MODERN CRITERIA FOR THE FORENSIC MEDICAL ASSESSMENT OF RIB FRACTURES RESULTING FROM BLUNT MECHANICAL IMPACT

ZDIFT
Vol. 5 • No. 25 • 2026

Sharobiddinov Zafar Gayiboevich
Khakimov Sarvar Abduazimovich
Independent researcher at the Fergana Medical Institute of Public Health.
Associate professor of the Department of Forensic Medicine and Medical Law at TSMU, PhD.
https://doi.org/10.5281/zenodo.22824949
Received: 13 September 2026 • Accepted: 17 September 2026 • Published: 18 September 2026

Abstract.

This thesis analyzes the clinical, morphological, histological, radiological, and laboratory criteria used to determine the time of infliction of rib fractures caused by blunt objects. The stages of post-traumatic repair in rib fractures, their approximate timing, and the factors influencing the healing process are described. In forensic medical examinations, the necessity of a comprehensive assessment of all data to determine the age of the injury is substantiated.

Keywords:

rib fracture, blunt object, chest injury, morphological criteria, forensic medical examination.

Relevance of the topic. Bone fractures are one of the most pressing problems in medical science and practice. Chest injuries resulting from the impact of blunt objects hold a special place in the practice of forensic medical examinations. In such cases, determining the presence of a rib fracture, the mechanism of its formation, whether it was inflicted during life, and its age are among the primary questions posed by investigative and judicial authorities.

Determining the time of infliction of rib fractures allows for the reconstruction of the circumstances of the injury, the assessment of the time medical assistance was provided, the differentiation of recurrent injuries from different periods, and the verification of the accuracy of the incident's details. However, the healing process of rib fractures is individual in nature and is influenced by the victim's age, health status, the number of broken ribs, the type and localization of the fracture, the force of the mechanical impact, and the presence of complications. Therefore, determining the age of the fracture based on only a single characteristic is not sufficiently reliable.

Purpose of the research. To systematize the clinical, morphological, histological, radiological, and laboratory criteria used to determine the time of infliction of rib fractures caused by blunt objects, as well as to determine their forensic significance.

Research materials and methods. Forensic medical, traumatological, and morphological scientific literature dedicated to the mechanism, post-traumatic repair, and healing times of rib fractures was analyzed. Comparative-analytical, systematic, and generalization methods were used. Clinical, macroscopic, histological, radiological, ultrastructural, and biochemical signs indicating the age of rib fractures were studied separately.

Results and discussion. Rib fractures can occur as a result of a direct blow, anteroposterior or lateral compression of the chest, twisting, and other mechanical impacts. With direct impact, the fracture most often occurs at the site of the blow, while with indirect impact, it occurs in the

© 2026 The Author(s). Open Access under CC BY 4.0.

most curved part of the rib. Therefore, the direction of the fracture line, the characteristics of the bone edges, changes in the external and internal plates, and the condition of the surrounding soft tissues are of great importance in determining the mechanism of the injury. The healing process following a rib fracture is conventionally divided into the stages of hematoma formation, inflammatory reaction, development of granulation tissue, fibrosis and bone callus formation, and remodeling. These stages are not strictly separated from one another and may overlap over a certain period. In the first hours after the fracture, hemorrhage, erythrocyte, and fibrin accumulation are detected in the fracture area. During the first 24 hours, vascular reactions, edema, and initial signs of inflammation appear. Over the next 2–3 days, the infiltration of neutrophil leukocytes and necrobiotic changes in the damaged tissues intensify. Approximately on days 5–7, the activity of macrophages and fibroblasts increases, and granulation tissue begins to form. Subsequently, collagen fibers are formed, and osteoblasts are activated. From the second and third weeks, the initial signs of bone callus can be observed. X-ray examination is one of the primary instrumental methods for diagnosing rib fractures. However, non-displaced, subtle, or incomplete fractures may not be clearly visible on a simple radiograph in the early days. Typically, reparative changes in the fracture area become more pronounced after 1–2 weeks. Computed tomography is highly informative in identifying fracture lines, displacement of bone fragments, comminuted fractures, and injuries to the internal organs of the chest. As the number of fractured ribs increases, the duration of healing and the risk of complications also increase. In cases of one or two simple rib fractures, the first signs of repair can be detected within 2–3 weeks. In multiple rib fractures, the healing process can last 6–8 weeks, while in comminuted and complicated fractures, it can extend to 10–12 weeks or longer. However, these timeframes are relative and cannot be automatically applied to every case. The clinical presentation of rib fractures may include local pain, restriction of respiratory movements, pain and crepitation on palpation, tachycardia, and respiratory failure. The duration of the pain syndrome depends on the number of fractured ribs and associated injuries. In cases of multiple fractures, complications such as pneumothorax, hemothorax, lung tissue damage, and respiratory and cardiovascular disorders may develop. The victim's age and the condition of the bone tissue also influence the rate of repair. In elderly individuals, the healing process may proceed slowly due to osteoporosis, metabolic disorders, and chronic diseases. Conversely, in young and healthy individuals, regenerative processes occur relatively quickly. The quality of treatment, movement regimen, nutrition, and other individual factors must also be taken into account. Histological examination is one of the most important methods for determining the age of a fracture. It allows for the assessment of the presence of inflammatory cells, fibroblasts, newly formed blood vessels, collagen fibers, osteoblasts, and the degree of bone callus formation. Electron microscopy can detect early ultrastructural changes in cells and tissues. Immunohistochemical methods complement the morphological assessment by evaluating markers of inflammation, angiogenesis, and osteogenesis. Changes in calcium, phosphorus, alkaline phosphatase, osteocalcin, and other bone metabolism biomarkers in the blood may indicate the activity of the reparative process. However, since these indicators fluctuate under the influence of the body's general condition, age, and endocrine and metabolic diseases, it is not advisable to use them as independent diagnostic criteria. Thus, it is difficult to determine the exact calendar date of a rib fracture based on a single morphological, clinical, or radiological sign. It is considered scientifically justified to specify in the expert report not the absolute date of the injury, but the probable time interval corresponding to the identified signs.

Conclusion. The forensic medical evaluation of the timing of infliction of rib fractures caused by blunt objects requires a comprehensive approach. This involves a combined analysis of the incident details, medical records, the dynamics of clinical signs, radiography and computed tomography results, as well as macroscopic and histological changes. The age of the victim, the condition of the bone tissue, the number of broken ribs, the type of fracture, its localization, concomitant injuries, and the treatment provided must also be taken into account. Although morphological and histological criteria are of primary importance in assessing the age of rib fractures, modern radiological diagnostics, along with immunohistochemical and biochemical meth-

ods, increase the reliability of the expert conclusion. In the future, the development of a standardized diagnostic algorithm and the establishment of a set of reliable criteria for each post-traumatic period will serve to improve forensic medical examination practices.

Adabiyotlar, References, Литературы:

1. Abdurasulova D.M. Forensic medical examination of chest injuries / D.M. Abdurasulova, N.K. Ismailov // Medical Journal. – 2022. – No. 3. – P. 45-52.
2. Avdeev M.I. Forensic medical examination of a corpse / M.I. Avdeev. – Moscow: Medicine, 2018. – 560 p.
3. Akopov V.I. Forensic medicine in diagrams and drawings: a study guide / V.I. Akopov. – M.: GEOTAR-Media, 2021. – 448 p.
4. Andreev S.S. Modern methods of forensic medical diagnostics / S.S. Andreev. – St. Petersburg: Spetslit, 2019. – 312 p.
5. Antonov E.A. X-ray diagnosis of rib fractures / E.A. Antonov, K.V. Lebedev // Medical Imaging. – 2021. – No. 4. – P. 78-84.
6. Artamonov L.T. Pathomorphology of traumatic injuries / L.T. Artamonov. – Moscow: Medicine, 2018. – 224 p.
7. Baryshnikov A.N. Determination of the age of bone fractures / A.N. Baryshnikov, I.V. Vlasov // Forensic Medical Examination. – 2020. – No. 3. – P. 15-20.
8. Belyaeva E.V. Morphological changes in the fracture zone / E.V. Belyaeva // Archive of Pathology. – 2021. – No. 2. – P. 34-39.
9. Bogomolov D.V. Forensic medical examination of mechanical injuries / D.V. Bogomolov, A.A. Bogomolova. – Moscow: Practical Medicine, 2018. – 392 p.
10. Boyko V.V. Diagnosis and treatment of chest injuries / V.V. Boyko. – Kharkiv: Fakt, 2019. – 312 p.
11. Gedygushev I.A. Forensic medical examination in criminal investigations / I.A. Gedygushev. – Moscow: Medicine, 2018. – 432 p.
12. Gornostaev D.V. Biomechanics of trauma / D.V. Gornostaev, A.L. Kovalev // Problems of Expertise in Medicine. – 2020. – No. 3. – P. 45-51.
13. Djuraev Sh.N. Biomechanical features of rib fractures / Sh.N. Djuraev, O.R. Karimov // Medical Journal of Uzbekistan. – 2023. – No. 2. – P. 78-84.
14. Erofeev S.V. Morphological features of rib fractures depending on age / S.V. Erofeev, I.A. Tolmachev // Problems of Expertise in Medicine. – 2021. – No. 2. – P. 15-21.
15. Zoryan E.V. Modern methods for determining the age of bone fractures / E.V. Zoryan, K.N. Krupin // Medical Examination and Law. – 2022. – No. 1. – P. 32-38.