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Traumatic acromioclavicular joint separation – Current concepts

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Traumatische Akromioklavikulargelenksluxation – Aktuelles Behandlungskonzept

Zusammenfassung. *Grundlagen:* Das Behandlungsregime nach traumatischen Läsionen des Akromioklavikulargelenkes ist in den letzten Jahren deutlich in Diskussion geraten. Die Indikation zur operativen Therapie bei höhergradigen Dislokationen des Gelenkes kann aufgrund fehlender Studien, die nach den Regeln der evidence based medicine aufgebaut sind nicht zweifelsfrei dargestellt werden. Unterschiedliche Klassifikationen, differente diagnostische Kriterien und mannigfaltige Therapiekonzepte lassen nur unzureichende Vergleiche verschiedener Studien zu.

Methodik: Die vorliegende Arbeit stellt einen Überblick über die rezente Literatur zu diesem Thema dar. Die verschiedenen therapeutischen Möglichkeiten, von rein konservativer Therapie über perkutane Kirschnerdrahtfixation oder andere transartikuläre Techniken, extraartikuläre Techniken oder sekundäre Rekonstruktionen, werden miteinander verglichen.

Ergebnisse: Derzeit anerkannte therapeutische Algorithmen orientieren sich an der morphologischen Klassifikation ebenso wie an der individuellen klinischen Erscheinung der Läsion und den Erwartungen des Patienten. Die verschiedenen Implantate die zur Versorgung zur Verfügung stehen lassen aufgrund unterschiedlicher biomechanischer Eigenschaften keine einheitliche Empfehlung zu.

Schlussfolgerungen: Die vorliegende Literaturübersicht soll daher helfen die möglichen Behandlungskonzepte für akute und chronische Läsionen in komprimierter Form darzustellen und zu diskutieren. Die Indikation zu einer operativen Intervention sollte auf den jungen, sportlich aktiven Patienten beschränkt sein und nur bei höhergradiger Instabilität des Gelenkes erfolgen.

Schlüsselwörter: Akromioklavikulargelenk, Akromioklavikularluxation, Biomechanik, Therapie.

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Summary. *Background:* The concept of treatment strategies in dislocations of the acromioclavicular joint has changed in recent years. The recommended indication for operative treatment of complete dislocations has been questioned due to the lack of evidence-based results indicating the superiority of such treatment. Although the traumatic acromioclavicular joint separation is a well-known topic, there are different classifications, diagnostic procedures, concepts of intervention and a great variety of implants. Therefore a comparison of the numerous papers dealing with this topic is difficult.

Methods: An overview of the recent literature is given in this paper. The different therapeutical methods, ranging from non-operative techniques to different operative procedures such as percutaneous K-wires or other transarticular techniques, extraarticular techniques or secondary procedures like tendon transfers are compared.

Results: The current therapeutical algorithms that help to decide on whether operative or non-operative treatment are the best solution orientate themselves on the morphological classification, the clinical appearance of the injury and the individual patient's expectations. The wide range of implants available demand a decision based on anatomical and biomechanical considerations.

Conclusions: In this paper an overview of current concepts is given and possible treatment options for acute and chronic cases are discussed. The indication for operative intervention is restricted to the young and physically active patient with a high-grade dislocation of the AC-joint.

Key words: Acromioclavicular joint, acromioclavicular dislocation, biomechanics, therapy.

Introduction

Traumatic dislocations of the acromioclavicular joint are a common injury. In the vast majority of cases it occurs either during sport or other daily activities [1, 2, 3]. Most frequently the mechanism of injury is a force acting on the shoulder from the lateral side with the arm in an adducted position [4]. During the impact the acromion is shifted towards the lateral end of the clavicle, which may cause strain to the ligamentous fixation of the joint as well as to the attachments of the surrounding muscles. Depending on the amount of damage to the capsule-ligamentous complex of the joint, the result is a downward

and medial dislocation of the scapula due to the weight of the upper extremity, and an upward migration of the lateral end of the clavicle following the force of the trapecius muscle [4]. The aim of this paper is to discuss the treatment options for the different types of acromioclavicular joint dislocations.

Anatomy and biomechanics

The acromioclavicular joint consists of the lateral end of the clavicle and its corresponding medial end of the acromion. It is surrounded by a capsule with ligament-like reinforcements on the superior and inferior side ("Superior – and inferior acromioclavicular ligament") and an intraarticular meniscus-like fibrocartilagenous structure, which is not constantly present. Its form may vary from complete (disc-like) to incomplete (meniscoid) [5, 6, 7, 8]. The alignment of the articular surfaces show a huge variety in the vertical plane with a possible angulation between 0 degrees and almost 50 degrees downwards medially [6]. The coracoclavicular ligaments are secondary stabilizers of the AC joint. They represent a syndesmotic junction between the clavicle and the scapula. The conoid part of this ligament is oriented almost horizontally from the medial part of the coracoid base, while the trapezoid part shows a sagittal orientation.

Fukuda et al. could show that the strongest resistance against depressive forces on the acromion is given by the superior acromioclavicular ligament, that bears about 90 % of the load [9]. The trapezoid part of the coracoclavicular ligament is a stabilizer for anterior dislocation of the scapula, the conoid part works against dorsal dislocation. The acromioclavicular joint allows a longitudinal rotation of about 40 degrees, which is limited by the surrounding capsule as well as by the coracoclavicular ligaments [10].

Therefore, it is clear that the direction of the impending force on the shoulder is responsible for very specific damage to the ligamentous structures.

Classification

Depending on the joint's loss of passive stabilization, the residual tension of the surrounding muscles creates a more or less clinically apparent dislocation. The classification by Tossy is most frequently cited in Europe [11]. The author describes three grades of dislocation, namely ligamentous strain without any major displacement (Tossy I), rupture of the acromioclacicular ligaments (Tossy II), and complete disruption of the acromioclavicular and coracoclavicular ligaments with marked upward migration of the lateral end of the clavicle following the tension of the trapezius muscle (Tossy III). The classification introduced by Rockwood [4] gives more specific information about the concomitant injuries of the trapezius and deltoid muscles (Rockwood V) as well as about the dislocation of the clavicle in the horizontal plane. A type Rockwood IV is present if the lateral clavicle is displaced posteriorly and has perforated the trapezius muscle (see Fig. 1). Finally the type VI is defined as a subcoracoidal displacement of the clavicle and very rarely observed.

Fig. 1. Clinical finding in an acromioclavicular joint dislocation type Rockwood IV [Rockwood]

Diagnostic procedures

Patient assessment consists of exploring the medical history and comprehensive clinical examination. A fall on the adducted arm is present in most of the cases. High velocity injuries like motorcycle accidents sometimes lead to excessive external rotation and abduction and may cause subcoracoidal dislocation of the lateral end of the clavicle. In acute cases, local tenderness is most frequently found superior to the joint line. In addition, loss of forward elevation may be caused by pain or additional injuries to the anterior part of the deltoid muscle. Passive translation in the horizontal and vertical plane is painful and shows more laxity in comparison to the uninjured collateral side. In chronic cases, pain is often restricted to active motion and cross-body action, whereas the instability is still present.

Radiological assessment is achieved by plane x-ray and stress x-ray in the a.p. and axial view [4]. MRI still does not play an important role in the common diagnostic path of this entity. Ruptures of the coracoclavicular ligaments can be easily detected in acute cases. However, until today, it is not possible to show any correlation between degenerative changes in the MRI and the clinical appearance of this joint [12].

Treatment options and discussion

The treatment of acromioclavicular joint injuries is adapted to the degree of dislocation. Type I injuries are treated conservatively, either by the use of a sling or other immobilizing bandages for a few days to prevent discomfort. In addition, immediate functional rehabilitation is initiated, including passive motion and restricted axial load until pain relief. Even the so-called skillful neglect is recommended as a possible treatment option [13, 14, 15]. In cases of type II injuries, the majority of authors recommend non-operative treatment [16, 17]. Nevertheless, in a certain number of patients persistent painful conditions due to intraarticular cartilaginous lesions or disruption of the articular disc are observed. This may lead to secondary operative procedures, such as lateral

clavicular resection or arthroscopic debridement [18, 19, 20].

In contrast, complete disruptions of acromioclavicular ligaments and coracoclavicular ligaments with additional lesions of the deltoid or trapezius muscles (Rockwood IV – VI) are determined for operative repair. Many authors recommend the non-operative therapy in case of Rockwood type III dislocations [14, 21, 22, 23]. The indication is limited to highly active patients, manual workers or for cosmetic reasons [17]. The argumentation for non-operative therapy in such cases is based on the reported high complication rate after operative procedures and a sufficient functional result in clinical evaluation [13].

There is a great variety of operative treatment options. Open reduction of the acromioclavicular joint and reconstruction of the ligaments without any further fixation leads to insufficient results. The different fixation methods can be grouped into transarticular acromioclavicular techniques, coracoclavicular fixation techniques, and secondary interventions like excision of the lateral clavicle or muscle transfer procedures.

Transarticular fixation either by K-wires, screws, or tension-band techniques are commonly used. Several authors have described a high rate of complications, such as bending, breakage or migration of the pins [24, 25, 26]. Stabilization by the use of hinged plates, like Balser's, Rhamanzadeh's or Wolter's plates, definitely improves stability of the repair, and allows early mobilization [27, 28, 29]. On the other hand, it represents an extensive procedure with the necessity of an equivalent access for an eventual implant removal. Additional repair of the acromioclavicular ligaments is optional, but not recommended in all cases. The coracoclavicular ligaments are normally not addressed during these procedures [30].

Extraarticular fixation techniques such as the Bosworth screw, coracoclavicular loop wire, Dacron® loop (Nemours & Co, E. I. DuPont, France), or polyethylen augmentation devices like LARS® ligaments (LARS comp., Arc sur Tille, France) represent an indirect fixation method of the joint [31, 32, 33, 34]. The argumentation for recommending these techniques is based on the fact that there is no additional iatrogenic lesion to the AC joint [35]. Bosworth himself did not recommend the repair of the coracoclavicular ligaments [31]. Kennedy described frequent ossification along the screw, which he defined as extraarticular arthrodesis, but could not find any restriction to the mobility of the joint [36].

In the authors' opinion, the observable ossifications have to be considered as calcified ligaments. The coracoclavicular ligaments anatomically represent a syndesmotic junction, which works as a stress shield for dislocations in the horizontal plane rather than in the frontal plane. In agreement with Kennedy, the authors see no restriction to the AC joint mobility due to these calcifications at all, except for rotation.

The loop reconstruction techniques, such as loop-wire, Dacron®loop, Vicryl® tape (Ethicon, Johnson & Johnson, USA), PDS® cord (Ethicon, Johnson & Johnson, USA) or LARS® offer the option of early postoperative functional treatment. Especially in cases of biodegradable devices there is no need for a secondary operation. Some authors report osteolysis or clavicular erosions due to the knitted structure of the implants [33]. Improvements in implant technology seem to have minimized these problems in the latest generation of artificial ligaments [32, 37].

In cases of painful chronic dislocations, lateral clavicula resection can be considered, as first described by Mummford [19]. Weaver and Dunn introduced a procedure of lateral clavicula resection, combined with a transfer of the coracoacromial ligament into the lateral end of the clavicle and temporary internal fixation [38, 39]. This procedure is frequently used nowadays, resulting in superior outcome compared with dynamic muscle transfer techniques, e.g. transfer of the coracoid process to the clavicle, along with the tendons of the coracobrachial and short head of the biceps. Arthroscopic techniques offer the opportunity of lateral clavicular resection under the protection of the superior acromioclavicular ligament, if present [18, 40, 41, 42, 43]. The indication for this technique, thus, is restricted to patients with painful conditions, where instability is not the leading symptom.

Postoperative care

Postoperative treatment is focussed on adequate physiotherapy according to the specific operative technique. Transarticular fixation of the acromioclavicular joint requires a restricted early motion. A shoulder sling is given for comfort and pain reduction until the second postoperative day.

Subsequently, patients treated with K-wires are allowed to abduct unto 40 degrees [44], whereas those operated with a hook plate may abduct up to 90 degrees [28]. In both groups, the active range of motion is restricted for 6 weeks. K-wires are removed after this period followed by further unrestricted physiotherapy. The hook plate has to remain in situ for a minimum of one year according to the surgeon's individual concept. The risk of implant failure or loosening after forced physiotherapy is due to the rigid mechanical characteristics of these implants.

Indirect fixation has a greater variety of postoperative management. After the use of a Bosworth screw, the upper extremity is immobilized in a fixed shoulder bandage for 4 weeks. This is followed by active motion up to 60 degrees forward movement and abduction for another 4 weeks. A greater range of motion would create a critical load at the implant site [45]. After this period of 8 weeks, the implant is removed and full range of motion is allowed.

All techniques using loop techniques, like wires, biodegradable or permanent implants have in common the advantage of early and unrestricted motion. A sling is only used for comfort and reduction of postoperative pain. Despite this quite aggressive approach to physiotherapy, implant failure or loosening is rarely seen because the implants try to imitate the damaged anatomic structures.

To prevent complications under physiotherapy, it is important to bear the characteristics of each specific implant in mind.

Conclusion

The Rockwood classification is a well-accepted guideline for setting up the indication for a refined approach to alternative treatment strategies. Rockwood type I injuries are treated conservatively. In Rockwood type II dislocations, non-operative management is recommended. Nevertheless, there is still a remarkable number of patients who need secondary operative treatment, due to chronic pain and limited range of motion.

The Rockwood type IV – VI joint separations represent a clear indication for operative intervention due to serious accompanying pathologies of the surrounding structures.

The treatment of Rockwood type III injuries still remains a matter of controversial discussion. The vast number of literature reports show similar clinical results comparing operative vs. non-operative therapy. The finding of adequate treatment for each individual patient is a challenge each surgeon is faced with. Therefore, operative treatment should be restricted to patients undergoing strenuous physical activities (e.g. manual workers or high-level athletes) or those for whom cosmetic demands play a part.

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