

# Hip Hip Hooray for X-ray!

## Introduction

Diagnostic imaging allows medical professionals to evaluate the condition of internal anatomy and create an effective plan of care based on their findings. The efficiency of this process is important when it comes to care in a trauma setting. Trauma to the pelvis and related vessels in the pelvic cavity can be seen quickly with the use of ultrasound, computed tomography, and radiography. Nonsurgical, surgical, and radiologic interventions are all life-saving resources for patients who endure a severe pelvic injury. The most common ways to fracture the pelvis are motor vehicle accidents or a fall from significant height.<sup>1</sup>

## Imaging

In some cases, the pelvic cavity is able to hold up to 5 liters of blood, which can disguise severe bleeding in patients who are hemodynamically unstable.<sup>2</sup> The common iliac arteries, external iliac artery, internal iliac arteries and more also run through the pelvis. The rupture of a main pelvic artery has a mortality rate of 50-75%.<sup>3</sup> To assess internal bleeding and fracture severity, computed tomography is the best option if the patient is stable. CT scans with contrast are able to highlight venous or arterial phases. If no bleeding is detected, no angiography is needed. If the patient is not stable upon arrival, standard X-ray or ultrasound are the most efficient options. X-ray is able to show hip dislocation or pelvic fracture. Although great tools, ultrasound and X-ray are not able to detect specific location of a bleed, or posterior pelvic ring instability.<sup>1</sup>

## Associated Injury

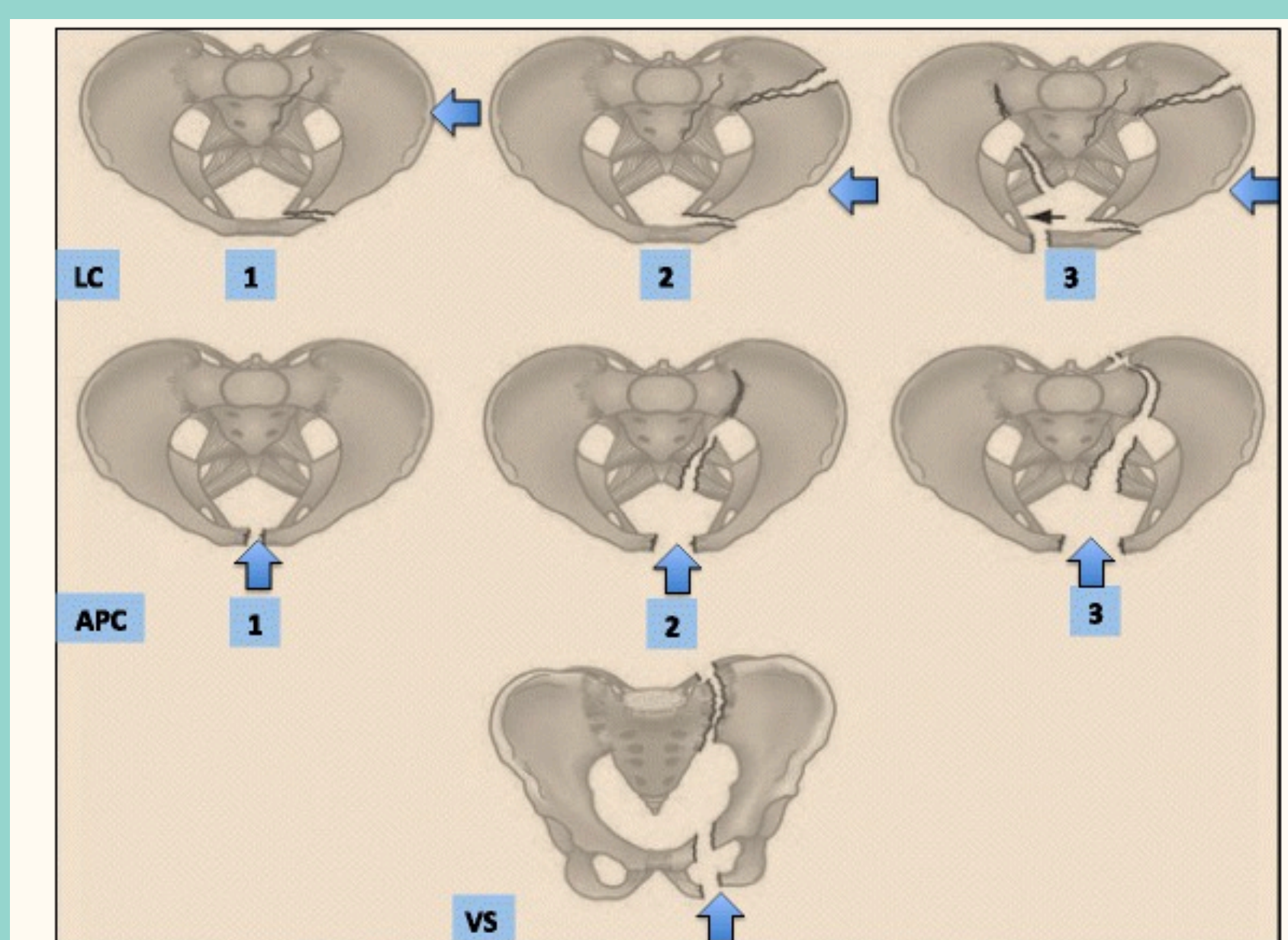
After undergoing severe pelvic trauma, patients often suffer from many other injuries. After assessing 78 pelvic fracture patients, a study in the early 2000s revealed that roughly

- 35.9% of patients also had abdominal trauma.
- 20.5% of these patients had vertebral fractures
- 51.2% had limb fractures as well.
- Urethral and bladder damage can also be associated with pelvic trauma.<sup>3</sup>

When pelvic injury is accompanied by severe head trauma, the pelvic hemorrhage and coagulopathy can worsen the head injury.<sup>4</sup> This makes the trauma teams job difficult.

## Classification of Fracture

The 2 main categories of pelvic fracture are acetabular and pelvic ring. Most pelvic ring fractures will break in 2 places due to its ring shape. Lateral compression 1 fractures are typically caused by fall, while lateral compression 2/3 fractures are side impact motor vehicle accidents. An anterior-posterior compression (APC) fracture is usually a "crush" injury or "open book" fracture which has separated the pubic symphysis.<sup>2</sup> A vertical sheer injury is caused by falling from a significant height and often causes displacement of the sacroiliac joints and ischial spine from the ligament.<sup>2</sup>



**Figure 1.** Lateral compression, anterior-posterior compression, and vertical sheer pelvic fractures demonstrated.<sup>4</sup>

## Interventions

Interventional radiology is able to do arterial embolization on patients with a pelvic bleed to stop the bleed. They must use contrast enhanced angiography to visualize the vessel and localize the bleed. Arterial bleeding is found in 59% of mechanically unstable pelvic ring fractures.<sup>1</sup> If pelvic bleed is arterial, an interventional radiologist will gain femoral access with a 4-5 fr sheath, then use contrast to locate the bleed. If contrast is extravasating or "blushing" around a vessel, this indicates a bleed. Coils or gelfoam can be used to embolize the vessel.<sup>5</sup> The mortality rate of patient who undergo embolization is 27-47%, and the success rate is 85-100%.<sup>3</sup>



**Figure 2.** A: angiogram of the internal iliac artery, arrows indicate contrast extravasation. B: Occluded internal iliac artery after embolization using gelfoam.<sup>1</sup>

## Non-surgical Intervention

Traction and physical therapy are common non-surgical interventions implemented post-pelvic injury. For example, if the patient is not a surgical candidate right away, orthopedic professionals can use traction to pull the femur into the acetabular region.<sup>2</sup> Physical rehabilitation can repair mobility, balance, function and strength for patients.<sup>6</sup> To reduce pain, a physical therapist may use ultrasound, heat, electric stimulation, manual therapy, or tape.<sup>6</sup> Patients could be referred to physical therapy as an alternative to surgery, or following surgery to regain mobility and strength.

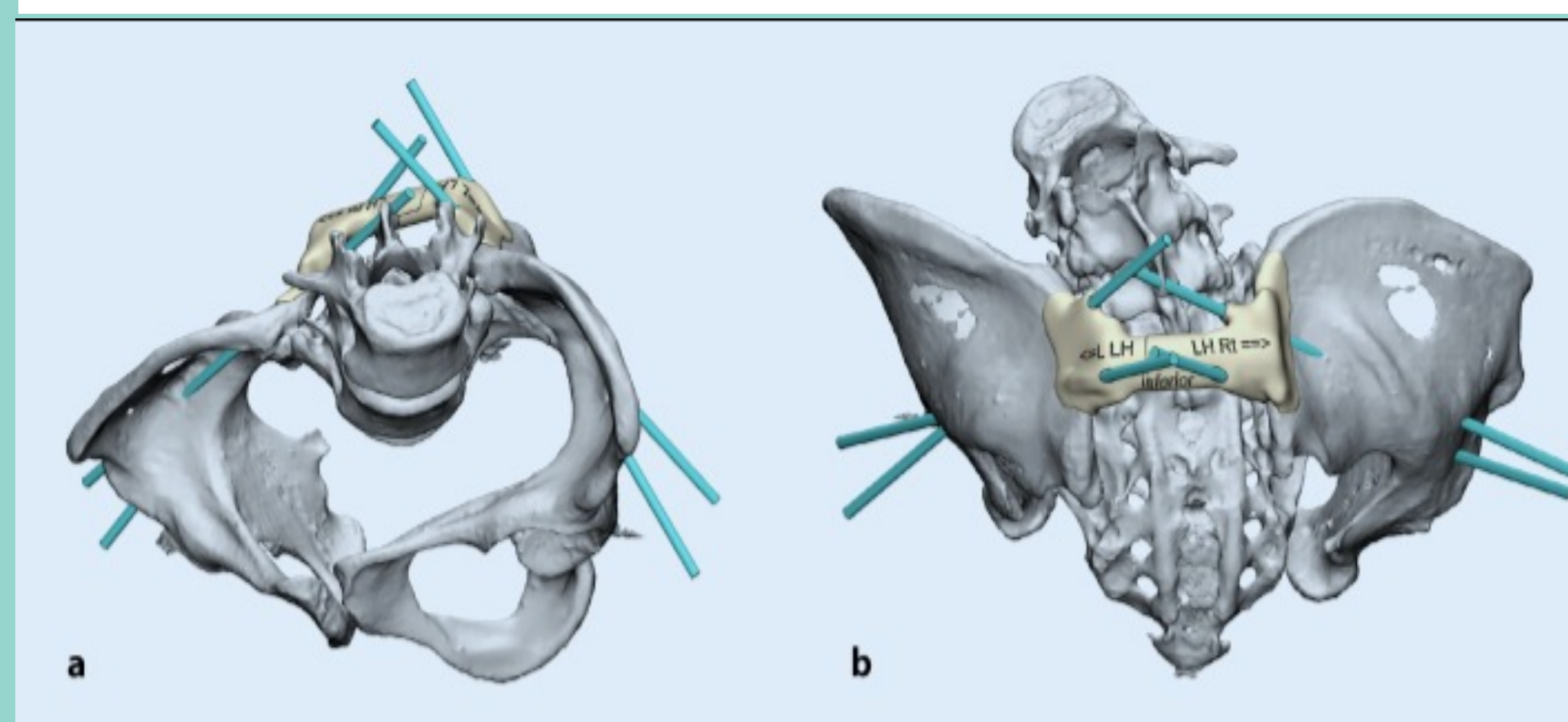
## Surgical Intervention

If the patient is not stable enough for surgery, external fixation is an option. External fixation is most commonly used to temporarily stabilize an "open book" fracture in which pubic diastasis has occurred.<sup>2</sup> External fixation uses hardware placed in the pelvis by an orthopedic surgeon, that is stabilized outside of the body.<sup>2</sup> This will eventually be replaced by screws and plates internally. Most often, LC1 fractures will not be operated on. LC2 and LC3 fractures are fixed using plates to stabilize sacroiliac joints, as well as pubic rami fractures and ilium displacement. The plates should not be used in the sacrum due to potential nerve damage.<sup>2</sup>

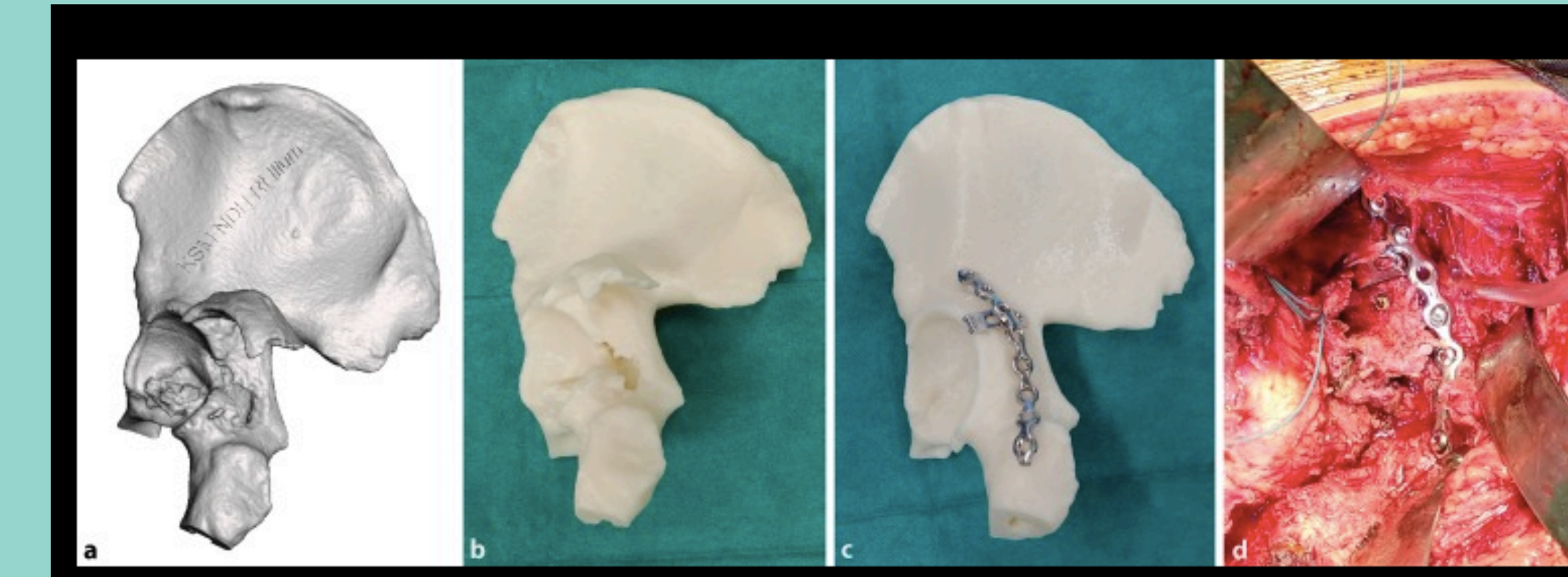
## Benefits of 3D Printing

CT is able to gather the information needed to format and print the body pelvis in 3D to assist in surgical planning.<sup>7</sup>

- Medical professionals can assess anatomy
- Surgeons can review hardware options
- Can be sterilized and brought into OR as a tool
- Faster surgical times
- Fewer complications
- Decreased blood loss



**Figure 3.** design of a drill-guide for the surgical placement of bilateral iliac screws on a specific patient. Inlet and posterior views shown above.<sup>7</sup>



**Figure 4.** A:3D printed model of the posterior acetabular fracture. B: Mirrored model is printed using the opposite intact hemi-pelvis. C: Surgical plan after fracture fixation using a plate and screws. D: Implants placed according to surgical plan<sup>7</sup>

## Post-Op

Rehabilitation for pelvic trauma patients is critical to their quality of life. The pelvic organs such as, bladder and reproductive organs can experience some dysfunction following an injury of this nature. Patients can expect 10-12 weeks of non-weightbearing post-surgery.<sup>2</sup> Other potential issues a patient could experience are:

- Chronic back pain
- Nerve and ligament damage
- Infection

If the peroneal nerve is impaired, the patient will present with a foot drop. In order to gain walking function in that foot, the patient must wear a brace to hold the foot in flexed position.<sup>2</sup> If a woman is in child bearing years when internal fixation of the pubic symphysis occurs, she must have the hardware removed before becoming pregnant; typically 9-12 months after the procedure.<sup>2</sup> If the hardware must be removed, there is a chance of causing severe bleeding or nerve and ligament damage.<sup>2</sup>

## Resources

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