



# Sonography of Occult Rib and Costal Cartilage Fractures: A Case Series



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## Abstract

**Objective:** The purpose of this case series is to describe the use of diagnostic ultrasound (US) in the detection of occult rib and costal cartilage fractures presenting as chest wall pain to a chiropractic clinic.

**Clinical features:** Three patients presented with chest wall pain and tenderness. Two of the patients presented with acute chest wall injury and 1 carried a previous diagnosis of rib fracture after trivial trauma 2 months earlier.

**Intervention and outcomes:** Diagnostic US was selected as a non-ionizing imaging tool for these patients after negative digital radiography studies. All fractures were considered isolated as there was no associated injury, such as pneumothorax. Both of the acute cases were followed up to complete healing (evidence of osseous union) using US. All patients eventually achieved pain-free status.

**Conclusion:** In these cases, US was more sensitive than radiography for diagnosing these cases of acute rib and costal cartilage fractures. Early recognition of rib injury could avoid potential complications from local manipulative therapy.

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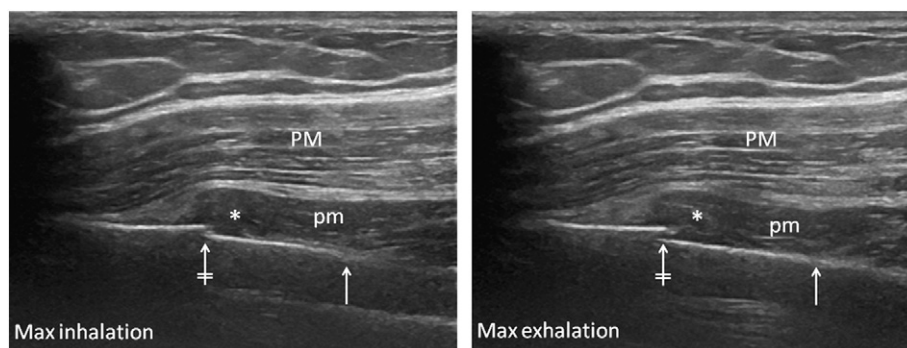
## Introduction

Fracture of the rib or costal cartilage is a diagnosis that should be excluded even in the setting of trivial trauma to the chest wall. Up to 50% of rib fractures may

be missed at radiography, so the true incidence of rib fractures cannot be determined using radiography as the primary diagnostic test.<sup>1</sup> Moreover, Palvalen et al reported the incidence and complications of rib fractures due to minimal trauma have been increasing in the last 30 years, especially in the elderly. They suggest this may be due to an increased tendency for falls amongst frail and elderly patients who are surviving to a later age due possibly to advancements

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**Fig 1.** Diagnostic US in the longitudinal plane of a rib during maximal inhalation demonstrating cortical offset (crossed arrow) consistent with a fracture and surrounding hematoma (asterisk) displacing the overlying pectoralis minor muscle (pm) and a portion of the pectoralis major muscle (PM). The costochondral junction (solid arrow) is located medial to the fracture. US of the same rib demonstrates increased cortical offset during maximal exhalation.

in medicine.<sup>2</sup> Previous studies have shown diagnostic ultrasound (US) is more sensitive than radiography for the detection of acute rib fractures.<sup>3</sup>

Although displaced acute rib fractures, healing fractures with callus formation, or those associated with other injuries may be readily identified with radiography, costal cartilage is not visible unless it undergoes physiologic calcification.<sup>4</sup> Isolated rib fractures are defined as having no associated injury, regardless of the number of ribs fractured.<sup>5</sup>

Accurate diagnosis of such rib injuries may positively influence patient outcomes and avoid potential complications. Therefore, the purpose of this case series is to describe the use of US in the detection of radiographically occult rib and costal cartilage fractures. We present a series of 3 fractures, 2 in ribs and 1 in costal cartilage, which were detected by US, but undetectable by digital radiography.

## Case Reports

The patients discussed in the following cases each gave written consent to educational usage of their images and clinical data.

### Case 1

A 35-year-old man fell and sustained direct trauma to his upper left, anterior chest. The patient presented 1 day following the injury. His symptoms included pain with breathing (especially forced expiration), coughing, sneezing, yawning, and left arm movement. Vital signs were normal. Physical exam revealed pain and tenderness covering a broad area over the left pectoralis

major muscle, worse in the mid-clavicular line. Any activation of the pectoralis major muscle increased his pain. There was edema and erythema in the mid-clavicular line. US of the left anterior chest wall was performed for evaluation of the muscle injury and to rule out rib fracture. He was examined with a GE Logiq E9 (GE Healthcare, Milwaukee, WI) ultrasound system using a high frequency linear transducer (ML6-15) operating at 12 MHz utilizing a standardized rib protocol. It consisted of imaging each symptomatic rib and the adjacent asymptomatic ribs in the longitudinal and transverse planes along its entire extent. US examination in the longitudinal plane revealed cortical discontinuity of the left third and the fourth anterior ribs approximately 1.5 cm lateral to the costochondral junction. Overlying hematoma was evident at both fracture sites (Fig 1). Dynamic imaging obtained during the phases of respiration provided increased conspicuity of the cortical offset at the fracture site. Radiography of the chest and left ribs were ordered for confirmation of the fractures and exclusion of a pneumothorax. The images were interpreted as negative for fracture and there were no other complicating factors, such as pneumothorax. Over the next 3 weeks, the patient experienced disturbed sleep and continuation of his presenting symptoms with gradual improvement.

Follow-up US examinations at 1-week intervals<sup>2</sup> and then 2-week intervals<sup>2</sup> demonstrated interval hematoma organization, callus formation, and eventual US evidence of osseous union. This information was utilized to inform the patient about his clinical status and to indicate when fracture healing was achieved. The US appearance of his fracture was used to guide his level of activity and his return to regular activity, both at work and during athletics.

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