Ipsilateral midshaft clavicle fracture and acromioclavicular joint dislocation: a review of literature and evidence-based diagnosis guidelines

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Case report

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Abstract

Background: Ipsilateral midshaft clavicle fracture and AC joint dislocation are rare, with very few cases reported. Once the AC joint dislocation were missed diagnosis, the shoulder function may be affected and medical dispute was easy to occur. The aim of this study was to gather data relating to ipsilateral midshaft clavicle fracture and AC joint dislocation to develop evidence-based diagnosis guidelines as none are currently available.

Methods: A study was conducted of the PubMed and Google Scholar databases to identify cases of ipsilateral midshaft clavicle fracture and AC joint dislocation. Data collected about each case included age and gender of the patient, mechanism of injury, fracture and dislocation classification. The authors report 2 additional ipsilateral midshaft clavicle fracture and AC joint dislocation cases.

Results: 21 cases were identified for inclusion in this research, 19 from the literature and 2 reported by the authors. All the patients were injured by high energy trauma. For the midshaft fracture, 16/21 (76.2%) patients belonged to Type A classification, and 5/21 (23.8%) patients belonged to Type B classification. For AC joint dislocation, 11/21 (47.6%) patients belonged to Type IV classification, 4/21 (19.0%) patients belonged to Type VI classification, 5/21 (23.8%) patients belonged to Type III classification and 1/21 (4.7%) patients belonged to Type V classification.

Conclusions: There are limited data available about the diagnosis of ipsilateral midshaft clavicle fracture and AC joint dislocation. From the cases reviewed, we find that simple midshaft clavicle caused by high energy injuries may be associated with ipsilateral AC joint dislocation. Physical examination, careful observation of preoperative X-ray and fluoroscopy including the AC joint during operation were key to diagnose the injury.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Background

Mid-shaft clavicle fracture and acromioclavicular (AC) joint dislocation are very common injuries¹⁷. While concurrent injuries to both mid-shaft clavicle fracture and AC joint dislocation seem to be rare, most of the literatures^{1-3, 5-10, 12-16, 18-22} are case reports. The latest review paper¹¹ reveals that incidence of ipsilateral clavicle fracture and AC joint dislocation is 6.8%, much more common than what was traditionally believed. This means that there are nearly 7 ipsilateral AC joint dislocation for every 100 mid-shaft clavicles. In order to avoid missed diagnosis of the AC joint dislocation, timely diagnosis of the unusual injured is very important. There are currently no published evidence-based diagnosis guidelines or recommendations available

The authors present a review of the literature relating to ipsilateral midshaft clavicle fracture and AC joint dislocation as well as 2 additional cases and for the first time provide evidenced-based recommendations

for the diagnosis of this rare injury

Methods

The study was conducted of the PubMed and Google Scholar databases to identify cases of ipsilateral midshaft clavicle fracture and AC joint dislocation. The references of relevant literatures were manually sought to identify additional cases. Cases that included details about general conditions of the patient, mechanism of injury, fracture and dislocation classification, and radiological material were included in this research. Data collected about every case included age and gender of the patient, mechanism of injury, mid-shaft clavicle fracture and AC joint dislocation classification. The classification were identified by the description by author and judgment according to

X ray. Except for the literature data, the authors report 3 more ipsilateral midshaft clavicle fracture and AC joint dislocation cases to add to the data analysis.

Data from all included cases were then tabulated to identify any mechanism of injury and classification to develop evidence-based diagnosis recommendations

Results

Review of literature

A total of 20 literatures^{1-3, 5-16, 18-22} about ipsilateral midshaft clavicle fracture and AC joint dislocation were searched. According to literatures, there were 19 case reports from 1990 to 2017 and 1 review paper in 2017^{1-3, 5-10, 12-16, 18-22}. 23 cases were reported in the case reports. There are 20 cases with the preoperative X-ray, and one case of the X-ray⁹ reported by LANCOURT in 1990 was blurry and could not be used to confirm the classification. Thus, a total of 19 cases X-rays were adopted.

The first reported cases of ipsilateral midshaft clavicle fracture and AC joint dislocation was published in 1992 by Wurtz²⁰. He reported a series of 4 cases, all of whom sustained ipsilateral midshaft clavicle fracture and AC joint dislocation. Two patients were caused by falling from horse, one by Motor-vehicle accident and one by falling from bicycle. According to description of the author, three of four patients had a Type-IV dislocation of the AC joint, one had a Type-II dislocation. The classification of the clavicle fracture was not described. According to the X-ray of case 1, the patten of clavicle fracture was type A according to OTA classification.

In 1995, Heinz et al⁵ published a case of mid-shaft fracture of the clavicle with Type-IV AC joint dislocation, caused by landing directly onto the anterior aspect of his left shoulder in a track cyclist. The X-ray revealed that the mid-shaft clavicle fracture was oblique, type A classification.

Juhn et al⁶ described a type VI AC joint dislocation with middle-third clavicle fracture after impacting in ice hockey sport in a 21-year-old ice hockey player. The X-ray revealed that the mid-shaft clavicle fracture

was oblique, type A classification.

Wisniewski¹⁸ similarly described a type VI AC joint dislocation with midshaft clavicle fracture sustained after striking on the back of the left shoulder by a passing car in a 32-year-old cyclist. The X-ray revealed that the midshaft clavicle fracture was oblique, type A classification.

Yeh PC et al²¹ published a type IV AC joint dislocation with midshaft clavicle fracture after falling on a horse in a 46-year-old horseback rider. The X-ray revealed that the midshaft clavicle fracture was oblique, type A classification.

Kakwani RG et al⁷ similarly described a type IV AC joint dislocation with midshaft clavicle fracture sustained by a road traffic accident in a 45-year-old man. The X-ray revealed that the midshaft clavicle fracture was spiral, type A classification.

More recently in 2011, Psarakis SA et al¹² published a type V AC joint dislocation with midshaft clavicle fracture caused by a road traffic accident in a 38-year-old man. The X-ray revealed that the midshaft clavicle fracture was spiral, type A classification.

In 2013, Woolf SK et al¹⁹ published a type IV AC joint dislocation with midshaft clavicle fracture after ejecting through the open sunroof of a sport-utility vehicle in a high-speed rollover by a motor vehicle collision. The X-ray revealed that the midshaft clavicle fracture was spiral, type A classification. Grossi EA et al⁴ published a type VI AC joint dislocation with midshaft clavicle fracture suffered a fall from a bicycle in a 19-year-old man. The X-ray revealed that the midshaft clavicle fracture was transverse, type A classification. Wijdicks CA et al¹⁷ published a series of 2 patients, all of whom sustained ipsilateral midshaft clavicle fracture and AC joint dislocation. Case 1 was caused by motorcross bike accident with type B classification of the midshaft clavicle fracture, and case 2 was involved in a severe constellation of injuries from an ATV rollover, the pattern of clavicle fracture was type B classification.

Paryavi E et al¹¹ reported a type IV AC joint dislocation with midshaft clavicle fracture in a rollover motor vehicle collision. The X-ray revealed that the midshaft clavicle fracture was transverse, type A classification. Beytemür O et al¹ published a type III AC joint dislocation with midshaft clavicle fracture in a rollover motor vehicle collision. The X-ray revealed that the midshaft clavicle fracture was oblique, type A classification.

In 2014, Solooki S et al¹⁴ similarly described a type III AC joint dislocation with midshaft clavicle fracture after car turn over in a 40-year-old man. The X-ray revealed that the midshaft clavicle fracture was spiral, type A classification. Davies EJ et al² reported a type VI AC joint dislocation with midshaft clavicle fracture after a fall down stairs. The X-ray revealed that the midshaft clavicle fracture was spiral, type A classification. Tidwell JE et al¹⁵ described a type IV AC joint dislocation in a 19-year-old man. He sustained direct impact to his right shoulder when driving an all-terrain vehicle after hitting a bridge and. The X-ray revealed that the midshaft clavicle fracture was oblique, type A classification.

In 2015, Madi et al⁹ published a type IV AC joint dislocation with midshaft clavicle fracture a road traffic accident. The X-ray revealed that the midshaft clavicle fracture was oblique, type A classification.

Sharma et al¹³ described a type III AC joint dislocation with midshaft clavicle fracture and mid shaft humerus fracture sustained by a high velocity road traffic accident in a 65-year-old man. The X-ray revealed that the midshaft clavicle fracture was oblique, type B classification.

In 2017, Dong et al³ reported a case of simultaneous bilateral midshaft clavicle fractures with left dislocation of the acromioclavicular joint (type IV classification) aof the midshaft clavicle fracture, type B classification.

Authors' case 1

A 51-year-old female presented after a high-speed motor vehicle accident. He sustained his shoulder with marked ecchymosis, swelling, and tenderness at the mid-clavicle. The neurovascular status of the right upper extremity was normal. The X-ray (Fig. 1a) revealed that the left midshaft clavicle fracture was type B classification. ORIF was performed and the ipsilateral AC joint dislocation was found. Two k-wires were utilized for fixing the AC joint(Fig. 1b). The k-wires were removed three months after the operation, the X-ray showed the AC joint was normal(Fig. 1c).

Authors' case 2

A 43-year-old female was involved in a road traffic accident and suffered an injury to his left shoulder. He complained of his shoulder with marked ecchymosis, swelling, and tenderness at the mid-clavicle. The neurovascular status of the left upper extremity was normal. The X-ray (Fig. 2a) and CT (Fig. 2b) revealed that the left midshaft clavicle fracture was oblique, type A classification. After ORIF for midshaft clavicle fracture, the X ray postoperation reavealed of type III AC joint dislocation(Fig. 2c). Reviewed the preoperative X-ray(Fig. 2a, red circle), the gap of injured AC joint widens significantly compared with the normal AC joint. Thus the preoperative type IV AC joint dislocation was missed diagnosis.

A summary of all 25 cases can be seen in Table I.

Discussion

The incidence of ipsilateral midshaft clavicle fracture and AC joint dislocation was not as low as one thought. Ottomeyer¹¹ has reported that the incidence of this injury is 6.8%, and the retrospective research reveals that the incidence of this injury is 3.0%. Although the incidence is lower than Ottomeyer report¹¹, caution should be taken when treating midshaft clavicle fracture.

In order to obtain the relative true injury data, case reports^{1-3, 5-10, 12-16, 18-22} which have the entire case data were selected, to analyze the features of midshaft clavicle fracture and AC joint dislocation. According to the literatures about ipsilateral midshaft clavicle fracture and AC joint dislocation, it was

found that all midshaft clavicle fractures belong to the relatively simple pattern of this injury. The majority of AC joint dislocation are type IV (10/19) and VI (4/19) which should be caused by direct high energy trauma on the shoulder. The mechanism of ipsilateral midshaft clavicle and AC joint dislocation is complex and has not been described so far. Few cases may be the major reason. Through the analysis of all the cases reported by various authors from different countries, it was found that all the patients were injured by high energy trauma, associated with relatively simple midshaft clavicle fracture and different type of AC joint dislocation. The study considered that the mechanism is direct high energy impact for shoulder combined with simultaneous torsion with the trunk. The direct trauma causes the AC joint dislocation first, the high energy on the shoulder caused serious AC joint dislocation, then the trauma energy was transmitted towards medial of AC joint when torsion impact occurred, and the energy became weak. The midshaft clavicle is the mechanical weakness, midshaft clavicle fracture is prone to break with the spiral, oblique or wedge clavicle fracture.

Interestingly, the classification of AC joint dislocation identified by literatures^{1-3, 5-10, 12-16, 18-22} is very different from the only review paper. Ottomeyer¹¹ reported that 18/26 were type II AC joint dislocation, 7/26 were type III and 1/26 was type V in the injury of ipsilateral midshaft clavicle fracture and AC joint dislocation. It was found that type IV and type VI AC joint dislocation were more common according to the literatures. There are several possible reasons, the first is that the example reported by case report may be more severe for acromioclavicular joint dislocation, and imaging diagnosis is very clear, so it is easy to accept and publish. The second is that type II AC joint dislocation sometimes is not very easy to diagnose. This means that some cases of ipsilateral midshaft clavicle fracture and AC joint dislocation may be diagnosed with a clavicle fracture, the type II AC joint dislocation is easy to be misdiagnosed.

For ipsilateral midshaft clavicle and AC joint dislocation, the timely and correct diagnosis of AC joint dislocation is a key point. According to Rockwood classification, type III, V and IV injuries are easy to be diagnosed, while type II and VI are prone to be misdiagnosed. The type II AC joint dislocation may be changed to type III after fixation of midshaft clavicle fracture, the noncontoured plate or iatrogenic injury of the coracoclavicular ligament is the possible reason. The type IV AC joint dislocation is not a common injury, caused by high energy injury with coracoclavicular ligament rupture, deltoid and trapezius tear injuries from distal clavicle. The distal clavicle is displaced towards the posterior position, thus sometimes it is prone to ignore this injury through the X-ray. When the gap of AC joint widens, type IV AC dislocation should be considered. Physical examination and CT scan can help in diagnosis.

Once the ipsilateral AC joint dislocation was found intraoperation, the k-wires can be used to fix the AC joint. The incision needs to be extended laterally, expose the AC joint, clear the hematocoele and soft tissue and then reduce the AC joint. Two k-wires were inserted from acromion to distal clavicle. After 3 months postoperation, the k-wires are recommended to be removed so that they won't splinter.

There are several substantial limitations to the study. First, the conclusions may not be generalizable because of the small number of cases. Second, identification of the midshaft clavicle fracture classification may not be very accurate, because some images were not very clear, identification for type

A or type B may be difficult. So the study described the midshaft clavicle fracture as a simple or complex fracture.

Conclusions

From the limited data available relating to ipsilateral midshaft clavicle fracture and AC joint dislocation, the authors make the following recommendations:

1. Shoulder surgeons should be aware of this unusual presentation of ipsilateral midshaft clavicle fracture and AC joint dislocation.
2. Simple midshaft clavicle caused by high energy injuries may be associated with ipsilateral AC joint dislocation. According to Rockwood classification, type II and IV are easy to be misdiagnosed.
3. Pain physical examination of AC joint should be done for all the patients of midshaft clavicle fracture. Once pain about the AC joint, AC joint dislocation should be considered.
4. When operation midshaft clavicle fracture, fluoroscopy should be included the AC joint.

Abbreviations

AC: Acromioclavicular; ORIF: Open Reduction and internal fixation

Declaration

Ethics approval and consent to participate

This study was a combination of literature review and retrospective study of 2 cases. The study was conducted in compliance with the ethical principles originating in or derived from the Declaration of Helsinki and in compliance with Good Clinical Practice Guidelines.

Consent for publication

Written consent to publish the content of this report along with the accompanying images was obtained from all patients.

Availability of data and materials

The datasets used and analyzed during the study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

RA, JZ, JC, JZ and BY conceived and designed the experiments. DL, XZ and XJ analyzed the data. RA and ZJ wrote the paper. All authors read and approved the final manuscript.

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Table

Table I is not available with this version of the manuscript.

Figures

Figure 1

a. one patient was diagnosed with midshaft clavicle fracture pre-operation. b. the ipsilateral AC joint dislocation was found intra-operation, and two k-wires were utilized for fixing the AC joint. c. k-wires were removed three months after the operation.

Figure 2

a,b. the X-ray and CT scan of one patient indicated that simple left midshaft clavicle fracture. c. the superior locking plate was used for treating a midshaft clavicle fracture and ipsilateral AC joint dislocation was showed post-operation. d. two k-wires were utilized for fixing the AC joint (1month after first operation). e. k-wires were removed 4 months after second operation.