Luxatio erecta humeri: Report of a swimming injury with analysis of the mechanism of the injury and associated injuries in literature

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ABSTRACT

Inferior shoulder dislocation also referred to as luxatio erecta is an unusual and rare type of shoulder dislocation. Its incidence is about 0.5% among all shoulder dislocations. After an exhaustive search of all the available literature we were unable to find a swimming accident case that did not have other associated injuries and an uneventful reduction. The mechanism of the injury was mostly related to direct axial loading and indirect hyperabduction lever arm. We would like to emphasize the importance of this being a swimming accident, a type of accident that requires awareness of the possibility of dangerous asphyxia injuries caused by panic in the water (swimming pool, river, lake, sea, etc.). We described the nature of the injury and review the literature concerning the mechanism of the injury and associated neurovascular impairment at admission time. We also presented a supplemental video to contribute to the education of young residents and orthopedic surgeons.

Key Words: Dislocation, inferior shoulder dislocation, shoulder, swimming injury

INTRODUCTION

Middledorpf and his assistant Scharm, in 1859 are generally credited with first recognizing the unique nature of luxatio erecta humeri.¹,²

The clinical presentation of this type of shoulder dislocation is unique, with the arm fully abducted, elbow flexed and the forearm is resting on or behind the patient’s head.³ Anterior and posterior dislocations are observed in the ratio of 95%:4.5% respectively in patients with shoulder dislocations. Inferior shoulder dislocation (luxatio erecta humeri) is a relatively rare form of glenohumeral dislocation, accounting for only 0.5% of all shoulder dislocations.⁴

Case reports published irregularly in emergency medicine and orthopedic literature. The mechanism of this injury involves either direct axial loading on a fully abducted extremity or leverage of the humeral head across the acromion by a hyperabduction force.²,⁵,⁶

The direct mechanism is more common and results from axial loading of a fully abducted upper extremity. This leads to impaction of the humerus into the inferior capsule, often accompanied by a rotator cuff tear and fracture of the greater tuberosity. The indirect mechanism is a hyperabduction force on a fully abducted upper extremity causing the proximal humerus to be forced over the acromion. This may also cause rotator cuff, inferior glenohumeral capsule or glenohumeral ligament tears.³

Closed reduction (traction-countertraction method) treatment regime should be chosen first. Neurovascular injuries may be associated with luxatio erecta humeri. Concomitant fracture of the acromion, clavicle, coracoid, greater tuberosity, and humeral neck and head may also be seen.³,⁷
In this article, we want to present a classic case of luxatio erecta humeri with a didactic video supplement (See the video), describe the nature of the injury (see the Figure 2) and review the literature concerning the mechanism of injury and associated neuravascular impairment at admission time.

CASE REPORT

A 38-year-old right handed male was admitted to the Emergency Department with an erected right arm over his head (29 July 2013-Memorial Hospital Antalya/Turkey) The injured person was a tourist in our country who did not speak Turkish or any of the major languages covered by our hospital translation staff. Consequently we had difficulty communicating with him and could not establish how the injury occurred. The only definite information we had was that he was dressed in a swimming costume and the paramedics informed us that they had removed him from a swimming pool.

Physical examination revealed the patient to be a well-developed male who was in severe pain. He was awake and oriented. His right upper extremity was abducted at the right shoulder, flexed at the elbow, with his right forearm pronated, a position characteristic of an inferior shoulder dislocation (luxatio erecta). His humeral head was palpated inferior to the glenoid fossa and was in the axillary fold, no neurovascular impairment detected. Any attempt at movement of the right shoulder elicited extreme pain and apprehension on the part of the patient. Radiographs revealed an inferior glenohumeral dislocation [Figure 1a and b].

INVESTIGATIONS

On inspection the right erected arm was observed to be over the head and the right shoulder was locked in a fixed position causing intense pain.

Computed tomography revealed inferior glenohumeral dislocation without any associated fracture [Figure 1c].

DIFFERENTIAL DIAGNOSIS

This clinical entity is unique for that reason so there is not another disease in the differential diagnosis check list.

TREATMENT

A closed reduction under a sedoanalgiesia treatment regime was chosen initially (if unsuccessful this treatment should not be attempted more than once). The closed reduction was carried out with a traction-counter traction technique [Figure 1d-See the Video 1] and the reduction was confirmed by X-ray [Figure 1e]. One hour after reduction the shoulder was immobilized within a 40° abduction by utilizing a cushioned sling for 3 weeks.

Three week after reduction, a coddman exercise program was initiated twice a day and a standard arm sling for daytime use was recommended. By the 6th week the patient claimed to be asymptomatic.

OUTCOME AND FOLLOW UP

The patient was allowed to do active exercise. He regained his shoulder functions within 3 months.

DISCUSSION

There have been few previously published case reports and clinical series focusing on the mechanism of the injury concerning luxatio erecta.

A systematic search of the PubMed database was performed. The following research criteria were applied:

1. Papers written in English or which we could obtain english written abstract,
2. Papers examining luxatio erecta,
3. Cases involving a mechanism of injury.

Of 86 articles only 57 fulfilled the inclusion criteria. Other papers involved non English languages, papers which we could not obtain full text articles or abstracts (18 articles) and other issues [luxatio erecta hip-12 articles].

In this study, we reviewed the mechanism of injuries of all cases (57 articles) and classified the injuries into seven parts: Falling accidents (25 articles), accidents related to working (5 articles), sport related injuries (9 articles), traffic accidents (10 articles), alcholism, epilepsy, syncope, seizure and sleeping related injuries (6 articles), unusual age (infant) with unusual mechanism (1 article), boat accident (1 article) [Table 1].

We found 20 articles that reported neurovascular injury at admission time (16 articles reported neurologic injury-4 articles reported vascular injury) [Table 2].

We could not obtain full text of one additional article to the 57 stated above, which reported neurovascular injury in vascular surgery concerned journal.

The common point of many falling accidents and the boat accident was seen to be indirect injury (Trying to stop the falling action by grabbing something, causing arm leverage to the shoulder through acromion and resulting in luxation erecta).

In our case, we believed that the overhead position of the arm facilitated this type of the injury. We would like to show the mechanism of the injury in Figure 2. We would again stress...
Table 1: See the article list which were arranged according to mechanism of the injury

| Mechanism                                                                 | References |
|--------------------------------------------------------------------------|------------|
| Falling from somewhere                                                   | Zimmer et al (1983) |
| (ladder, side walk, exercise treadmill, height, bicycle, stairs, escalator... associated with hyperabduction injury) | Somville et al (2008) |
| (5 articles)                                                             |            |
| Accident related with working                                            | Garcia et al (1997) |
| (accidental axial loading, construction workers, heavy object fall, farm equipment accident) | Davison et al (2009) |
| (5 articles)                                                             |            |
| Sport related injuries                                                   | Suchida et al (2001) |
| (high jump with hyperabducted arm, tennis, football, roller skating, badminton, body surfing, squash, wrestling, bull riding, mountain climbing, basketball) | Morgan et al (2008) |
| (9 articles)                                                             |            |
| Traffic accident                                                         | Laskin RS et al (2005) |
| (motorcycle accident, motorcycle collision, motor vehicle collision, motorcycle struck, pedestrian traffic accident) | Kramer et al (2009) |
| (10 articles)                                                            |            |
| Alcoholism, epilepsy, syncope, seizure, sleeping related injuries         |        |
| (6 articles)                                                             |            |
| Unusual age with unusual mechanism                                       |            |
| (1 article)                                                              |            |
| Boat accident                                                            |            |
| (1 article)                                                              |            |
| Swimming injury our case                                                 |            |

Figure 1: (a) Radiographic appearance of luxatio erecta. (b) Typical clinical appearance of the patient. Hand is on or over head, elbow flexed, notice the injured right arm shortened (Line — a is shorter than Line—b). (c) Three dimensional — computed tomography revealed no associated fracture. (d) Traction — counter traction technique. (e) Post operative radiography shows uncomplicated reduction

the awareness required of possible asphyxia when treating the results of swimming related accidents.

The youngest patient of the publications reviewed was an infant who had an Erb-Duchene palsy and was accidentally injured by

his mother while he was being manipulated-1971. The oldest patient was 94-year-old woman who lost her balance while using a walker and fell onto her right side.

According to criteria of mechanism of injury in that it was a swimming related injury, our case publishes unique information. Luxatio erecta humeri has a distinctive clinical appearance, failure to aware of this could lead an incorrect diagnosis and inappropriate reduction maneuvers, which would be painful for the patient and could possibly lead to neurovascular injury. Attention should be paid to possible neurovascular injury during...
Table 2: See the list of articles which were arranged according to neurovascular injury

| Article                                                                 | Vascular injury | Neurologic injury            |
|------------------------------------------------------------------------|-----------------|------------------------------|
| Imerci A, Gölcük Y, Uluşar SG, Urasvaş HT, Savran A, Süer L(1)          | —               | ± Axillary nerve injury       |
| Inferior glenohumeral dislocation (luxatio erecta humeri): Report of six cases and review of the literature | —               | Axillary nerve injury         |
| Ulus Travma Acil Cerrahi Derg. 2013 Jan;19(1):41-4. doi: 10.5505/tjtes.2013.35305 | —               | Mixed nerve lesion           |
| Freundlich BD(2)                                                        | —               |                              |
| Luxatio erecta                                                          | —               |                              |
| J Trauma. 1983;27(3):434-6                                              | —               |                              |
| Gardham JR, Scott JE(3)                                                 | Axillary artery occlusion |                              |
| Axillary artery occlusion with erect dislocation of the shoulder        | Injury. 1992 Nov;11(2):155-8 |                              |
| Somville F(4)                                                           | —               |                              |
| Plexus injury after reduction of anterior causal dislocation of the shoulder | —               |                              |
| Acta Chir Belg. 2008 May-Jun;108(3):362-4                                | —               |                              |
| Musmeci E, Gaspari D, Sandri A, Regis D, Bartolozzi P(5)                 | —               |                              |
| Bilateral luxatio erecta humeri associated with a unilateral brachial plexus and bilateral rotator cuff injuries: A case report | —               |                              |
| J Orthop Trauma. 2008 Aug;22(7):498-500. doi: 10.1097/BOT.0b013e3180b0f03 | —               |                              |
| Wang KC, Hsu KY, Shih CH(6)                                              | —               |                              |
| Brachial plexus injury with erect dislocation of the shoulder            | Venous thrombosis | —                            |
| Orthop Rev. 1992 Nov;21(11):1345-7                                       | —               |                              |
| Garcia R, Ponsky T, Brody F, Long J(7)                                   | Axillary arterial compression | —                            |
| Bilateral luxatio erecta humeri complicated by venous thrombosis        | J Trauma. 2006 May;60(5):1132-4 |                              |
| Garrigues GE, Nagda SH, Yu J(8)                                          | —               |                              |
| Open luxatio erecta: A case report and literature review                 | —               |                              |
| J Orthop Trauma. 2012 Apr;27(4):e34-7. doi: 10.1097/BOT.0b013e3280dca68 | —               |                              |
| Yamamoto T, Yoshiya S, Kurosaka M, Nagira K, Nabeshima Y(9)              | —               |                              |
| Luxatio erecta (inferior dislocation of the shoulder): A report of 5 cases and a review of the literature | —               |                              |
| Am J Orthop (Belle Mead NJ). 2003 Dec;32(12):601-3. Review             | —               |                              |
| Frank MA, Laratta JL, Tan V(10)                                         | —               |                              |
| Irreducible luxatio erecta humeri caused by an aberrant position of the axillary nerve | —               |                              |
| J Shoulder Elbow Surg. 2012 Jul;21(7):e65-7. doi: 10.1097/JSE.0b013e32812e3a3c | —               |                              |
| Mallon WJ, Bassett FH 3rd, Goldner RD(11)                                | —               |                              |
| Luxatio erecta: The inferior glenohumeral dislocation                    | —               |                              |
| J Orthop Trauma. 1990;41(1):19-24                                       | —               |                              |
| Rae PJ, Sylvester BS(12)                                                | —               |                              |
| Luxatio erecta — two cases without direct injury                         | —               |                              |
| Injury. 1988 Sep;23(9):621-2                                            | —               |                              |
| Groh GI, Wirth MA, Rockwood CA Jr(13)                                    | —               |                              |
| Results of treatment of luxatio erecta (inferior shoulder dislocation)  | —               |                              |
| J Shoulder Elbow Surg. 2010 Apr;19(3):143-6. doi: 10.1016/J.JSE.2009.07.062 | In 26 cases 7 articles have neurovascular injury (med/rad,ulnar nerve ) , (unlateral nerve) (axillar nerve) ( radial nerve) (axillary nerve) (axillary and radial nerve) |
| Foad A, LaPrade RF(14)                                                  | —               |                              |
| Am J Orthop (Belle Mead NJ). Bilateral luxatio erecta humeri and bilateral knee dislocations in the same patient | —               |                              |
| 2007 Nov;36(11):611-3                                                   | —               |                              |
| Patel DN, Zuckerman JD, Egal KA(15)                                      | —               |                              |
| Luxatio erecta: Case series with review of diagnostic and management principles | —               |                              |
| Am J Orthop (Belle Mead NJ). 2011 Nov;40(11):566-70                     | In 11 cases 2 cases with brachial plexus injury |                              |
| Mesa M, Carpintero P, Carpintero J(16)                                   | —               | Median and axillary nerve     |
| Bilateral luxatio erecta humeri                                          | —               |                              |
| Acta Orthop Belg. 1996 Jun;62(2):116-9                                    | —               |                              |
| Kumar KS, O’Rourke S, Pillay JG(17)                                      | —               |                              |
| Hands up: A case of bilateral inferior shoulder dislocation              | —               |                              |
| Emerg Med J. 2001 Sep;28(3):404-5                                       | —               |                              |
| Tsuchida T, Yang K, Kimura Y, Taniwaki M, Ishigaki S, Itoi E(18)         | —               |                              |
| Luxatio erecta of bilateral shoulders                                    | —               | Axillary nerve injury         |
| J Shoulder Elbow Surg. 2001 Nov-Dec;10(6):595-7                          | —               |                              |
| Iakovlev M, Marchand JB, Poirier P, Bargoin K, Gouëffic Y(19)            | —               |                              |
| Posttraumatic axillary false aneurysm after luxatio erecta of the shoulder: case report and literature review | —               |                              |
| Ann Vasc Surg. 2014 Jul;28(5):132-3. doi: 10.1016/J.AVSG.2014.01.006   | —               | Axillary false aneurysm       |
| Ellanti P, Davarinos N, Connolly MJ, Khan HA(20)                         | —               |                              |
| Bilateral luxatio erecta humeri with a unilateral brachial plexus injury | +               | Brachial plexus injury        |
| J Emerg Trauma Shock. 2013 Oct;6(4):308-10. doi: 10.4203/0974-2700.120396 | —               |                              |
the initial trauma. Close follow up must be performed after the reduction in order to monitor the neurovascular status of the upper extremity.

If reduction cannot be achieved at the first attempt, the possibility of the humeral head trapping in soft tissue or buttonholed through the glenohumeral ligament or inferior capsule must be considered. In this case open reduction is mandatory. Inferior glenohumeral dislocations are thought to cause greater soft-tissue injury involving the labrum, capsule, rotator cuff. The humeral head may buttonholed through the inferior capsule, making these injuries difficult to close and reduce.[9]

On rare occasions, the humeral head may rupture the inferior capsule preventing closed reduction and the injury may be severe enough to create an open inferior glenohumeral dislocation.[14]

In a recent case report, arthroscopy after the reduction of inferior glenohumeral dislocation demonstrated detachment of the superior labral anterior posterior complex, which extended to the anteroinferior portion of the glenoid labrum.[19] The authors performed open reduction of the greater tuberosity fragment, followed by arthroscopic labral repair with three suture anchors.[19]

If the patient’s expectancy is an active life and rotator cuff tear is documented after the reduction, surgical repair at a later date must be considered. An associated greater tuberosity fracture can often be seen. Other rarely associated fractures noted were: Humeral fracture (Groh et al.[43]), glenoid fracture (Imerci et al.[4], Fung et al.[42], Patel et al.[47]), nondisplaced scapular spine fracture (Begaz et al.[49] 2006), humeral head fracture, acromion fracture and A-C joint dislocation (Mallon et al.[49]), both bone forearm fracture (Frank et al.[17]), surgical neck fracture of humerus (Tomcovčik et al.[13]), clavicle fracture, lateral humeral epicondyle fracture, scapula fracture, bony bankart lesion (Patel et al.[47]).

Two open dislocations were reported (Garrigues et al.[14] and Davison et al.[50]). In our case there was no associated injury.

**CONCLUSION**

Inferior shoulder dislocation (luxatio erecta humeri) is relatively rare form of glenohumeral dislocation accounting for only 0.5% of all shoulder dislocations.

Luxatio erecta humeri have a distinctive clinical appearance; failure to be aware of this appearance could lead an incorrect diagnosis and inappropriate reduction maneuvers, which would be painful and could possibly, lead to neurovascular injury.

The mechanism of this injury can involve either direct axial loading on a fully abducted extremity or leverage of the humeral head across the acromion by a hyperabduction force.

Closed reduction under sedoanalgnesia treatment method should be chosen first.

Attention should be paid to the possibility of neurovascular injury during initial trauma, reduction, and close follow up must be performed after the reduction.

Attention must be paid to neurovascular status of the upper extremity.

If the first attempt at reduction could not be achieved, the possibility of humeral head trapping in soft tissue or buttonholed through the glenohumeral ligament or capsule must be considered.

If the patient’s expectancy is an active life and a rotator cuff tear is documented after the reduction, a surgical repair at a later date must be considered.

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