isolated congenital/ Idiopathic	16	4	-	-
Peeling Skin Syndrome	8	-	-	-
Congenital Ichthyosis	4	-	-	-
Keratoderma	4	-	-	-
Post-burn contractures	-	4	-	-
Systemic sclerosis	-	6	-	-
Dyskeratosis congenita	2	-	-	-
Reticulate acropigmentation of Kitamura	2	-	-	-

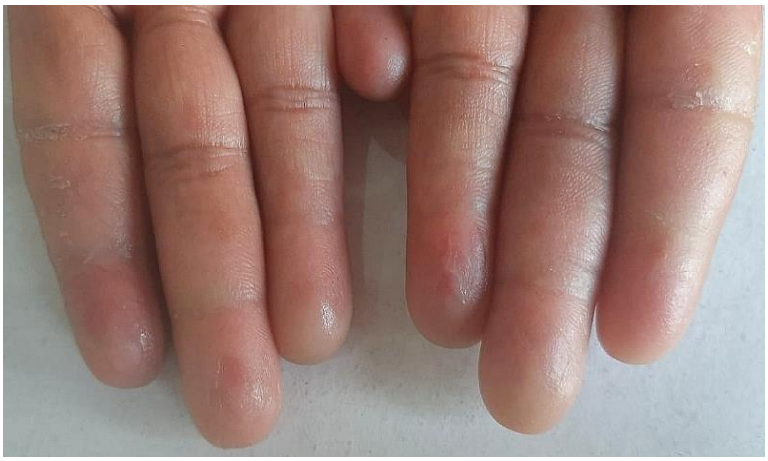

Figure 2

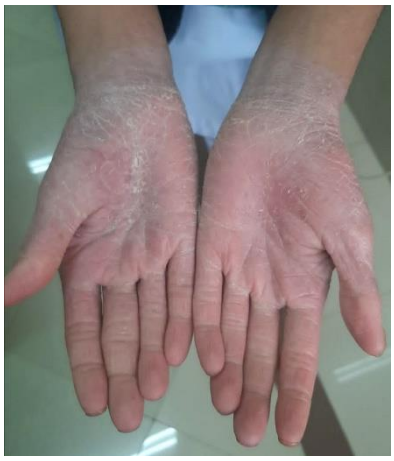

Figure 3

Figures showing adermatoglyphia due to peeling skin syndrome (Figure 2) and keratoderma (Figure 3)

when they first apply for their national identity card. Senile changes predominate in elders **(Table 2)** and was the commonest cause of adermatoglyphia noted **(Figure 1)**.

Discussion

Importance of fingerprinting in security, forensic, anthropometry and many other domains is inevitable.[9] However, adermatoglyphia poses a huge barrier to individual identification. Diagnosing adermatoglyphia can also be quite challenging. Therefore, it is important to know its causes and pattern in our population since not much work has been done to address this issue in our part of the world.

In our study population, there was a male predominance and higher proportion of younger patients presenting first due to issues with issuance of National Identity Card. These results were contrasting to those reported by Haber et al,[10] who reported higher incidence in females, elders and eczema as the leading cause.

Jeewandeep et al[11] highlighted the role of various genetic disorders in causing adermatoglyphia. We too noted many genetic diseases causing adermatoglyphia like peeling skin syndrome **(Figure 2)** and keratoderma **(Figure 3)**.

Bhat et al[12] also worked on the genetic causes of

adermatoglyphia. Dereure held mutations in SMARCAD1 gene responsible for congenital adermatoglyphia.[13]

Diagnosis of adermatoglyphia can be quite challenging since patients usually present late as they pay no heed to the absence of fingerprints. This makes the attending physician miss out on the actual cause of adermatoglyphia.

Advancing technology has made biometric analysis of individuals inevitable. Researchers have therefore, emphasized the importance of alternative modes of indentification.[14] These include finger vein patterns,[15] lip prints,[16] tongue prints,[17]etc.

Conclusion

The prevalence and psychosocial impact of adermatoglyphia can't be underestimated in modern world. This calls for the need of universally acceptable guidelines based on newer, easier, readily available and reproducible modes of individual identification and verification for those with adermatoglyphia.

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