

# Retrosternal displacement of the clavicle after medial physeal fracture in an adolescent: MRI

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Retrosternal displacement of the medial clavicular metaphysis after a medial physeal fracture is a rare and potentially fatal injury because of possible damage of neurovascular structures, trachea and oesophagus. As the medial clavicular epiphysis does not ossify until 18–20 years of age and the medial clavicular physis is the last to close, around 22–25 years of age, this injury is difficult to demonstrate with plain radiographs in younger patients and is often mistaken for a sternoclavicular joint dislocation. We report on a 16-year-old boy with a fracture of the medial clavicular physis with retrosternal displacement of the metaphysis that was diagnosed with MRI, and discuss the diagnostic tools and treatment

## Introduction

Retrosternal displacement of the medial clavicular metaphysis after a medial physeal fracture is a rare and potentially fatal injury [1]. The medial clavicular epiphysis does not ossify until 18–20 years of age and the medial clavicular physis is the last to close, around 22–25 years of age [1–4]. The physis is the weakest link in the sternoclavicular joint (SCJ) and injuries to this area in patients younger than 25 years of age are usually physeal [4–6]. Ligamentous structures around the SCJ are stronger than the physis and remain attached to the bone [7], preventing sternoclavicular dislocation. The metaphysis displaces behind the sternum, and this injury is often mistaken for an SCJ dislocation [6,8]. The medial clavicular epiphysis is also small in size, which can lead to misdiagnosis as well. Radiographs provide a false impression of a dislocation of the SCJ when in fact a medial clavicular physis fracture has occurred, leaving the SCJ intact. Imaging with computed tomography (CT) and especially MRI aid in the differentiation of the type of injury and shows the possible damage of neurovascular structures, trachea and oesophagus that lie in a vulnerable position just behind the clavicle [5,9].

## Case report

A 16-year-old boy was admitted with pain in the anterior chest wall and right shoulder, inability to move his right arm and difficulty with breathing after a fall down the stairs in school. Physical examination indicated tenderness and swelling in the right SCJ, fullness of the neck veins, numbness in the right arm, pain with right shoulder movements and dyspnoea. A chest radiograph showed no obvious injury (Fig. 1). A CT scan was ordered to better

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visualize the injury. CT indicated posterior displacement of the medial clavicular metaphysis consistent with a posterior sternoclavicular dislocation (Fig. 2). An MRI was performed to differentiate a posterior sternoclavicular dislocation from a physeal fracture. It showed a Salter–Harris type II fracture separation of the medial clavicular physis (Fig. 3) with posterior displacement of clavicular metaphysis with maintenance of the epiphysis against the manubrium. The medial clavicular metaphysis was in

**Fig. 1**



Immediate postinjury radiograph showing no obvious injury.

**Fig. 2**



Three-dimensional computed tomographic reconstruction shows posterior displacement of the medial clavicular end consistent with a posterior sternoclavicular dislocation, with a small fragment of bone left on the sternal side (arrow). The medial clavicular epiphysis is not yet ossified and its position relative to the metaphysis is not determined on this image.

**Fig. 3**



T2-weighted coronal MRI shows a Salter–Harris type II fracture separation of the medial clavicular physis. The separated epiphysis remains in its normal location against the manubrium.

contact with the left brachiocephalic vein at its confluence with the superior vena cava (Fig. 4).

**Fig. 4**



T2-weighted axial MRI shows posterior displacement of the clavicle, the medial clavicular metaphysis (black arrow) butting against the left brachiocephalic vein (white arrow) at its confluence with the superior vena cava (hollow arrow).

**Fig. 5**



Postreduction T2-weighted coronal MRI shows anatomic reduction of the medial clavicular physis.

The fracture was reduced under general anaesthesia with the patient lying in the supine position with a sand bag under his dorsal spine, the surgeon pulling the clavicle anteriorly with his fingers while an assistant applied

lateral traction to the arm with the shoulder in 90° of abduction. The numbness in the right arm and the difficulty with breathing were relieved immediately. Postreduction MRI showed satisfactory reduction of the medial clavicular epiphysis upon the metaphysis (Fig. 5). The right arm was immobilized in a sling for 3 weeks and at the 1-year follow-up, the patient was symptom free, with complete shoulder function.

## Discussion

SCJ injuries account for less than 3% of all joint injuries, and accurate diagnosis and treatment are vital because of the life-threatening potential of these injuries [1,4,8,10]. Physeal fracture of the medial end of the clavicle with retrosternal displacement is an even rarer and potentially more fatal injury because associated complications such as compression of the trachea, oesophagus or great vessels may occur [1,2,5,9]. Potential injury to these structures makes diagnosis and treatment without a delay crucial.

The weakest connection around the SCJ is the medial clavicular physis because the SCJ comprises strong ligaments, namely, the intra-articular disc ligament, anterior and posterior sternoclavicular (capsular) ligaments, the interclavicular ligament and the costoclavicular ligament [3,4,11,12]. The sternoclavicular ligaments are the strongest and their clavicular attachment is primarily onto the medial clavicular epiphysis. Hence, injuries to this area in patients younger than 25 years of age, in whom the medial clavicular physis may still be open, are often physeal [3–5,13]; whereas the ligaments hold the epiphysis in its place, the weak physis gives way. For this reason, the medial clavicular physis usually fractures before true dislocation occurs in this age group [8]. However, when a medial clavicular physeal fracture occurs, especially in a Salter–Harris type I physeal fracture, plain radiographs and CT usually provide an impression of dislocation of the SCJ although the SCJ is intact [6,9,10]. Furthermore, the clavicular medial epiphysis does not begin to ossify until 18–20 years of age and it is small, thus contributing towards obscuring the actual nature of the injury as seen by plain radiographs and CT. MRI can delineate both the epiphysis and the physeal injury.

Differentiation of true sternoclavicular dislocation from medial clavicular physeal fracture is important because treatment alternatives and outcomes are not similar in these two separate entities [2]. Anterior displacement of the clavicular metaphysis may remodel completely, leaving no residual deformity, but posterior physeal injuries should be reduced [3]. Because of the great healing potential in children and adolescents, closed reduction of the medial clavicular physeal fracture is the optimal method of treatment [1,4,14], but it may fail [9]. If closed reduction fails, particularly in the absence of symptoms of mediastinal compression, conservative

treatment on the basis of the remodelling potential of the physis is an option [14]. However, posterior physeal injuries must be reduced, surgically if necessary, in symptomatic patients [1,3,4].

Surgeons have stressed the importance of the timing in achieving a close reduction. A delay of more than 48 h appears to increase the incidence of failure [4]. Late surgery is hazardous because of the proximity of the bone to the great vessels and the presence of scar tissue [8]. If open reduction is indicated, reduction of the joint or the physeal fracture should be performed, preferably without metal implants, to avoid the numerous complications described in the literature that can potentially result from metal devices [1,3,15].

Most authors recommend CT of the injured area not only for an accurate diagnosis but also for imaging of the potentially catastrophic complications of unrecognized retrosternal displacement of a medial clavicular fracture. However, CT cannot properly visualize either the medial clavicular epiphysis or a medial clavicular physeal fracture. Besides, the justifiability of the additional radiation dose of a CT scan is questionable. MRI, however, can visualize both the medial clavicular epiphysis and the medial clavicular physeal fracture, as well as the surrounding structures at risk [10].

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### Conflicts of interest

There are no conflicts of interest.

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