

Usefulness of ultrasonography for first rib stress fracture: A case report

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[Abstract] Stress fractures of the first rib are relatively rare in athletes. The author describes the case of a 17-year-old man, elite baseball player, who had pain in the right posterior shoulder. Ultrasound image revealed a discontinuity of the cortex and echo-free spaces on the bone surface. The distance between the first rib and the subclavian artery was significantly increased compared to the healthy side. Plain radiography of the right first rib revealed a stress fracture of the first rib. Following conservative treatment with rest from baseball activities and physical therapy, the patient returned to baseball with complete fracture healing. Ultrasonography successfully visualized the fracture of the first rib. Early diagnosis and appropriate conservative treatment with physical therapy are essential for successful clinical outcome and early return to sport.

Introduction

Stress fractures of the first rib are relatively rare and can be seen in high-level athletes who perform overhead throwing or other repetitive upper extremity motions^{1,2)}. There have been few reports on the incidence of the stress fracture of the first rib. The diagnosis of stress fractures of the first rib can be difficult because plain radiographs have low sensitivity in detecting stress fractures³⁾. A case of a stress fracture of the first rib in a baseball player, which was successfully detected with ultrasonography and resulted in complete fracture healing, is reported.

Case

A 17-year-old, right hand-dominant, male, elite baseball player (infielder) presented to our clinic

with a 3-week history of dull pain in the right posterior shoulder. He experienced an acute increase in pain during batting practice a few days ago. He had no previous trauma to his right shoulder.

Physical examination revealed no obvious deformity, swelling, or muscle atrophy around the shoulder and upper extremity. There was tenderness to palpation over the medial scapula and supraclavicular fossa. The range of motion of the shoulder and neck was normal, although forward flexion and abduction were painful. There were no neurological abnormalities. Ultrasound examination of the right first rib revealed a discontinuity of the cortex and an echo-free space on the bone surface (**Fig. 1A**). A plain anteroposterior radiograph revealed a subtle linear radiolucency at the middle portion of the right first rib (**Fig. 2**). The patient was diagnosed with a stress fracture of the right first rib.

The patient was treated with rest from baseball activities for four weeks and physical therapy, which included postural correction and

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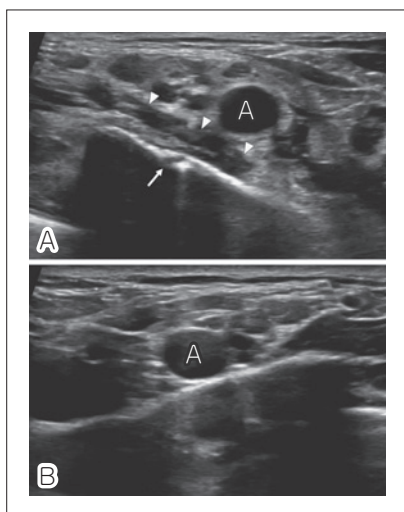


Figure 1 Ultrasound image of the right first rib (A) showing the fracture line (arrow) and the surrounding hematoma (arrowheads). The distance between the first rib and the subclavian artery was significantly increased compared to the healthy side. Normal ultrasound image of the left first rib (B) showing the subclavian artery just above the first rib. A, subclavian artery.

scapulothoracic mobilization, and stretching of the scalene and serratus anterior muscles was begun immediately after the pain subsided. At the four-week follow-up, he was pain-free, and radiographs showed osseous bridging callus formation. He gradually advanced to baseball activity and returned to competitive baseball at two months. At the final follow-up after 12 months, he was symptom-free with full functional recovery, and radiographs revealed fracture union with bridging callus formation (Fig. 3).

The patient and his parents were informed that the data concerning the case would be submitted for publication, and they provided consent.

Discussion

Stress fractures of the first rib in athletes are relatively rare and commonly occur at the subclavian artery groove, which is the anatomically

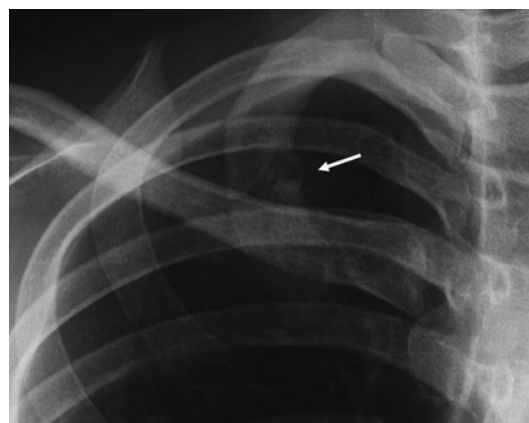


Figure 2 A plain radiograph of the right first rib showing a fracture line (arrow).



Figure 3 A plain radiograph of the right first rib at the final follow-up after 12 months showing complete healing of the fracture.

thinnest and weakest portion of the first rib^{1,4)}. Symptoms of stress fractures of the first rib are typically nonspecific and cause diffuse pain in the shoulder girdle, upper chest, or base of the neck^{1,2)}. Previously reported cases showed that most patients presented with pain in the posterior region of the shoulder, especially at the medial site of the scapula, as in the present case^{1,2,5)}.

Stress fractures of the first rib can be difficult to diagnose with conventional radiographs because they are obscured by the clavicle, scapula, and soft tissues. Funakoshi et al.¹⁾ reported the clinical characteristics and radiographic findings of 24 overhead throwing athletes with first rib stress fractures. The accuracy of the first radiographic diagnosis was 55.6% (5/9) for rib radio-

graphs, 28.6% (2/7) for shoulder radiographs, 80% (4/5) for chest radiographs, 100% (4/4) for cervical spine radiographs, and 0% (0/1) for acromioclavicular joint radiograph. Thus, an anteroposterior radiograph of the shoulder was not valuable and should be evaluated for first rib stress fracture via cervical radiography. Therefore, other imaging modalities such as computed tomography, bone scan or magnetic resonance imaging may be required for the definitive diagnosis of stress fractures, although these have disadvantages of higher cost, time-consuming, increased radiation exposure, or not widely available³⁾.

Ultrasonography is now commonly used to diagnose musculoskeletal disorders⁶⁾ and can demonstrate occult fractures and early-phase stress fractures that are often undetected by X-ray examination⁷⁻⁹⁾. Ultrasonography is a non-invasive, cost-effective, reproducible and portable imaging technique. However, stress fractures in the early phase can be missed by non-expert operators because the accuracy of ultrasonography depends on the operator's skill⁶⁾. A recent case series of stress fractures of the first rib reported that ultrasound detected cortical irregularity in all three cases and may be useful as a screening imaging modality⁵⁾. Ultrasound examination of the healthy side of the first rib showed no echo-free space on the bone surface because the subclavian artery normally runs just above the first rib, the so-called subclavian artery groove (**Fig. 1B**). In the present case, ultrasound examination revealed an echo-free space on the bone surface in addition to the cortical discontinuity. The increased distance between the first rib and the subclavian artery was thought to be the hematoma or swelling caused by the fracture. Therefore, careful examination of both bone structure and surrounding soft tissue abnormalities may be required to avoid misdiagnosis of stress fractures of the first rib.

Stress fractures of the first rib have a relatively good prognosis with conservative treatment. However, previous reports have shown an unexpectedly high non-union rate with 29-50%^{1,4)}.

The most common mechanism of first rib stress fractures has been reported to be repetitive muscle contraction of the scalene, serratus anterior and intercostal muscles, which attach to the first rib. Considering the mechanism of this injury, the author believes that physical therapy intervention, including relaxation or stretching of these muscles, is critical for reducing the load on the fracture site to and promoting fracture healing.

In conclusion, this study detailed a case of a stress fracture of the first rib in a baseball player that was successfully visualized with ultrasound imaging was described. Ultrasonography is a useful diagnostic screening tool and should be considered in clinically doubtful cases of stress fractures of the first rib.

Conflicts of Interest

The authors declare that they have no conflict of interests regarding the publication of this paper.

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超音波検査が有用であった第1肋骨疲労骨折の1例

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キーワード：第1肋骨，疲労骨折，超音波検査

〔要旨〕（はじめに）超音波検査が診断に有用であった第1肋骨疲労骨折の1例を報告する。（症例）17歳男性（野球選手）。3週間前より右肩甲部に鈍痛あり，バッティング時に痛みの急性増悪あり当科初診となった。超音波所見では，第1肋骨の骨折線および骨表面の echo free space を認め，第1肋骨・鎖骨下動脈間距離は，健側に比べ有意に増大していた。超音波検査および単純X線にて第1肋骨疲労骨折と診断した。4週間の運動中止および理学療法による保存療法を施行し，受傷後2か月で骨癒合が得られ，野球に完全復帰した。（考察）第1肋骨疲労骨折は，特徴的な症状に乏しく，初診時に診断に至らないことも多いとされている。スポーツ選手における肩甲部痛の診断においては，第1肋骨疲労骨折を念頭に置くとともに，超音波検査が診断に有用であると考えられる。