

CASE REPORT

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# Imaging pitfalls in fragility fractures of the pelvis: a case series

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## Abstract

**Background** Fragility fractures of the pelvis are low-energy pelvic ring fractures commonly occurring in older adults. Early diagnosis of fragility fractures of the pelvis is important because of the possibility of fracture progression and deterioration. Herein, we report the imaging characteristics of fragility fractures of the pelvis in three patients that resulted in delayed diagnoses and discuss ways to improve the diagnostic accuracy.

**Case presentation** We reviewed the images of three Japanese patients with delayed fragility fractures of the pelvis diagnoses (one male, two females, aged 74–89 years), whose diagnoses were confirmed by orthopedic trauma surgeons after the initial treatments were completed. Their images all showed fractures with minimal displacements, such as those with continuous deformities of the bone cortex, bulging of the bone cortex, and those visible only on multiplanar reconstruction images.

**Conclusion** We identified several key imaging features related to the delayed diagnosis of fragility fractures of the pelvis. Emergency physicians should be familiar with the characteristics and imaging features of fragility fractures of the pelvis to prevent delays in their diagnoses.

**Keywords** Case series, Delayed diagnosis, Fragility fractures of the pelvis, Imaging, Older adults

## Background

Fragility fractures of the pelvis (FFPs) are low-energy pelvic ring fractures commonly occurring in older adults [1]. Early diagnosis of FFPs is important because of the possibility of fracture progression and deterioration [1, 2]. However, it is difficult to diagnose FFPs on the basis of chief complaints, physical findings, or imaging [2–8]. We

report the characteristics of three patients with delayed FFP diagnosis to clarify the imaging features of FFPs that contribute to its delayed diagnosis and discuss ways to improve diagnostic accuracy.

## Case presentation

Of the 13 (7 males, 6 females) Japanese patients who presented to our emergency department between November 2022 and July 2023 and were ultimately diagnosed with FFPs, we retrospectively reviewed the images of 3 patients with delayed diagnoses. The other ten patients were not included in the analysis as they were accurately diagnosed during the initial medical examination. The diagnoses of the three patients who were included were confirmed by orthopedic trauma surgeons after the initial treatments were completed because the emergency department and the orthopedic trauma team have daily conferences in our

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institution. Computed tomography (CT) images of the pelvic region were obtained for all patients. This report has been prepared in compliance with the CARE guidelines.

**Case 1:** An 89-year-old female patient presented to the hospital after a fall injury with complaints of pain in her buttocks. The patient had tenderness over her buttocks and underwent a CT but was sent home without a fracture diagnosis. Upon further review, the orthopedic trauma surgeon diagnosed a Rommens classification [1] type Ia FFP with a plastic deformity-like fracture and continuous cortical deformity (Fig. 1).

**Case 2:** A 79-year-old female patient presented after a fall injury with buttock pain. The patient had tenderness over the sciatic region and underwent CT imaging. This initially suggested a pubic bone cyst, and the patient was discharged home. The orthopedic trauma surgeon later diagnosed her with a type IIc FFP caused by a torus fracture and fracture of the sacral cortex (Fig. 2).

**Case 3:** A 74-year-old male patient presented after a fall injury with difficulty walking. The patient experienced pain in the anterior aspect of the hip joint and was unable to raise his lower limbs. CT revealed fractures of the pubic bone and ischium, but the patient was discharged home nonetheless. The attending orthopedic trauma surgeon later identified a sacral fracture visible only on multiplanar reconstruction (MPR) images and diagnosed it as a type IIc FFP (Fig. 3).

## Discussion and conclusions

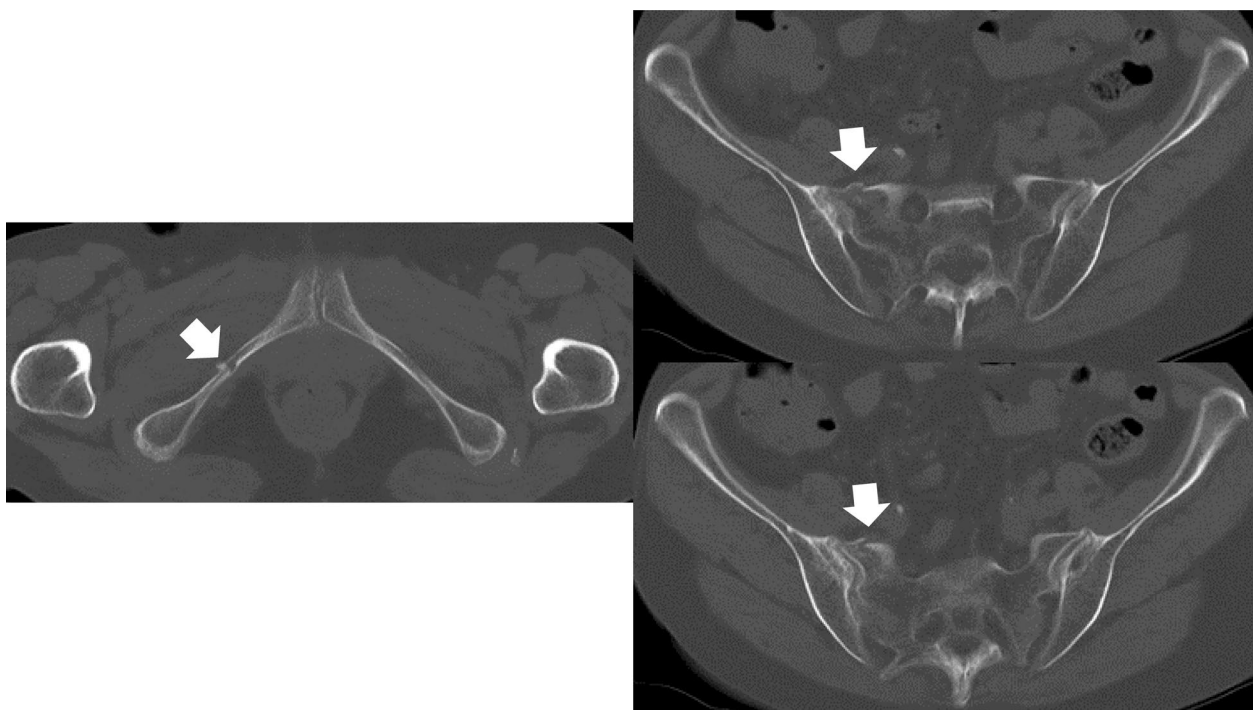
The images from these patients with delayed FFP diagnoses all showed fractures with minimal displacements, such as continuous deformities or bulging of the bone cortex, which were visible only on MPR images. In some cases where several fractures coexisted, only certain findings were noted, while other areas were overlooked.

Patients (39.2%) with long-term pain and limited range of motion in the pelvic region have FFPs [2]. However, approximately half of these patients report being able to load weight onto the joint and have no hip pain [3], making the diagnosis difficult on the basis of chief complaints and physical examination findings alone. Imaging-based diagnoses can be challenging, with reports that 11–51% of patients with suspected hip fractures have FFPs [3], and that in 4.4% of patients with FFPs, the fractures could not be visualized on hip radiographs [4]. Magnetic resonance imaging (MRI) has been reported to be effective in certain cases [1, 5], but MRI is not regularly indicated in the emergency department, as it is time-consuming and may be contraindicated in certain cases; as a result, it may be difficult to perform in all settings. Recently, dual-energy CT has been reported [6], but this is not yet a commonly available method. Occult fractures of the sacrum are detectable on MRI and MPR CT [7], and this method could be used in many facilities.

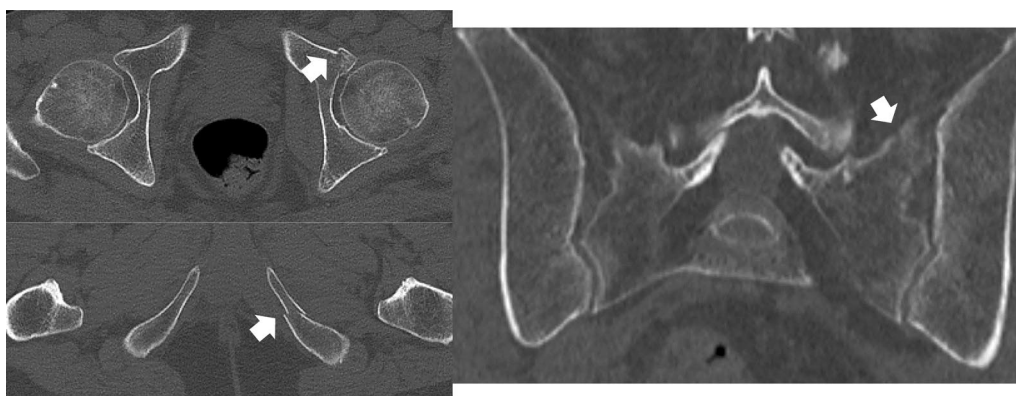
In this study, a few of the patients with delayed FFP diagnoses had multiple fractures, of which one or more were missed. FFPs (75%) involve multiple fractures, and 60–80% of patients with pubic fractures have concomitant posterior injuries [3, 8]. Familiarity with the



**Fig. 1** Computed tomography image showing a fragility fracture of the pelvis type Ia in an 89-year-old female patient. The computed tomography image shows the continuity of the cortex with a plastic deformity-like pubic bone fracture (white arrow), diagnosed as a Rommens classification type Ia fragility fractures of the pelvis



**Fig. 2** Computed tomography image showing a type IIc fragility fracture of the pelvis in a 79-year-old female patient. The computed tomography image shows a torus fracture-like bulge of the bone cortex on the pubic and sacral anterior surfaces (white arrow), which led to the diagnosis of a type IIc fragility fracture of the pelvis



**Fig. 3** Computed tomography image showing a type IIc fragility fracture of the pelvis in a 74-year-old male patient. A computed tomography image showing a pubic bone and ischium fracture with minimal displacement and a multiplanar reconstruction image showing a fracture of the sacrum (white arrow), which led to the diagnosis of a type IIc fragility fracture of the pelvis

characteristics and imaging features of FFPs may help prevent its delayed diagnosis. Early diagnosis of FFPs is important because a natural course of creeping pelvic collapse during conservative treatment has been noted [1, 2]. To reduce this, we recommend educating emergency physicians on the physical characteristics of FFPs and instructing them to order imaging studies, such as plain radiographs or CT scans with MPR,

when FFPs are suspected. Creating MPRs in coronal, sagittal, and horizontal views can help reveal fracture lines. If the suspicion of FFPs remains after a detailed review, an MRI or another imaging modality should be considered. Cooperation between the emergency department and the trauma team is useful, as radiologist reviews and reports are not always immediate, and results often take time to obtain. A limitation of this

report is the small number of cases, which may limit its generalizability.

In conclusion, we identified key imaging features that resulted in delayed FFP diagnoses. Emergency physicians in charge of initial trauma care should familiarize themselves with the characteristics and imaging features of FFPs to prevent their delayed diagnoses and ways to improve diagnostic accuracy.

#### Abbreviations

CT	Computed tomography
FFP	Fragility fracture of the pelvis
MPR	Multiplanar reconstruction
MRI	Magnetic resonance imaging

#### Acknowledgements

Not applicable.

#### Author contributions

KT and TK analyzed and interpreted the patient data regarding the radiographic and CT images. SO, YN, TG, TS, and MG performed the clinical examinations of the patients and were major contributors in writing the manuscript. All authors read and approved the final manuscript.

#### Funding

Not applicable.

#### Availability of data and materials

The data that support the findings of this report are available from the authors upon reasonable request and with the permission of our institute. However, restrictions apply as they were used under license for the current report and are not publicly available.

#### Declarations

##### Ethics approval and consent to participate

This report conformed to the principles of the Declaration of Helsinki and its amendments. Written and verbal informed consent to participate was obtained from all patients before treatment and participation.

##### Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

##### Competing interests

The authors declare that they have no competing interests.

Received: 16 October 2024 Accepted: 27 February 2025

Published online: 24 March 2025

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