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CLINICAL REPORT

Proximal clavicle physeal fracture-separation mimicking an anterior sterno-clavicular dislocation

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KEYWORDS

Fracture-separation; Physeal; Clavicle; Sternoclavicular joint Summary Proximal physeal fracture-separation of the clavicle is a very rare injury occurring in the adolescent and in the young adult which involves a contact loss with fracture between the clavicle and its cartilaginous ossification center similar in appearance to a sternoclavicular dislocation. The authors report an unusual case of a proximal physeal fracture-separation of the clavicle with avulsion of sternoclavicular periosteal and ligamentous structures without vasculonervous injury in a 16-year-old young person. A CT scan examination is essential. Surgical management consisted in costoclavicular ligament and periosteum reattachment associated with reduction of the fracture-separation and pin fixation. This repair demonstrated a successful outcome at 8-month follow-up.

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Introduction

Proximal physeal fracture-separation of the clavicle is an unrecognized entity due to the appearance then late fusion of the epiphyseal nucleus between the age of 22 and 25 [1].

This very rare lesion which usually occurs in the adolescent and the young adult, involves a loss of contact (with or without fracture) between the clavicle and its epiphyseal nucleus, thus similar in appearance to a sternoclavicular dislocation.

Sternoclavicular dislocations (including physeal fractures-separations) account for 3% of all surgical disorders of the shoulder [2].

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In children, differential diagnosis between sternoclavicular dislocation and physeal separation is often difficult to perform.

Surgical management has not been clearly established vet and numerous means of fixation are suggested by the authors. Physeal fracture-separation associated with posterior displacement of the clavicle as well as symptomatic anterior instability should be surgically managed.

Case report

Clinical data

A 16-year old right-handed student, playing competitive football, sustained a high-energy trauma to his right shoulder after a fall during a motorcycle accident in June 1999. At presentation, the patient complained of pain localized in

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Figure 1 CT scan imaging with 3D reconstruction revealing a proximal physeal fracture-separation of the clavicle.

the right parasternal region and in the shoulder associated with functional impairment of the right upper limb.

On admission, examination revealed a painful clavicle exacerbated when pressure was applied, an abnormal major protrusion in the right parasternal region with no sign of cutaneous pain, an oedema in the sternoclavicular joint and no vascular or neurological impairment.

Imaging

A/P chest radiograph did not reveal any mediastinal or pulmonary injuries. However, the orientation of the clavicle in the sagittal plane could not be visualized on the whole radiographs. Oblique radiographs, of which the Heinig view, were not performed in our patient since it appeared difficult to acquire and analyze.

Osteoarticular scan associated with 3D reconstruction, after contrast agent injection, revealed an anterior sternoclavicular pseudodislocation with type III Salter-Harris physeal fracture-separation of the proximal end of the clavicle (Fig. 1).

Due to the major displacement and to prevent any sequellae, a surgical procedure was planned and the patient was operated on the fourth day after initial trauma.

Treatment

Surgery was performed under general anesthesia in the semi-sitting position. A 8 mm cutaneous incision was made centered on the first rib and the right-half of the sternal manubrium. Once the lesions were exposed, the clavicle appeared completely deperiosted at the level of its proximal part.

Fracture-separation visible on CT scan involved the upper posterior 1/4 of the physeal nucleus surface which remained attached to the intact posterior capsular elements and sternal manubrium, while the clavicle and the anterior 3/4 of the nucleus were displaced anteriorly from the sternum.

The costoclavicular ligament was still attached to the periosteum of the inferior aspect of the clavicle.



Figure 2 Postoperative A/P radiographic control at Day+1 showing the claviculosternal pin in place.

The costoclavicular ligament and periosteum were fixed using a ''U'' shaped transosseous suture located about 2,5 cm from the internal end of the clavicle, the fracture was reduced than stabilized by means of a 20/10 pin inserted from the clavicle to the sternal manubrium, the end of the pin was then curved (Fig. 2).

The periosteum of the inferior aspect of the clavicle with the costoclavicular ligament were then fixed in place by means of a double transosseous suture.

Follow-up

A Mayo Clinic type splint immobilization was applied for a 6-week period, passive and active mobilization of the elbow and wrist were initiated after splint removal. The patient could return to sport after 3 months.

The pin was removed under short general anesthesia after 6 postoperative weeks; A shoulder rehabilitation programme was initiated with mild and progressive mobilization, no ROM limitations and strengthening exercises.

After an 8-month follow-up period, no pain was reported during clinical examination upon palpation of the injured area and mobilization of the upper limb in all ROM. The patient could return to his pre-injury level of activities (Fig. 3).

During follow-up, no secondary displacement of the physeal fracture-separation site could be observed on standard radiographs, nor delayed healing or sternoclavicular instability. Radiographic findings were confirmed by CT scan (Fig. 4).

Discussion

Sternoclavicular mobilization was achieved in all planes, $30-35^{\circ}$ in elevation–lowering antepulsion–retropulsion and $45-50^{\circ}$ in axial rotation. This mobility is essential since



Figure 3 Clinical examination at 8 months demonstrating satisfactory functional recovery and painless mobilization.

it enables mobilization of the cleidoscapular block on the trunk, block on which takes place the glenohumeral mobility [3,4].

Epidemiologically, our patient corresponds to the age, gender, origin of injury (road accident) criteria of dislocations and physeal fractures-separations of the proximal end of the clavicle [5]. However, due to the late ossification of the internal end of the clavicle and its proximity to the joint, it is often difficult to differentiate a true sternoclavicular dislocation from a physeal separation [6]. It should be



Figure 4 CT scan at 3 months after pin removal.

systematically suspected after indirect high-energy shoulder traumatism in the adolescent and young adult [7].

Standard radiographs do not provide proper evaluation and additional CT scan should be performed [8]. CT scan helps assess the relationship between clavicular extremity and major vessels located just posterior to it to establish the exact position of the fragment and plan reduction as well as osteosynthesis [9–12].

Surgical management of proximal physeal fracturesseparations of the clavicle is not systematically performed [13]. In case of true physeal separation, the periosteal sleeve is often intact with stable reduction. Once reduction has been achieved, a conservative treatment is carried out. Conservative reduction is easily performed by combining retropulsion of the shoulder while pression is applied on the anterior aspect of the internal end of the clavicle [10,14].

In our case, there was an avulsion of the periosteal and costoclavicular structures, these elements being essential in providing a stable sternoclavicular joint in case of fracture-separation of the physeal nucleus. We believe stabilization was very useful since there was a great amount of displacement of the proximal clavicular fragment. The periosteum and costoclavicular ligament were reinserted by means of a "U" shaped transosseus suture. In order to protect this suture, a temporary sternoclavicular joint fixation was performed by inserting a pin from the clavicle to the sternal manubrium, the clavicular end of the pin being curved to prevent any migration. Many authors proscribe the use of this type of device (pin). However, according to our experience, the pin [15] curvature and its appropriate removal should prevent any complication.

Many fixation techniques are available. According to some authors, proper restoration of the anatomical structures is essential, and can be combined or not with the use of a fixation device [16]. Other techniques are available to ensure capsuloligamentous repair through ligamentoplasty by means of natural or synthetic tissue-engineered implants (Achilles, sub-clavious, fascia lata, long palmar tendons, Dacron band...). Among the most commonly used techniques, that of Jackson Burrows using the subclavious muscle tendon or those performing temporary joint fixation by means of internal fixation devices such as osteosutures, cerclage wirings or cannulated screws) [3,17,18].

Conclusion

Dislocation and physeal fracture-separation of the proximal end of the clavicle is a very rare entity due to the multiple strong ligaments of the sternoclavicular joint. It mostly involves physeal separations due to the late fusion of the internal ossification nucleus of the clavicle (22- to 25-yearold).

CT scan must be performed. Anterior dislocations and physeal fracture-separations of the proximal end of the clavicle can be conservatively managed. However, in case of major displacement which could threaten the skin, surgery should be the treatment of choice. None.

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