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Risk factors for failure of reduction of anterior glenohumeral dislocation without sedation

Ryogo Furuhata, MD[a,*], Yusaku Kamata, MD[a], Noboru Matsumura, MD, PhD[b], Aki Kono, MD[a], Hideo Morioka, MD, PhD[a]

[a]*Department of Orthopaedic Surgery, National Hospital Organization Tokyo Medical Center, Tokyo, Japan*
[b]*Department of Orthopaedic Surgery, Keio University School of Medicine, Tokyo, Japan*

Background: Although anterior glenohumeral dislocations are common, the reduction procedure is often difficult, requiring sedation or anesthesia. To date, the risk factors for reduction failure without sedation have not been fully investigated. This study aimed to clarify the predictive factors that render the reduction of anterior glenohumeral dislocation without sedation difficult by use of multivariate analyses.

Methods: We retrospectively reviewed 156 patients who underwent attempted reduction of anterior glenohumeral dislocation between 2006 and 2019. Patients were included based on the following criteria: traumatic dislocation, undergoing attempted reduction using the traction-countertraction method, and acute dislocation in which reduction was attempted within 2 days of the injury. The dependent variable was set as an irreducible glenohumeral dislocation without sedation, which was defined as a reduction failure in this study. Explanatory variables included age, sex, side of injury, recurrent dislocation, axillary nerve injury, time from dislocation to attempted reduction, greater tuberosity fracture, humeral neck fracture, glenoid rim fracture, and glenohumeral osteoarthritis. We evaluated these outcomes from radiographs and clinical notes. Univariate and multivariate analyses were performed. Baseline variables, which were observed to be significant in the univariate analysis, were included in multivariate models, which used logistic regression to identify independent predictors of reduction failure.

Results: Of the 156 patients, 25 (16.0%) experienced reduction failure. Multivariate analyses showed that older age (≥55 years) (odds ratio [OR], 3.4; 95% confidence interval [CI], 1.1-10.4; $P = .036$), greater tuberosity fractures (OR, 3.6; 95% CI, 1.1-12.2; $P = .033$), and glenoid rim fractures (OR, 11.5; 95% CI, 1.5-87.7; $P = .018$) were risk factors for reduction failure.

Conclusions: Our results demonstrated that multiple factors were associated with unsuccessful reduction of anterior glenohumeral dislocation without sedation. In elderly patients or patients with concurrent greater tuberosity fractures and glenoid rim fractures, reduction failure could occur in the absence of sedation; thus, the administration of sedatives or anesthesia should be considered.

Level of evidence: Level III; Retrospective Cohort Comparison Using Large Database; Treatment Study

Keywords: Shoulder dislocation; reduction; irreducible; multivariate analysis; age; greater tuberosity fracture; glenoid rim fracture

This study was approved by the National Hospital Organization Tokyo Medical Center Independent Ethics Committee (no. R19-128).

*Reprint requests: Ryogo Furuhata, MD, Department of Orthopaedic Surgery, National Hospital Organization Tokyo Medical Center, 2-5-1, Higashigaoka, Meguro-ku, Tokyo, Japan, 152-8902.

E-mail address: ryogo4kenbisha@gmail.com (R. Furuhata).

Anterior glenohumeral dislocation is the most common dislocation in the large joint, occurring at a frequency of 1.7% or 8.2-17 per 100,000 individuals per year.[13,21,40] Approximately half of anterior glenohumeral dislocations occur in younger patients, aged 15-29 years, followed by patients aged 50-60 years.[23,36,51] The frequency in male patients is approximately 3-fold that in female patients.[51]

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There are various reduction maneuvers that can be applied for anterior glenohumeral dislocation, and most patients experience favorable reduction with these closed-reduction maneuvers.[4,50] In contrast, failed attempts may further contribute to patients' discomfort, increase the requirement for hospital resources, and increase the risk of complications such as neurovascular damage.[19,41,46] Because muscle relaxation is considered crucial for the success of closed reduction,[37] reduction can be performed under sedation or anesthesia. However, the use of sedation has been reported to result in more complications, such as nausea, vomiting, central nervous system depression, and respiratory depression; a longer stay in the emergency department; and higher costs.[8,25,29,43] Although newer anesthetics, such as propofol and etomidate, have a quicker onset and shorter half-life than traditional benzodiazepines, these anesthetics reportedly have adverse effect rates as high as 25%, including deeper sedation and myoclonus.[8] Thus, reduction under sedation or anesthesia should be kept to a minimum. Although reductions in atraumatic, early (within 6 hours), and recurrent dislocations are considered feasible without sedation,[4] the indications that require sedation or anesthesia have not been well documented. Moreover, the time from dislocation to the first attempted reduction has been similarly reported in 2 studies as a factor affecting reduction success[1,19]; however, other factors are not yet fully understood.

This study aimed to clarify the predictive factors that render the reduction of anterior glenohumeral dislocation difficult in the absence of sedation by use of multivariate analyses.

Materials and methods

Patients

This was a retrospective study that consisted of patients who underwent attempted reduction of anterior glenohumeral dislocation between April 2006 and December 2019. The study was performed at a single general hospital in a city, and attempted reduction was performed by 37 orthopedic surgeons. The inclusion criteria included traumatic dislocation, undergoing attempted reduction using the traction-countertraction method,[50] and acute dislocation in which the reduction was attempted within 2 days of the injury.

Reduction procedure

Reduction was initially attempted in all patients using the traction-countertraction method without sedation. The patient was placed in the supine position. The affected limb was pulled laterally while an assistant applied counterforce by pulling on the axilla of the affected side toward the unaffected side.[50] Reduction was attempted 3-4 times, and if a reduction position could not be achieved, reduction was attempted under sedation by the intravenous administration of anesthetic agents, such as thiamylal or propofol. If the reduction procedure was more challenging, reduction was attempted under general anesthesia in the operating room. Notably, open reduction was attempted if closed reduction under general anesthesia was complicated.

Outcome measures

The dependent variable was set as an irreducible glenohumeral dislocation in the absence of sedation, which was defined as a reduction failure in this study. Explanatory variables included age, sex, affected side of the shoulder, recurrent dislocation, axillary nerve injury, time from dislocation to the first attempted reduction, greater tuberosity fracture, humeral neck fracture, glenoid rim fracture, and glenohumeral joint osteoarthritis. A single examiner evaluated the clinical notes and plain radiograph images obtained before and after reduction.

Statistical analysis

All statistical analyses were conducted using the SPSS software program (version 26.0; IBM, Armonk, NY, USA). In univariate analyses, the Student t test was used to compare the average of continuous values (age and time from dislocation to the first attempted reduction) whereas the Fisher exact test was used to compare the proportion of discrete variables (sex, side of injury, recurrent dislocation, axillary nerve injury, type of concurrent fracture, and osteoarthritis). Baseline variables with $P < .05$ in the univariate analyses were included in the multivariate models. Multivariate analyses were performed using logistic regression analysis to identify the independent predictors of reduction failure. Regression model fit was estimated with the Hosmer-Lemeshow goodness-of-fit test. Furthermore, we developed a logistic regression equation for independent predictors derived from logistic regression analyses; in addition, we estimated the probability of reduction failure for each combination of predictors based on a previous study.[20] The threshold for significance was $P < .05$.

Results

In this study, we identified 156 patients (82 male and 74 female patients) who met the criteria. The mean age of the patients at the time of injury was 52.2 ± 25.6 years (range, 14-94 years). The injured side was the right in 80 patients and the left in 76. The mean time from injury to the first attempted reduction was 0.04 ± 0.25 days (median, 0 days; range, 0-2 days). Axillary nerve palsy was observed in 7 patients (4.5%), all of whom had only mild sensory palsy. Moreover, 28 patients (17.9%) had greater tuberosity fracture complications, 8 (5.1%) experienced humeral neck fractures, and 5 (3.2%) experienced glenoid rim fractures (Table I).

In total, 131 patients (84.0%) underwent successful reduction without sedation. Twenty-one patients were subjected to intravenous anesthetic sedation. Reduction (closed reduction) under general anesthesia was not feasible in any patient, and open reduction was required in 4 patients. Complications such as iatrogenic nerve injury were

Table I Patient demographic characteristics

Characteristic	Data (N = 156)
Age, yr	52.2 ± 25.6
Sex: male	82 (52.6)
Affected side: right	80 (51.3)
Recurrent dislocation	53 (34.0)
Axillary nerve injury	7 (4.5)
Time from injury to first reduction attempt, days	0.04 ± 0.25
Greater tuberosity fracture	28 (17.9)
Humeral neck fracture	8 (5.1)
Glenoid rim fracture	5 (3.2)
Glenohumeral OA	4 (2.6)
Reduction success without sedation	131 (84.0)
Reduction success with sedation	21 (13.5)
Reduction success with general anesthesia	0 (0)
Open reduction	4 (2.6)

OA, osteoarthritis.
Data are presented as mean ± standard deviation or number of patients (percentage).

not observed in all patients; however, the humeral head was left in the axillary region after reduction in 1 patient, thus requiring open reduction–internal fixation. In addition, complications associated with anesthesia administration were not observed in patients who underwent sedation or general anesthesia.

In the univariate analysis, older age ($P < .001$), recurrent dislocation ($P = .011$), greater tuberosity fractures ($P < .001$), humeral neck fractures ($P = .023$), and glenoid rim fractures ($P = .030$) were significantly associated with reduction failure (Table II). In this study, we generated receiver operating characteristic curves for the relationship between age and the presence or absence of reduction failure during univariate analyses to determine the optimal cutoff value to define "older age" (Supplementary Fig. S1). Consequently, we selected age ≥ 55 years as the cutoff value for older age.

Table II Univariate predictors of reduction failure

Variable	Univariate predictor		
	Reduction failure (n = 25)	Reduction success (n = 131)	*P* value
Age, yr	69.4 ± 19.4	49.0 ± 25.3	<.001
Sex: male	13	69	>.999
Affected side: right	12	68	.828
Recurrent dislocation	3	50	.011
Axillary nerve injury	1	6	>.999
Time from injury to attempted reduction, days	0.16 ± 0.54	0.02 ± 0.12	.205
Greater tuberosity fracture	11	17	<.001
Humeral neck fracture	4	4	.023
Glenoid rim fracture	3	2	.030
Glenohumeral OA	2	2	.121

OA, osteoarthritis.
Data are presented as mean ± standard deviation or number of patients.

Multivariate analyses showed that older age (≥55 years) (odds ratio [OR], 3.4; 95% confidence interval [CI], 1.1-10.4; $P = .036$), greater tuberosity fractures (OR, 3.6; 95% CI, 1.1-12.2; $P = .033$), and glenoid rim fractures (OR, 11.5; 95% CI, 1.5-87.7; $P = .018$) were risk factors for reduction failure without sedation (Table III). The Hosmer-Lemeshow goodness-of-fit test showed no significant departure from good model fit ($P = .339$). Reduction was achieved under sedation in 8 of 11 reduction failure patients with greater tuberosity fractures (72.7%) and 3 of 4 reduction failure patients with glenoid rim fractures (75.0%).

We constructed an algorithm to determine the predicted probability of reduction failure based on 8 possible combinations (2 × 2 × 2) of the 3 binary independent multivariate predictors (Table IV). For example, a 60-year-old male patient in whom concomitant greater tuberosity fractures and glenoid rim fractures developed had a 90.2% predicted probability of reduction failure without sedation.

Complications of greater tuberosity fractures and neck fractures similarly developed in 3 of the 4 patients who required open reduction; they underwent osteosynthesis or humeral head replacement in addition to open reduction. One elderly patient experienced massive rotator cuff tears, and rotator cuff repair with suture anchors was performed in addition to reduction (Table V).

Discussion

This study showed that glenohumeral dislocations were successfully reduced in 84.0% of the dislocated cases by use of the traction-countertraction method without sedation and that older age, greater tuberosity fractures, and glenoid rim fractures were the risk factors for reduction failure. This study provides new information on the predictive factors affecting the failure of reduction in anterior glenohumeral dislocation.

Previous studies have reported a success rate of 70%-100% for the reduction of anterior glenohumeral dislocations,[5,7,9,24,28,30,32,33,38,45,48] and our results are consistent with these previous reports. The time interval from injury to the first attempted reduction has been reported in 2 studies as a factor significantly affecting reduction success.[1,19] However, a significant association was not observed between the time from injury to the first attempted reduction and reduction success in our study. Other reported factors affecting reduction success are the

Table III Multivariate predictors of reduction failure

Variable	Multivariate predictor	
	OR (95% CI)	*P* value
Older age (≥55 yr)	3.4 (1.1-10.4)	.036
Recurrent dislocation	0.5 (0.1-2.2)	.342
Greater tuberosity fracture	3.6 (1.1-12.2)	.033
Humeral neck fracture	1.2 (0.2-7.1)	.822
Glenoid rim fracture	11.5 (1.5-87.7)	.018

OR, odd ratio; *CI*, confidence interval.

reduction method and low pain level on admission to the emergency department.[1] Besides these factors, our study identified older age, presence of greater tuberosity fractures, and presence of glenoid rim fractures as factors contributing to reduction failure. Conversely, previous studies have reported that sex and recurrent dislocation had no significant association with reduction success,[19] which was consistent with the results obtained in this study.

In this study, older age was significantly associated with an increased incidence of reduction failure in this study. Although the mean age of patients included in this study was relatively high for glenohumeral instability, age ≥ 55 years was detected as a risk factor for failure of reduction. To date, there have been no reports showing a direct association between age and reduction failure. As a characteristic of glenohumeral dislocation in elderly patients, rotator cuff tears are known to be associated with a high incidence rate.[10,11,35,44] The rotator cuff is thought to contribute to the stability of the glenohumeral joint because the compressive force applied to the glenoid by the rotator cuff tendon maintains the humeral head centered on the glenoid.[47] These reports raised the possibility that the presence of rotator cuff tears in elderly patients affects reduction failure; however, further research will be needed to establish this hypothesis.

We found that glenohumeral dislocations were irreducible without sedation in 44% of patients with concurrent greater tuberosity fractures, and a significant association between these fractures and reduction failure was observed. Anterior glenohumeral dislocation with greater tuberosity fractures is less likely to present with recurrent instability after reduction,[14] but the presence of greater tuberosity fractures has been reported as a factor preventing reduction in cases of irreducible anterior glenohumeral dislocation.[2,6,12,15,16,18,31,34,39,42] Interposition of the long head of the biceps (LHB) tendon has been reported as the most common cause of irreducible anterior glenohumeral dislocation,[34] and posterolateral subluxation of the LHB can occur when the displaced humeral head is medial to the coracoid process or if a large greater tuberosity fracture coexists with >1 cm of displacement from the humeral head.[26] Thus, in patients with concurrent greater tuberosity fractures, posterolateral subluxation of the LHB arises, which could inhibit the reduction. As 94% of anterior glenohumeral dislocations with greater tuberosity fractures can be reduced with sedation,[49] reduction under sedation would also need to be taken into consideration, particularly in patients with greater tuberosity fractures.

In addition, reduction of dislocations was difficult in 60% of patients with glenoid rim fracture complications, and this was also found to be significantly associated with the occurrence of reduction failure. The intra-articular interposition of fragments of the anterior inferior glenoid rim reportedly hinders the reduction of dislocations.[27] In addition, bone defects caused by glenoid rim fractures are known to cause anterior glenohumeral instability and anterior subluxation,[3,17,22] which raises the possibility that even if the humeral head were reduced, the humeral head cannot remain centered on the glenoid, thus making reduction challenging. In this study, irreducible anterior glenohumeral dislocation with glenoid rim fractures could also be reduced at a high rate using sedation; hence, reduction under sedation should be considered a feasible option in patients with glenoid rim fractures.

There are 3 major limitations to this study. First, because this was an observational study, it could have been affected by residual confounding due to bias caused by unmeasured factors between groups. For example, although reduction in this study was attempted by 37 orthopedic surgeons, the effect of surgeon or assistant competence was not evaluated. Additionally, patients in whom a traction-countertraction method was performed were extracted by reviewing procedure notes on the reduction method; however, there is still a possibility of inconsistency across the reduction procedures performed by the surgeons, leading to the possibility of bias. Second, because this study only included patients who underwent reduction using the traction-countertraction maneuver, it may not be applicable to other methods of dislocation reduction. Third, the mean age in this cohort study was 52 years and was relatively old for glenohumeral dislocation. Because this study was conducted in an emergency hospital, the target patients were more often transported to the emergency department, and

Table IV Algorithm for probability of reduction failure

Multivariate predictor			Predicted probability of reduction failure, %
Older age (≥55 yr)	Greater tuberosity fracture	Glenoid rim fracture	
Yes	Yes	Yes	90.2
Yes	Yes	No	46.5
Yes	No	Yes	66.2
Yes	No	No	16.4
No	Yes	Yes	69.2
No	Yes	No	18.4
No	No	Yes	32.3
No	No	No	4.6

Table V Details of patients requiring open reduction

Age, yr/sex	Time to reduction, days	Associated bone lesion	Intraoperative findings observed
84/F	2	—	Complete tear of subscapularis, supraspinatus, and infraspinatus
59/M	0	Greater tuberosity fracture and humeral neck fracture	Interposition of long head of biceps tendon
59/M	0	Greater tuberosity fracture and humeral neck fracture	Humeral head left in axillary region
87/F	0	Greater tuberosity fracture and humeral neck fracture	Torn long head of biceps tendon

F, female; *M*, male.

there were fewer walk-in patients. This fact might be a reason that the mean age in this cohort study was relatively higher than the age of typical patients experiencing anterior glenohumeral dislocation. The older age of this cohort could possibly influence the present results, and this may decrease the generalizability of the study findings.

Conclusion

Our results demonstrated that multiple factors were associated with unsuccessful reduction of anterior glenohumeral dislocation without sedation. In elderly patients or patients with concurrent greater tuberosity fractures and glenoid rim fractures, reduction failure could occur in the absence of sedation; thus, the administration of sedatives or anesthesia should be considered.

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Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2020.06.005.

References

1. Amar E, Maman E, Khashan M, Kauffman E, Rath E, Chechik O. Milch versus Stimson technique for nonsedated reduction of anterior shoulder dislocation: a prospective randomized trial and analysis of factors affecting success. J Shoulder Elbow Surg 2012;21:1443-9. https://doi.org/10.1016/j.jse.2012.01.004
2. Amroodi MN. Irreducible anterior shoulder dislocation associated with displaced fracture of the greater tuberosity: an analysis of seven cases. Shafa Orthop J 2015;2:10-4. https://doi.org/10.17795/soj-4023
3. Aston JW Jr, Gregory CF. Dislocation of the shoulder with significant fracture of the glenoid. Bone Joint Surg Am 1973;55:1531-3.
4. Dala-Ali B, Penna M, McConnell J, Vanhegan I, Cobiella C. Management of acute anterior shoulder dislocation. Br J Sports Med 2014; 48:1209-15. https://doi.org/10.1136/bjsports-2012-091300
5. Danzl DF, Vicario SJ, Gleis GL, Yates JR, Parks DL. Closed reduction of anterior subcoracoid shoulder dislocation. Evaluation of an external rotation method. Orthop Rev 1986;15:311-5.
6. Davies MB, Rajasekhar C, Bhamra MS. Irreducible anterior shoulder dislocation: the greater tuberosity Hill-Sachs lesion. Injury 2000;31: 470-1.
7. Eachempati KK, Dua A, Malhotra R, Bhan S, Bera JR. The external rotation method for reduction of acute anterior dislocations and fracture-dislocations of the shoulder. J Bone Joint Surg Am 2004;86: 2431-4. https://doi.org/10.2106/00004623-200411000-00011
8. Fitch RW, Kuhn JE. Intraarticular lidocaine versus intravenous procedural sedation with narcotics and benzodiazepines for reduction of the dislocated shoulder: a systematic review. Acad Emerg Med 2008; 15:703-8. https://doi.org/10.1111/j.1553-2712.2008.00164.x
9. Garnavos C. Technical note: modifications and improvements of the Milch technique for the reduction of anterior dislocation of the shoulder without premedication. J Trauma 1992;32:801-3.
10. Gumina S, Postacchini F. Anterior dislocation of the shoulder in elderly patients. J Bone Joint Surg Br 1997;79:540-3.
11. Hawkins RJ, Bell RH, Hawkins RH, Koppert GJ. Anterior dislocation of the shoulder in the older patient. Clin Orthop Relat Res 1986:192-5.
12. Henderson RS. Fracture-dislocation of the shoulder with interposition of long head of biceps. J Bone Joint Surg Br 1952;34-B:240-1.
13. Hovelius L. Incidence of shoulder dislocation in Sweden. Clin Orthop Relat Res 1982:127-31.
14. Hovelius L, Eriksson K, Fredin H, Hagberg G, Hussenius A, Lind B, et al. Recurrences after initial dislocation of the shoulder. Results of a prospective study of treatment. J Bone Joint Surg Am 1983;65: 343-9.
15. Ilahi OA. Irreducible anterior shoulder dislocation with fracture of the greater tuberosity. Am J Orthop (Belle Mead NJ) 1998;27:576-8.
16. Inao S, Hirayama T, Takemitsu Y. Irreducible acute anterior dislocation of the shoulder: interposed bicipital tendon. J Bone Joint Surg Br 1990;72:1079-80.
17. Itoi E, Lee SB, Berglund LJ, Berge LL, An KN. The effect of a glenoid defect on anteroinferior stability of the shoulder after Bankart repair: a cadaveric study. J Bone Joint Surg Am 2000;82:35-46.

18. Janecki CJ, Barnett DC. Fracture-dislocation of the shoulder with biceps tendon interposition. J Bone Joint Surg Am 1979;61:142-3.
19. Kanji A, Atkinson P, Fraser J, Lewis D, Benjamin S. Delays to initial reduction attempt are associated with higher failure rates in anterior shoulder dislocation: a retrospective analysis of factors affecting reduction failure. Emerg Med J 2016;33:130-3. https://doi.org/10.1136/emermed-2015-204746
20. Kocher MS, Zurakowski D, Kasser JR. Differentiating between septic arthritis and transient synovitis of the hip in children: an evidence-based clinical prediction algorithm. J Bone Joint Surg Am 1999;81:1662-70.
21. Krøner K, Lind T, Jensen J. The epidemiology of shoulder dislocations. Arch Orthop Trauma Surg 1989;108:288-90.
22. Kummel BM. Fractures of the glenoid causing chronic dislocation of the shoulder. Clin Orthop Relat Res 1970;69:189-91.
23. Leroux T, Wasserstein D, Veillette C, Khoshbin A, Henry P, Chahal J, et al. Epidemiology of primary anterior shoulder dislocation requiring closed reduction in Ontario, Canada. Am J Sports Med 2014;42:442-50. https://doi.org/10.1177/0363546513510391
24. Maity A, Roy DS, Mondal BC. A prospective randomised clinical trial comparing FARES method with the Eachempati external rotation method for reduction of acute anterior dislocation of shoulder. Injury 2012;43:1066-70. https://doi.org/10.1016/j.injury.2012.01.019
25. Matthews DE, Roberts T. Intraarticular lidocaine versus intravenous analgesic for reduction of acute anterior shoulder dislocations. A prospective randomized study. Am J Sports Med 1995;23:54-8.
26. McLaughlin HL. Dislocation of the shoulder with tuberosity fracture. Surg Clin North Am 1963;43:1615-20.
27. Mihata T, Doi M, Abe M. Irreducible acute anterior dislocation of the shoulder caused by interposed fragment of the anterior glenoid rim. Orthop Sci 2000;5:404-6.
28. Milch H. The treatment of recent dislocations and fracture-dislocations of the shoulder. J Bone Joint Surg Am 1949;31A:173-80.
29. Miller SL, Cleeman E, Auerbach J, Flatow EL. Comparison of intra-articular lidocaine and intravenous sedation for reduction of shoulder dislocations: a randomized, prospective study. J Bone Joint Surg Am 2002;84:2135-9. https://doi.org/10.2106/00004623-200212000-00002
30. Mirick MJ, Clinton JE, Ruiz E. External rotation method of shoulder dislocation reduction. JACEP 1979;8:528-53.
31. Mullaney PJ, Bleakney R, Tuchscherer P, Boynton E, White L. Posterior dislocation of the long head of biceps tendon: case report and review of the literature. Skeletal Radiol 2007;36:779-83. https://doi.org/10.1007/s00256-007-0285-7
32. Noordeen MH, Bacarese-Hamilton IH, Belham GJ, Kirwan EO. Anterior dislocation of the shoulder: a simple method of reduction. Injury 1992;23:479-80.
33. O'Connor DR, Schwarze D, Fragomen AT, Perdomo M. Painless reduction of acute anterior shoulder dislocations without anesthesia. Orthopedics 2006;29:528-32. https://doi.org/10.3928/01477447-20060601-09
34. Pantazis K, Panagopoulos A, Tatani I, Daskalopoulos B, Iliopoulos I, Tyllianakis M. Irreducible anterior shoulder dislocation with interposition of the long head of the biceps and greater tuberosity fracture: a case report and review of the literature. Open Orthop J 2017;11:327-34. https://doi.org/10.2174/1874325001711010327
35. Pevny T, Hunter RE, Freeman JR. Primary traumatic anterior shoulder dislocation in patients 40 years of age and older. Arthroscopy 1998;14:289-94.
36. Rowe CR. Prognosis in dislocations of the shoulder. J Bone Joint Surg Am 1956;38:957-77.
37. Rumian A, Coffey D, Fogerty S, Hackney R. Acute first-time shoulder dislocation. Orthop Trauma 2011;25:363-8. https://doi.org/10.1026/j.mporth.2011.06.001
38. Sayegh FE, Kenanidis EI, Papavasiliou KA, Potoupnis ME, Kirkos JM, Kapetanos GA. Reduction of acute anterior dislocations: a prospective randomized study comparing a new technique with the Hippocratic and Kocher methods. J Bone Joint Surg Am 2009;91:2775-82. https://doi.org/10.2106/JBJS.H.01434
39. Seradge H, Orme G. Acute irreducible anterior dislocation of the shoulder. J Trauma 1982;22:330-2.
40. Simonet WT, Melton LJ III, Cofield RH, Ilstrup DM. Incidence of anterior shoulder dislocation in Olmsted County, Minnesota. Clin Orthop Relat Res 1984:186-91.
41. Stayner LR, Cummings J, Andersen J, Jobe CM. Shoulder dislocations in patients older than 40 years of age. Orthop Clin North Am 2000;31:231-9.
42. Strobel K, Treumann TC, Allgayer B. Posterior entrapment of the long biceps tendon after traumatic shoulder dislocation: findings on MR imaging. AJR Am J Roentgenol 2002;178:238-9. https://doi.org/10.2214/ajr.178.1.1780238
43. Suder PA, Mikkelsen JB, Hougaard K, Jensen PE. Reduction of traumatic, primary anterior shoulder dislocations with local anesthesia. J Shoulder Elbow Surg 1994;3:288-94.
44. Toolanen G, Hildingsson C, Hedlund T, Knibestöl M, Oberg L. Early complications after anterior dislocation of the shoulder in patients over 40 years. An ultrasonographic and electromyographic study. Acta Orthop Scand 1993;64:549-52.
45. Uglow MG. Kocher's painless reduction of anterior dislocation of the shoulder: a prospective randomised trial. Injury 1998;29:135-7.
46. Visser CP, Coene LN, Brand R, Tavy DL. The incidence of nerve injury in anterior dislocation of the shoulder and its influence on functional recovery. A prospective clinical and EMG study. J Bone Joint Surg Br 1999;81:679-85.
47. Warner JJ, Bowen MK, Deng X, Torzilli PA, Warren RF. Effect of joint compression on inferior stability of the glenohumeral joint. J Shoulder Elbow Surg 1999;8:31-6.
48. Westin CD, Gill EA, Noyes ME, Hubbard M. Anterior shoulder dislocation. A simple and rapid method for reduction. Am J Sports Med 1995;23:369-71.
49. Wronka KS, Ved A, Mohanty K. When is it safe to reduce fracture dislocation of shoulder under sedation? Proposed treatment algorithm. Eur J Orthop Surg Traumatol 2017;27:335-40. https://doi.org/10.1007/s00590-016-1899-z
50. Youm T, Takemoto R, Park BK. Acute management of shoulder dislocations. J Am Acad Orthop Surg 2014;22:761-71. https://doi.org/10.5435/JAAOS-22-12-761
51. Zacchilli MA, Owens BD. Epidemiology of shoulder dislocations presenting to emergency departments in the United States. J Bone Joint Surg Am 2010;92:542-9. https://doi.org/10.2106/JBJS.I.00450