

Clinical and surgical aspects of treating fractures and dislocations of the acromial end of the clavicle

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Abstract

The article examines the clinical and surgical aspects of treating fractures and dislocations of the acromial end of the clavicle. An analysis of modern diagnostic methods, including radiography, magnetic resonance imaging, and computed tomography, as well as their role in treatment planning, is presented. Comparative data on the effectiveness of conservative and surgical approaches are provided, with particular attention given to minimally invasive fixation methods such as arthroscopic stabilization with TightRope and endobutton osteosynthesis. Special emphasis is placed on patient rehabilitation, including modern physiotherapy and therapeutic exercise protocols, which contribute to shorter recovery times and improved functional outcomes. The authors highlight the necessity of developing national treatment and rehabilitation protocols and implementing innovative technologies into clinical practice.

Keywords: Acromioclavicular Joint; Fracture; Dislocation; Diagnosis; Minimally invasive methods; Arthroscopy; Rehabilitation; Physiotherapy; TightRope; Endobutton osteosynthesis

1. Introduction

Fractures and dislocations of the acromial end of the clavicle constitute a significant portion of shoulder girdle injuries, particularly among the working-age population. According to studies, these injuries account for 7% to 26% of all skeletal dislocations, ranking third in frequency after shoulder and forearm dislocations [1]. The majority of cases occur in men engaged in physical labor or sports, which is associated with the specific mechanisms of injury [2].

The acromioclavicular joint (ACJ) plays a crucial role in ensuring the stability and mobility of the shoulder girdle. ACJ injuries can result from both direct impact to the acromion and indirect trauma mechanisms, such as a fall on an outstretched hand [3]. Disruption of the joint's ligamentous integrity leads to instability, pain, and restricted mobility [4].

Diagnosis of acromial clavicular injuries relies on clinical examination and radiography. In standard cases, two-projection radiographs are sufficient; however, magnetic resonance imaging (MRI) and computed tomography (CT) may be employed for assessing complex injuries and soft tissue conditions [5]. According to Russian and Uzbek studies, the use of advanced imaging modalities significantly enhances diagnostic accuracy [6].

Treatment of ACJ injuries can be either conservative or surgical. Conservative methods are used for minimal displacement or joint stability, whereas surgical intervention is indicated for significant displacements and ligament ruptures. Among surgical methods, fixation with plates, endobuttons, and minimally invasive arthroscopic techniques

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are most commonly employed [7]. Modern approaches enable the restoration of the joint's anatomical integrity and functionality in the majority of patients [8].

In Uzbekistan, despite the adoption of modern technologies, certain challenges remain in the treatment of acromial clavicular injuries. These challenges stem from limited access to high-tech diagnostic and therapeutic methods in regional healthcare facilities. Studies conducted in the country report that up to 60% of patients treated conservatively continue to experience chronic pain and restricted mobility [9].

The aim of this article is to systematize current data on the diagnosis, treatment, and rehabilitation of acromial clavicular injuries, incorporating insights from both domestic and international research.

2. Methods

A comprehensive approach was employed for the study, involving an analysis of literature published over the past 10 years to systematize contemporary data on the diagnosis, treatment, and rehabilitation of acromial clavicle injuries. The primary data sources included international databases such as PubMed and Scopus, as well as regional resources like Cyberleninka and materials from the National Library of Uzbekistan. The search utilized keywords such as "acromioclavicular joint," "dislocation of the acromial end of the clavicle," "clavicle fracture," "surgical treatment of the acromioclavicular joint," "minimally invasive fixation methods," and "rehabilitation after shoulder girdle injuries." Publications addressing diagnostics, treatment, and rehabilitation written in Russian and English and published between 2015 and 2024 were included.

The research methods comprised an analysis of modern diagnostic approaches, such as radiography, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography. Particular emphasis was placed on comparing the diagnostic accuracy of these imaging modalities, enabling the identification of their advantages and limitations. The evaluation of treatment methods included both conservative approaches and surgical interventions, such as fixation with plates, endobuttons, and arthroscopic techniques. For each method, indications, contraindications, efficacy, and risk of complications were analyzed.

Special attention was devoted to studying rehabilitation programs. The recovery stages of patients were examined, including physiotherapy, therapeutic exercises, the use of orthopedic devices, and programs aimed at restoring mobility and strength in the shoulder joint. A critical analysis of the literature was conducted, including meta-analyses, clinical trials, and case reports, to identify the most relevant and reliable data.

The collected data were structured into key sections: diagnostics, conservative treatment, surgical methods, and rehabilitation. The analysis results were presented in visual tables and diagrams, highlighting the key differences between approaches and identifying promising directions for future research. Approaches proposed in international publications were compared with clinical practice conditions in Uzbekistan to develop localized recommendations.

3. Results

The data analysis revealed that injuries to the acromial end of the clavicle account for 7% to 26% of all skeletal dislocations, with 78% of cases occurring in men aged 20 to 40 years who are actively engaged in physical labor or sports [1, 2, 3]. The primary mechanisms of injury include direct impact to the acromion region (60% of cases) and falls onto an outstretched hand (40%) [7, 10]. Biomechanical studies confirm that sudden force applied to the joint area significantly increases the likelihood of injury [8, 9].

The diagnosis of acromial clavicle injuries is primarily based on radiography, which remains the "gold standard" for initial assessment [11]. However, radiography demonstrates a sensitivity of only 78% in evaluating complex injuries [12]. To improve diagnostic accuracy, magnetic resonance imaging (MRI) and computed tomography (CT) are employed, enabling the detection of ligament injuries and associated soft tissue damage. According to international studies, the use of MRI increases diagnostic accuracy by 30–40% compared to radiography [13, 14]. In Uzbekistan, the use of MRI and CT is limited in regional medical facilities, which reduces diagnostic quality [15].

Conservative treatments, such as immobilization and pain management therapy, demonstrated satisfactory results for minor displacements. However, 40% of patients reported chronic pain and restricted mobility [5, 16]. Surgical intervention is indicated for significant displacements and joint instability. Among surgical methods, arthroscopic techniques proved most effective, achieving full joint mobility in 92% of cases and reducing complications by 20%

compared to open methods [17, 18]. These findings align with international meta-analyses confirming the advantages of minimally invasive approaches [19, 20].

Table 1 Provides a comparative analysis of various diagnostic, treatment, and rehabilitation methods for acromial clavicle injuries

Diagnostic/Treatment Method	Effectiveness (%)	Complication Rate (%)	Reduction in Recovery Time (%)
Radiography	78	18	0
Magnetic Resonance Imaging (MRI)	95	5	10
Computed Tomography (CT)	92	8	10
Conservative treatment	60	40	0
Surgical treatment (open methods)	80	20	15
Surgical treatment (arthroscopic methods)	92	10	25
Individualized rehabilitation programs	85	15	25

Rehabilitation is a critical stage of treatment. Programs incorporating physiotherapy, therapeutic exercises, and orthopedic devices reduced recovery time by 25% and lowered complication rates to 15% [21, 22, 23]. In Uzbekistan, there remains a shortage of comprehensive rehabilitation programs, highlighting the need for adopting modern approaches [24].

Thus, the analysis confirms that a comprehensive approach integrating advanced diagnostic methods, surgical techniques, and rehabilitation is essential for successfully treating acromial clavicle injuries. These findings emphasize the importance of technological development and enhancing the qualifications of medical professionals.

4. Discussion

Injuries to the acromial end of the clavicle remain a pressing issue in traumatology due to their high incidence and significant impact on shoulder girdle functionality. Despite advancements in diagnostic and treatment technologies, the optimal management strategy for such patients continues to be debated. A review of current literature suggests that treatment and rehabilitation methods must be tailored to the individual needs of the patient and the extent of the injury.

Studies indicate that radiography remains the primary method for initial diagnosis due to its accessibility and informativeness in assessing bone structures [25, 26]. However, its sensitivity is limited for soft tissue injuries. Magnetic resonance imaging (MRI) and computed tomography (CT) significantly enhance diagnostic accuracy. Research shows that MRI can detect ligament tears with up to 98% sensitivity, particularly in Grade III–VI injuries [27, 28]. Efforts are underway in Uzbekistan to implement comprehensive diagnostic approaches, including MRI and ultrasound, for evaluating soft tissue conditions [29].

Conservative treatment remains the method of choice for Grade I and II injuries based on the Rockwood classification. However, more than 30% of patients undergoing conservative therapy report chronic pain and limited mobility [30, 31]. Systematic reviews reveal that prolonged immobilization may contribute to secondary complications, such as adhesive capsulitis [32].

Surgical treatment is indicated for significant injuries (Grade III–VI) and joint instability. Among surgical approaches, minimally invasive techniques such as arthroscopic fixation using cortical stabilization systems (e.g., TightRope) are most prominent. A meta-analysis of 15 studies involving over 1,200 patients demonstrated that these methods provide anatomical joint reconstruction and reduce complication rates by 20% compared to open surgeries [33, 34]. Additionally, endobutton osteosynthesis remains an alternative, particularly for severe deformities, showing high functional recovery rates [35].

Rehabilitation plays a crucial role in restoring shoulder girdle function. Individualized rehabilitation programs incorporating therapeutic exercises, physiotherapy, and orthotic devices reduce recovery times by 25–30% [36, 37]. Programs emphasizing early mobilization are particularly effective. Patients who began physiotherapy within two

weeks post-surgery achieved full functional recovery 20% faster than those who started rehabilitation later [38]. In Uzbekistan, the development of centralized rehabilitation centers remains a priority to improve program accessibility for patients [39].

Emerging technologies, such as the use of biological materials for ligament reconstruction, represent promising directions in the treatment of acromioclavicular joint injuries. The use of autologous grafts or synthetic materials, according to experimental data, facilitates faster restoration of joint stability, although their application remains limited due to high costs [40, 41]. Another promising direction is the use of robotic systems for minimally invasive surgeries, enabling even more precise reconstructions [42].

Despite advances in treatment, challenges remain concerning the availability of modern technologies in regional medical facilities. Insufficient equipment and a shortage of qualified specialists necessitate the development of national standards and training programs for trauma and orthopedic surgeons [43].

5. Conclusion

Injuries to the acromial end of the clavicle require an integrated approach to diagnosis, treatment, and rehabilitation. Modern imaging methods, such as MRI and CT, significantly improve diagnostic accuracy, facilitating effective treatment planning. Conservative management remains appropriate for minor injuries, while surgical interventions, particularly minimally invasive techniques, yield superior functional outcomes for severe injuries.

Rehabilitation is an essential component of successful treatment, requiring the adoption of modern methods focused on early mobilization and individualized care. To enhance treatment accessibility and effectiveness, it is necessary to develop national protocols adapted to the capacities of regional medical centers and to implement educational programs for specialists.

Future research should focus on long-term outcomes of minimally invasive treatment methods, the development of ligament reconstruction technologies, and evaluating their cost-effectiveness. Improving specialist training and infrastructure development will play a pivotal role in enhancing treatment outcomes for this patient category.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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