Treatment of Acromioclavicular Joint Dislocation

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4.1 Epidemiology

Acromioclavicular joint dislocation occurs as a result of an acute traumatic event. Patients are most often young and active in sports. The incidence of acromioclavicular joint separation varies with the sportive activity and can reach up to 20 % in skiing. Altogether, separation of the acromioclavicular joint accounts for 4–6 % of all joint dislocations [1]. Injuries of the shoulder complex are associated with a decreased range of motion and may be followed by serious consequences when diagnosis is delayed or even wrong.

4.2 Anatomy

4.2.1 Bones

The acromioclavicular joint is a diarthrodial joint, built by the acromion on its lateral aspect and the lateral clavicle on its medial margin. A fibrocartilaginous intraarticular disc is located between the osseous segments.

4.2.2 Ligaments and Fascias

Stability is achieved by the acromioclavicular and coracoclavicular ligaments. The acromioclavicular ligament provides horizontal stability and consists of superior, inferior, anterior, and posterior components. The superior ligament is known to be the strongest, followed by the posterior ligament. The coracoclavicular ligaments (trapezoid and conoid) provide vertical stability and insert 3 cm from the distal end of the clavicle (trapezoid) and 4.5 cm (conoid) from distal end of clavicle on its dorsal margin. Additionally, the capsule as well as deltoid and trapezius fascias act as additional stabilizers [8, 9].

4.2.3 Motion

The acromioclavicular joint accounts for 40 % of scapular movement [2]. While the clavicle rotates nearly 40–50°, only 8 % of the rotation passes the acromioclavicular joint. The majority of motion is caused by the bones, not by the joint itself. The acromioclavicular joint differs anatomically and can be classified by the DePalma classification.

4.3 Classification (Table 4.1)

4.4 Diagnostics

When the patient has suffered from a traumatic event, a direct blow to the adducted arm is frequently described. Bruises and cranial dislocation of the lateral

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Table 4.1 Rockwood classification [2]

Type	Description
Type I:	Sprain of the acromioclavicular or coracoclavicular ligament
Type II:	Subluxation of the acromioclavicular joint associated with a tear of the acromioclavicular ligament; coracoclavicular ligaments is intact
Type III:	Dislocation of the acromioclavicular joint with injury to both acromioclavicular and coracoclavicular ligaments
Type IV:	Dislocation of the acromioclavicular joint with injury to both acromioclavicular and coracoclavicular ligaments. Clavicle is displaced posteriorly through the trapezius muscle
Type V:	Gross disparity between the acromion and clavicle, which displaces superiorly
Type VI:	Dislocated lateral end of the clavicle lies inferior to the coracoid

clavicle are recognized. A neurovascular exam of the involved extremity is important and reducibility of the joint with upward pressure of the elbow stabilizing the clavicle superiorly can be performed (note that the shoulder drops down, the clavicle does not move up).

Using X-rays, a.p. projection of the glenohumeral joint as well as Y-view or transaxillary views are taken. To evaluate the acromioclavicular joint directly, the Zanca view should be used by tilting the center-beam 30–45° caudocranial, aiming on the acromioclavicular joint (Zanca 1971). The Alexander view (Y-view with maximum arm adduction) helps to verify subluxation in acromioclavicular joints (Alexander 1954). If a full dislocation is suspected, a.p. projections comparing both sides should be taken, using 5–10 kg weights. Transaxillary views are highly recommended to diagnose a horizontal instability. Ultrasound offers a good diagnostic tool for degenerative changes as well as lower grade injuries of the acromioclavicular joint (Rockwood I–II). In higher-grade lesions (Rockwood IV–VI), muscle hematoma and ruptured muscle insertions can be diagnosed. The distance from the coracoid process to the clavicle can be measured and compared to the healthy contralateral side. The results correlate positively with X-ray findings [10, 11]. CT scan and scintigraphy (arthritis) can be performed but are of lesser importance than an MRI. Early osteolysis (repetitive trauma) or rheumatoid arthritis can be diagnosed through MRI. In acute acromioclavicular dislocations, a huge number of missed injuries (15 % SLAP lesion, 5 % fractures, 4 % rotator cuff tears) were found [12]. Acromioclavicular separations are classified by Tossy (1963) and Rockwood (1984). Kraus et al. published a new measurement tool for instability of the acromioclavicular joint, the acromioclavicular joint instability score (ACJI), in 2010.

4.5 Treatment

Treatment strategies vary and controversy remains regarding the optimal course of action. There are more than 150 different conservative and operative treatment options to stabilize the joint [2]. There is little literature about long-term results, even for well-established treatment strategies. Likewise, no long-term results for newly developed operative procedures are available [3–7]. At this point, there is no therapeutic gold standard for acromioclavicular joint dislocation. Typically, a surgical indication is made with higher-grade acromioclavicular separations. Rockwood III grade injuries must be evaluated individually.

4.5.1 Conservative Treatment

There is a broad consensus for nonoperative treatment of Rockwood type I and type II lesions. The most accepted method of conservative treatment is a brief period of immobilization in a sling to support the weight of the upper extremity and to limit the stress on the joints ligament. This period of immobilization is accompanied by ice and oral analgesic medication. The patient is encouraged to initiate range of motion activities within the first week of injury to reduce pain and inflammation in an effort to decrease associated morbidity. Strengthening exercises with a specific focus on scapular stabilization follow.

4.5.2 Operative Treatment

After indication for operative treatment (type IV, V, and VI) is made, ruptured ligaments that are unable to be reconstructed need to be removed. Also, the interarticular disc needs inspection. The clavicle must be repositioned and fixation must be performed. Good alignment needs to be achieved and ligaments are thought to heal by scarring. If muscle fascia insertions are partially or completely ruptured, surgical intervention is necessary. Furthermore, other damaged anatomical structures must be addressed. Regarding

Fig. 4.1 Arm position

horizontal stability, surgical treatment of ruptured muscle fascia insertions is of the highest importance.

4.5.2.1 Positioning

The patient is positioned in beach-chair position. The surgeon should check that no material will interfere with fluoroscopy. Frequently, the patient is positioned towards the injured side and the operating table is tilted towards the contralateral side to avoid the patient sliding down off the table. The arm is laid onto a splint and the elbow hangs freely (Fig. 4.1). The ventral and dorsal shoulder aspect as well as the sternoclavicular joint are cleaned and prepared for operation. The arm is freely movable and covered up to the biceps muscle.

4.5.2.2 Procedures

Regarding the anatomy, there are different options available. Bridging the acromioclavicular joint is possible; techniques that address the coracoid process are also available. Combinations of these options are possible as well.

Transarticular K-Wire Fixation

This technique was first described by Murray and Phemister. Using either a frontolateral approach parallel to the clavicle or a saber-type incision, preparation of the coracoclavicular and acromioclavicular ligaments as well as muscle insertions are possible. The insertion point for the K-wires can be set up. After reconstruction or resection of the ligaments and inspection and debridement of the discus has been performed, the clavicle is repositioned. The result is controlled by fluoroscopy before two K-wires (2 mm diameter) are drilled in from the lateral aspect of the acromion, aiming toward the cranial corticalis of the clavicle. Both wires should be positioned in parallel (Fig. 4.2a). Some authors prefer to use just one K-wire to reduce damage to the cartilage. It must be clearly stated that rotation stability is not achieved, which increases the risk of material loosening or even breakage.

In addition to K-wires a metal cerclage can be used. This helps to achieve an even greater stability, and the width of the acromioclavicular joint can also be adjusted. A certain risk of cartilage damage and later degenerative changes is created when compression of the joint participants is too high. The operation ends by adapting the initially prepared sutures of the ligaments and/or suturing the muscle fascia insertions if ruptured. The above-described technique is also used in lateral clavicular fractures, when the fracture zone is seen very laterally. K-wires are also an option in coracoid process fractures (Fig. 4.2b) when the process cannot be used for acromioclavicular stabilization (TightRope, band augmentation). The most striking argument not to use the above-mentioned implants is the need of a second operation for implant removal. Also, partial loss of the reduction result may occur (Fig. 4.2c).

Hook Plates

In case of a fracture zone that is positioned in the area of the coracoclavicular ligaments or even more medially, K-wires should not be used. The clavicular shape inhibits the positioning of the wires and healing will not be achieved. Here we use hook plates, which are not used in cases of isolated acromioclavicular dislocation. Even though modern hook plates (e.g., Dreithaler) seem not to have the disadvantages of earlier implants, the long-term results are not convincing.

TightRope System

The TightRope system (Arthrex, Naples/USA) offers another technique to stabilize the acromioclavicular joint. Compared with other established procedures, it was shown that comparable repositioning results were achieved. Significant advantages for either of the procedures were not shown [13]. Although the

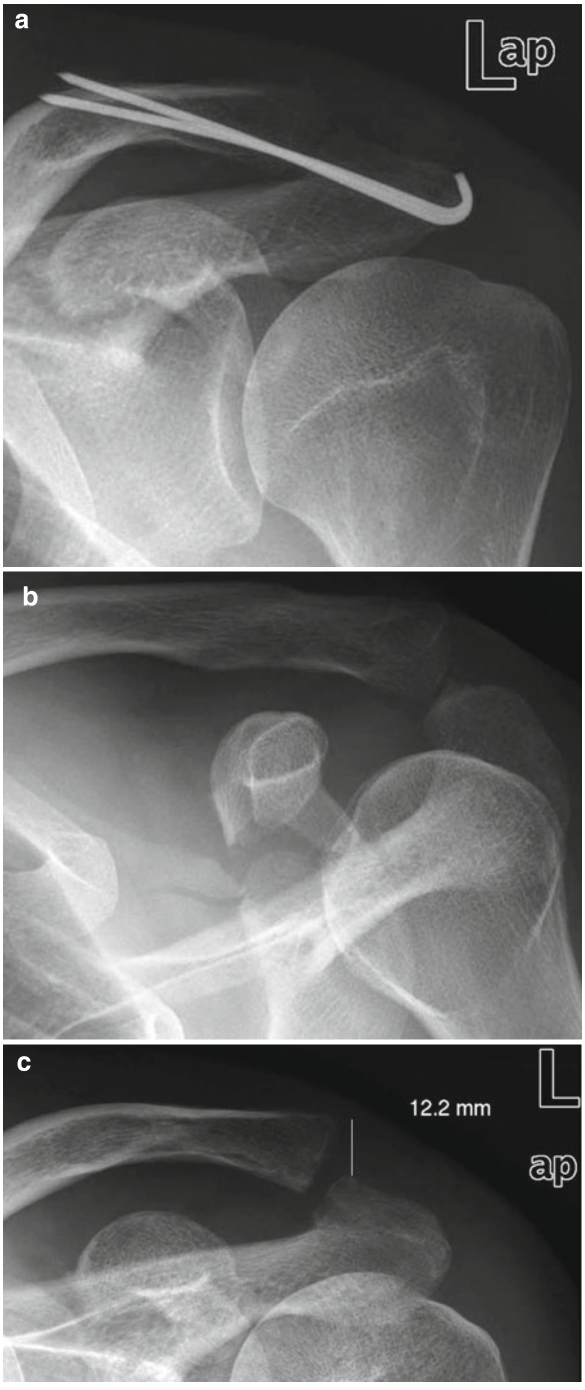

Fig. 4.2 (**a**) Postoperative result. (**b**) Fracture of the coracoid process (oblique view). (**c**) Follow-up after metal removal (week 6), partial loss of reduction result is seen

operative procedure can be assisted arthroscopically, we prefer a minimally invasive approach to the craniodorsal aspect of the clavicle and the ventral margin

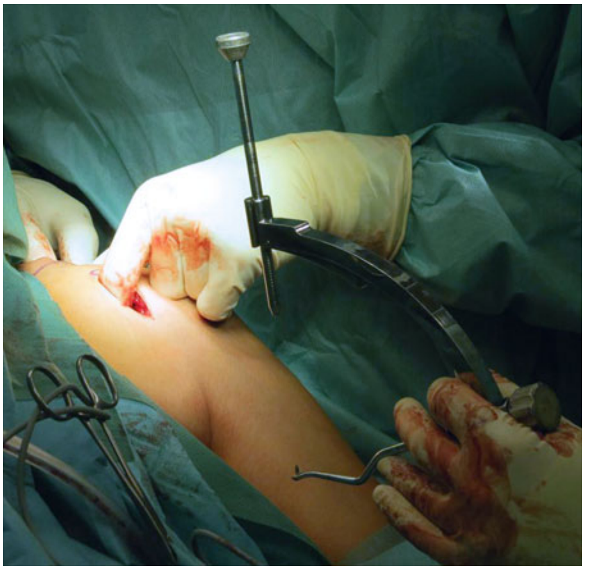

Fig. 4.3 Positioning of the aiming device

of the coracoid process. By using these incisions, muscle damage or ruptured muscle fascia insertions can be addressed. The biceps tendon is incised longitudinally and the tip of the coracoid process can be touched. After preparation, the caudal part of the aiming device is now positioned underneath the coracoid process, while cranially it is positioned on the craniodorsal aspect of the clavicle (Fig. 4.3). A K-wire is drilled towards the clavicle. The first drill hole should touch the insertion of the conoid ligament, which is centrally located on the base of the coracoid process. The position is controlled and overdrilled (diameter 4 mm). The tip of the wire should be protected to avoid descensus and damage by perforation through a moving K-wire (Fig. 4.4). A guiding suture is now brought in through the cannulated drill (Fig. 4.5). The drill is removed afterwards and the aiming device can be set to perform another drill hole that follows the trapezoid ligament and should perforate the coracoid process where the ligament inserts. It is not clear whether it makes sense to have the clavicular holes drilled in parallel or V-shaped. Kraus et al. showed that both procedures are associated with good to very good results [14]. The TightRope itself is next pulled through using the guiding sutures (Fig. 4.6). The endobutton now goes into reverse position underneath the caudal aspect of the coracoid process (Fig. 4.7) and the fixation button can be positioned above the clavicle (Fig. 4.8). Repositioning is performed and controlled via fluoroscopy (Fig. 4.9). When good alignment is achieved, the fixation button above the clavicle is pulled downwards and knots are set. The button needs to touch the clavicle (Figs. 4.8 and 4.12). The ends of the cut sutures must not irritate the covering soft tissue. This may impair wound healing. Alternatively sutures can be guided ventral to the clavicle and around the TightRope itself before another knot is set. In our department, we frequently change the direction in which the TightRope is brought in. Especially in thin people with less soft tissue above the clavicle, the TightRope is brought in caudally. This way the small endobuttons are positioned onto the clavicle (Fig. 4.10) and the fixation button is positioned underneath the coracoid process. Using a knotting aid, fixation of the endobutton is easily achieved (Fig. 4.11). Soft tissue irritation is minimized. The operation ends by careful primary wound closure.

Fig. 4.4 Overdrilling the K-wire and protection of the K-wire's tip

4.6 Acromioclavicular Joint Arthritis

4.6.1 Conservative Treatment

Degenerative changes in the acromioclavicular joint may have different causes. Former injuries to the joint are one possibility. Typically, conservative treatment is preferred but operative techniques are available as well to solve persistent problems.

4.6.2 Operative Technique

4.6.2.1 Open Lateral Clavicular Resection

Gurd and Mumford described an open resection technique in 1941. After the joint capsule is incised, the joint is prepared and the lateral clavicle is resected using an oscillating saw. The interarticular disc is

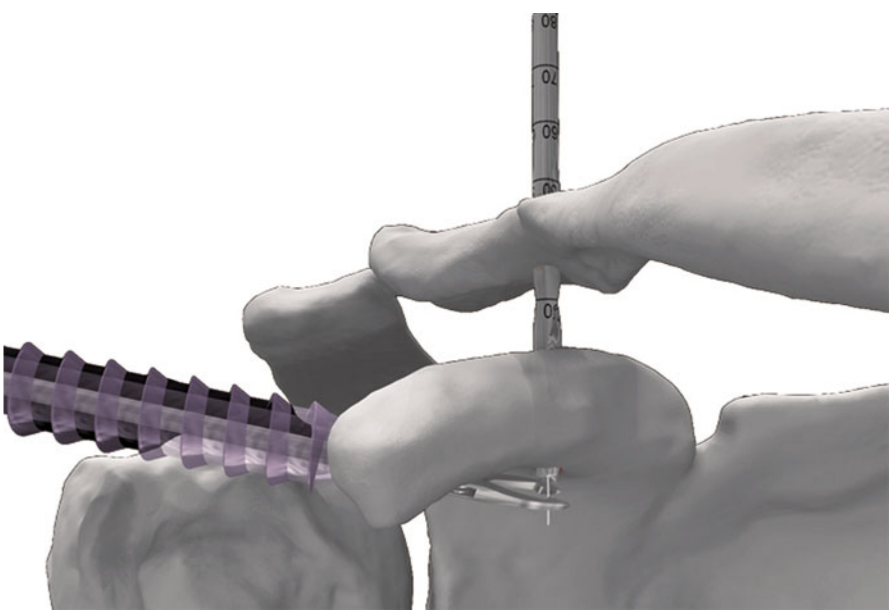

Fig. 4.5 Pulling the guiding suture through the drill (By kind permission of the publisher Arthrex, Naples/USA)

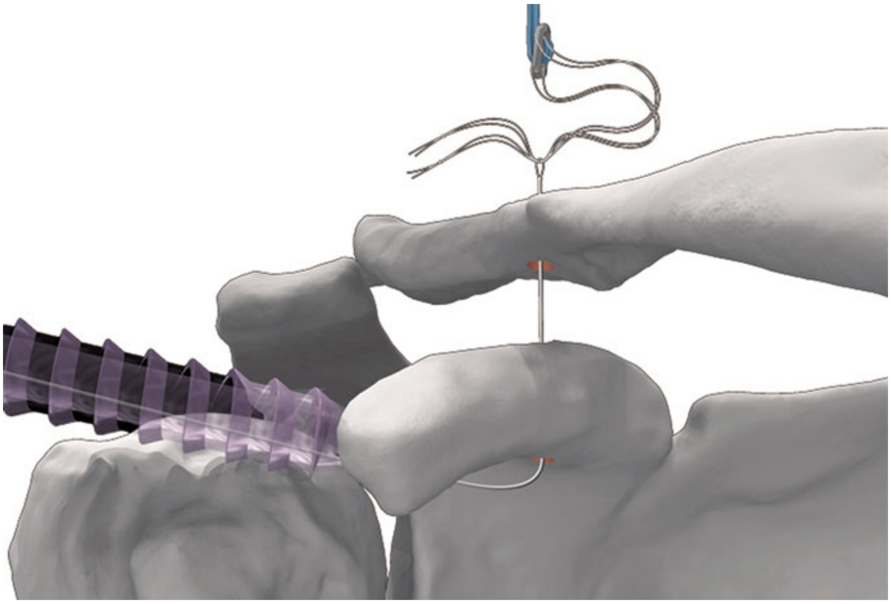

Fig. 4.6 Pulling the TightRope through the holes (By kind permission of the publisher Arthrex, Naples/USA)

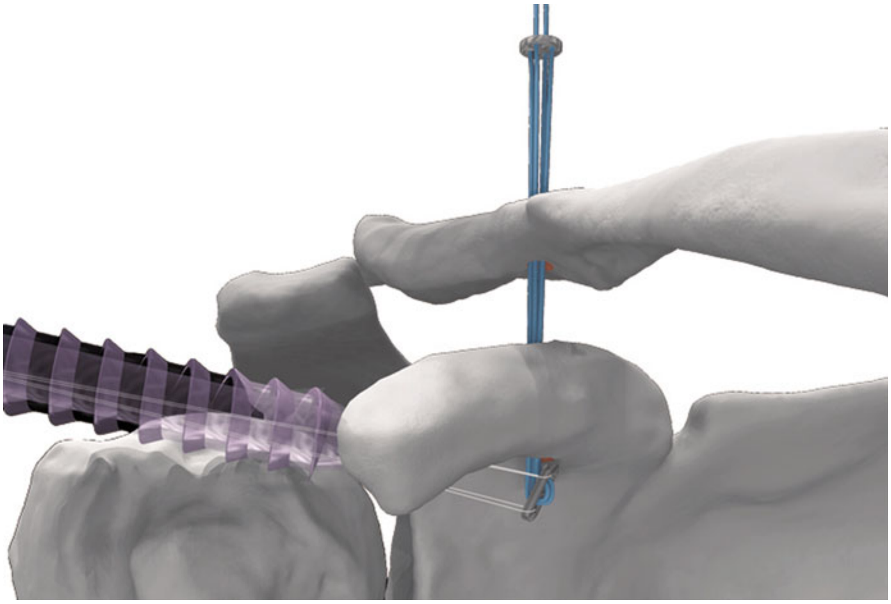

Fig. 4.7 The endobutton flips into reverse position underneath the coracoid process (By kind permission of the publisher Arthrex, Naples/USA)

removed. Literature about the correct resection length varies. There is information about lengths of 2.5 cm to 1.8 cm to 1 cm. Resection lengths over 1 cm seem to be associated with a worse outcome. The reason seems to reside in the acromioclavicular ligaments. Their insertions are affected when the resection length is larger than 1 cm, which decreases their function [15, 16].

4.6.2.2 Arthroscopic Lateral Clavicular Resection

Resection of the lateral clavicle can also be achieved arthroscopically using a shaver. A side effect of this technique is that the ligaments are partially resected. Furthermore, intraarticular joint resection is possible using a mini shaver. This is a demanding technique that is associated with a high technical effort, special instruments,

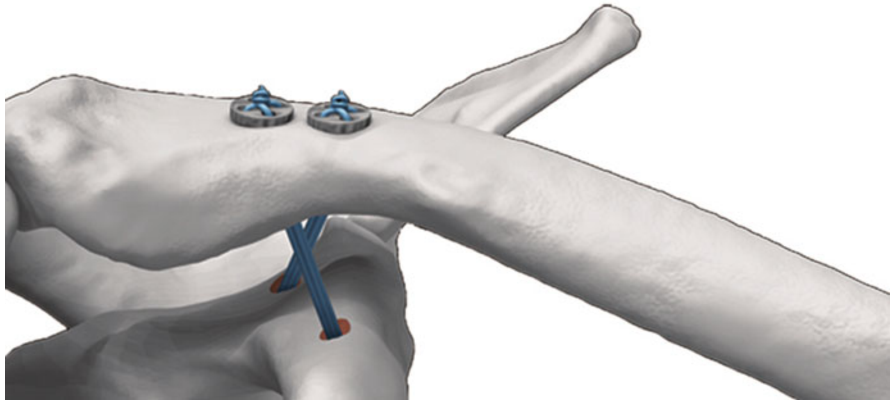

Fig. 4.8 The fixation buttons lay onto the clavicle (By kind permission of the publisher Arthrex, Naples/USA)

Fig. 4.9 Intraoperative radiographic control

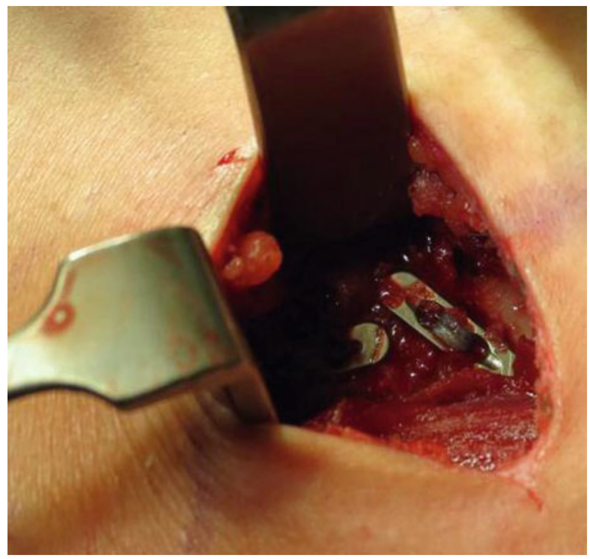

Fig. 4.10 The reversed endobuttons above the clavicle

and increased costs and may be too challenging for an inexperienced surgeon. Postoperatively, the joint components should not have contact, in order to avoid a painful decreased range of motion. It is highly important not to damage the coracoclavicular ligaments. A ligament reconstruction is difficult.

4.6.2.3 Weaver and Dunn Procedure

Weaver and Dunn [19] modified the above-mentioned technique. The coracoacromial ligament is removed from the caudal aspect of the coracoid process and positioned toward the remaining end of the resected clavicle. Transossary fixation is performed. Technically, this procedure is easy and treatment of side injuries in this area is possible. The described procedure is not an adequate treatment option in older acromioclavicular joint separation with a large vertical instability. Also, horizontal stability is not achieved with a Weaver-Dunn technique. Additional band augmentation is necessary and, in case of horizontal instability, a reconstruction of the initial anatomy is of the highest importance. The first biomechanical results using autologous ligament reconstruction techniques seem to be promising [17, 18]. The anatomical situation has changed in patients who have undergone prior surgery of the shoulder (e.g., a Weaver-Dunn operation) and therefore the experienced surgeon must question doing any kind of revision surgery. These operations must be planned carefully; the area where ligaments are taken from needs to be thoughtfully chosen and follow-up treatment is predicated on good compliance.

Fig. 4.11 Reposition maneuver and TightRope fixation

Table 4.2 Follow-up treatment

Postoperative week	K-wire	Tightrope
1–2	Passive Internal/external rotation 90-0-0 Abduction/flexion max. 30°	
3–4	Active-assisted Internal/external rotation 90-0-0 Abduction max. 70° Flexion max. 90°	Active-assisted Internal/external rotation 90-0-0 Abduction/flexion max. 45°
5–6	Active Internal/external rotation free Abduction/flexion max. 60°	
7–8	Removal of K-wires	Free range
12–16	Full weight bearing	
16–24	Training phase for professional athletes, full weight bearing	

4.7 Follow-Up Treatment

The patient receives a Gilchrist bandage. We recommend the bandage for up to 3 weeks. If weight is brought onto the operated area too early, this may result in impaired healing of repaired muscle fascia insertions. Passive-assisted physiotherapy is possible after the first postoperative week. Flexion and abduction is limited to 30°. External rotation should be strictly avoided. With the third postoperative week the patient can start active-assisted training. Flexion and abduction is limited to 45° and external rotation should be avoided until the end of the fourth postoperative week. If K-wires are used, the limitation in flexion and abduction should be 90° to avoid any material breakage. External rotation is possible the beginning of the fifth postoperative week when using TightRopes. Flexion and abduction to 60° is then possible and full range of motion is possible from the seventh postoperative week on. The K-wires should be removed by this time and any restrictions in range of motion be revoked. The patient is allowed full weight bearing 3–4 months after the operation (Table 4.2). Radiographic control can be performed (Fig. 4.12).

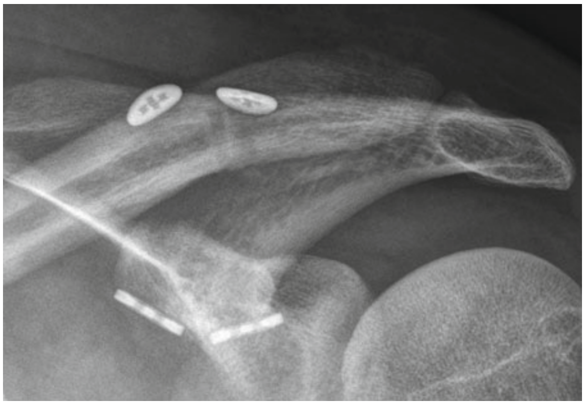

Fig. 4.12 Long-term result (>4 months)

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