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Classification of Acetabular Fractures

Disclosures

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Introduction

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For the purposes of classification of fracture patterns, the acetabulum is divided into an anterior and posterior column, of which the anterior column is the larger (Figure 1). The anterior column comprises the anterior border of the iliac wing, the entire pelvic brim, the anterior wall, and the superior pubic ramus (Figure 2). The posterior column comprises the greater and lesser sciatic notches, the ischial tuberosity, the posterior wall, and the entire retroacetabular surface (Figure 3). Radiographic classification of fractures of these structures was the subject of a presentation given by this author, Dr. Matthew L. Jimenez, Illinois Bone and Joint Institute, at the second annual Chicago Trauma Symposium, June 23-25, 2000.

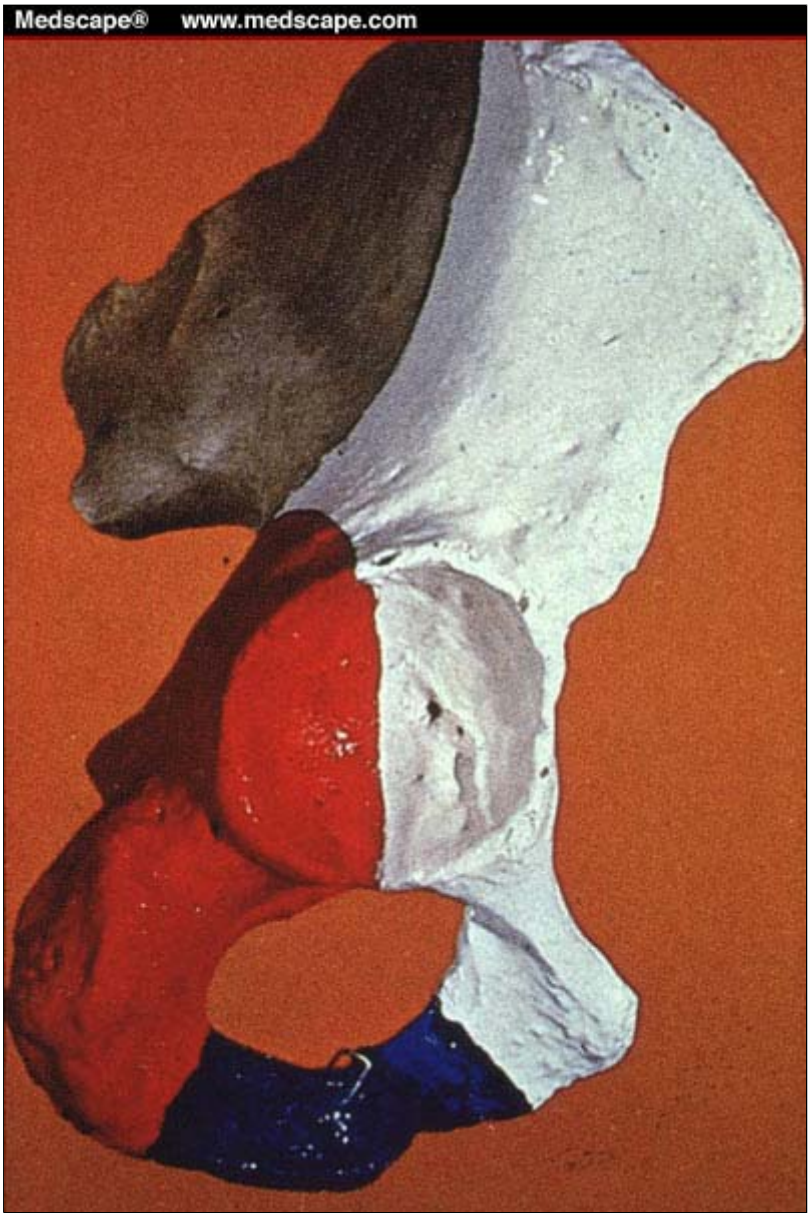

Figure 1. Anterior column in while, posterior column in red.

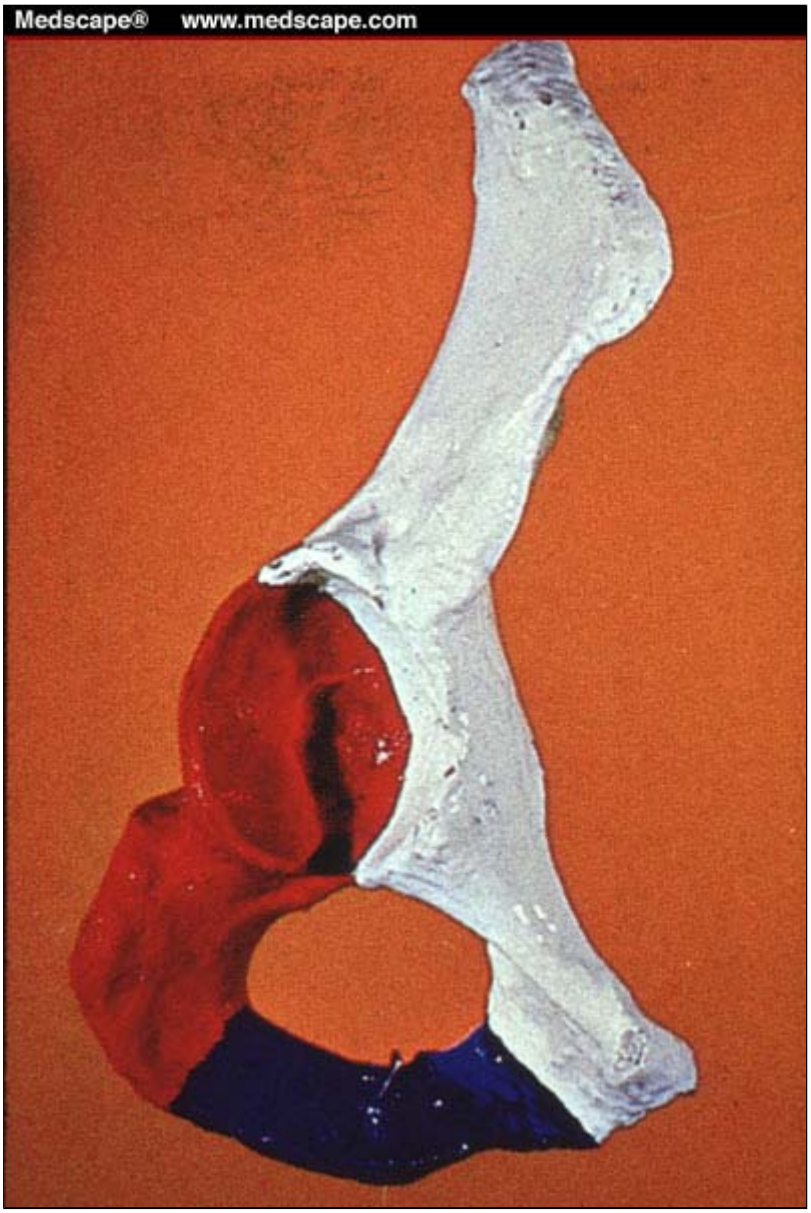

Figure 2. The anterior column is in white.

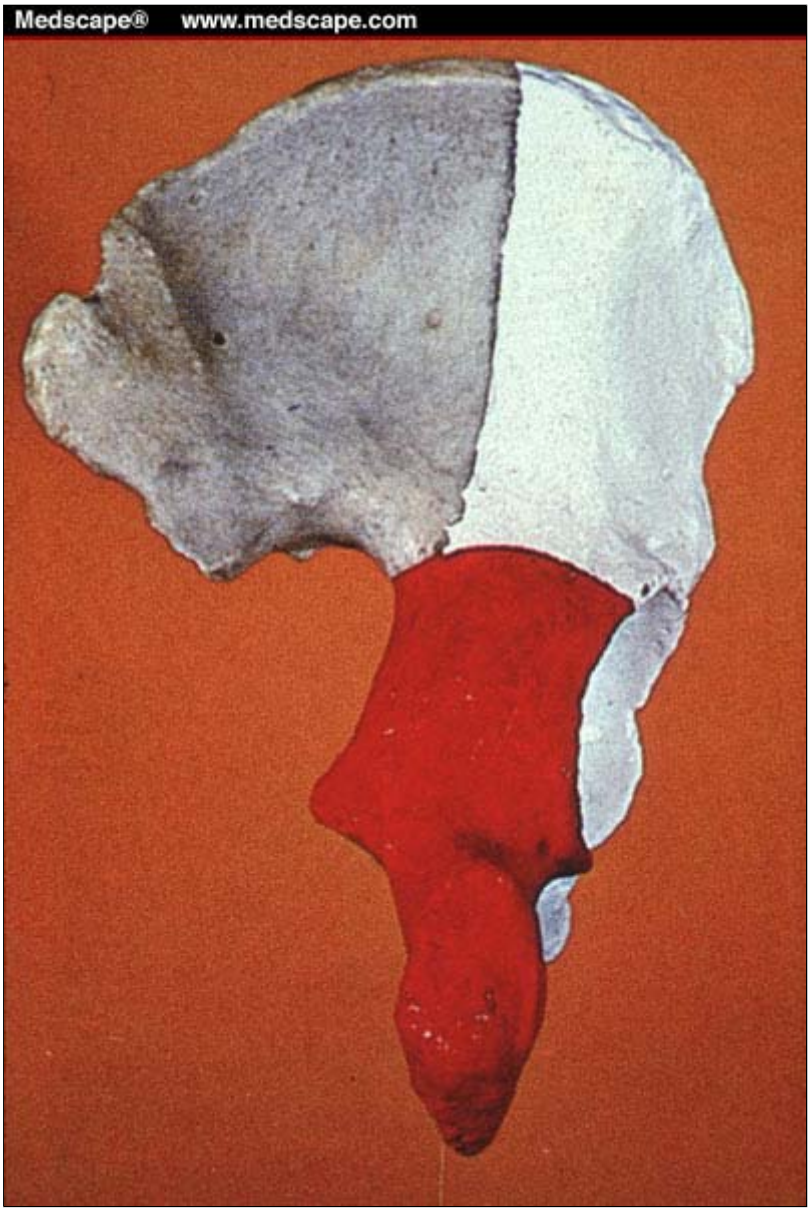

Figure 3. The posterior column is in red.

Anteroposterior Radiograph Lines

On anteroposterior (AP) radiographs of the acetabulum, 6 major lines should be considered (Figures 4-5):

- the iliopectineal line (1)
- the ilioischial line (2)
- the teardrop (the medial portion of the teardrop represents the quadrilateral surface and the lateral portion represents the medial aspect aspect of the acetabular floor) (3)
- the dome (4)
- the anterior wall (5)
- the posterior wall (6)

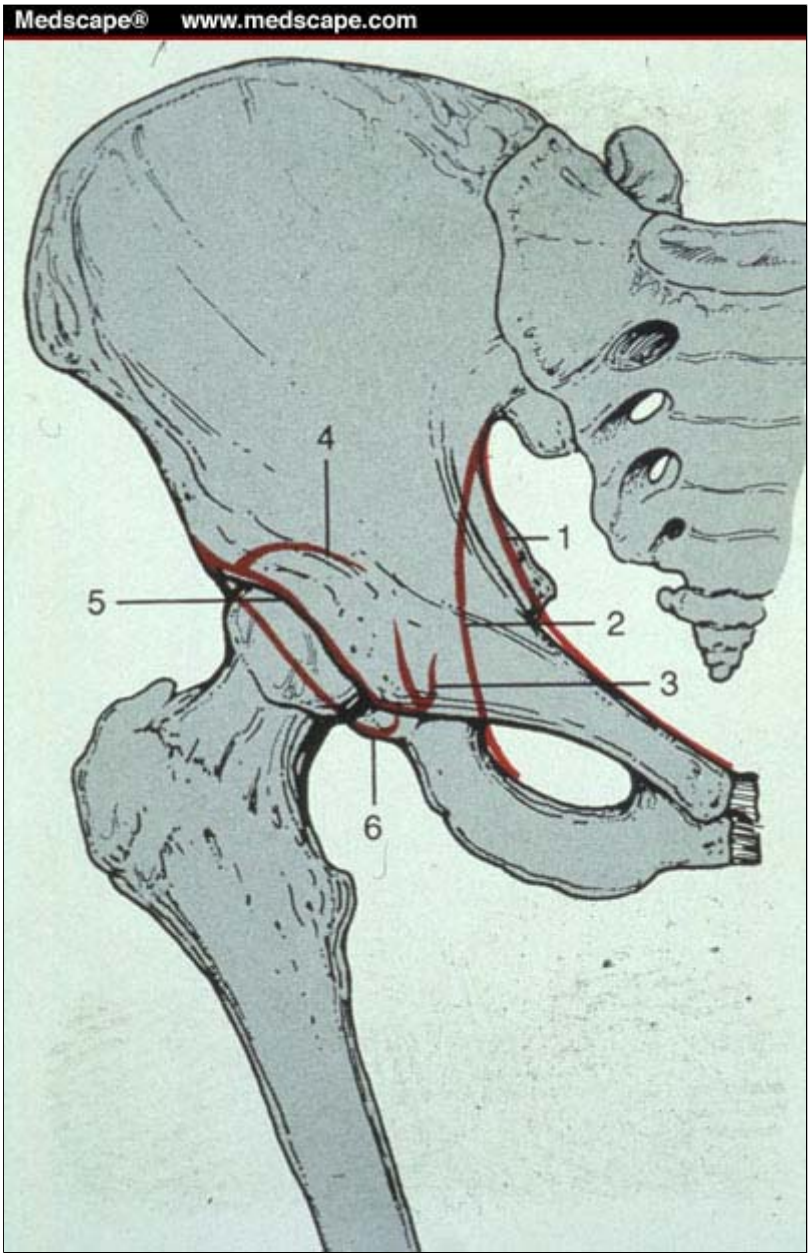

Figure 4. The 6 major lines to be considered on the AP view of the pelvis.

Figure 5. A radiographic correlation to Figure 4.

Each of the preceding is merely a representation of that portion of the acetabulum and can be considered to be a segment of bone that is tangential to the x-ray beam. For example, the iliopectineal line is not the entire anterior column of the acetabulum, but a representation of a portion of bone in the anterior column that is tangential to the x-ray beam. Similarly, the ilioischial line is a representation of the posterior column or a segment of bone that is tangential to the x-ray beam.

Other Views

During radiographic assessment of an acetabular fracture, the surgeon must evaluate the obturator oblique radiograph, iliac oblique radiograph, and 2-dimensional computed tomography (CT) scans. The obturator oblique view allows the surgeon to view the anterior column and posterior wall. The iliac oblique view allows the surgeon to image the posterior column and the anterior wall. The inlet view allows the surgeon to view anteroposterior displacement of the hemipelvis. The outlet view allows evaluation of superior and inferior displacement of the hemipelvis.

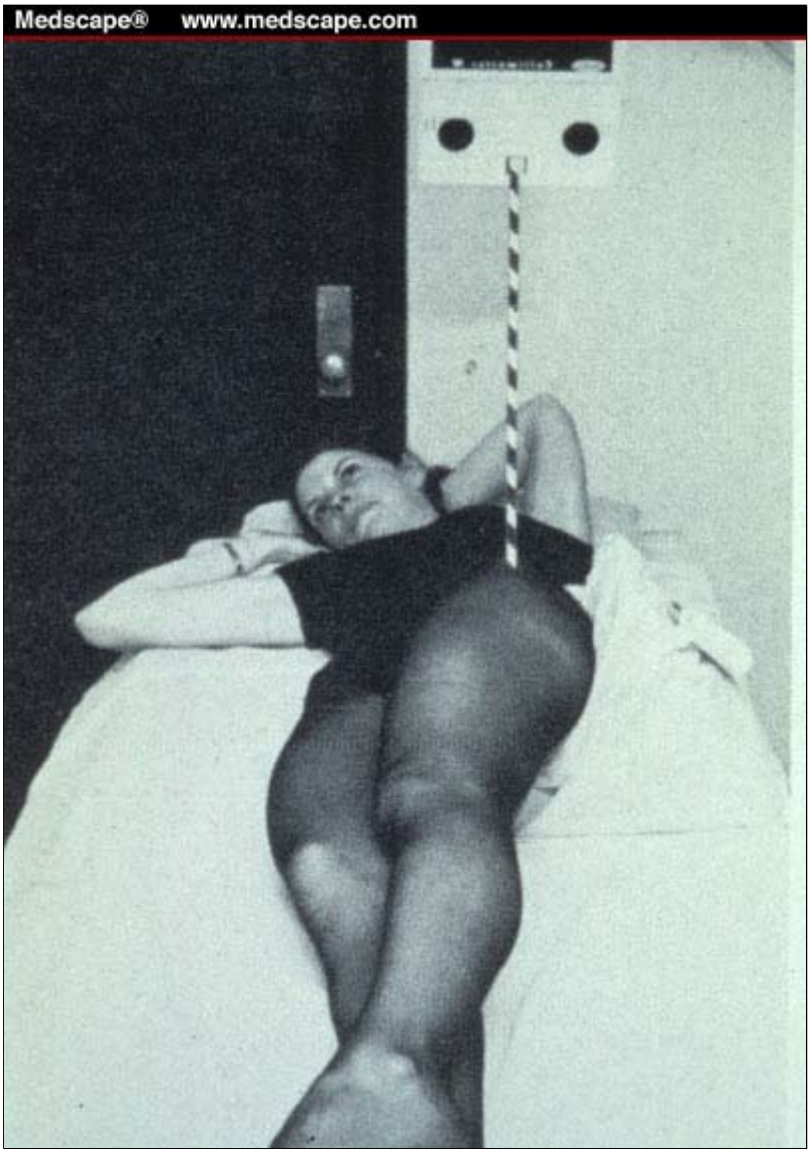

Figure 6. Patient positioning for the obturator oblique view.

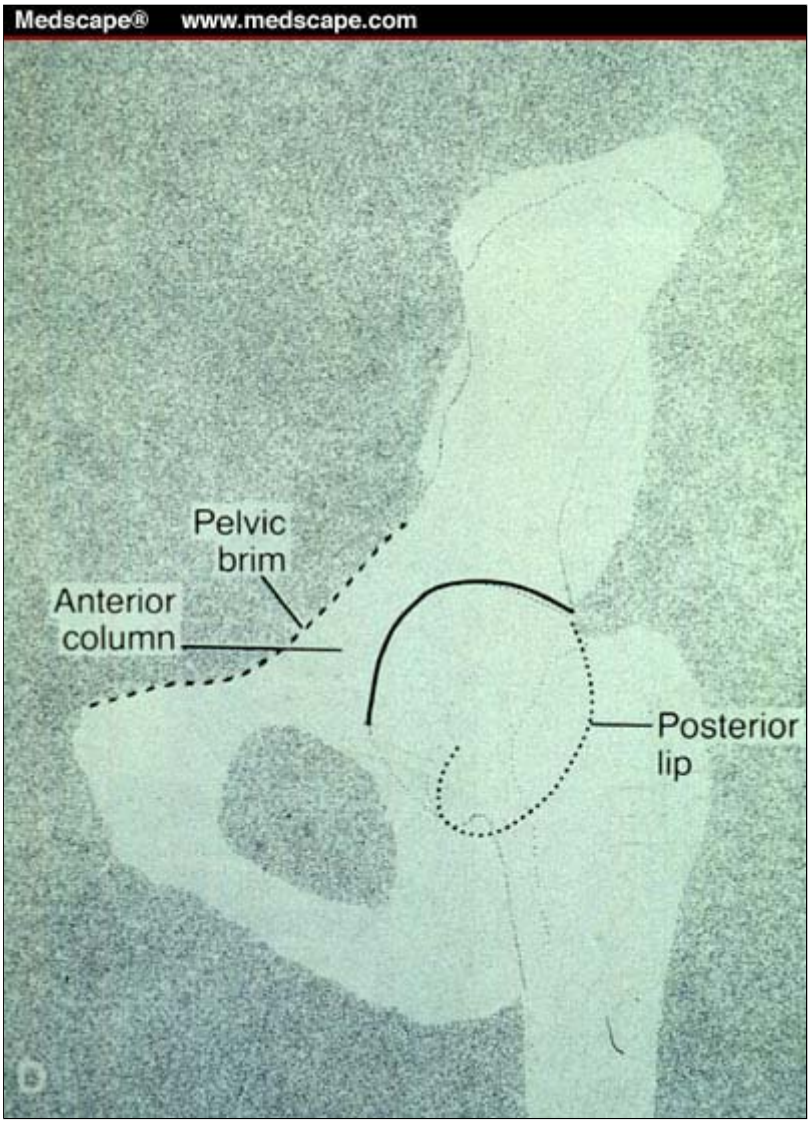

Figure 7. Landmarks on the obturator oblique view.

Figure 8. Patient positioning for the iliac oblique view.

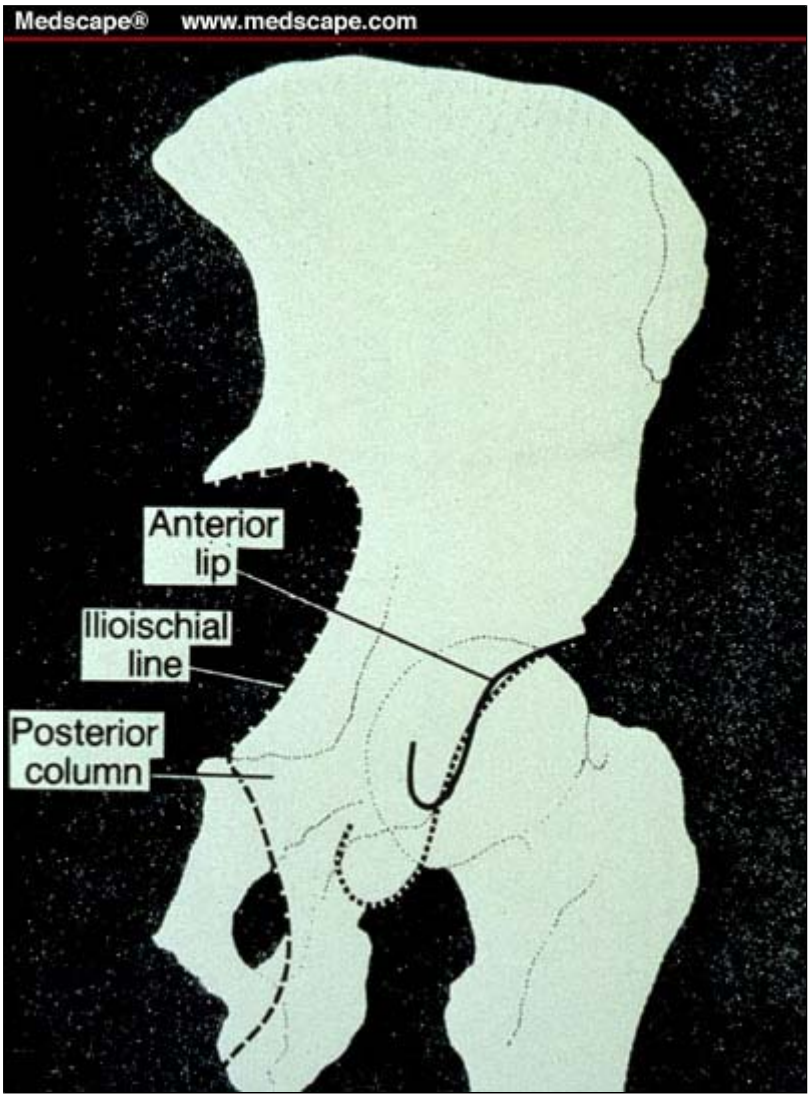

Figure 9. Landmarks on the iliac oblique view.

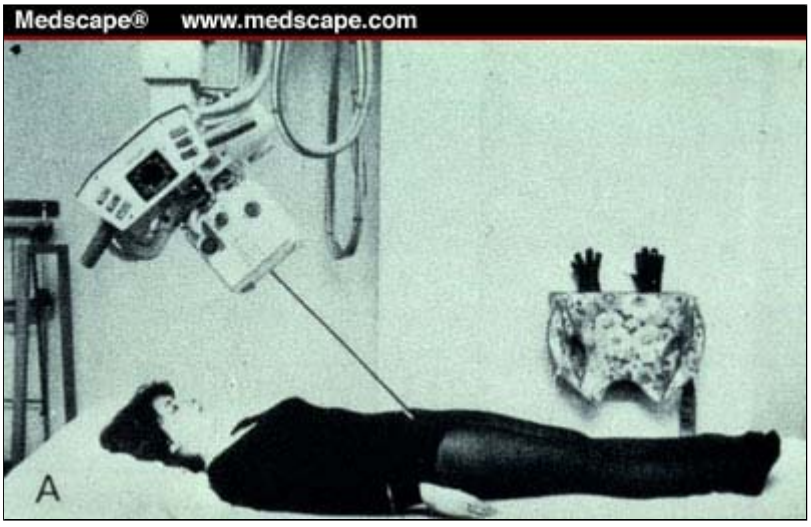

Figure 10. Positioning for the inlet view.

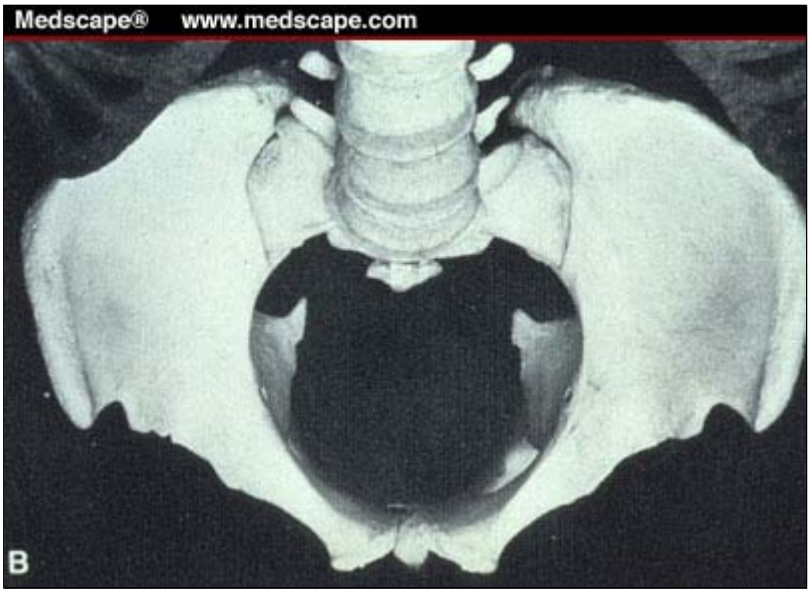

Figure 11. Skeletal anatomy represented on inlet view.

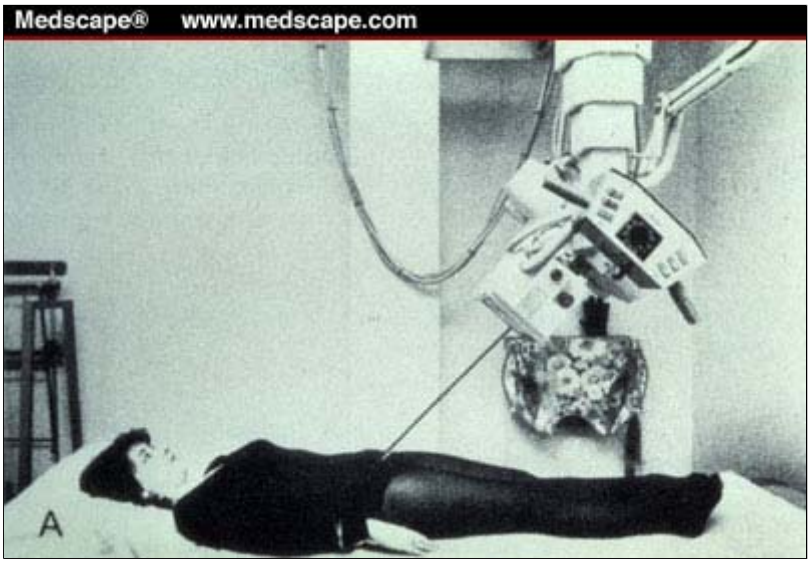

Figure 12. Positioning for the outlet view.

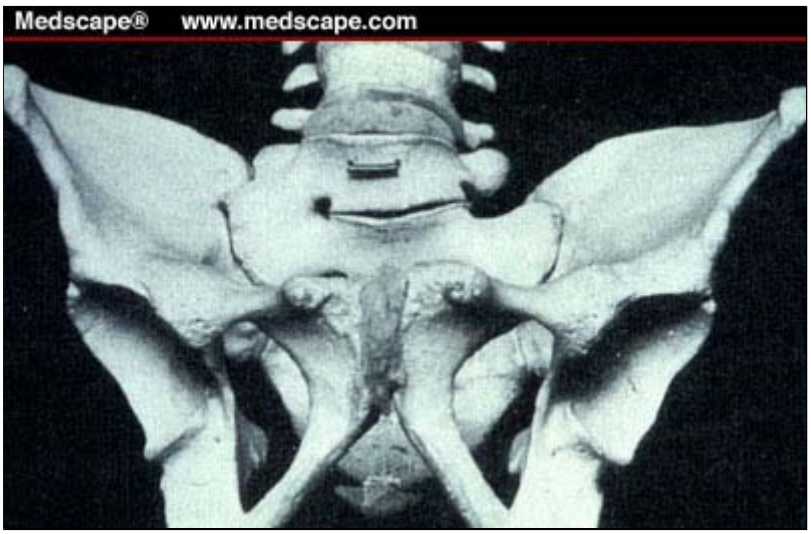

Figure 13. Skeletal anatomy represented on outlet view

Two- and three-dimensional CT scans are useful in evaluating intra-articular fragments as well as specific morphologic characteristics of any given fracture pattern. Before a 3-dimensional CT scan is ordered, the fracture patterns should be drawn on a 3-dimensional model of the pelvis to compare the 3-dimensional reconstructions.

This exercise, combined with comparing the fracture morphology found during surgery with the reconstructions after surgery, is invaluable in learning to appreciate the anatomy of complex acetabular fractures.

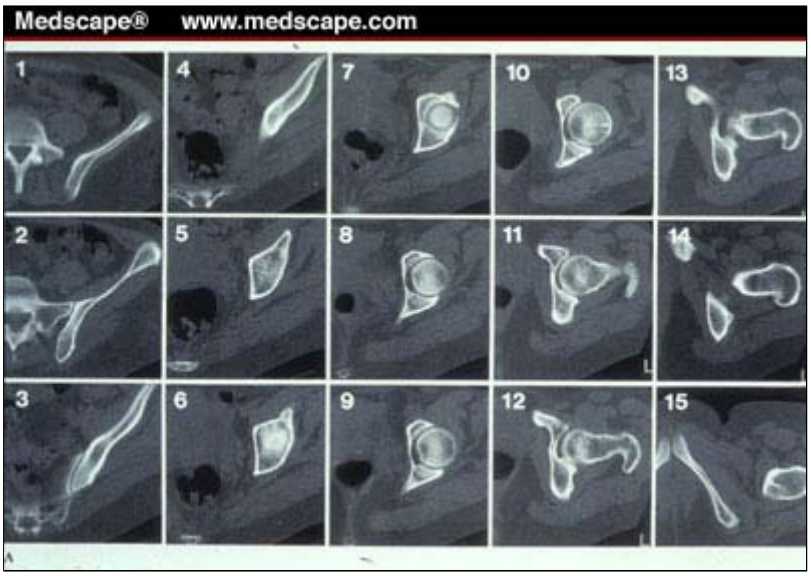

Figure 14. 2-D CT scan transverse cuts through the acetabulum.

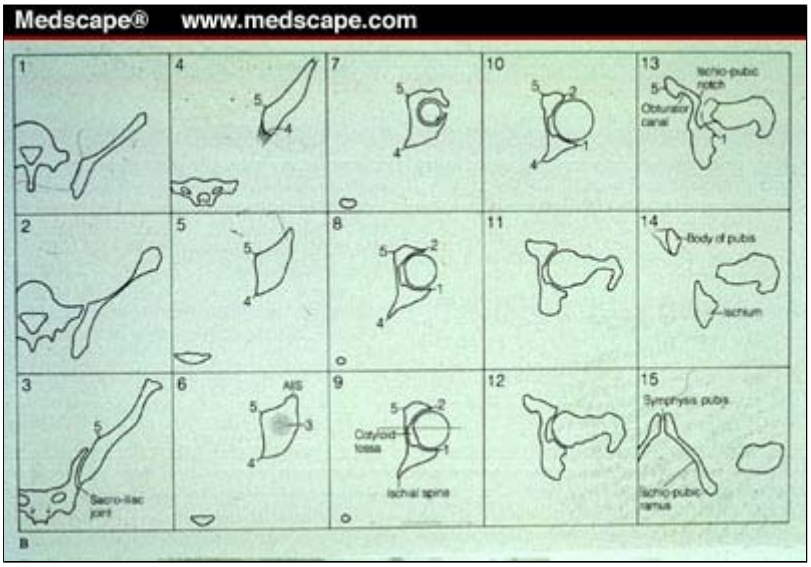

Figure 15. Line drawing corresponding to bony anatomy in Figure 14.

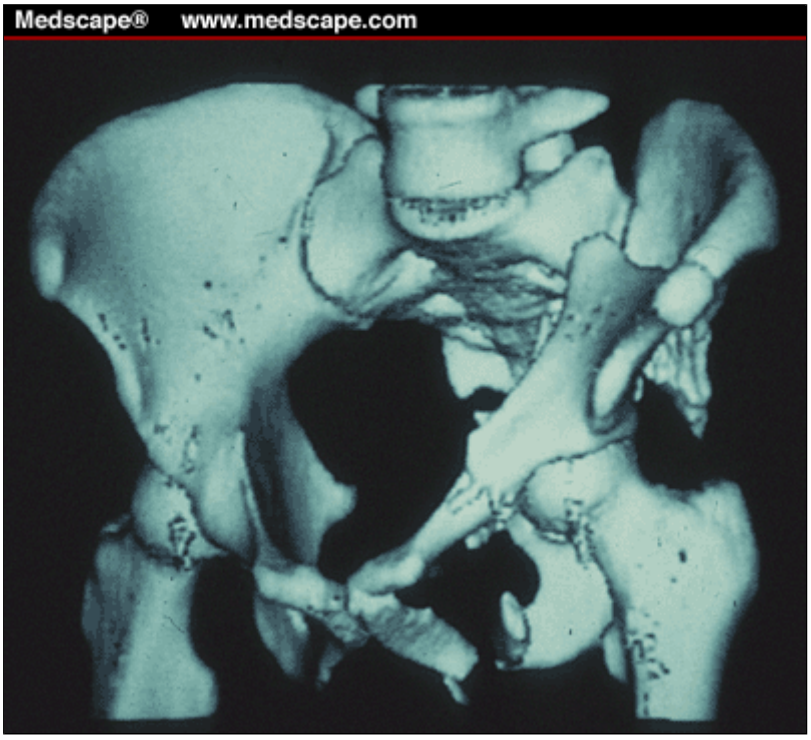

Figure 16. 3-D CT scan of a both-column acetabular fracture; obturator oblique view.

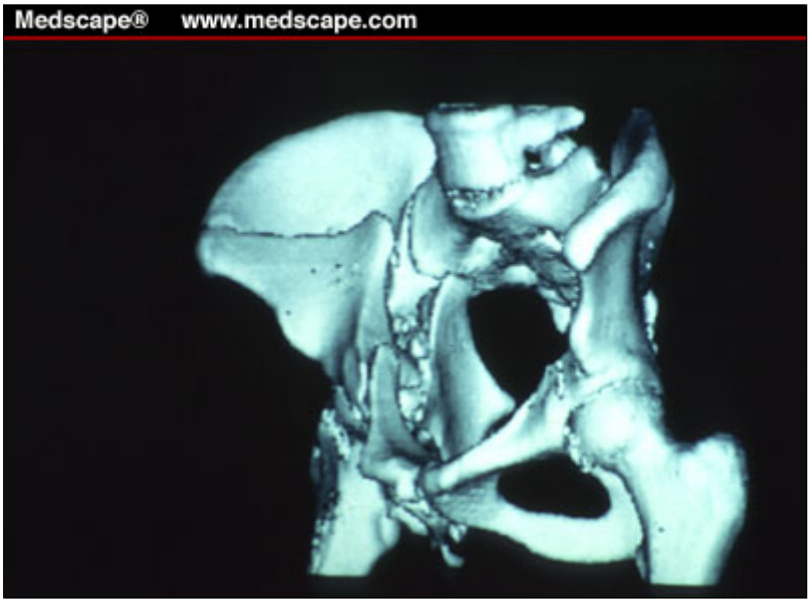

Figure 17. . 3-D CT scan of a both-column acetabular fracture; iliac oblique view.

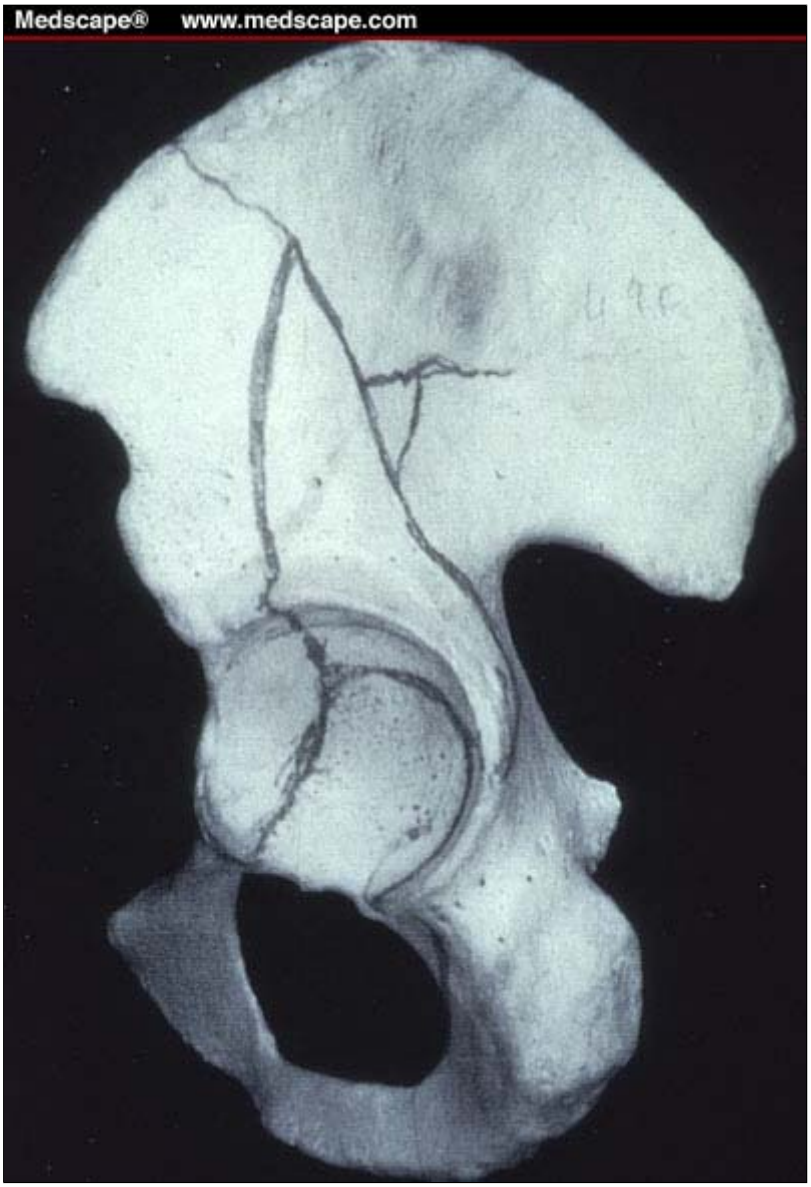

Figure 18. Line drawing of fracture on a pelvic model.

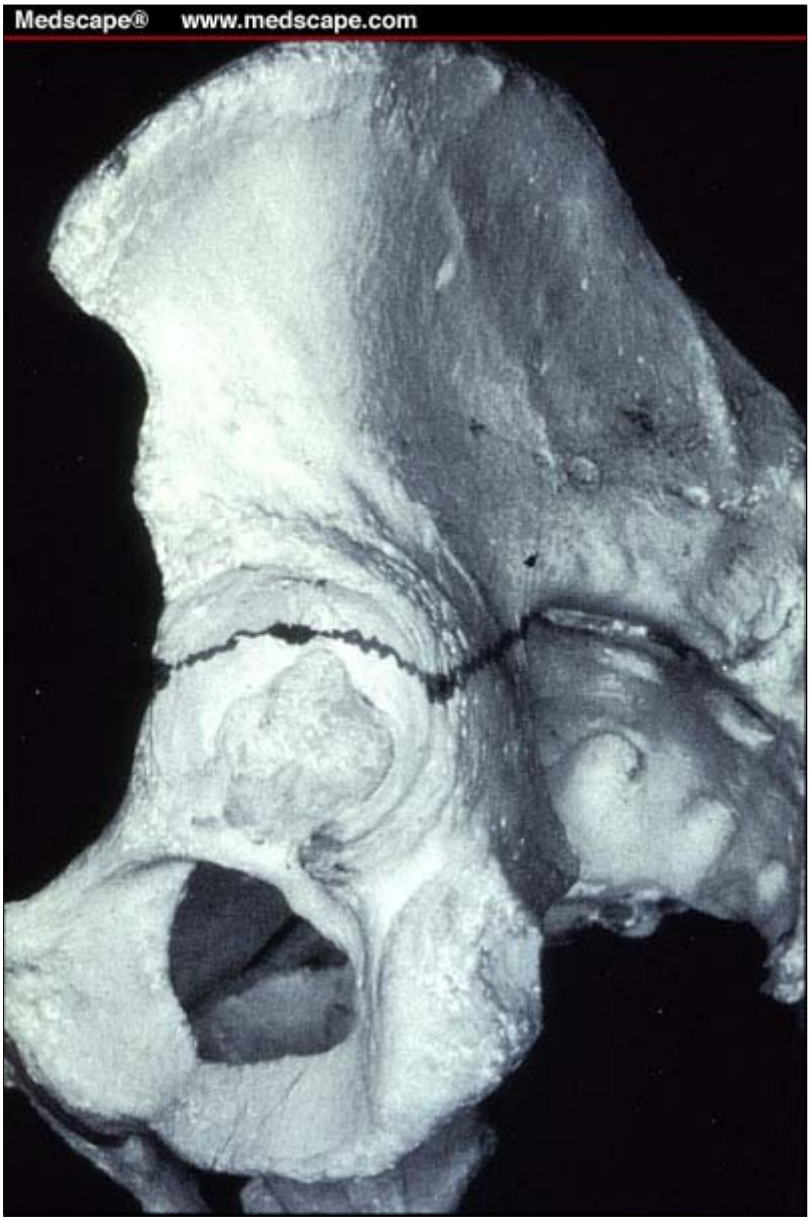

Figure 19. Line drawing of fracture on a pelvic model.

Classification

The most widely used classification of acetabular fractures is the Letournel classification,[1] which is a modification of the 1964 Judet anatomic classification.[2] Letournel's system classifies acetabular fractures into 10 major fracture patterns, which consist of 5 simple patterns and 5 complex patterns. (Figures 20-21)

The 5 simple patterns are the following:

- posterior wall fractures (A)
- posterior column fractures (B)
- anterior wall fractures (C)
- anterior column fractures (D)
- transverse acetabular fractures (E)

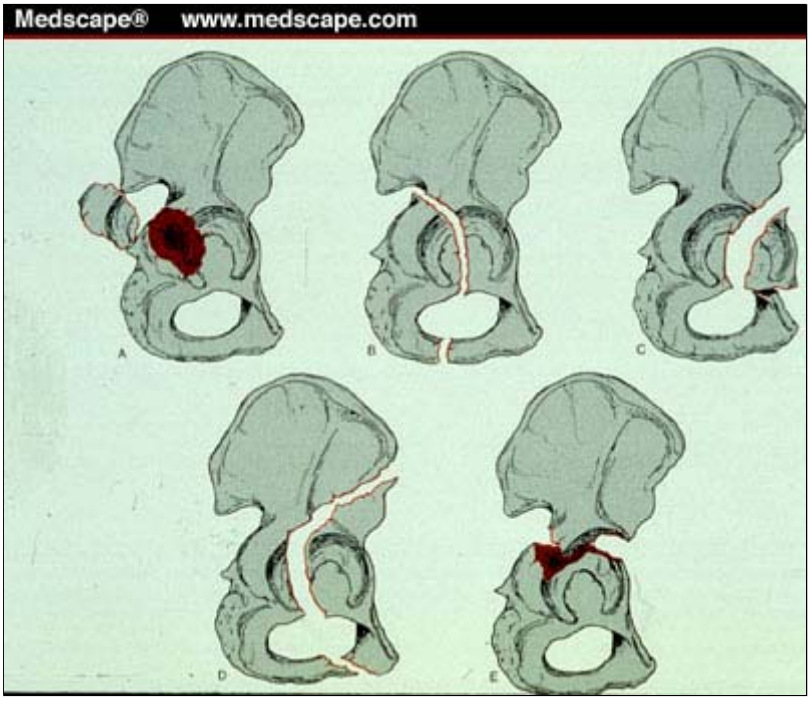

Figure 20. The 5 simple fracture patterns.

The 5 complex patterns are combinations of the simple patterns:

- posterior column with a posterior wall fracture (F)
- transverse with a posterior wall fracture (G)
- T-type fracture (H)
- anterior column with a posterior hemitransverse fracture (I)
- both-column fracture. (J)

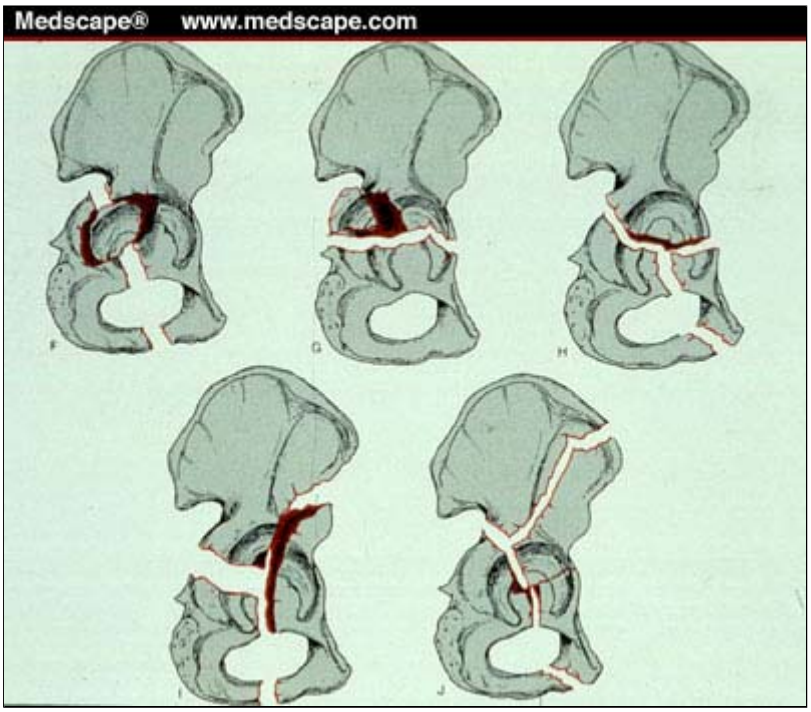

Figure 21. The 5 complex fracture patterns.

Posterior wall and posterior column fractures can be distinguished easily. In a posterior column fracture, the ilioischial line is interrupted, while only the retroacetabular surface is disrupted in a posterior wall fracture. (Figures 22-25)

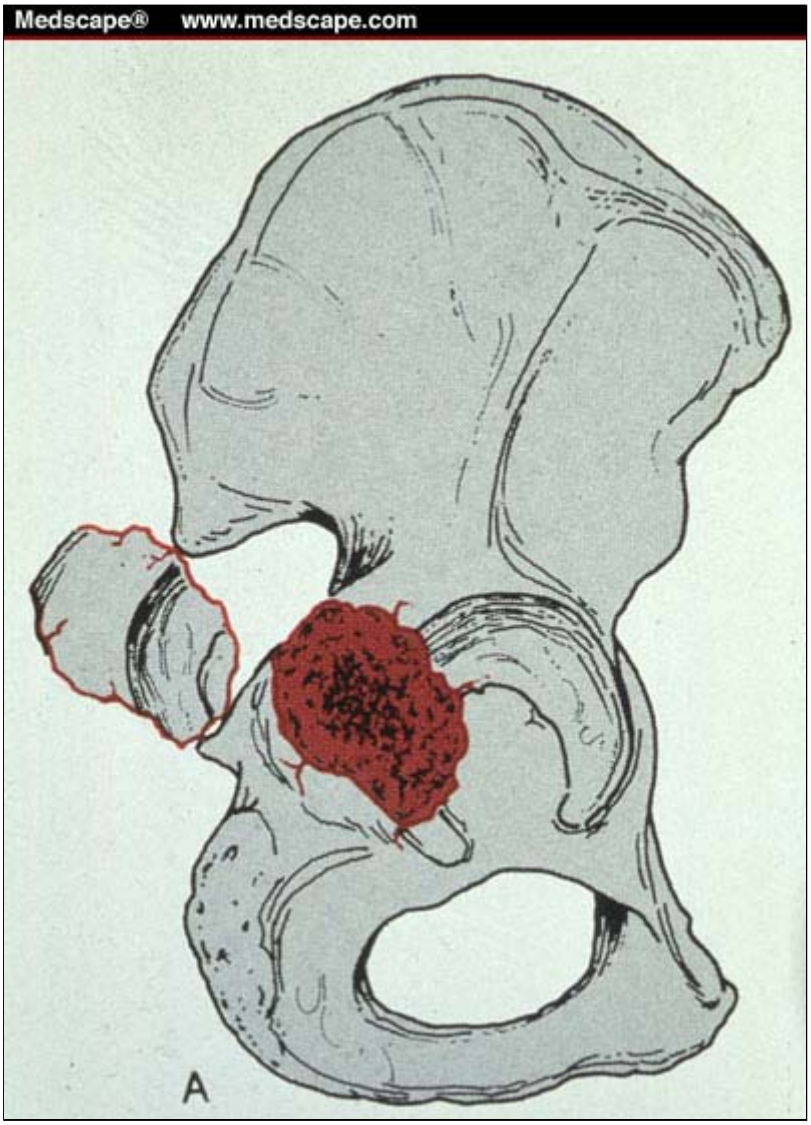

Figure 22. Line drawing of a posterior wall fracture.

Figure 23. Radiograph of posterior wall fracture.

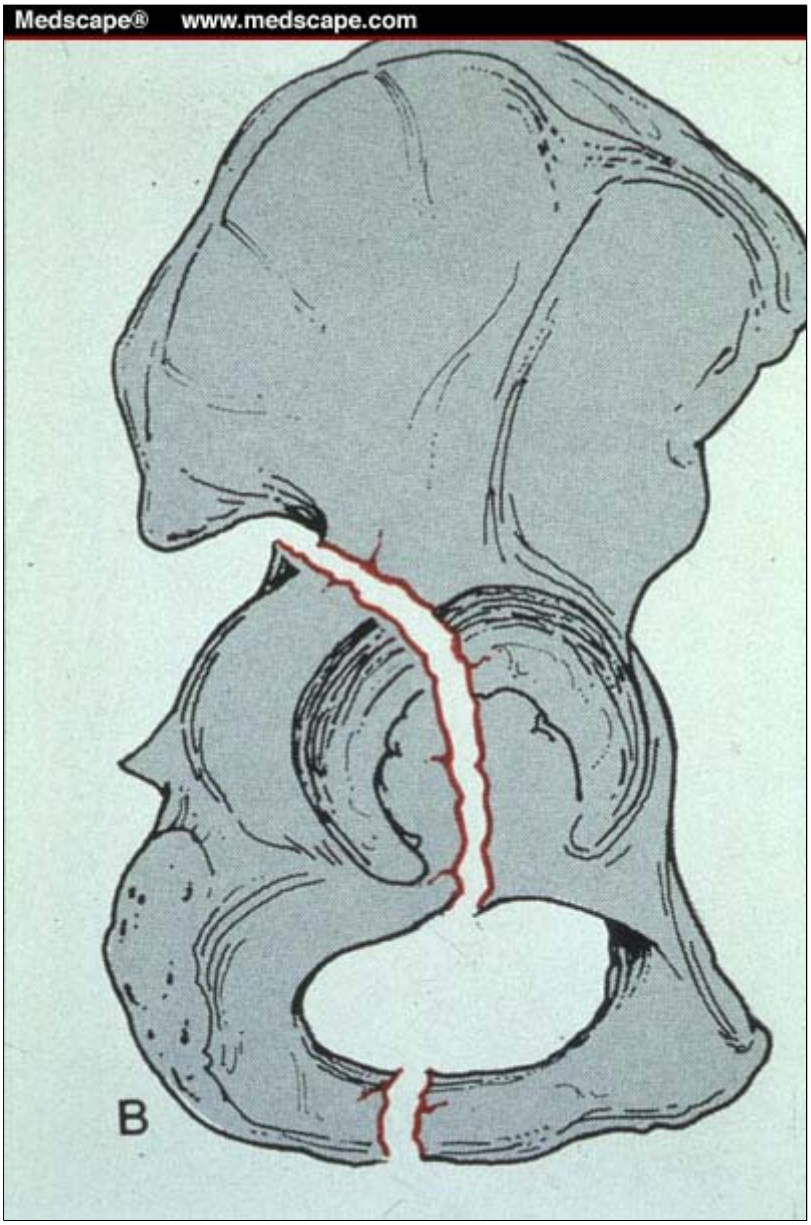

Figure 24. Line drawing of a posterior column fracture.

Figure 25. Radiograph of a posterior column fracture.

Similarly, anterior wall and anterior column fractures can be distinguished by the additional break in the ischiopubic segment of the pelvis present in the anterior column fracture. (Figures 26-29)

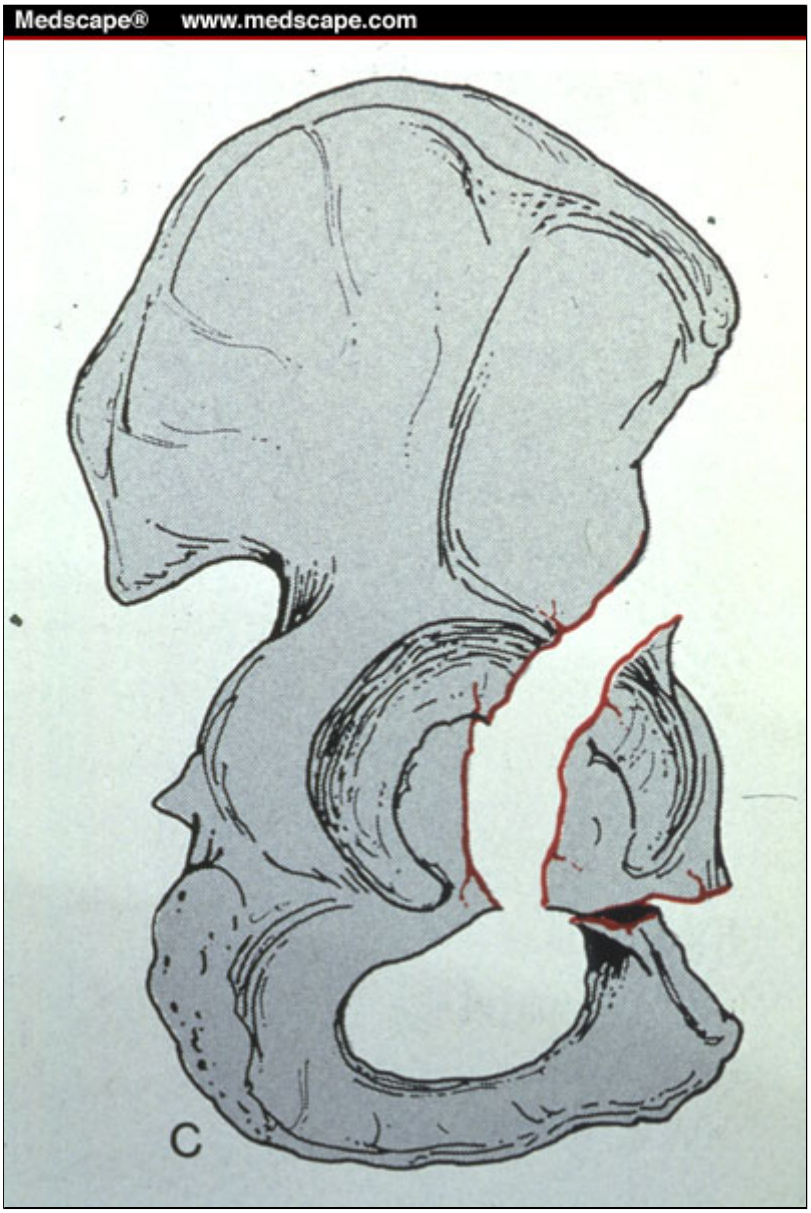

Figure 26. Line drawing of anterior wall fracture.

Figure 27. Radiograph of anterior wall fracture.

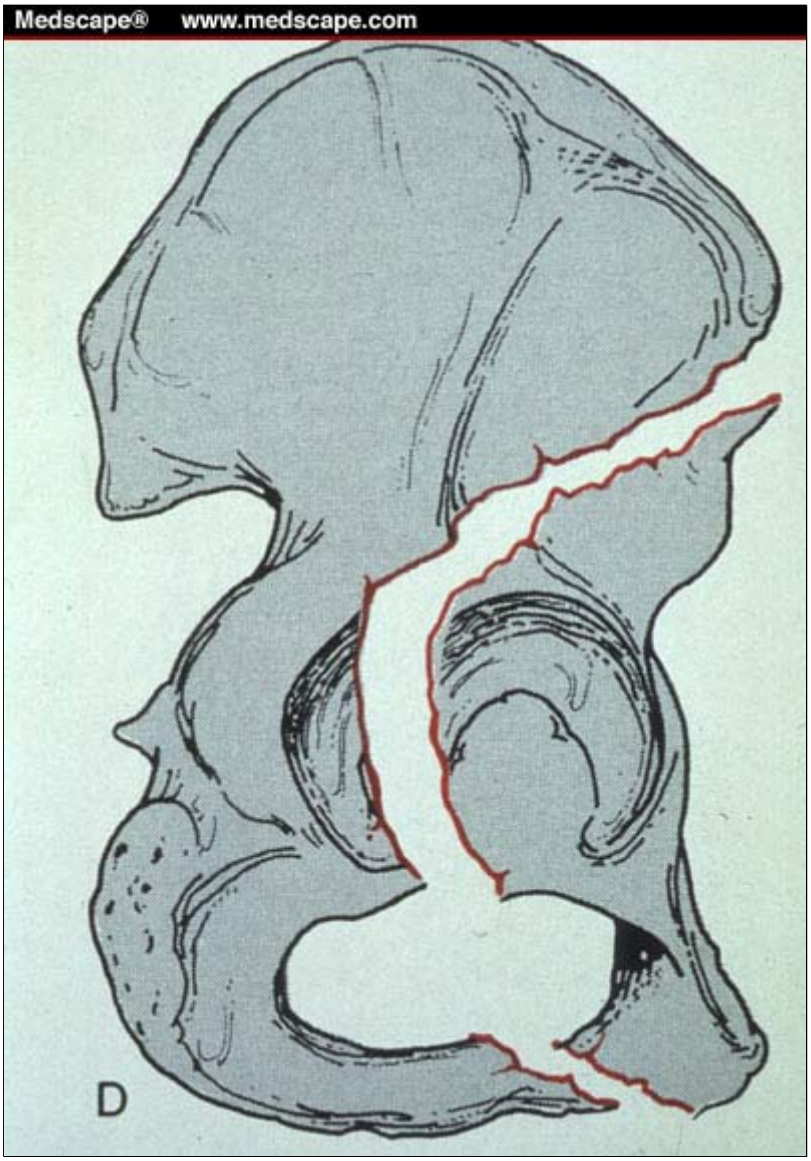

Figure 28. Line drawing of anterior column fracture.

Figure 29. Radiograph of anterior column fracture.

Transverse Fractures

A transverse acetabular fracture involves a fracture line that goes through both columns of the acetabulum, but a portion of the dome of the acetabulum remains attached to the constant fragment of the iliac wing. (Figures 30-32)

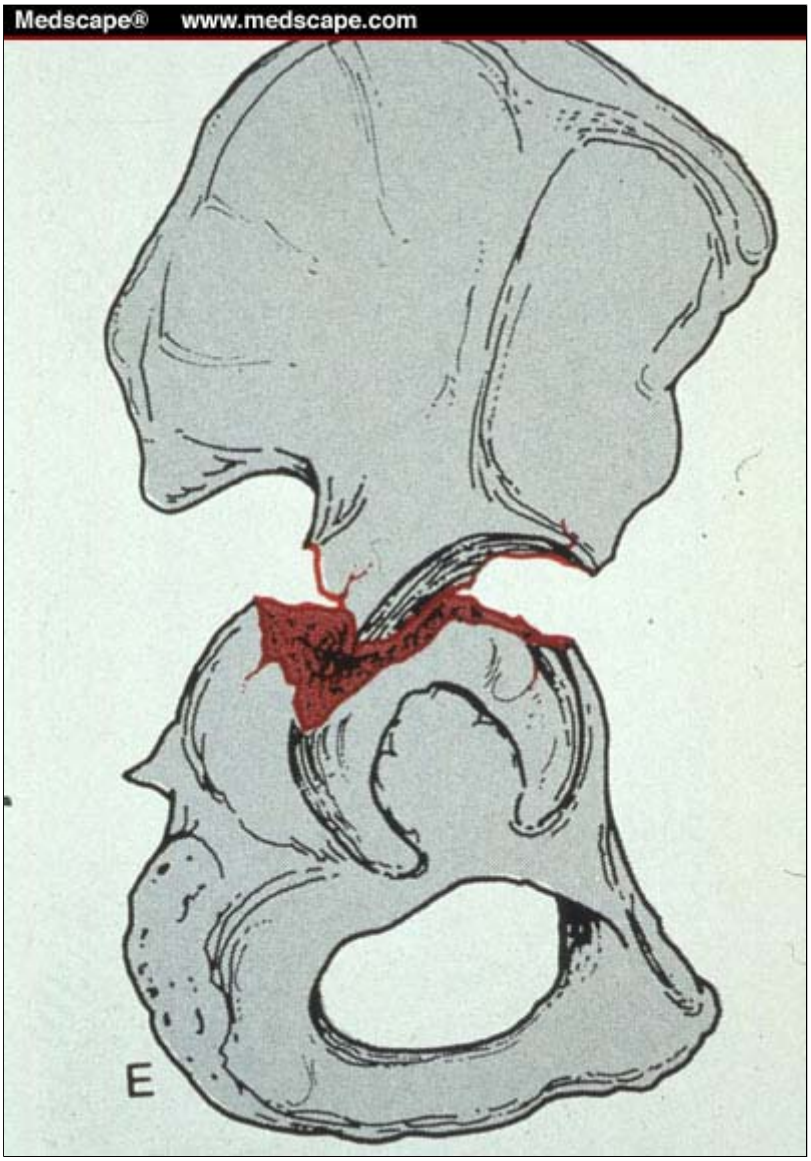

Figure 30. Line drawing of transverse fracture

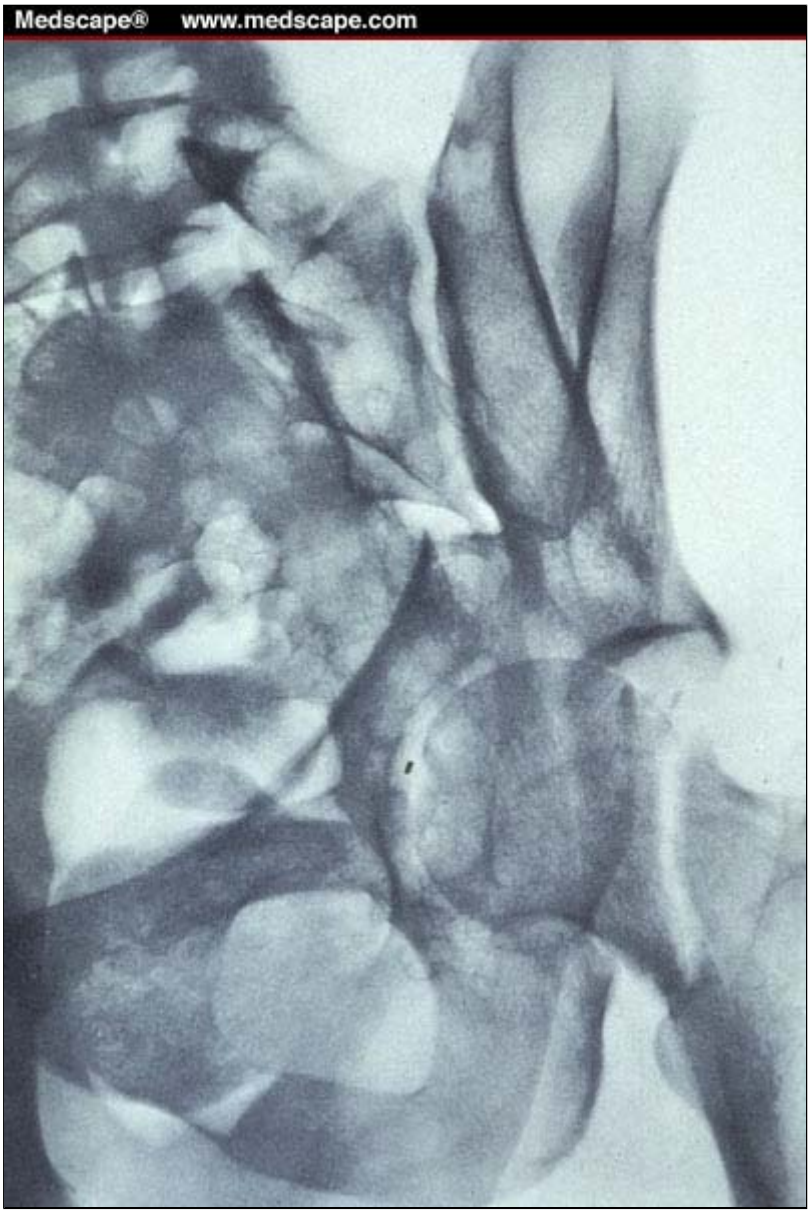

Figure 31. Obturator oblique view of transverse fracture.

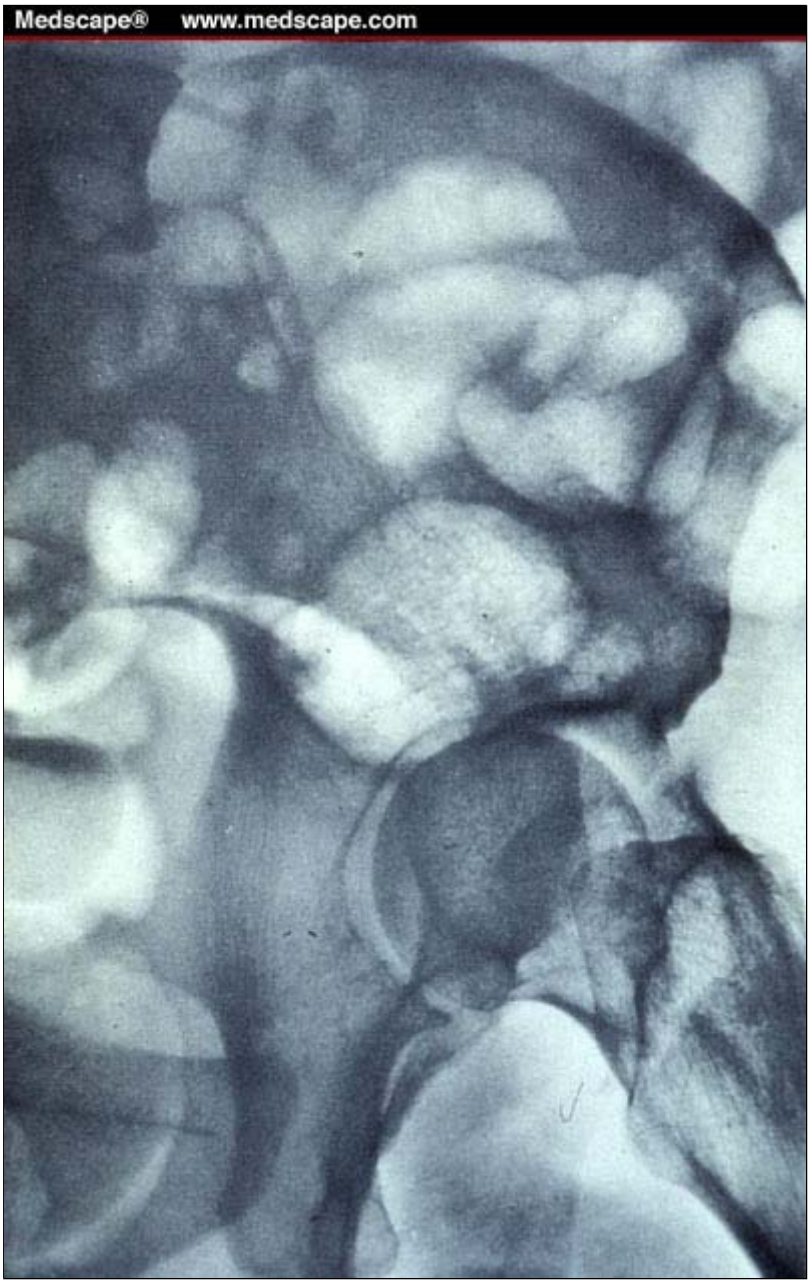

Figure 32. Iliac oblique view of transverse fracture.

Transverse acetabular fractures can be divided into transtectal, juxtatectal, and infratectal fractures, depending on the orientation of the fracture line relative to the dome or tectum of the acetabulum. Transtectal fractures are less forgiving and must be reduced anatomically, whereas infratectal fractures, if low enough, can be treated without surgery, depending on the pattern. (Figure 33)

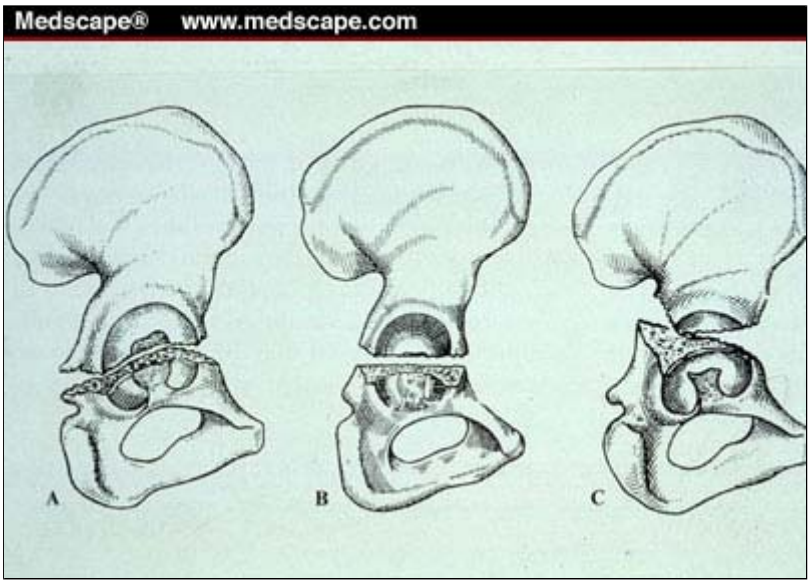

Figure 33. A. Infratectal B. Juxtatectal C. Transtectal

Transverse fractures are sagittal plane fractures whereas both column fracturesare coronal plane fractures. (Figures 34-35)

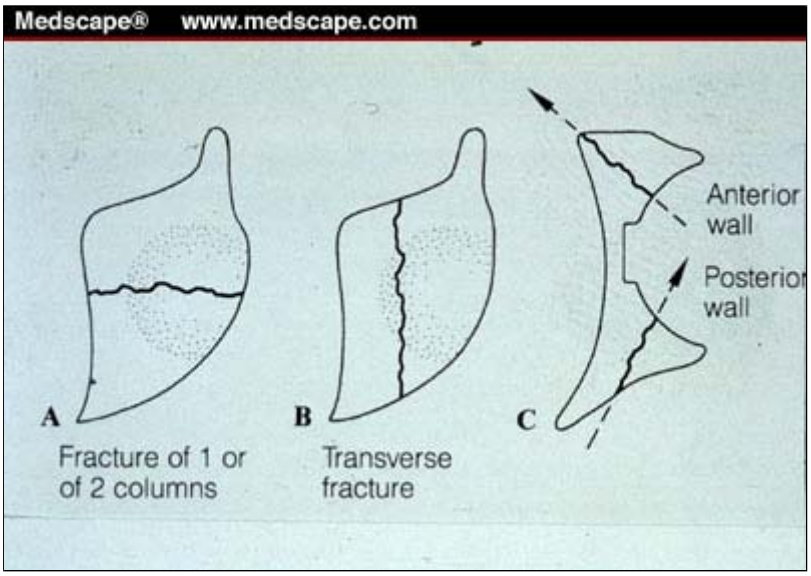

Figure 34. A. Coronal plane fracture B. Sagittal plane fracture

Figure 35. CT cut of transverse fracture in the sagittal plane.

T-Type Fractures

T-type fractures differ from transverse fractures by the additional fracture line that runs through the quadrilateral surface. As a result, the anterior column and posterior column are separated by fracture lines. This becomes important when choosing a surgical approach to the acetabulum. In a pure transverse fracture, the anterior and posterior columns may be reduced through a single approach. Once the anterior column has been reduced, the posterior column will follow the reduction and can be palpated indirectly.

In a T-type fracture, the 2 columns must be reduced independently. This becomes extremely important when choosing a surgical approach; therefore, it is important to recognize the subtle difference between transverse and T-type fractures when they are not significantly displaced. (Figures 36-39)

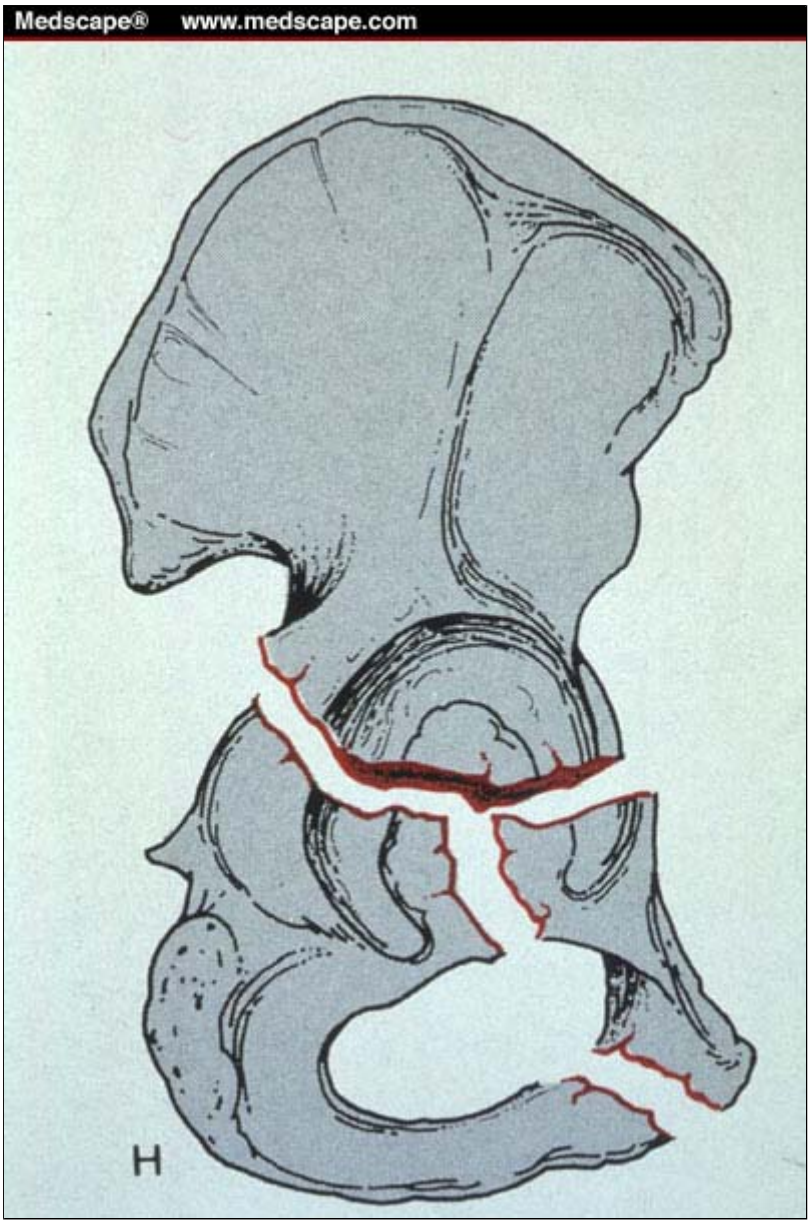

Figure 36. Line drawing of a T-type fracture

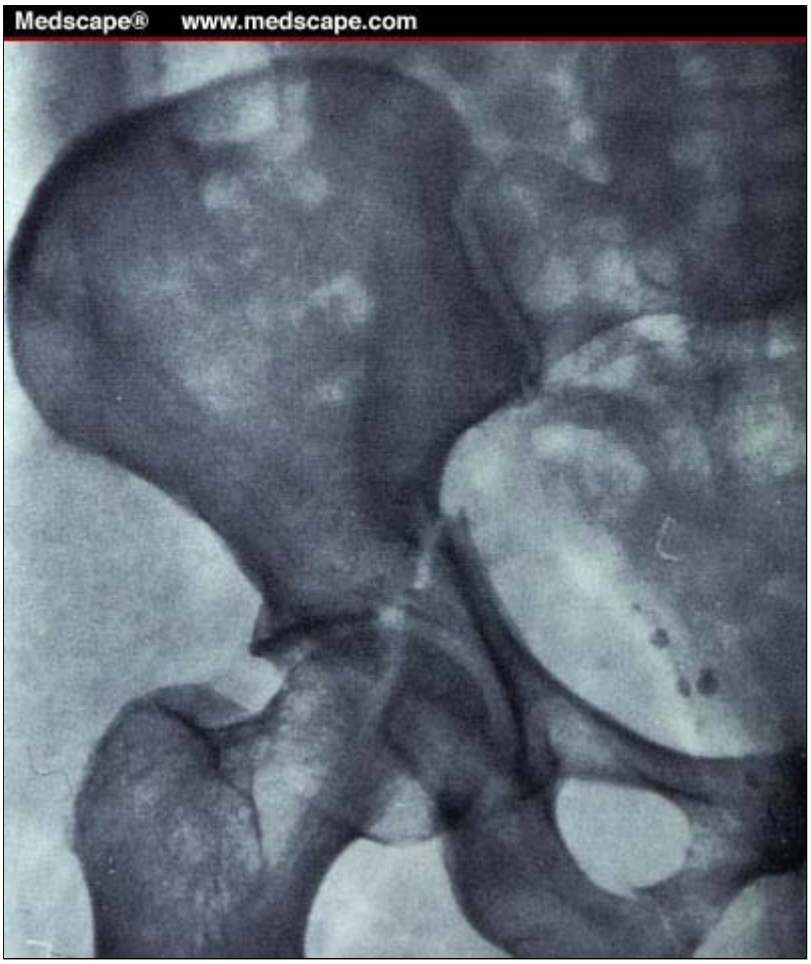

Figure 37. Radiograph of a T-type fracture. Note the undisplaced fracture in the ischiopubic ramus. This break in the obturator ring correlates with an additional fracture line in the quadrilateral plate.

Figure 38. 2-D CT cut of T-type fracture.

Figure 39. Note in the T-type fracture the anterior and posterior columns are disassociated.

Both-Column Fractures

In a both-column fracture, the entire acetabulum is separated from the iliac wing. This is considered a "floating" acetabulum, and the "spur-sign," which is best seen on the obturator oblique view, is pathognomonic for the both-column fracture. (Figures 40-41)

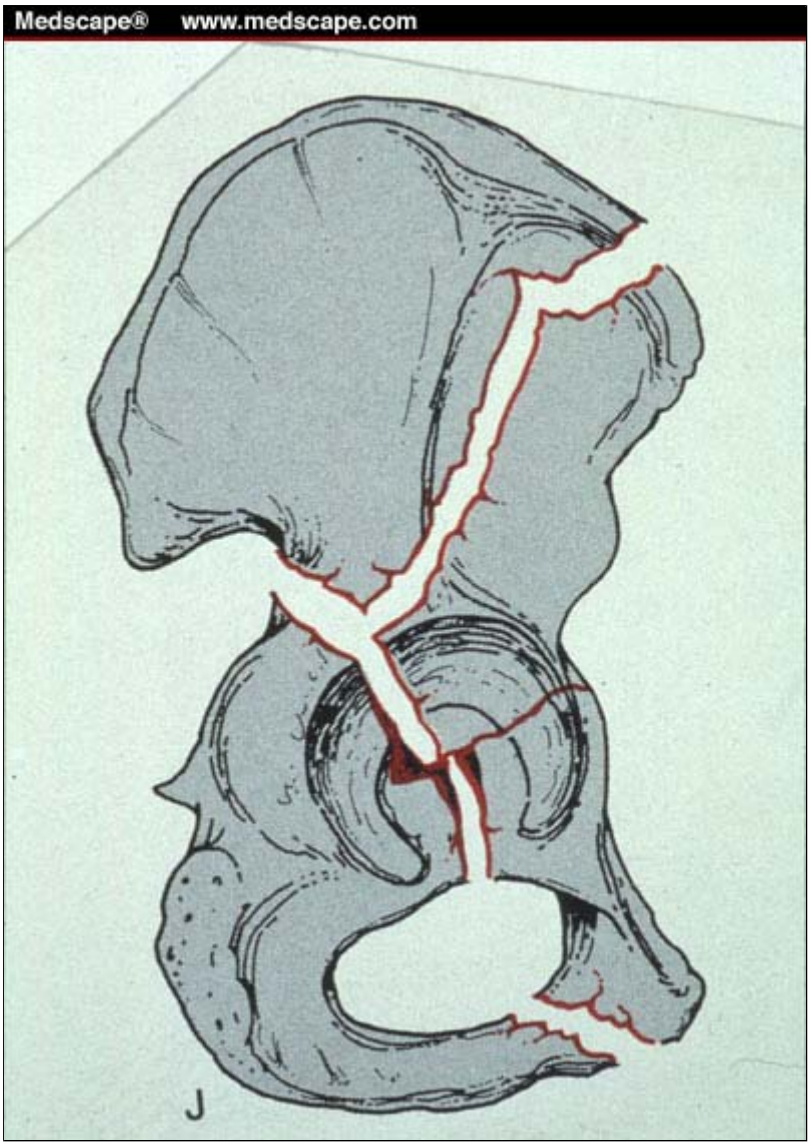

Figure 40. Line drawing of a both-column fracture.

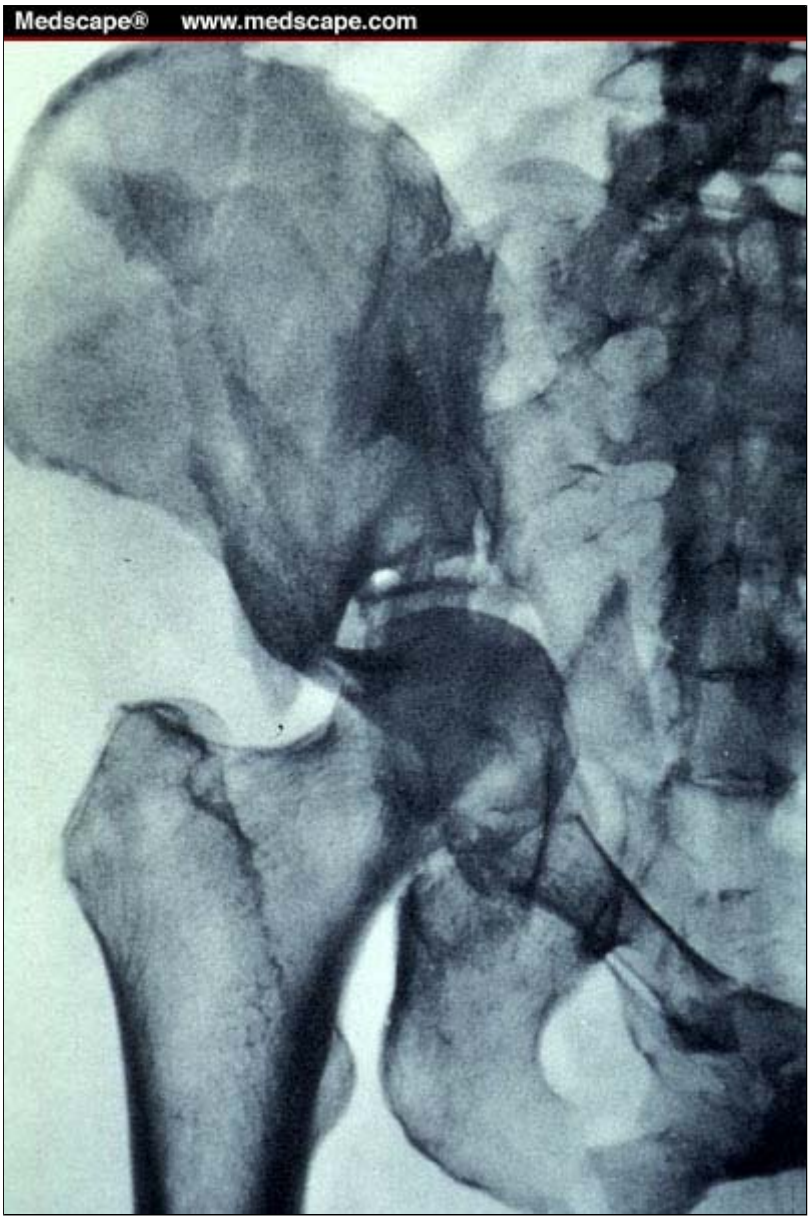

Figure 41. "Spur-sign" seen on the obturator oblique view, pathognomonic for the both-column fracture.

Case Study

An 18-year-old woman was inadvertently struck on the lateral aspect of the hip by a police officer while marching in a homecoming parade.

Figure 42. Obturator oblique view of a both-column fracture.

Figure 43. Iliac oblique view of a both-column fracture.

AP, obturator oblique, and iliac oblique views showing a both-column acetabular fracture. The obturator oblique view shows the pathognomonic "spur-sign." Note that the spur represents the iliac wing fragment, or the constant fragment, and the entire acetabulum has been medialized. None of the dome of the acetabulum remains attached to the iliac wing.

Figure 44. CT scan of a both-column fracture.

Figure 45. CT scan of a both-column fracture.

Figure 46. 3-D CT of a both-column fracture.

Figure 47. 3-D CT of a both-column fracture.

Two- and three-dimensional CT scans show an ipsilateral disruption of sacroiliac joint and extreme comminution through the dome of the acetabulum. This patient also had disruption of the pubic symphysis, creating an ipsilateral unstable hemipelvis with a both-column acetabular fracture.

Figure 48. Final reconstruction.

Figure 49. Final reconstruction.

Postoperative radiographs showing anatomic reduction of the hemipelvis along with anatomic reduction of the acetabular fracture. In high-energy trauma injuries such as this, stability of the hemipelvis must be obtained first, by stabilizing the anterior and posterior aspects of the pelvis, after which the acetabular fracture is addressed. Anatomic alignment of the pelvic inlet and outlet should also be regained before the articular component of the injury (acetabular fracture) is addressed.

Conclusion

Acetabular fractures must be classified before an appropriate surgical approach can be chosen. Because the Letournel scheme is an anatomic classification, acetabular fracture classification easily follows the radiographic assessment. Such assessment must include AP, obturator oblique, and iliac oblique views. Two- and three-dimensional CT scans are also useful in defining the morphologic characteristics of acetabular disruption.

References

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Suggested Readings

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