

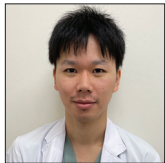
Case Report

Novel within ring fixation using iliac screws and an iliosacral screw locking system technique for fragility fracture of the pelvis

Ryohei Sawada¹, Tetsuhiro Ishikawa¹, Mitsutoshi Ota², Joe Katsuragi¹, Yasuhito Sasaki¹, Masahiro Suzuki¹, Tomotaka Umimura¹, Yuki Nagashima¹, Daisuke Hashiba¹, Takuma Yoshimoto¹, Naoki Yamoto¹, Seiji Ohtori³

¹Department of Orthopaedic Surgery, Sanmu Medical Center, Chiba, ²Department of Orthopedic Surgery, Seirei Yokohama Hospital, Kanagawa, ³Department of Orthopaedic Surgery, Chiba University, Chiba, Japan.

E-mail: *Ryohei Sawada - m0111045@icloud.com; Tetsuhiro Ishikawa - tetetetetetu@hotmail.com; Mitsutoshi Ota - ootacoid2000@yahoo.co.jp; Joe Katsuragi - joe_katsuragi@hotmail.com; Yasuhito Sasaki - yasuhito9540@aol.com; Masahiro Suzuki - within07230930@yahoo.co.jp; Tomotaka Umimura - adna4547@gmail.com; Yuki Nagashima - naga78.0706@gmail.com; Daisuke Hashiba - johnjohndice@gmail.com; Takuma Yoshimoto - takuma.y.0306@gmail.com; Naoki Yamoto - ny@8boox.com; Seiji Ohtori - sohtori@faculty.chiba-u.jp



*Corresponding author:

Ryohei Sawada,
Department of Orthopaedic
Surgery, Sanmu Medical Center,
Chiba, Japan.

m0111045@icloud.com

Received : 31 March 2022

Accepted : 30 June 2022

Published : 16 September 2022

DOI

10.25259/SNI_301_2022

Quick Response Code:



ABSTRACT

Background: Surgical indications for fragility fracture of the pelvis (FFP) have been reconsidered recently, and the indications to perform surgery have increased. However, the optimal surgical method to obtain sufficiently strong fixation in elderly patients with minimal invasiveness is not yet clear. In this report, we present the case of a patient with FFP who was treated with a novel posterior within ring fixation technique using a combination of iliac screws and an implant that locks the original iliosacral (IS) screw in the sacrum.

Case Description: A 90-year-old man was diagnosed with FFP (Rommens classification: Type IIc) and hospitalized for conservative treatment. However, 6 weeks after the injury, pain reappeared in his right buttock and computed tomography showed additional fractures of the right subpubic branch and right sacrum (Rommens classification: Type IVb). The fracture was considered to have progressed from being stable to unstable, and surgical treatment was planned. To obtain strong fixation with minimal invasion, we performed posterior fixation using E.Spine Tanit (Euros, France) compact posterior thoracolumbar instrumentation, an implant that combines an IS screw with a sacral anchoring system. The patient started walking unaided 2 weeks after the surgery, suggesting a good outcome of this surgical approach to FFP.

Conclusion: We performed posterior fixation surgery for a patient with an unstable FFP that recurred and progressed after conservative treatment. We have achieved good results using a minimally invasive, strong, and within ring fixation technique.

Keywords: Fragility fracture of pelvis, Iliosacral screw, Pelvic fracture, Rommens classification, Spinopelvic fixation, Within ring fixation

INTRODUCTION

The super-aging of society is a global trend, and the population of people aged 65 and over is expected to double between 2010 and 2040.^[3] As the population ages, the number of fractures as a consequence of bone fragility is increasing. There are 2 million fragility fractures per year in the

United States.^[19] Fragility fracture of the pelvis (FFP), which is caused by low-energy trauma based on bone fragility, is also increasing in daily practice. FFP is more common in the 80–90 age group: the annual incidence of FFP in people over 60 years of age is 25.6 cases/100,000, but increases dramatically to 110 cases/100,000 in people more than 80 years of age.^[1,6]

FFP has been reported to have a good outcome after conservative treatment.^[4,5,9] However, it has become clear that some patients require surgical treatment. Conservative treatment may result in pseudoarthrosis, or, in cases of severe pain, prolonged hospitalization, and reduced activities of daily living even if bone healing is achieved.^[1,11,12] The classification of FFP proposed by Rommens *et al.* is based on the degree of progression of the fracture type and is useful in determining a treatment strategy for FFP.^[16] FFP Type I are anterior pelvic ring fractures only, FFP Type II are nondisplaced posterior pelvic ring fractures with or without an anterior pelvic ring fracture, FFP Type III are unilaterally displaced posterior pelvic ring fractures, and FFP Type IV are bilaterally displaced posterior pelvic ring fractures. Rommens *et al.* recommended that for Type I and Type II FFP, surgery should be considered when there is no improvement with conservative treatment, whereas FFP Type III and FFP Type IV should be treated surgically.^[15]

There are several surgical methods to fix pelvic fracture; spinopelvic fixation, within ring fixation, and percutaneous screw fixation, but each has its own problems, such as the degree of fixation achieved and extent of invasiveness. Therefore, we focused on a system that is used as a distal anchor for long fixation in surgery for spinal deformity. The combination of iliac screws and an implant that locks the original iliosacral (IS) screw in the sacrum allows for within ring minimally invasive surgery and strong fixation. In this report, we present the case of a patient with FFP who was treated with a novel posterior within ring fixation technique using this system with a good postoperative outcome.

CASE REPORT

A 90-year-old man complained of the left thigh pain after he fell lightly on his buttocks during farm work. Before the injury, he was able to walk independently. His medical history includes asthma, postoperative inguinal hernia, and left total knee joint replacement. Plain radiographs and computed tomography (CT) showed fractures of the sacrum and pubis [Figure 1]. The patient was diagnosed with FFP (Rommens classification: Type IIc) and was hospitalized for conservative treatment. The pain gradually decreased, and he was able to walk 4 weeks after the injury and was discharged home. However, 6 weeks after the injury, pain reappeared in his right buttock and he returned to our hospital. CT showed additional fractures of the right subpubic branch and right sacrum (Rommens classification: Type IVb), and surgical

treatment was planned [Figure 2]. To obtain strong fixation with minimal invasion, we performed a posterior fixation using E.Spine Tanit (Euros, France) compact posterior thoracolumbar instrumentation, an implant that combines an IS screw with a sacral anchoring system. With the patient positioned supine, the Wiltse approach was used for each side, exposing the lumbosacral joint [Figure 3]. A bony foramen was created slightly lateral to the base of the S1 superior articular process on the cephalad side of the S1 neural foramen (the same as the insertion point for the S1 pedicle screw) and a sacral connector was inserted. An IS screw was

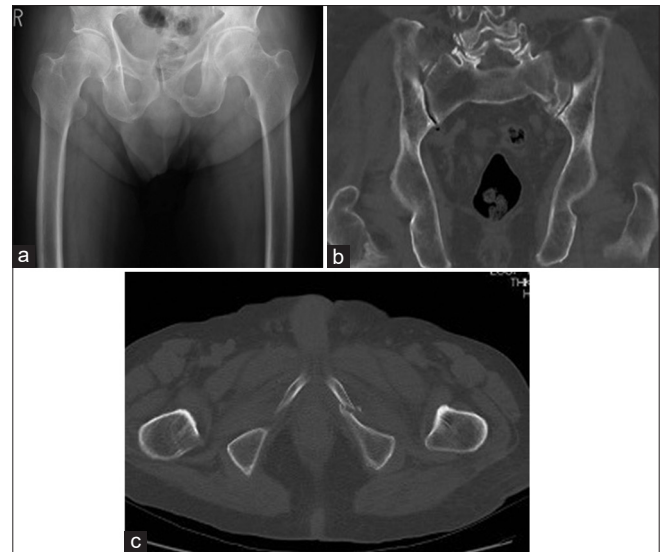


Figure 1: Plain radiographs (a) and computed tomography showing fractures of the sacrum (b) and pubis (c). The patient was diagnosed with a fragility fracture of the pelvis (Rommens classification: Type IIc).

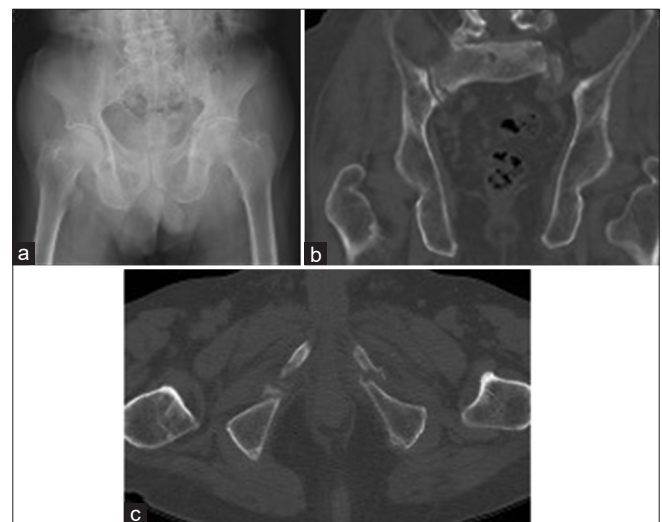


Figure 2: Plain radiographs (a) and computed tomography (b,c) 2 weeks after discharge, showing additional fractures of the right subpubic branch and right sacrum (Rommens classification: Type IVb).

inserted and fixed through the device placed in the sacral connector. Iliac screws were inserted under fluoroscopic guidance, and bilateral iliac screws were connected with rods. Finally, the sacral connector and iliac screw rods were connected [Figure 4]. The operative time was 3 h and 28 min, and the blood loss was 421 mL. We instructed the patient to walk with full weight-bearing from the day after surgery. The patient started to walk using parallel bars for support 2 days after the surgery, with a cane 1 week after the surgery, without a cane 2 weeks after the surgery, and was able to walk unassisted 4 weeks after surgery. When the patient visited our outpatient clinic 4 months after the surgery, his ADLs were independent and he was walking by himself without pain.

DISCUSSION

In this case, progression from stable (Rommens classification: Type IIc) to unstable fracture (Rommens classification: Type IVb) was observed after symptom relief with conservative treatment. FFP can be easily detected in pubic sciatic fractures on a plain radiograph, but posterior sacral fractures are usually difficult to diagnose without CT and require attention.^[5,16] Even stable fractures can sometimes progress to become unstable in patients with FFP.^[17] Therefore, careful follow-up is necessary,



Figure 3: Postoperative scar.

keeping in mind the progression of instability of the posterior elements even in stable fractures. Treatment strategies for FFP have been systematized, and there is an opinion that surgery is recommended, not only for Rommens Type III or Type IV patients but also for Type II patients with severe pain who are unable to move and leave their bed.^[10] Surgery is recommended for proximal femur fractures to achieve ADL quickly.^[14] It is important to fully consider the need for early fixation surgery for FFP as well as for proximal femur fractures.

Surgical procedure

There are three main surgical methods: spinopelvic fixation to extend the fixation area to the lumbar spine for stability, within ring fixation to keep the fixation in the pelvic ring, and percutaneous screw fixation. Spinopelvic fixation has been reported mainly in the form of crab-shaped fixation, triangular osteosynthesis, and the Galveston method. Due to its strong fixation by anchoring to the lumbar spine, the vertical shearing force of the pelvis can be suppressed, and vertical dislocation can be corrected intraoperatively. However, fixation between the healthy lumbar vertebrae and the pelvis should be avoided for pelvic ring injuries, and there are concerns about the extent of invasion, adjacent segment disease, and need for implant removal, even for elderly patients.^[7,10,13]

Within ring fixation includes the plate fixation technique for the sacroiliac joint, sacroiliac rod fixation (SIRF), and transverse iliac rod fixation (TIRF), which have been reported to provide strong fixation without anchoring to the lumbar spine. However, plates are more invasive and should be avoided for the elderly, SIRF raises concerns about the fixation of S1 pedicle screws and the limited direction for inserting S1 pedicle screws on the injured side of the sacrum, and TIRF requires the addition of an IS screw, because the sacrum is not fixed [Figure 5].

Common percutaneous screw fixation methods include rami screws, IS screws, and transiliac transsacral (TITS) screws. While percutaneous screws are minimally invasive, the TITS has a narrow corridor for insertion, and the IS screw has inferior fixation strength, because the tip of the screw is in the sacral cancellous bone.^[8]

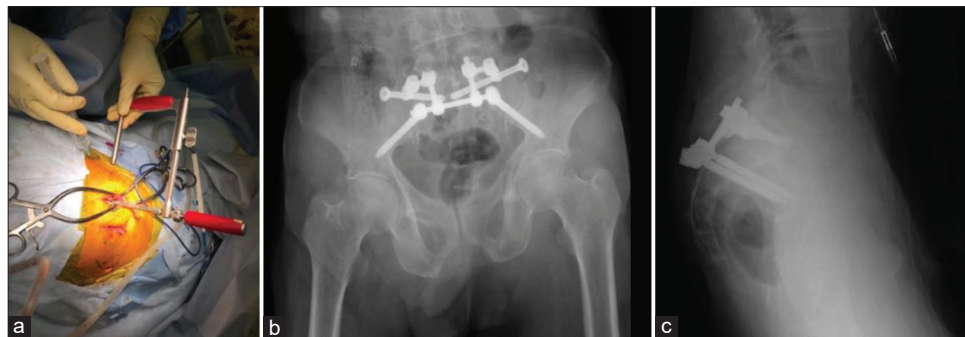


Figure 4: Representative images for the within ring fixation technique using E.Spine Tanit. An Intraoperative image(a) and postoperative radiographs(b,c).

Rommens *et al.* stated that the important points of surgical treatment in FFP are to focus on achieving stability rather than precise anatomical reduction and to use the least invasive technique possible.^[18] In other words, we need to achieve mutually exclusive objectives: minimal invasion and strong fixation.

Within ring fixation using E.Spine Tanit

E.Spine Tanit is a pelvic fixation system consisting of a sacral connector and IS screw and is used as a pelvic anchor for

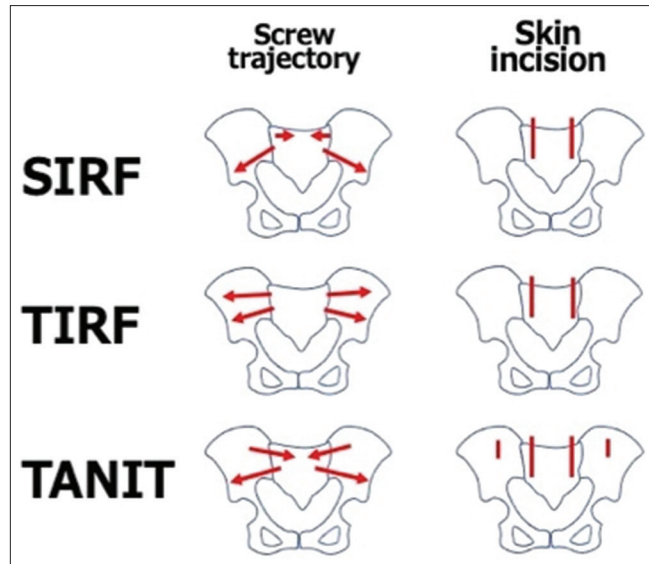


Figure 5: Screw trajectory (red arrows) and skin incision (red lines) of each techniques.

long fixation in spinal deformity surgery [Figure 6].^[2,4] We applied this implant to the surgery for FFP. The advantages of this technique are that the iliac and IS screws can be inserted in a small skin incision, that the IS screw can be locked in the connector, and that they are in a torsional position. Provided that the IS screw can be locked in the connector, there is strong fixation and the procedure can be completed in the pelvis [Figure 5]. In addition, because the IS screw can be inserted using a device from the sacral connector, it can be inserted using fluoroscopic guidance alone and no intraoperative navigation is required. In this case, the patient was able to walk using parallel bars for support 2 days after the surgery and started walking unaided 2 weeks after the surgery, suggesting a good outcome of this surgical approach to FFP.

Limitations

First, this technique cannot be applied in cases, in which there is vertical shear dislocation and requires a procedure for correction. Second, it was difficult to control the depth of the sacral connector, which made it difficult to connect the iliac screws to the rods that connect them, so the connection took time in this case. Establishing a suitable method to connect each implant is warranted.

CONCLUSION

We performed posterior fixation surgery for a patient with an unstable FFP that recurred and progressed after conservative treatment. We achieved good results using a minimally invasive, strong, and within ring fixation technique.

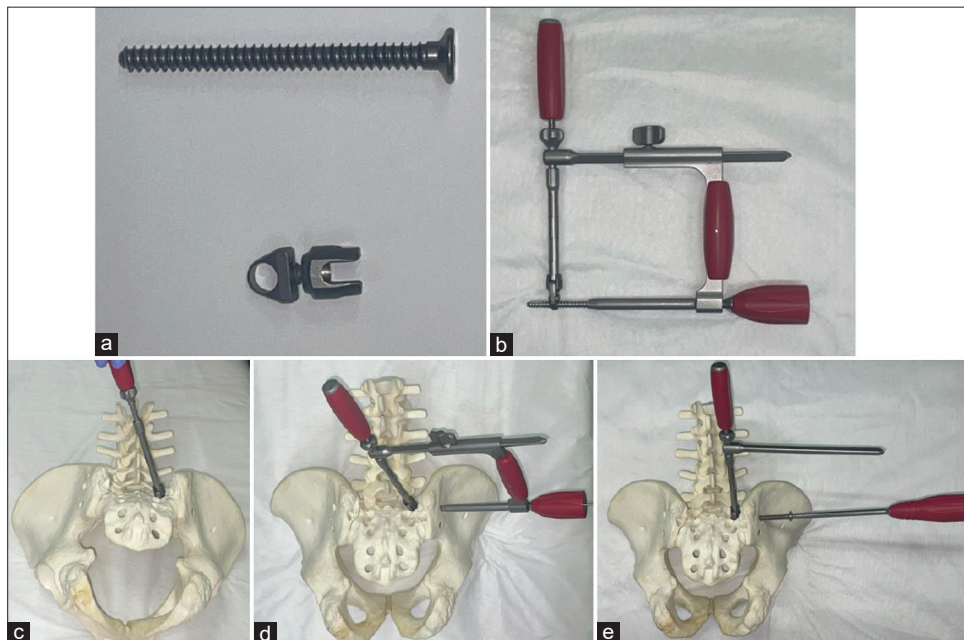


Figure 6: (a-e) Representative images for the within ring fixation technique using E. Spine Tanit.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Alnaib M, Waters S, Shanshal Y, Caplan N, Jones S, St Clair Gibson A, *et al.* Combined pubic rami and sacral osteoporotic fractures: A prospective study. *J Orthop Traumatol* 2012;13:97-103.
- Camp JF, Caudle R, Ashmun RD, Roach J. Immediate complications of Cotrel-Dubousset instrumentation to the sacro-pelvis. A clinical and biomechanical study. *Spine (Phila Pa 1976)* 1990;15:932-41.
- Cauley JA. Public health impact of osteoporosis. *J Gerontol A Biol Sci Med Sci* 2013;68:1243-51.
- Dubousset J. Pelvic obliquity. A three dimensional deformity. Paris Groupe d'étude de la scoliose 1973.
- Grasland A, Pouchot J, Mathieu A, Paycha F, Vinceneux P. Sacral insufficiency fractures: An easily overlooked cause of back pain in elderly women. *Arch Intern Med* 1996;156:668-74.
- Hill RM, Robinson CM, Keating JF. Fractures of the pubic rami. Epidemiology and five-year survival. *J Bone Joint Surg Br* 2001;83:1141-4.
- Karakaşlı A, Ceçen B, Erduran M, Taylan O, Hapa O, Havıtcıoğlu H. Rigid fixation of the lumbar spine alters the motion and mechanical stability at the adjacent segment level. *Eklemler Hastalıkları Cerrahisi* 2014;25:42-6.
- Kim JW, Oh CW, Oh JK, Kyung HS, Park KH, Yoon SD, *et al.* The incidence of and factors affecting iliosacral screw loosening in pelvic ring injury. *Arch Orthop Trauma Surg* 2016;136:921-7.
- Koval KJ, Aharonoff GB, Schwartz MC, Alpert S, Cohen G, McShinaw A, *et al.* Pubic rami fracture: A benign pelvic injury? *J Orthop Trauma* 1997;11:7-9.
- Lawrence BD, Wang J, Arnold PM, Hermsmeyer J, Norvell DC, Brodke DS. Predicting the risk of adjacent segment pathology after lumbar fusion: A systematic review. *Spine* 2012;37:S123-32.
- Leslie MP, Baumgaertner MR. Osteoporotic pelvic ring injuries. *Orthop Clin North Am* 2013;44:217-24.
- Mears DC, Velyvis JH. *In situ* fixation of pelvic nonunions following pathologic and insufficiency fractures. *J Bone Joint Surg Am* 2002;84:721-8.
- Park P, Garton HJ, Gala VC, Hoff JT, McGillicuddy JE. Adjacent segment disease after lumbar or lumbosacral fusion: Review of the literature. *Spine (Phila Pa 1976)* 2004;29:1938-44.
- Pincus D, Ravi D, Wasserstein D, Huang A, Paterson JM, Nathens AB, *et al.* Association between wait time and 30-day mortality in adults undergoing hip fracture surgery. *JAMA* 2017;318:1994-2003.
- Rommens PM, Dietz SO, Ossendorf C, Pairon P, Wagner D, Hofmann A. Fragility fractures of the pelvis: Should they be fixed? *Acta Chir Orthop Traumatol Cech* 2015;82:101-12.
- Rommens PM, Hoffman A. Comprehensive classification of fragility fracture of the pelvic ring: Recommendation of surgical treatment. *Injury* 2013;44:1733-44.
- Rommens PM, Ossendorf C, Pairon P, Dietz SO, Wagner D, Hofmann A. Clinical pathways for fragility fracture of the pelvis ring: Personal experience and review of the literature. *J Orthop Sci* 2015;20:1-11.
- Rommens PM, Wagner D, Hofmann A. Fragility fractures of the pelvis. *JBJS Rev* 2017;5:e3.
- Rousculp MD, Long SR, Wang S, Schoenfeld MJ, Meadows ES. Economic burden of osteoporosis-related fractures in Medicaid. *Value Health* 2007;10:144-52.

How to cite this article: Sawada R, Ishikawa T, Ota M, Katsuragi J, Sasaki Y, Suzuki M, *et al.* Novel within ring fixation using iliac screws and an iliosacral screw locking system technique for fragility fracture of the pelvis. *Surg Neurol Int* 2022;13:421.