Open Access Maced J Med Sci **electronic publication ahead of print,**
published on November 20, 2018 as https://doi.org/10.3889/oamjms.2018.478

ID Design Press, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences.
https://doi.org/10.3889/oamjms.2018.478
eISSN: 1857-9655
Clinical Science

The Relationship between Clinical Findings of Shoulder Joint with Bone Damage of Shoulder Joint in Patients with Isolated Shoulder Blunt Trauma

Amin Zamani, Mohammad Davood Sharifi, Roohie Farzaneh, Hamideh Feiz Disfani, Behrang Rezvani Kakhki, Amir Masoud Hashemian*

Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

Citation: Zamani A, Sharifi MD, Farzaneh R, Disfani HF, Kakhki BR, Hashemian AM.. The Relationship between Clinical Findings of Shoulder Joint with Bone Damage of Shoulder Joint in Patients with Isolated Shoulder Blunt Trauma. Open Access Maced J Med Sci. https://doi.org/10.3889/oamjms.2018.478

Keywords: Shoulder; Radiography; Blunt Trauma; Clinical Symptoms

***Correspondence:** Amir Masoud Hashemian. Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. E-mail: hashemianam@mums.ac.ir

Received: 13-Oct-2018; **Revised:** 07-Nov-2018; **Accepted:** 08-Nov-2018; **Online first:** 20-Nov-2018

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Due to the prevalence of shoulder injuries among athletes and other people and the prevalence of radiography for these injuries, there are still no valid criteria for indication of doing shoulder radiography.

AIM: This study aimed to examine the relationship between some signs and clinical examinations of the shoulder with shoulder bone injuries and the need for radiography.

METHODS: This is a cross-sectional study. All patients aged 18-70 years who referred to the emergency ward of Imam Reza and Hasheminejad Hospital in the year 2014 due to blunt trauma and had criteria for entering the study and lacking exclusion criteria were included in the study process. Data on clinical symptoms, radiographic results, and final diagnosis were extracted from the patients' records through a questionnaire and analysed statistically.

RESULTS: There was a significant relationship between the clinical signs of patients Existence of ecchymosis in the shoulder fractures with glenoid and humerus fractures ($p = 0.029$, $p = 0.004$ respectively). There was also a significant relationship between clavicle fracture and limitation in shoulder rotation and abduction ($p = 0.000$ and $p = 0.001$ respectively). Other clinical symptoms did not show any significant relationship with radiographs indicative of the problem requiring specific treatment.

CONCLUSION: Although it is possible to define critters based on clinical symptoms that reduce the need for unnecessary radiographs that the does not reliably help inpatient treatment, but finding these critters to indicate the performance of the graphs in shoulder injuries requires further studies with the higher population and more clinical variables.

Introduction

The shoulder joint is a complex and intricate joint collection [1]. This joint has the greatest range of motion in the joints of the body and moves in an area more than one hemisphere [2]. In Emergency medicine, we commonly encountered with shoulder injuries [3]. The statistics show that 8-13% of all athletes injuries are related to shoulder and shoulder dislocation accounts for 50% of total dislocation in the emergency room [4]. Damage to the shoulder can be caused by a hit (direct or indirect) or excessive use. Shoulder injuries are common in most sports because almost every major sport uses a shoulder joint in some way [5].

Most shoulder injuries are evaluated based on bone damage with simple radiography, and in a few cases, CT scan, MRI, or shoulder ultrasound are needed [6]. Shoulder injuries consist of a large percentage of athlete's shoulder injuries, and they are a common cause for emergency attendance [7]. Timely diagnosis, treatment, and management of these patients are among the important tasks of the emergency department [8]. Getting accurate biography and physical examination in the first place

is the most important and most complete work to be done, including physical examination of the clavicle, shoulder, arm including precise inspection, touch, examination of active and passive motion of the joint, neurovascular evaluation, muscular strength tests and diagnostic tests [9].

Deformities due to glenohumeral dislocation, clavicle fracture, acromioclavicular joint separation are usually clinically apparent [10]. Effusion, ecchymosis, and erythema should be taken into account at first glance [11]. Sternoclavicular joint, clavicle, acromioclavicular joint and proximal humerus should be investigated in line with tenderness [12]. The lack of early diagnosis of shoulder bone damage results in undesirable long-term outcomes and, in some cases, permanent in the shoulder joint, some of which include chronic dislocation, degenerative injuries, and major vascular injuries [13].

The method for detecting the type and extent of injury to the shoulder joint is completed at first in the clinic, by taking into account the patient's precise history and physical examination, and it is used in the post-imaging phase to help diagnose that the simplest of which is standardised radiographs of the shoulder. Performing radiography involves spending time and expenses and exposing the patient to radiation [14]. Also, researches have shown that in many cases these graphs do not show any particular problem and are not a guide to treatment; therefore, researchers have always sought to find criteria for the diagnosis of suitable part of the body for the radiography of the damaged part of the body. In this regard, Ottawa and Nexus Critters have been developed as criteria for knee and neck radiography in trauma. In this regard, due to the prevalence of shoulder injuries among athletes and other people and the prevalence of radiography for these injuries, there is still no valid indication for shoulder radiography.

Therefore, in this study, we aimed to investigate the relationship between some signs and clinical examinations of the shoulder with shoulder bone injuries and the need for radiography.

Material and Methods

This study was a cross-sectional study. All patients aged 18-70 years who referred to Emam Reza and Hasheminejad Hospitals due to blunt shoulder trauma and had criteria for entering the study and did not have exclusion criteria were studied. On admission, the clinical criteria were evaluated with an initial examination including abduction, rotation, and examination of the localised tenderness of the acromioclavicular joint, clavicle, humerus, to examine shoulder joint ecchymosis. Then, the results of the examination were recorded in pre-prepared forms, followed by standard shoulder radiography (three posterior-anterior, axillary, Y-view views). Then the results of the graphs were examined and recorded. Then the findings of clinical examination were compared with radiographic findings.

Inclusion criteria:

1. Patients with shoulder blunt trauma.

2. Patients aged 18-70 years.

Exclusion criteria:

1. Previous history of shoulder bone injury.

2. Dissatisfaction for participating in the study.

3. Patients with previous shoulder deformity.

4. Patients with previous shoulder surgery.

5. Patients with inflammatory and degenerative diseases of the shoulder.

Based on $n = z^2pq/d^2$ with a confidence coefficient of 95% and $p = q = 0.5$, in the most conservative mode, the sample size of the sample can be calculated for a high value and finally 100 cases were considered.

The results after being recorded were analysed by SPSS software, MacAdam test, and Kappa coefficient, the agreement between clinical examinations and radiographic findings was assessed.

Results

In this study, of 104 patients referred to Emam Reza and Hasheminejad Hospital during the 2014 and 2015 due to blunt shoulder trauma, 67 were males (64%), and 37 were female (34%). This number of patients was divided by age into four groups: in the first group, that was the age range of 18 to 30 years, 59 patients with a frequency of 56.7%, in the second group who were between the ages of 31 and 43 years, 20 patients with a frequency of 19.2%, in the third group, in the age range of 44 to 56 years old, 14 patients with a frequency of 13.5% and the fourth group, aged between 57 and 70, there were 11 patients with a frequency of 10.6 % that the highest frequency was in the age group of 18-30 years and the lowest was in the age group of 57 and above.

These 104 patients were also categorised about damage in five groups: falling with 19 participants (18.3%), direct hit with 29 (27.9%), pedestrian and vehicle collisions with 16 (15.4%), bikers with 25 (24%) and car drivers with 15 (14.4%)

In the clinical examination for each patient,

the prevalence of clinical signs before radiography showed that 18 (17.3%) of patients were affected by joint ecchymosis, 92 (88.5%) had shoulder joint tenderness, 47 (45.2%) had limitations Shoulder joint rotation and 41 (39.4%) had had shoulder joint abduction limitation.

According to radiographic images, it was shown that 2 (1.9%) patients had combined fracture of shoulder bones, 2 (1.9%) had glenoid fracture, 2 patients (1.9%) had acromion fracture, 10 patients (9.6 %) had a clavicle fracture, 4 (3.8%) had scapular fracture, and 3 (2.9%) had a proximal humerus fracture.

Data analysis showed that there was no significant relationship between the four diagnostic variables in clinical examinations including joint ecchymosis, shoulder joint spotted tenderness, shoulder joint rotation limitation, shoulder joint abduction limitation with a combined fracture of shoulder bones (P > 0.05) (Table 1).

Table 1: Relationship between combined fracture of shoulder bones and clinical examination findings

		Combination fracture of shoulder bones		
		Has	Does not have	
Joint ecchymosis	Has	0	18	P-value
	Does not have	2	84	0.381
Shoulder joint spotted tenderness	Has	2	90	
	Does not have	0	12	0.481
Shoulder joint rotation limitation	Has	2	45	
	Does not have	0	57	0.202
Shoulder joint rotation abduction	Has	2	39	
	Does not have	0	63	0.153

Data analysis also showed that there is a significant relationship between joint ecchymosis and glenoid fracture (P < 0.05), but there is no meaningful relationship with other variables of clinical symptoms including shoulder joint spotted tenderness, shoulder joint rotation limitation and shoulder joint rotation abduction with glenoid fracture (P > 0.05) (Table 2).

Table 2: Relationship between glenoid fracture and Clinical examination findings

		Glenoid fracture		
		Has	Does not have	
Joint ecchymosis	Has	2	16	P-value
	Does not have	0	86	0.029
Shoulder joint spotted tenderness	Has	2	90	
	Does not have	0	12	0.481
Shoulder joint rotation limitation	Has	1	46	
	Does not have	1	56	0.891
Shoulder joint rotation abduction	Has	0	41	
	Does not have	2	61	0.518

Data analysis showed that there is no significant relationship between any of the diagnosed clinical symptoms with acromion fracture (P > 0.05) (Table 3).

Table 3: Relationship between acromion fracture and clinical examination findings

		Acromion fracture		
		Has	Does not have	
Joint ecchymosis	Has	3	15	P-value
	Does not have	6	80	0.186
Shoulder joint spotted tenderness	Has	9	83	
	Does not have	0	12	0.593
Shoulder joint rotation limitation	Has	4	43	
	Does not have	5	52	0.962
Shoulder joint rotation abduction	Has	5	36	
	Does not have	4	59	0.518

Also, data analysis showed that there is a significant relationship between the rotation limitation and shoulder joint abduction with clavicle fracture (P < 0.05) (Table 4).

Table 4: Relationship between Clavicle Fracture and Clinical Findings

		Clavicle fracture		
		Has	Does not have	
Joint ecchymosis	Has	2	16	P-value
	Does not have	8	78	0.683
Shoulder joint spotted tenderness	Has	8	84	
	Does not have	2	10	0.324
Shoulder joint rotation limitation	Has	9	37	
	Does not have	0	57	0.000
Shoulder joint rotation abduction	Has	9	32	
	Does not have	1	62	0.001

According to (Table 5) and P value, it was found that there was no significant relationship between any of the findings of clinical symptoms with Scapular fracture (P > 0.05).

Table 5: Relationship between scapular fracture and clinical examination findings

		Scapular fracture		
		Has	Does not have	
Joint ecchymosis	Has	2	16	P-value
	Does not have	2	84	0.683
Shoulder joint spotted tenderness	Has	3	89	
	Does not have	1	11	0.324
Shoulder joint rotation limitation	Has	1	46	
	Does not have	3	54	0.000
Shoulder joint rotation abduction	Has	2	39	
	Does not have	2	61	0.001

Also according to (Table 6) and P value, it was determined that there was a significant relationship between shoulder joint ecchymosis and humerus fracture (P < 0.05). However, in other clinical symptoms, there was no significant relation with the fracture of the humerus.

Data analysis showed that none of the trauma mechanisms included falling, direct hit, pedestrian, and collisions with the vehicle, bikers, and car drivers have no statistical relationship with clinical diagnostic symptoms including shoulder joint ecchymosis (P-value = 0.231), the shoulder joint spotted tenderness (P-value = 0.136), shoulder joint rotation limitation (P-

value = 0.603), and shoulder joint abduction limitation (P-value = 0.967).

Table 6: Relationship between Humerus Fracture and Clinical Findings

		Humerus Fracture		
		Has	Does not have	
Joint ecchymosis	Has	3	15	P-value
	Does not have	0	86	0.004
Shoulder joint spotted tenderness	Has	3	89	
	Does not have	0	12	0.387
Shoulder joint rotation limitation	Has	1	46	
	Does not have	2	55	0.672
Shoulder joint rotation abduction	Has	0	41	
	Does not have	3	60	0.277

Also, the findings of the relationship between gender and clinical signs of diagnosis including ecchymosis, tenderness, rotation limitation, and limitation of shoulder abduction showed that gender was significantly correlated with shoulder joint ecchymosis (P-value = 0.017), so that among women is common to be affected by ecchymosis, gender had no significant relationship with other clinical diagnostic symptoms.

Finally, the findings of the relationship between age and clinical symptoms showed that the age of patients had statistically significant relationship with shoulder joint ecchymosis (P-value = 0.001) and shoulder joint rotation limitation (P-value = 0.002) and did not have a statistically significant relationship with shoulder joint spotted tenderness (P-value = 0.131) and shoulder joint abduction limitation (P-value = 0.313).

The frequency of clinical signs of patients is shown in (Table 7).

Table 7: Table of Clinical Symptoms Frequency

	Frequency	Percentage
Ecchymosis	2	1.9
Ecchymosis and tenderness	10	9.6
Ecchymosis and tenderness and abduction	1	1
Ecchymosis and Tenderness and Rotation	2	1.9
Ecchymosis and tenderness and routine and abduction	3	2.9
Rotation	2	1.9
Rotation and abduction	8	7.7
Tenderness	31	29.8
Tenderness and abduction	13	12.5
Tenderness and rotation	16	15.4
Tenderness and rotation and abduction	16	15.4

To describe or find a pattern between clinical signs and radiographic findings and the occurrence of these symptoms, the Associate rules algorithms are used that is one of the data mining algorithms; these algorithms are variable in line with the coordinated occurrence of events in variables.

The meaningful and interesting rules are extracted as follows.

1. In 42% of cases, there was no ecchymosis and rotation, but tenderness was positive.

2. In 30% of the cases, there was no ecchymosis and no rotation and abduction, but tenderness was positive.

3. In 96% of cases, those who did not have rotation had a positive tenderness.

4. In 94% of the cases, those who did not have an addiction had positive tenderness.

Discussion

The shoulder is the most mobile joint that performs a vast range of actions, but on the other hand, it can be unstable and can, therefore, be at increased risk of injury [15]. In emergency medicine, we commonly encountered with shoulder injuries [16]. The statistics show that shoulder joint dislocation accounts for half of the total dislocation in the emergency room [4]. Timely diagnosis, treatment, and management of these patients are among the important tasks of the emergency department. Getting a precise biography and physical examination is what should be done first [17]. Failure to diagnose shoulder bone injuries leads to long-term adverse effects of the shoulder while paying attention to signs and symptoms in the doctor's examination leads to timely diagnosis, even in rare cases [18].

Various studies have been conducted to assess the value of clinical signs and different physical tests of shoulder to distinguish between types of shoulder injuries. Litaker and colleagues conducted a study to determine the value of biographies and physical examination in predicting the results of arthrography in older patients with the suspicion of Rotator Cuff Tear. This study aimed to reduce the need for other diagnostic measures, taking into account the age of patients and the value of correct diagnosis along the patient's bed. In their study, shoulder pain in 87.7% of cases was associated with Rotator Cuff Tear. They conclude that physical examinations can effectively show the rupture of Rotator Cuff, with important symptoms including the presence or absence of specific symptoms, the duration of symptoms, and the mechanism of injury [19].

Hedges and colleagues also conducted a systematic study of the diagnostic value of physical examination tests, and they concluded that it was not clear at the time of examination that the usual physical examination tests were useful in differentiating shoulder injuries [20]. In another study, they updated their previous study. Hedges has stated in this article that, based on the results of the previous study and his new study, he does not recommend using any shoulder physical examination (SHPE) alone for diagnosis. Of course, there are some tests that look like these, but they should be evaluated in more than

one study. Also, the use of several physical examinations together improves the accuracy of the diagnosis. The findings of this study appear to suggest that more emphasis should be placed on a comprehensive clinical evaluation, including biographies and physical examination [21].

After the biography and physical examination, the next diagnostic procedure is usually radiography to assess the type of shoulder injury. Most of the shoulders injuries in bone damage are examined with simple radiography, and in rare cases, CT scan, MRI, or shoulder ultrasound are needed. In this regard, some studies have shown that the use of shoulder radiography in the emergency department is excessive, which imposes cost and exposure to unnecessary radiation and time spent [22] [23]. In a study published by Fraenkel and colleagues in 1998, the results showed that only 20% of patients with shoulder radiography showed a special problem that needed special treatment and helped treat it [22]. Another study by Fraenkel et al., (2000) found that 88% of the patients with shoulder pain who received radiography in the emergency ward, radiography was not helpful therapeutically and did not provide any particular information to the therapist [23]. With regard to the research that has been made and the similar studies that have been carried out with regard to the use of radiography in knee trauma (Ottawa knee rule) and neck trauma (NEXUS Low-risk Criteria), it seems that Criteria can be defined according to the clinical symptoms of the patient with shoulder pain, which reduces the unnecessary use of radiography [24] [25].

This study aimed to investigate the relationship between some clinical signs and symptoms of the patient with the shoulder with the type of shoulder injury and the usefulness of shoulder radiography in the next therapeutic intervention.

The results of this study showed that 28 patients (27%) out of 104 patients had fractures, and therefore their radiography was helpful in treatment, which included 2% glenoid fracture (2 patients), 9% acromion fracture (9 patients), 10% clavicle fracture (10 cases), 4% Scapular fracture (4%), 3% proximal Humerus fracture (3 patients) and 2 patients with combined fractures. These results are roughly the same and close to the results of Fraenkel’s study, which showed that about 20% of the combs' radiographs are medically informative and show a fracture or dislocation.

Among the clinical symptoms of patients, there was a significant relationship between ecchymosis in the shoulder and the glenoid and humerus fracture ($p = 0.029$ and $p = 0.004$, respectively). All cases of Humerus (3) and Glenoid fractures (2) were associated with ecchymosis, but the total number of cases was 18. In total, the clinical symptom of ecchymosis was useful in fractures and radiography in 27% of cases.

In the present study, there was a significant relationship between Clavicle fracture and limitation in shoulder rotation and abduction ($p = 0.001$ and $p = 0.001$ respectively). Of the 10 cases, the fracture of the clavicle of each 10 cases was associated with restriction of the shoulder joint rotation and 9 cases with the limitation of abduction. 45% of the subjects had had shoulder joint rotation limitation before radiography, and 39% had shoulder joint abduction limitation before the radiography.

In Fraenkel's study, the deformity was the most important variable in shoulder examination with radiography, so that among 23 patients diagnosed with deformity, 21 cases had suitable radiographs and indicating specific damage. Among the other 162 patients, only people over 43.5 years of age with a history of falls (40) had a great chance to have radiographs. No illness without deformity and a history of the crash (90) did not provide radiographs [22].

In our study, the relationship between ecchymosis and fracture of glenoid and humerus was significant, but in general, ecchymosis was useful only in 27% of cases with radiography. Also, in the present study, there was a significant relationship between Clavicle bone fracture with limitation of rotation and abdominal aberration, however, with 45% of subjects having had shoulder rotation limitation and the total fracture with limitation was 15 (including 10 clavicle fracture, 4 Acromion, and a scapula) and 39% had shoulder joint abduction, while the total fractures with it were 13 (including 9 cases of clavicle and 4 acromion fractures). Therefore, it can be said that the limitation of joints rotation and joint abduction in approximately 1/3 of the cases with is associated with fractures and, consequently, radiographs have been helpful. In Fraenkel study, the deformity was found in 91% of cases with fractures and helping factors in radiography, while in our study, the association between abduction and rotation and radiotherapy was 33% and ecchymosis was 27%. Regarding these results, it can be said that although the abnormalities and limitation of abduction and rotation have a significant relationship with radiography, this association is not so strong that it can be used as a guide critter to perform shoulder radiography and in case of using them as radiographic criterion, again in 66% of cases, unnecessary radiographies have been done.

In conclusion, the results of our study, along with the results of Fraenkel's studies [22], show that, although based on critters clinical symptoms, we can define that the need for unnecessary radiology, which does not help the patient treatment, is reduced, but finding these critters and generalizing the using them like the Ottawa and Nexus Critters require more studies with higher population and more clinical variables.

Acknowledgement

This article has been extracted from thesis written by Dr. Amin Zamani in the Faculty of Medicine, Mashhad University of Medical Science, and this article has IRCT code with number: IR.mums.REC.1393.106.

References

1. McKoy BE, Bensen CV, Hartsock LA. Fractures about the shoulder: conservative management. Orthop Clin North Am. 2000; 31(2):205-16. https://doi.org/10.1016/S0030-5898(05)70141-3

2. Morey VM, Chua KH, Ng ZD, Tan HM, Kumar VP. Management of the floating shoulder: does the glenopolar angle influence outcomes? A systematic review. Orthopaedics & Traumatology: Surgery & Research. 2017. PMid:29246483

3. Strudwick K, McPhee M, Bell A, Martin-Khan M, Russell T. Methodology for the 'rapid review'series on musculoskeletal injuries in the emergency department. Emergency Medicine Australasia. 2018; 30(1):13-7. https://doi.org/10.1111/1742-6723.12906 PMid:29224233

4. Heyward OW, Vegter RJK, de Groot S, et al. Shoulder complaints in wheelchair athletes: A systematic review. PLoS One. 2017; 12(11):e0188410. https://doi.org/10.1371/journal.pone.0188410 PMid:29161335 PMCid:PMC5697842

5. Sekiguchi T, Hagiwara Y, Momma H, et al. Coexistence of Trunk or Lower Extremity Pain with Elbow and/or Shoulder Pain among Young Overhead Athletes: A Cross-Sectional Study. Tohoku J Exp Med. 2017; 243(3):173-178. https://doi.org/10.1620/tjem.243.173 PMid:29162768

6. Pezeshki Rad M, Mohammadifard M, Ravari H, et al. Comparing color Doppler ultrasonography and angiography to assess traumatic arterial injuries of the extremities. Iran J Radiol. 2015; 12(1):e14258. PMid:25785180 PMCid:PMC4347799

7. Yard EE, Comstock RD. Injuries sustained by pediatric ice hockey, lacrosse, and field hockey athletes presenting to United States emergency departments, 1990-2003. J Athl Train. 2006; 41(4):441-9. PMid:17273471 PMCid:PMC1748420

8. Gibbons LJ. Managing acute shoulder injuries in the emergency department. Emerg Nurse. 2014; 22(6):20-9. https://doi.org/10.7748/en.22.6.20.e1350 PMid:25270818

9. Beck S, Chilstrom M. Point-of-care ultrasound diagnosis and treatment of posterior shoulder dislocation. Am J Emerg Med. 2013; 31(2):449.e3-5. https://doi.org/10.1016/j.ajem.2012.06.017 PMid:22944540

10. Hootman JM. Acromioclavicular Dislocation: Conservative or Surgical Therapy. J Athl Train. 2004; 39(1):10-11. PMid:15085205 PMCid:PMC385255

11. Brun S. Initial assessment of the injured shoulder. Aust Fam Physician. 2012; 41(4):217-20. PMid:22472683

12. Lancaster ST, HOROwITz MA, Alonso JO. Complete acromioclavicular separations. A comparison of operative methods. Clinical orthopaedics and related research. 1987; (216):80-8. PMid:3815974

13. Razmjou H, Lincoln S, Geddes C, et al. Management of Acute Work-Related Shoulder Injuries by an Early Shoulder Assessment Program: Efficiency of Imaging Investigations. Physiother Can. 2016; 68(4):357-366. https://doi.org/10.3138/ptc.2015-49 PMid:27904235 PMCid:PMC5125498

14. McFarland E, Bernard J, Dein E, et al. Diagnostic Injections About the Shoulder. J Am Acad Orthop Surg. 2017; 25(12):799-807. https://doi.org/10.5435/JAAOS-D-16-00076 PMid:29176503

15. O'Kane JW, Toresdahl BG. The evidenced-based shoulder evaluation. Curr Sports Med Rep. 2014; 13(5):307-13. https://doi.org/10.1249/JSR.0000000000000090 PMid:25211618

16. Callaghan MJ, Baombe JP, Horner D, et al. A prospective, observational cohort study of patients presenting to an emergency department with acute shoulder trauma: the Manchester emergency shoulder (MESH) project. BMC Emerg Med. 2017; 17(1):40. https://doi.org/10.1186/s12873-017-0149-y PMid:29273012 PMCid:PMC5741868

17. Helfen T, Ockert B, Pozder P, et al. Management of prehospital shoulder dislocation: feasibility and need of reduction. Eur J Trauma Emerg Surg. 2016; 42(3):357-62. https://doi.org/10.1007/s00068-015-0545-5 PMid:26156391

18. Asker M, Waldén M, Källberg H, et al. A prospective cohort study identifying risk factors for shoulder injuries in adolescent elite handball players: the Karolinska Handball Study (KHAST) study protocol. BMC Musculoskelet Disord. 2017; 18(1):485. https://doi.org/10.1186/s12891-017-1852-2 PMid:29166930 PMCid:PMC5700469

19. Litaker D PM, El Bilbeisi H, Brems J. Returning to the bedside: using the history and physical examination to identify rotator cuff tears. J Am Geriatr Soc. 2000; 48(12):1633-7. https://doi.org/10.1111/j.1532-5415.2000.tb03875.x PMid:11129754

20. Hegedus EJ GA, Campbell S, Morin A, et al. Physical examination tests of the shoulder: a systematic review with meta-analysis of individual tests. Br J Sports Med. 2008; 42(2):80-92. https://doi.org/10.1136/bjsm.2007.038406 PMid:17720798

21. Hegedus EJ1 GA, Cook CE, Michener L, et al. Which physical examination tests provide clinicians with the most value when examining the shoulder? Update of a systematic review with meta-analysis of individual tests. Br J Sports Med. 2012; 46(14):964-78. https://doi.org/10.1136/bjsports-2012-091066 PMid:22773322

22. Fraenkel L LM, Felson D. The use of radiographs to evaluate shoulder pain in the ED. Am J Emerg Med. 1998; 16(6):560-3. https://doi.org/10.1016/S0735-6757(98)90218-2

23. Fraenkel L, Shearer P, Mitchell P, et al. Improving the selective use of plain radiographs in the initial evaluation of shoulder pain. J Rheumatol. 2000; 27(1):200-4. PMid:10648039

24. Panacek EA, Mower WR, Holmes JF, et al. Test performance of the individual NEXUS low-risk clinical screening criteria for cervical spine injury. Ann Emerg Med. 2001; 38:22-2. https://doi.org/10.1067/mem.2001.116499 PMid:11423807

25. Stiell IG, Wells GA, Hoag RH, et al. Implementation of the Ottawa Knee Rule for the use of radiography in acute knee injuries. JAMA. 1997; 278(27):2075–9. https://doi.org/10.1001/jama.1997.03550230051036 PMid:9403421