



Is conservative treatment still defensible in grade III acromioclavicular dislocation ? Are there predictive factors of poor outcome ?

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The optimal treatment of grade III acromioclavicular (AC) dislocation is still controversial. Recent studies recommend surgery at that stage whereas meta-analysis favours conservative management. The objective of the present investigation was to analyse a clinical series of non-operated grade III AC dislocations and to determine their functional status.

Thirty-five patients treated conservatively with a grade III acromioclavicular dislocation were retrospectively reviewed. Simple shoulder test, Oxford shoulder and bilateral Constant shoulder score were used for assessment. Various predictive criteria of poor outcome, particularly scapular dyskinesis were taken into account for analysis.

Overall mean and median Constant Score of the injured side were 92.9 and 94, whilst the contralateral shoulder values were respectively 94.9 and 95 (mean and median scores). Ten patients had scapular dyskinesis. Laterality, shoulder activity and scapular dyskinesis were not statistically related to worse outcome. Twenty-eight (80%) patients resumed normal activity within six months. All but two patients were subjectively very satisfied or satisfied.

Conservative treatment provided satisfactory results whatever the shoulder activity. No risk factors were predictive of a poorer outcome. Conservative management should remain the first option to manage these injuries.

Keywords : acromioclavicular dislocation ; scapular dyskinesis ; grade III dislocation ; non-operative treatment.

INTRODUCTION

Grade III acromioclavicular (AC) dislocation treatment is still controversial (4,6,20). Recent meta-analysis (38), prospective trials (23,1,35), systematic reviews and (17,33,16,2,19) comparative studies (12) report similar or even superior results with conservative treatment, and therefore recommend a conservative management. Unfortunately these studies (17,23,1,14) have investigated procedures either performed more than twenty-five years ago or associated with a higher incidence of complications (pin transfixation, coracoclavicular screw or banding). The recommendation of conservative treatment might be obsolete.

The unsightly residual bump of the dislocated joint and the unsatisfactory outcome in some patients managed conservatively have led some surgeons to reconsider surgery as a potentially better treatment for this type of injury. Recent

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results (7,47) are encouraging, with a reported lower complication rate at short follow-up in small groups of patients.

Several risk factors have been pointed (16,42) out to be related to fair results in conservative treatment and are being suggested as indication for surgery. Among these factors, scapular dyskinesia was an abnormal finding observed in disabled throwing athletes (5) and in chronic AC dislocations (15). Burkhart and Kibler (5) originally described this clinical entity as an abnormal motion of the scapula during scapulohumeral movements and is subsequent to an unbalanced scapular muscles activation after shoulder injury. The authors of the present investigation hypothesized that scapular dyskinesia might be a predictive factor of poor outcome after grade III acromioclavicular dislocation. Providing comparable results and identifying other risk factors of poor outcome were the main objectives of this study.

MATERIAL & METHODS

Every patient with an acute grade III AC dislocation diagnosed in our institution between 2005 and 2008 was treated conservatively. This consecutive series was retrospectively reviewed.

Diagnosis of grade III AC dislocation was established when a complete dislocation of the joint was present as classified by Rockwood, visible on anteroposterior (15° cephalic tilt) views radiographs. No dynamic studies of the acromioclavicular joints were performed. Shoulder sling and analgesics made up the conservative treatment protocols as well as full information to patient on the injury and consequence. Early motion of the shoulder was encouraged. Return to normal professional activity was allowed when possible but sport was not authorized during the first six weeks. No further control was requested.

Forty-eight patients were recruited. Exclusion criteria were: an age over 70 years ($n = 2$) and a late surgery ($n = 4$). Seven patients could not participate in the study. Four of them refused to enter the study and have not been operated on whereas the recent fate of three others remains unknown.

Thirty-five patients entered the study and a complete clinical history was collected including the following criteria: age, sex, age at trauma, follow-up time, dominant and injured sides, professional and sport activities before and after injury.

Three subgroups were distinguished among professional occupations: administrative worker, manual worker and student. The latter was gathered with administrative workers for statistical analysis. Sport activities were divided into four groups, which included athlete or professional sportsman, intensive shoulder user (overhead, contact and throwing sports), recreational sportsman and sedentary.

The patients were asked the time they took to recover (less than three months, between three and six months, between six months and a year, and more than a year) and go back to sports either the same level or not and the subjective overall treatment satisfaction (very satisfied, satisfied, not satisfied). Clinical examination was performed in all patients, with palpation of the AC joint and assessing any limitation in the shoulder range of movement. The presence of scapular dyskinesia if any was also noted.

Simple shoulder test (SST), Oxford shoulder test (OST) (21) and bilateral Constant shoulder score (CSS) (9) including an arm strength evaluation with the Isobex Dynamometer (Cursor AG, Bern, Switzerland) were performed. The questionnaire was filled in to assess global objective shoulder function (Table I). Finally patients were asked if they would have acted differently with the benefit of hindsight.

Statistical analysis was performed using standard descriptive statistics including means, standard deviation, median, minimum and maximum for continuous variables, frequency counts and percentages for categorical variables. The software SPSS 15.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analysis.

The Wilcoxon signed-rank test was used to compare CSS of injured and healthy shoulders. The Mann-Whitney and Kruskal-Wallis test were performed to compare the CSS, OSS and SST between subgroups of professional and sport activities, respectively. Fisher's exact test or Chi-square test was implemented to examine the statistical significance of each factor, depending on the number of observations. For all analysis, p -values < 0.05 were considered significant.

Median values of CSS instead of mean values were used for analysis because of non homogenous distribution of values among Constant score (all patients ranging between 76 and 100/100) in order to detect subtle significant variations among groups.

RESULTS

Thirty-five patients (32M, 3F; Mean age \pm SD 36.4 ± 14.6) were included in the series. Mean fol-

low-up was thirty-three months ($SD \pm 12.4$). Minimal follow-up was one year. Twenty patients (57%) injured their dominant side, sixteen (45.7%) patients were manual workers, sixteen (45.7%) were administrative workers, others were students (8.3%). Categorization of sports into subgroups is listed (Table II).

Mean and median Constant shoulder score were 92.9(/100) and 94(/100) (Min-Max : 76-100) at the injured side and 94.9(/100) and 95(/100) at the opposite side. Mean and median Oxford shoulder score were 46.6(/48) and 48(/48). Mean and median Simple Shoulder Test were 11.5 (/12) and 12 (/12) respectively (Min-Max : 9-12). Worst CSS, OSS and SST scores were respectively 76, 34 and 10 (Table I).

All patients resumed sport activity except for three football players. Two injured their dominant side and were subjectively dissatisfied. The first was an administrative worker and had similar poor CSS (82/100) at review in both shoulders, whereas the second was a manual worker, with a poor CSS and OSS but excellent SST. He recovered in less than three months. The last football player stopped because of pain, while having normal mobility and strength. CSS was poor despite excellent OSS and SST, and he took more than a year to recover (Table I).

42.8% of patients (15/35) had a normal shoulder at 3 months, 37.2% (13/35) between three and six months, 11.4% (4/35) between six and twelve months and 8.6% (3/35) more than a year later.

Ten (25.8%) patients had scapular dyskinesia, with either an inferior medial scapular border prominence (type I) or a medial scapular border prominence (II) (Fig. 1) on comparison of both scapular positions.

Overall 94.4% of patients were very satisfied ($n = 22$) or satisfied ($n = 11$) with their shoulder at follow up.

Injury at the dominant side was not predictive of a poor outcome. Comparison of dominant and non-dominant side scores yielded no significance ($p = 0.88$) Median CSS for the dominant and non-dominant sides were 93.5 and 94 respectively. Similar conclusions were drawn regarding work and sport activities (Table III).

Independently of the sidedness, t-test of median Constant scores between office and manual workers showed no significance ($p = 0.233$), as for the four subgroups of sport ($p = 0.163$). Therefore, none of the professional or sport categories among grade III AC dislocations were predictive of a poorer outcome.

Shoulder activity was suspected to influence the healing time, notably in manual work and high level sports. Our data clearly showed no evidence for such an association. The overall satisfaction rate was not influenced either by work ($p = 0.992$), by sport activity (intensive, athlete or recreational, sedentary) ($p = 0.204$), or by the injured side (dominant) ($p = 0.148$).

Finally, scapular dyskinesia was the last criteria we investigated. Ten patients were identified in our study, more frequently in the shoulder intensive users groups. Statistical analysis failed again to show any relation between scapular dyskinesia and the level of sporting activity ($p = 0.657$), as well as for administrative and manual workers ($p = 0.493$). Mean CSS was better in patients with dyskinesia than in patients without dyskinesia.

DISCUSSION

Up to now, there is no firm recommendation for treatment of grade III AC. The meta-analysis (38) and systematic reviews in the literature (4,16,39,40) have failed to provide recommendations because they were based on low evidence studies. Those reviews generally recommend conservative treatment because of the non-superiority of surgery and the avoidance of multiple potential complications such as infection (33,16,26,18), implant discomfort (8,18) or failure (44,40), loss of reduction (24,31,26,8,18,22,11,28), second surgery for removal or revision (8,18,11), osteolysis (6), coracoclavicular ossifications (6,28), osteoarthritis (6) or unaesthetic scarring.

However, newer techniques of anatomic restitution and stabilisation of the AC joint have been reported in addition to the historical Weaver-Dunn (45), Bosworth (3,44) and Phemister (32,25) procedures, with emergence of modified techniques (10) of these latter. These anatomic reconstructions are based on the theoretical but unconfirmed benefits on

Table I. — Used parameters for the study

Age at trauma	Follow up time	Dominant side	Injured side	Job	Sport before	Sport after	Time for recovery (months)	Constant score (/100)	Contralateral Constant (/100)	Oxford score (/48)	STT (/12)	Scapular dyskinesis	Satisfaction
					1 = Professional								
					2 = Intensive								
					3 = Recreational								
					4 = Sedentary								
18	43	Right	Right	Manual	2 Soccer	same	0-3	96	94	48	12	Yes	very sat
30	53	Right	Right	Manual	3 Running	same	3-6	89,5	92	46	10	No	satisfied
43	51	Right	Left	Office	/	same	0-3	95,4	96,4	48	12	Yes	satisfied
16	24	Right	Right	Student	2 Soccer	same	0-3	93	94	48	12	No	very sat
28	49	Right	Left	Manual	1 Sport teacher	same	3-6	96	100	46	12	No	satisfied
48	47	Left	Left	Manual	3	same	0-3	91,2	92,8	47	12	No	very sat
30	48	Right	Right	Manual	4 /	same	0-3	100	100	48	12	No	very sat
36	44	Right	Right	Office	2 Soccer	change	> 12	82	81,5	46	10	No	NOT sat
58	44	Right	Right	Manual	3	same	0-3	96	93	48	12	Yes	very sat
59	41	Right	Left	Manual	4 /	same	0-3	100	83	48	10	No	very sat
33	39	Left	Left	Office	2 Soccer	same	3-6	98,6	95	48	12	Yes	very sat
30	40	Right	Right	Office	3	same	3-6	99,5	100	48	12	No	very sat
61	38	Right	Right	Manual	4 /	same	0-3	87	93	48	12	No	very sat
52	37	Right	Left	Office	3	same	3-6	75,5	88	44	10	No	satisfied
13	37	Left	Left	Student	3	same	6-12	94	100	48	12	Yes	very sat
45	34	Right	Right	Office	3 Climbing	same	0-3	95,5	95	47	12	No	satisfied
33	33	Right	Left	Office	3	same	0-3	96	100	48	12	No	satisfied
18	29	Left	Left	Office	2 Football	change	3-6	88,9	94,4	48	12	No	satisfied
27	29	Right	Left	Manual	3	same	6-12	93,2	97	45	12	No	satisfied
22	28	Right	Right	Office	3	same	0-3	87	84	46	11	No	very sat
67	26	Right	Left	Office	3	same	3-6	100	100	48	12	Yes	very sat
18	23	Right	Left	Student	2 Soccer	same	3-6	93,5	98	48	12	No	very sat
57	21	Left	Right	Office	3	same	3-6	81	91	48	12	No	very sat
43	21	Right	Left	Office	2 Soccer	same	> 12	86	99	47	10	No	very sat
22	20	Right	Right	Office	3 Running	same	0-3	96	94	48	12	No	very sat
30	18	Right	Right	Manual	2 Soccer	change	0-3	86	99	39	11	No	NOT sat
45	17	Right	Left	Manual	3 Running	same	> 12	91,5	86	30	10	Yes	satisfied
53	17	Right	Right	Manual	1 Sport teacher	same	0-3	94	92	48	12	No	very sat
29	16	Left	Right	Manual	3	same	6-12	96,4	98,8	46	12	Yes	very sat
25	14	Right	Right	Manual	3 Cycling	same	0-3	100	100	48	12	Yes	very sat
24	14	Right	Left	Office	2 Hockey	same	3-6	92	97	48	12	No	very sat
35	13	Right	Right	Office	2 tennis	same	0-3	92,5	94	48	12	No	satisfied
26	11	Right	Left	Manual	2 Boxing	same	6-12	93	100	46	10	Yes	satisfied
46	30	Right	Left	Office	3	same	3-6	96	100	46	9	No	very sat
37	42	Right	Right	Manual	1 Sport teacher	same	3-6	100	100	48	48	No	very sat
Mean	Mean						Mean	Mean	Mean	Mean	Mean		
35,9	31,2						92,9	94,9	46,6	11,5			



Fig. 1

motion, strength, indolence, and correction of the deformity. These techniques have been developed to restore the coracoclavicular ligaments, using hook plates (14,26,11) or arthroscopy (43,31,49,7,47,11, 13,27), with tendon grafts (24,41,36), artificial ligaments (8,28) and various augmentation sutures (37,22, 27,46) and endobuttons (7). These newer techniques, especially with arthroscopy, are aimed at achieving better cosmetic appearance while reducing surgery related complications and finally shorten recovery time. Unfortunately, follow-up generally does not exceed two years. A recent study (29) has pointed out the high rate of potential complications. The Constant Shoulder Score was used as our standard reference to analyse the score of the injured shoul-

ders mainly for comparison with other studies. Our results, like others (12,6), confirm the efficacy of conservative treatment in grade III acromioclavicular dislocations at short-term outcome, with very satisfactory CSS, compared with unaffected sides and scores of surgically treated patients in other studies. Particularly some patients had a follow-up of only one year, but with a good and stable evolution for several months Leidel *et al* (25) evaluated the long term outcome of seventy K-wire transfixations of the AC joint. They reported a mean Constant score of 88/100 (+/-10) out of the three studied groups (short, middle, and long-term follow-up). The results between groups were alike and statistically insignificant. Another study about similar procedure and follow-up has given same conclusions. Temporary transfixation is a reliable and satisfactory technique for the grade III dislocation. Kienast *et al* (18) reported on a large sample of 225 hook plates at three-year follow-up, and revealed a CSS of 92.4/100, notably due to plate discomfort in all patients (but vanished at removal of the plate). The results are in concordance with another technique used by Lädermann *et al* (22) who assessed thirty-seven patients at four-year follow-up using no implant but a cerclage augmentation for the stabilisation of the AC joint, with a CSS of 96/100. They recommended their treatment based on the absence of implant or second surgery complications. Arthroscopic repair using synthetic ligament (8), tendon autograft (24), modified Weaver-Dunn associated with hook plates (22) and endobutton (31,49,7) failed to demonstrate significant superiority when evaluated with CSS. Few recent studies however showed interesting early results and a promising future for arthroscopic techniques (CSS of 97/100 (31)). In

Table II. — Categorization of sports into subgroups

	Professional	Intensive	Recreational	sedentary
n patients	3 (8.6%)	11 (31.4%)	17 (47.6%)	4 (11.4%)
sports	kite surf teacher	american football	running	
	school sport teacher	football	climbing	
		tennis	Mountain biking	
		boxing		
		climbing		

Table III. — Student’s T-test between subgroups of work and sport activity (whatever the side)

W O R K	Office (n 19)	→	93.95 (76-100)	p = 0.233
	Manual (n 16)	→	95 (82-100)	
S P O R T	Professional (n 3)	→	96 (94-100)	p = 0.163
	High risk (n 11)	→	92.5 (82-99)	
	Lower risk (n 17)	→	95.5 (76-100)	
	No sport (n 4)	→	97.7 (87-100)	

that grade of injury, more than 160 techniques have been described (2), but none has proven to be more effective than conservative management, especially for people who favor function over esthetics.

Several authors (16,42) have mentioned factors suspected of poor outcomes in conservative management. Some surgeons therefore consider overhead and contact sports, manual labour (23), young and active patients (19) as indication for surgery, despite the absence of evidence (4,16). Our statistical analysis failed to ascertain them as surgery predictive factors. Equivalent conclusions were also reported in other studies (48). Rangger (34) observed more dismissals from sport when surgery was performed on overhead athletes. Our CSS were equal (93/100 versus 92.3/100) and not statistically significant within same subgroups of sport and work when using laterality as comparison criteria. Constant scores between our four subgroups of sport activity (professional, intensive or overhead, recreational and no sport) failed to show statistical significance. Unfortunately because of our small sample size within subgroups a significant relation could not be excluded.

Recovery time from injury was another factor to support operative treatment. In our series, 80% healed before six months. Seven patients took longer time. Three of them have reported their shoulder

not recovered yet at the time of evaluation (two practising intensive and one recreational sport activity). The analysis found no correlation between the types of work and sport performed. The average mean time for recovery from injury in the literature was between eight and fourteen weeks. Law (24) recommended surgery because of their good results with a mean fourteen weeks to recover. Two review articles (41,42) showed a delay to return to work when surgery was performed, but these results were based on old surgical techniques (17,12,23,1). The precise time to return to work was not investigated in the present study, and we were not able to compare our results with those reported in the literature.

Scapular dyskinesia is a recently described entity (5) which is believed to be more prevalent among throwing athletes and injured shoulders, notably in case of acromioclavicular lesion. Three different clinical patterns are identified. Type I, showing inferior medial scapular border prominence, type II, with a protruding medial scapular border, and the type III pattern, displays prominence of the superomedial border of the scapula when compared to other scapula. Gumina (15) reported it in 70% of his chronically injured dislocations. Although it was less common, we surprisingly observed that 25% of the patients of our series presented a clinical anomaly but they were free of symptoms. Although one

study (30) yielded lower incidence among patients undergoing surgery, these data did not change our management so far.

This study has some limitations such as being a small cohort, especially for subgroups statistics, retrospective and the variability of the follow-up of our patients.

Based on this study, we were unable to figure out factors related to a poorer outcome, and even if the new techniques have shown encouraging results, they still have to prove their benefit in comparison with conservative management over time. In the meantime, the non operative treatment in a grade III AC dislocation remains appropriate and should be recommended as the primary treatment.

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REFERENCES

- 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 : 848-850.
- Beitzel K, Cote MP, Apostolakis J, Solovyova O, Judson CH, Ziegler CG et al.** Current concepts in the treatment of acromioclavicular joint dislocations. *Arthroscopy* 2013 ; 29 : 387-397.
- Bosworth BM.** Acromioclavicular Dislocation : End-Results of Screw Suspension Treatment. *Ann Surg* 1948 ; 127 : 98-111.
- Bradley JP, Elkousy H.** Decision making : operative versus nonoperative treatment of acromioclavicular joint injuries. *Clin Sports Med* 2003 ; 22 : 277-290.
- Burkhart SS, Morgan CD, Kibler WB.** The disabled throwing shoulder : spectrum of pathology. Part II : evaluation and treatment of SLAP lesions in throwers. *Arthroscopy* 2003 ; 19 : 531-539.
- Calvo E, López-Franco M, Arribas IM.** Clinical and radiologic outcomes of surgical and conservative treatment of type III acromioclavicular joint injury. *J Shoulder Elbow Surg* 2006 ; 15 : 300-305.
- Chen M, Ye X, Ni Y, Mou Z, Huang L.** [Application of endobutton in the treatment of acute acromioclavicular joint dislocation]. *Zhongguo Gu Shang* 2011 ; 24 : 189-191.
- Cohen G, Boyer P, Pujol N, Hamida Ferjani B, Massin P, Hardy P.** Endoscopically assisted reconstruction of acute acromioclavicular joint dislocation using a synthetic ligament. Outcomes at 12 months. *Orthop Traumatol Surg Res* 2011 ; 97 : 145-151.
- Constant CR, Murley AH.** A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res* 1987 ; 160-164.
- Dearden PMC, Ferran NA, Maqsood M.** A modified Weaver-Dunn procedure without need for internal fixation. *Acta Orthop Belg* 2010 ; 76 : 120-123.
- Di Francesco A, Zoccali C, Colafarina O, Pizzoferrato R, Flamini S.** The use of hook plate in type III and V acromioclavicular Rockwood dislocations : clinical and radiological midterm results and MRI evaluation in 42 patients. *Injury* 2012 ; 43 : 147-152.
- Galpin RD, Hawkins RJ, Grainger RW.** A comparative analysis of operative versus nonoperative treatment of grade III acromioclavicular separations. *Clin Orthop Relat Res* 1985 ; 150-155.
- Glanzmann MC, Buchmann S, Audigé L, Kolling C, Flury M.** Clinical and radiographical results after double flip button stabilization of acute grade III and IV acromioclavicular joint separations. *Arch Orthop Trauma Surg* 2013 ; 133 : 1699-1707.
- Gstettner C, Tauber M, Hitzl W, Resch H.** Rockwood type III acromioclavicular dislocation : surgical versus conservative treatment. *J Shoulder Elbow Surg* 2008 ; 17 : 220-225.
- Gumina S, Carbone S, Postacchini F.** Scapular dyskinesis and SICK scapula syndrome in patients with chronic type III acromioclavicular dislocation. *Arthroscopy* 2009 ; 25 : 40-45.
- Hootman JM.** Acromioclavicular Dislocation : Conservative or Surgical Therapy. *J Athl Train* 2004 ; 39 : 10-1.
- Imatani RJ, Hanlon JJ, Cady GW.** Acute, complete acromioclavicular separation. *J Bone Joint Surg Am* 1975 ; 57 : 328-332.
- Kienast B, Thietje R, Queitsch C, Gille J, Schulz AP, Meiners J.** Mid-term results after operative treatment of rockwood grade III-V acromioclavicular joint dislocations with an AC-hook-plate. *Eur J Med Res* 2011 ; 16 : 52-56.
- Korsten K, Gunning AC, Leenen LPH.** Operative or conservative treatment in patients with Rockwood type III acromioclavicular dislocation : a systematic review and update of current literature. *Int Orthop* 2014 ; 38 : 831-838.
- Kraeutler MJ, Williams GR Jr, Cohen SB, Ciccotti MG, Tucker BS, Dines JS et al.** Inter- and intraobserver reliability of the radiographic diagnosis and treatment of acromioclavicular joint separations. *Orthopedics* 2012 ; 35 : e1483-1487.
- L'Insalata JC, Warren RF, Cohen SB, Altchek DW, Peterson MG.** A self-administered questionnaire for assessment of symptoms and function of the shoulder. *J Bone Joint Surg Am* 1997 ; 79 : 738-748.
- Lädermann A, Grosclaude M, Lübbecke A, Christofilopoulos P, Stern R, Rod T et al.** Acromioclavicular and coracoclavicular cerclage reconstruction for acute acromioclavicular joint dislocations. *J Shoulder Elbow Surg* 2011 ; 20 : 401-408.

23. **Larsen E, Bjerg-Nielsen A, Christensen P.** Conservative or surgical treatment of acromioclavicular dislocation. A prospective, controlled, randomized study. *J Bone Joint Surg Am* 1986 ; 68 : 552-5.
24. **Law KY, Yung SH, Ho PY, Chang HT, Chan KM.** Coracoclavicular ligament reconstruction using a gracilis tendon graft for acute type-III acromioclavicular dislocation. *J Orthop Surg (Hong Kong)* 2007 ; 15 : 315-8.
25. **Leidel BA, Braunstein V, Kirchoff C, Pilotto S, Mutschler W, Biberthaler P.** Consistency of long-term outcome of acute Rockwood grade III acromioclavicular joint separations after K-wire transfixation. *J Trauma* 2009 ; 66 : 1666-71.
26. **Liu H-H, Chou Y-J, Chen C-H, Chia W-T, Wong C-Y.** Surgical treatment of acute acromioclavicular joint injuries using a modified Weaver-Dunn procedure and clavicular hook plate. *Orthopedics* 2010 ; 33 : doi: 10.3928/01477447-20100625-10
27. **Liu X, Huangfu X, Zhao J.** Arthroscopic treatment of acute acromioclavicular joint dislocation by coracoclavicular ligament augmentation. *Knee Surg Sports Traumatol Arthrosc* 2013.
28. **Lu N, Zhu L, Ye T, Chen A, Jiang X, Zhang Z et al.** Evaluation of the coracoclavicular reconstruction using LARS artificial ligament in acute acromioclavicular joint dislocation. *Knee Surg Sports Traumatol Arthrosc* 2014 ; 22 : 2223-7.
29. **Martetschläger F, Horan MP, Warth RJ, Millett PJ.** Complications after anatomic fixation and reconstruction of the coracoclavicular ligaments. *Am J Sports Med* 2013 ; 41 : 2896-903.
30. **Murena L, Canton G, Vulcano E, Cherubino P.** Scapular dyskinesis and SICK scapula syndrome following surgical treatment of type III acute acromioclavicular dislocations. *Knee Surg Sports Traumatol Arthrosc* 2013 ; 21 : 1146-50.
31. **Murena L, Vulcano E, Ratti C, Ceconello L, Rolla PR, Surace MF.** Arthroscopic treatment of acute acromioclavicular joint dislocation with double flip button. *Knee Surg Sports Traumatol Arthrosc* 2009 ; 17 : 1511-5.
32. **Phemister D.** The treatment of dislocation of the acromioclavicular joint by open reduction and threaded-wire fixation. 1942 ; 4 : 166-8.
33. **Phillips AM, Smart C, Groom AF.** Acromioclavicular dislocation. Conservative or surgical therapy. *Clin Orthop Relat Res* 1998 ; 10-7.
34. **Rangger C, Hrubesch R, Paul C, Reichkendler M.** [Capacity to participate in sports after injuries of the acromioclavicular joint]. *Orthopade* 2002 ; 31 : 587-90.
35. **Sehmisch S, Stürmer EK, Zabka K, Losch A, Brunner U, Stürmer KM et al.** [Results of a prospective multicenter trial for treatment of acromioclavicular dislocation]. *Sportverletz Sportschaden* 2008 ; 22 : 139-45.
36. **Shao R, Zhang Y, Lou C, Shi G, Yu J, Luo C et al.** [Coracoclavicular ligament reconstruction using autologous double-strand palmaris longus tendon and artificial ligament for the treatment of acromioclavicular joint dislocation]. *Zhongguo Gu Shang* 2011 ; 24 : 202-4.
37. **Shetty NS, Yoo YS, Kim DY, Lee SS, Jeong US.** Open anatomical coracoclavicular ligament reconstruction using a tendon graft with an Endobutton loop. *Acta Orthop Belg* 2009 ; 75 : 828-31.
38. **Smith TO, Chester R, Pearse EO, Hing CB.** Operative versus non-operative management following Rockwood grade III acromioclavicular separation : a meta-analysis of the current evidence base. *J Orthop Traumatol* 2011 ; 12 : 19-27.
39. **Spencer EE Jr.** Treatment of grade III acromioclavicular joint injuries : a systematic review. *Clin Orthop Relat Res* 2007 ; 455 : 38-44.
40. **Tamaoki MJS, Belloti JC, Lenza M, Matsumoto MH, Gomes Dos Santos JB, Faloppa F.** Surgical versus conservative interventions for treating acromioclavicular dislocation of the shoulder in adults. *Cochrane Database Syst Rev* 2010 ; CD007429.
41. **Tauber M, Gordon K, Koller H, Fox M, Resch H.** Semitendinosus tendon graft versus a modified Weaver-Dunn procedure for acromioclavicular joint reconstruction in chronic cases : a prospective comparative study. *Am J Sports Med* 2009 ; 37 : 181-90.
42. **Trainer G, Arciero RA, Mazzocca AD.** Practical management of grade III acromioclavicular separations. *Clin J Sport Med* 2008 ; 18 : 162-6.
43. **Trikha SP, Acton D, Wilson AJ, Curtis MJ.** A new method of arthroscopic reconstruction of the dislocated acromio-clavicular joint. *Ann R Coll Surg Engl* 2004 ; 86 : 161-4.
44. **Tsou PM.** Percutaneous cannulated screw coracoclavicular fixation for acute acromioclavicular dislocations. *Clin Orthop Relat Res* 1989 ; 112-21.
45. **Weaver JK, Dunn HK.** Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. *J Bone Joint Surg Am* 1972 ; 54 : 1187-94.
46. **Ye T, Ouyang Y, Chen A.** Evaluation of coracoclavicular stabilization of acute acromioclavicular joint dislocation with multistrand titanium cables. *Eur J Orthop Surg Traumatol* 2013 ; 24 : 1061-6.
47. **Yoo Y-S, Seo Y-J, Noh K-C, Patro BP, Kim D-Y.** Arthroscopically assisted anatomical coracoclavicular ligament reconstruction using tendon graft. *Int Orthop* 2011 ; 35 : 1025-30.
48. **Zarzycki W, Lorczyński A, Ziółkowski W.** [Nonoperative treatment of acute, grade III acromioclavicular dislocation in judo competing athletes]. *Chir Narzadow Ruchu Ortop Pol* 1998 ; 63 : 321-7.
49. **Zhu R-T, Ying Y-R, Gao F-M, Wang B, Chen M, Ying G-H et al.** [Clinical study on the treatment of acromioclavicular joint dislocation of tossy grade III with double endobutton]. *Zhongguo Gu Shang* 2009 ; 22 : 653-4.