Case Report

Journal of Emergency Medicine Case Reports

# Detection of Sternum Fracture with POCUS Despite Computed Tomography Findings Reported as Normal: Case Report

Songül Tomar Güneysu[1], Mehmet Ali Aslaner[2], Okşan Derinöz Güleryüz[1]
[1]Pediatric Emergency Department, Department of Pediatrics, Gazi University Faculty of Medicine, Ankara, Turkey.
[2]Emergency Medicine Department, Gazi University Faculty of Medicine, Ankara, Turkey.

## Abstract

Sternal fractures are extremely rare in children. It often develops after high-energy chest trauma. Many methods other than ultrasonography are used in the diagnosis of sternal fractures. However, Point-of-care ultrasound (POCUS) can outperform other methods due to its ease of use, less radiation, and fast results.A thirteen-year-old male patient was brought to the Pediatric Emergency Department by ambulance due to chest pain that started following blunt chest trauma after falling from a height of 160 cm. The patient's respiratory and cardiovascular examinations were normal in his initial evaluation in the trauma room. On palpation, there was local tenderness in the middle 1/3 of the sternum. No pathology was detected in Extended-Focused Assessment with Sonography in Trauma (E-FAST). The portable postero-anterior chest radiograph was normal. POCUS was performed after the patient did not respond to analgesic treatment and had local sensitivity on the sternum. A sternal fracture was detected. Suspicious cortical irregularity was detected in repeated lateral chest X-ray and thorax Computed Tomography (CT) was reported as normal by the radiology department. When CT was re-evaluated, a greenstick fracture was observed in the sternum body. The patient was discharged without any complications.In this article, the importance of diagnosing a sternal fracture case whose CT was reported as normal with POCUS and integrating rapid, noninvasive and radiation-free ultrasonography into the physical examination will be discussed in managing these patients.

**Keywords:** Sternal fracture, trauma, POCUS

## Introduction

The incidence of sternum fractures in children is reported to be between 0.5-3%. Although it often occurs with a high-energy trauma mechanism such as motor vehicle accidents, it can also be seen as a result of blunt traumas directly to the chest area without intra-thoracic injury or flexion-compression injuries without spinal injury (1).

The first question that often comes to mind when suspecting a sternal fracture is whether pulmonary and/or cardiac injury accompanies this fracture due to the anatomical location of the sternum. In this case, it is necessary to find answers to which radiological method should sternal fracture be demonstrated, and whether further imaging should be performed in the presence of fracture (1-2).

The purpose of this case is to emphasize the importance of integrating rapid, noninvasive, and radiation-free ultrasonography into physical examination in emergency departments. Point-of-care ultrasound (POCUS) may help diagnose sternum fractures in children.

## Case Report

A thirteen-year-old male patient was brought to the Pediatric Emergency Department (PED) by ambulance due to chest pain that started following blunt chest trauma after falling from a height of 160 cm. In his initial triage evaluation, he was conscious and his vital signs were normal. In his initial evaluation in the trauma room, the patient's respiratory and cardiovascular examinations were found to be normal, with active chest pain. On palpation, there was local tenderness in the middle 1/3 of the sternum. No pathology was detected in the Extended-Focused Assessment with Sonography in Trauma (E-FAST). Portable postero-anterior (PA) chest radiograph was normal. Electrocardiography (ECG) revealed sinus rhythm and 1 mm ST elevation in leads V2, V3. Cardiac biomarkers were normal. Oral analgesic was given. The PED and emergency department physician performed POCUS to evaluate the sternal fracture, as no fracture was observed in the PA chest X-ray of the patient who did not respond to analgesic treatment and whose local

**Corresponding Author:** Songul Tomar Guneysu
**e-mail:** tomarsongul@gmail.com
**Received:** 08.06.2023 • **Revision:** 10.11.2023 • **Accepted:** 22.11.2023
**DOI:** 10.33706/jemcr.1311287


**Cite this article as:** Guneysu Tomar S, Aslaner MA, Derinoz Guleryuz O. Detection of sternum fracture with pocus despite computed tomography findings reported as normal: case report. Journal of Emergency Medicine Case Reports. 2023;14(4): 77-80

10.33706/jemcr.1311287
Journal of emergency medicine case reports. 2023;14(4): 77-80

sensitivity on the sternum continued. A sternal fracture was detected (Figure 1 determined with POCUS). No significant pathology was observed in bedside echocardiography (ECHO). Upon detection of a sternal fracture, chest lateral X-ray and thorax CT were taken to the patient. Suspected cortical irregularity was detected in the chest lateral X-ray (Figure 2). Since the detection of the fracture with POCUS is user dependent and the suspected irregularity in the lateral chest radiograph was taken later, a thorax CT was performed to confirm the diagnosis and exclude additional serious injuries. And the thoracic CT was reported normal. When CT was re-evaluated, a greenstick fracture was observed in the sternum body (Figure 3). Cardiac monitoring was performed throughout the observation period. No pathology was observed in ECG and cardiac markers during follow-up. The patient was discharged with a non-steroidal anti-inflammatory drug without any complications.

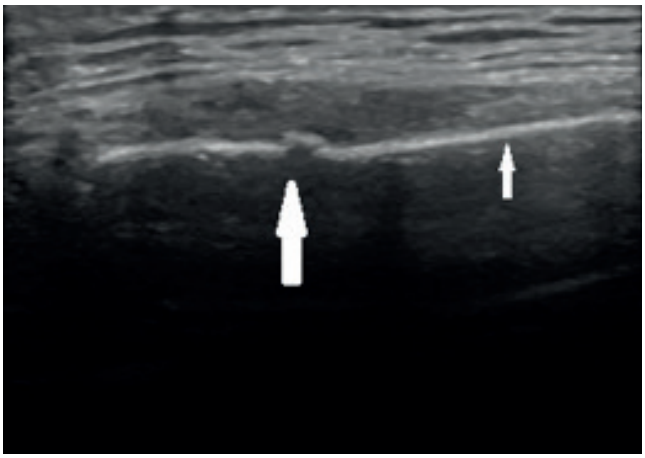

**Figure 1.** Sternal image with linear probe. Cortical irregularity (thick arrow) on the sternum (thin arrow)

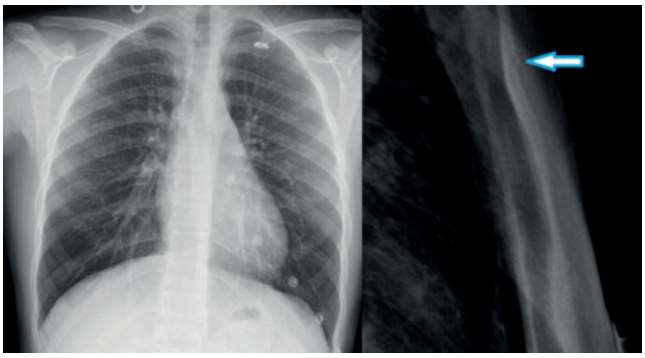

**Figure 2.** Normal appearance of the sternum in the anterior-posterior chest X-ray, irregularity in the cortical bone in the middle 1/3 of the sternum in the lateral chest X-ray (blue arrow)

***Sonographic examination:***

The sonographic examination was performed by a pediatric emergency and an emergency medicine specialist who were unaware of each other and had two years of POCUS experience. The sternal fracture was visualized with a high-frequency linear probe (3.6-12 MHz), and cardiac examination with a phased array probe (1-4 MHz). The sonographic examination was completed supine with the GE Logic E (GE Medical Systems, USA).

## Discussion

The approach in patients with chest trauma depends on the severity of the trauma and the underlying suspected injury. Life-threatening conditions such as tension pneumothorax, hemothorax, cardiac tamponed, or great vessel injury in children with severe thoracic trauma and respiratory or circulatory disorders at the time of first presentation should be immediately identified and stabilized quickly. The exact extent of the injury can be determined later by a detailed history, careful physical examination, and diagnostic tests (3).

Imaging modalities that can be used to evaluate children with chest trauma include X-ray, POCUS by an experienced clinician, ECHO, and CT. In many studies, it has been reported that abnormal respiratory system auscultation findings and tenderness on palpation of the chest wall may indicate thoracic injury (4).

An X-ray should be performed in the primary evaluation of children with major thoracic trauma or multi-trauma (4). It is easy to access, inexpensive, and can also identify many clinically significant life-threatening injuries. Children with normal blood pressure, Glasgow coma scale scores of 15, and no localizing findings on chest examination are unlikely to have pathology in the radiograph. Therefore, imaging may not be required in children with isolated

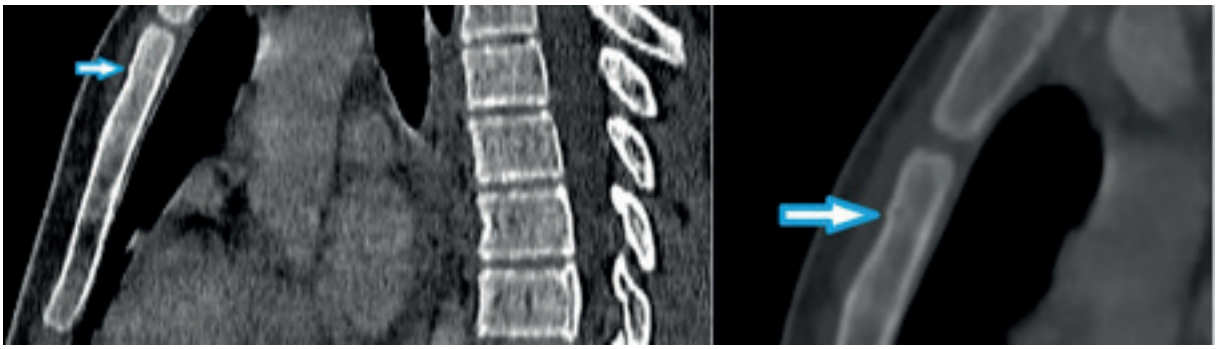

**Figure 3.** CT image of the torus fracture on the cortical bone in the middle 1/3 of the sternum (blue arrows)

minor thoracic trauma (4). However, in isolated blunt chest trauma, if the patient describes localized pain, especially in the sternal region and the pain increases with palpation, it should be considered that there may be a sternal fracture (1-2). We first evaluated our case as an isolated thorax injury. For this reason, we wanted to exclude life-threatening situations by taking only postero-anterior radiographs in the first evaluation. We performed POCUS because his pain continued and he had localized findings during follow-up. Since a fracture and ECG changes were detected, we wanted to confirm the diagnosis and perform a CT scan. Although the CT report was normal, when we re-examined the tomography, we saw the fracture on the tomography and confirmed our diagnosis. Although the guidelines do not recommend further examination, we performed a CT scan considering that it is a rare fracture in the childhood age group and that thoracic injuries in children may cause internal organ injuries without bone fractures, as stated in the literature. We wanted to discuss this case for this purpose.

There is no standard protocol for diagnostic examination and treatment. Diagnosis of sternal fracture in adults can be made by X-ray. Still, the sensitivity is limited and some studies have reported that X-ray misses the diagnosis in 25-50% of cases. When evaluated together with lateral radiographs, the sensitivity increases slightly (5).

Ultrasonography may be more sensitive and specific than X-ray in the diagnosis of sternal fractures, but it depends on the experience of the person doing it (5). There is no definite information about which patients with sternum fractures should have a CT scan. Although it is said that CT is not required in patients with non-displaced, isolated sternal fractures and no associated multiple trauma, thoracic CT imaging continues to be the preferred method in adults when fractures are detected in X-ray or ultrasonography (6). The CT scan for children remains an essential life-saving tool for diagnosing serious thoracic injuries, as long as it is performed properly and justified clinically. However, ultrasonography remains an individualized diagnostic tool with a smaller scanning area than other imaging modalities such as MRI, X-ray or CT (7).

X-ray is the first method used to diagnose sternum fractures in children. However, the sternal fracture may be overlooked in the evaluation of anteroposterior chest radiographs, especially in severely traumatized cases (7). However, in addition to X-ray and CT, USG should also be considered to demonstrate a sternum fracture. Recently, the success of USG in the diagnosis of sternal fracture has also been reported (1-2, 7). USG is overlooked by X-ray in diagnosing fractures, as it reflects the image of the cortical surface very well and allows acceptable cortical changes to be seen clearly (8). In a study, the sensitivity and specificity of X-ray were 70.8% and 75%, while the sensitivity and specificity of USG were 100% and 95% (9). Another study with 31 patients showed that multi-detector CT was 100% sensitive, but axial slices were 65% and coronal slices 59% sensitive (5).

It should be evaluated by long-axis scanning technique using a high-frequency linear probe for superficial, subcutaneously located bones and a curved probe for deeper bones. It can best show long bone fractures. On POCUS, fractures appear as a marked deterioration in the echogenic line corresponding to the cortical surface of the bone (10). For sternal fractures, scanning should be performed along the entire sternum in both the longitudinal and transverse planes, with the patient lying supine. POCUS is helpful in children who can show the sensitivity area, and the sensitivity area should be evaluated by comparing it with other areas. It should be borne in mind that the ossification zones in children fuse at about 25. Therefore, ossification sites should not be confused with fractures. While the edges of the ossification centers are round; Sonographic distinction can be made with the appearance of irregular and notched fractures (8).

## Conclusion

Since the probability of intrathoracic injury is low in patients with isolated sternal fractures, aggressive investigation is not required. Stable patients can be followed safely without hospitalization. POCUS can be superior to other methods due to its ease of use, lack of radiation risk, and immediate results. Complementary advanced diagnostic imaging modalities may be performed if clinically relevant intrathoracic injuries are suspected.

## References

1. Ferguson LP, Wilkinson AG, Beattie TF. Fracture of the sternum in children. Emergency medicine journal 2003; 20(6): 518-20.
2. Ramgopal S, Shaffiey SA, Conti KA. Pediatric sternal fractures from a Level 1 trauma center. Journal of pediatric surgery 2019; 54(8): 1628-31.
3. Holmes JF, Sokolove PE, Brant WE, Kuppermann N. A clinical decision rule for identifying children with thoracic injuries after blunt torso trauma. Annals of emergency medicine 2002; 39: 492-9.
4. Gittelman MA, Gonzalez-del-Rey J, Brody AS, DiGiulio GA. Clinical predictors for the selective use of chest radiographs in pediatric blunt trauma evaluations. Journal of Trauma and Acute Care Surgery 2003; 55(4): 670-6.
5. Kim EY, Yang HJ, Sung YM, Hwang KH, Kim JH, Kim HS. Sternal fracture in the emergency department: diagnostic value of multidetector CTwith sagittal and coronal reconstruction images. European journal of radiology 2012; 81(5): e708-e711.
6. Perez MR, Rodriguez RM, Baumann BM, Langdorf MI, Anglin D, Bradley RN, Raja AS. Sternal fracture in the age of pan-scan. Injury 2015; 46: 1324-7.

10.33706/jemcr.1311287
Journal of emergency medicine case reports. 2023;14(4): 77-80

**7.** Sesia SB, Prüfer F, Mayr J. Sternal fracture in children: diagnosis by ultrasonography. European journal of pediatric surgery reports 2017; 5(01): e39-e42.
**8.** Khalil PA, Benton C, Toney AG. Point-of-care ultrasound used to diagnose sternal fractures missed by conventional imaging. Pediatric emergency care 2021; 37(2): 106-7
**9.** You JS, Chung YE, Kim D, Park S, Chung S. Role of sonography in the emergency room to diagnose sternal fractures. Journal of Clinical Ultrasound 2010; 38(3): 135-7.
**10.** Racine S, Drake D: BET 3: Bedside ultrasound for the diagnosis of sternal fracture. Emergency Medicine Journal 2015; 32(12): 971–2