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Case Report
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# Fixation of Pelvic & Acetabular Fractures – Out with the Old, In with the Navigated

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## Abstract

Acetabular fractures can be some of the most difficult injuries to manage for orthopedic surgeons. This is not only because of the rich neurovascular bundle surrounding the hip joint but also because these patients often present after high-velocity trauma with associated injuries.

## Introduction

Anatomic reduction has been shown to be the most accurate predictor of clinical outcome for these patients [1]. To achieve this, most surgeons perform an open reduction and internal fixation of the acetabulum using one of several approaches depending on the type of fracture. The ilioinguinal approach is widely accepted as the standard approach for anterior column fractures but this requires extensive dissection which comes with its own risks including neurovascular injury and infection [2]. Given the risks and side effects of the open approach for pelvic or acetabular fractures there has been a growing interest in minimally invasive techniques [3]. Although percutaneous fixation offers great benefits it can also present with significant risks given the narrow anterior column corridor surgeons must place their screw in and multiple neurovascular structures surrounding said window [4].

We present the case of a man who presented with a left anterior column fracture and right sacroiliac joint disruption which we managed with navigation assisted percutaneous screw fixation. We believe with the use of CT assisted navigation we can reap the benefits of percutaneous fixation while minimizing the risks of misplaced screws.

## Case Presentation

We present the case of a fifty-year-old gentleman who was airlifted to our hospital after sustaining a crush injury to his pelvis while working on his farm. On arrival he had a CT head, cervical spine, thorax, abdomen and pelvis which found multiple fractures including bilateral anterior column fractures, pubic symphysis diastasis and right sacroiliac joint disruption. He received two grams of tranexamic acid, and two units of red cell concentrate which helped stabilize the patient. He was neurovascularly intact with good pulses in both feet. The patient was stabilized, and we planned to do an open reduction internal fixation of his pubic symphysis along with bilateral percutaneous screw fixation of his anterior column fractures and right sacroiliac joint screw fixation. Using the Brainlab Navigation system we could pre plan our screw lengths and diameters for his bilateral anterior column fractures and his right sacroiliac joint disruption.

We positioned the patient in the supine position. In line with standard practice, our first fixation was the most posterior and we moved anteriorly. We placed our right sacroiliac joint screw under x-ray guidance with the aid of having pre planned our screw length and diameter on our pre-operative CT scan.

We moved onto the open reduction of his pubic symphysis diastasis via a Pfannenstiel incision. We held the pubic symphysis with an AO reduction clamp to give us stability when inserting our two anterior column screws. Once reduction was achieved, we could use Brainlab Navigation's 3D C-arm to merge his preoperative CT with his current position. This was done by putting the array on his left anterior superior iliac spine followed by an intra-operative CT with the C-arm. This allowed us to see, in real-time, the position and trajectory of our percutaneous screws in relation to our ideal, pre-planned, screws.

For the anterior column screws, we used stab incisions to pass our drill and drill guide towards

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**Figure 1:** All 7 screws planned pre-operatively.

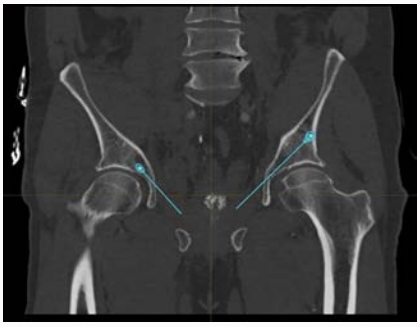

**Figure 2:** Coronal view of our pre-operatively planned anterior column screws.

**Figure 3:** Sagittal view of our pre-operatively planned left anterior column screw.

the ilium. Using Brainlab's navigation system we were able to accurately drill through the anterior column without perforating the acetabulum or entering the pelvis. The navigation system allows us to drill for 60 mm under guidance which is enough to confirm we are in drilling in the right plane. We then placed our guide wire, took one inlet view x-ray to confirm our positioning, and then placed our pre-planned 6.5 mm Asnis screw. To confirm the position of the screw we took two more x-rays, one inlet and one outlet which were both satisfactory. We repeated this sequence for the contralateral anterior column screw. Finally, we used a matta pubic symphysis 4-hole plate with 3.5 matta screws to fix the pubic symphysis.

Post-operatively he stayed in the high dependency unit where he was allowed partially weight bear for transfers only. He was recovering well without any complications until day 6 post op when we diagnosed a deep vein thrombosis via a Doppler ultrasound. He was started on therapeutic clexane which he received for seven days


**Figure 4:** X-ray pelvis 6 weeks post-operatively.

at which time he was put on a rivaroxaban for three months. He was deemed fit for discharge to a step-down facility two weeks post-operatively and will be followed up in our outpatient's department.

## Discussion

The management of high energy pelvic and acetabular trauma is complex. Patients often present with haemodynamic instability with a high rate of morbidity and mortality [5]. Intra-operative complications during pelvic surgery can be life threatening. The goal of acetabular surgery is to achieve a stable congruent joint surface to reduce the likelihood of developing post traumatic arthritis [6].

Traditionally pelvic fractures were treated with open reduction and internal fixation, however this requires extensive surgical dissection and increased risk to neurovascular structures [7]. There has been an interest in minimally invasive techniques owing to less local trauma and a more rapid recovery for the patient.

The use of percutaneous stabilisation reduces the high rate of wound complications and infection associated with open procedures [4]. Technique related complications are common in acetabular surgery due to the complex three-dimensional anatomy and placement of screws in narrow bony corridors which is technically demanding and requires fluoroscopy.

There is a narrow margin of error in anterior column acetabular screw placement. Incorrect placement of acetabular screws can lead to intra-articular hip penetration or iatrogenic injury to neurovascular structures [8]. When using 2-D fluoroscopy for acetabular screw placement multiple images in different planes are required to ensure the correct screw trajectory (Figures 1-4) [9]. This leads to potentially prolonged operative time and radiation exposure [10].

The accuracy of screw placement can be improved with the use of navigation systems compared to traditional fluoroscopy [11]. Navigation systems were first introduced in neurosurgical cases in the 1990's. Navigation systems are commonly utilised in spinal surgery, their usage in non-spinal trauma cases is low. The main benefit of navigation is to assist the surgeon in the accurate placement of screws. Navigated procedures were introduced to reduce relatively high screw misplacement and also to reduce radiation usage and increase the safety of screw placement. Incorrect screw placement may result in implant related or neurovascular complications, with as little as 4 degree of screw mispositioning damaging neurovascular structures. Ochs et al. demonstrated a screw penetration rate of 7% using 3-D fluoroscopy assisted navigation compared to 20% using 2-D fluoroscopy assisted procedure [12].

## Conclusion

As discussed, there is a clear interest in percutaneous fixation of pelvic and acetabular fractures, particularly with the aid of 3D-navigation. We presented this case due to the complexity of his injuries which historically would have required a much longer surgery or more likely multiple trips to theatre. We show that 3D navigated fixation of anterior column fractures can be done safely and swiftly helping reduce the risks associated with prolonged anaesthetic time.

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