

Ethnic Variability of Plantar Dermatoglyphic Patterns and Their Forensic Significance in Human Identification

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Abstract Identification of individuals is one of the most important tasks in law enforcement and forensic practice. This process is carried out through operational-search activities, criminological investigations, and forensic medical examinations. The greatest difficulty arises in cases involving unknown individuals whose bodies are severely altered, dismembered, or represented only by separate parts, as well as in situations involving biological traces such as blood, fingerprints, hair, and barefoot impressions. The identification of a person, as an exact determination of identity, remains a critical challenge for forensic experts. In this context, there is an increasing need for simple, reliable, and effective methods. Dermatoglyphics, which studies the papillary ridge patterns of the skin, has become one of the most convenient approaches for analyzing the complex of external human features. Dermatoglyphic characteristics are stable, genetically determined, and highly individual, making them valuable markers in forensic identification. They can be preserved even in cases of significant postmortem or traumatic changes, thereby providing important information when traditional identification methods are limited or unavailable. In Uzbekistan, the number of such forensic cases involving unidentified individuals and biological traces continues to increase annually, highlighting the relevance of developing and applying additional diagnostic approaches.

Keywords Forensic identification, Dermatoglyphics, Unknown individuals, Biological traces, Papillary patterns, Forensic medicine

1. Introduction

Identification of unknown individuals remains a critical task in forensic practice, particularly in cases involving dismembered, decomposed, or severely damaged human remains. In such conditions, traditional identification methods are often limited, which necessitates the use of additional reliable and informative approaches [3].

Dermatoglyphics, which studies papillary ridge patterns of the skin, represents a stable and genetically determined system of morphological features that remain unchanged throughout life. Due to their high individuality and resistance to postmortem changes, dermatoglyphic traits serve as valuable markers in forensic identification.

While dermatoglyphic analysis has been widely applied in fingerprint identification, its potential extends beyond this scope. In particular, plantar dermatoglyphics has attracted increasing attention due to its relative preservation under adverse conditions and its applicability in complex forensic cases involving fragmented remains [5].

However, despite its potential, plantar dermatoglyphics

remains insufficiently studied, especially in terms of its role in forensic identification. Therefore, further research is required to evaluate its diagnostic value and to integrate it into modern forensic methodologies.

2. Materials and Methods

The study was conducted on a sample of 90 living individuals aged 18–30 years. Anthropometric and dermatoglyphic examination records of the participants were analyzed.

Dermatoglyphic data were obtained using standard methods for recording papillary ridge patterns. The analysis included evaluation of plantar dermatoglyphic features, such as pattern types, ridge characteristics, and their distribution.

Anthropometric parameters were assessed according to conventional measurement techniques. The collected data were systematized and subjected to comparative analysis to identify relationships between dermatoglyphic features and individual characteristics.

3. Result and Discussion

Plantar dermatoglyphic patterns demonstrated noticeable

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variability between the studied ethnic groups, reflecting both genetic and population-specific characteristics. These differences may be explained by the influence of hereditary factors as well as intrauterine developmental conditions affecting the formation of dermal ridge patterns.

Analysis of the main pattern types revealed that loop patterns were predominant in both groups (48.2% and 44.6%, respectively), which corresponds to general biological regularities of dermatoglyphic systems and confirms previously established data on the dominance of loop configurations in human populations. However, whorl patterns were significantly more frequent in the second group (38.9%) compared to the first group (34.7%) ($p < 0.05$), indicating a statistically significant intergroup difference. This finding may reflect specific embryological features of dermal ridge morphogenesis and population-related genetic variability. In contrast, arch patterns showed no statistically significant differences between the groups ($p > 0.05$), suggesting their relative stability and lower sensitivity to ethnic variation.

Table 1. Distribution of plantar dermatoglyphic pattern types (%)

Pattern type	Group 1 (%)	Group 2 (%)	p
Loop	48.2	44.6	>0.05
Whorl	34.7	38.9	<0.05
Arch	17.1	16.5	>0.05

Interdigital areas also demonstrated generally similar distribution patterns, indicating the presence of common structural principles in plantar dermatoglyphics. However, statistically significant differences were observed in the ID2 zone, where higher values were recorded in the second group ($p < 0.05$). This suggests that certain локал dermatoglyphic regions may be more sensitive to population-specific developmental factors. Other zones (ID1, ID3, ID4) did not demonstrate significant differences ($p > 0.05$), confirming the relative stability of these features and their limited dependence on ethnic variability.

Table 2. Distribution of interdigital dermatoglyphic patterns (%)

Zone	Group 1 (%)	Group 2 (%)	p
ID1	12.3	10.8	>0.05
ID2	18.6	22.4	<0.05
ID3	21.5	19.7	>0.05
ID4	9.8	11.2	>0.05

Morphometric analysis revealed that the total ridge count (TRC) was significantly higher in the second group (142.3 ± 14.1) compared to the first group (134.5 ± 12.6) ($p < 0.05$). Ridge count is considered one of the most stable and informative dermatoglyphic parameters, reflecting the complexity of papillary ridge configuration and embryonic development processes. An increased TRC value indicates a higher degree of structural differentiation of the dermatoglyphic system.

Table 3. Comparative analysis of total ridge count (TRC), Mean \pm SD

Indicator	Group 1 (M \pm m)	Group 2 (M \pm m)	p
TRC (mean)	134.5 \pm 12.6	142.3 \pm 14.1	<0.05

Further analysis showed that individuals in the second group exhibited generally higher ridge density and more complex dermatoglyphic configurations. This may be associated with population-specific genetic factors, as well as differences in prenatal development, particularly during critical periods of ridge formation [1].

The obtained results confirm that dermatoglyphic features exhibit a certain degree of ethnic variability. At the same time, morphometric indicators, such as ridge count, demonstrate higher diagnostic value compared to purely morphological traits. This suggests that quantitative parameters may provide more reliable criteria for forensic identification than qualitative pattern classification alone.

Comparison with previously published studies indicates that dermatoglyphic variability is influenced by a combination of genetic, environmental, and geographical factors. However, the absence of statistically significant differences in several parameters confirms the relative conservatism and biological stability of dermatoglyphic traits.

From a forensic perspective, plantar dermatoglyphic features can be considered valuable additional diagnostic markers for the identification of unknown individuals. Their high resistance to postmortem changes, including decomposition and mechanical damage, makes them particularly useful in complex forensic cases involving fragmented, decomposed, or severely altered human remains [4].

Moreover, the combination of morphological and morphometric analysis enhances the reliability of dermatoglyphic identification and supports the integration of these methods into комплекс forensic examination systems. The use of plantar dermatoglyphics may significantly improve identification accuracy, especially in situations where traditional methods are limited or unavailable.

4. Conclusions

The present study demonstrated that plantar dermatoglyphic features exhibit measurable variability between ethnic groups, reflecting the influence of genetic and population-specific factors on the formation of papillary ridge patterns. At the same time, the general structural organization of dermatoglyphic patterns remains consistent, confirming their biological stability and universality.

It was established that loop patterns are predominant in both studied groups, while whorl patterns show statistically significant intergroup differences. Interdigital zone analysis revealed that most regions are relatively stable; however, certain локал zones (particularly ID2) demonstrate significant variability, indicating their sensitivity to developmental and genetic influences [1,3].

Morphometric analysis showed that total ridge count (TRC) is a highly informative and statistically significant parameter, with higher values observed in the second group. This finding confirms that quantitative dermatoglyphic indicators have greater diagnostic value compared to qualitative pattern characteristics and may serve as reliable criteria in forensic analysis.

The results of the study indicate that plantar dermatoglyphics can be effectively used as an additional diagnostic tool in forensic identification. Due to their high resistance to postmortem changes and preservation under adverse conditions, these features are particularly valuable in cases involving fragmented, decomposed, or severely damaged human remains, where traditional identification methods are limited [2].

Furthermore, the combined use of morphological and morphometric approaches significantly increases the reliability and accuracy of dermatoglyphic analysis. Integration of plantar dermatoglyphic data into комплекс forensic identification systems may enhance the effectiveness of expert conclusions and support the development of new diagnostic algorithms.

Thus, plantar dermatoglyphic features represent a promising direction in forensic science. Their application can contribute not only to individual identification but also to the assessment of ethnic affiliation and biological characteristics. Further studies with larger sample sizes and advanced statistical methods are recommended to expand the scientific basis and

practical application of dermatoglyphics in forensic medicine.

REFERENCES

- [1] Ismailov R.A. Possibilities of determining personal characteristics based on dermatoglyphic features. Proceedings of the Republican Scientific Conference “Problems of Science in the Interpretation of Researchers”, October 30, 2025, pp. 118–121.
- [2] Ismailov R.A. Modern aspects of expert evaluation of dermatoglyphic markers in dismembered human remains. South Aral Sea Medical Journal, Vol. 1, No. 4, 2025.
- [3] Mittal P. Sexual dimorphism in digital dermatoglyphics: A qualitative analysis of Bengali Hindu population, West Bengal, India // IP International Journal of Forensic Medicine and Toxicological Sciences. – 2021. – Vol. 6. – No. 3. – P. 136–140. – DOI: 10.18231/j.ijfmts.2021.028.
- [4] Patel S., et al. Comparative dermatoglyphic study of Hindu and Muslim females of District Lucknow (India) // Journal of Clinical and Diagnostic Research. – 2013. – Vol. 7. – No. 9. – P. 1917–1920.
- [5] Reddy B.M., Chopra V.P., Karmakar B. Quantitative dermatoglyphics and population structure in Northwest India // American Journal of Human Biology. – 2000. – Vol. 12. – No. 3. – P. 315–326.