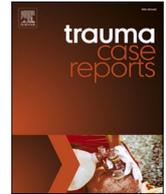




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# Trauma Case Reports

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## The role of the bilateral subcutaneous plate in the minimal invasive stabilization of fragility fractures of the pelvis

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### ABSTRACT

**Introduction:** Anterior pelvic ring fractures are common in geriatric patients. Current treatment algorithms recommend osteosynthesis if no pain free mobilisation is possible. For this a multitude of surgical techniques have been described. Among these the Supraacetabular External Fixator (SEF) is regarded a simple and effective surgical procedure. However, this technique is associated with significant drawbacks.

Alternatively, there is the option of an internal fixator or a formal plate osteosynthesis. It is the objective of this case report to present the Subcutaneous Iliopubic Plate (SIP) in a fragility fracture of the anterior and posterior pelvic ring.

**Case report:** An 83-year-old female patient sustained a fracture of the anterior pelvic ring, the lateral sacrum and the medial femoral neck. After initially refusing any surgery, the patient agreed to have the endoprosthesis implanted first, and then secondarily to dorsoventral osteosynthesis of the pelvis. Dorsally a transiliosacral screw osteosynthesis was performed. Anteriorly a bilateral subcutaneous iliopubic plate-osteosynthesis was chosen, a plate position that is anterior to the aponeurosis.

**Conclusions:** The subcutaneous plate has proven to be a quick and uncomplicated surgical procedure that is significantly better tolerated by patients than external stabilization.

### Introduction

Fragility fractures of the pelvis affect global stability of the pelvis leading to limited mobility, loss of independence and increased mortality. Between 1993 and 2010 a 24 % increase in the absolute number of geriatric pelvis fractures was observed [1]. The USA National Hospital Discharge Survey identified approximately 1.5 million patients with pelvic ring fractures between 1990 and 2007; 10.4 % of these underwent surgical fixation. In this survey internal fixation was associated with decreased odds of mortality, decreased number of adverse events and decreased number of nonroutine discharge to inpatient facilities [2].

Even if being a recognized and widely used technique [3], external fixation (Fig. 1) comes along with significant drawbacks. The Schanz screws must remain in situ for several weeks, until the fragments are bridged by a callus. Complications may arise from soft tissue breakdown, pin tract infection, and pin loosening, especially in obese patients. All of these complications are regarded as drawbacks related to external techniques [4]. Consequently, internal techniques have been developed [5].

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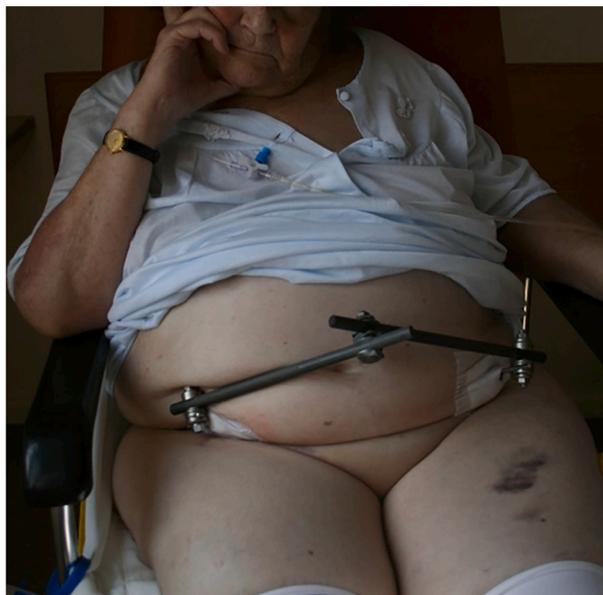
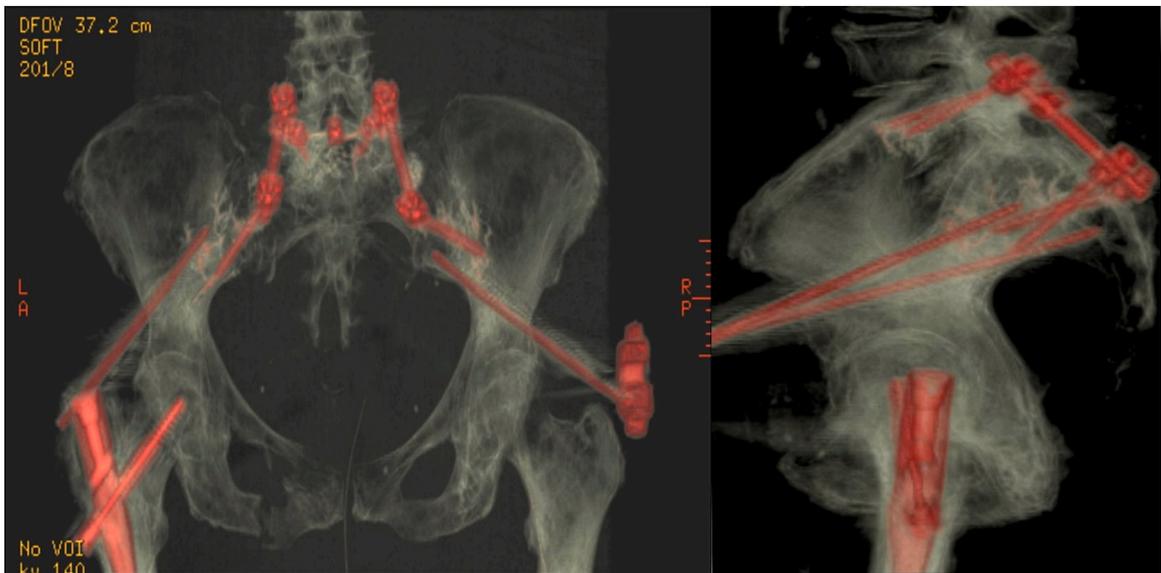
E-mail addresses: [Gerich.torsten@chl.lu](mailto:Gerich.torsten@chl.lu) (T. Gerich), [ahmed.soliman@uni.lu](mailto:ahmed.soliman@uni.lu) (A. Soliman), [Stefan.maas@uni.lu](mailto:Stefan.maas@uni.lu) (S. Maas).

Gardner et al. applied a polyaxial internal fixator approaching through the supra-acetabular region [6]. The connecting rod was tunneled subcutaneously-epifascially. The mean distance between connecting rod and the vascular bundle was 22 mm [7].

In a retrospective Level IV study using the internal fixator Vaidya et al. published their results on 91 patients. With a follow-up of 15 months all patients could stand, sit, and lie on their side. Fracture consolidation without loss of correction was observed in 89 patients. As named complications early revision surgery had to be performed in 6 patients due to technical errors and in 3 due to infections. In 27 patients in total, there was irritation of the lateral femoral cutaneous nerve in the early phase. Asymptomatic heterotopic ossifications occurred in 27 cases [8].

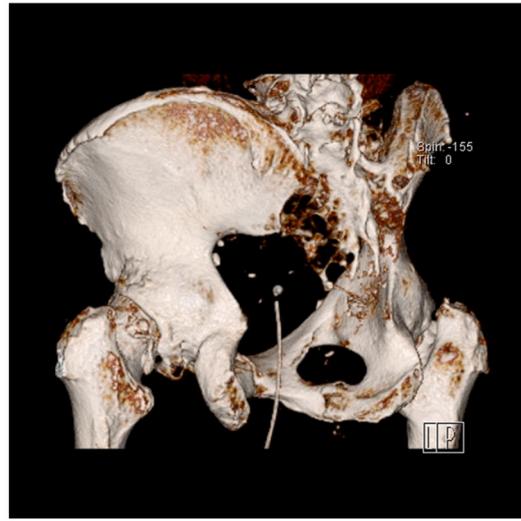
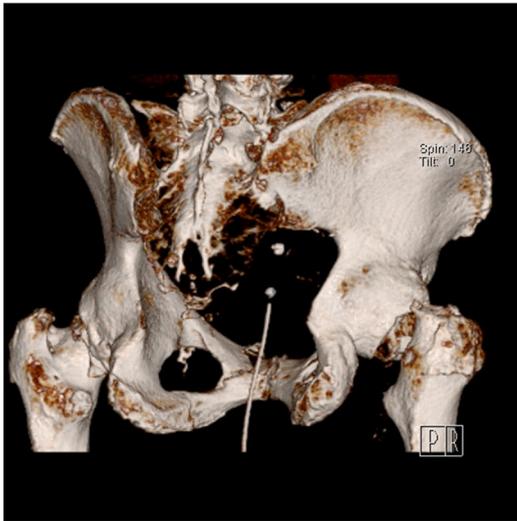
Moazzam et al. performed a subcutaneous stabilization using a single fixed-angle 3.5 mm reconstruction plate that bridged the ilium and symphysis [9].

In this case report we describe a modification of the technique of Moazzam that stabilizes the anterior pelvic ring but spares the symphysis [10].

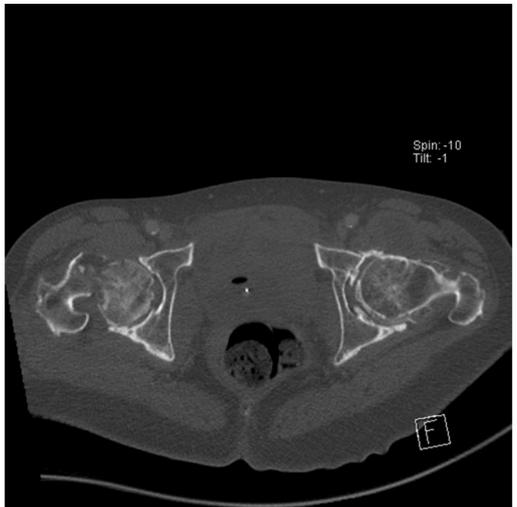


**Fig. 1.** A-M, H. 81 years. FFP IIb treated with bilateral iliosacral screw fixation and SEF (supraacetabular external fixator). Compression of the abdominal wall and irritation of the soft tissues along the Schanz screws are responsible for the high complication rate of this procedure.

A

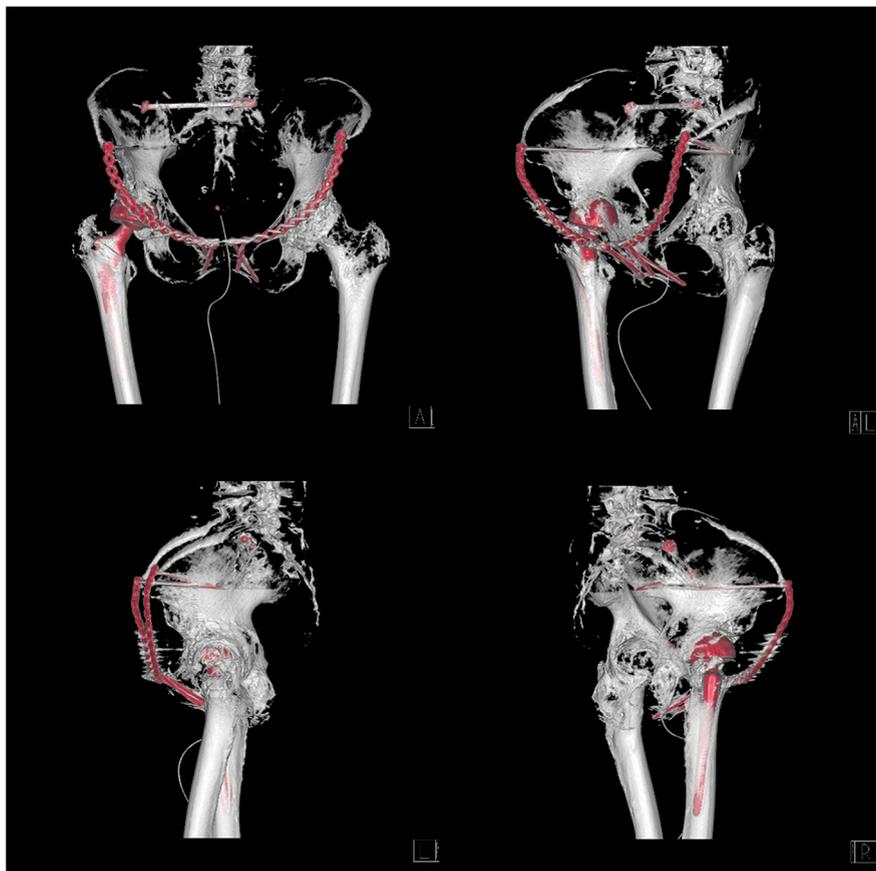


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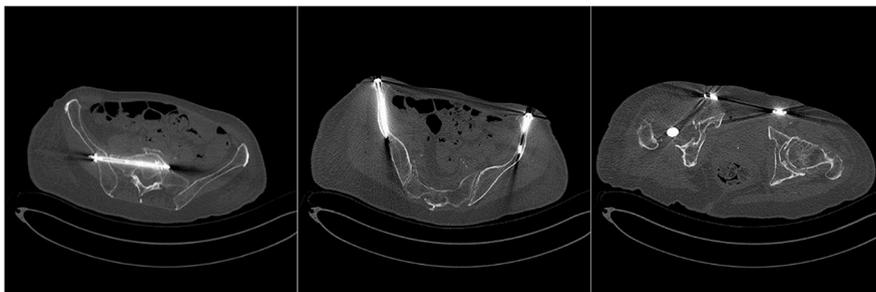


**Fig. 2.** P-D, G 83 years. Combined fracture of the anterior, posterior pelvic ring, and displaced femoral neck fracture. See case report for clinical details.

C



D



E



Fig. 2. (continued).

## Case report

At the time of the accident, the patient was 83 years old and living in a retirement home. She was mobilised there without any aids. On the day of admission, a CT scan of the pelvis was performed, which showed a right medial femoral neck fracture, a bilateral fracture of the anterior pelvic ring and a right lateral sacral fracture (Fig. 2A, B). At first, the patient had refused any surgical intervention. Only after 2 days did she consent to arthroplasty of the femoral neck fracture. Typically, patients with a fragility fracture are treated as indicated by Wagner et al. [11]. In this case, a combined treatment would have been appropriate, but was also rejected. The patient only recognized the need for it when she experienced persistent pain during mobilisation; the dorsoventral treatment was performed on day 12 after admission. Because of a limited screw purchase the sacroiliac screw was augmented with cement. A postoperative CT scan was taken at the earliest possible time. This shows the subcutaneous plate position on both sides and the correctly positioned sacroiliac screw (Fig. 2C, D, E).

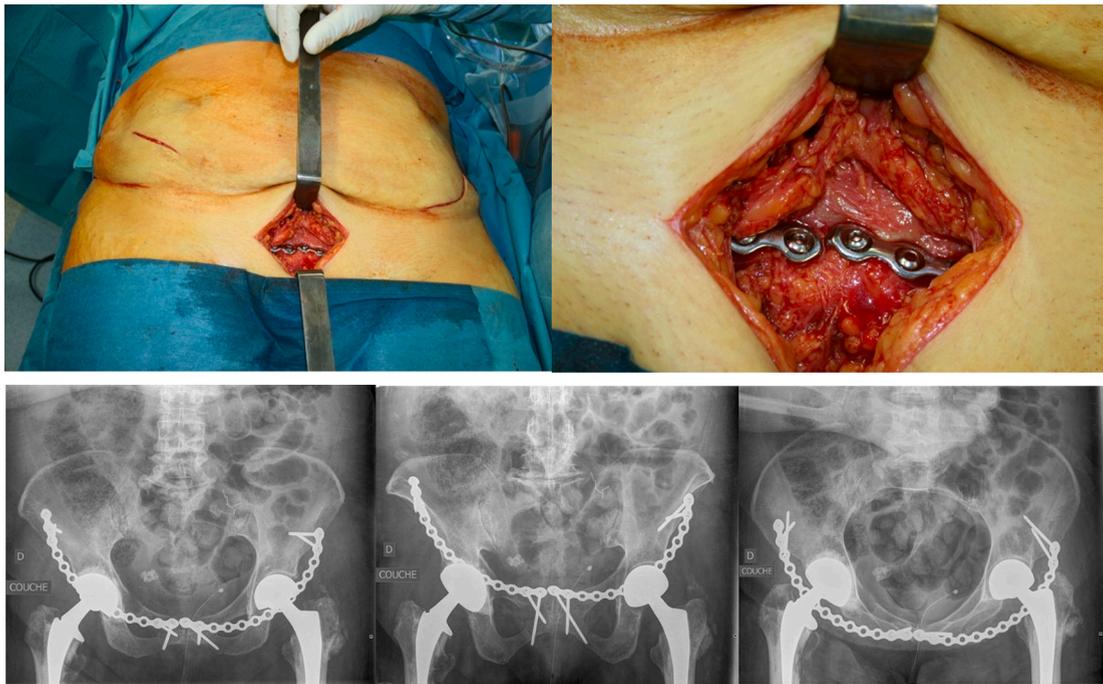
### The subcutaneous plate

The procedure is performed under general or spinal anaesthesia, the patient is placed on a radiolucent table in supine position. Complete translucency is mandatory, including the 45° oblique projections. The entire abdomen as well as the pelvic region are included in the draping.

The first incision is made over the palpable anterior superior iliac spine (ASIS) with a length of about 5 cm. A further incision is placed above the symphysis as a horizontal Pfannenstiel type incision. Both approaches are digitally connected by blunt epifascial tunneling (Fig. 3). Depending on the size of the patient, a curved 12 to 16 holes 3.5 mm reconstruction plate is inserted. The plate is directed to lie on the fascia of the external oblique muscle. Depending on the local anatomy, the implant must be rotated inwards at the iliac spine over 2 to 3 holes and slightly bent. The medial end of the reconstruction plate is positioned directly lateral to the symphysis.

The first screw insertion can be performed lateral under guidance of the index finger along the internal aspect of the ASIS and iliac crest. It is aligned to the caudal section of the sacroiliac joint. Generally, 2 to 3 screws can be fixed in this position. Medial anchoring is achieved by 2 screws; a cross-divergent screw position is preferred to increase pull-out strength (Fig. 3).

Physiotherapy started preoperatively and is continued on the first postoperative day; full weight bearing is permitted. Every patient gets a postoperative CT to evaluate implant position. The average distance between the plate and the neurovascular structures is calculated to be 10 mm (Fig. 2D).



**Fig. 3.** A-M, C. 70 years. Bilateral fracture of the anterior pelvic ring. The first incision is made just above the symphysis; the rectus fascia is not opened or detached. The lateral incisions are made directly above the palpable anterior iliac spine. Both incisions are blunt digitally connected. The slightly pre-bent plate is pushed through and comes to rest epifascially. In the symphysis, a divergent screw position is preferred to increase the pull-out force.

## Discussion

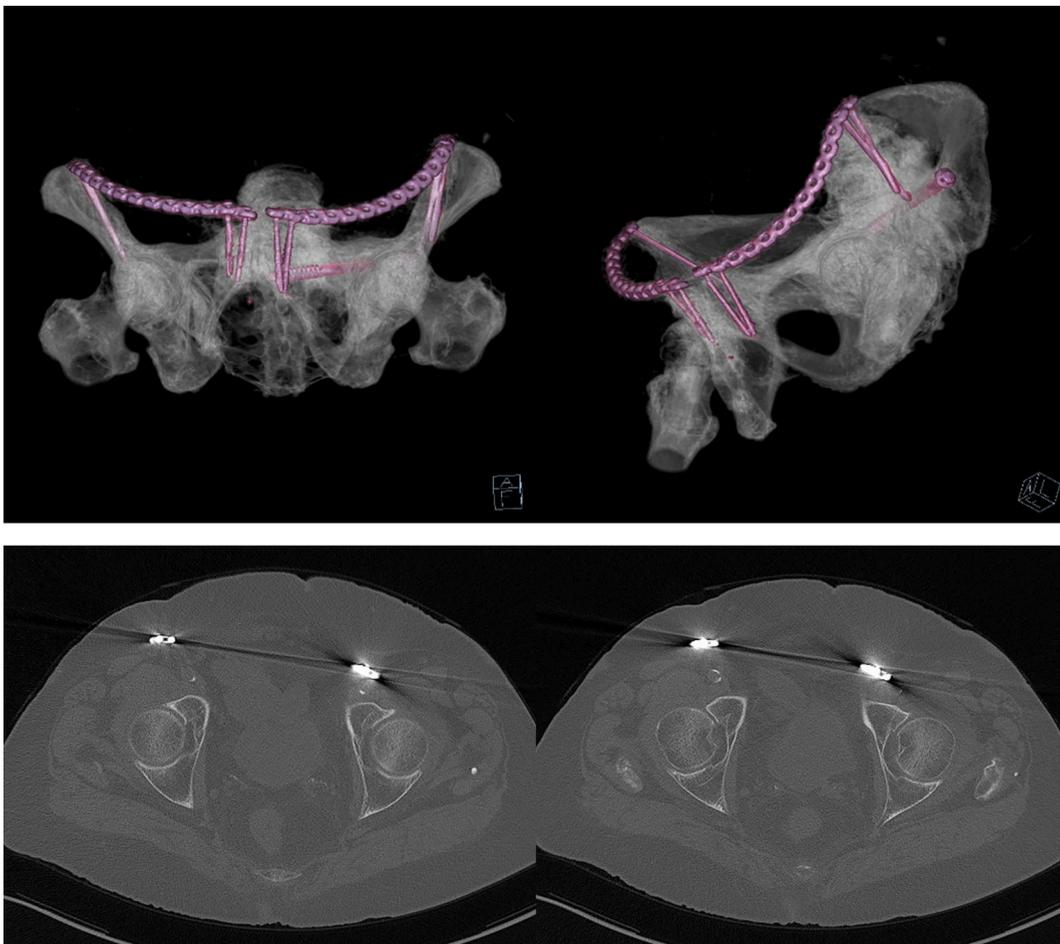
Hill et al. reported on a mortality rate of 20 % one year after pelvic ring fracture, and 44.4 % after 5 years [12]. This is partially attributed to prolonged immobilisation. Based on these figures, surgical treatment to advance early mobilisation is preferred. Stabilization of fractures of the anterior pelvic ring with a SEF is an established and widely used procedure [13,14], if indicated in combination with transiliosacral lag screw fixation. The stability of the pelvic frame significantly reduces pain, facilitates early mobilisation, and lowers mortality rate [13]. The external fixator stays in situ for 4–6 weeks.

However, external fixation is associated with increased rates of infections along the Schanz screws and loosening [4]. In addition, the fixator often leads to problems with mobilisation, clothing, and hygiene. Obese patients can only sit upright to a limited extent. Overall, the current literature shows a complication rate of up to 62 % [15,16].

To avoid these immanent complications internal procedures have been developed. Internal stabilization can be differentiated into a formal plate osteosynthesis or bridging technique, either bilateral [9] or unilateral [10]. In the unilateral configuration the plate acts as a subcutaneous-epifascial bridging plate between the ASIS and the ipsilateral symphysis (Fig. 4). A number of these procedures have been investigated anatomically [17], clinically and biomechanically [18–20].

The technique presented here is a modification of the technique published by Moazzam et al. [9]. They performed a subcutaneous stabilization on 5 cadaveric specimens using a fixed-angle 3.5 mm reconstruction plate. The mean proximity between the implant and the neurovascular bundle was 22 mm. The authors concluded that no relevant anatomical relevant structure was at risk [9].

In addition to these anatomical considerations, biomechanical aspects should also be discussed. The greater distance between the fixator and the anterior pelvic ring results in less force transmission compared to a plate that is closer to the pelvic ring. In addition, a SEF bridges the symphysis. This results in either premature loosening or stress concentration in the posterior pelvic ring [21]. Both are equally undesirable.



**Fig. 4.** B-R, A. 92 years. FFP IIb treated with unilateral dorsal iliosacral screw fixation and bilateral anterior SIP. The symphyseal screws are in slightly convergent position. The distance between the implant and the external iliac artery on the right side is 10 mm. On the left side only the external aponeurosis separates the plate and the artery.

## Conclusions

The percutaneous plate osteosynthesis between the anterior superior iliac spine and the symphysis is a simple, rapid, and stable osteosynthesis. Compared to the external or internal fixator, there are potential advantages that seem to be particularly relevant. The iliopubic subcutaneous plate does not cross and therefore does not immobilize the symphysis. Permitted physiologic micromotion around the symphysis avoids the drawback of rapid implant loosening. Additionally, by the insertion of minimum 2 divergent screws pullout strength is increased compared to single screw fixation.

## Abbreviations

ASIS	Anterior Superior Iliac Spine
SEF	Supraacetabular External Fixateur
SIP	Subcutaneous Iliopubic Plate

## Ethics approval and consent to participate

Not applicable.

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## Declaration of competing interest

The authors declare that they have no competing interests.

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