Medical Science

To Cite:
Bochyński C, Kropidłowska D, Józefiak A, Szczepanik M, Mazurek G, Góralski P, Mazurek J. Unsuccessful surgical treatment with Kirschner wires grade 3 AC joint separation: A review. *Medical Science* 2024; 28: e111ms3420
doi: https://doi.org/10.54905/dissi.v28i150.e111ms3420

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Peer-Review History
Received: 05 June 2024
Reviewed & Revised: 08/June/2024 to 16/August/2024
Accepted: 19 August 2024
Published: 25 August 2024

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY SCIENTIFIC SOCIETY

Unsuccessful surgical treatment with Kirschner wires grade 3 AC joint separation: A review

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ABSTRACT

Introduction: The acromioclavicular joint is where the acromion, a part of the shoulder blade (scapula), meets the outer end of the collarbone (clavicle). This spherical joint allows for the lowering and raising of the scapula, its forward and backward extension, and rotational movements. Falls on the elbow, shoulder, or hand are among the most common causes of injury to this joint. *The aim:* This article presents the case of a patient who experienced unsuccessful surgical treatment with Kirschner wires for a grade 3 AC joint separation. *Case report:* A 25-year-old patient experienced a dislocation of the right acromioclavicular (AC) joint after a fall from a height of five meters. *Results:* The diagnosis was based on a thorough medical history, patient examination, and X-ray examination of both acromioclavicular joints. *Conclusions:* Kirschner wires are an old method of surgical treatment for grade 3 AC joint separation. The patient should be under orthopedic supervision, and the hand's joint and range of motion should be monitored. Newer and better treatment methods, such as arthroscopy, are available.

Keywords: Kirschner wire, Grade 3 AC joint dislocation, AC Joint, joint dislocation

1. INTRODUCTION

The acromioclavicular (AC) joint is part of the shoulder girdle complex, also known as the shoulder joint (Baren et al., 2022). This ball-and-socket joint facilitates the range of movements characteristic of such joints. It contains an articular disc that can occasionally fill the entire joint cavity, effectively converting the joint into a synchondrosis. However, the disc is most commonly either incomplete or entirely absent (Frank et al., 2019). The joint is supported by ligaments, including:

Acromioclavicular ligament
Coracoclavicular ligament and its subdivisions

Movements possible in this joint include elevation and depression of the scapula, protraction and retraction of the shoulder girdle, and minor rotational movements (Berthold et al., 2022).

Injuries to the Acromioclavicular Joint

Injuries to this joint are common among people who participate in contact sports, such as football and rugby, as well as activities like climbing, skiing, horseback riding, and other high-impact sports (Flores et al., 2020). These injuries predominantly affect men. Injuries cause joint deformity, pain, and reduced muscle strength in the limb (Farrell and Zoga, 2020).

Classification of AC Joint Dislocations

Various scales are used to assess and classify AC joint injuries, but the Rockwood scale is the most commonly employed. The Rockwood scale categorizes AC joint injuries into six types (Cote et al., 2010):

I – Partial tear of the acromioclavicular ligament without change in clavicle position.

II – Tear of the acromioclavicular ligament with stretching of the coracoclavicular ligament.

III – Tear of both the acromioclavicular and coracoclavicular ligaments with clavicle displacement.

IV – Posterior displacement of the lateral end of the clavicle, visible as posterior dislocation on X-ray.

V – A complete tear of the ligaments, with the clavicle exhibiting instability during examination.

VI – Displacement of the clavicle under the acromion or coracoid process.

Treatment

The selection of a treatment approach is based on the severity of the AC joint injury, the degree of ligament damage, and the impact on surrounding muscles (Peebles et al., 2023). Type I, type II, and type III injuries (such as those in elderly or less active individuals) are typically treated with conservative methods. Surgical treatment is required for other type III injuries as well as for types IV through VI. For type III injuries, various treatment options may be used, such as kinesiotaping, braces, or casts (Reid et al., 2012).

The most common method for managing these injuries involves using a shoulder and arm brace with added pressure on the clavicle, along with a sling, to relieve stress on the joint (Ha et al., 2014). Conservative treatment typically includes short-term immobilization, followed by mobilization and rehabilitation. Symptomatic treatment often involves anti-inflammatory and pain-relief medications (Cisneros and Reiriz, 2017; Pedowitz et al., 2011; Hanchard et al., 2014). In this review, we will focus on a case where surgical treatment using Kirschner wires for Grade 3 AC joint separation was unsuccessful.

2. METHODOLOGY

This review was conducted by searching for current papers on PubMed and Google Scholar using the search phrases (Kirschner wire) AND (Grade 3 AC joint dislocation) AND (AC Joint) AND (joint dislocation). After eliminating duplicates, we appraised all publications using the titles and abstracts. Following an exact revision of complete manuscripts, 20 articles met the inclusion criteria. The research took place in June 2024.

3. CASE DESCRIPTION

A 25-year-old patient was brought to the hospital emergency department after a fall from a height of five meters. The patient was conscious and oriented autopsychically and allopsychically. He reports pain in the right shoulder joint and lower abdominal region. On physical examination: Heart rate 140/min, blood pressure 125/80 mmHg, blood saturation 97%. There is visible swelling and bruising in the right shoulder joint area. Visible fresh blood in the right temporal region. Pupils are equal, reactive to light, without nystagmus. On auscultation of the heart: regular heart function without pathological murmurs. On abdominal examination: Lower abdominal pain. Peristalsis present. Peritoneal signs are absent. On auscultatory examination of the lungs, respiratory sounds diminished on the right side of the chest.

The doctors decided to perform a Trauma-CT scan

Presence of a small subdural hematoma in the right temporal region. Other than that, post-traumatic changes within the head and craniofacial region were not visible on CT examination. A typical image of the brain, parietal-cerebral spaces, bony structures of the brain, and craniofacial region. The temporal cusps' nasal paranasal sinuses and mastoid processes were suitably airy. The examination did not visualize pathology within the orbits. The examination did not visualize post-traumatic changes in the spine. Cervicothoracic junctions are normal. Intervertebral spaces, vertebral heights, and morphology are standard. The spinal canal and intervertebral openings are without stenosis. Spinal tissues were radiologically routine.

Pneumothorax on the right side, ventricle up to 35mm thick arranged along the anterior chest wall and over the diaphragm. Areas of interstitial thickening are present in the lower and middle lobes of the right lung suggestive of lung contusion. Visible rupture in the anterior inferior margin of the right lung - the area of pulmonary parenchymal rupture. Multi-level fractures of the posterior (cranial) segments of the right ribs V-X on the right side, without displacement of the fragments. The examination did not reveal any other intra-thoracic traumatic lesions. Left pleural cavity without fluid or emphysema. Lungs are typically airy and without thickening or foci, except for the described interstitial thickening on the right side. Mediastinal structures are typical.

Fracture of the upper branch I of the shaft (involving the pubic symphysis) of the left pubic bone without displacement of the fragments. Minor fracture of the shaft of the pubic bone shaft on the right side (without involvement of the acetabulum of the hip joint). Preperitoneal hematoma of approximately 31mm located along the anterior wall of the lower abdomen, probably due to pelvic fractures. The hematoma is compressing the anterior wall of the urinary bladder. The examination did not reveal other post-traumatic lesions of the abdomen and pelvis. Free fluid or gas or pathological intraperitoneal reservoirs were not visualized. Other than that, a standard image of the abdominal and pelvic organs (liver, spleen, pancreas, kidneys, adrenal glands - without changes, the surrounding organs homogeneous).

Typical image of the vascular structures of the abdomen and pelvis. Apart from the pubic bone foliation described in the introduction, a normal image of the other bony structures of the abdomen. X-ray of the right AC joint shows a dislocation at the shoulder-clavicular joint with clavicular displacement. Shoulder bone rotated. No other traumatic lesions of the shoulder are visible (Figure 1). The shoulder radiograph shows fragmentary signs indicative of pneumothorax. Doctors inserted a chest drain into the right pleural cavity due to right-sided pneumothorax and suspected pulmonary parenchymal rupture. The drain was placed in a typical manner, with a slight air leak visible on deeper breaths.

Local assessment of the joint was complex due to swelling. Temporary immobilization of the right upper limb in a triangular bandage was applied. Due to the suspected lung contusion and the risk of deterioration of blood morphology parameters, the doctors of the hospital emergency department decided to transport the patient to the hospital with pulmonology department facilities. The patient's condition was stable on admission to the intensive care unit at the pulmonology hospital. The patient reports pain in the pelvic area and right shoulder joint. Blood count laboratory tests showed a low red blood cell count and low level of hemoglobin (Table 1).

Table 1 Laboratory tests on admission to the intensive care unit.

Analyte	Result	Normal range
RBC	3.05	4.00 - 5.80 [mln/ul]
WBC	11.4	4.0 -10.0 [tys/ul]
HGB	9	14.0 - 18.0 [g/dl]
MCV	86.6	80.0 - 98.0 [fl]
MCH	29.5	26.5 - 33.5 [pg]
MCHC	34.1	31.0 - 38.0 [g/dl]
Creatinine	70	50 - 135.0 [umol/l]
EGFR	200.9	>60 [ml/min1.73^2]
D-dimer	1198	< 500 [ng/ml FEU]
INR	1.37	0.80 - 1.20
PT	15.3	8.9 - 13.4 [sec]
APTT	31.6	27.4 - 41.2 [sec]

The anaesthesiologists decided to administer Paracetamol 3x0.5g p.o. and Metamizole 3x1.0g p.o. as a daily dosage for pain relief and 40mg of enoxaparin sodium as thromboprophylaxis. Due to the low hemoglobin levels, the doctors decided to transfuse two packed red blood cells. On another chest X-ray in the intensive care unit, Suspicion of pulmonary parenchymal rupture was not confirmed. Pleural drainage was continued. The drain was removed 5 days after admission to the ward. Chest X-ray after drain removal: small trace pneumothorax presents at the top of the right lung - presumably after air was drawn in when the drain was removed. In the following days of the stay blood count parameters and general condition improved

Table 2 Laboratory results at the end of the intensive care unit stay.

Analyte	Result	Normal range
RBC	3.42	4.00 - 5.80 [mln/ul]
WBC	8.2	4.0 -10.0 [tys/ul]
HGB	10.4	14.0 - 18.0 [g/dl]
MCV	87.1	80.0 - 98.0 [fl]
MCH	30.4	26.5 - 33.5 [pg]
MCHC	34.9	31.0 - 38.0 [g/dl]
Creatinine	47	50 - 135.0 [umol/l]
INR	1.26	0.80 - 1.20
PT	14	8.9 - 13.4 [sec]
APTT	35.1	27.4 - 41.2 [sec]

The anesthetists telephoned the doctors in the trauma and orthopedic surgery department. They decided to transport the patient to a third hospital for treatment of the shoulder joint. An ambulance transported the patient to a hospital in the Department of Trauma and Orthopaedic Surgery. Because of the non-displaced fragments of the fractured pelvic bones, doctors decided to treat the pelvis conservatively without surgical intervention. The orthopedic surgeons decided to treat the shoulder joint surgically. The doctors performed closed repositioning and an internal stabilization of proper AC joint dislocation with three Kirschner wires. The orthopedic surgeons recommended further anticoagulant treatment and calcium supplementation. They also advised using a sling to stabilize the right upper limb and daily post-operative wound hygiene. The doctors informed the patient not to lift the elbow above shoulder level. The patient was discharged home in good condition.

The patient presented six weeks after discharge to the hospital's orthopedic outpatient clinic. X-ray examination of the shoulder joint showed no evidence of Kirschner wire displacement. The doctors removed the Kirschner wires from the joint and recommended rehabilitation and slow movements of the right upper limb within pain limits. After three weeks, the patient came again to the orthopedic outpatient clinic. The patient reports a displacement of the clavicle above the height of the acromion before the operation and a feeling of stiffness in the shoulder-clavicular joint. Physical examination revealed a "piano key sign" (the clavicle goes down when the examiner applies pressure on it). The doctor diagnosed a failed shoulder operation. The doctor recommended further rehabilitation and, if severe pain developed, a second operation involving coracoclavicular ligament reconstruction.

Figure 1 AC joint dislocation (type III) - elevation of the clavicle above the acromion of the scapula.

4. DISCUSSION

The most prevalent type of AC joint dislocation was Rockwood type III, representing 55.7% of cases. The incidence rate was 19.3 per 100,000 person-years. Young and middle-aged men were most susceptible, with most injuries occurring during sports activities, particularly contact and climbing sports (Haugaard et al., 2023). For type I and II injuries, non-surgical treatment is preferred, typically involving using a sling to reduce the load on the CC and AC joints. Immobilization lasts 7 to 10 days for type I injuries and 4 to 6 weeks for type II injuries. Rehabilitation starts with passive and active-assisted range of motion (ROM) exercises. Once full ROM has been achieved, isometric strengthening exercises have been introduced, followed by isotonic exercises. Return to contact sports and weightlifting generally occurs 8 to 12 weeks post-injury (Longo et al., 2017).

Surgical treatment is recommended for acute AC dislocations of types IV, V, and VI due to extensive tissue damage. The main goal of surgery is to reduce and stabilize the AC joint anatomically. Patients with type III injuries initially managed conservatively but experiencing chronic pain or instability may also benefit from surgery, though the evidence is inconclusive (Cook et al., 2018). The ISAKOS Upper Extremity Committee has recently recommended non-operative treatment for type III injuries, advising surgical options

only if pain or functional impairment persists beyond a month. Non-surgically treated patients often return to work and pre-injury activities quickly. At the same time those undergoing surgery face a higher complication rate, although overall clinical outcomes are similar for both approaches (Kim and Koh, 2018).

Despite advancements in surgical techniques for AC joint injuries, no single method has emerged as the gold standard. Decisions regarding surgical intervention should consider the patient's age, physical demands, and the surgeon's expertise (Jeong and Chun, 2020). Complications can arise from non-surgical and surgical treatments, with common issues including pain, stiffness, deformity, and weakness. The complication rate for surgical treatments ranges from approximately 27 to 44% (Boström-Windhamre et al., 2022). Modern methods, such as arthroscopic treatment, offer less invasive options with better outcomes, lower infection risks, and earlier rehabilitation (Tiefenboeck et al., 2017; Hislop et al., 2019).

5. CONCLUSIONS

The acromioclavicular (AC) joint dislocation is most frequently attributed to a direct fall onto the shoulder while performing physical activity. Most frequently, the injury occurs when an individual falls directly onto an outstretched arm, resulting in the clavicle striking the sternum and ribs. This impact transfers stress to the AC joint, damaging its capsule through straining and destabilizing ligaments. In cases where the injury results in a displaced fracture of the distal clavicle, surgical intervention is necessary to realign the bone and restore the stability of the AC joint. Grade 3 AC joint dislocation requires a complex surgical approach. Accurate assessment of the dislocation degree is essential prior to determining the appropriate treatment strategy. Type A dislocations are treated conservatively, whereas Type B dislocations require operative treatment to prevent further complications.

Fixing of this type of dislocation using Kirschner wire is a cost-effective method; however, it demands significant precision and experience from the surgeon. Severe postoperative complications associated with traditional methods, such as the use of Kirschner wire, include infection, wire displacement or fracture, and recurrent damage to surrounding structures. In cases of certain post-operative negative outcomes such as chronic pain, diagnostic procedures like arthroscopy should be involved. Statistically, the majority of patients require additional surgical intervention in the subsequent proceedings as the primarily deteriorated joint is prone to further injuries as well as degenerative changes with subsequent deformity. Therefore, proper classification of AC joint injury and adjusting the appropriate treatment method are critical for optimal results.

Author's Contribution

Cezary Bochyński: Methodology, Conceptualization
Dominika Kropidłowska: Resources, writing- rough preparation
Anna Józefiak: Conceptualization, methodology
Magdalena Szczepanik: Conceptualization, investigation
Gabriela Mazurek: Review, Visualization, data curation
Patryk Góralski: Resources, writing- rough preparation
Jolanta Mazurek: Review and editing, formal analis
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Informed consent

Not applicable.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Ethical approval

Not applicable.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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