

Neurovascular complications due to the Hippocrates method for reducing anterior shoulder dislocations

Markus Regauer, Hans Polzer, Wolf Mutschler

Markus Regauer, Hans Polzer, Wolf Mutschler, Department of Trauma Surgery, Campus Innenstadt, Ludwig-Maximilians-University, 80336 Munich, Germany

Author contributions: Regauer M was the treating physician and was responsible for acquisition of data, writing the paper and design of illustrations and figures; Polzer H revised the article critically for important intellectual content and helped to design the illustrations and figures; Mutschler W was responsible for the final approval of the version to be published.

Correspondence to: Markus Regauer, MD, Department of Trauma Surgery, Campus Innenstadt, Ludwig-Maximilians-University, Nussbaumstrasse 20, 80336 Munich, Germany. markus.regauer@med.uni-muenchen.de

Telephone: +49-89-51602511 Fax: +49-89-51602662

Received: June 26, 2013 Revised: October 6, 2013

Accepted: November 1, 2013

Published online: January 18, 2014

Abstract

In spite of the fact that the Hippocrates method hardly has been evaluated in a scientific manner and numerous associated iatrogenic complications have been reported, this method remains to be one of the most common techniques for reducing anterior shoulder dislocations. We report the case of a 69-year-old farmer under coumarin anticoagulant therapy who sustained acute first time anterior dislocation of his dominant right shoulder. By using the Hippocrates method with the patient under general anaesthesia, the brachial vein was injured and an increasing hematoma subsequently caused brachial plexus paresis by pressure. After surgery for decompression and vascular suturing, symptoms declined rapidly, but brachial plexus paresis still was not fully reversible after 3 mo of follow-up. The hazardousness of using the Hippocrates method can be explained by traction on the outstretched arm with force of the operator's body weight, direct trauma to the axillary region by the physician's heel, and the topographic relations of neurovascular structures and the dislocated humeral head. As there is a variety of alternative reduction techniques which have been evalu-

ated scientifically and proofed to be safe, we strongly caution against the use of the Hippocrates method as a first line technique for reducing anterior shoulder dislocations, especially in elder patients with fragile vessels or under anticoagulant therapy, and recommend the scapular manipulation technique or the Milch technique, for example, as a first choice.

© 2014 Baishideng Publishing Group Co., Limited. All rights reserved.

Key words: Anterior shoulder dislocation; Reduction technique; Hippocrates method; Complications; Brachial plexus paresis; Brachial vein injury; Scapular manipulation technique

Core tip: By using the Hippocrates method for reducing an anterior shoulder dislocation with the patient under general anaesthesia, the brachial vein was injured and an increasing hematoma subsequently caused brachial plexus paresis. The hazardousness of the Hippocrates method can be explained by traction on the outstretched arm with force of the operator's body weight, direct trauma to the axillary region by the physician's heel, and the topographic relations of neurovascular structures and the dislocated humeral head. Therefore we strongly caution against the use of the Hippocrates method as a first choice.

Regauer M, Polzer H, Mutschler W. Neurovascular complications due to the Hippocrates method for reducing anterior shoulder dislocations. *World J Orthop* 2014; 5(1): 57-61 Available from: URL: <http://www.wjgnet.com/2218-5836/full/v5/i1/57.htm> DOI: <http://dx.doi.org/10.5312/wjo.v5.i1.57>

INTRODUCTION

Shoulder dislocations account for about 50% of all major joint dislocations presenting to emergency departments,

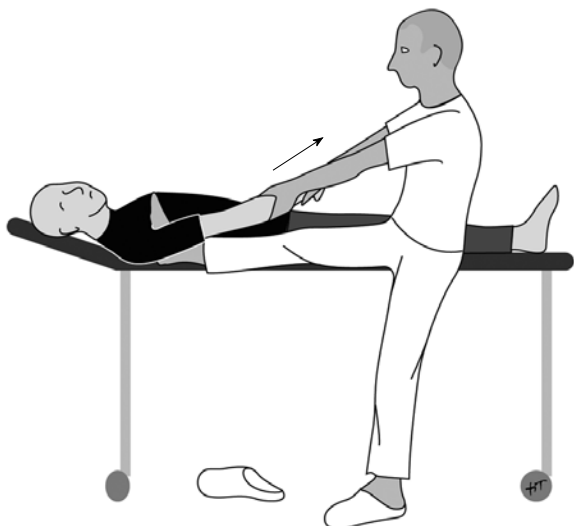


Figure 1 The most famous Hippocrates method for reducing anterior shoulder dislocations using the operator’s heel in the patient’s axilla for counter-traction. The operator can use his whole body weight to perform traction on the injured arm.

and the most common type (95%-98%) of this frequent injury is the anterior shoulder dislocation^[1-9]. Acute anterior shoulder dislocations usually represent impressing orthopaedic emergency cases, and reduction should be performed as soon as possible, as reduction is the most effective pain relief therapy.

More than 2500 years ago Hippocrates (460-377 B.C.) described in detail various methods for reducing shoulder dislocations, and reduction with the heel has become the most famous one (Figure 1). Hippocrates stated, that “reduction is to be effected, if possible, immediately while still warm, otherwise as quickly as it can be done for reduction will be a much quicker and easier process for the operator and a much less painful one to the patient if effected before swelling comes on”^[10-14].

Since that time, at least 34 different methods for reducing shoulder dislocations have been reported in the literature and are used, often not evidence based and with little scientific theory behind their use^[2,8,10-13,15-34]. And in spite of the fact that the Hippocrates method hardly has been evaluated in a scientific manner and numerous associated iatrogenic complications have been reported, this method remains to be one of the most common techniques for reducing anterior shoulder dislocations, especially in European countries^[8,25,26,35-40].

We report the case of a 69-year-old farmer under coumarin anticoagulant therapy who sustained acute first time anterior dislocation of his dominant right shoulder. By using the Hippocrates method with the patient under general anaesthesia, the brachial vein was injured and an increasing hematoma subsequently caused brachial plexus paresis by pressure.

CASE REPORT

A 69-year-old farmer fell off his tractor and thereby sustained a traumatic first-time anterior dislocation of his

dominant right shoulder. Due to cardiac arrhythmia he has been under coumarin anticoagulant therapy since 15 years. On admission at a foreign clinic in a rural area more than six hours after the occupational accident the neurovascular status of the right arm was documented as regular. The right shoulder region revealed the typical clinical signs of an anterior shoulder dislocation, but there were absolutely no signs of soft tissue swelling or hematoma. Radiological evaluation of the right shoulder (true anteroposterior and outlet views) confirmed a sub-coracoidal anterior shoulder dislocation with a classical Hill-Sachs lesion. Closed reduction was performed subsequently under general anaesthesia using the Hippocrates method. Post-reduction X-rays showed successful relocation of the right shoulder and the already known Hill-Sachs lesion, but additional fractures could be excluded.

Twelve hours after reduction the patient complained about an increasing swelling in the right axillary region combined with paresthesia of the whole right hand. Clinical examination revealed a right drop hand, and active flexion of the right elbow was not possible anymore. Coumarin medication had already been stopped at admission, but the current international normalised ratio value was still 3.1. Open magnetic resonance imaging (MRI) examination showed ruptures of the rotator cuff and of the short tendon of the biceps muscle as well as a massive retropectoral hematoma (5.0 cm × 7.5 cm × 8.5 cm) compressing the axillary neurovascular bundle (Figure 2). Thereupon the patient was transferred to our level one trauma centre for surgical treatment.

Immediate surgical exploration of the right axillary region was performed under medical promotion of coagulation by prothrombin complex concentrate (PPSB) and showed extensive soft tissue trauma with disruption of the short tendon of the biceps muscle, rupture of the coracobrachial muscle and 300 mL retropectoral hematoma which was evacuated. The whole neurovascular bundle was surrounded by hematoma and there was severe soft tissue edema especially at the course of the radial nerve near to the outflow of the deep brachial artery. After meticulous exposure of the neurovascular bundle we finally found a small tear of the proximal brachial vein which had to be sutured microsurgically. The radial, median and ulnar nerves as well as the deep brachial artery were found to be intact.

After recovery from general anaesthesia motor function of the right arm increased rapidly, but neurological examination three days after surgery still revealed incomplete brachial plexus palsy without sensory deficits. Therefore the patient performed prolonged physiotherapy, and six months after trauma motor function of the right hand had fully recovered. Activities of daily living were nearly not restricted and working as a farmer was possible again, but due to the rotator cuff tears the patient still had problems performing overhead activities like combing hair, for example.

DISCUSSION

The presented case report shows that the Hippocrates

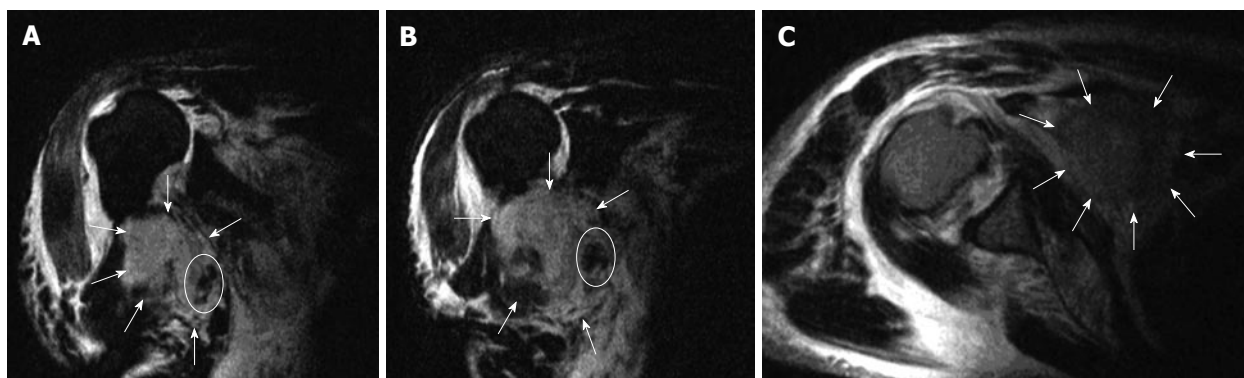


Figure 2 Open magnetic resonance imaging coronar STIR T2 (A and B) and axial TSE T2 (C) sequences representing a large retropectoral hematoma (arrows) compressing the neurovascular bundle (ellipse). Note striking raised position of the humeral head due to massive rotator cuff tears (A and B).

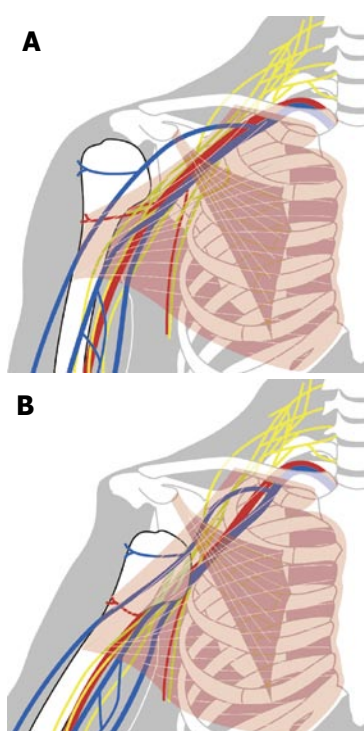


Figure 3 Topographic relations between the axillary neurovascular bundle and the humeral head in normal (A) and anteriorly dislocated (B) position. The humeral head, acting as a fulcrum, and the tight caudal rim of the pectoralis minor muscle can lead to pincer-like forces on the neurovascular bundle during performing the Hippocrates method for reducing anterior shoulder dislocations.

method for reducing anterior shoulder dislocations can at least in inexperienced hands and feet lead to severe iatrogenic complications. In this case we have the rare advantage of an extensive and accurate documentation of the initial treatment in the foreign clinic, as a standardized documentation is mandatory when treating an occupational accident. Documented lapse of symptoms as well as intraoperative findings confirm the strong suspicion that the described neurovascular complications were iatrogenically caused by the use of the Hippocrates method under general anaesthesia and not by the primary trauma, as the first symptoms of neurovascular damage occurred twelve hours after reduction and as the whole neurovascular bundle was surrounded by hematoma and

there was a severe soft tissue edema at the course of the radial nerve near to the outflow of the deep brachial artery, and this is exactly where the operator's heel has been positioned while performing the reduction.

Of course it is not always possible to decide if a vascular injury had been caused by the dislocation trauma itself or iatrogenically by the reduction manoeuvre. A lesion of a vein or a smaller artery caused by the initial trauma might primarily be occluded by the dislocated humeral head and might start bleeding not before a successful reduction has diminished the occluding pressure on the injured vessel. But in our case the patient was under coumarin anticoagulant therapy and the first clinical examination was performed more than six hours after trauma, so that it is very unlikely that the tear of the proximal brachial vein was caused by the initial trauma without development of a significant axillary haematoma within six hours.

Allie reported that 19 out of 27 patients with primary axillary artery injuries after shoulder dislocation showed a striking axillary mass already at the time of initial presentation^[37].

Regarding the Hippocrates method for reducing anterior shoulder dislocations numerous iatrogenic complications have been reported in the literature^[35,36,38-40]. Schmal reported a tear of the subscapular artery, for example, and Cyffka recognized an iatrogenically caused displaced humeral head fracture after performing the Hippocrates method^[35,36].

Several pathogenic mechanisms can be proposed in order to explain neurovascular damage caused by performing the Hippocrates method. On the one hand, the dislocated humeral head can act as a fulcrum over which the neurovascular bundle is bent while performing traction on the injured arm, and the operator's heel can push the vessels against the tight inferior rim of the pectoralis minor muscle and thus cause a pincer-like shear stress on the vessels as well as severe direct local damage (Figure 3). On the other hand, simple tethering of the axillary vessels by their subscapular and circumflex branches can lead to disruption by performing traction on the arm and counter-traction by use of the heel, whereupon excessive forces are possible by use of the whole body weight

(Figure 1).

Predisposing factors for vascular injuries during shoulder reduction are old age with associated atherosclerotic changes of the vessels and recurrent shoulder dislocations, as repeated trauma can cause periscapular fibrosis and adhesions with fixation of the axillary artery and vein branches, which may lead to tearing of the vessels during a subsequent reduction manoeuvre^[39].

Another relevant risk factor for iatrogenic damage by performing shoulder reductions might be the primary use of general anaesthesia, as the physician can not get any feedback from the patient during as well as a certain period after reduction until the patient is conscious again. In our case, the patient might have recognized the ongoing development of neurovascular damage some hours earlier without the use of general anaesthesia. And in our long-time experience more than 90% of anterior shoulder dislocations can successfully be reduced without the use of general anaesthesia (unpublished data).

According to the original description of the Hippocrates reduction method by use of the heel “the patient must lie supine, usually on the floor. The doctor must stand on the side of the injured shoulder. He holds the upper extremity with both hands, pulls it toward his side, and by using, for example, his right heel in the right axilla, he counterpushes the head of the humerus, which is thus easily reduced.” Hippocrates additionally stated that “it is wise to put a small hard cotton ball in the axilla before starting to push to minimize trauma and maximize the surfaces where pressure is applied”^[12]. But this ancient advice is usually not considered anymore today.

There are at least 33 alternative reduction techniques for anterior shoulder dislocations reported in the literature, among which the Kocher method, the Milch technique and the Scapular Manipulation technique have been evaluated scientifically in several studies each^[2,8,10-13,15-34].

Like the Hippocrates method, also the Kocher method is associated with iatrogenic complications and thus should not be used as a first choice in our opinion^[12,33]. The Milch technique and the Scapular Manipulation technique, however, have proved to be safe as well as successful^[10,16,27-32]. According to these data we are primary using a modified Scapular Manipulation technique for reducing anterior shoulder dislocations at our department^[33].

In conclusion, the hazardousness of using the Hippocrates method can be explained by traction on the outstretched arm with force of the operator’s whole body weight, direct trauma to the axillary region by the physician’s heel, and the topographic relations of neurovascular structures and the dislocated humeral head. As there is a variety of alternative reduction techniques which have been evaluated scientifically and proofed to be safe, we strongly caution against the use of the Hippocrates method as a first line technique for reducing anterior shoulder dislocations, especially in elder patients with fragile vessels or under anticoagulant therapy, and recommend the Scapular Manipulation technique or the Milch technique, for example, as a first choice.

ACKNOWLEDGMENTS

The authors thank Hella Thun for excellent designing and preparing of figures 1 and 3, Andrea Freitag-Krickovic, MD, (Kernspintomographie-Zentrum im Krankenhaus Landshut Achdorf, Germany) for assignment for use of the open MRI scans (Figure 2), and Martin Simmel, MD, Stefan Brunner, MD and Heino Sartor, MD (Landshut, Germany) for providing the reports of neurological examinations.

REFERENCES

- 1 **Blake R**, Hoffman J. Emergency department evaluation and treatment of the shoulder and humerus. *Emerg Med Clin North Am* 1999; **17**: 859-76, vi [PMID: 10584106 DOI: 10.1016/S0733-8627(05)70101-2]
- 2 **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**: 311-315 [PMID: 3453939]
- 3 **Hill JA**. Epidemiologic perspective on shoulder injuries. *Clin Sports Med* 1983; **2**: 241-246 [PMID: 9697635]
- 4 **Krøner K**, Lind T, Jensen J. The epidemiology of shoulder dislocations. *Arch Orthop Trauma Surg* 1989; **108**: 288-290 [PMID: 2789505 DOI: 10.1007/BF00932317]
- 5 **Owens BD**, Dawson L, Burks R, Cameron KL. Incidence of shoulder dislocation in the United States military: demographic considerations from a high-risk population. *J Bone Joint Surg Am* 2009; **91**: 791-796 [PMID: 19339562 DOI: 10.2106/JBJS.H.00514]
- 6 **Owens BD**, Duffey ML, Nelson BJ, DeBerardino TM, Taylor DC, Mountcastle SB. The incidence and characteristics of shoulder instability at the United States Military Academy. *Am J Sports Med* 2007; **35**: 1168-1173 [PMID: 17581976 DOI: 10.1177/0363546506295179]
- 7 **Rowe CR**. Acute and recurrent anterior dislocations of the shoulder. *Orthop Clin North Am* 1980; **11**: 253-270 [PMID: 7001307]
- 8 **te Slaa RL**, Wijffels MP, Marti RK. Questionnaire reveals variations in the management of acute first time shoulder dislocations in the Netherlands. *Eur J Emerg Med* 2003; **10**: 58-61 [PMID: 12637865 DOI: 10.1097/00063110-200303000-00015]
- 9 **Yeap JS**, Lee DJ, Fazir M, Borhan TA, Kareem BA. The epidemiology of shoulder dislocations in Malaysia. *Med J Malaysia* 2004; **59** Suppl F: 19-23 [PMID: 15941156]
- 10 **Beattie TF**, Steedman DJ, McGowan A, Robertson CE. A comparison of the Milch and Kocher techniques for acute anterior dislocation of the shoulder. *Injury* 1986; **17**: 349-352 [PMID: 3533776 DOI: 10.1016/0020-1383(86)90161-0]
- 11 **Hippocrates**. On the articulations. The genuine works of Hippocrates. *Clin Orthop Relat Res* 2002; **(400)**: 19-25 [PMID: 12072741]
- 12 **Hippocrates**. Injuries of the shoulder. Dislocations. *Clin Orthop Relat Res* 1989; **(246)**: 4-7 [PMID: 2670389]
- 13 **Poulsen SR**. Reduction of acute shoulder dislocations using the Eskimo technique: a study of 23 consecutive cases. *J Trauma* 1988; **28**: 1382-1383 [PMID: 3418764 DOI: 10.1097/0005373-198809000-00013]
- 14 **Rang M**. Anthology of Orthopaedics. Edinburgh and London: E. & S. Livingstone, 1966: 225
- 15 **Bhan S**, Mehara AK. A simple and universal method for reduction of dislocation of the shoulder. *Int Orthop* 1994; **18**: 14-15 [PMID: 8021061 DOI: 10.1007/BF00180171]
- 16 **Russell JA**, Holmes EM, Keller DJ, Vargas JH. Reduction of acute anterior shoulder dislocations using the Milch technique: a study of ski injuries. *J Trauma* 1981; **21**: 802-804

- [PMID: 7277546 DOI: 10.1097/00005373-198109000-00009]
- 17 **Manes HR.** A new method of shoulder reduction in the elderly. *Clin Orthop Relat Res* 1980; **147**: 200-202 [PMID: 7371296]
 - 18 **Ito H, Takayama A, Shirai Y.** Abduction-and-horizontal-adduction technique for reduction of acute anterior shoulder dislocations: a simple technique evaluated with radiographs. *Am J Orthop (Belle Mead NJ)* 2001; **30**: 201-204 [PMID: 11300128]
 - 19 **Walz M, Kolbow B, Auerbach F.** [A painless technique for reposition of anterior shoulder dislocation]. *Unfallchirurg* 2006; **109**: 551-555 [PMID: 16788781 DOI: 10.1007/s00113-006-1119-0]
 - 20 **Noordeen MH, Bacarese-Hamilton IH, Belham GJ, Kirwan EO.** Anterior dislocation of the shoulder: a simple method of reduction. *Injury* 1992; **23**: 479-480 [PMID: 1446937 DOI: 10.1016/0020-1383(92)90068-4]
 - 21 **Ceroni D, Sadri H, Leuenberger A.** Anteroinferior shoulder dislocation: an auto-reduction method without analgesia. *J Orthop Trauma* 1997; **11**: 399-404 [PMID: 9314145 DOI: 10.1097/00005131-199708000-00003]
 - 22 **Boss A, Holzach P, Matter P.** [Analgesic-free self-reduction of acute shoulder dislocation]. *Z Unfallchir Versicherungsmed* 1993; Suppl 1: 215-220 [PMID: 8123332]
 - 23 **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-A**: 2431-2434 [PMID: 15523014]
 - 24 **Marinelli M, de Palma L.** The external rotation method for reduction of acute anterior shoulder dislocations. *J Orthop Traumatol* 2009; **10**: 17-20 [PMID: 19384630 DOI: 10.1007/s10195-008-0040-4]
 - 25 **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**: 2775-2782 [PMID: 19952238 DOI: 10.2106/JBJS.H.01434]
 - 26 **Chalidis B, Sachinis N, Dimitriou C, Papadopoulos P, Samoladas E, Pournaras J.** Has the management of shoulder dislocation changed over time? *Int Orthop* 2007; **31**: 385-389 [PMID: 16909255 DOI: 10.1007/s00264-006-0183-y]
 - 27 **Anderson D, Zvirbulis R, Ciullo J.** Scapular manipulation for reduction of anterior shoulder dislocations. *Clin Orthop Relat Res* 1982; **164**: 181-183 [PMID: 7067283]
 - 28 **Kothari RU, Dronen SC.** Prospective evaluation of the scapular manipulation technique in reducing anterior shoulder dislocations. *Ann Emerg Med* 1992; **21**: 1349-1352 [PMID: 1416331 DOI: 10.1016/S0196-0644(05)81900-6]
 - 29 **Goh SH, Low BY.** The scapular manipulation method for reducing anterior shoulder dislocations. *Ann Acad Med Singapore* 1996; **25**: 134-138 [PMID: 8779533]
 - 30 **McNamara RM.** Reduction of anterior shoulder dislocations by scapular manipulation. *Ann Emerg Med* 1993; **22**: 1140-1144 [PMID: 8517564 DOI: 10.1016/S0196-0644(05)80979-5]
 - 31 **Chanwai G, Bonning J.** Nurse initiated shoulder reduction by scapular manipulation technique: expediting care in the emergency department. *Emergency Medicine* 2004; **16**: 87-88
 - 32 **Baykal B, Sener S, Turkan H.** Scapular manipulation technique for reduction of traumatic anterior shoulder dislocations: experiences of an academic emergency department. *Emerg Med J* 2005; **22**: 336-338 [PMID: 15843700 DOI: 10.1136/emj.2004.019752]
 - 33 **Regauer M, Tischer T, Kanz KG, Schieker M, Kettler M, Mutschler W.** [Anterior dislocation of the shoulder—a reduction technique that is easy on the patient]. *MMW Fortschr Med* 2005; **147**: 38-41 [PMID: 16138634]
 - 34 **Kuah DE.** An alternative slump reduction technique of anterior shoulder dislocations: a 3-year prospective study. *Clin J Sport Med* 2000; **10**: 158-161 [PMID: 10959924 DOI: 10.1097/0042752-200007000-00002]
 - 35 **Schmal H, Strohm PC, Rosahl SK, Südkamp NP.** [Rupture of the arteria subscapularis following reduction of an anterior shoulder dislocation]. *Unfallchirurg* 2006; **109**: 153-155 [PMID: 16059727 DOI: 10.1007/s00113-005-0983-3]
 - 36 **Cyffka R, Jackisch T, Lein T, Bonnaire F.** [Simultaneous bilateral ventral and dorsal shoulder dislocation following an epileptic convulsion—a rare combination of injuries]. *Unfallchirurg* 2005; **108**: 327-331 [PMID: 15856129 DOI: 10.1007/s00113-004-0878-8]
 - 37 **Allie B, Kilroy DA, Riding G, Summers C.** Rupture of axillary artery and neuropraxis as complications of recurrent traumatic shoulder dislocation: case report. *Eur J Emerg Med* 2005; **12**: 121-123 [PMID: 15891444 DOI: 10.1097/00063110-200506000-00005]
 - 38 **Rockwood CA Jr, Wirth MA.** Subluxations and Dislocations about the gleno-humeral joint. In: Rockwood CA, Green DP, Bucholz RW and Heckman JD (eds) *Fractures in adults, Fourth edition, Vol. 2.* Philadelphia: Lippincott-Raven Publishers, 1996: 1193-1339
 - 39 **Zanchetta M, Rigatelli G, Dimopoulos K, Pedon L, Zennaro M, Maiolino P.** Endoluminal repair of axillary artery and vein rupture after reduction of shoulder dislocation. A case report. *Minerva Cardioangiol* 2002; **50**: 69-73 [PMID: 11830721]
 - 40 **Maliński B, Palka J, Rykowski H.** [Rupture of axillary artery during reduction of a dislocated shoulder joint]. *Chir Narzadow Ruchu Ortop Pol* 1975; **40**: 433-435 [PMID: 1157623]

P- Reviewer: Grigoriadis S S- Editor: Song XX

L- Editor: A E- Editor: Liu SQ





百世登

Baishideng®

Published by **Baishideng Publishing Group Co., Limited**

Flat C, 23/F., Lucky Plaza, 315-321 Lockhart Road,

Wan Chai, Hong Kong, China

Fax: +852-65557188

Telephone: +852-31779906

E-mail: bpgoffice@wjgnet.com

<http://www.wjgnet.com>

