VILNIUS UNIVERSITY
MEDICAL FACULTY

The Final thesis

Percutaneous Fixation of Pelvic Ring Injuries

Student **Hamza Bouboual, VI year, group 1**

Department/ **INSTITUTE OF CLINICAL MEDICINE /CLINIC OF RHEUMATOLOGY, ORTHOPAEDICS TRAUMATOLOGY AND RECONSTRUCTIVE SURGERY**

Supervisor Assist Prof. Igoris Šatkauskas

Consultant (if applicable) ___________________

The Head of Department/Clinic Prof. Irena Butrimienė

2024

Email of the student__hamza.bouboual@mf.stud.vu.lt___

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I. Introduction

Pelvic ring fractures provide a significant risk of morbidity and mortality because they induce serious bleeding and internal organ injury, there is a considerable risk of morbidity and fatality **(Perumal et al., 2021).** For most orthopedic surgeons, managing these fractures is a substantial challenge. It was rare to find epidemiological data on these injuries in the literature. In the United States, there were 24059 cases of unstable pelvic ring fractures (PRF) between 2000 and 2009; the in-hospital fatality rate was 8.3%. **(Boudissa et al., 2020)**

There is ongoing discussion on the most effective stabilizing technique, especially in cases of unstable fractures. Open reduction internal fixation (ORIF) is a procedure that requires a great deal of exposure and entails a high risk of intra- and postoperative complications, including deep vein thrombosis, aberrant bone development, nerve and blood artery injury, and substantial bleeding **(Han et al., 2022).** Many authors have used closed reduction with percutaneous screw fixation—a minimally invasive procedure—to treat patients with pelvic ring fractures (PRF) and acetabular fractures (AF).since its introduction **(Qoreishi et al., 2019).** These trials show that percutaneous screw therapy for pelvic and acetabular fractures reduces soft tissue damage, blood loss, and infection risk **(Abou-Khalil et al., 2020)**

. Furthermore, percutaneous screw fixation will enable early weight-bearing ambulation. The process could result in issues such an increased risk of internal organ damage, screw fractures, misplaced screws, and neurovascular injuries **(Al-Naseem et al., 2023)**

Aim of the study

The study aims to investigate the Percutaneous Fixation of Pelvic Ring Injuries and its clinical outcomes

The use of traditional internal fixation techniques can occasionally result in lengthy surgical operations **(Li et al., 2021).** These procedures have a significant risk of infection, damage to vital blood vessels or nerves, and problems with wound healing **(Makelov, 2023).** Rather than the initial injury, the bulk of these issues are related to the surgical exposure. Therefore, it makes sense to look into less invasive options. The use of percutaneous pelvic fixation has grown in favor as a means of lowering the morbidity linked to difficult and drawn-out surgical procedures. Sacroiliac dislocation can be effectively treated with percutaneous iliosacral screw fixation, which minimizes the risk of infection and blood loss while providing adequate biomechanical stability **(Joukar et al., 2021)**. Other methods for treating pelvic fractures have been developed in addition to the percutaneous iliosacral screw, including iliac wing, transverse screw location, and anterograde and retrograde intramedullary pubic ramus screw fixation **(Alencar et al., 2021).**

II. Percutaneous screw fixation of pelvic ring injuries

The development of computer-assisted surgery holds promise for increasing surgeon performance and trust in these procedures **(Tonutti et al., 2017).** Throughout the entire procedure, from intraoperative imaging to fracture reduction techniques to the actual application of the final fixation, these instruments support the surgeon **(Jiménez-Delgado et al., 2016).** As a result, more and more people are using percutaneous iliosacral screw fixation methods that are guided by computer tomography (CT) or fluoroscopic imaging (**Rommens et al., 2021**). Because of the complex anatomy of the pelvis and its proximity to neurovascular pathways, percutaneous screw fixation is a very challenging treatment requiring a high degree of surgical and anatomical competence from the operator**(Meng et al., 2022)**. Fluoroscopy, however, is applied to the patient and the surgical team for a considerable amount of time. To lessen these restrictions, 3D-fluoroscopic navigation devices were developed for pelvic ring injury screw fixation. An instance of a 3D-fluoroscopic navigation system is the O-ARM®, which generates two- and three-dimensional images by rotating a full 360 degrees around its central axis **(Alzobi et al., 2023).**

Thanks to the three-dimensional analysis, the pelvic anatomy of the patient can be completely studied multiplanarly in just 13 seconds. The 3D examination is shown in three windows on a large dedicated display using a typical viewfinder centring system, providing images in the axial, coronal, and sagittal planes as needed **(Florio et al., 2020)**. The best method for creating three-dimensional images of bone anatomy is the O-arm method **(Jeyaseelan et al., 2019).** This expands the system's usefulness not only for the insertion of spinal pedicle screws during back surgery but for all other orthopedic uses as well, where precise tool placement and three-dimensional imaging allow the surgery to be carried out in total safety **(Gu et al., 2020).** Specifically, for pelvic surgery and trauma surgery involving the extremities, the O-arm system can be utilized alone or in combination with the Stealth Station® guidance system. In addition to providing extremely precise surgery, image-guided technology lowers the amount of ionizing radiation produced in the operating room **(Florio et al., 2020)**

III. Recent advancements in the identification and management of pelvic ring injuries.

Acute exsanguination, venous thromboembolism and multiple organ failure after an injury, are the main causes of death associated with pelvic ring injury (PRI) **(Marmor et al., 2020)**. All of these seemingly unrelated disorders are directly linked to major blood loss. The correlation between acute exsanguination and multiple organ failure is well-established **(Marshall et al., 1995).** However, the severity of traumatic shock, which is defined by metabolic acidosis and the need for transfusions, is a powerful and independent indicator of both multiple organ failure and fatal venous thromboembolism **(Guerado et al., 2016).** Even though there aren't many potentially avoidable deaths in established trauma systems, hemorrhage associated with PRI is frequently the cause of death **(Faulconer et al., 2018).** The absence of a structured institutional plan results in a death rate over 30% for individuals with hemodynamically unstable pelvic ring injuries. Nevertheless, among this demanding group of patients with multiple traumatic injuries, implementing a systematic approach to treatment can significantly reduce mortality rates to below 10%. These findings emphasize the significance of a targeted and efficient strategy for managing bleeding in PRIs **(Abo-Elsoud et al., 2023).**

Many of these methods are used simultaneously or in combination, and the order and preferences of these methods vary greatly throughout institutions. Pelvic binders are an integral aspect of prehospital treatment. If they are not immediately accessible upon the patient's admission, they should be promptly employed in the emergency room **(Khaliq & Rodham, 2024).** Their main purpose is similar to that of limb splinting; they ensure the required tissue stability for the formation of blood clots by precisely aligning the corresponding anatomical features **(Lee et al., 2023).**

Maintaining the level of the medial malleoli, bringing the internally rotated hips and knees together, and tightening the binder at the greater trochanter level are all crucial while applying **(de Ridder et al., 2023).** By tightening the binder and employing the femora as levers to reduce the pelvic ring, the goal is to maintain pelvic reduction. Although the use of binders enhances the radiographic reduction of the majority of PRIs, LC injuries may exhibit worsening displacement; nevertheless, no specific damage related to this method has been documented. Binders can be kept in situ until the hemorrhage ceases. It's crucial to routinely check the skin when using pelvic binders for a prolonged amount of time to avoid skin degeneration **(Yoon et al., 2021).**

Preperitoneal pelvic packing, or PPPP, has gained popularity in North America after being used extensively in Europe for a long time **(Ascenti et al., 2024).** This approach gained popularity before modern hemostatic resuscitation procedures were developed, and it was developed to treat severe venous hemorrhage **(Watkins & Hsu, 2020).** While packing pressure greater than 100 mm Hg is necessary for PPPP to temporarily stop arterial bleeding, this could be detrimental to the muscles' and intrapelvic organs' perfusion**(Aseni et al., 2023).** Pelvic packing can be performed expeditiously, however, it has a substantial risk of infection and other problems. In addition, this procedure necessitates a minimal level of skeletal stiffness, which serves as a basis for packing. Controlling arterial bleeding is crucial because up to 30% of patients with PPPP may potentially need AE after the initial surgery **(Parry et al., 2021).**

While the duration for PPPP is reported to be less than that for AE, it is important to consider the total time necessary for both PPPP and AE as an indicator of the overall time needed for effective bleeding control**(Bugaev et al., 2020).** Recent systematic reviews and meta-analyses have concluded that it is not feasible to compare PPPP and AE studies due to inconsistent reporting, changes in timing, and inconsistencies in research populations. Recent studies from formerly supportive groups suggest a decline in the efficacy of hemostatic resuscitation in managing bleeding **(Lu et al., 2020).**

Resuscitative endovascular balloon occlusion of the aorta is an innovative method for managing potentially life-threatening pelvic hemorrhages **(Lendrum et al., 2019)**. An effective strategy involves the placement of a small and inconspicuous balloon catheter, which can be activated as needed, somewhat above the point where the aorta divides into two branches. Nevertheless, the existing case reports and retrospective series lack sufficient evidence to substantiate the assertion that this approach surpasses fast AE. This method is applicable for both AE and selective balloon tamponade **(Klingebiel et al., 2023).** Theoretically, implementing a partial closure of the caudal aorta could facilitate the formation of blood clots, halt bleeding, and reduce the likelihood of severe reperfusion injury. In instances where resuscitative endovascular balloon occlusion of the aorta is employed in highly critical situations, complications may arise both at the site of vascular access and in the lower limbs. In order to address these problems, it may be necessary to perform a fasciotomy, undergo vascular surgery, or in severe cases, consider amputation **(Klingebiel et al., 2023)**

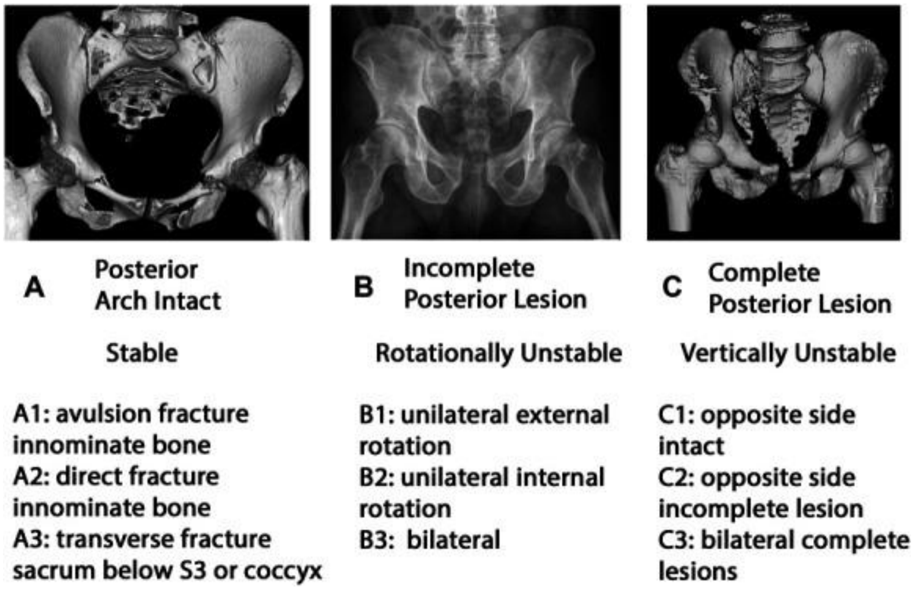

Figure 1: AO/OTA pelvic fracture classification ***(Han et al., 2022)***

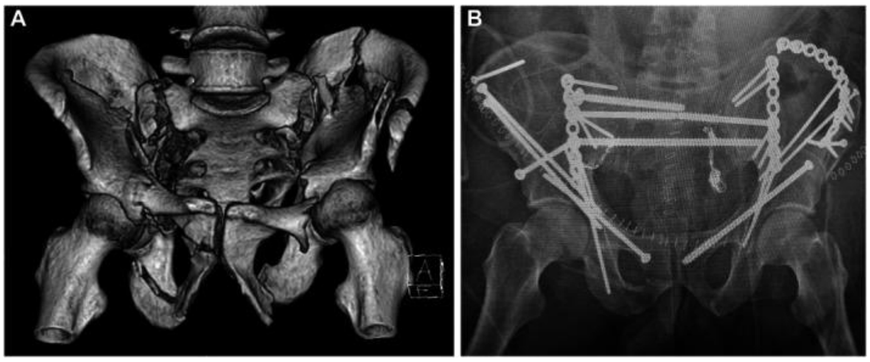

Figure 2:A 3D model done before surgery of a complicated unstable pelvic ring injury that includes fractures of the sacrum, sacroiliac, iliac wing, and both superior and inferior rami. B, An AP x-ray taken after surgery showing a hard fix. To fix two broken pubic rami, a partly threaded screw that goes retrograde on the right and anterograde on the left are in place. A mix of screws and plates are used to fix the iliac wing fracture and plates are used to fix the pelvic brim fracture. For injuries to both SI joints and sacral fractures in the upper sacral segment, oblique sacroiliac screws are used. For injuries in the second sacral

segment, transverse, transsacral, and transiliac screws are used ***(Prost et al., 2021).***

IV. Open versus percutaneous fixation of unstable posterior pelvic ring injuries

High-energy trauma is a common cause of pelvic ring fractures, which are substantial energy forces associated with other bone injuries **(Basile et al., 2022).** Unstable disruptions of the pelvic rings have been associated with elevated rates of morbidity, encompassing bleeding, nerve impairment, nonunion, malunion, and debilitating chronic pain. By decreasing bleeding, relieving discomfort, permitting early patient mobility, and allowing the pelvic ring to heal in its anatomical location, precise reduction in conjunction with secure fixation improves the patient outcome **(Balasubramanian et al., 2023).**

Achieving permanent stability of the pelvic ring dislocation remains a challenge for the orthopedic surgeon. External pelvic fixators are not able to stabilize the posterior lesion in an unstable type C pelvic disruption, however they can help lower pelvic volume and manage hemorrhage in an emergency **(Yang et al., 2022).**

Internal fixation is a considerably better option than external fixation or conservative treatment for addressing unstable pelvic ring abnormalities. Percutaneous iliosacral screw fixation offers good biomechanical stability but is a less invasive procedure that still demands a high level of professional skill. In this study, unstable posterior pelvic ring injuries are compared between open and percutaneous stabilization techniques **(Pan et al., 2021).**

V. Structural stability of the pelvic ring

. There are three different bones in the pelvis. These are the sacrum, the left and right innominate bones the anterior/posterior SI ligaments, the interosseous ligament, the sacro-spinous and sacro-tuberous ligaments, and the sacroiliac (SI) joint connect the sacrum to the innominate bones. These are the body's strongest ligaments. Two sets of tendons and a flexible, fibrocartilaginous disc connect the front of the pelvic ring to the lower back. The hip is attached to many muscles, such as the rotators, glutei, adductors, abdominal, and paraspinal muscles.

These muscles place a great deal of stress on the pelvis, which leads to fixation failure and post-reparative surgery deformity **(Rovere et al., 2021).**

.The first clinical method for assessing the stability and mobility of the SI joints and pubic symphysis was described by Chamberlain in 1930. To assess the vertical mobility of the pubic symphysis, the patient is placed in a flamingo stance in a radiographic anteroposterior (AP) view, with one leg hanging freely and not carrying any weight. For the vertical motion (y-axis) of the pubic symphysis, Chamberlain determined the following normal values: adult male 0–0.5 mm, adult nulliparous female 0–1.0 mm, and adult multiparous female 0–2.0 mm. Pelvic joint pain was seen in every single instance with symphyseal mobility more than 2 mm **(de Ridder et al., 2023).**

The pubic symphysis moves along with the spine and innominate bones when you walk. A study showed that in healthy people, the sacrum can bend and stretch laterally around a horizontal plane that is located at the interosseous ligament of the SI joint **(Leo, 2022)**. Nutation and counternutation are the names for these two movements. "Nutation," which comes from the Latin word for "to nod," means the anterior rotation of the sacrum around the plane of the axial ligament **(Alderink & Ashby, 2023)**. This makes the apex and tip of the coccyx move backwards, and the promontory moves forward and backwards. The point of the sacrum moves forward in the opposite direction, which is called counternutation. When you walk, these two things happen at the same time: the heavy hemipelvis nutates during the heel strike/stance phase, and the opposite side counter-nutates **(Obey et al., 2022).**

The phrase for this complementing motion, with a maximum range of two degrees, is reciprocal unilateral motion **(Ziran et al., 2022).** Different people have very different bone structures and ligamentous flexibility (SI ligaments, interosseous SI ligaments, and sacro-spinous/sacro-tuberous ligaments)**(Ziran et al., 2022).** This action of nutation and counternutation can also happen on both sides at the same time. Bilateral nutation makes the pelvis leak more, while counternutation makes the pelvis let more fluid in **(Abd-Elsayed, 2023)**. At the start of the 20th century, Farabeuf showed how important this nutation/counternutation movement is for the SI joint during childbirth. According to Farabeuf's study, the pelvic outlet was bigger when the thighs were rotated inward and the hips were bent 90 degrees. The pelvic inlet was bigger when the thighs were rotated outward. Because of pregnancy, the pubic symphysis is more flexible, which makes it easier for the baby to pass through. The posterior pelvic ring is also more flexible. A lot of writing has been done about the SI joint. **(Xu et al., 2023).**

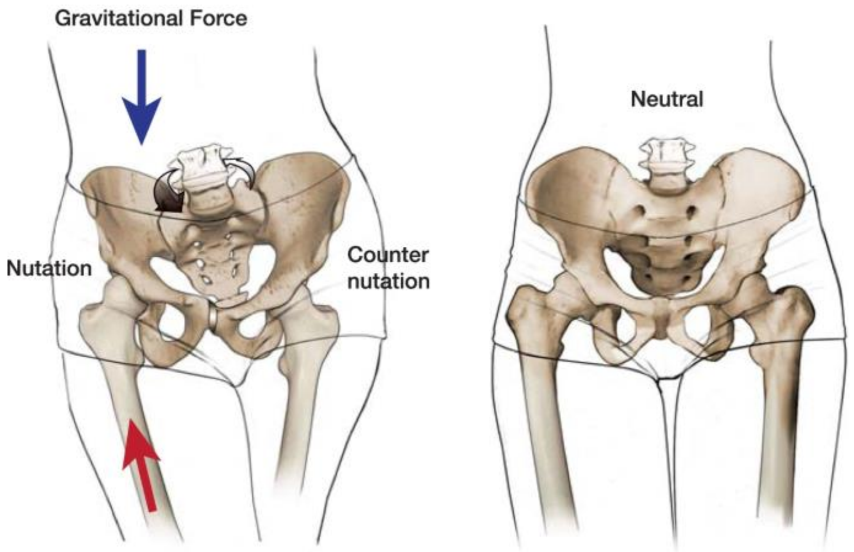

Figure 3: A picture that shows how the pelvis is loaded when walking.

When you put weight on one side of your body, the reactive normal force vector, which is pointing up, makes the pelvis and tailbone move outward. Nutation, which means "to nod," happens when the distal sacrum tilts backwards toward the ilium and the sacral base (promontory) tilts forward and downward **(Rahman et al., 2023).**Through the pubic symphysis, the left hemipelvis moves slightly to the right along the y-axis. The contralateral hip moves in the opposite direction, which is called counternutation. For the sake of explanation, the pictures' motion is sped up. This switching movement that happens when you walk is called reciprocal unilateral motion **(Rahman et al., 2023).**

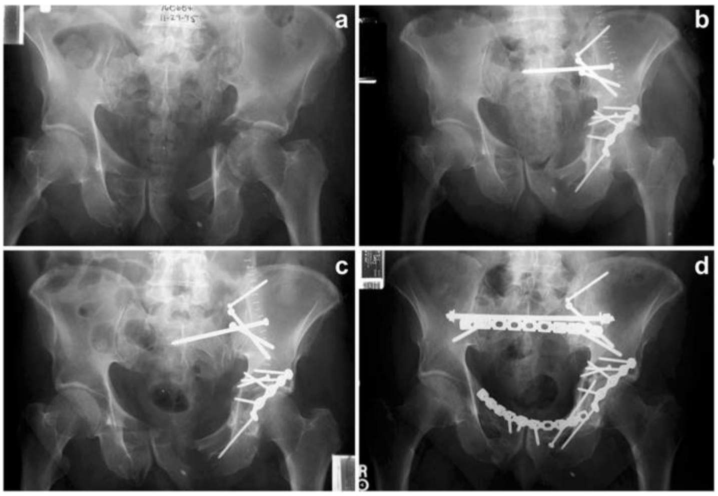

Figure 4: radiographic pictures of a T-shaped acetabular fracture and a concomitant left SI fracture-dislocation (A). Following fracture fixation (B), the posterior pelvic fixation failed (C), requiring revision with anterior ring fixation, a posterior tension band plate, and a trans-sacral screw. (**D**) **(Timmer et al., 2023).**

VI. Biomechanics of screw fixation

Typically, writers utilize a 7.3 or 8.0 mm partially-threaded screw. The surgeon may have preferences based on the screw's diameter (6.5, 7.3, vs. 8.0 mm) and whether it is partially or fully threaded **(Berk et al., 2023).** Larger screw diameters are linked to greater mechanical advantage and resistance to cantilever bending. The screw's circumference over pitch is the definition of mechanical advantage (MA = C/P). In the contralateral iliac cortex or the S1 body, a screw with a larger diameter and circumference would therefore have a greater mechanical advantage given similar pitch. This mechanical advantage would make the larger screw more resistant to toggle in the coronal plane **(Wu et al., 2021).**

Illiosacral screws with a long thread (32 mm) were almost three times stronger at pulling out bone than screws with a small thread (16 mm) in the sacral body. Screws with long threads were ten times stronger than screws with short threads when they were put in the sacral ala. Which distal threads you buy—ISS or TSS—determines how much the SI joint or fracture is compressed and how resistant it is to vertical stress **(Du et al., 2020).** For instance, in the coronal plane, a screw that isn't firmly attached to the S1 body is more likely to move. When you put these screws in, you must make sure that the threads are in the S1 body and not the ala on the other side. As was already said, the iliac cortex, the bone next to the SI joint, and the top plate of the S1 body are the hardest bones. Osteoporotic bone makes it more likely that an iliosacral screw with bad thread purchase at S1 will fail at the toggle. It can be helpful to contact the superior endplate of S1 when treating people who may not have a lot of bone stock **(Du et al., 2020).**

VII. Percutaneous posterior fixation for unstable pelvic ring fractures

The standard treatment for unstable pelvic ring fractures (type C in the AO classification) involves anterior and posterior fixation. There are several posterior fixation techniques that have been documented, such as the least intrusive technique, the percutaneous technique, and the open technique using screws, plates, or rods with the related risk of infection issues. This article describes a percutaneous posterior fixation technique for unstable pelvic fractures based on spinal instrumentation, as well as the subsequent clinical and radiological assessments **(Namm et al., 2021).**

- **Surgical technique**

Under general anesthesia, patients are laid out prone on a radiotransparent table. If the surgical fluoroscopy images reveal a vertical displacement greater than 2 cm, transcondylar traction is applied **(Liu et al., 2010).** Following fluoroscopy control, two 2-cm skin incisions are made over the posterosuperior iliac spine and the bigger sciatic notch. A rongeur is used to make a notch in the cortex that exposes the bone in order to bury the screw heads **(Tahmassebi et al., 2020)**. The vertically implanted Jamshidi trocar, which is placed between the two cortices of the iliac crest, is replaced with a K-wire. Before inserting a cannulated polyaxial pedicular screw (Longitude®, Medtronic), the K-wire is tapped over and the required length is measured **(Zarei et al., 2022).**

The screw position is confirmed by fluoroscopy. This procedure is continued until two screws are in each iliac crest. A 6-mm diameter rod is subfascially implanted percutaneously on the fracture side, usually during spine surgery **(Wang, 2012).** Compression can be applied via a clamping device. Caps are put on the screw heads to fasten them to the rod. The screw heads are buried by sealing each layer; thus no drains are used. Following surgery, patients are prohibited from bearing weight on the broken side for six weeks **(Luo et al., 2023).**

Figure 5: Preoperative X-ray of a type C1.2 pelvic fracture **(Jäckle et al., 2020).**

Open posterior fixation methods for pelvic ring fractures are linked with significant morbidity, including >2 hours of surgery, >1500 mL of intraoperative bleeding, and a 5% to 30% postoperative infection incidence **(Suh et al., 2021).** Percutaneous sacroiliac screws have helped to reduce the morbidity (shorter operation time, less bleeding), despite a substantial vascular and neurological risk. Eleven patients underwent the treatment in an average of forty-five minutes, with a blood loss of less than fifty milliliters and no neurological or vascular complications (one patient however develop a postoperative infection **(Hadeed et al., 2022).**

While a more stable fixation can be achieved with two sacroiliac screws than with one, this is insufficient to prevent a vertically displaced fracture from worsening **(Heiman et al., 2022)**. Although the build is more robust when the sacroiliac screws are connected by a rod, this is insufficient in complex fracture instances. technique uses spine surgical tools that are often seen in operating rooms treating polytrauma patients. The placement of two rods and two iliac screws on each side offers a great deal of stability. However, biomechanical research is necessary in order to compare the design with existing constructs **(Alkhateeb et al., 2020).**

VIII. The Impact of Minimally Invasive Surgery to Align and Stabilize the Back of the Pelvic Ring on Patient-Reported Results

In patients with pelvic ring injuries are a leading source of long-term morbidity and mortality and can be challenging to treat **(Roszman et al., 2023).** When employing novel safe techniques for percutaneous fixation, patients can gain tremendous stability without incurring higher morbidity **(Dussik et al., 2023).** 1-3 Open approaches may not be practicable because to local soft-tissue damage. Closed reduction and percutaneous fixation (CRPF) decreases both blood loss and surgical duration, but direct open procedures provide a lower chance of malreduction **(Jordan et al., 2014).** This is a result of the indirect fluoroscopic reduction methods used by CRPF. There is no agreement on what level of misalignment, if any, is regarded "acceptable." Prior research has established a correlation between unfavorable results and improper alignment of fractured bones and damage to the brain. Specifically, when the residual displacement exceeds one centimeter, the consequences tend to be more severe. The validity of reliability as an outcome predictor is in question due to conflicting findings from later research assessing patient outcomes **(Xia et al., 2024).**

The Patient-Reported Outcomes Measurements Information System (PROMIS), created by the National Institutes of Health in 2004, has been utilized in various orthopaedic surgery subspecialties such as trauma, sports, spine, hand, hip and knee replacements, shoulder replacements, and fifteen foot and ankle procedures. However, there is currently a lack of research on the assessment of PROMIS scores in patients with pelvic ring injuries. As far as we know, there has been no prior research that has examined the impact of malreduction or posterior pelvic ring CRPF on PROMIS ratings **(Romanelli et al., 2020).**

Figure 6: Post-operative x-ray showing Stabilization of the Back of the Pelvic Ring **(Tisano et al., 2020).**

An inherent drawback of percutaneous fixing is the challenge of achieving anatomical alignment because it lacks the ability to directly reduce fractures **(Valencia & Foruria, 2023).** Research that indicated insufficient reduction of posterior ring damage did not correspond with bad outcomes has cast doubt on the historical association between significant malreduction of posterior pelvic injuries and poor functional outcomes **(Jäckle et al., 2022).** Studies have also looked at how functional results are affected by residual pelvic asymmetry in patient populations with and without skeletal maturity. According to one study, patients with asymmetry greater than 1 centimeter had worse functional results after 6.5 years on average.38

Patients in this study with residual pelvic asymmetry < 1 cm and > 1 cm had the same PROMIS scores at the conclusion of the follow-up **(Moussa et al., 2023).**

Evaluating functional outcomes in persons with multiple injuries following posterior pelvic ring CRPF can be challenging, particularly in terms of assessing the quality of reduction **(Obey et al., 2022).** Undoubtedly, concurrent injuries have a significant impact on results and have been linked to chronic pain, aberrant walking patterns, and sexual dysfunction **(Li et al., 2020).** Often, patients with more severe injuries and related complications exhibit poorer outcomes. Similarly, patients with higher ISSs had lower 12-week PROMIS ratings. When comparing PROMIS scores between patients who received both anterior and posterior fixation and those who received only posterior fixation, there was a notable difference in physical function scores at the 8- and 12-week time points **(Obey et al., 2022).** The scores approached statistical significance, with the combined fixation group scoring 29.5 and 33.2, compared to the posterior fixation group scoring 35.6 and 43.0, respectively. The p-values were 0.09 and 0.07, indicating a trend towards significance. While the observed differences were not statistically significant, they did vary by 1 standard deviation over a period of 12 weeks, which might be considered clinically significant **(Son et al., 2021).**

IX. Indications for surgery of pelvic ring injuries

Surgery is recommended for zone 3 fractures according to the Schatzker classification., cases with cognitive impairment, displacement over 10 mm, complete fractures, and bilateral rami fractures **(Gaski et al., 2014).** Nonoperative treatment is typically employed for type I anteroposterior compression (APC) and lateral compression (LC) injuries due to their inherent stability and ability to resist normal physiological stress **(Wong & Bucknill, 2017).** There are four specific reasons why surgical stabilization is recommended in this group: (1) significant displacement of the fracture; (2) the presence of abdominal injury that requires laparotomy; (3) a tilt fracture that extends into the perineum; and (4) persistent and unresponsive discomfort. According to Olson and Pollack, severe displacement is characterized by a rotational deformity that results in the complete loss of internal or external rotation in the lower limbs, or a leg length difference over 1.5 cm.

However, patterns such as APC and LC types II and III frequently experience rotational instability and substantial displacement. These patterns typically indicate the need for surgical stabilization **(Wang et al., 2020).**

Treatment of these fractures is often not needed because the risks of surgical dissection to correct concomitant pubic rami fractures exceed the benefits **(Nguyen et al., 2022**). Similarly, the instability of the vertical shear (VS) pattern in both the rotating and vertical directions calls for its correction. However, due to sometimes substantial bleeding associated with VS pattern, external fixation, with or without skeletal tension, is often used as a temporary measure until final fixation can be safely executed. With internal fixation and gradual open reduction, traction can assist by preventing the hemipelvis from shortening **(Ziran et al., 2022).**

- **Percutaneous fixation**

Percutaneous iliosacral fixation has become more common in recent years due to posterior ring instability **(Ziran et al., 2022)**. Because wounded posterior skin is more likely to degrade during open reduction, this technique is very helpful in these cases **(Abdelgaid et al., 2018).** This retrospective analysis of 32 patients with posterior pelvic ring instability who received conservative treatment or percutaneous iliosacral screws revealed that at one-year follow-up, the percutaneous fixation group had significantly better functional and general health outcomes, better pain relief, and significantly less residual displacement. According to Schweitzer et al., in a separate group of 71 patients who had Tile B1 and C fractures and were treated with posterior screw fixation, 86% of them were able to resume their previous career and leisure activities. Among a group of 25 patients with LC1 and II fractures, the use of percutaneous iliosacral screw fixation alone resulted in stability. Only 2 patients (8%) required extra anterior stabilization. The three most commonly described adverse consequences of percutaneous fixation in the literature are loss of reduction, screw misplacement, and nerve root damage **(Green et al., 2022).**

Clinical presentation

An injured 50-year-old man came in with broken bones after falling from a ladder about 2.5 meters high. He had breaks in the right lateral mass of the sacrum, both rami of the pubic bone, and the right transverse process of the L5 vertebra when he was checked out. Because of the type of fractures and how the patient was acting, percutaneous stabilization was used to keep the pelvic ring stable and make it easier for the patient to move around right away. For pelvic ring injuries, percutaneous stabilization is better than open surgery in a number of ways. First, it doesn't damage the soft tissues around the wound too much, which lowers the risk of problems like infection and blood loss. Compared to open surgery, it also allows for shorter operating times and maybe even faster healing. The smaller cuts also improve the appearance of the skin and lessen pain after surgery, which makes the patients happier.

Figure 7: CT-Scan imaging shows the fracture of the right lateral mass of the sacrum is seen.

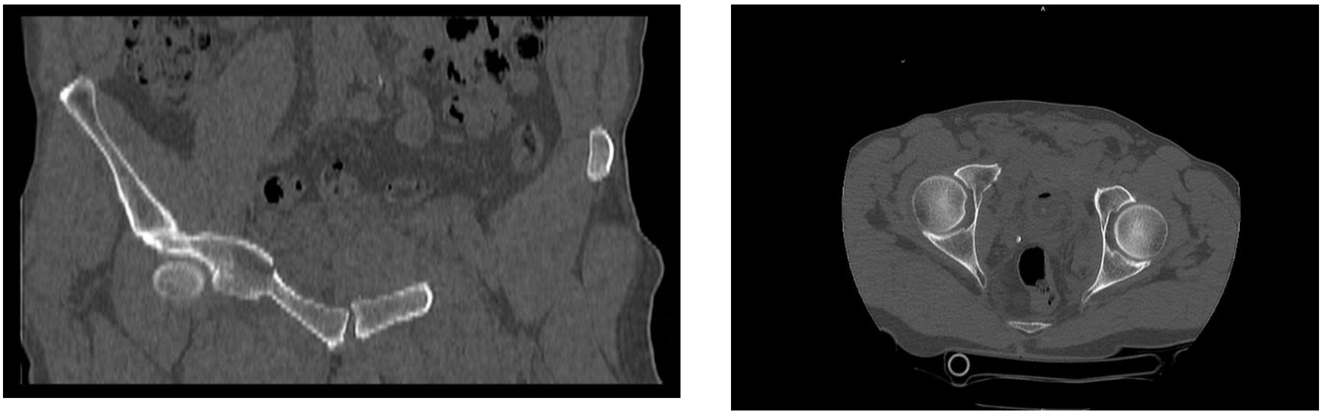

Figure 8: CT-Scan shows fracture of the right superior ramus of the pubis.

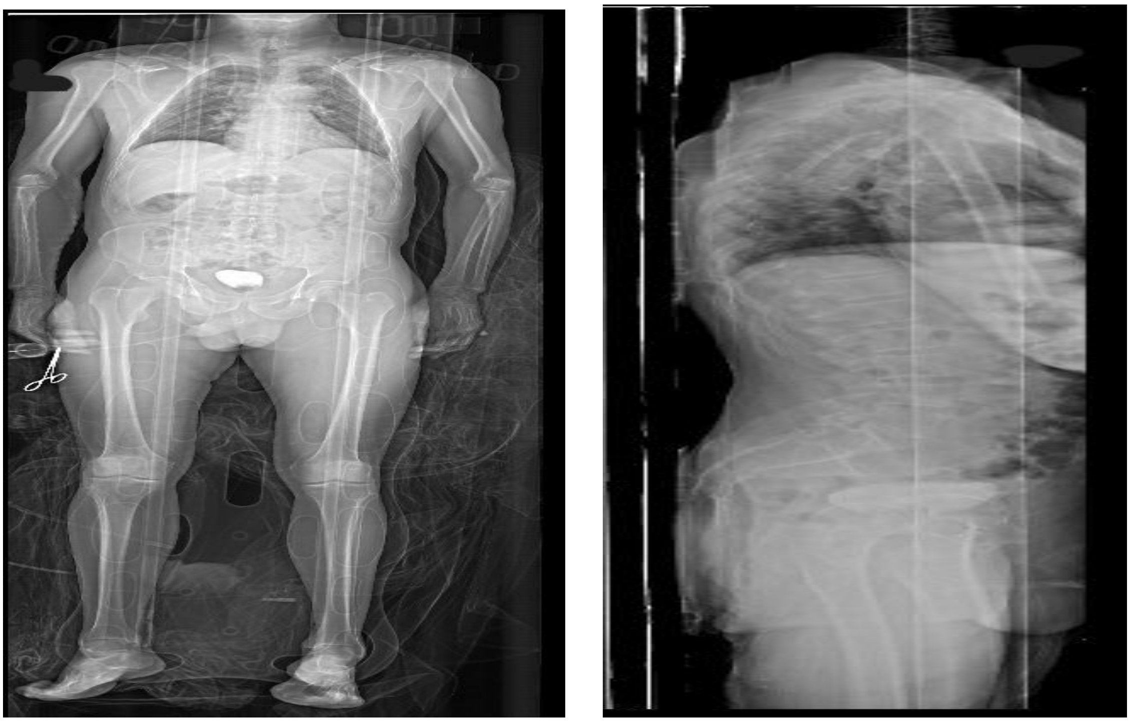

Figure 9: pelvic fracture is suspected from these images (LODOX view).

In this case, screws were put into the sacrum and pubic bone as part of the percutaneous stabilization. This kept the broken pelvic ring stable. Using fluoroscopic help makes sure that the screws are put in correctly and that the pelvic ring is in the right place. It is important to keep in mind, though, that percutaneous stabilization might not work for all people with pelvic ring injuries. For proper reduction and stabilization, open surgical methods may be needed for fractures with complicated patterns, large displacement, and other injuries. There is also ongoing discussion about the long-term effects and durability of percutaneous fixation versus standard open techniques.

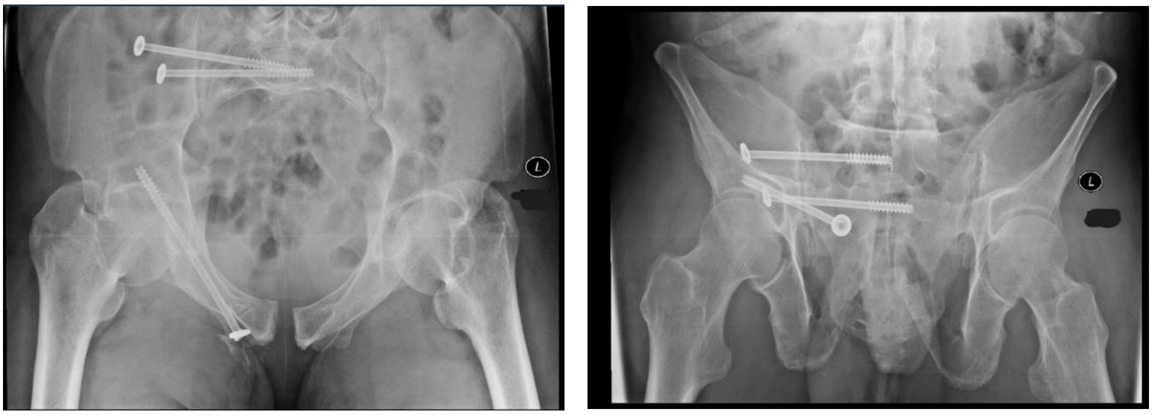

Figure 10: percutaneous stabilization of pelvic ring injuries after intervention.

For these reasons, percutaneous stabilization of pelvic ring injuries is a good way to treat some patients because it is less invasive than surgery but still keeps the pelvic ring stable. But picking the right patients and planning everything before surgery are very important to make sure the best results. More study is needed to improve surgical methods and figure out what role percutaneous fixation plays in treating pelvic ring injuries.

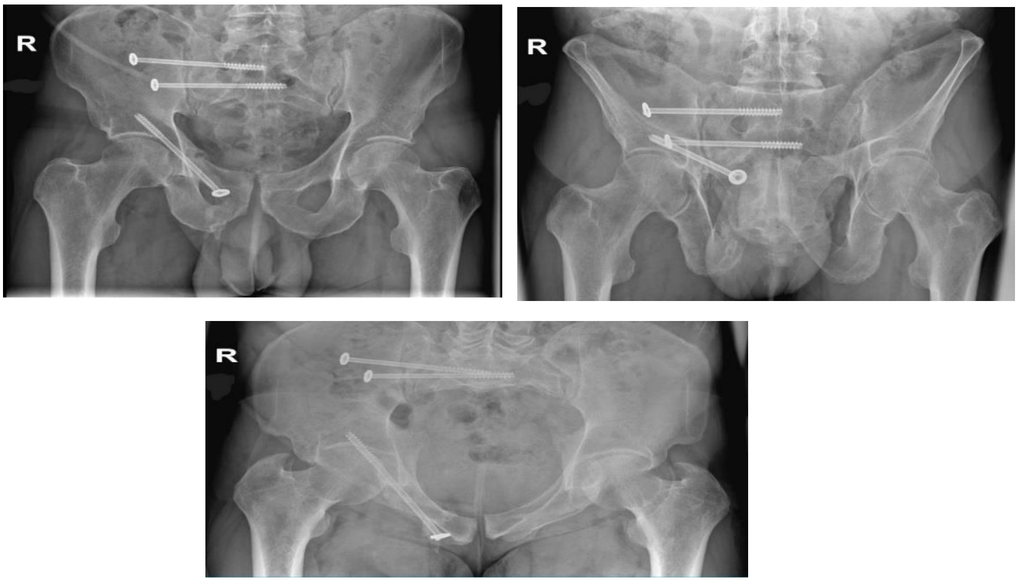

Figure 11: Imaging after 3months of applying percutaneous fixation**.**

Figure 12: Imaging after 6 months of applying percutaneous fixation**.**

Conclusion

Nonetheless, it is important to remember that not all patients with pelvic ring injuries will benefit from percutaneous stabilization. To guarantee proper reduction and stability, open surgical treatments could be necessary for fractures with complicated patterns, significant displacement, and other injuries.

Regarding the endurance and long-term effectiveness of percutaneous fixation versus open techniques, there is also a continuing discussion .Because it is less invasive than surgery and still maintains pelvic ring stability, percutaneous stabilization of pelvic ring injuries is a viable therapy option for certain individuals. But in order to guarantee the best outcomes, choosing the right patients and getting everything ready before surgery are essential. To enhance surgical methods and understand the role percutaneous fixation plays in treating pelvic ring injuries, more study is required.

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