CT evaluation of acetabular fractures

e-Poster: 1296

Congress: ESSR 2008

Type: Educational

Topic: Musculoskeletal / Bone

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MeSH:

Acetabulum [A02.835.232.043.825.108]

Fractures, Bone [C21.866.404]

Keywords: Ct, Acetabular fractures

1. Introduction

Learning Objectives

Review the classification of Judet and Letournel for acetabular fractures. To explain how to interpret CT images to clarify these fractures.

Background

Acetabular fractures are almost universally classified by the method described by Judet and Letoumel, based on anteroposterior radiograph and two oblique views. In this classification, fractures are divided into elementary and associated patterns. The classification of Judet and Letournel is the first step in surgical decision making.

The authors present a systematic method to facilitate classification by those who are not expert at evaluating these fractures. The CT appearances of the fracture types of the Judet and Letournel classification are described. CT is also able to detect intraarticular fragments and shows articular discontinuity better than radiography does. Rotation of fragments can be difficult to assess by radiography and may be better examined with CT.

2. Discussion

I. NORMAL ANATOMY

The acetabulum is made up of two columns and two walls, each termed anterior or posterior.

The anterior column represents the longer, larger portion, which extends superiorly from the superior pubic ramus into the iliac wing. The posterior column extends superiorly from the ischiopubic ramus as the ischium toward the ilium. The anterior and posterior columns of bone unite to support the acetabulum.

The anterior and posterior walls extend from each respective column and form the cup of the acetabulum.

The iliac wing and the obturator ring are additional important structures in the setting of acetabular fractures.

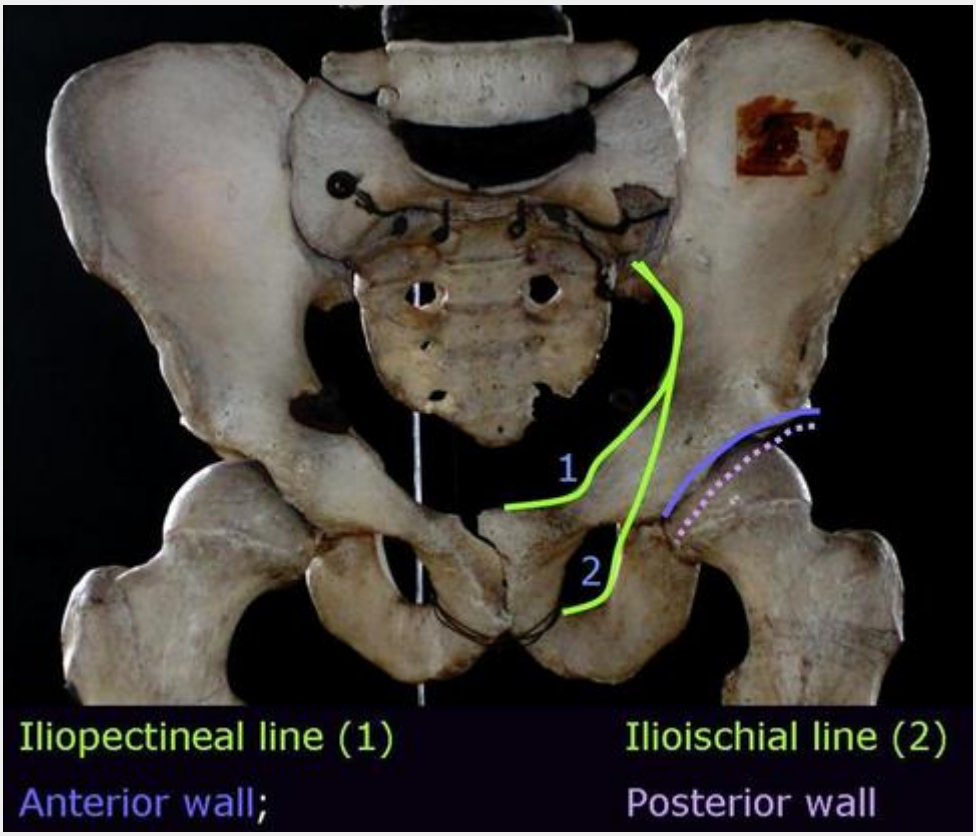
The anterior column extends above the dome into the iliac wing, and fracture lines disrupting the iliac wing indicate an anterior column component to the fracture pattern.

The obturator rings are composed of the osseous structures that surround the obturator foramen, which include the superior pubic ramus and a combination of the inferior pubic ramus and ischium (or ischiopubic ramus).

The iliopectineal line runs from the superior margin of the greater sciatic notch, extending anterior to follow the pelvic brim along the superior pubic ramus to the symphysis pubis.

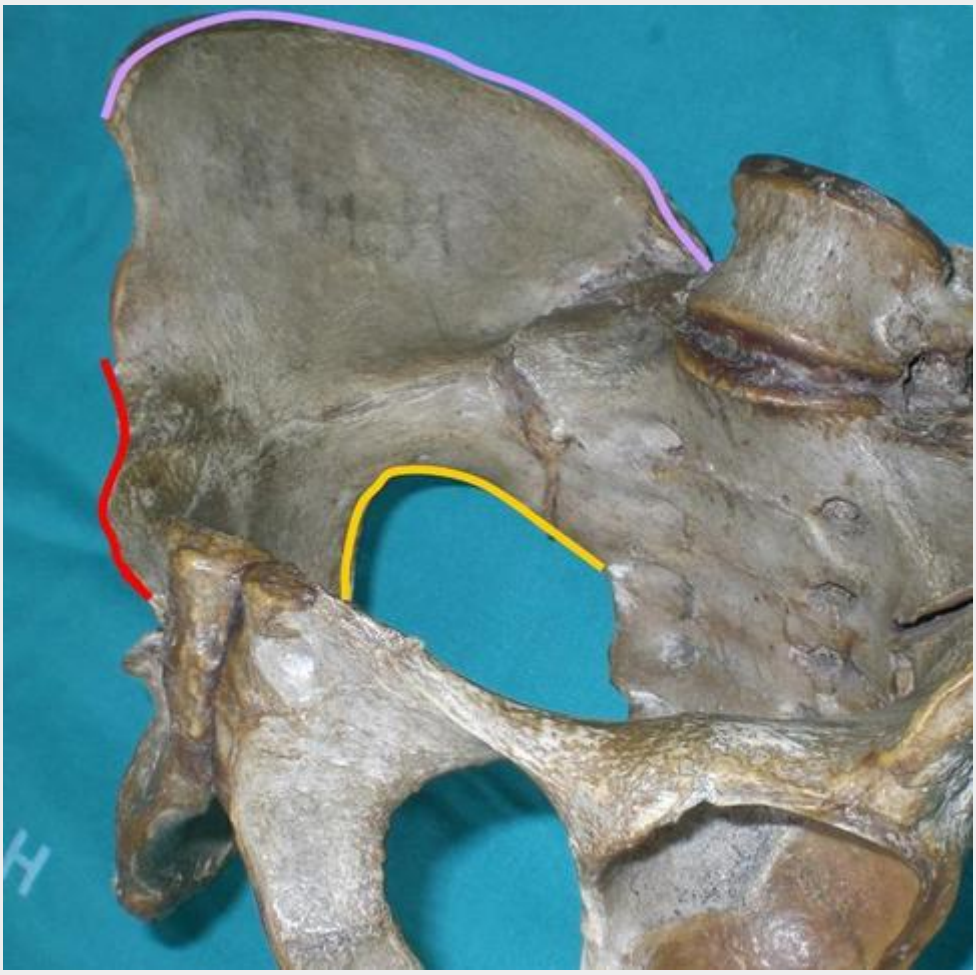
The ilioischial line runs from the greater sciatic notch vertically past the cotyloid notch, superimposing on the lateral side of the teardrop, extending inferior to the level of the obturator ring.

Figure 1



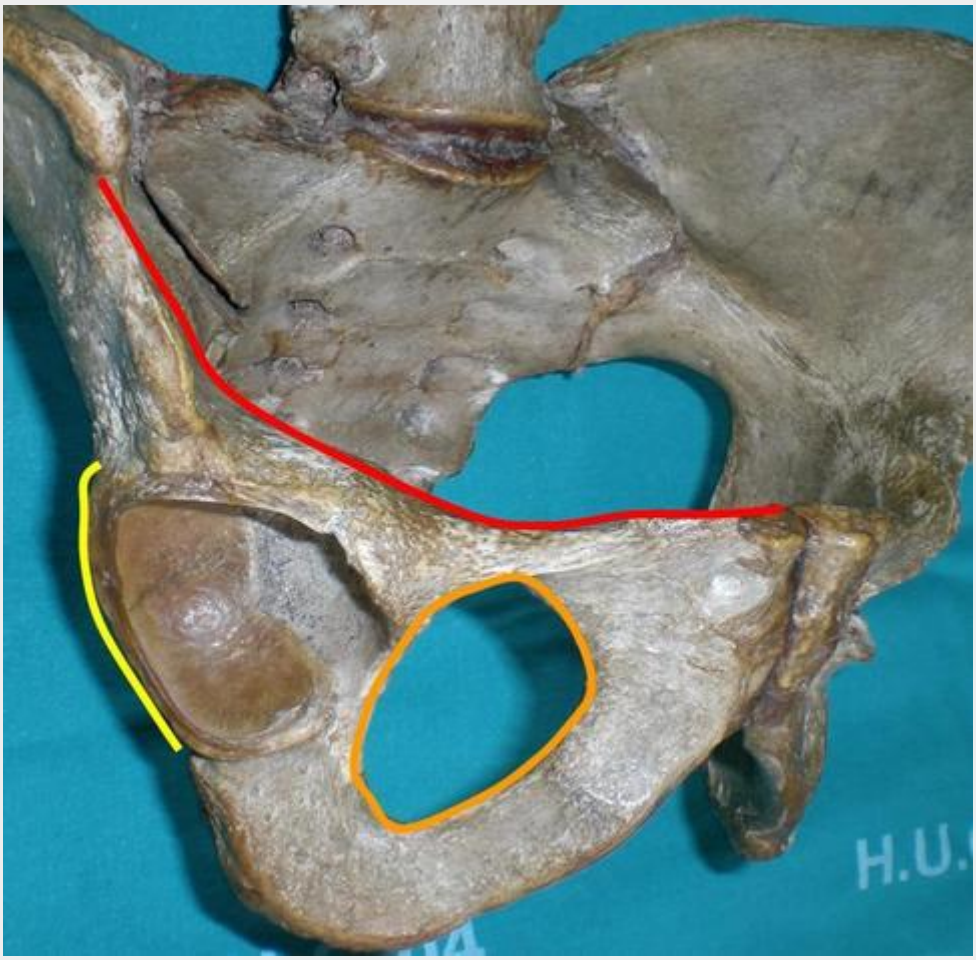
Normal anatomy of acetabulum. Anteroposterior view of pelvis shows ilioischial and iliopectineal lines and anterior and posterior walls outlined on left acetabulum.

Figure 2



Normal anatomy of acetabulum. In "iliac oblique view", the greater sciatic notch (yellow) and iliac wing are well seen. Part of the anterior column is outlined (red).

Figure 3



Normal anatomy of acetabulum. "Obturator oblique view" shows the obturator ring to advantage. Also, iliopectineal line (red) and posterior wall (yellow) are well seen.

II. JUDET AND LETOURNEL CLASSIFICATION

The Judet and Letournel classification is based on the distribution of fracture lines and fragments as recorded on an anteroposterior (AP) radiograph of the pelvis and AP internally (obturator) and externally (iliac) rotated oblique radiographs of the involved acetabulum.

Fractures are divided into elementary and associated patterns. The elementary fractures consist of a single main fracture line, whereas associated fractures involve combinations of elementary fractures.

The elementary fracture includes:

- anterior wall,
- [Posterior wall fracture.] posterior wall,
- anterior column,
- posterior column and
- transverse fractures.

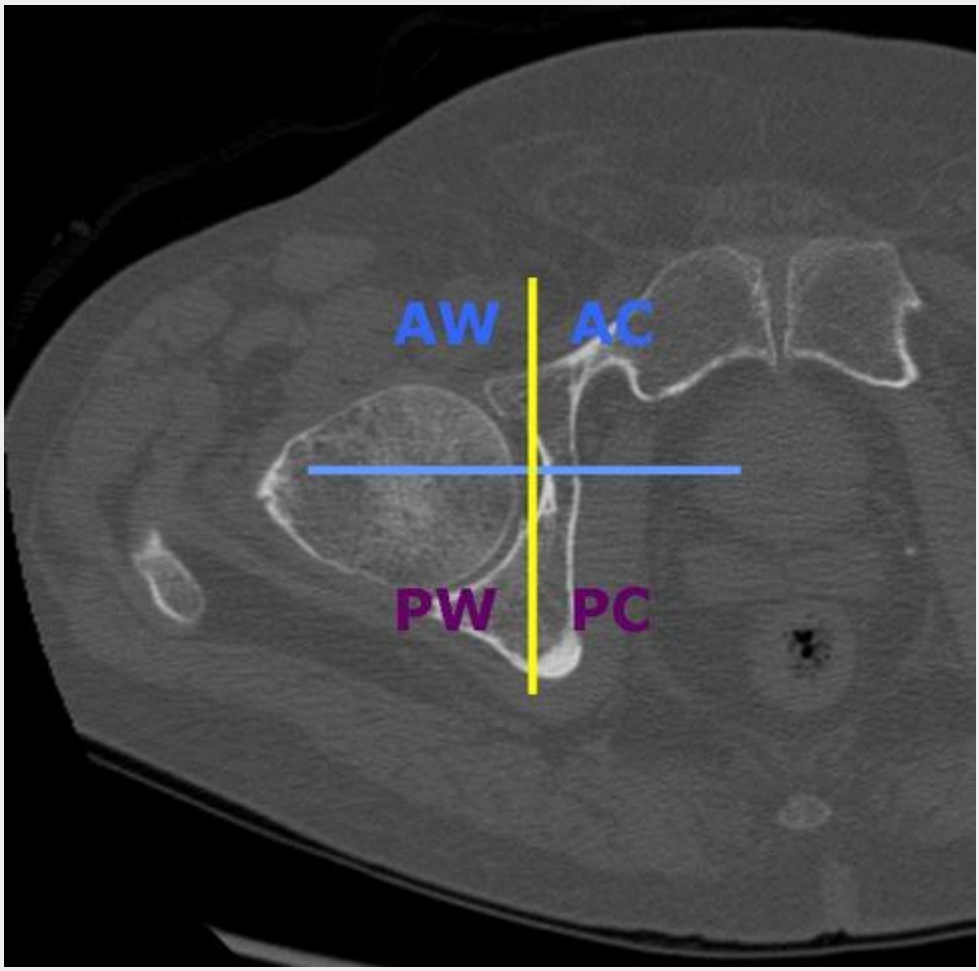
The associated fractures include:

- [Both-column fracture.] both-column,
- T-shaped,
- [Transverse with posterior wall acetabular fracture.] transverse with posterior wall,
- posterior column with posterior wall and
- anterior column with posterior hemi-transverse fractures.

III. CT EVALUATION

2D CT and 3D CT reformations are the definitive imaging techniques for the assessment of acetabular fractures.

Figure 4



Anterior and posterior walls and columns of the right acetabulum are seen in this axial CT scan.

Three-dimensional reconstructions are helpful for surgical planning. Techniques that improve fracture visualization include disarticulating the ipsilateral hip and reconstructing only the fractured hemipelvis.

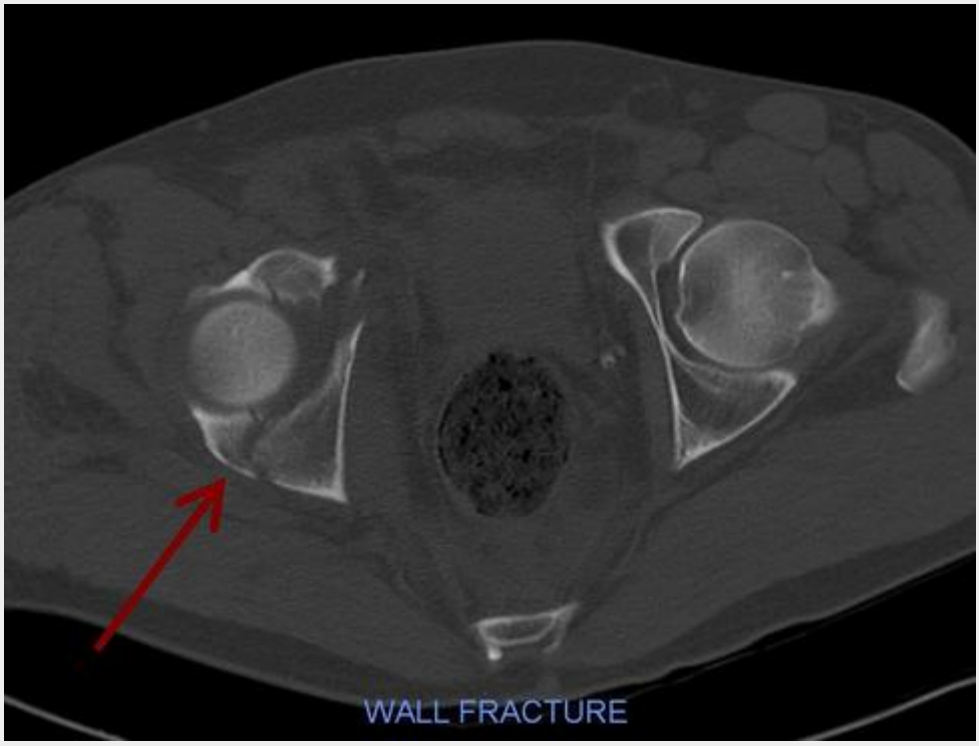
Another way to organize the 10 fracture type is to divide them into those that are predominantly:

- [Wall-type fractures.] wall-type fractures;
- [Column-type fractures.] column-type fractures, or
- [Transverse-type fractures.] transverse-type fractures.

They may occur as isolated injuries or in conjunction with any other category of acetabular fracture.

Wall fractures have an oblique orientation on CT scans.

Figure 8



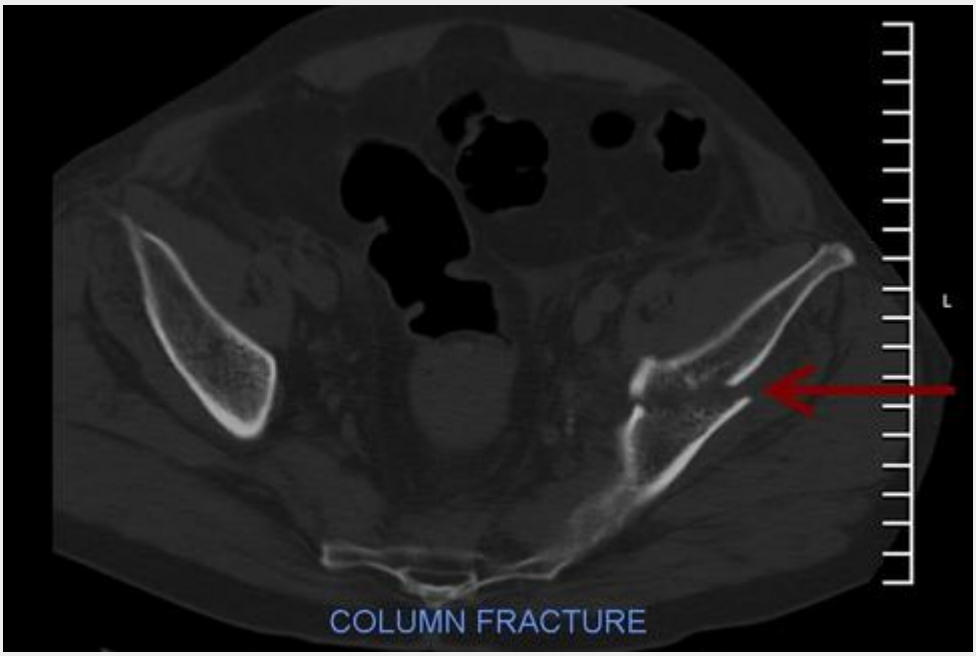
CT scan of a patient with posterior wall fracture of left acetabulum shows oblique orientation of main fracture plane (arrow).

Isolated fractures of the walls generally do not involve the obturator ring or iliac wing and do not disrupt the ilioischial or iliopectineal lines.

Size of the wall fragment is important for predicting posterior stability of the hip and correlates with altered force distribution in the hip.

For **column-type fractures**, the main fracture plane on CT is from medial to lateral, producing a horizontal fracture on the CT image.

Figure 9

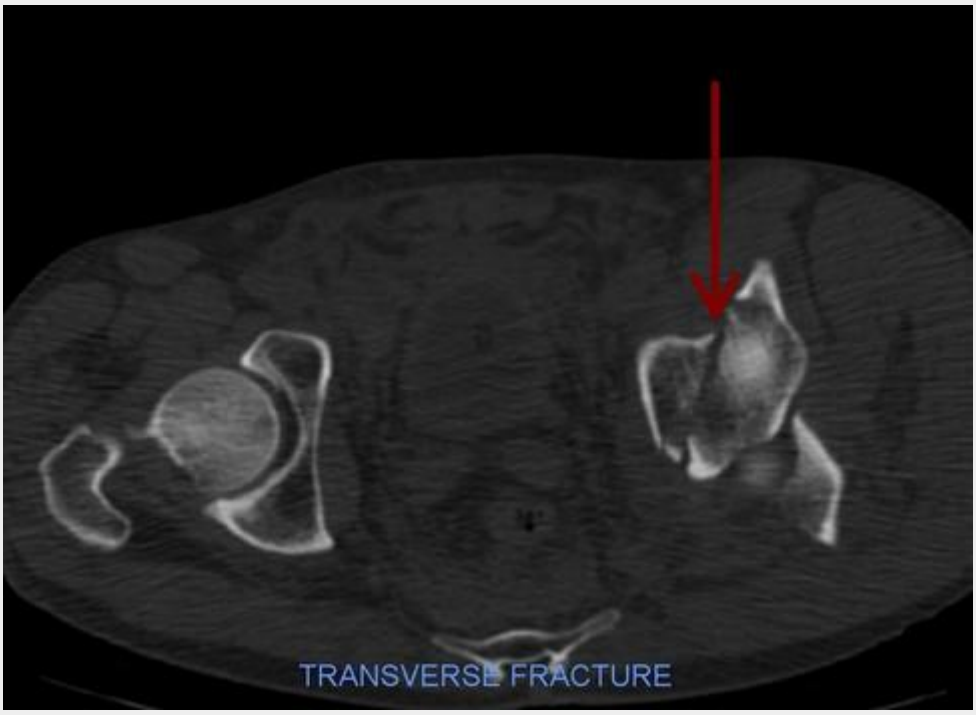


CT scan of a patient with anterior column fracture of left acetabulum, with superior extension to the iliac wing, shows horizontal orientation of fracture line.

Because nearly all column fractures extend down into the obturator ring, detection of the obturator ring fractures is important.

With **transverse-type fractures**, the main fracture plane runs through the acetabulum from the back to the front of the pelvis.

Figure 10



CT scan of a patient with fracture of the left acetabulum shows a vertically oriented main fracture line. A second fracture plane is seen with oblique orientation.

On CT, these fractures show an anteroposterior (vertical) fracture plane. The fracture line is not actually in the anatomic transverse plane, but rather it is transverse relative to the acetabulum. The transverse fracture of the acetabulum is limited to the acetabulum, without involvement of the obturator ring.

The usual location for **obturator ring fractures** is inferior at the ischiopubic junction, but anterior column patterns will involve the anterior part of the ring at the puboacetabular junction or superior pubic ramus.

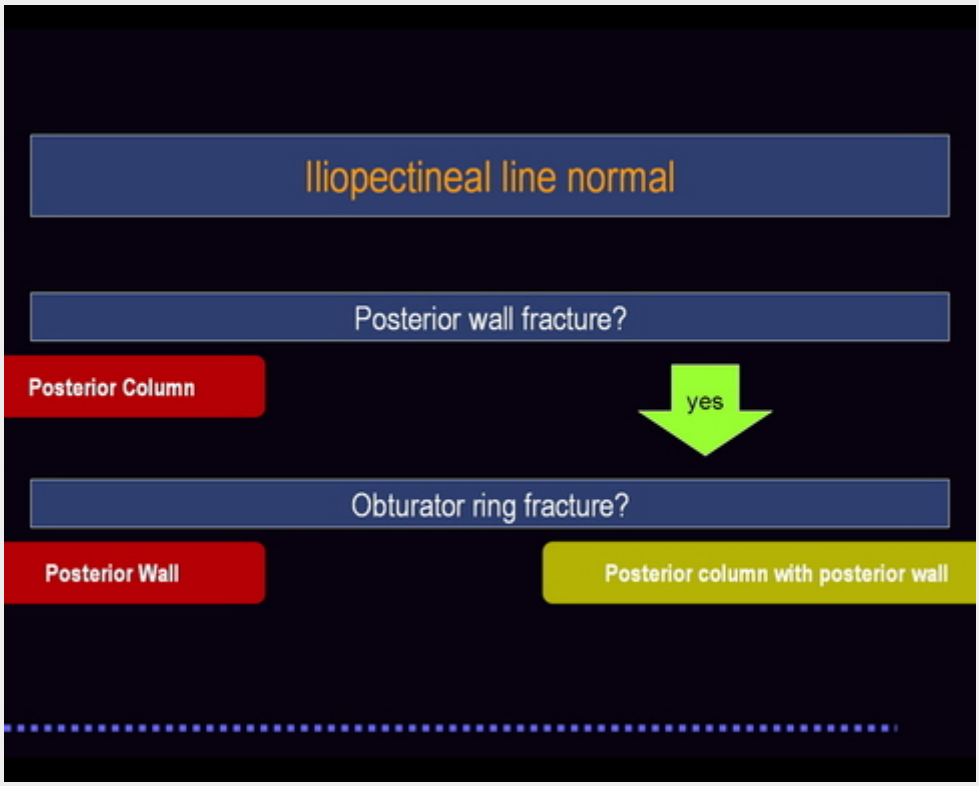
In the setting of acetabular fracture, if the obturator ring is broken, then the patient has either a column-type fracture or a T-shaped fracture.

It is important to note that obturator ring fractures may be associated with other pelvic injuries outside of the acetabulum.

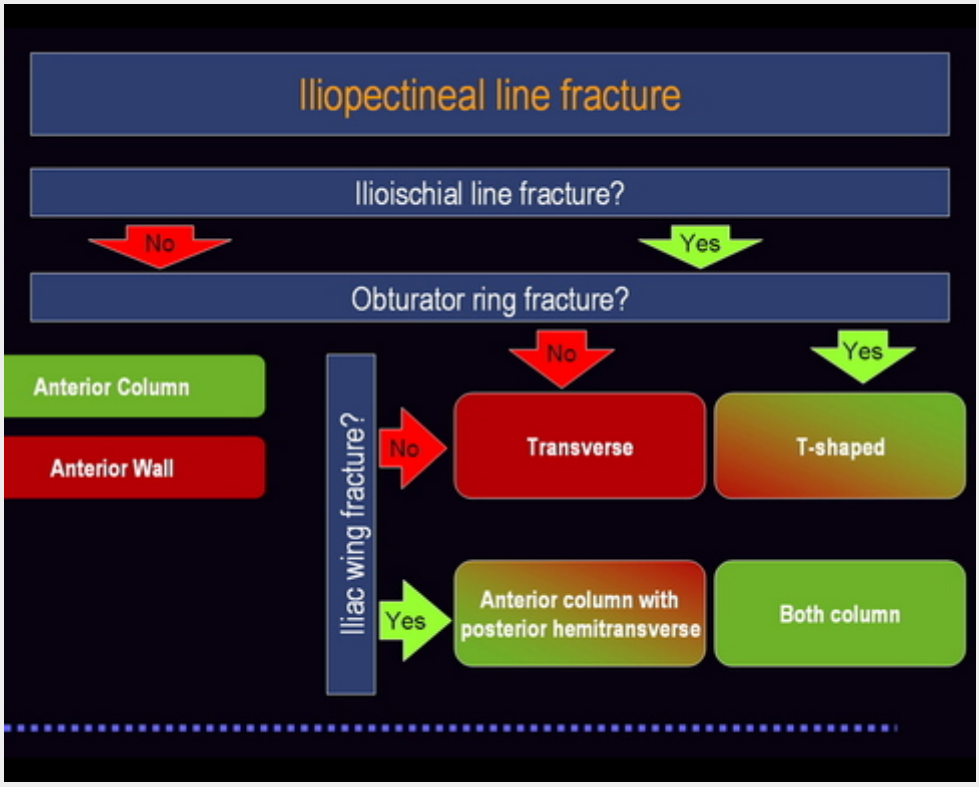
The **spur sign** represents posterior displacement of the sciatic buttress of the iliac wing fracture, which essentially disconnects the roof of the acetabulum from the axial skeleton. If present, it is a pathognomonic sign of a both-column fracture. However, not all both-column fractures will have a spur sign: only those with medial displacement of the acetabular fragments.

IV. SYSTEMATIC APPROACH

algoritmo diagnóstico 1.jpg



algoritmo diagnóstico 2.jpg



V. CONCLUSION

For inexperienced observers, the classification of Judet and Letournel is complicated to use. CT provides reliable information for the staging of acetabular fractures.

3. References

1. Acetabular Fractures: Easier Classification with a Systematic Approach; Eric Brandser, J. L.Marsh; AJR:171 November 1998 1217-1228

1. Acetabular Fractures Revisited: Part 2, A New CT-Based Classification; John H. Harris, Jr., Kevin J. Coupe, Jody S. Lee, Thea Trotscher; AJR 2004;182:1367–1375

1. Classification of Common Acetabular Fractures: Radiographic and CT Appearances; N. Jarrod Durkee, Jon Jacobson, David Jamadar, Madhav A. Karunakar, Yoav Morag, Curtis Hayes; AJR 2006; 187:915–925

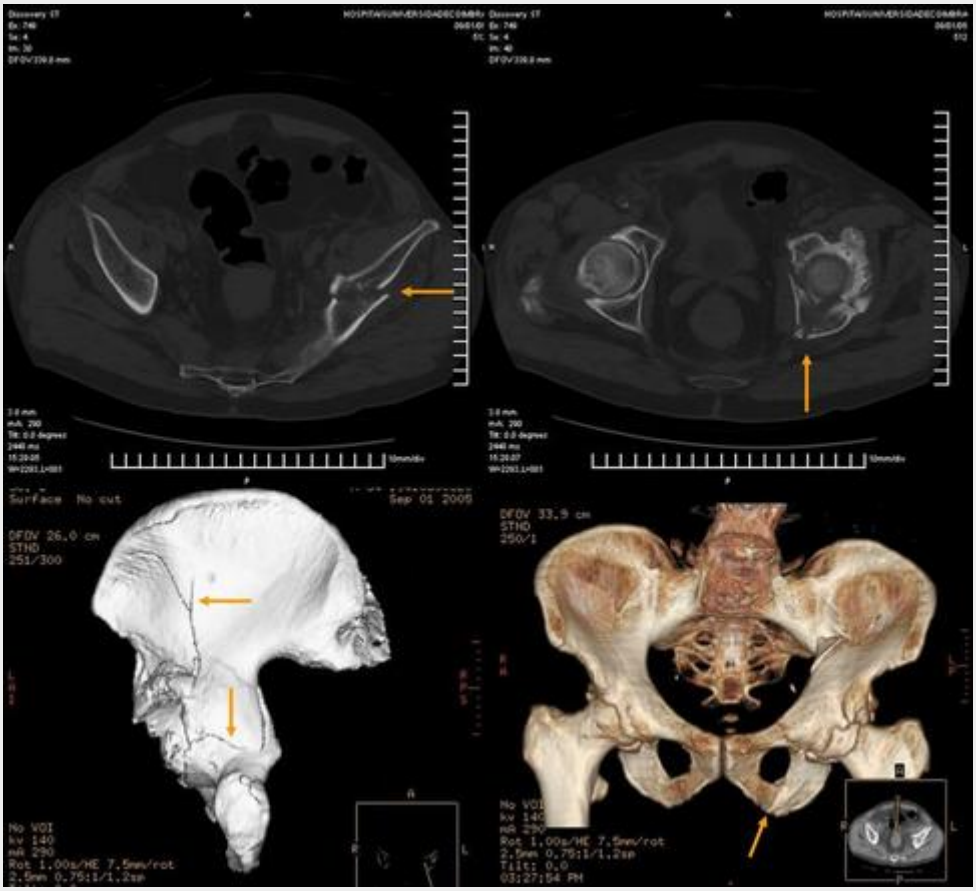
1. Fractures of the Acetabulum: Imaging, Classffication, and Understanding; Paul S. Potok, Kenneth D. Hopper, Marjorie J Umlauf; RadioGraphics 1995; 15:7-23

1. Evaluation of Acetabular Fractures with Two- and Three-dimensional CT; Carlos R. Martinez, Thomas G. Di Pasquale, David L. Helfet, Angus W. Graham, Roy W. Sanders, Lisa D. Ray; RadioGraphics 1992; 12:227-242

1. Interobserver Agreement for Letournel Acetabular Fracture Classification with Multidetector CT: Are Standard Judet Radiographs Necessary?; Kenjirou Ohashi, Georges Y. El-Khoury, Khalil W. Abu-Zahra, Kevin S. Berbaum; Radiology: Volume 241: Number 2—November 2006

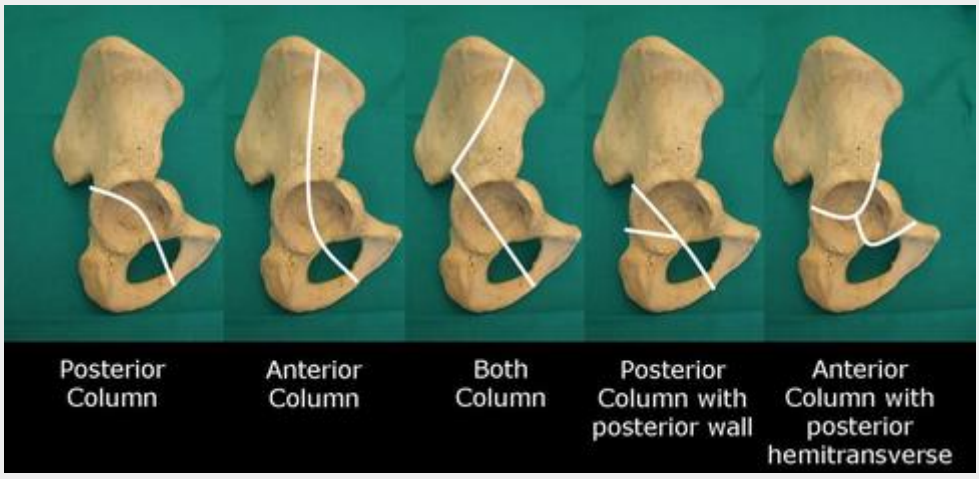
4. Mediafiles

Both-column fracture.



CT scan shows superior extension of anterior column fracture into iliac wing, associated with fracture of the posterior column. There is also fracture of the left inferior pubic ramus.

Column-type fractures.



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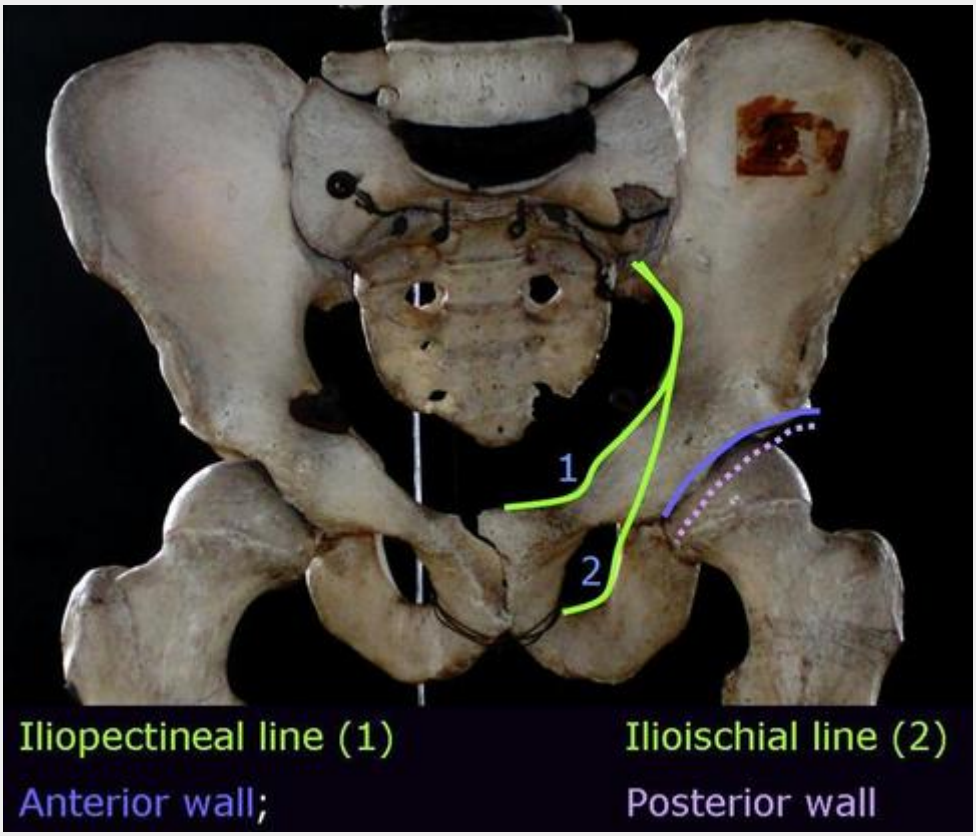

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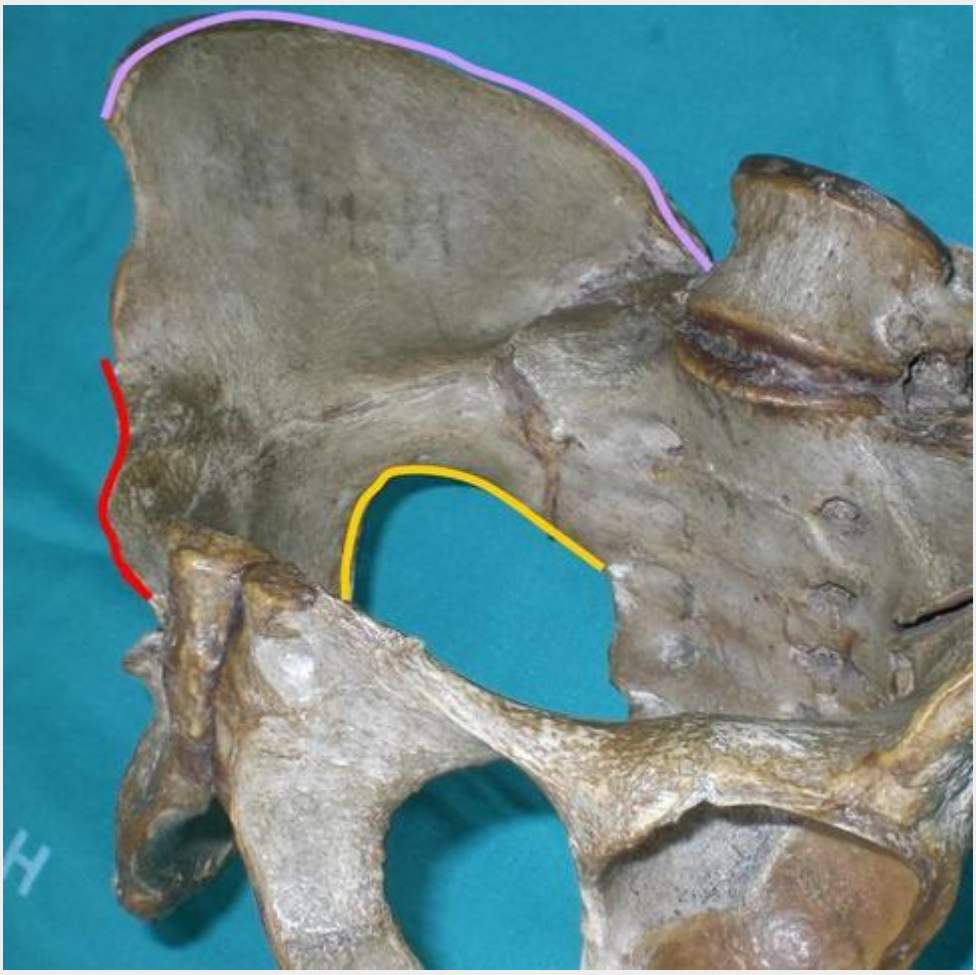

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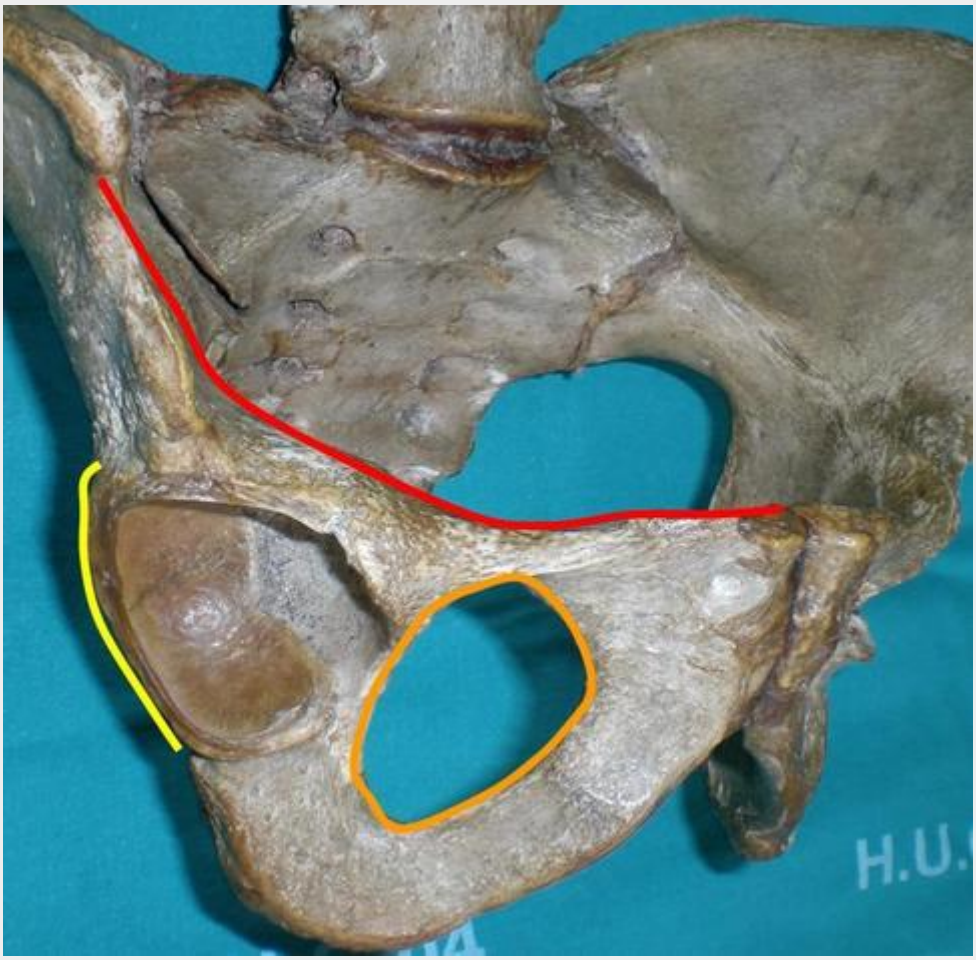

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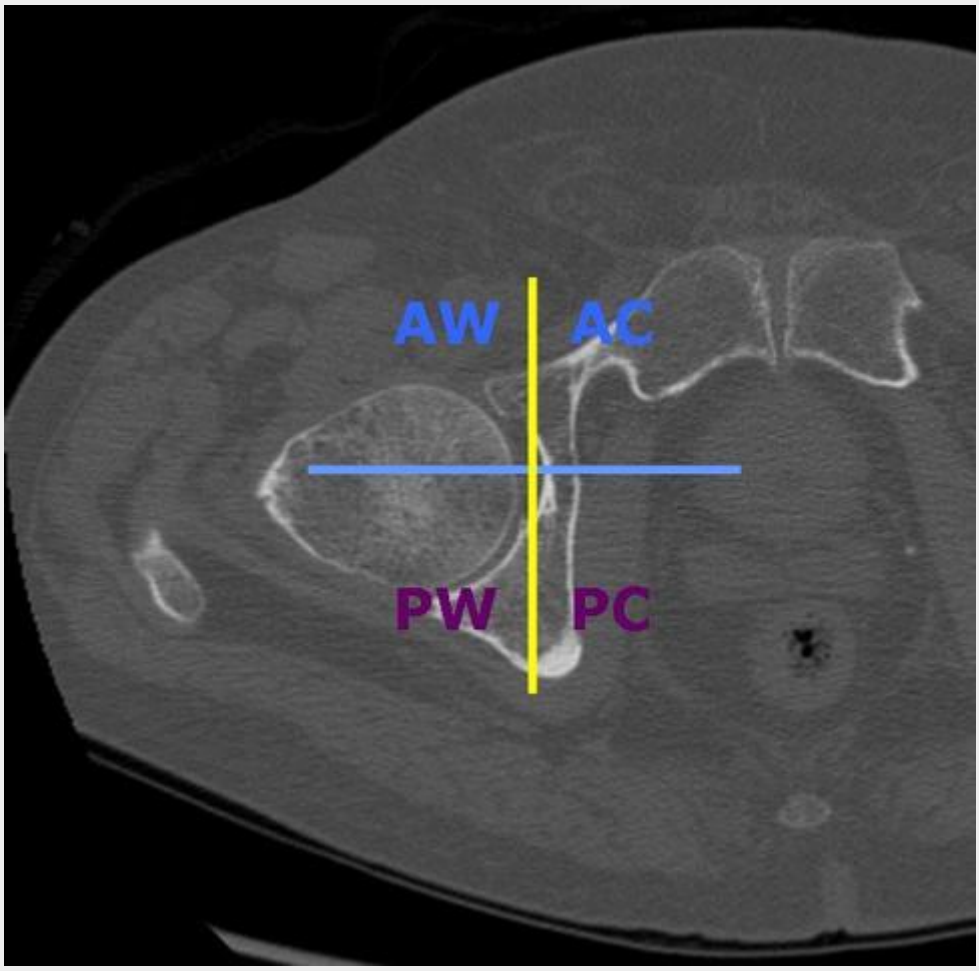

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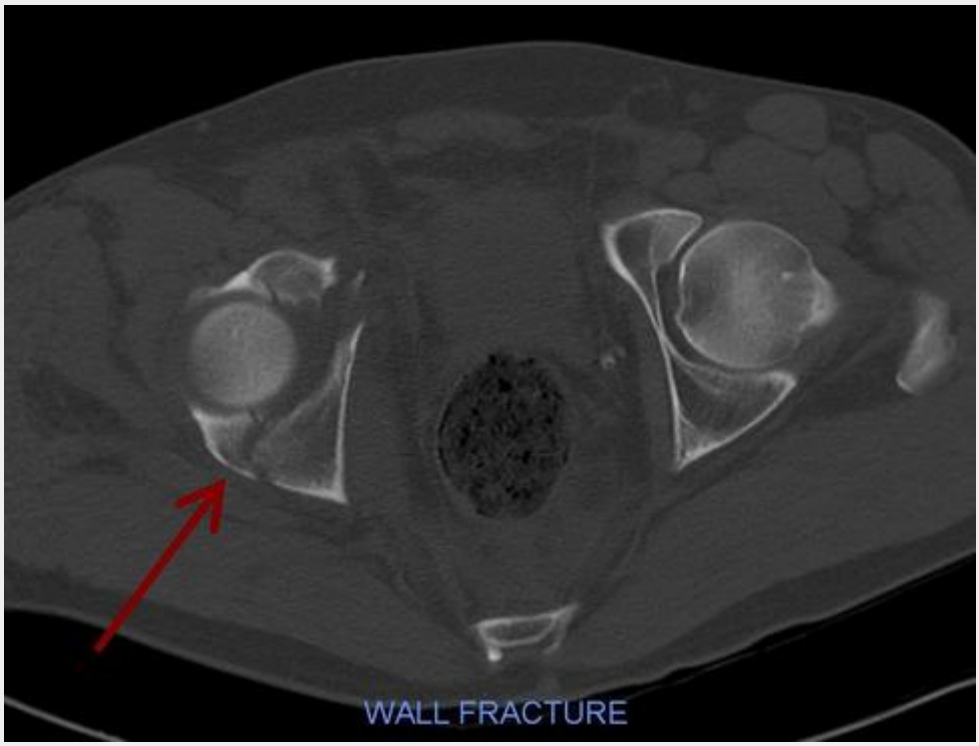
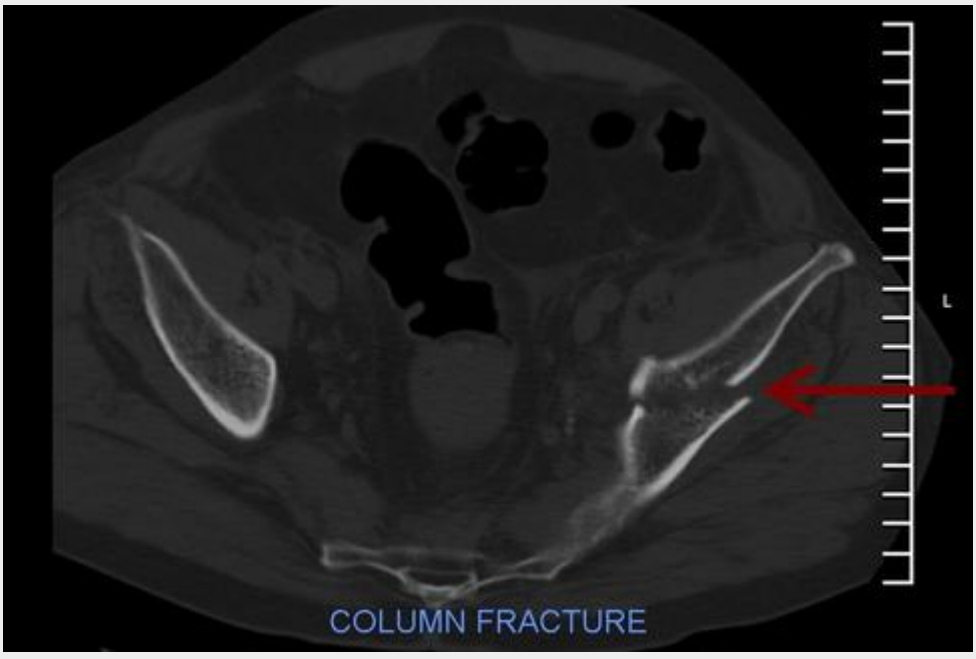


CT scan of a patient with posterior wall fracture of left acetabulum shows oblique orientation of main fracture plane (arrow).

Figure 9



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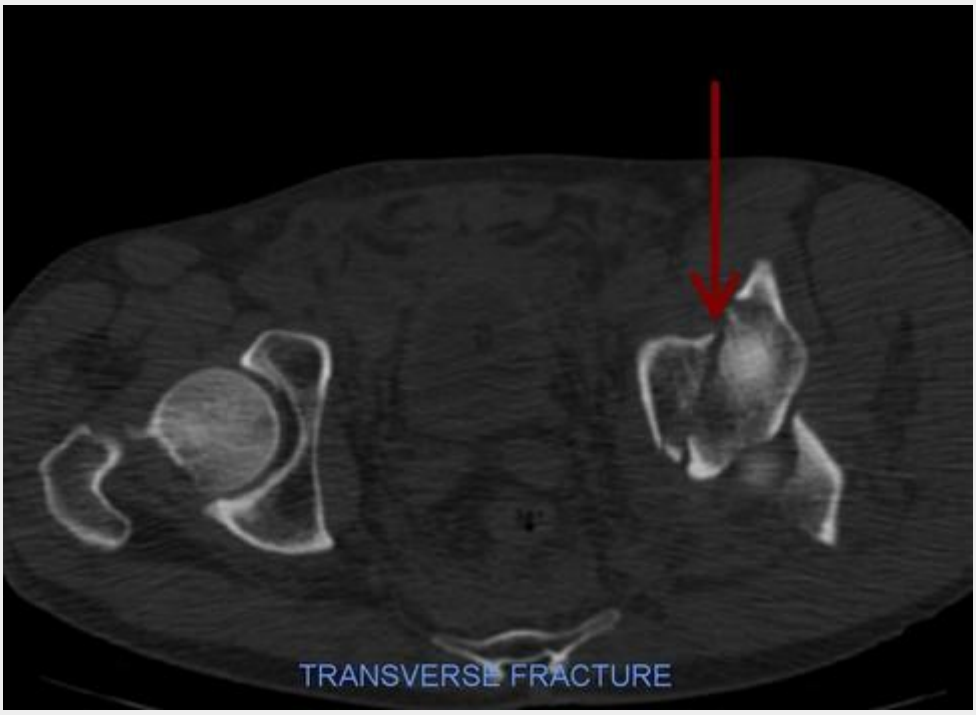

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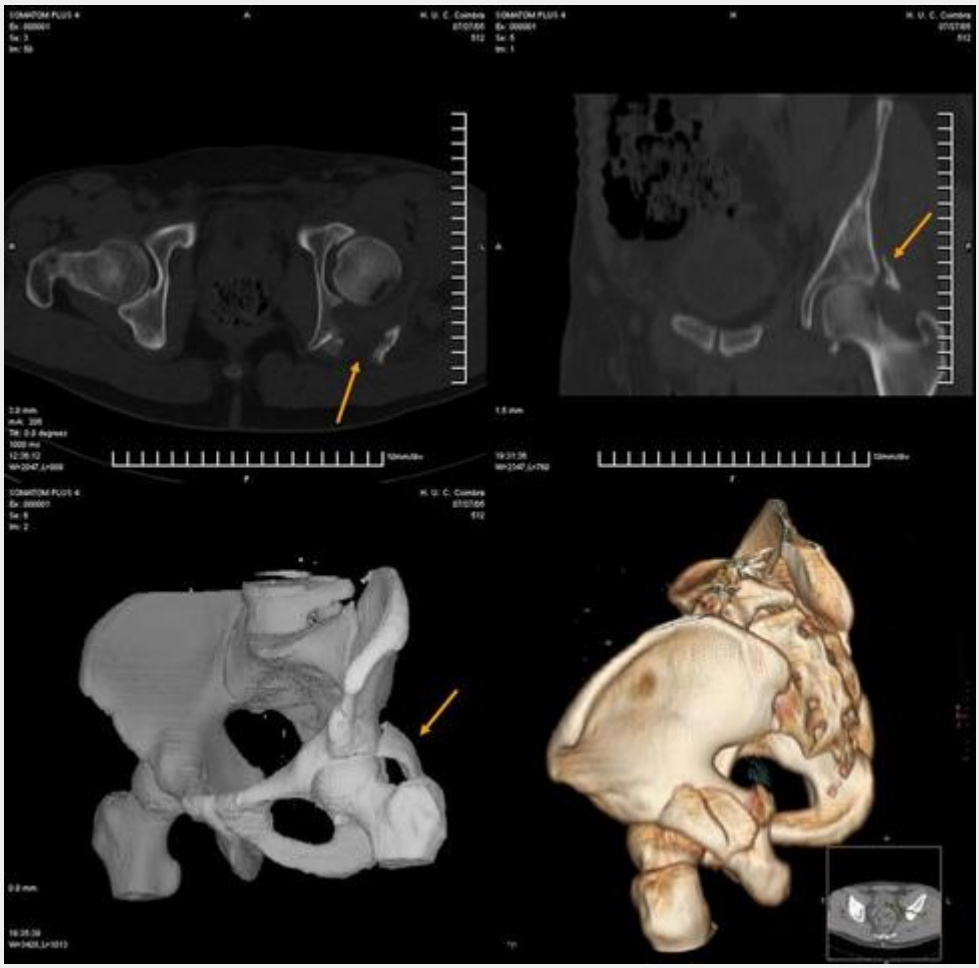
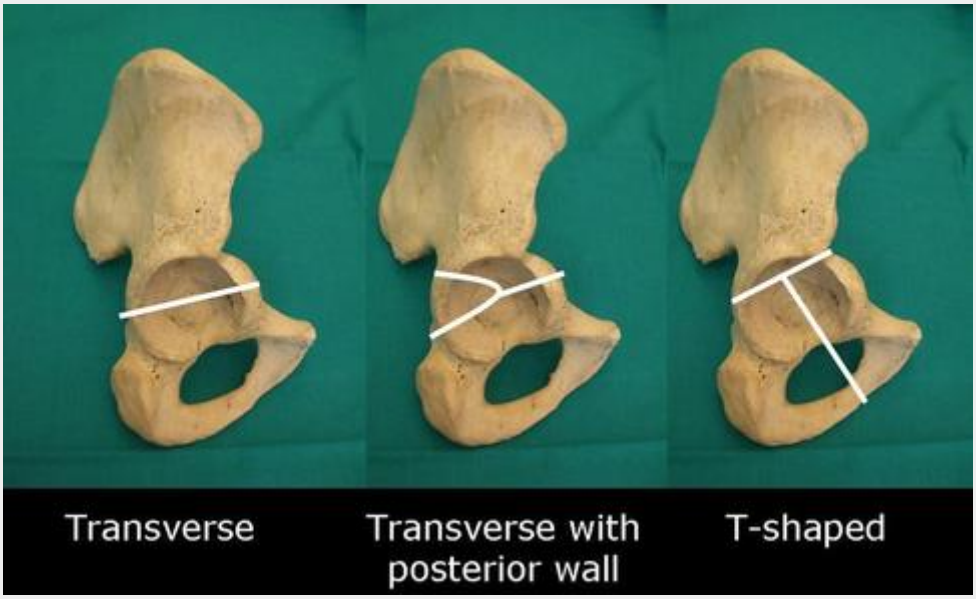
Posterior wall fracture.

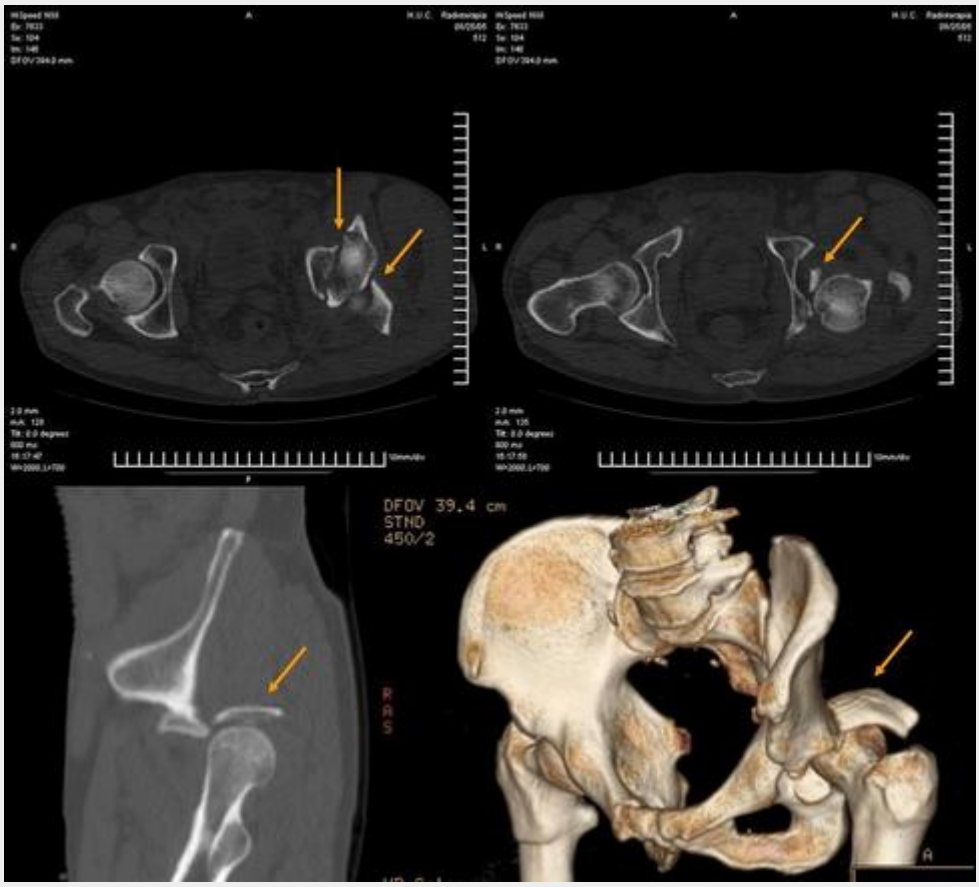


CT scans show displaced posterior wall fracture of left acetabulum.

Transverse-type fractures.

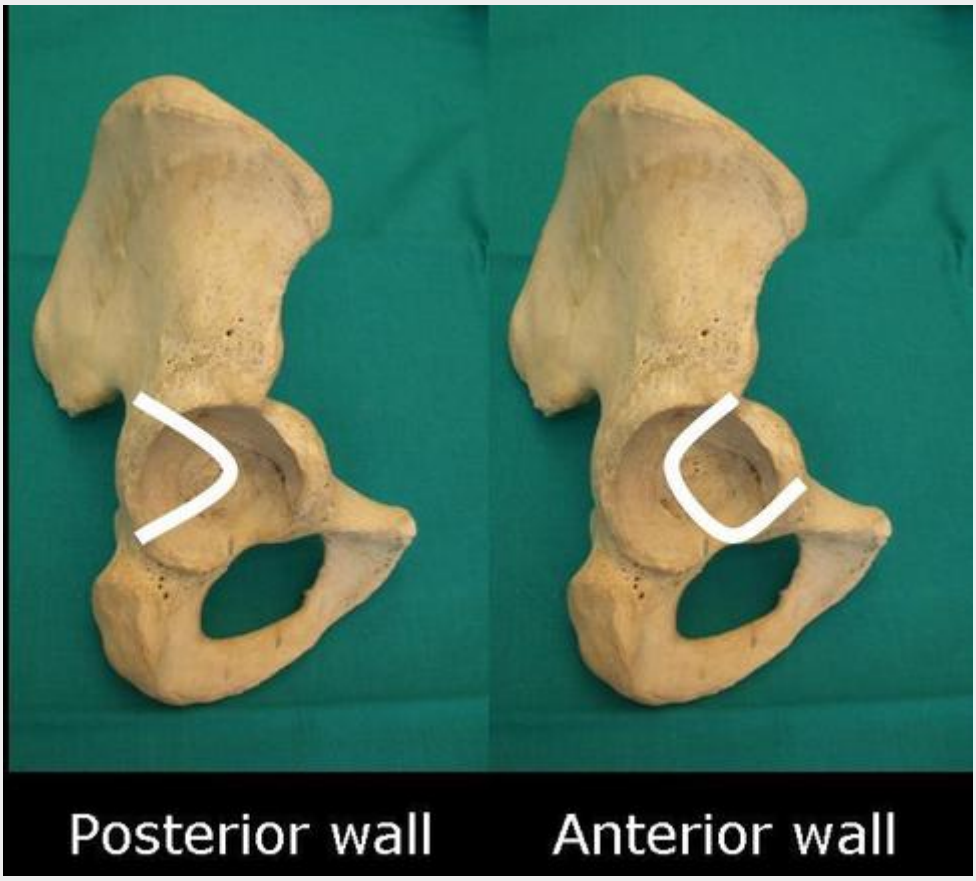


Transverse with posterior wall acetabular fracture.



Transverse fracture disrupting iliopectineal and ilioischial lines with displaced posterior wall fracture fragment. There is also an intra-articular fragment.

Wall-type fractures.



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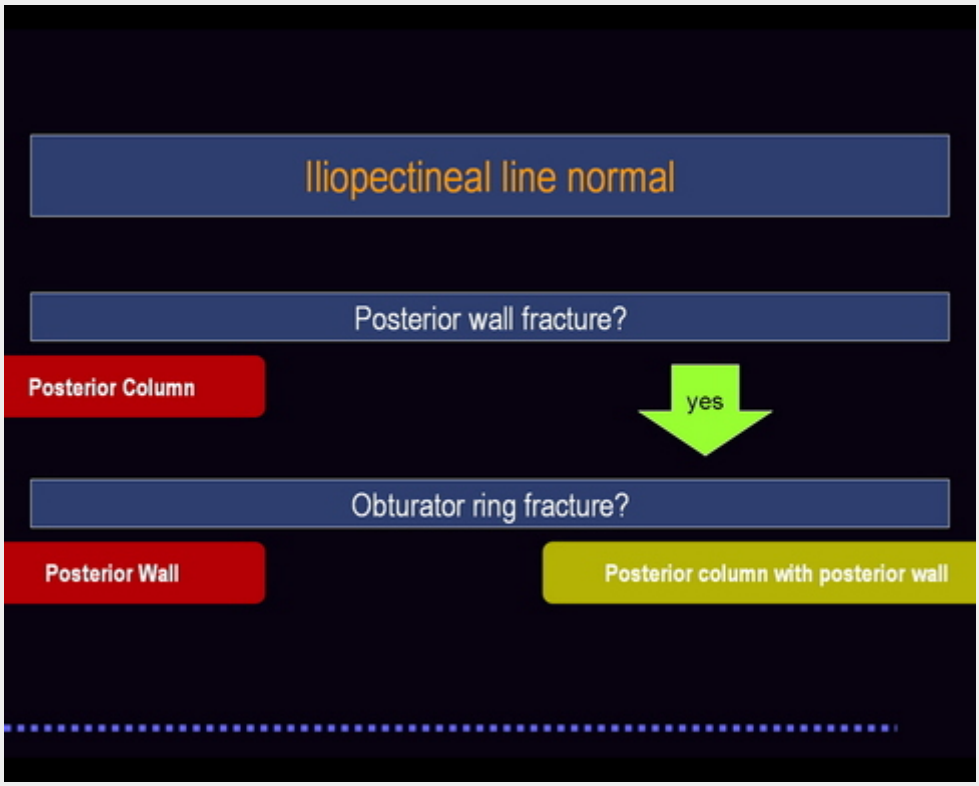

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