

# Pelvic trauma

## Anatomical considerations

(What diagnostic and interventional radiologist on-call needs to know!)

### Imaging

NORDTER  
8<sup>th</sup> Nordic Trauma Radiology Course  
Stockholm, Sweden  
May 19th-22, 2014  
Johann Baptist Dormagen, MD, PhD  
Oslo University Hospital, Norway



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### Overview

- Bones and ligaments
- Fracture classification
- Pelvic arteries
- Pelvic CT
  - How to detect hemorrhage?
  - Arterial versus venous bleeding

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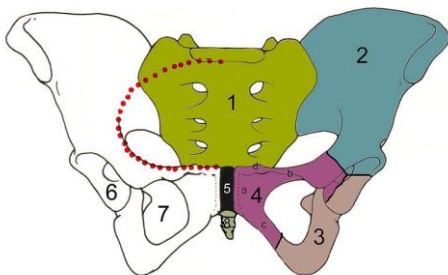
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- Sacrum, coccyx, three innominate bones: Ilium, ischium and pubis

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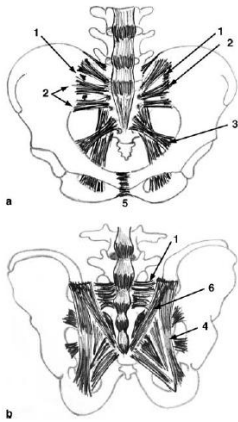
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Theumann, 2002

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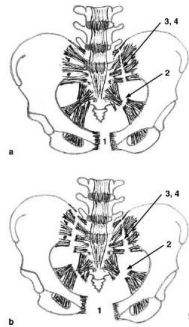
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### Injury mechanisms

- Anterior-posterior compression:
  - Force applied to the pubis or the posterior pelvis.
  - Iliac external rotation
  - Symphyseal separation
  - Sacroiliac dislocation



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### Type B (partial stable)

Disrupture or fracture of the symphysis, associated with unilateral or bilateral anterior sacroiliac joint rupture



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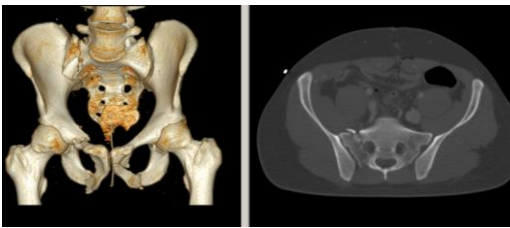
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### Subtypes of type B fractures



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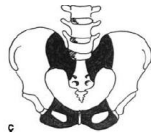
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### Type C

- Unstable with complete disruption of the posterior arch caused by vertical shearing forces
- C1: Unilateral
- C2 Bilateral (one side partially stable)
- C3 Bilateral unstable



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### Moderate inter- and intraobserver agreement!

Classification of Pelvic Ring Injuries Using the Tile Classification System*			
Observer	n, %		
	A	B	C
1	7 (7.87)	61 (68.53)	21 (23.60)
2	27 (30.34)	38 (42.69)	24 (26.97)
3	41 (46.07)	29 (32.58)	19 (21.35)
4	8 (8.99)	77 (86.52)	4 (4.49)
5	40 (44.94)	35 (39.33)	14 (15.73)
Total	123 (27.64)	240 (53.93)	82 (18.43)

\*Interobserver variability kappa value equal to 0.47 (95% CI 0.42, 0.52)

Intraobserver Agreement Results for Young-Burgess and Tile Classification Systems			
Observer	Kappa Value (95% CI)		
	Young-Burgess With Subclasses	Young-Burgess No Subclasses	Tile
1	0.54 (0.39, 0.69)	0.72 (0.66, 0.78)	0.55 (0.47, 0.63)
2	0.52 (0.46, 0.58)	0.64 (0.57, 0.71)	0.56 (0.49, 0.63)
3	0.60 (0.54, 0.66)	0.73 (0.67, 0.80)	0.55 (0.48, 0.62)
4	0.60 (0.54, 0.66)	0.76 (0.69, 0.83)	0.25 (0.12, 0.38)
5	0.69 (0.65, 0.74)	0.76 (0.70, 0.82)	0.45 (0.38, 0.52)
Mean	0.61 (0.53, 0.69)	0.72 (0.66, 0.78)	0.47 (0.37, 0.64)

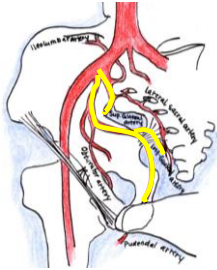
- Furey, Orthopedics, 2009

### Accuracy of pelvic plain film: Their 2005, Eur Rad

- Low sensitivity for fractures, 55%, esp. in the posterior ring.
- Significant discrepancies between plain film and MDCT for Tile classification, 31% for A,B,C and 86% for subtype classification.
- In 40% MDCT unstable fractures were classified as stable on plain film.

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## Basic anatomy of pelvic branches of the internal iliac artery



- Three main branches:
  - Sup. gluteal a. (post.)
  - Internal pudenda a. (ant.)
  - Inf. gluteal a. (ant.)
- Other arteries

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Original Article

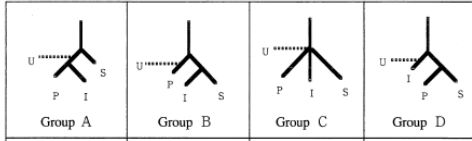
Kansensho Medical Journal, 41, 333-343, 1998

### A Statistical Study of the Branching of the Human Internal Iliac Artery

KOH-ICHI YAMAKI, TSUYOSHI SAGA, YOSHIAKI DOI,  
KATSUMARO AIDA AND MITSUAKI YOSHIZUKA

645 pelvic halves of Japanese cadavers.

Simplified the Adachi classification for medical purpose.



S= Sup. glut. art., I= Inf. glut. art., P= Intern. pud. art.,  
( U= umbil. art., excluded from study)

Frequency			
80%	15%	5%	< 1%

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Surg Radiol Anat (2011) 33:151–159  
DOI 10.1007/s00276-010-0716-3

ANATOMIC BASES OF MEDICAL, RADIOLOGICAL AND SURGICAL TECHNIQUE

### Branching patterns of the male internal iliac artery: imaging findings

Tiago Bilhim · Diogo Casal · Andrea Furtado ·  
Diogo Pats · João Erse Goyri O'Neill ·  
João Martins Pisco

- Using angio MR, angio CT and digital angiography
- 42 pelvic halves in 21 male patients
- Compared findings to the Yamari classification

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### MDCT in pelvic trauma

#### Basic principles

- Technique
- Findings
  - Hemorrhage
  - Ongoing bleeding
  - Arterial vs venous bleeding?
  - Other vessel injuries

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### How we do it in Oslo

Standard whole body CT with 3-phasic contrast injection

Shortly after non-contrast imaging of the brain, face and cervical spine inject 20 ml i.v. contrast

Then:



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### Technical parameter with a 64 slice CT and 3 phasic contrast injection

- Rotation speed 0.74 sec/rotation
- Pitch: 0.515-0.8-1.1 (depending on the body habitus)
- Scan time (thorax-greater trochanter): ca. 55-60 sec

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### Patients with higher risk of pelvic bleeding:

- Positive FAST
- Pelvic fracture with dislocation
- Hemodynamically minimally unstable
- High-energy MOI with clinically or radiographically suspected aortic injury



Arterial scanning first, followed by portovenous scanning

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### Vascular imaging findings

- **Arterial active bleeding**
- Occlusion
- Venous bleeding
- PSA
- Stenosis/Spasm

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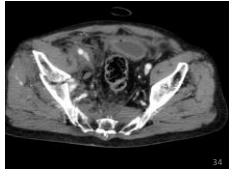
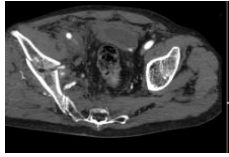
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### Arterial extravasation

- Small foci of high attenuation
- Enlarging in portovenous phase
- Irregular margins



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### Occlusion

- Typically after intima disruption with subsequent thrombosis
- Less frequently embolus or spasm
  
- Abrupt interruption in the flow
- Important: Even with no extravasation on CT, significant hemorrhage can develop

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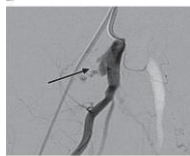
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Kertesz, Radiographics 2009

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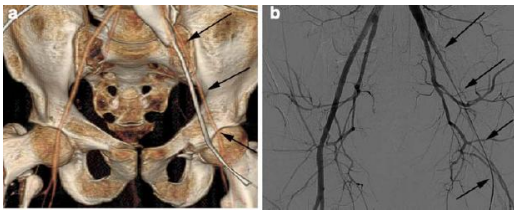




## Other features

- Stenosis /Spasm
  - Irregular narrowing of the arterial lumen
  - Difficult to differ from focal spasm
  - Other differential diagnosis:
    - Intramural hematoma
    - Partial thrombosis

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- Diffuse narrowing of the left external iliac artery.
- Uyeda Emer Radiol, 2010

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## Conclusions

- Try to differ on plain film and CT between stable, partial stable and completely (vertically) unstable
- Three main branches to identify on angio
  - Injuries of vessels close to bony structures
  - Corona mortis
- CT angio only in subgroup of patients
- Differ between arterial and venous bleeding

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