## Review Article:

# Loss of fingerprints: A hidden problem facing during biometric identification

**Rehnuma Nasim[1], Md. Shahidullah Sikder[2]**

1. Consultant Dermatologist, National Institute of Cancer Research and Hospital, Mohakhali, Dhaka-1212, Bangladesh.
2. Professor, Dept. of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbagh, Dhaka, Bangladesh.

## Abstract

In the era of globalization as well as digitalization fingerprinting is the most acceptable form of digital recognition. It is the most available unique method for identification and individuality. But in recent years people from different corners of the world have noticed to have no fingerprinting incidentallywhen they are facing problems in digital identification and authentication systems. A thorough literature review was conducted involving different medical databases, using the following terms: loss of fingerprints, adermatoglyphia, and biometrics both individually and in combination. Surprisingly, no articles were found discussing specific guidelines for adermatoglyphic patients who have to undergo mandatory fingerprint verification. However, few case reports and scientific studies reveal that it will be a burning issue within the next decade. This article highlighted the epidemiology, types of adermatoglyphia, and challenges in diagnosing the cases and the importance of imposing other biometric methods to overcome the problem.

**Keywords:** Adermatoglyphia, fingerprints,

## Introduction

The scientific and methodical study of complex patterns andfingerprints from palms, fingers, soles and toes isreferred to as dermatoglyphics.[1,2,3] Dermatoglyphics (or fingerprints) is a Greek word meaning skin (derma) and carvings (glyphe). These ridges are distinctive carvings of nature especially prominent over the palmar surface of hands and plantar surface of feet.[4] More than a century ago, Sir Francis Galton discovered that these ridge patterns areincredibly constant throughout the lifespan of an individual.[5] Later, the term“dermatoglyphics” wasintroduced by Dr. Harold Cummins in 1936.[6] All over theworld, fingerprinting is the most widely used method for individual identificationand authentication (I&A). Dermatoglyphics form a major portion of mass data collection,biometric surveillance, and verification.Adermatoglyphia is defined as the congenital or 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".[7] Adermatoglyphia, or simply, lossof fingerprints attributedto a medical cause, represents a taxing situation for such biometric scrutiny systems requiring afingerprint scan as a mandatory phase in identification and authentication procedure. The scenario can be extremelydebilitating for adermatoglyphic patients, especially when the condition is permanent orirreversible.[8]

The disparityin ridge pattern of every individual is partly determined by genetics during gestational weeks 7th to 21st and partly by changes, trauma and diseases acquired during life.[9,10] Biometric methods which are used for identification inrecent days are complex, however, the use of fingerprints is less complex, cost-effective, readily available and therefore, universally used compared to other modalities. However, numerous hereditary and acquired causes of adermatoglyphia pose a huge

**Corresponding author**
Dr. Rehnuma Nasim. Consultant Dermatologist, National Institute of Cancer Research and Hospital, Mohakhali, Dhaka-1212, Bangladesh. rehnuma2009@gmail.com phone: 88-01711236561
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hurdle in individual identification.[11]

Epidemiology

Adermatoglyphia is not a known topic and no extensive work has not been done on it. So, there is a dearth of literature. However, nowadays the need for biometrics in identification, authentication and forensics application have exposed cases of hidden adermatoglyphiaand the field of interest is increasing. Haber et al. conducted a national survey in Lebanon in collaboration with the Ministry of internal affairs in 2014 which recorded 0.18%

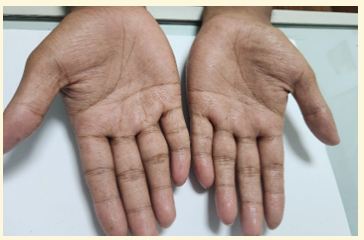
cases of adermatoglyphia with a female predominance and an increased incidence in the ageing population with dermatitis as thecommonest cause.[12]

A cross-sectional survey was carried out in the Department of Dermatology, Services Hospital, Lahore. All patients were referred by the National Database and Registration Authority (NADRA) through the Medical Examination Department (MED) of Services Hospital for verification of adermatoglyphia. A total of 152 patients with adermatoglyphia were enrolled over two years. Out of them, 96 (63.2%) were males while 56 (36.8%) were females. The mean age of the patients was 41.89 ± 23.72 years. Among their 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.[11]

Loss of fingerprints can be congenital or acquired.[8,13] The congenital form can be part of a complex syndrome and the prevalence will mirror that of the syndrome. Individuals with completely missing fingerprints as an isolated finding is extremely rare. Four generations were reported to have this isolated form of adermatoglyphia inherited in an autosomal dominant fashion.[14]

The acquired forms are more common andcould result from other dermatological conditions.[8,14-15]

A 27-year service holder visited in a private chamber referred by a travel agency in July 2023 for medical evaluation. He realizedthe loss of his fingerprints when he was unable to give his fingerprint during passport issuing, requiring his to be ten-printed (i.e., all fingers and thumbs of both hands were scanned/printed). Physical examination reveals hyperhidrosis of both palms andlaboratory reports reveal no abnormalities.He was treated as a case of idiopathic palmar hyperhidrosis and adviced to follow up after 2 months.



Loss of fingerprints of a 27 years male due to palmar hyperhidrosis

BBC reported in December 2020,that a Bangladeshi family where 3 generations had no fingerprints faced obstacles in issuing national ID cards, driving licences, buying SIM cards and office attendance systems. A dermatologist in Bangladesh has diagnosed the family's condition as congenital palmoplantar keratoderma. More genetic testing would be needed but these were not available in this resource-poor country.They got their NID card issued by the Bangladesh Governmentafter presenting a medical certificate.The cardused other biometric data too-retina scan and facial recognition.16

Congenital palmoplamterkeratodrma of a Bangaladeshi male[16]

The rationale of the review

Clinically adermatoglyphia is defined as the absence of an epidermal ridge pattern that may be due to congenital or acquired causes.6A few or all digitscan be affected. It may also refer to the absenceof the ridge patterns formed on the plantar aspects of the feet. Furthermore, adermatoglyphiacan refer to a partial loss of the ridges (i.e., ridges are unnoticeable on general evaluation but detectable on deep inspection or under a magnifying lamp) or a complete absence (depictingtotal effacement) of epidermal ridges. These are time-consuming challenges not only for the concerned authorities but also for the individual who has to face the problem in completing verification procedures. Face recognition and fingerprinting are the primary modes ofbiometric I&A

all over the world. Any technical problem or error hindering these steps of verification can cause the entire verification process to come to a halt.[12] Mostpatients with adermatoglyphia are unaware of the fact that they cannot produce their fingerprints and are surprisingly shocked when biometricanalysis fails.Nothing can be done except resorting to other modalities of identification. This is also achallenge in other areas such as forensics and criminal identification as it slows the process.Diagnosing adermatoglyphia is quite challenging.Therefore, a reliable alternativeto fingerprinting that is cheap, unique and readily available must be sought shortly.

Table1. Congenital causes of adermatoglyphia and their associated genes[17]

| S/no | Disease condition | Associated Gene |
|---|---|---|
| 1 | Basans syndrome | Smarcad1 |
| 2 | Naegeli-franceschetti-jadassohn syndrome | Krt14 |
| 3 | Dermatopathia pigmentosa reticularis | Krt14 |
| 4 | Reticulate acropigmentation of Kitamura | Krt14, dkc1 |
| 5 | Rothmund thomas syndrome | Wrn,blm |
| 6 | Dyschromatosis universalis hereditaria | Smarcad1,dkc1 |

Table 2. Dermatological and non-dermatological causes of acquired adermatoglyphia[17]

| Dermatological | Non dermatological |
|---|---|
| Allergic and irritant contact dermatitis | Trauma |
| Atopic dermatitis | Burn |
| Dyshidrotic eczema | Amputation |
| Cutaneous LE | Caustic abrasion |
| Epidermolysis bullosa | Denervation injuries |
| Pemphigus vulgaris | Capecitabine |
| Psoriasis | Topical steroid |
| Keratoderma blennorrhagica | Retapamulin |
| Palmar wart | Atorvastatin |
| Leprosy | |
| Pyoderma/impetigo | |
| Coxsackie | |
| Tinea mannum | |
| Erythema multiforme | |
| Steven johnson syndrome | |
| Toxic epidermal necrolysis | |
| Serum sickness | |
| Primary hyperhidrosis | |
| Lichen | |
| Acrodermatitis | |

## Methods of human identification and authentication

The necessity of a second-line substitute I&Asystem, especially for patients suffering from irreversible adermatoglyphia can only be realized when people get into the hassle of identification. Imperatively a medicalcertificate can be medico-legally issued but only provides a temporary solution, as the validityand the authenticity of such certificates might not be acceptable by other organizations.Different set-ups demand different types of biometric verification, often involvingmandatory, multi-modal biometric functions operating without a backup plan.[18,19] Additionally, some corporations require only thumb-printing for monitoring office attendanceor bank account verification. Other agencies granting citizenship, driver's licenses, passports,and immigration papers require a more stringent policy, requiring individuals to be ten-printed.Therefore, a substitute I&A system is recommended that can function globally as a defaultprogram for patients suffering from irreversible adermatoglyphia.

## Biometrics

Over the past few decades, many advancements have been made in biometric technology withthe introduction of new measurable biological traits as potential biometric targets. Table 3presents a concise review of the indispensable characteristics required for a biometric indicator.

While many of these biological traits fulfil the necessary characteristics required toqualify as a biometric indicator, feasibility becomes the most important factor based on
efficacy, social acceptability, the technical complexity of systems, ease of applicability, andcost-effectiveness. Consequently, there is no single biometric indicator that ideally achieves allthese parameters. Therefore, hybrid or complex multi-modal biometric systems are used toenhance the accuracy and efficacy of I&A.[18,19]

**TABLE 3: Essential qualities of a biometric indicator**

| Characteristic | Definition |
|---|---|
| Generality | Universally present in all individuals |
| Uniqueness | No individuals share the same configuration |
| Stability | Unchanging throughout the lifespan |
| Quantifiable | Measurable for comparison |

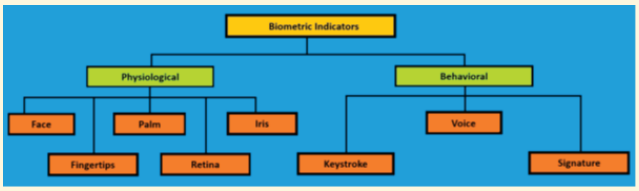



Fig: Biometric Subtypes

**Classification is based on physiological and behavioural traits**

In addition to facial recognition and fingerprinting technology, extensive research has beenconducted on other biometric recognition techniques, namely, iris/retinal scanning, handgeometry and palm prints, DNA fingerprinting, voice recognition, signature scanning, gait
patterns, and keystroke patterns.[20-23] Future endeavours will involve the exploration of otheranatomical organs and parts, with the potential for I&A to fulfil essential biometric features. These domains include but are not limited to, finger-vein patterns,[21] foot-printing,[24] dorsal finger pattern,[25] lip-printing,[26] and tongue-printing. [27]

Challenges

Diagnosing adermatoglyphia in Bangladesh is quite challenging. Patients usually present with difficulty in capturing fingerprints duringbiometrics. Further evaluation to enable the Attending physicians cannot get a chance to find out a specific cause because of the lack of molecular genetic testing.Thisis the primary investigation to ascertain whetherthe patient has smarcad1gene and keratin[14] mutation which are the major gene mutations seen in adermatoglyphia. [28,29] Theseinvestigations are not readily available anddefinitive diagnosis is halted. Other investigative modalities like volar pad biopsy are usually refuged by patients as they see the absence of fingerprints as a variant of normal and will resist attempts for invasive procedures. Another challenge is tracing family members to ascertain whether they also have adermatoglyphia.

The paucity of data on adermatoglyphia is also an issue as most patients with the condition do not present to a health care facility except when in need of a medical report. Patients are usually seen during biometrics in the banks, borders or immigration offices and access to
these data is met with some bureaucracies. The psychosocial impact patients with adermatoglyphia face during biometric screening is also enough trauma to make them avoid further analysis.

## Conclusion

Adermatoglyphia, especially due to acquired causesisnot an uncommon finding in the geriatric age group and manual labourers. It is also found in the young population. Despite itsbenign nature, the persistent invasion of biometric identification in modern life via fingerprintverification creates huge hassles for patients with irreversible adermatoglyphia. As fingerprinting is the most available and cheaper method for biometric identification, it provides the identification and authentication system quicker and is applied in different systems and institutions.However, aperson with absent or permanent loss of fingerprinting has to undergo enormous hardships due to lack of any alternative options. Therefore, specific guidelines or a substitute I&A system is recommendedthat can function worldwide, as a default program, facilitating I&A for patients suffering from irreversible adermatoglyphia.

## Conflict of Interest

None

## Funding source

None

## Patient Consent

Taken

## IRB approval status

Not applicable

## References

1. Moucdcy A, Arbenz GO. Digital dermatoglyphics. Possibility for a new index. Revista da Faculdade de Odontologia da Universidade de Sao Paulo. 1973 Jan 1;11(1):111-4.
2. Verbov J. Clinical significance and genetics of epidermal ridges-a review of dermatoglyphics. Journal of investigative dermatology. 1970 Apr 1;54(4):261-71.
3. Bose PK, Kabir MJ. Fingerprint: a unique and reliable method for identification. Journal of Enam Medical College. 2017 Jan 30;7(1):29-34.
4. Cummins, H. and Midlo, C., Finger Prints, Palms and Soles.(philadelphia: Blakison).1943
5. Galton F: Fingerprints. Macmillan & Co, New York; 1892.
6. Cummnis H, Midlo C. Palmar and plantar epidermal

ridge configurations (dermatoglyphics) in European-Americans. Am J Phys Anthropol. 1926;9:471-502.
7. Onyemocho A, Omala E, Onum E, Anigilaje EA. A cause of serious delay in issuance of Immigration epassport to a christian pilgrim in Nigeria: A case report. Int. J. Adv. Case Reports. 2015;2(12):732-5.
8. Sarfraz N. Adermatoglyphia: barriers to biometric identification and the need for a standardized alternative. Cureus. 2019 Feb 8;11(2).
9. Babler WJ. Prenatal selection and dermatoglyphic patterns. American journal of physical anthropology. 1978 Jan;48(1):21-7.
10. Seidenberg-Kajabova H, Pospisilova V, Vranakova V, Varga I. An original histological method for studying the volar skin of the fetal hands and feet. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2010 Sep 1;154(3):211-8.
11. Batool S, Tariq H, Shahid M, Siddiqui S, Batool S, Aman S. Causes of adermatoglyphia: A hurdle to biometric authentication. Journal of Pakistan Association of Dermatologists. 2022 Mar 29;32(1):42-6.
12. Haber R, Helou J, Korkomaz J, Habre M, Ghanem A, Tomb R. Absence of fingertips with focus on dermatological etiologies: national survey and review. J Clin Dermatol. 2015;3(1):21-6.
13. Dereure O. Adermatoglyphia or" immigration delay disease": the role of mutations in the SMARCAD1 gene. InAnnales de dermatologie et de venereologie 2012 Jan (Vol. 139, No. 1, pp. 75-76).
14. Haber R, Helou J, Korkomaz J, Habre M, Ghanem A, Tomb R. Absence of fingertips with focus on dermatological etiologies: national survey and review. J Clin Dermatol. 2015;3(1):21-6.
15. Kaur J, Batra AP. Role of dermatoglyphics in medical disorders. Indian Journal of Fundamental and Applied Life Sciences. 2013;3(3):5
16.https://www.bbc.com/news/world-asia-55301200 36.
17. Dieprebi AA, D AltraideDasetima DA, Bolaji OO, Belema A. Adermatoglyphia: Challenges and prospects in diagnosis. Asian Journal of Research in Dermatological Science. 2020 Jun 17;3(1):30-9.
18. Shen W, Tan T. Automated biometrics-based personal identification. Proceedings of the National Academy of Sciences. 1999 Sep 28;96(20):11065-6.
19. Sim T, Zhang S, Janakiraman R, Kumar S. Continuous verification using multimodal biometrics. IEEE transactions on pattern analysis and machine intelligence. 2007 Feb 20;29(4):687-700.
20. Kalyani CH. Various biometric authentication techniques: a review. Journal of Biometrics & Biostatistics. 2017 Oct;8(05).
21.Yang W, Wang S, Hu J, Zheng G, Chaudhry J, Adi E, Valli C. Securing mobile healthcare data: a smart card based cancelable finger-vein bio-cryptosystem. IEEE Access. 2018 Jun 5;6:36939-47.
22.Pato JN, Millett LI, National Research Council, Whither Biometrics Committee. Cultural, Social, and Legal Considerations. InBiometric Recognition: Challenges and Opportunities 2010. National Academies Press (US).
23.Hollien H, Didla GS. Perspectives about voiceprints. Journal of Indian Academy of Forensic Medicine. 2019;41(3):201-5.
24. Uhl A, Wild P. Footprint-based biometric verification. Journal of Electronic Imaging. 2008 Mar 19;17(1):011016.
25.Chattopadhyay S, Sukul B. Identification from dorsal finger pattern: a new approach. Medicine, Science and the Law. 2012 Jan;52(1):17-21.
26.Herrera LM, Fernandes CM, Serra MD. Evaluation of lip prints on different supports using a batch image processing algorithm and image superimposition. Journal of forensic sciences. 2018 Jan;63(1):122-9.
27. Radhika T, Jeddy N, Nithya S. Tongue prints: A novel biometric and potential forensic tool. Journal of forensic dental sciences. 2016 Sep;8(3):117.
28.Burger B, Fuchs D, Sprecher E, Itin P. The immigration delay disease: Adermatoglyphia–inherited absence of epidermal ridges. Journal of the American Academy of Dermatology. 2011 May 1;64(5):974-80.
29.Nousbeck J, Burger B, Fuchs-Telem D, Pavlovsky M, Fenig S, Sarig O, Itin P, Sprecher E. A mutation in a skin-specific isoform of SMARCAD1 causes autosomal-dominant adermatoglyphia. The American Journal of Human Genetics. 2011 Aug 12;89(2):302-7.