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Case Report

Set-screw loosening of spinopelvic crab-shaped fixation for a patient with vertically unstable pelvic ring fracture^{☆,☆☆}Yohei Yanagisawa^{a,b,*}, Tomomi Kotaki^b, Shun Nakajima^b, Masafumi Uesugi^c, Masashi Yamazaki^b^a Department of Emergency and Critical Care Medicine, University of Tsukuba Hospital, 2-1-1 Amakubo, Tsukuba, Ibaraki 305-8576, Japan^b Department of Orthopaedic Surgery, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8575, Japan^c Department of Orthopedic Surgery, Ibaraki Seinan Medical Center Hospital, 2190 Sakai, Ibaraki 306-0433, Japan

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ABSTRACT

Spinopelvic fixation (SPF) is an effective treatment method for vertically unstable pelvic ring fractures with spinopelvic dissociations (Patel et al., 2022). A heavy container fell on a 35-year-old man who was trapped and sustained injuries. His pelvic ring fracture dislocation was identified as AO Classification 61-C2.3 with rotational and vertical unstable pelvic ring; thus, crab-shaped fixation (SPF modification) was performed (Okuda et al., 2019). The pelvic fracture was fused, and the clinical outcome was good with modified Majeed score of 96. However, set-screw loosening was observed during the postoperative course. Reports of implant failures in SPF for unstable pelvic ring fractures commonly occur. However, only a few reports have demonstrated implant failure of crab-shaped fixation. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Introduction

Spinopelvic fixation (SPF) is one of the surgical treatments for AO classification C-type pelvic ring fractures and fracture dislocations with rotational and vertical instability. It has reported good clinical outcomes in imaging and motor functional evaluation and is the standard surgical treatment for complete unstable pelvic ring fractures^{1,3}.

Systematic review of some reports about vertically unstable AO type-C pelvic ring fractures revealed some surgical complications, such as surgical site infections, skin problems, and implant failures, among others¹. The review showed that hardware prominence had pooled estimated rates of 21.3 %, a high rate of implant-related complications¹. Some case reports demonstrated early postoperative skin problems from implant irritation, and some required implant removal after bone union. As for implant failure, some cases reported rod breakage and iliac screw loosening³.

Herein, we report our experience of set-screw loosening, a rare implant-related complication, in a patient treated with the crab-shaped fixation, a modified SPF subtype.

[☆] This work has not been previously presented.

^{☆☆} Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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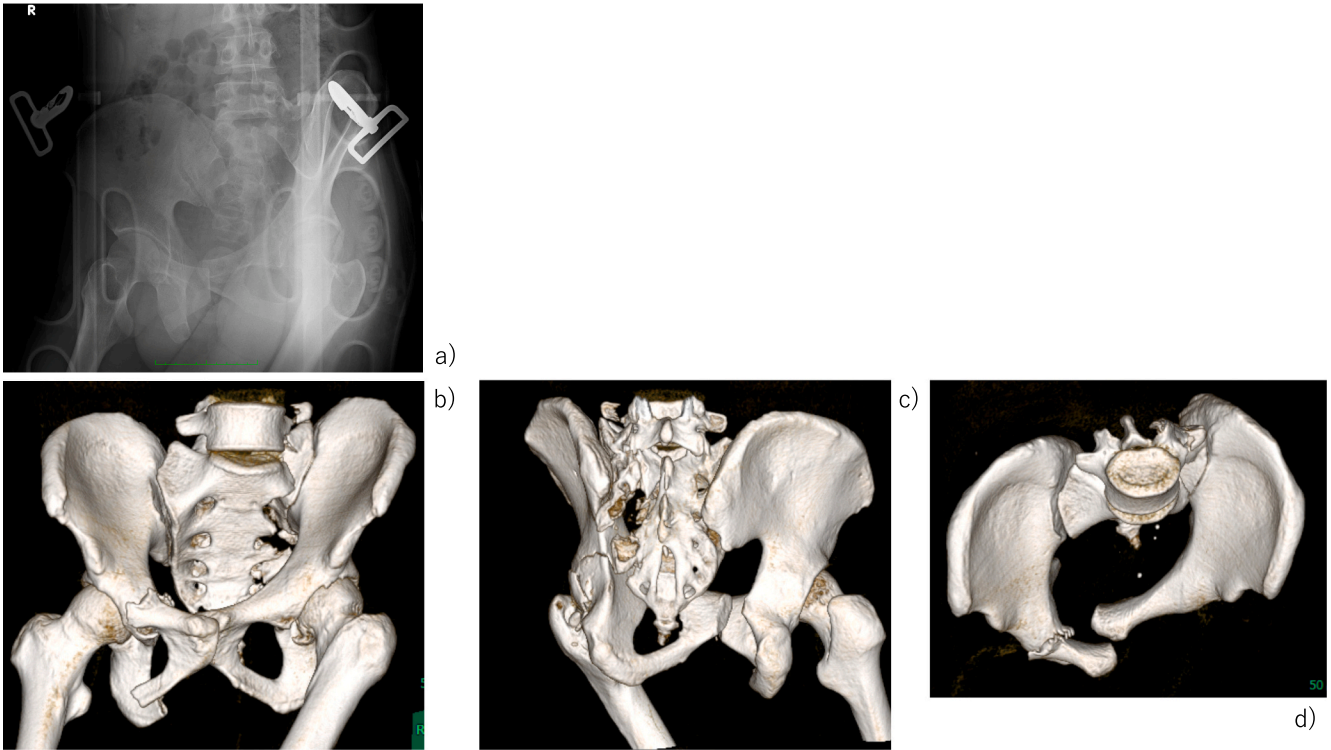
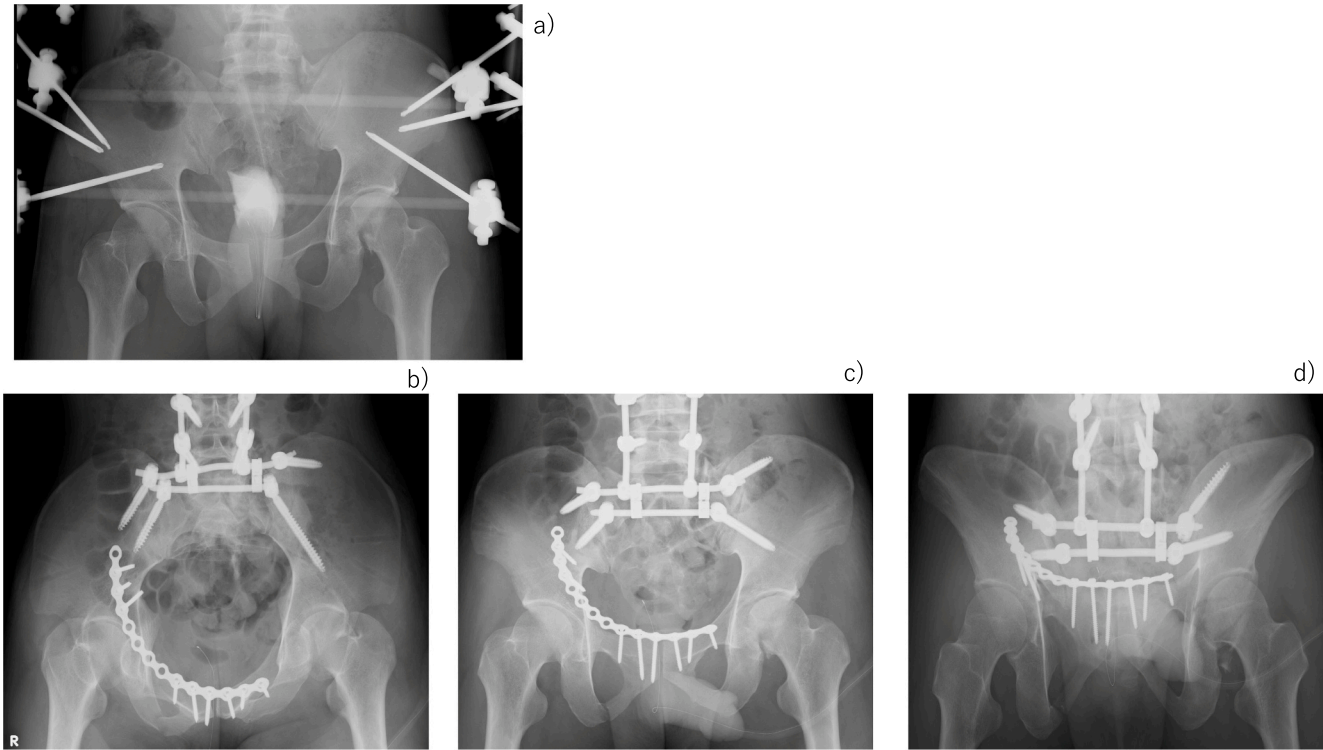


Fig. 1. (a) Anteroposterior X-ray at the emergency room with a pelvic binder.
(b)(c)(d) Preoperative 3D-CT during the placement of a pelvic binder.



3

Fig. 2. (a) Anteroposterior pelvic X-ray after placing the temporary external fixator.
(b) Inlet pelvic X-ray after SPF.
(c) Anteroposterior pelvic X-ray after SPF.
(d) Outlet pelvic X-ray after SPF.

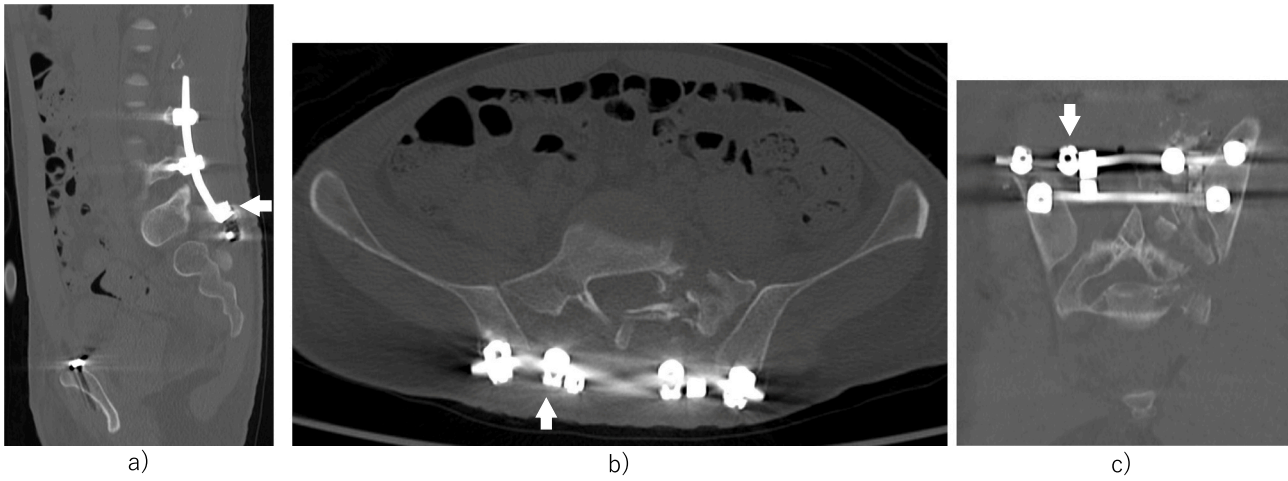


Fig. 3. (a) One week after obtaining operative sagittal CT image.
(b) One week after obtaining operative axial CT image.
(c) One week after obtaining operative coronal CT image. The set-screw remained at the correct position (white arrows).

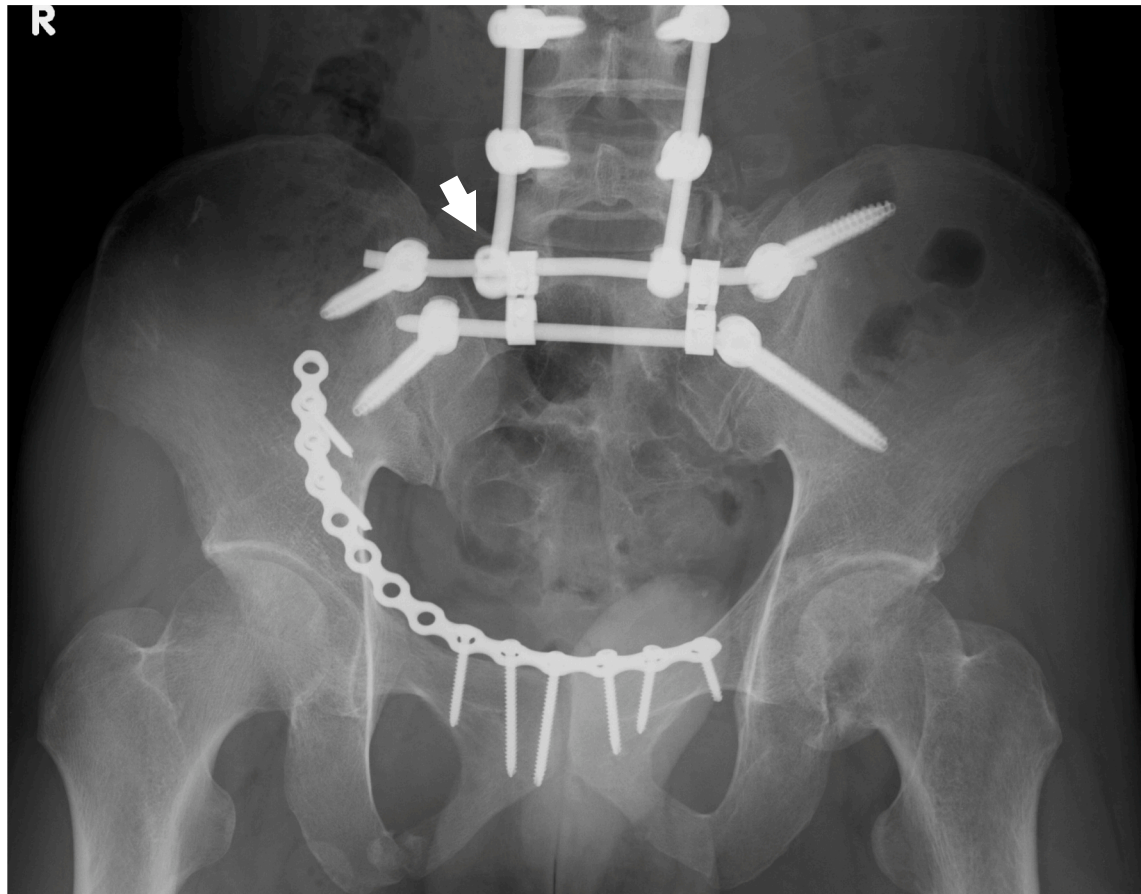


Fig. 4. Anteroposterior X-ray. These show loosened ‘set-screw’ (white arrows) lying outside the screw head.

Case presentation and operative techniques

The patient is a 35-year-old man trapped under a heavy container (weight, 350 kg) that fell on him, resulting in sustained injuries. The patient was in shock when he was transported by ambulance and upon hospital arrival. Pelvic ring injuries included right pubic rami and right sciatic bone fractures, pubic symphysis disruption, right sacroiliac joint partial disruption, left sacral fracture (Denis classification zone 2), and left acetabular fracture. His pelvic ring fracture dislocation was determined as AO Classification 61-C2.3 with unstable rotational and vertical pelvic ring (Fig. 1). The patient had no other combined injuries such as fractures or organ injuries. No active arterial bleeding and neurologic deficits were observed. The patient underwent temporary external fixation on the same day of injury (Fig. 2(a)). The patient underwent open reduction and anterior plate fixation 10 days post-injury.

The patient underwent crab-shaped fixation in prone position 19 days post-injury. We used the DePuy Synthes VERSE® spinal fixation system (J&J Co, Paoli, PA). Pedicle screws were inserted bilaterally into L4 ($\varnothing 7.0$ –40 mm) and L5 ($\varnothing 7.0$ –40 mm) pedicles. Four iliac screws ($\varnothing 8.0$ mm) were inserted bilaterally into the iliac crests. Then, $\varnothing 5.5$ -mm titanium-alloy rods were used to connect bilateral iliac screws in the right–left direction. These rods were connected with two cross-connectors. The connection between the pelvic ring and spine was made using two lateral connectors (Figs. 2(b, c, d) and 3(a, b, c)).

Patients were prohibited from weightbearing with his left lower extremity for 6 weeks postoperatively. The patient had symptoms of skin irritation at the heads of bilateral cranial iliac screws. During sleep, the patient remained in supine position and complained of screw-head irritation against the lying surface. The modified Majeed score was 96 (except sexual intercourse, which was 4 points out of a possible 96) at 1 year postoperatively. X-ray images taken 3 months postoperatively showed that the set screw of the lateral connector connecting the rod to the L4 and L5 pedicle screw on the right side was loose and had deviated from the screw hole of the lateral connector (Figs. 4 and 5(a, b, c)). No adverse events were thought to be associated with this set-screw loosening. One year postoperatively, the fracture sites had bony union.

The patient wished to improve the skin irritation symptoms caused by bilateral cranial iliac screw heads, and thus, these implants were removed 16 months after the initial surgery. Regarding pelvic ring stability, the anterior element was complicated by a pubic symphysis disruption, and the right posterior pelvic ring injury was a trans-sacroiliac joint disruption; therefore, posterior caudal iliac screws and the anterior plate were retained, considering that ligament repair and restoration of these strengths were not compensated.

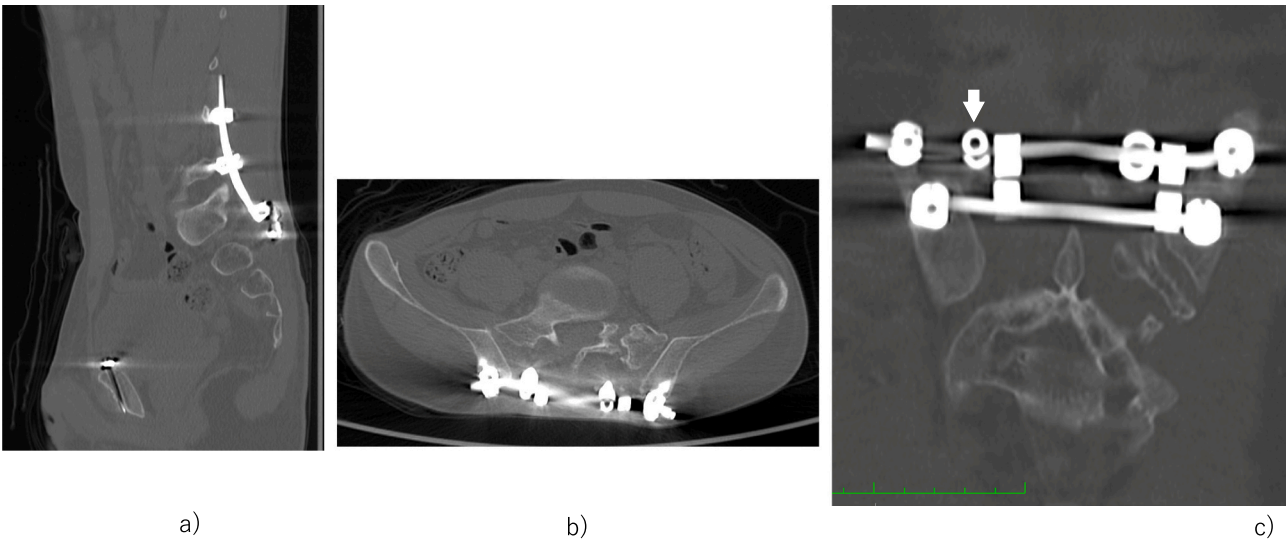


Fig. 5. CT sagittal image. (b) CT axial image. (c) CT coronal image. These show loosened 'set-screw' (white arrows) lying outside the screw head.



Fig. 6. Intraoperative images showing loosened 'set-screw' lying outside the screw head.

As shown in the intraoperative image (Fig. 6) taken during the implant removal surgery, the set screw of the lateral connector connecting the rod to the L4 and L5 pedicle screws on the right side was loose and had deviated from the screw hole of the lateral connector.

After removing the set-screw and lateral connector from the body, the connectivity between the set screw and screw hole of the lateral connector was examined and found to be smoothly connected. No obvious breakage of the set-screw threads and screw hole were observed in the lateral connector.

Discussion

SPF is one of useful surgical methods using spinal instrumentation for vertically unstable pelvic ring fractures¹. Crab-shaped fixation is a modified SPF first reported by Okuda et al.. The use of lumbar pedicle and iliac screws (with a bridging rod) reduces the vertical length of the required SPF, providing a rigid rotational and vertical stability across the bilateral sacrum, sacroiliac joints, and ilium. In the present case, crab-shaped fixation was selected to reduce the dislocation of a left-sided completely vertically and rotationally unstable pelvic ring fracture and to fix the disruption and rotational instability of the right sacroiliac joint.

We experienced a set-screw loosening after crab-shaped fixation, which was not reported as one of its implant-related complications among the 16 cases reported by Okuda et al.². A systematic review of the surgical outcomes of SPF for AO type-C pelvic ring fractures was performed by Patel et al. in 2022¹. The review showed that hardware prominence had a pooled estimated rate of 21.3 %, a high rate of implant-related complications¹. This high rate of skin irritation with SPF implants has been reported to result in skin problems and later require implant removal. Other implant-related complications include rod breakage at the lumbosacral junction and iliac screw loosening. No set-screw loosening was identified from the 22 papers cited in this systematic review^{1,3-6}.

With regard to set-screw loosening, Agrawal et al. described the following findings in a case of spinal fixation⁷. Implant-related complications may be surgeon-related sometimes. To avoid such implant failure, the rods over the screw head should be properly applied in a straight perpendicular angle and applications of set screws in the correct mechanical manner.

The set screw of the lateral connector, which connects the lumbosacral junction of the crab-shaped fixation, deviated. The difference between crab-shaped fixation and conventional SPF is the connection between implants at the lumbosacral junction. Then, the crab-shaped fixation is fastened to the rod connecting the bilateral iliac screws using a lateral connector or the like. In SPF, the pedicle screw and iliac screw of the lumbar spine are directly fastened to the rods, or even when lateral connectors are used, the connection is made in the left-right direction, not in the craniocaudal direction. In SPF, the rod may break due to stresses in the lumbosacral junction³. As the connection method is different from that of SPF as described above, stresses are concentrated on the set screw, which may have deviated. However, stress analysis such as FEM could not be performed at this time; thus, it is not confirmed.

The possibility of defect of set screws intraoperatively cannot be ruled out. Multiple postoperative X-rays were obtained and confirmed no set-screw loosening. The set-screw loosening occurred 3 months postoperatively in this case (Figs. 4 and 5(a, b, c)), which we believed to be possibly caused by stress. Other improvements to the spinopelvic crab-shaped fixation, such as an improved locknut structure on the implant for greater strength and an increase in the number of rods across the spinopelvic junction, may be necessary to improve the stability and outcome for the treatment of vertically unstable pelvic ring fractures.

Funding

None.

Ethical approval

Due to the retrospective nature of this study, ethical approval was not required.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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