

*Ministry of Defence*

## **Synopsis of Causation**

# **Pelvic Fractures**

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## **Disclaimer**

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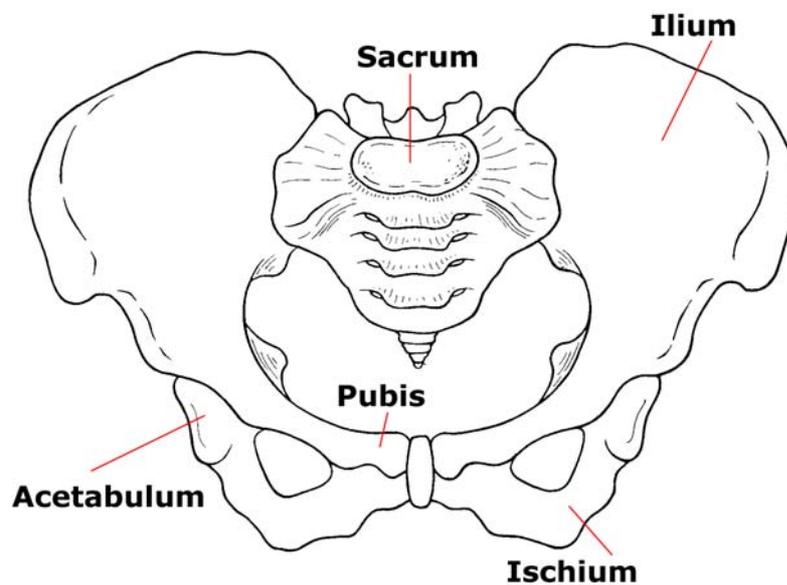
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# 1. Definition

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- 1.1. The bony pelvis, so called from its resemblance to a basin, is a bony structure interposed between the vertebral column (spine), which it supports, and the two femurs (thigh bones). It contains and protects the pelvic organs and is composed of four bones, that is two hip bones, the sacrum, and the coccyx (see Figure 1). In turn, the hip bones have three parts; ilium, ischium, and pubis. The coccyx is of minor importance only. The acetabulum is a specialised area of the pelvis which forms the socket of the joint with the femoral head. This area is covered by articular cartilage – present in all joints – that allows easy movement of the hip due to its low friction characteristics.
- 1.2. A pelvic fracture is a break in one or more bones of the pelvis. This is generally a result of substantial injury, such as that from a motor vehicle accident or a fall from a significant height.
- 1.3. The ilium, ischium, and pubis form an anatomic ring with the sacrum. Disruption of the pelvic ring often also injures the organs and blood vessels contained within. The amount of damage to the bone and soft tissues is dependent on the type of fracture.<sup>1</sup>
- 1.4. Acetabular fractures involve the parts of the pelvis forming the socket of the hip joint. Anatomically, the acetabulum is made of two columns (anterior and posterior) and two walls (anterior and posterior). Acetabular fractures form a subgroup of pelvic fractures which needs specific management (often operative) to restore the joint surface accurately and limit arthritis secondary to the damage.



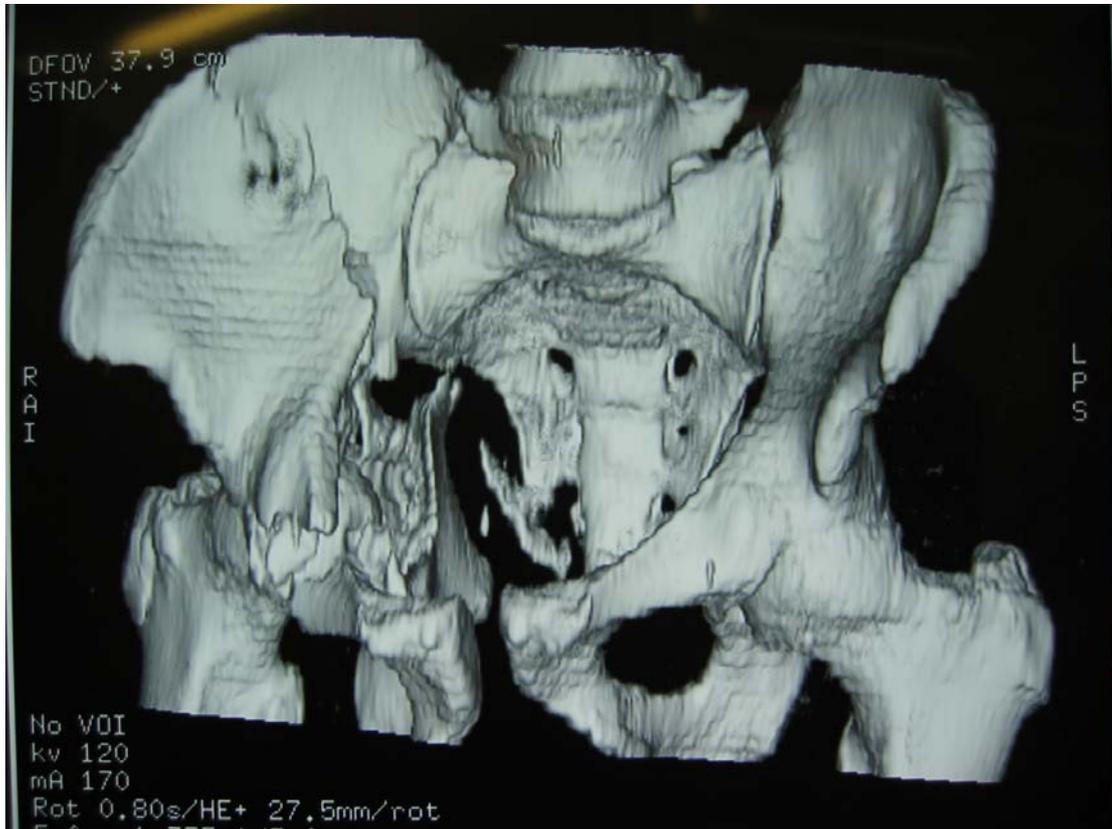
**Figure 1: Anatomy of the pelvis**

## 2. Clinical Features

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- 2.1. Pelvic fractures are often a part of multiple injuries and patients present with different clinical features according to the nature of the injuries. The fracture is often indicated by pain over the area and tenderness over the pelvic ring. This forms a part of assessment of the injured patient.
- 2.2. In the presence of pain, instability of the pelvis is looked for. This is usually diagnosed by pelvic springing, which involves applying alternating gentle compression and distortion over the pelvis. The instability may be palpable as relative movement between the parts of the pelvis.
- 2.3. Pelvic fractures are often associated with injuries to pelvic organs and/or blood vessels. These can be significant, with a resulting mortality rate of about 10%.<sup>2-6</sup>
  - 2.3.1. Large loss of circulating blood volume of about 1.5 litres can occur.<sup>7</sup> Blood loss may result from bleeding from fracture surfaces, small local venous and arterial tears, or disruption of major blood vessels. The close relationship of the internal iliac artery, its tributaries, and their accompanying veins in front of the sacro-iliac joint and ligaments is often responsible for the high incidence of injury to blood vessels and associated bleeding seen with pelvic fractures. The lowest incidence of bleeding is seen in lateral compression injuries as these do not stretch the vessels. The most frequent association is with the more severe antero-posterior compression injuries.<sup>1</sup>
  - 2.3.2. Open pelvic fractures i.e. communicating either with the exterior or a hollow organ such as the rectum, have had mortality rates of 50% in the past.<sup>8</sup> Aggressive multidisciplinary treatment has reduced mortality rates in recent years.<sup>9</sup>
  - 2.3.3. Commonly associated urologic injuries are reported to be as high as 16% overall. These include injuries of the urethra, corpora cavernosa (penis), bladder, and bladder neck (7%). Signs of urethral injury in males include a high-riding or boggy prostate on rectal examination, or blood at the urethral meatus. Urologic trauma related to pelvic fractures is seen more often in men than women (21% versus 8% respectively), largely because urethral injury may occur in up to 16% of men but is very rare in women.
  - 2.3.4. Vaginal bleeding or palpable fracture line on internal examination suggests open pelvic fracture in females.
  - 2.3.5. Other associated injuries are head injury, long bone fractures, thoracic injuries, solid organ damage e.g. spleen, liver, kidney, gastrointestinal tract etc.
- 2.4. Acetabular fractures often present with the hip dislocated (out of its socket). This is clinically recognised from the abnormal position of the affected leg.
  - 2.4.1. There may be associated nerve injuries, for example to the sciatic or superior gluteal nerves. These present as areas of numbness in the skin and also weakness of movements due to muscle paralysis. Sometimes this can be difficult to diagnose initially as the affected muscles cannot be tested due to pain.

2.4.2. Bleeding complications are also possible, especially from the superior gluteal artery which may require embolisation.



**Figure 2**

A CT Scan showing fracture of the right pelvis and acetabulum with the femoral head dislocating out of joint. The pelvic fracture involves the right ilium, ischium, and pubis. The sacrum is also broken. The left side is essentially normal.

### 3. Aetiology

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- 3.1. Pelvic fractures are usually caused by high energy accidents. There is also a smaller group with low energy injuries. The special group of acetabular fractures usually results from high energy injury.
- 3.2. Pelvic fractures are usually a result of significant trauma. The commonest cause is a high velocity road traffic accident,<sup>10</sup> the other causes being falls and crush injuries. The fracture is of different type dependent on the direction of force:<sup>11</sup>
  - **AP compression** – when the direction of the force is from anterior to posterior (front to back), usually seen in head-on accidents
  - **Lateral compression** – when the applied force is from the side. Side-impact accidents commonly cause this
  - **Vertical shear** – usually resulting from falls from a height

Combinations can occur when elements of more than one type of injury are seen due to a combination of vectors.

- 3.3. Low energy pelvic fractures involve fractures of individual bones of the pelvic ring without damage to the true integrity of the ring structure. These are less serious injuries, e.g. pubic ramus fracture. Mechanisms include:
  - Domestic falls (e.g. “straddle” injury from a fall in the bathtub); this is an aetiology frequently found in the elderly population
  - Avulsion injuries of the muscle attachments, where bits of bone may be detached by a sudden muscle pull. This is usually seen in skeletally immature patients
- 3.4. Significant trauma is required to cause acetabular fractures. The direction of the force also determines acetabular fracture patterns. The recognition of the pattern is important in planning treatment, as different surgical approaches are used for different fractures. The affected part of the acetabulum is used in fracture description.
  - Force applied to the head of the femur (thigh bone) from the front is transmitted to the posterior wall and column. This is seen when the flexed knee hits the dashboard
  - Conversely, a posterior force affects the anterior wall and column
  - A force to the lateral aspect of the femoral head is directed toward the medial wall of the acetabulum, often resulting in transverse acetabular fractures

## 4. Prognosis

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### Pelvic Fractures

- 4.1. High energy pelvic fractures are serious injuries and can be life threatening. The prognosis is improved by adequate evaluation and treatment. Evaluation of a high energy fracture of the pelvis or acetabulum requires a thorough medical history, physical examination, and radiographic studies. The best approach is to assess the patient in two stages with a multidisciplinary trauma team, the so-called primary and secondary survey. In primary survey, immediate life threatening problems should be identified. Bleeding caused by the fracture must be identified and, if present, urgent fracture stabilisation is necessary. This restores the anatomy and often stops catastrophic haemorrhage. External fixation is a quick and simple technique for rapid stabilisation of pelvic fractures and is the usual method used.
- 4.2. After the acutely injured patient is stable, the second stage of evaluation should take place. This identifies all other injuries which are appropriately prioritised and treated. This step also involves reassessment of the fracture, often using specialised CT scans, in preparation for definitive treatment.
- 4.3. There are certain possible long-term sequelae from pelvic fractures which in general reflect the associated injuries sustained. These are discussed below.
  - 4.3.1. The high mortality associated with pelvic fractures is primarily due to blood loss, and is reduced by early external fixation. Mortality rates in one study for pelvic ring injury patients fell from 26% to 6% after external fixation became common.<sup>12</sup>
  - 4.3.2. Long-term pain and disability may be related to the degree of residual deformity after pelvic ring injury.<sup>13</sup> Over 1 cm displacement of the fracture has been found to cause increased symptoms.
  - 4.3.3. Complications of associated urologic injuries (see 2.3.3) are urethral stricture, incontinence, and impotence.<sup>14</sup>
  - 4.3.4. Overall about 80% return to their previous occupation.<sup>15,16</sup> The literature, however, is vague in this area.
  - 4.3.5. Sexual dysfunction also occurs with about 75% of patients returning to their previous sexual function.<sup>15,16</sup> In women, pain during sexual intercourse (dyspareunia) was more common with fractures displaced greater than or equal to 5 mm than in those with non-displaced fractures.<sup>17</sup>
  - 4.3.6. A significant increase in the rate of Caesarean section delivery was seen after pelvic fracture (14.5% pre-injury, 48% post-injury), and was particularly high (80%) among women with displaced pelvic fracture.<sup>17</sup>
- 4.4. Complications can affect the prognosis:
  - 4.4.1. Infection has not been shown to alter the prognosis.<sup>18</sup>
  - 4.4.2. Thromboembolism – deep vein thrombosis (DVT) is common after pelvic fractures. Rates of proximal DVT in 35% of patients and involvement of the pelvic veins in 49% have been seen in studies.<sup>19</sup> This can lead to life

threatening pulmonary embolism (PE), and routine thromboprophylaxis is recommended.

- 4.4.3. Abnormal healing of fractures can occur i.e. nonunion (when the fracture does not heal), and malunion (the healing is not accurate). This is uncommon but may require complex surgery for symptom relief.<sup>20</sup>

### **Acetabular Fractures**

- 4.5. Acetabular fractures in isolation are rarely life threatening, although significant bleeding can occur. The main issue with acetabular fractures is the development of secondary osteoarthritis within the hip joint as a result of the injury. This can take a variable course but often progresses rapidly to severe painful arthritis requiring further surgical procedures such as a total hip replacement. Most acetabular fractures require surgery to try and minimise this complication, by restoring the anatomy of the hip joint back to as near normal as possible. Secondary osteoarthritis may also result from, or be made worse by, associated problems such as chondrolysis and osteonecrosis.
- 4.6. The overall prognosis depends on accurate surgical reduction of acetabular fractures which in turn depends on the surgeon's experience.<sup>21,22</sup>
- 4.7. Late complications include heterotopic ossification, osteonecrosis of the femoral head, chondrolysis, and post-traumatic osteoarthritis.
- 4.7.1. Osteonecrosis is due to a disruption of the blood supply to the femoral head usually seen in dislocations. Prolonged hip dislocation may result in increased incidence of this problem, and an attempt should be made to reduce a dislocated hip within 6 hours. Osteonecrosis results in significant morbidity with pain and functional limitations. Many of these patients go on to require one or more surgical procedures, e.g. hip replacements although the available data does not quantify this.
- 4.7.2. Chondrolysis is often a sign of post-traumatic osteoarthritis in a patient who has not had surgical intervention. Post-surgical chondrolysis may be a result of metal penetrating the joint. This again may require further surgery such as a hip replacement, although detailed evidence is not available.
- 4.7.3. Post-traumatic osteoarthritis is related to the nature of the fracture and its treatment. Accurate reduction on radiographs predicted a better result with about 75% of displaced fractures treated with surgery obtaining excellent to good results.<sup>23</sup> Presence of radiographic signs of osteoarthritis can also be strongly correlated with hip muscle weakness.<sup>24</sup>
- 4.7.4. Heterotopic ossification (HO) can cause stiffness of the hip joint and is a complication of acetabular surgery. It is also seen frequently in patients who have had associated head injuries. HO of varying degree occurs in up to 11% of traumatic brain injury patients although the mechanism is not well understood.

## **5. Summary**

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- 5.1. Pelvic fractures are usually caused by significant trauma. This is also true for acetabular fractures, which form a subgroup.
- 5.2. Pelvic fractures are associated with considerable mortality and morbidity, often due to associated injuries.
- 5.3. Long term problems may be reduced by accurate reduction of the fracture.

## **6. Related Synopses**

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Osteoarthritis of the Hip

Blast Injury to the Thorax and Abdomen

Low Back Pain

Prolapsed Intervertebral Disc

## 7. Glossary

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chondrolysis	Chondrolysis represents a process characterised by progressive destruction of articular cartilage resulting in secondary joint space narrowing and stiffness.
dislocated	Dislocations occur when bones forming a joint lose their normal relationship. This can cause additional problems such as chondrolysis and osteonecrosis.
external fixation	Surgical fixation of bone with the fixation hardware outside the skin.
heterotopic ossification	Bone formation in soft tissues; often follows acetabular surgery and can cause movement restriction.
incontinence	Loss of voluntary control of bladder and/or bowel.
tenderness	Pain elicited by clinician on examination as opposed to that complained of by the patient.
urethral stricture	Narrowing of the urethra, usually resulting in difficulty passing urine.
osteonecrosis	Bone death due to lack of blood supply.
thromboprophylaxis	Ways of attempting to prevent blood clots in veins (usually leg veins). Drugs as well as mechanical devices (compression stockings) can be used.

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