Original Article

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Acute Complete Acromioclavicular Dislocations: A Prospective Multicenter Therapeutic Study Comparing Combined Intra-articular and Extra-articular Fixation with Intra-articular K-wire Fixation

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Learning Points for this Article

Isolated intra-articular K-wire fixation also fails to provide the required stability to the injured joint, especially in developing countries, where patients fail to adhere to the rehabilitation protocol. Thus, combining both, the intra-articular and coracoclavicular fixations seem to be a promising modality in terms of stability and secure fixation. Combining the intra- and extra-articular techniques significantly decreases the complication rates as seen with the isolated fixation techniques.

Abstract

The AC joint is commonly involved in traumatic injuries that affect the shoulder.Treatment of these injuries has been controversial and continues to evolve to this day ranging from conservative management and k-wire fixations to screw fixation, and more recently, arthroscopically assisted ligament reconstructions with no definite consensus about the ideal method of treatment.Each modality has its own advantages and disadvantages. In this prospective therapeutic multicenter study, we compared combined intra-articular fixation and screw coracoclavicular repair versus the intra-articular fixation with k-wires alone to assess the stability, failure rates, and outcomes of combining the two methods of fixation versus isolated intra-articular fixation.combining both, the intra-articular and coracoclavicular fixations seem to be a promising modality in terms of stability and secure fixation. Combining the intra- and extra-articular techniques significantly decreases the complication rates as seen with the isolated fixation techniques.

Keywords: Acromioclavicular dislocations, intra-articular, multicenter.

Introduction

The acromioclavicular (AC) joint is a diarthrodial joint which is the main component of superior shoulder suspensory complex. It is involved in shoulder movements and weight transmission across pectoral girdle. The AC joint is commonly involved in traumatic injuries that affect the shoulder. Most injuries are related to falls onto the shoulder and to repetitive use of the shoulder, such as heavy labor and athletics. AC joint injuries represent nearly half of all athletic shoulder injuries [1], and stability of this joint depends on the integrity of the AC ligaments and capsule as well as the coracoclavicular ligaments and the trapezius and deltoid muscles [1]. Treatment of these injuries has been controversial and continues to evolve to this day [2], ranging from conservative management and k-wire fixations to screw fixation, and more recently, arthroscopically assisted ligament reconstructions with no definite consensus about the ideal method of treatment. Historically, most of these cases have been treated conservatively, but as the technology improved, the functional demands of patients increased, the need for a perfect AC joint with normal shoulder biomechanics became more obvious. Currently, conservative management is indicated in Rockwood Type 1 and Type 2 injuries only, and for Type 3, many surgeons advocate conservative [2, 3], while some favor operative interventions [1, 4, 5, 6, 7, 8, 9, 10]. Rockwood Types 4, 5, and 6 AC dislocations are universally accepted as indications for operative management [1, 4, 5, 6, 7, 8, 9, 10]. There are an array of available operative interventions ranging from intra-articular k-wire, Steinmann pin fixation, ligament reconstruction procedures [4, 10], extra-articular coracoclavicular repairs [7], and clavicular hook plate fixation [5, 6]. Each modality

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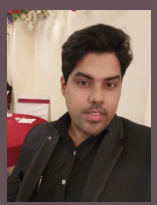
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Materials and Methods

We prospectively operated patients with Rockwood Group's Grade 3 and 4 AC joint injuries from June 2012 to September 2014 at three centers in Odisha, India. Patients visiting outdoor/casualty with an AC joint injuries (Rockwood Type 3, 4, 5 and 6) (Fig. 1) who were operated and completed a minimum 1-year follow-up were included in the study. A total of 54 patients (34 male and 20 femaleatie pnts) were operated in this study.

Inclusion criteria

Patients (20-50 years) with isolated AC joint injuries (Rockwood Type 3, 4, 5, and 6), any etiology, 1 week of injury, and treated operatively were included in the study.

Exclusion criteria

AC joint injuries (Rockwood Type 1 and 2), compound injuries, old injuries (>7 days), neurovascular deficits, patient unfit for anesthesia, patient refused to give consent, and patients treated conservatively were excluded from the study.

Variables assessed

The age distribution, sex distribution, mechanism of injury, fracture pattern, the timing of operation, timing of weight bearing, average union time, complications, and post-operative functional hip score were assessed.

Methodology

The AC joint injuries were classified according to the most widely accepted classification system Rockwood's group [11], based on the original work of Tossy et al. [12] in 1963, and were further subdivided into compound and simple AC joint injuries. After obtaining consent from all the patients, the patients were randomly divided into two treatment groups and allocated either of the two treatment options, i.e., combined intra-articular fixation with coracoclavicular repair in Group 1 and intra-articular k-wire fixation alone in Group 2. The randomization was based on computer-generated numbers. All the cases were evaluated clinically and radiographically by an experienced orthopedician. Magnetic resonance imaging supplemented by AC joint radiographs was performed in anteroposterior, and lateral and Stryker notch view were performed in all the cases.

Surgical procedure

All the patients were operated under general anesthesia, under fluoroscopy control and standard curvilinear incision over the AC joint followed by meticulous dissection. In Group 1, intra-articular k-wire fixation was performed using two 1.5 mm k-wires in a crossed fashion supplemented by a coracoclavicular repair with one 6.5 mm cannulated lag screw was performed (Fig. 2). In Group 2, intra-articular k-wire fixation was performed using two 1.5 mm k-wires in a crossed fashion.

Postoperative protocol

Intravenous antibiotics were given for 3 post-operative days, and analgesics as required were provided. The shoulder was immobilized for 14 days, following which shoulder pendulum exercises were encouraged. The range of motion (ROM) and strengthening exercises initiated at 8 weeks. Overhead abduction, lifting of heavy weights >4 lbs, and participation in sports activities were restricted for 6 weeks. Assessment of the final outcome was made at the last follow-up visit using the constant shoulder scores which evaluates pain, function, and joint mobility.

Follow-up

All patients were followed up for an interval of 1-2 years. A good outcome was rated as a "satisfactory outcome," and fair and poor outcomes or the presence of complications was rated as an "unsatisfactory outcome." Radiographs were also evaluated for joint congruency, arthritic changes, and implant position on follow-ups.

Statistical analysis

Data were analyzed by Microsoft Office tools, and variables were interpreted as mean, range, and standard deviation. Student's t-test and P values were calculated for continuous variables.

Results

In our study, the mean age of the 54 patients was 32.8 years with range from 22 to 45 years. Group 1 had 27 patients (male - 20, female - 7) with a mean age of 33.6 years, while Group 2 had 27 patients (male - 21, female - 6) with a mean age of 32.1 years. Timing of injury and surgery in Group 1 was 2.8 days (mean) and Group 2 was 3 days (mean). Mean follow-up was 18 months (range - 15-28 months) in the 54 patients. Implant removal was performed in 54 patients at a mean 9.6 weeks post-surgery (range - 8-12 weeks). The most common injury pattern was Rockwood Type 3, i.e., 85% in Group 1 and 88% in Group 2. Patient characteristics and injury pattern for both the groups are represented in the (Fig.3). Pre-operative mean constant shoulder scores for Group 1 and 2 were 10.16 and 10.21, respectively ($t = 0.31$, $P \geq 0.1$, insignificant). At 2, 4, and 8 weeks and 6 months postoperatively, mean shoulder scores improved considerably and significantly, for Group 1 and 2, were 22 and 21.1 ($t = 4.74$, $P \leq 0.001$, significant), 54.5 and 42.4 ($t = 60.5$, $P \leq 0.001$, significant), 76.5 and 63.9 ($t = 78.8$, $P \leq 0.001$, significant), and 93 and 83.5 ($t = 47.5$, $P \leq 0.001$, significant), respectively (Fig. 4).Complications were seen in 22.2% (6/27) of patients in Group 1 and 59% (13/27) of patients in Group 2. Most common being implant failure in 14.8% (8/54) of patients, followed by loss of reduction in 5.5% (3/54) patients. Complications for both groups are represented in (Fig.5). 64.8% (35/54) of patients were free from relative complications and had constant improvement in ROM, strength, and functional output of the shoulder.

Discussion

From the earliest publications through the time of Paul of Aegina (7th century), dislocations of the AC joint have become better recognized. Their treatment, however, has remained essentially unchanged. Hippocrates [13] stated that no impediment, small or great, will result from such an injury. He further stated that there would be a "tumefaction" or deformity, "for the bone cannot be

properly restored to its natural situation." This statement apparently was, has been, and will be received by the orthopedic community as a challenge. There is probably not another joint in the body that has been treated in so many different ways as the AC joint in attempts to "properly restore" it to "its natural situation." The treatment of AC joint injuries has evolved and changed as our understanding of the nature of the problem, and the biomechanics of the joint has developed. Fractures associated with AC separations may include fractures of the clavicle, the acromion process, the coracoid process, and the sternoclavicular joint. AC joint injuries represent nearly half of all athletic shoulder injuries [1], and stability of this joint depends on the integrity of the AC ligaments and capsule as well as the coracoclavicular ligaments and the trapezius and deltoid muscles [1]. The coracoclavicular ligament is majorly involved in the weight transmission across the pectoral girdle and is most often injured in injuries involving the shoulder joint. Direct force is the most common mechanism of injury and is produced by the patient falling onto the lateral aspect of the shoulder with the arm in an adducted position. The force drives the acromion downward and medially. Bearn [14] showed that downward displacement of the distal clavicle is primarily resisted through an interlocking of the sternoclavicular ligaments. If no fracture occurs, the force first sprains the AC ligaments (a mild sprain), then tears the AC ligaments (a moderate sprain), and stresses the coracoclavicular ligament, and finally, if the downward force continues, tears the deltoid and trapezius muscle attachments from the clavicle and ruptures the coracoclavicular ligaments (a severe AC sprain, which completes the dislocation). At this point, the upper extremity has lost its suspensory support from the clavicle and the scapula displaces inferiorly. Although recent advances have been made in the treatment of AC joint injuries, they are still challenging for shoulder surgeons. There is a consensus that Type I and II injuries should be treated nonoperatively, whereas acute Type IV, V, and VI injuries should be treated surgically. There is no algorithm for correctly diagnosing and treating Type III injuries. Some studies recommend the conservative treatment [2, 3] of AC joint Grade 3 injuries, but conservative treatment is not always successful. Biomechanical studies have demonstrated that anatomic AC joint reconstruction is the most effective treatment for persistent instability [1, 4, 5, 6, 7, 8, 9, 10]. Recommended techniques for stabilization in cases of acute and late symptomatic instability include screw fixation of the coracoid process to the clavicle, coracoacromial ligament transfer, and coracoclavicular ligament reconstruction. Nowadays, treatment addresses the specific pathology involved, and many of the injuries thought to need treatment in the past are successfully treated with conservative measures. Treatment remains controversial in many circumstances, and as over the years, numerous surgical methods have been described. In 1917, Cadenat [15] described the transfer of the coracoacromial ligament, which was later popularized by Weaver and Dunn [16] and remains the most commonly used and successful surgical treatment we have today for many complete AC dislocations. Surgical treatment was very common in the 1940s to the 1960s for complete dislocations [13]. Recent literature [10] has proposed an increased role for the use of arthroscopy in the treatment of AC joint injuries. Wolf and Pennington [17] in their 4 patients described an all-arthroscopic technique of AC joint reconstruction. The coracoid is visualized through the subcoracoid recess in the anterior aspect of the joint. An anterior cruciate ligament guide is used to drill a hole through the clavicle and coracoid, and secure strand cable is used for fixation. Lancout et al. [18] published an all-arthroscopic technique for coracoclavicular ligament reconstruction, which releases the coracoacromial ligament from the undersurface of the acromion and transfers it to the inferior clavicle. Advantages of the arthroscopic reconstruction were as follows: A minimally invasive technique with less violation of delto-trapezial fascia, faster postoperative recovery, less pain, and fewer complications. The treatment of AC joint injuries with coracoclavicular repair is based on the understanding that coracoclavicular ligament ruptures in all cases of completely displaced AC dislocations, hampering the weight transmission and producing a cosmetically visible deformity. Coracoclavicular repairs help in normalizing the clavicle-coracoid process gap and also restore the load transmission across the joint. For restoring the ligament, various techniques have been tried vis-à-vis screw fixation, cerclage wiring, and mersilene tape application [2]. Coracoclavicular screw fixation by the Bosworth technique adds stability to the intra-articular construct and minimizes the chances of loss of reduction and/or implant failure [2]. Only coracoclavicular screw fixation with screws was reported in many series to have high complication rates including screw back out and osteolysis.

Conclusion

Isolated intra-articular K-wire fixation also fails to provide the required stability to the injured joint, especially in developing countries, where patients fail to adhere to the rehabilitation protocol. Thus, combining both, the intra-articular and coracoclavicular fixations seem to be a promising modality in terms of stability and secure fixation. Combining the intra- and extra-articular techniques significantly decreases the complication rates as seen with the isolated fixation techniques.

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