Percutaneous screw fixation for sacral insufficiency fractures
A REVIEW OF THREE CASES

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Sacral insufficiency fractures are traditionally treated with bed rest and analgesia. The importance of early rehabilitation is generally appreciated; but pain frequently delays this, resulting in prolonged hospital stay and the risk of complications related to immobility. We describe three women with sacral insufficiency fractures who were treated with percutaneous sacroiliac screws and followed up for a mean of 18 months (12 to 24). They had immediate pain relief, uncomplicated rehabilitation and uneventful healing.

Osteoporotic fractures of the pelvis are more prevalent than is widely appreciated and are increasing in incidence. Sacral insufficiency fractures are often overlooked as a potential cause of low back and pelvic pain in patients presenting without a significant history of trauma, thereby resulting in diagnostic delay. They are invariably treated non-operatively with bed rest, analgesia and early rehabilitation. These measures often fail to provide adequate pain relief, with consequent prolonged bed rest. The subsequent complications are well recognised and interfere further with recovery.

Interventional methods of treating sacral insufficiency fractures have been described, based on injection of polymethylmethacrylate (PMMA) cement into the fracture site to reduce painful micromovement and allow earlier rehabilitation. We present our experience of percutaneous sacroiliac screw fixation for the treatment of such fractures in three patients.

Case reports

Case 1. A 56-year-old woman with osteoporosis was referred with a five-month history of continuing low back and pelvic pain after a low-impact fall at home. She did not seek medical attention initially. Her pain was felt over the right sacroiliac joint and at the pubic symphysis. After eight weeks, she noted that the sacral pain was bilateral. On examination, she had an antalgic gait and localised tenderness over her sacroiliac joints, but no neurological deficit. The levels of alkaline phosphatase were raised (309 IU/l, 70 to 300 IU/l), but her biochemical profile and inflammatory markers (C-reactive protein, white cell count, erythrocyte sedimentation rate) were normal. An anteroposterior (AP) radiograph of the pelvis revealed fractures of the right superior and inferior pubic rami (Fig. 1). A bone scan (99mTc medronate methylene diphosphonate) demonstrated the ‘H’ sign, indicating bilateral activity at the sacral alae (Fig. 2). A CT scan showed sclerosis of the right alar wing, indicating an attempt at healing (Fig. 3). Magnetic resonance imaging showed changes in both alae confirming bilateral sacral insufficiency fractures (Fig. 4). Because of her chronic disability and relatively good bone quality on MRI and CT she underwent bilateral sacroiliac screw fixation.

Recovery was uneventful and she was discharged home one week post-operatively. Outcome was assessed by the EuroQol Visual Analogue Scale (EQ-VAS), which ranges between 0 (no pain) and 10 (worst pain). This demonstrated improvement from 9/10 pre-operatively to 5/10 within two weeks of surgery. She was mobilised initially in a wheelchair for three weeks, then to full weight-bearing over a further month. At 12 months, she reported 2/10 on the EQ-VAS scale.

Case 2. A 73-year-old woman with a painful gait due to left-sided sacral pain presented eight weeks after a trivial domestic fall. She had undergone resection and chemotherapy for colonic carcinoma five years earlier, and had sustained a Colles’ fracture. Pelvic examination revealed a positive FABER (flexion, abduction and external rotation of the hip) test.
Blood biochemistry showed a raised alkaline phosphatase level (561 IU/l) but tumour markers, including Carcinoembryonic antigen (CEA), CA 19.9, CA 15.3, CA125 and Alpha-Fetoprotein (AFP), were normal. A pelvic radiograph showed fractures of the left superior and inferior pubic rami (Fig. 6a). Inlet and outlet views suggested a sacral insufficiency fracture on the left. Bone \(^{99m}\text{Tc}\) methylene diphosphonate (MDP) scintigraphy demonstrated activity in the left side of the sacrum. Based on the low levels of tumour markers and a normal scan in the rest of the skeleton, metastatic disease was excluded. Percutaneous left sacroiliac screw fixation was undertaken with a bone biopsy obtained via the cannulated screw hole.

She made an uneventful recovery and was discharged home one week post-operatively. She reported an improvement from 8/10 pre-operatively to 4/10 post-operatively on the EQ-VAS within two weeks. She was mobilised in a wheelchair for three weeks then gradually mobilised to full weight-bearing over the next month. She described 2/10 on the EQ-VAS at 18 months, and radiographs showed consolidation of the fracture (Fig. 6b). **Case 3.** A 69-year-old woman with a previous Colles’ fracture presented with a three-month history of unexplained low back and pelvic pain. The FABER test\(^7\) was positive for both sacroiliac joints, and there was tenderness in the right groin. The hips were clinically normal. Inlet and outlet views of the pelvis showed a healing fracture of the right
superior pubic ramus and a suspected vertical fracture of the ipsilateral sacrum. The levels of serum alkaline phosphatase were raised (361 IU/l) and CT demonstrated bilateral sacral insufficiency fractures. Because of persistent symptoms, pelvic instability and relatively good bone stock, she underwent bilateral sacroiliac screw fixation. She made an uneventful recovery, was discharged home five days post-operatively, and placed on supplementary bisphosphonates for her osteoporosis. Her EQ-VAS improved from 7/10 pre-operatively to 2/10 within two weeks of operation. At 24 months, she had 0/10 on EQ-VAS, and radiological examination showed consolidation of the fracture.

Discussion
In elderly patients, sacral insufficiency fractures are not uncommon and likely to be underdiagnosed as a possible cause of low back and pelvic pain.\textsuperscript{5,8} Osteoporosis is the main risk factor but corticosteroid-induced osteopenia, rheumatoid arthritis and radiation therapy for intrapelvic malignant conditions are also important predisposing causes.\textsuperscript{3} Other conditions which may present similarly include osteoporotic vertebral fractures, spinal stenosis, discogenic pain and neoplasms.\textsuperscript{8} Therefore, a full history, examination and investigation must exclude these differential diagnoses.

Plain radiographs, including inlet/outlet views, are useful in assessing the integrity of the pelvic ring but are usually inadequate in demonstrating sacral insufficiency fractures.\textsuperscript{9} A fracture of the pubic ramus should raise the suspicion of a concomitant sacral fracture,\textsuperscript{10} and imaging such as bone scintigraphy, CT and MRI can be used for further investigation. Bone scintigraphy is the most sensitive and provides strong evidence of sacral insufficiency fracture with a characteristic H-shaped pattern in bilateral

Case 1 - a) Post-operative radiograph demonstrating bilateral sacroiliac screws and consolidation of the pubic rami fractures. b) Axial CT scan demonstrates bilateral sacroiliac joint screws in place. There is sclerosis at the left and right sacral alae indicating healthy process.

Case 2 - a) Anteroposterior radiograph. Fractures are seen through the left superior and inferior pubic rami. Appearances of the pelvis are otherwise unremarkable, but radiographs of the pelvis are suboptimal for visualising the sacrum. b) Outlet view demonstrating the sacroiliac screw through the healing fracture site at 18 months’ follow up. The arrow indicates the zone of healing sclerosis.
cases. These findings may, however, be non-specific and accurate interpretation of atypical patterns can be difficult. Further tests should be performed if there is a suspicion of infection or malignancy.

Attempts to stabilise the sacral fracture using balloon kyphoplasty and sacroplasty by injecting bone cement have produced significant reduction in pain, thereby allowing early mobilisation. However, this treatment has not been fully investigated and has disadvantages in relation to the accuracy of needle placement, with the consequent potential for hot cement to extrude into neural foramina or the spinal canal. We feel that injected cement may impair fracture healing and cause a void-filling effect without measurable stability.

Our technique of percutaneous screw fixation provides biomechanical stability for direct primary healing, pain relief and early mobilisation. However, it requires experience in the fixation of pelvic fractures and risks the possibility of neurological or vascular injuries.

Our study needs to be interpreted in the context of its non-experimental design. The majority of patients sustaining these fractures are older than ours and would not be suitable for percutaneous fixation because of poor quality of bone and the risks of surgery and anaesthesia. Nevertheless, we have demonstrated that percutaneous screw fixation in selected patients enabled direct primary healing and early rehabilitation in these fractures. No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References