Iatrogenic Sacral Root Entrapment after Iliosacral Screw Fixation in a Patient with Pelvic Ring Fracture
- A Case Report -

Seung Min Son, M.D., Ph.D., Seung Hun Woo, M.D., Jung Shin Kim, M.D., Won Chul Shin, M.D., Ph.D., Nam Hoon Moon, M.D., Ph.D.

J Korean Soc Spine Surg 2020 Mar;27(1):26-30.
Originally published online March 31, 2020;
https://doi.org/10.4184/jkss.2020.27.1.26

Korean Society of Spine Surgery
SMG-SNU Boramae Medical Center, 20, Boramae-ro 5-gil, Dongjae-gu, Seoul 07061, Korea
Tel: +82-2-831-3413 Fax: +82-2-831-3414
©Copyright 2017 Korean Society of Spine Surgery
pISSN 2093-4378 eISSN 2093-4386

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://www.krspine.org/DOIx.php?id=10.4184/jkss.2020.27.1.26

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Iatrogenic Sacral Root Entrapment after Iliosacral Screw Fixation in a Patient with Pelvic Ring Fracture - A Case Report -

Seung Min Son, M.D., Ph.D., Seung Hun Woo, M.D., Jung Shin Kim, M.D., Won Chul Shin, M.D., Ph.D., Nam Hoon Moon, M.D., Ph.D.*

Department of Orthopaedic Surgery, Pusan National University Yangsan Hospital, Yangsan, Korea

* Department of Orthopaedic Surgery, Pusan National University Hospital, Pusan, Korea

Study Design: Case report.

Objectives: Despite precise iliosacral (IS) screw placement, we encountered a case of a neurological deficit due to a bony fragment that remained around the nerve root after reduction of the fracture gap in a patient with a pelvic ring injury.

Summary of Literature Review: Percutaneous IS screw fixation is a commonly used procedure because it enables an adequate fixation force to be secured through a minimally invasive method in patients with pelvic ring fractures. Percutaneous IS screw fixation using C-arm fluoroscopy has been well described. In addition, several studies have investigated methods to prevent neurological damage.

Materials and Methods: A 48-year-old man was diagnosed with a lateral compression type 1 pelvic ring fracture. Bilateral IS screw fixation was performed in the patient, who had no preoperative neurological abnormalities. He complained of pain around the sacroiliac joint that radiated to the lower leg after percutaneous IS screw fixation, and he was diagnosed with S1 radiculopathy on electromyography.

Results: While reviewing the patient’s preoperative computed tomography images, a bony fragment in the fracture gap on the left S1 root was noted. After confirming S1 root entrapment, decompressive laminectomy was performed.

Conclusions: Surgeons should be aware that postoperative neurological symptoms may be caused by a bony fragment resulting from the fracture, regardless of screw malposition in percutaneous IS screw fixation. Preoperative planning with meticulous image review and intraoperative neurological monitoring, as well as using full-threaded screws, may help to prevent this problem.

Key words: Pelvis, Fracture, Spinal Nerve Root, Entrapment, Iatrogenic
studies reported neurological deficits after IS screw fixation
due to screw malposition.6,7 Routt et al reported a 2%
incidence of misplaced screws and of 5 cases, only 1 resulted
in neurologic injury.6 Keating et al reported a 15% incidence
of iatrogenic nerve injury in their series of 38 patients with
misplaced IS screw fixation.7 However, no report are available
on new-onset neurologic deficit due to first sacral nerve root
entrapment with a bony fragment.

Case Report

A 48–year–old male patient was injured in a traffic accident.
At the time of the accident, the patient was thrown out of the
car, and subsequently, he had loss of consciousness. At the
time of admission, the patient complained of chest pain and left
pelvic pain, and on examination, no neurological abnormalities
were found.

Physical examination revealed tenderness over the left sacrum
and the right pubis. Radiographs and computed tomography
(CT) revealed a disruption of the pelvic ring with an impacted
fracture of the left sacral ala in the region of the foramina (zone
II of Denis et al.); a minimally displaced fracture of the right
pubis, and a minimally displaced right posterior iliac fracture.
There was internal and anterior rotation of the left hemipelvis
with pivoting at the site of the zone–II fracture8 of the sacral
ala (Fig. 1). The fracture was classified as a lateral compression
type 1 injury according to the system of Young and Burgess.
The patient also had multiple rib fractures.

The disruption of the pelvic ring was judged to be stable.
However, the patient wanted to return to work early; therefore,
minimally invasive surgery using percutaneous IS
screws bilaterally was performed (Fig. 2). After the IS screws
were inserted under C–arm guidance, the fracture site was
stabilized, and the fracture gap was reduced.

Immediately after surgery, the patient began to suffer from
intense S1 radicular pain to his left buttock, posterior thigh,
and leg along with severe local pain around the left sacroiliac
joint area. The pain subsided after administration of pain
medications. One month after discharge, the patient was

---

Fig. 1. Preoperative 3-dimensional computed tomography.
(A) Anterior view of a minimally displaced fracture of the right pubis
(arrows). (B) Posterior view of the disruption of the pelvic ring with an
impacted fracture of the left sacral ala in the region of the foramina (arrow)
and a minimally displaced right posterior iliac fracture (arrowhead).

Fig. 2. Postoperative radiograph.
Iliosacral screws were inserted bilaterally for the disrupted pelvic ring
injury.
walking with a significant limp and was complaining of the same pain.

Physical examination revealed reduced motor strength (4/5 left tibialis posterior and gastrocnemius) and hyperesthesia in the left S1 dermatome. The left ankle jerk was diminished. Barring these findings, the neurological examination was normal. A CT scan was conducted and compared with preoperative CT images. There was a bony fragment in the anterior S1 root on the left side (Fig. 3B), which was also revealed in the preoperative CT image review (Fig. 3A). An electromyogram of the left lower extremity revealed left radiculopathy of the first sacral nerve root.

Before the reduction was performed, there was no root compression despite the presence of a bony fragment in front of the left S1 root due to the increased fracture gap.

The authors concluded that decompressing the S1 root was necessary, and left S1 hemilaminectomy was performed. After identifying the traversing S1 root, we did exploration along the route of the root. In the end, the bone fragment, which was confirmed by CT, was identified and removed (Fig. 3C). After we confirmed that there was no root compression through its passage till the foramen, the surgery was concluded.

Immediately after the surgery, the patient’s pain resolved. A six-month follow-up examination confirmed that the patient was pain free and had resumed all activities including sports. Complete neurologic recovery (including full plantar flexion strength of the toes and ankle) was observed at this time. The present study was approved by the Research and Ethical Review Board of our institution (IRB No. 04–2019–061).

Discussion

Several studies have reported the incidence of neurologic deficit associated with sacral fractures. Schmal et al. reported that unstable sacral fractures that require surgical fixation showed an increased risk of accompanying neurologic deficits (15.4%). In total, 11.5% of operative sacral stabilization procedures were supplemented with nerve root decompression. Among them, the S1 root was the most common (33% of cases). Concerns over neurologic deficits owing to misplaced screw after IS fixation have also been reported.

Measures to avoid neurologic injury concerned with IS screw fixation have been recommended in the literature and include the use of a lateral sacral radiograph to recognize the anterior alar slope and iliac cortical density, intraoperative neurologic monitoring, two C-arm fluoroscopy units, and computer-assisted surgery and image guidance systems.

In the present case, neurological symptoms in the stable...
pelvic ring injury were not caused by misplacement of the screw after percutaneous IS screw fixation, but because of the reduction of the fracture gap after insertion of the screw, causing S1 root compression due to the bony fragment in the foramen.

We recommend that surgeons should be aware of the possibility of postoperative root compression after IS screw fixation even in the absence of screw malposition. To prevent unexpected iatrogenic root entrapment, we recommend that extensive preoperative planning with meticulous review of the preoperative CT image should be performed and the use of somatosensory evoked potential (SSEP) and spontaneous electromyogram (EMG) monitoring during surgery is recommended. In addition, we recommend to use of full-threaded screws instead of partial-threaded screws for compression of fracture gap in relatively stable pelvic bone fracture. If unexpected postoperative neurologic deficit is present, early decompressive surgery through rapid identification of the cause can produce good results.

The primary goal when treating unstable pelvic injuries is to obtain an adequate reduction and stable internal fixation. Careful preoperative planning is mandatory for achieving this aim and to avoid damaging surrounding neurovascular structures. This includes reviewing the preoperative CT scan to determine the safe corridor for SI screw placement and to prevent root entrapment after screw fixation. In addition, adequate intraoperative neurologic monitoring must be performed during hardware insertion. IS screw fixation is a simple and efficient procedure, but there is a possibility of iatrogenic neurologic deficit due to root entrapment with bony fragments during IS screw insertion. This procedure requires attention and careful consideration from the surgeon.

REFERENCES

1. Routt ML, Jr, Kregor PJ, Simonian PT, et al. Early results of percutaneous iliosacral screws placed with the patient in the supine position. J Orthop Trauma. 1995 Jun;9(3):207–14.
2. Simonian PT, Routt ML, Jr, Harrington RM, et al. Biomechanical simulation of the anteroposterior compression injury of the pelvis. An understanding of instability and fixation. Clin Orthop Relat Res. 1994 Dec;(309):245–56.
3. Yinger K, Scalise J, Olson SA, et al. Biomechanical comparison of posterior pelvic ring fixation. J Orthop Trauma. 2003 Aug;17(7):481–7.
4. Miller AN, Routt ML Jr. Variations in sacral morphology and implications for iliosacral screw fixation. J Am Acad Orthop Surg. 2012 Jan;20(1):8–16. DOI: 10.5435/JAAOS-20-01-008.
5. Routt ML, Jr, Simonian PT, Agnew SG, et al. Radiographic recognition of the sacral alar slope for optimal placement of iliosacral screws: a cadaveric and clinical study. J Orthop Trauma. 1996;10(3):171–7.
6. Routt ML, Jr, Simonian PT, Mills WJ. Iliosacral screw fixation: early complications of the percutaneous technique. J Orthop Trauma. 1997 Nov;11(8):584–9.
7. Keating JF, Werier J, Blachut P, et al. Early fixation of the vertically unstable pelvis: the role of iliosacral screw fixation of the posterior lesion. J Orthop Trauma. 1999 Feb;13(2):107–13.
8. Denis F, Davis S, Comfort T. Sacral fractures: an important problem. Retrospective analysis of 236 cases. Clin Orthop Relat Res. 1998 Feb;227:67–81.
9. Schmal H, Hauschild O, Culemann U, et al. Identification of risk factors for neurological deficits in patients with pelvic fractures. Orthopedics. 2010 Aug 11;33(8). DOI: 10.3928/01477447-20100625-13.
10. Ricci WM, Padberg AM, Borrelli J. The significance of anode location for stimulus-evoked electromyography during iliosacral screw placement. J Orthop Trauma. 2003 Feb;17(2):95–9.
11. Peng KT, Huang KC, Chen MC, et al. Percutaneous placement of iliosacral screws for unstable pelvic ring injuries: comparison between one and two C-arm fluoroscopic techniques. J Trauma. 2006 Mar;60(3):602–8.
12. Kim JJ, Jung CY, Eastman JG, et al. Measurement of Optimal Insertion Angle for Iliosacral Screw Fixation Using Three-Dimensional Computed Tomography Scans. Clin Orthop Surg. 2016 Jun;8(2):133–9. DOI: 10.4055/cios.2016.8.2.133. Epub 2016 May 10.
골반골 골절 환자에서 경피적 장천골 나사 고정술 후 발생한 의인성 천추 신경근 포착 - 증례 보고 -
손승민, 우승훈, 김정신, 신원철, 문남훈
양산부산대학교병원 정형외과, 부산대학교병원 정형외과

연구 계획: 증례 보고
목적: 골반골 골절 환자에서 정확한 위치에 장천골 나사를 삽입했더라도 골절 간극이 감소되면서 신경근 주변에 남아 있던 골편에 의해 신경근이 포착된 환자를 보고하고자 한다.

결과: 술전 CT 영상 검토 중 좌측 S1 신경근 전방에 골편이 위치하고 있었고 수술로 인해 골절 간극이 좁아지면서 신경근이 포착되었음을 확인되었다. 감압적 후궁절제술 시행 후 증상 완화를 보였다.

결론: 골반골 골절의 장천골 나사 고정술 시 나이나 위치의 이상이 없음에도 골절에 의한 신경근 압박을 유발할 수 있으며 수술 전 면밀한 영상 검토와 수술 중 신경근 감시 장치, full threaded screw를 이용하여 예방할 수 있다.