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Detecting microfragments of glass in scar tissues

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ABSTRACT

The identification of traumatic causes in the case of damage caused by sharp objects has always been one of the main issues of interest to the investigating authorities. Currently, forensic medicine allows for determining a specific acute traumatic object, including glass fragments. However, in the available literature, no information is available about the possibility of detecting microfragments of glass in the scar. Herein, the case of a man who suffered a chest wound is presented. The patient was brought to the hospital, where the wound was sutured. In the medical records, the wound was described as a stab wound and could have been caused by a knife. The accused categorically denied inflicting a knife wound on this person and argued that the victim was in a state of severe alcoholic intoxication and fell repeatedly, including on a sideboard, glass from which was found during an inspection of the scene. Four months later, the victim died from alcohol poisoning. A forensic medical examination was conducted to confirm the possibility of injury from glass fragments from the sideboard. A scar was identified on the victim's chest. Microparticles were found in the scar tissue, and their characteristics led to the conclusion that they were microfragments of colorless, transparent glass. Determining the presence of glass microfragments in scar tissue does not require complex technical equipment and are common in wide expert practice; their use has confirmed the possibility of detecting glass microfragments not only in soft tissues along the wound channel but also in scar tissue after wound healing.

Keywords: forensic medical examination; microfragments of glass; scar; possibility of detection; case report.

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О возможности выявления микроосколков стекла в рубцовых тканях

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АННОТАЦИЯ

Идентификация травмирующего орудия при повреждениях, причинённых острыми предметами, всегда являлась одним из основных вопросов, интересующих следственные органы. В настоящее время судебная медицина владеет возможностями определения конкретного острого травмирующего предмета, в том числе осколков стекла. Однако в доступной нам литературе мы не нашли сведений о способах обнаружения микроосколков стекла в рубце.

В представленном случае мужчине причинено ранение груди. Пострадавший доставлен в стационар, где рана ушита. Согласно описанию раны в медицинской документации, установлено, что рана является колото-резаной и могла быть причинена ножом. Обвиняемый категорически отрицал причинение данному лицу ножевого ранения и утверждал, что потерпевший находился в состоянии сильного алкогольного опьянения и неоднократно падал, в том числе на сервант, стекла от которого были обнаружены при осмотре места происшествия. Через 4 месяца потерпевший скончался от отравления алкоголем. Была проведена судебно-медицинская экспертиза для решения вопроса о возможности причинения ранения осколками стекла от серванта. На груди потерпевшего определено наличие рубца. В рубцовой ткани обнаружены микрочастицы, характеристики которых позволили заключить, что они являются микроосколками бесцветного, прозрачного стекла.

Методики, использованные для установления наличия в рубцовой ткани микроосколков стекла, не требуют сложного технического оснащения и распространены в широкой экспертной практике; применение их подтвердило возможность обнаружения микроосколков стекла не только в мягких тканях по ходу раневого канала, но и после заживления ранения, в уже сформировавшемся рубце.

Ключевые слова: судебно-медицинская экспертиза; микроосколки стекла; рубец; возможность выявления; случай из практики.

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检测瘢痕组织中微小玻璃碎片的可能性摘要

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摘要

锐器致伤致伤器的鉴定一直是侦查机关感兴趣的主要问题之一。目前，法医学有能力识别特定的尖锐创伤物，包括玻璃碎片。然而，在我们现有的文献中，还没有发现有关检测疤痕中玻璃微小碎片的方法的信息。

在本案中，一名男子胸部受伤。受害人被送往医院，伤口被缝合。根据医疗文件对伤口的描述，可以确定该伤口是刺伤和割伤，可能是由刀子造成的。被告断然否认刺伤了当事人，并声称受害人当时处于严重醉酒状态，多次摔倒，包括摔倒在餐具柜上，在检查现场时发现了餐具柜上的玻璃杯。四个月後，受害人死于酒精中毒。法医进行了检查，以确定伤口是否可能是由餐具柜上的玻璃碎片造成的。确定受害者胸部有疤痕。在疤痕组织中发现了微粒，根据这些颗粒的特征，可以断定它们是无色透明玻璃的微小碎片。

用于确定疤痕组织中是否存在玻璃微小碎片的方法不需要复杂的技术设备，在广泛的专家实践中得到了广泛应用。这些方法的应用证实，不仅可以在伤口管道沿线的软组织中检测玻璃微屑，还可以在伤口愈合后在已经形成的疤痕中检测玻璃微屑。

关键词：法医检查；玻璃微碎片；疤痕；检测的可能性；实践中的案例。

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INTRODUCTION

Identifying traumatic weapons in injuries caused by sharp objects has been the primary concern of investigative authorities. Currently, forensic medicine can determine the specific sharp traumatic object by its individual characteristics, including identifying established signs of injuries to the human skin caused by sharp objects with varying degrees of blade sharpness, composition, and design, as well as potential defects and conditions of injury [1].

Lacerations caused by glass shards through layers of clothing have been well-studied, despite such wounds externally appearing similar to injuries caused by other sharp objects, primarily knives [2, 3]. Detecting glass microshards in the tissues along the wound channel is a reliable method of confirming the impact of glass fragments on the skin, allowing to definitively determine if the wound was inflicted by glass [4].

The possibility of detecting glass microfragments in an already healed wound is uncertain. In 1962, I.M. Serebrennikov proposed a comprehensive methodology to examine skin scars [5], which was later augmented by the development of additional laboratory methods of research that consider the morphology of the scar tissue as well as the condition of surrounding and underlying tissues [6, 7]. These methods are currently used by forensic experts in the practical setting. A review of the literature revealed no information on the potential for detecting glass microfragments in scars.

CASE PRESENTATION

Three men were reportedly observed to consume alcohol in an apartment in a district in Karelia, Russia. On the following morning, the body of one of the men was discovered with multiple stab wounds. The second man had sustained a chest wound and was transported to a regional hospital for further treatment. The third man was subsequently apprehended on suspicion of causing serious bodily harm to the other two men.

An expert conducted forensic medical examination of the surviving victim on the basis of the victim's medical documents. Based on the surgical intervention protocol and characteristics of the described injury, the expert stated that the wound sutured by the surgeon was a stab wound caused by a stabbing and cutting object. The expert did not exclude the possibility that the wound was caused by a knife. The defendant categorically denied stabbing the victim and claimed that the victim was in a state of severe alcohol intoxication and had fallen repeatedly, including on a sideboard, the glass of which was found at the crime scene.

Four months later, the victim died of alcohol poisoning, and the lawyer of the suspect petitioned for a forensic examination to test the possibility of injury caused by broken glass from the sideboard.

Forensic medical examination of the victim revealed that the corpse was in a state of putrefactive transformation.

A scar measuring 2×0.3 cm was found on the left side of the chest in the projection of the seventh intercostal space along the midclavicular line. The skin fragment that had the scar was subjected to medical and forensic examination to check for microfragments in soft tissues.

The medical and forensic department received a section of breast skin exhibiting noticeable putrefactive changes. The skin was flabby and moist and presented with a peeling epidermis, giving the appearance of a dirty gray colored film. Underneath, the dermis had a dirty brown color with a greenish tint and sharp putrefactive odor (Fig. 1). Examination of the central portions of the specimen using stereomicroscopy revealed a scar that exhibited the characteristics of a skin depression and an irregular spindle shape with a 30-mm length, 20 mm width, and 1 mm depth.

The flap was treated with a vinegar–alcohol solution to reveal the features of the altered area on the skin. Following this, the skin exhibited discoloration, flattening, and swelling, thereby enhancing the visualization of the features of the altered area. The scar, which was in the form of a westernized area, measured 15 mm in length, 2–3 mm in width, and 1–2 mm in depth and resembled a trough. The edges had a rounded, sinuous morphology and converged at sharp angles at the ends. The bottom of the western area comprised dense connective tissue with whitish-brown color, an uneven texture, and fine granularity (Fig. 2).

For glass detection, the scar tissue was dissected and placed in a mixture of concentrated nitric and sulfuric acids. Then, the obtained mineralized material was diluted with distilled water in a ratio of 1:10 and filtered through paper filters. Following drying on their surface, stereomicroscopy revealed the presence of approximately 20 polygonal-shaped microparticles with dimensions ranging from 0.1×0.2×0.1 mm to 1.9×1.6×0.3 mm (Fig. 3).



Fig. 1. A fragment of putrefactive changed skin, submitted for research.

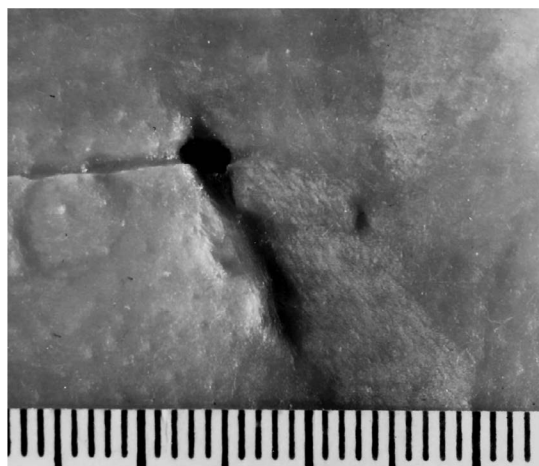


Fig. 2. Type of scar after treating the skin in an acetic-alcohol solution (division value 1 mm).

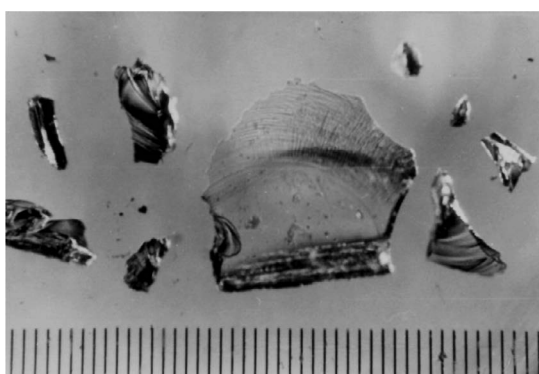


Fig. 3. Type of microfragments of glass, found in scar tissue (division value 0.1 mm).

In oblique light, the microparticles had a translucent, colorless appearance with glare, sharp arcuately striated facets, and sharp serrated edges and resembled microshards of glass. Upon examination under polarized light, these microparticles were a dark gray color with a matte tint, indicating their optically inactive nature.

One drop of a 0.1% solution of cresol red in acetone was added as an indicator to the microparticles to determine their nature. After 40–50 seconds, under stereomicroscopic observation, a pink-violet coloration emerged, indicating the presence of an alkali agent. Overall, the obtained data, i.e., external appearance, resistance to a mixture of nitric and sulfuric acids, optical inactivity in polarized light, and positive color indicating the presence of glass, indicated that

the microparticles found in the scar tissue were microshards of colorless, transparent glass. The microshards were further examined in a forensic laboratory, where chemical identification and matching with glass samples from the sideboard collected from the scene was conducted.

DISCUSSION

The presented case provides an intriguing insight into the detection of glass microshards not only within the soft tissues along the wound channel but also in the scar formed after wound healing. This observation corroborates the hypothesis of trauma formation resulting from the impact of shattered glass, a phenomenon that has not been documented in previous studies. During examination, a scar was noted on the left side of the chest in the seventh intercostal space along the midclavicular line, and the scar tissue exhibited approximately 20 microscopic fragments of transparent colorless glass.

CONCLUSIONS

The methods applied in this case do not require any sophisticated technical equipment and can be widely used by a diverse range of experts. Their implementation has highlighted the potential of detecting glass microfragments in the soft tissues along the wound channel trajectory as well as in the scar tissue formed after wound healing. Our findings enabled the suspect to dismiss the allegation against him of causing injuries.

ADDITIONAL INFORMATION

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