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Case Report

Neglected pelvic fragility fracture managed with unilateral triangular osteosynthesis

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ABSTRACT

We report on the treatment of a neglected displaced vertical shear pelvic fracture with functional impairment 6 months after injury in a 74-year-old woman with underlying osteoporosis. She was managed with open reduction and internal fixation and grafting of her left SI joint, while the ipsilateral pubic rami fractures were treated conservatively. She achieved union and pain free weight bearing 6 months postoperatively. Appropriate evaluation of the pathology and selection of the appropriate treatment in this elderly patient cohort is essential for a successful outcome. Experienced surgical team and individualized treatment approach are also vital to optimize the result of treatment.

Introduction

Pelvic fractures are often the result of a high energy injury, and can be associated with multiple other life-threatening injuries, that precede in the management pathway. Definitive treatment can be delayed until the physiological state of the patient has been restored. Reconstruction can be challenging based on the type of pelvic ring disruption sustained and the presence of other injuries. Stabilization of these lesions can be even more challenging when there is poor bone stock in elderly patients and when the fracture has been neglected [1,2]. In this situation, experience in the surgical team is desirable to evaluate in detail the underlying pathology and to implement the appropriate treatment plan. We present a case of a symptomatic neglected vertical shear pelvic fracture in an elderly patient and report on the principles of its management and outcome.

Case presentation

A 74-year-old woman was referred to our Pelvic and Acetabulum Clinic, complaining of debilitating pain in her left buttock. She had sustained a road traffic collision abroad, being pedestrian hit by a car, and suffered a right proximal femoral fracture and a significantly displaced vertical shear type fracture at her left hemipelvis. The former injury was definitively managed with intramedullary nailing, while the latter was treated conservatively. Before the injury she used to mobilize independently. During the first

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consultation at our clinic, 6 months after the injury, she was suffering from constant disabling pain in her left buttock and left lower back, radiating to her left lower extremity, and accompanied by intermittent paraesthesia in the dorsal and plantar aspect of her left foot (L5/S1 dermatome distribution). As a result of her symptoms, she was wheelchair-bounded, and she could not perform her daily life activities. Her past medical history included hypertension, diabetes, osteoporosis, and peripheral vascular disease.

Plain radiographs of her pelvis revealed disrupted left sacroiliac (SI) joint and left superior and inferior pubic rami fractures, resulting in cranial displacement >1 cm of left hemipelvis, (Fig. 1). The Computer Tomography scan with 3-dimensional reconstruction cuts confirmed the findings of the X-rays and the proximal femoral fracture union. The initial pelvic injury was classified as Vertical Shear type fracture according to Young and Burgess system [3], and Type C according to Tile and Pennal classification [4], while the subsequent neglected mal-alignment was classified as Type III in Mears and Velyvis classification [5]. The patient was informed about the complex nature of any surgical intervention and the potential intraoperative and postoperative complications, and a joint decision was made to proceed with operative intervention in order to address her ongoing painful symptoms.

Under general anaesthesia the patient was placed in prone position, on the OSI table. A dose of prophylactic antibiotics (flucloxacillin and gentamycin) was administered. The posterior approach to the sacrum and left sacroiliac joint was utilized to expose the upper part of the S1 body, upper left SI joint and the part of the ilium between the posterior superior iliac spine and posterior inferior iliac spine. The malalignment site and scar tissue was thoroughly debrided, and the fracture was subsequently mobilized and reduced with large reduction forceps and clamps.

Considering the fragile bone condition and the necessity of a stable fixation, the Universal Spinal System II (USS II) (DePuy Synthes, MA, USA) was used to hold and secure the reduction, with one screw in the S1 body and one screw in the iliac bone, connected by one bar. Furthermore, bone morphogenetic protein 7 (BMP-7) was implanted into the debrided SI joint for biological enhancement, acting as a bone graft substitute. After confirmation of satisfactory reduction, an 8 mm sacroiliac screw (S1 body) (Zimmer Biomet, Indiana, USA) was applied for compression and optimum stability. The whole procedure was performed under image intensifier guidance (Fig. 2).

Postoperatively the patient was advised to mobilize toe touch bearing on the left side and full weight bearing on the right side, using elbow crutches, (Fig. 3). Thromboprophylaxis (low molecular heparin 4.500 IU) was prescribed for 6 weeks. She was also prescribed bisphosphonate medication along with Vitamin D and calcium for bone protection. At the 6-week follow-up appointment, her pain and other symptoms had improved, while there was no local or systemic complication. She started full weight-bearing status of mobilization 3 months postoperatively and achieved pain-free weight bearing and hip range of motion at 6 months postoperatively. Fracture consolidation (full bony union) and return to previous activity level were achieved at 6 months postoperatively (Fig. 4).

Discussion

It is widely known that vertical shear fractures according to Young and Burgess, or type C fractures according to Tile and Pennal classification demonstrate the highest risk of mal-alignment and non-union while malreduction of the posterior pelvic ring elements can be tolerated by patients, if the vertical displacement of the SI joint is <1 cm [6]. Our patient sustained a vertical shear fracture with almost 2 cm of vertical displacement and while one would have expected to have been offered operative intervention this was not the case. We do not know the reasons for this decision, but we assume that there was lack of pelvic management expertise at the local hospital aboard where she was managed. Other indicators of early operative pelvic intervention include rotation of the hemipelvis >10 degrees, leg length discrepancy >5 mm, and imperfect facing of sacroiliac articular surfaces [7].

Management of such type C pelvic fractures particularly in the elderly population remains a challenge [1]. The underlying bone fragility, soft tissue delicacy and associated patient medical comorbidities could influence the decision-making opting towards non-

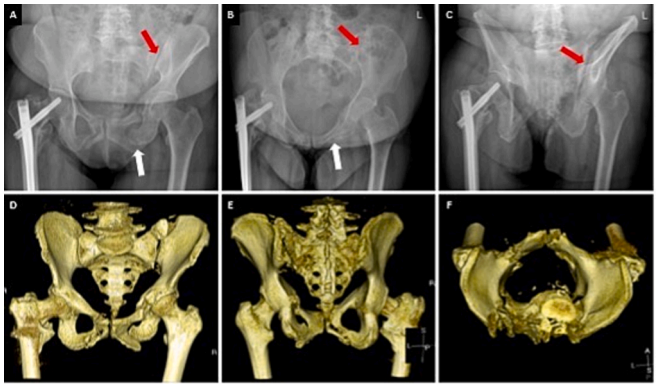

Fig. 1. Preoperative anteroposterior (A), inlet (B) and outlet (C) pelvic radiographs obtained at presentation to our centre. Anteroposterior (D), posteroanterior (E) and panoramic (F) three-dimensional CT models of the pelvis were generated pre-operatively to aid in management planning. Both imaging modalities demonstrated unreduced vertically displaced left SI joint (red arrows) and displaced partially healed left superior and inferior pubic rami fractures (white arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

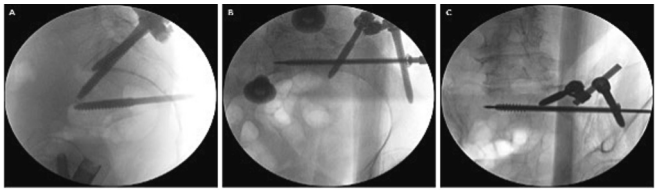

Fig. 2. Intra-operative lateral (A), inlet (B) and outlet (C) image intensifier views of pelvis demonstrating the reduction of the left sacroiliac joint and internal fixation of the posterior hemipelvis using USS II system and a cannulated S1 screw.

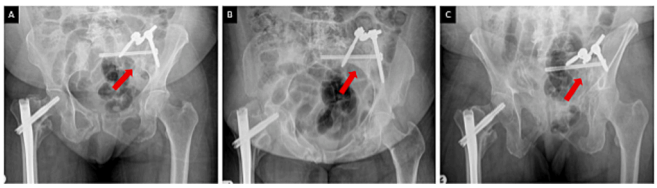

Fig. 3. Immediate post-operative anteroposterior (A), inlet (B) and outlet (C) pelvic radiographs demonstrating the left sacroiliac joint anatomical reduction (red arrows) and the triangular internal fixation. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 4. Post-operative anteroposterior (A), inlet (B) and outlet (C) pelvic radiographs at 6-months follow-up, demonstrating the posterior triangular fixation in place and bone healing of the pelvic ring both anteriorly and posteriorly.

operative treatment. All of the above could have been the parameters that influenced the decision of the local team when she was managed initially to be offered non-operative treatment.

Due to her ongoing intrusive symptoms, she was offered surgical reconstruction when she was seen in our clinic. Since there was already some healing present over the anterior elements of the pelvic ring (pubic rami), it was felt that this injury could be managed without any intervention, thus minimizing the degree of the surgical insult to the patient. The treatment carried out was focused purely on the posterior pelvic ring (sacroiliac joint), the strongest joint in the human body.

Different techniques have been reported for stabilization of the posterior ring in elderly patients with bone fragility. These include sacral bars, SI screws with or without cement augmentation, bilateral spinopelvic fixation techniques, plating of the anterior sacroiliac joint and most recently the infix system [8,9].

In our case as it was a neglected injury, it was decided that open reduction would be necessary which would necessitate debridement of the scar tissue formed followed by stable fixation. A posterior approach was selected as this would allow not only access to the joint for debridement but also reduction and fixation using the Universal Spinal System II (USS II) (DePuy Synthes, MA, USA) with one screw in S1 body and one screw in the iliac bone, connected by one bar. The addition of the SI screw (triangular configuration) provided a stable, balanced fixation allowing early mobilization.

There are different surgical reconstruction options to address vertical shear fractures in terms of spinopelvic fixation. Pedicle screw insertion at L4 or L5 level is usually considered for very displaced fracture patterns and when there is also injury of the L5/S1 facet joint. The different options for sacral fixation include S1 pedicle, S2 pedicle, sacral promontory and sacral alar screws. In the herein case we choose the S1 fixation in association with a SI screw since it was felt that the stability achieved would be adequate and there was no need to add to the construct L4 or L5 pedicle screws. In our case it was also felt that as the T-score was not indicative of a quite advanced osteoporotic condition, there was no need to perform bridging, trans-sacral or trans-iliac fixation extending to the opposite side to reduce the risk of another fracture at the contralateral side.

In order to facilitate fusion of the SI joint, instead of autologous bone grafting, BMP-7 was used as bone substitute. In this patient cohort, obtaining autologous graft is compromised by its limited availability in the iliac crest and the fact that the red marrow is replaced by yellow (fat) marrow thus possessing less osteogeneity, inductivity and conductivity. BMP-7 is a powerful inductive graft material that has been shown to be associated with favourable outcomes in the field of pelvic reconstruction [10].

In conclusion, the management of neglected pelvic ring injuries requires thorough preoperative planning, experienced surgical team, and selection of a treatment strategy that would provide optimum reduction, stable fixation facilitating healing and early patient

mobilization reducing the risks of development of deep vein thrombosis, muscular wasting, and further reduction of the already compromised patient bone mineral density due to immobility. Such a fixation strategy could be considered in the surgeon's armamentarium when dealing with similar cases like ours.

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Consent

Written informed consent was obtained from the patient. The authors confirm the manuscript is sufficiently anonymised in line with the anonymization policy stated in the “Guide for Authors”, and does not contain personal and/or medical information about any identifiable individual.

CRediT authorship contribution statement

Georgios Kotsarinis: Visualization, Investigation, Writing – original draft. **Oceane Mauffrey:** Writing – review & editing. **Sophia M. Wakefield:** Writing – review & editing. **Peter V. Giannoudis:** Supervision, Conceptualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests and/or personal relationships with other people or organisations that could have appeared to influence the work submitted.

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