

Diagnosis of Scar Tissue Injuries of the Skin in Forensic Medicine

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Abstract The diagnosis of scar tissue injuries of the skin occupies an important place in forensic medicine, as it focuses on the analysis and evaluation of skin damage resulting from injuries. Scars that form upon the completion of healing provide valuable information for forensic experts, as they help establish the circumstances surrounding the injury and its potential causes. Accurate interpretation of scar changes is critical for criminal investigations, as these changes can indicate the timeline of the injury, the nature of the traumatic impact, and the severity of the incident.

Keywords Skin scars, Diagnostics, Morphological analysis, Forensic examination

1. Introduction

The diagnosis of scar tissue injuries presents a complex and multifaceted problem that requires an interdisciplinary approach, encompassing morphological, instrumental, and clinical research methods. Existing traditional methods do not always provide complete information about the origin and characteristics of the injury [1,4]. Considering these factors not only helps reconstruct the events but also aids in achieving justice in cases related to violent actions. In this context, the study of diagnostic methods for scar tissue injuries becomes a relevant area of work for forensic specialists, facilitating the development of more precise and effective approaches to resolving legal issues [6].

The scientific hypothesis of the study consists of developing a unified algorithm for the forensic assessment of scar tissue injuries using modern digital technologies and instrumental diagnostic methods. It is known that injuries related to the violation of skin integrity, resulting from surgical interventions, trauma, burns, post-vaccination, post-injection complications, insect or animal bites, tattoos, and others, lead to the formation of scars. In the forensic examination process, scars serve as indicators of violent signs that allow for the identification of the external impact mechanism and its duration. On a micro-level, scars result from the replacement of skin tissue with connective tissue. At the same time, normal, uncomplicated scarring leads to the formation of flat scars that have the same color as the surrounding skin, while any disruption in the scarring process at any stage can lead to the formation of hypertrophic scars. The final maturation of a scar occurs within 1-2 years, which is why in forensic medicine, scars that have been

forming for more than 100 weeks are considered long-term (mature) [15].

The expertise of skin scars has emerged as one of the widely used forensic examinations characterized by a high degree of subjectivity, and it continues to remain so. Due to the stability of skin scars, victims often become the subject of forensic investigation when referred for late examination. In the absence of medical documentation or when it is inaccurately formalized, scars can reliably confirm the presence of prior injuries, allowing for assumption regarding their timing, mechanisms of formation, characteristics of the injurious agents, and the number of traumatic effects [2]. For instance, according to data from the expert examination department of the Vladimir region's forensic medical bureau, between 1998 and 2000, scar evaluations constituted an average of 1.5 percent of the total examinations conducted. The issue of action in emergency situations involving multiple victims remains urgent. In such situations, identification of individuals is of primary importance, and, as noted by N. Hunger (1978), the examination of scars plays a crucial role. The forensic evaluation of scars resulting from combat injuries is of particular social importance [5].

The subjectivity of expert conclusions is one of the most acute problems in forensic medicine. Yu.Yu. Shishkin (2005) and others have repeatedly emphasized the necessity of a comprehensive approach, which means the combination of traditional diagnostic methods with new, reliable methods for recording injury parameters, followed by mathematical data processing and the use of computer technologies. V.A. Klevno (2006) noted the necessity to explore the possibilities of new technologies in forensic examinations, both in investigating deceased individuals and conducting examinations of living persons [6].

A.A. Khalikov (2006) emphasizes the necessity of applying at least two objective methods for the quantitative

registration of damage together to ensure the accuracy of the expert conclusion. If the opinion of a practical expert is confirmed with numerical descriptions of certain magnitudes, the subjectivism arising from the expert's reliance on personal experience when assessing the injury "by eye" is eliminated [7].

To date, apart from the detailed studies of I.M. Serebrennikov (1962), there are no precise criteria for the objective assessment of scars in outpatient settings. According to I.M. Serebrennikov, "scars should be examined in sufficient daylight, as it is impossible to accurately determine the color and shades of a scar under artificial light. Scars are examined through visual inspection (with the naked eye and magnifying glass) and palpation. Additional examination methods are used when necessary: X-ray, ultraviolet light, and capillaroscopy." Among all the aforementioned methods, the radiographic method is considered sufficiently objective; however, it is only appropriate in cases involving bone injuries or for identifying foreign bodies, such as bullet wounds. Occasionally, histological examination of skin scars can be performed using excisional biopsy. The capillaroscopy method is not practiced due to the localization of scars, which in most cases does not allow for the quality adjustment of lighting and optics and ensures the immobility of the examined individual. The possibilities of the remaining methods are limited by the individual characteristics of the expert's visual perception of scar properties [8].

Due to the pronounced subjectivity in the conventional assessment of scars and the lack of fundamental research when applying objective diagnostic methods, expert opinions regarding the nature of scars often tend to be speculative and contradictory [13]. It is noteworthy that, since the research conducted by I.M. Serebrennikov, qualitative changes in the study of reparative processes have occurred. This is related to the development of the technical component— equipment, as well as the capability of computer processing of information, the discovery of cells, and advancements in biochemistry and immunohistochemistry. Research in this field has deepened from extracytoplasmic components directly to cells; however, the interplay of various cellular and intercellular mechanisms remains sufficiently intricate and obscure, making the issue highly relevant from both scientific and socio-economic perspectives [9].

N. Aspres and co-authors (2003), while evaluating appropriate methods for studying skin properties, have highlighted the increasingly promising bio-physical methods that allow for the high-precision assessment of parameters necessary for specialists to address many issues related to the duration (timing) of biological processes occurring in live and/or deceased bodies [10]. The specifics of scar formation, its dependence on certain factors (e.g., in surgical patients), and its duration are currently insufficiently illuminated and require further research.

Forensic examinations of living persons are among the most common types of assessments, with the evaluation of objects such as skin scars widely practiced in forensic examination [12]. Unfortunately, to this day, forensic

examinations often focus on the external characteristics of scars as defined by the expert during routine inspections. At the same time, their essential diagnostic parameters have been subjectively assessed, "by eye," and through palpation, which have been influenced by both external (natural lighting conditions, etc.) and internal factors (emotional state of the researcher, individual color perception traits, etc.) [11].

2. Conclusions

Thus, based on the comprehensive forensic examination results of scar tissue injuries of the skin, the following scientifically grounded conclusions have been formulated, a unified method for diagnosing scar injuries, including the following components, has been developed and tested.

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