Surgical treatment of chronic acromioclavicular dislocation: Comparison between two surgical procedures for anatomic reconstruction

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A B S T R A C T

Introduction: Surgical treatment of chronic complete acromioclavicular (AC) joint dislocation is still debated and no gold standard surgical procedure has been identified.
Materials and methods: A retrospective series of 90 patients treated for AC dislocations is reported here. Patients were divided into three groups: group 1 receiving AC reconstruction with a Dacron vascular prosthesis; group 2 receiving AC reconstruction with LARS® artificial ligament; group 3 receiving conservative treatment. Follow-up was performed after 1, 6 and 15 months with plain radiographs, UCLA, SPADI and modified UCLA acromioclavicular rating scales.
Results: Patients treated surgically presented significant better functional outcome compared to patients treated conservatively with overall positive results in 93.3% of patients for group 2 and 53.3% of patients for group 1. However, reconstruction with Dacron vascular prosthesis presented an unacceptable high complications rate (43.3%).
Conclusion: Our results show that anatomic AC reconstruction with LARS® artificial ligament resulted in both satisfactory functional outcome and low complication rate. Therefore, we recommend this procedure for the treatment of chronic complete AC dislocations.

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Introduction

Acromioclavicular (AC) joint dislocations typically occur through either a direct impact to the shoulder or by indirect force from a fall on an outstretched arm, thus affecting mainly active patients involved in contact sports.[7,9,14,27] This leads to aesthetically unpleasant bulging of the lateral aspect of the clavicle, pain, fatigue, muscular weakness, and impaired shoulder function.[14,28] Functions of AC joint are to suspend the scapula from the clavicle and to support the weight of the upper extremity, thus once the ligaments are destroyed, joint stability has to be maintained only by the muscles.[3,17,28] For this reason, many patients develop various degrees of disability, secondary to disruption to their normal AC anatomy.

The rationale of surgical treatment is, therefore, to restore normal anatomy, giving the patient the possibility of regaining normal shoulder function. Since the first report of Cooper in 1861,[8] a wide variety of surgical procedures have been reported, including transarticular pins or screws[21]; AC wire or suture fixation[15]; transfer of the coracoid muscles[4,26]; coroclavicular screws[5,16,29]; coroclavicular fixation with synthetic grafts.[10,12,24,25] Non-operative treatment has also been advocated[11]; however, results for types III–VI AC dislocation are poor, often leading to chronic instability. Moreover, frequently the extent of the consequences after conservative treatment of types I and II dislocation is underestimated.[19]

Whilst early repair of acute AC dislocations provides satisfactory results independently of the surgical procedure,[2,18,23] there is less consensus on the treatment of chronic lesions and the outcome after surgery is generally less favourable.[24] However, most reported surgical techniques involve a combination of coroclavicular and AC fixation, whilst resection arthroplasty of the distal clavicle has been demonstrated not to address the joint instability.[1] The aim of this study therefore is to compare the outcome of two surgical procedures of coroclavicular reconstruction with conservative treatment by reporting our experience in the treatment of chronic AC dislocations types III–VI according to Rockwood.[23]

Materials and methods

A series of 90 patients treated for chronic AC dislocation by the same surgeon (G.F.) in our Department from 1999 to 2009 is

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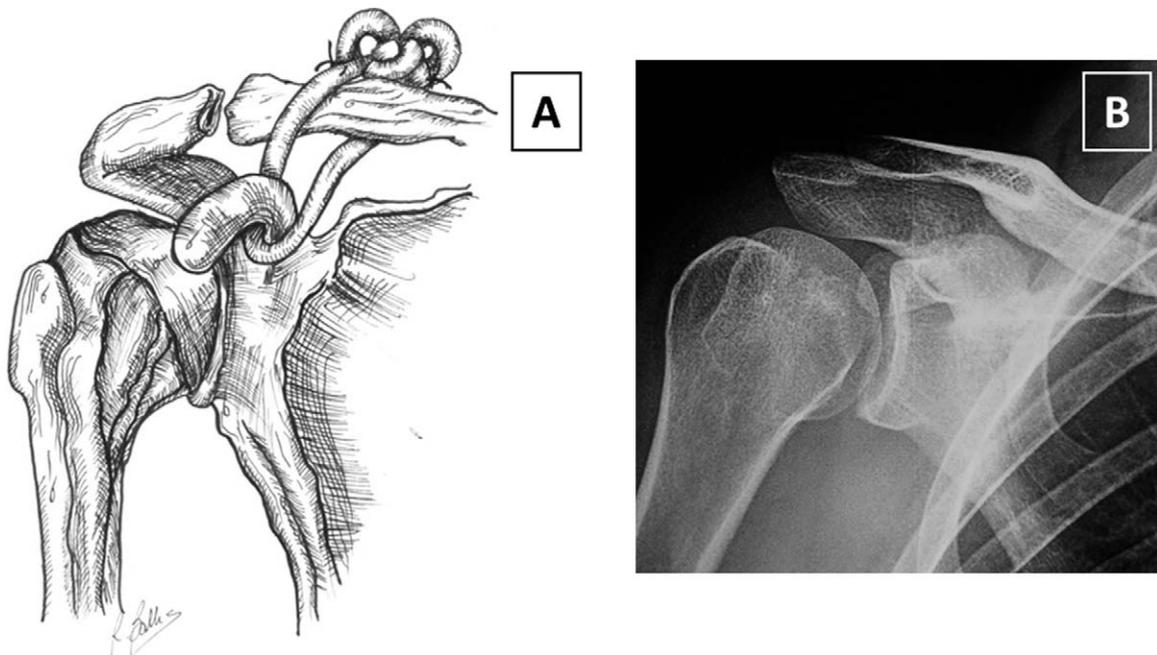
Fig. 1. (A) Surgical technique for AC reconstruction with a Dacron vascular prosthesis. With the patient lying in beach-chair position, a 7 cm long epiclavicular skin incision is made from the tip of the acromion to the medial side of the clavicle. After identification of the coracoid process, an acromioclavicular K-wire is placed in order to keep the AC joint stable. The vascular prosthesis is then passed around the coracoid and secured over the clavicle with a knot. (B) X-ray taken 15 months after surgery showing satisfactory reduction of the AC dislocation.

analysed here, including 84 men and 6 women. Ages ranged from 20 to 62 years, mean age of 31.5 years. The dominant extremity was involved in 66 injuries (74%). The time from injury averaged 3 months, (1–6). The injury was the result of a sport trauma in 67 patients (75%).

Patients were retrospectively divided into three groups according to the treatment received. The groups were homogeneous with respect to age, sex, type of trauma and duration of symptoms. Patients of group 1 underwent reconstruction with a Dacron vascular prosthesis (Fig. 1); patients of group 2 underwent reconstruction with LARS® (Ligament Advanced Reinforcement System; Surgical Implants and Devices, Arc-sur-Tille, France) and two interference screws (Fig. 2); patients of group 3 were treated conservatively. In both surgical groups an acromioclavicular K-wire was placed in order to provide antero-posterior stability and removed after 3 weeks. Pre-operative assessment included bilateral static plain radiographs and bilateral dynamic radiographs taken with the patients standing and holding a 5 kg weight in each hand. Inclusion criteria were as follows: (i) type III or higher AC dislocation according to Rockwood; (ii) minimum 1 month after trauma; (iii) no previous surgery performed. Post-operatively, the arm was kept in sling for 2 weeks.

Follow-up was performed by the Shoulder Unit of our Department in the outpatient's clinic at 1 month, 6 months, and 15 months after surgery. Patients were assessed with radiographs post-operatively and after 6 months. The modified UCLA acromioclavicular rating scale was used in all patients after 15 months in order to evaluate the overall success of the procedure. This scale includes maintenance of reduction, range of motion, strength, pain, weakness, change in occupation, patient satisfaction and complication.[13] In order to verify effectiveness of the procedure, the UCLA score, and the Shoulder Pain and Disability Index (SPADI) score were utilised in those patients who did not experience any complication. The various complications were separately recorded in order to highlight the safety of the procedure.

Data were statistically analysed by use of paired Mann–Whitney tests and one-way analysis of variance tests.

Results

Clinical outcome is summarized in Table 1 and in Figs. 3 and 4. After 6 months, patients of both groups 1 and 2 showed a significant ($p < 0.05$) improvement of function evaluated by the UCLA score (26 ± 1.2 and 26.9 ± 1, respectively) compared to the pre-operative assessment (15.3 ± 1.1) and also compared to patients treated conservatively (15.8 ± 0.9). After 15 months, according to the modified UCLA acromioclavicular rating scale, in group 1, 10 (33.3%) patients had excellent results, 6 (20%) had good results, 1 (3.3%) had fair results and 13 (43.3%) had poor results; in group 2, 12 (40%) patients had excellent results, 16 (53.3%) had good results, 1 (3.3%) had fair results and 1 (3.3%) had poor results. Patients of both groups 1 and 2 showed a significant ($p < 0.05$) improvement of function evaluated with the UCLA (27.9 ± 2.2, 28.4 ± 2.3, respectively) and the SPADI score ($17.9 \pm 4.3\%$, $16 \pm 2.2\%$, respectively) compared to patients treated conservatively (UCLA: 16.2 ± 0.9; SPADI: $64.9 \pm 7.3\%$).

As far as complications are concerned, 13 patients out of 30 (43.3%) of group 1 reported a complication including 7 (23.3%) recurrences due to neoligament rupture, 4 (13.3%) aseptic separations, 1 (3.3%) fracture of the clavicle and 1 (3.3%) fracture of the coracoid. In contrast, only 1 patient out of 30 (3.3%) of group 2 suffered from a complication, consisting in the neoligament rupture. Neither deep infection, nor nerve palsies were reported.

Discussion

We reported successful AC reconstruction after chronic AC dislocations and also identified a procedure, based on the use of LARS® artificial ligament, which allows for both satisfactory functional outcome and low complication rate with excellent or good results in 93.3% of the patients. The other procedure, based on the application of a coroclavicular Dacron band, was characterized by an unacceptable high complication rate (43.3%) with excellent or good results in only 53.3% of the patients. However, when a complication was not registered, also reconstruction with a Dacron
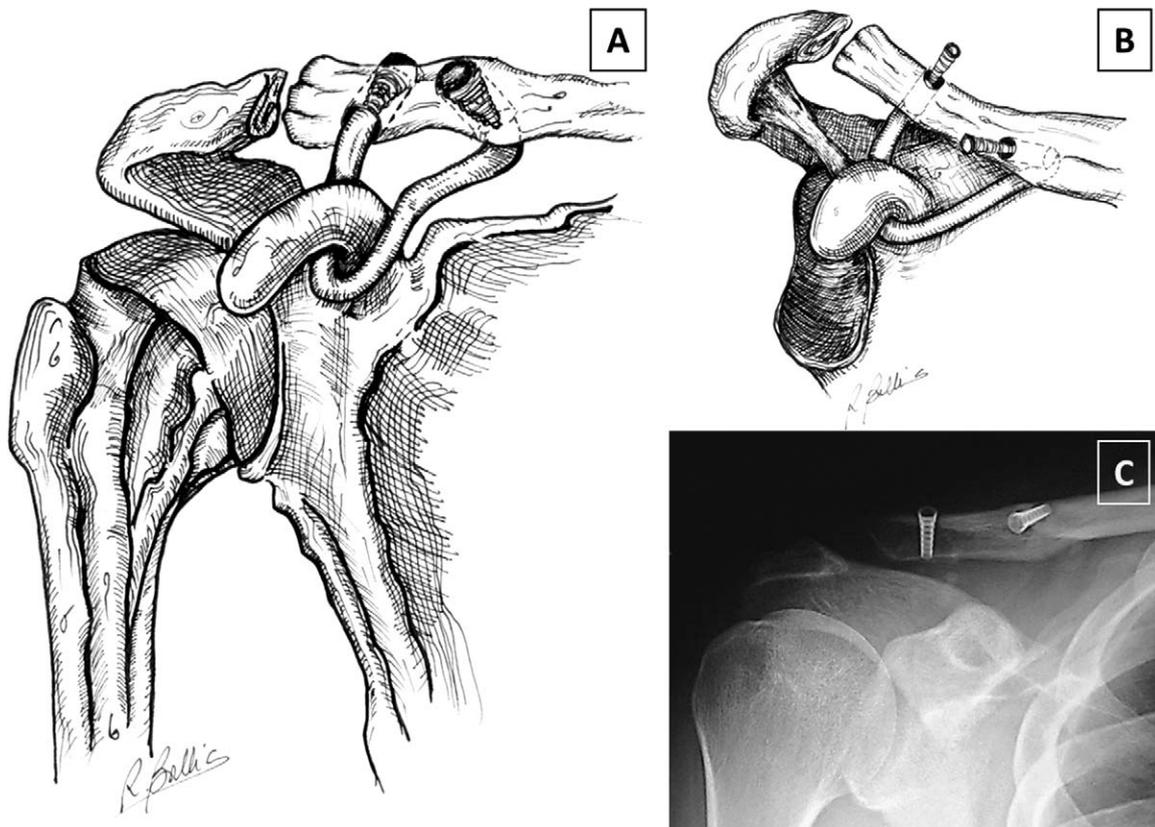
Fig. 2. (A) Surgical technique for AC reconstruction with LARS®. With the patient lying in beach-chair position, a 7 cm long epiclavicular skin incision is made from the tip of the acromion to the medial side of the clavicle. After identification of the coracoid process two transosseous tunnels are drilled into the clavicle. Great care is taken in performing these tunnels in oblique fashion in order not to weaken the clavicle. (B) LARS® is then passed around the coracoid and through the tunnels and secured with two conic interference screws. A short acromioclavicular K-wire is ultimately placed avoiding the two screws. (C) X-ray performed 15 months after surgery showing satisfactory reduction of the AC dislocation.

vascular prosthesis resulted in satisfactory outcome with full return to previous athletic activities after 15 months, comparable with that of the LARS® group. This suggests that reconstruction of chronic grades III–VI AC dislocation is an effective procedure which allows for anatomic reconstruction and, consequently, significantly better results than conservative treatment. In this study, also patients with chronic grade III AC were included, even if their surgical treatment had been questioned by other authors.[6] In fact, the severity of these injuries is often underestimated in primary diagnosis and most of them during surgery turn out to be grade IV and V.[22]

From a biomechanical standpoint, since reconstruction in the Dacron group was obtained performing a coroclavicular loop around the clavicle with an "over-the-top" knot, the clavicle is overloaded in a single point, thus increasing the risk of bone erosion and subsequent fracture. Conversely, LARS® is passed through two drill holes in the clavicle and fixed with two

interference screws, distributing the load in two points without "over-the-top" application of forces, and, therefore, transection of the clavicle from bone erosion unlikely occurs. In addition, the low rate of neoligament rupture in the LARS® group can be explained by its characteristic high resistance to the mechanical forces acting in the shoulder, consistent with previous satisfactory experience with anterior cruciate ligament (ACL) reconstruction.[20] On the other hand, previous experience with Dacron materials for ACL reconstruction reported high failures rate due to poor long-term stability.[22]

Another important issue is the rationale for late repair of chronic lesions. In the literature, early repair of AC dislocations

Table 1
Summary of results at 15 months follow-up.

	Control	Dacron	LARS®
Number of patients	30	30	30
Success rate (excellent or good)	0%	53.3%	93.3%
UCLA	16.2	27.94	28.44
SPADI	64.91	17.95	16.04
Complications	–	13/30 (43.3%)	1/30 (3.3%)
Neoligament rupture	–	7	1
Foreign body reaction	–	4	–
Clavicle fracture	–	1	–
Coracoid fracture	–	1	–
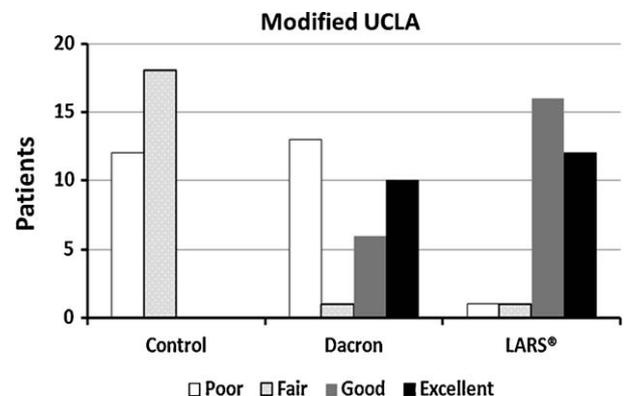
Fig. 3. Overall outcomes after 15 months from surgery according to the modified UCLA acromioclavicular rating scale.
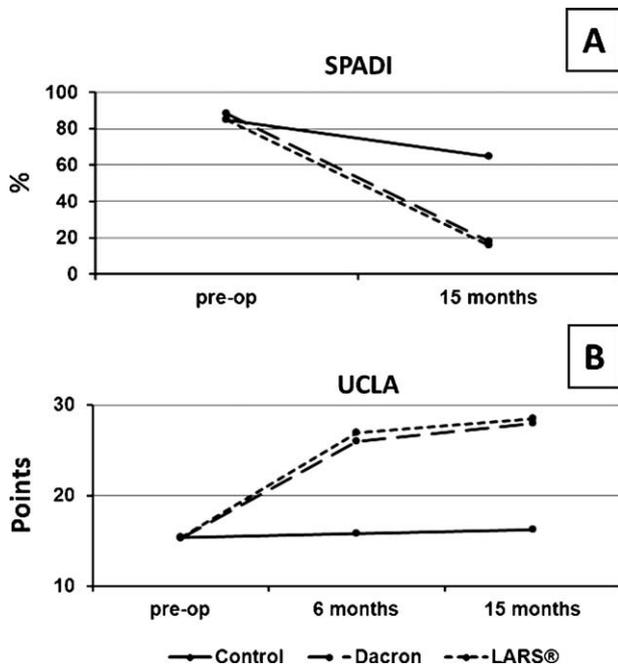
Fig. 4. Functional outcome according to the SPADI (A) and UCLA (B) rating scales.

has been reported to result in good clinical outcome. On the other hand, treatment of chronic AC dislocation is usually less effective and characterized by a higher complication rate and lower patients' satisfaction.[24,28] Weinstein et al. reported that when reconstruction is performed more than 3 months after trauma, results are significantly worse, probably because of the presence of abundant scar tissue and muscle retraction.[28] Nevertheless, we obtained satisfactory results even after 3 or more months following trauma when using LARS®. This can be explained by the fact that our series is characterized by a high number of athletes (75%) and that the devices used in this study provided more stable reconstruction than that obtained using no. 5 nonabsorbable sutures as used in the work of Weinstein et al.[28]

Conclusion

In conclusion, we advocate surgical treatment with anatomic acromioclavicular reconstruction with LARS® and two interference screws on the clavicle for active and motivated patients with complete acromioclavicular dislocations. Further long-term follow-up studies are needed to ultimately assess the long term efficacy of this procedure.

Conflict of interest

No financial support/benefit/interest could create a potential conflict of interest with regard to the work for any of the authors.

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References

1. Adam FF, Farouk O. Surgical treatment of chronic complete acromioclavicular dislocation. Int Orthop 2004;28(2):119–22.
2. Bannister GC, Wallace WA, Stableforth PG, Hutson MA. The management of acute acromioclavicular dislocation. A randomised prospective controlled trial. J Bone Joint Surg Br 1989;71(5):848–50.
3. Bargren JH, Erlanger S, Dick HM. Biomechanics and comparison of two operative methods of treatment of complete acromioclavicular separation. Clin Orthop Relat Res 1978;130:267–72.
4. Berson BL, Gilbert MS, Green S. Acromioclavicular dislocations: treatment by transfer of the conjoined tendon and distal end of the coracoid process to the clavicle. Clin Orthop Relat Res 1978;135:157–64.
5. Bosworth BM. Complete acromioclavicular dislocation. N Engl J Med 1949;241(6):221–5.
6. Ceccarelli E, Bondì R, Alviti F, et al. Treatment of acute grade III acromioclavicular dislocation: a lack of evidence. J Orthop Traumatol 2008;9(2):105–8.
7. Clayton Robert AE, Court-Brown CM. The epidemiology of musculoskeletal tendinous and ligamentous injuries. Injury 2008;39:1338–44.
8. Cooper ES. New method of treating long standing dislocations of the scapulo-clavicular articulation. Am J Med Sci 1861;41:389–92.
9. Dumontier C, Sautet A, Man M, Apoil A. Acromioclavicular dislocations: treatment by coracoacromial ligamentoplasty. J Shoulder Elbow Surg 1995;4(2):130–4.
10. Fleming RE, Tornberg DN, Kiernan H. An operative repair of acromioclavicular separation. J Trauma 1978;18(10):709–12.
11. Fremerey R, Freitag N, Bosch U, Lobenhoffer P. Complete dislocation of the acromioclavicular joint: operative versus conservative treatment. J Orthop Traumatol 2005;6(4):174–8.
12. Goldberg JA, Viglione W, Cumming WJ, et al. Review of coracoclavicular ligament reconstruction using Dacron graft material. Aust N Z J Surg 1987;57(7):441–5.
13. Guy DK, Wirth MA, Griffin JL, Rockwood Jr CA. Reconstruction of chronic and complete dislocations of the acromioclavicular joint. Clin Orthop Relat Res 1998;347:138–49.
14. Herrmann S, Schmidmaier G, Greiner S. Stabilisation of vertical unstable distal clavicular fractures (Neer 2b) using locking T-plates and suture anchors. Injury 2009;40(3):236–9.
15. Horn JS. The traumatic anatomy and treatment of acute acromio-clavicular dislocation. J Bone Joint Surg Br 1954;36-B(2):194–201.
16. Kennedy JC, Cameron H. Complete dislocation of the acromio-clavicular joint. J Bone Joint Surg Br 1954;36-B(2):202–8.
17. Kiefer H, Claes L, Burri C, Holzwarth J. The stabilizing effect of various implants on the torn acromioclavicular joint. A biomechanical study. Arch Orthop Trauma Surg 1986;106(1):42–6.
18. Lancaster S, Horowitz M, Alonso J. Complete acromioclavicular separations. A comparison of operative methods. Clin Orthop Relat Res 1987;216:80–8.
19. Mouhsine E, Garofalo R, Crevoisier X, Farron A. Grade I and II acromioclavicular dislocations: results of conservative treatment. J Shoulder Elbow Surg 2003;12(6):599–602.
20. Nau T, Lavoie P, Duval N. A new generation of artificial ligaments in reconstruction of the anterior cruciate ligament. Two-year follow-up of a randomised trial. J Bone Joint Surg Br 2002;84(3):356–60.
21. Phemister DB. The treatment of dislocation of the acromio-clavicular joint by open reduction and threaded-wire fixation. J Bone Joint Surg 1942;24:166–8.
22. Richmond JC, Manseau CJ, Patz R, McConville O. Anterior cruciate reconstruction using a Dacron ligament prosthesis. A long-term study. Am J Sports Med 1992;20(1):24–8.
23. Rockwood CA, William GR, Young DC. Injuries to the acromioclavicular joint. In: Rockwood CA, Green DP, Buchholz RW, Heckman JD, editors. Fracture in adults. 4th ed., Philadelphia: Lippincott; 1996. p. 1341–413.
24. Rolf O, Hann von Weyhern A, Ewers A, et al. Acromioclavicular dislocation Rockwood III–V: results of early versus delayed surgical treatment. Arch Orthop Trauma Surg 2008;128(10):1153–7.
25. Roper BA, Levack B. The surgical treatment of acromioclavicular dislocations. J Bone Joint Surg Br 1982;64(5):597–9.
26. Sloan SM, Budoff JE, Hipp JA, Nguyen L. Coracoclavicular ligament reconstruction using the lateral half of the conjoined tendon. J Shoulder Elbow Surg 2004;13(2):186–90.
27. Tibone JE, Lee TQ, Csintalan RP, et al. Quantitative assessment of glenohumeral translation. Clin Orthop Relat Res 2002;400:93–7.
28. Weinstein DM, McCann PD, McIlveen SJ, et al. Surgical treatment of complete acromioclavicular dislocations. Am J Sports Med 1995;23(3):324–31.
29. Weitzman G. Treatment of acute acromioclavicular joint dislocation by a modified Bosworth method. Report on twenty-four cases. J Bone Joint Surg Am 1967;49(6):1167–78.