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Surgical Correction of Pelvic Malunion and Nonunion

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Regardless of the method of treatment, as many as 5% of all pelvic fractures result in malunion or nonunion of the pelvis. However, there is not much information in the literature on the management of these late complications. Because they cause disabling symptoms and socioeconomic problems, some patients with malunion or nonunion of pelvic fractures need to undergo surgery. We report our experience with satisfactory results of surgery for pelvic malunion and nonunion in four patients. The key to successful reconstruction is thorough preoperative planning and methodical surgical intervention.

Keywords: *Pelvis, Fractures, Malunited, Ununited*

Malunion and nonunion of the pelvis usually occur in unstable injury patterns that were initially managed without surgery or solely by external fixation because of delay in definitive treatment of pelvic trauma due to associated severe injury.[1-4] These conditions result in chronic residual pain, deformity, and progressive functional disability. Treatment is sometimes difficult because of inexperience and lack of understanding of the injury on the part of the surgeon and inability to apply force to the vectors necessary for reduction. Surgical expertise is vital for achieving successful results. We report here four cases of pelvic malunion and nonunion which were managed satisfactorily.

CASE REPORTS

Case 1

A 27-year-old woman was injured when she fell from a height 9 months before presenting for treatment. The initial diagnosis was type C injury according to Tile's classification,[5] and she was treated without surgery because of polytrauma and complete peroneal nerve palsy. When she revisited our hospital, she reported buttock pain, limping, and sitting intolerance. Radiographs obtained during this visit showed posterior translation of the left hemipelvis on the inlet view and a significant 5.5-cm superior migration of left hemipelvis on the outlet view. A two-dimensional (2D) computed tomography (CT) scan showed nonunion through the left sacrum and pubic ramus and 15° internal rotation deformity of the left hemipelvis, and a three-dimensional (3D) CT scan showed superior and posterior migration—along with internal rotation and flexion deformity—of the left hemipelvis. We performed a three-stage pelvic reconstruction. In the first stage, the patient was placed in the supine position, and we used an ilioinguinal approach to perform osteotomies of the superior and inferior pubic rami near the original fracture site. The wound was irrigated and closed. Then, the patient was placed prone for the second stage of the procedure. Through a posterior approach, we performed an osteotomy at the site of nonunion in the sacral foramen. In this stage, it is very important to cut the sacrospinous and sacrotuberous ligament attachments to the sacrum to reduce the superior migration of the hemipelvis. Correction of cranial displacement was carried out using a variety of bone clamps and reduction forceps. A transverse tension band plate, placed posterior to the sacral lamina, required a second smaller posterior approach on the right. The posterior wound was closed, and the patient was rolled into the supine position. The anterior wound was reopened and the superior ramus was fixed with a plate and screws. A bone

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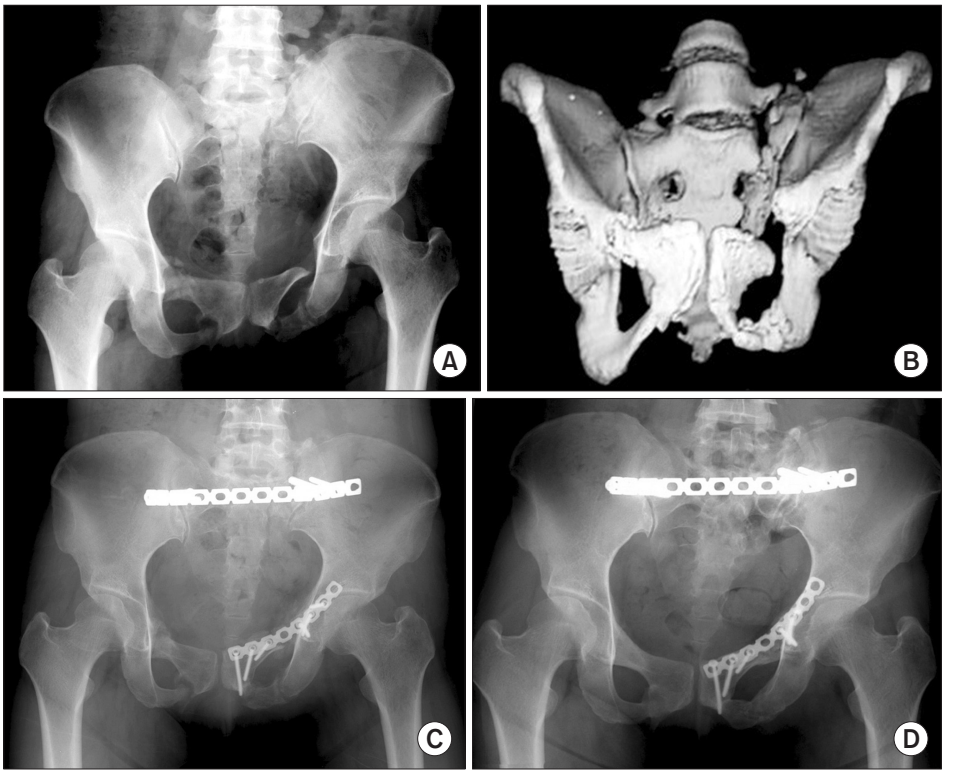

Fig. 1. Case 1. (A) Initial anteroposterior view. (B) The three-dimensional computed tomography image shows upward migration and internal rotation deformity of the left hemipelvis. (C) The radiograph obtained immediately after surgery shows correction of the deformity. (D) The radiograph obtained 4 years after surgery shows union and maintenance of the reduction.

graft was also added. Radiographs obtained immediately after surgery showed correction of superior migration and internal rotation deformity. Four years later, a follow-up radiograph showed union and maintenance of the reduction, and the patient had no clinical signs of pain, limping, or sitting intolerance. In addition, she showed complete recovery from peroneal nerve palsy (Fig. 1).

Case 2

A 28-year-old man was injured when he fell from a height 6 months before being referred to our institute; he was originally treated without surgery at another hospital. He was transferred to our hospital because he had a 5-cm leg-length discrepancy and pain in his right buttock. Anteroposterior radiographs of his pelvis showed cranial displacement of the right hemipelvis through the right iliac wing. Radiographs obtained in the outlet view showed a 4.8-cm cranial displacement, and the inlet view showed a decreased pelvic cavity. A 2D CT image showed nonunion through the right iliac wing and the left superior pubic ramus, but no significant rotational deformity. A 3D CT image showed upward migration, medial translation, and adduction and flexion deformity of the right hemipelvis. With the patient in the supine position, osteotomy was performed on the right iliac wing through a right iliac approach, and a left pubic osteotomy was performed through a left ilioinguinal approach. After reduction, we used a reconstruction plate for fixation and performed bone grafting. Radiographs obtained immediately after surgery showed correction of the superior migration of the right hemipelvis on the outlet view and excellent pelvic cavity on the inlet view. Postoperative CT images showed fixation of the iliac wing with a bone graft through the original site of nonunion. Clinical evidence showed that the patient's leg-length discrepancy had also been corrected. At 2.7 years after surgery, a follow-up radiograph showed that the lesion had healed without further complications; the patient reported no pain and he did not limp (Fig. 2).

Case 3

A 25-year-old woman was referred to our hospital because of nonunion with severe residual deformity of the right hemipelvis. The initial diagnosis was vertical shear injury according to the Young-Burgess classification,[6] and she underwent surgery at another hospital. When we saw her, she had severe buttock and pubic pain and moderate limping. Radiographs obtained at our hospital showed severe residual internal rotation deformity and 4-cm cranial displacement of the right hemipelvis. CT showed nonunion through the right iliac wing and the left pubic rami, along with upward migration, internal rotation, and adduction deformity. For surgery, the patient was placed in the

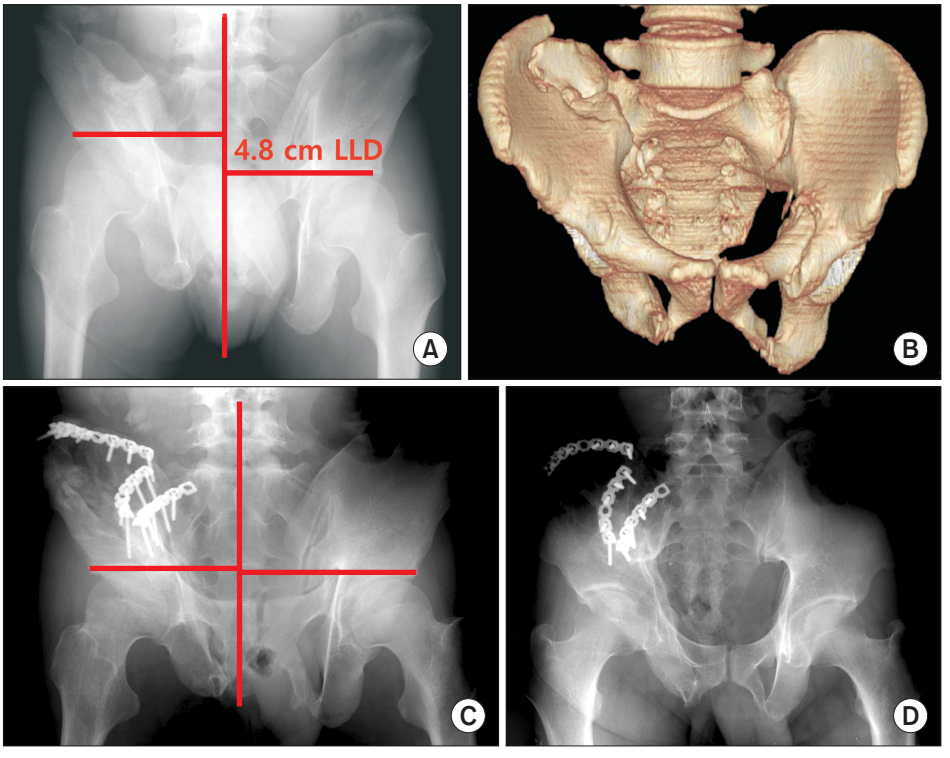

Fig. 2. Case 2. (A) The initial outlet view shows cranial displacement. LLD: leg-length discrepancy. (B) The three-dimensional computed tomography outlet view shows upward migration and medial translation deformity of the right hemipelvis. (C) The outlet view radiograph obtained immediately after surgery, shows correction of superior migration. (D) The radiograph obtained 2.7 years after surgery shows a well-maintained reduction.

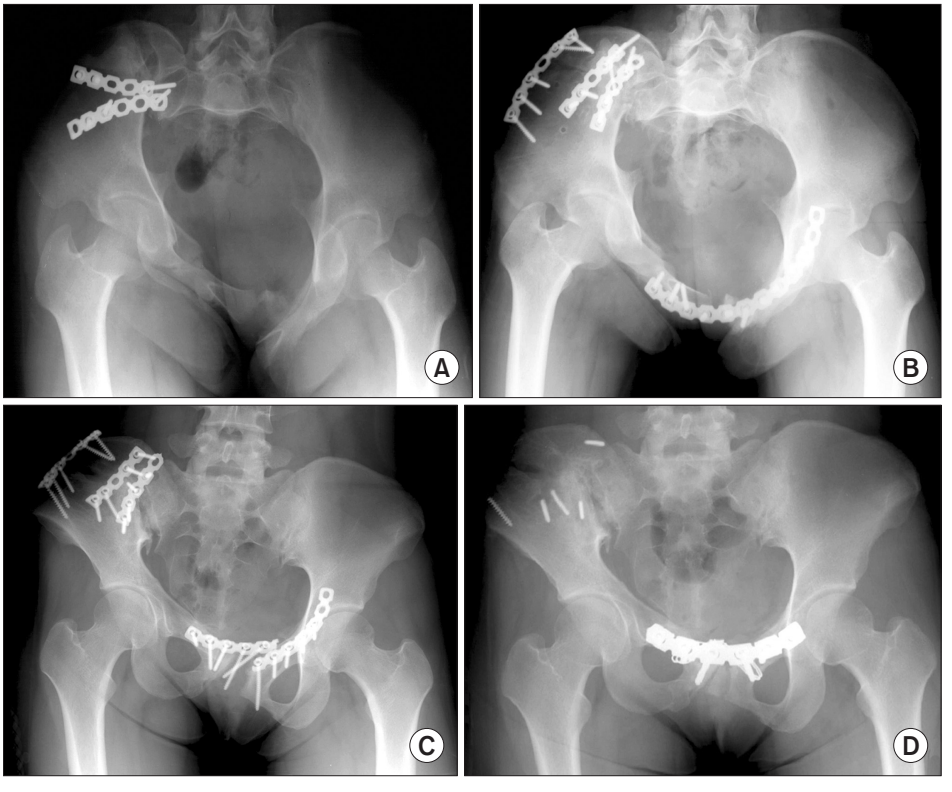

Fig. 3. Case 3. (A) The initial inlet view radiograph shows severe residual internal rotation deformity of the right hemipelvis. (B) The radiograph obtained immediately after surgery shows correction of the internal rotation. (C) The radiograph obtained 2 months after surgery shows loss of reduction, metal failure, and nonunion. (D) In revision surgery, the anterior lesion was reopened and fixed with a broad plate.

supine position. The right posterior hemipelvis was osteotomized for mobilization through an iliac approach and then fixed with a plate and screws. With the patient still in the supine position, we used an ilioinguinal approach for the anterior pelvis, where we performed plating and placed a bone graft at the osteotomy site. Radiographs obtained immediately after surgery showed correction of the internal rotation and superior migration deformity. However, radiographs obtained at a follow-up examination 2 months later showed loss of reduction, metal failure, and nonunion, especially in the anterior pelvis. Therefore, we decided to operate again. The anterior lesion was reopened and fixed with a broad plate and fused at the symphysis. The posterior lesion was united and the plate was removed at the same time. A follow-up examination 6 years later showed a well-fused symphysis and posterior pelvis; the patient reported no bothersome symptoms (Fig. 3).

Case 4

A 44-year-old woman was involved in a traffic accident 12 months before she was referred to our institution. At the time of the accident, the initially attending surgeon did not treat her surgically, due to severe polytrauma with liver laceration. The patient reported severe buttock pain and leg-length discrepancy. Radiographs showed posterior and superior migration of the right hemipelvis and nonunion of the left anterior pelvis. A CT image showed nonunion through the right sacrum and the left pubic rami, with displacement. We planned a three-stage pelvic reconstruction. During the first stage, we reconstructed her pelvis through the left pubic release. Then, we turned the patient into the prone position and osteotomized her sacrum. Reduction was performed by using a Matta clamp, and fixation was performed using a posterior tension band with a locking compression plate because of disuse osteoporosis. Finally, we rolled her into the supine position and then reopened the lower abdominal incision. The left superior rami was then fixed with a plate. During the operation, the patient was transfused with 18 packs of blood. Radiographs obtained immediately after surgery showed correction of the deformity, and radiographs obtained 14 months later during a follow-up examination showed maintenance of the reduction (Fig. 4).

DISCUSSION

Regardless of the treatment method, as many as 5% of all fractured pelvises remain in an unsatisfactory position after injury.[5] However, symptomatic posttraumatic pelvic malunion and nonunion are uncommon.[1-3] A patient

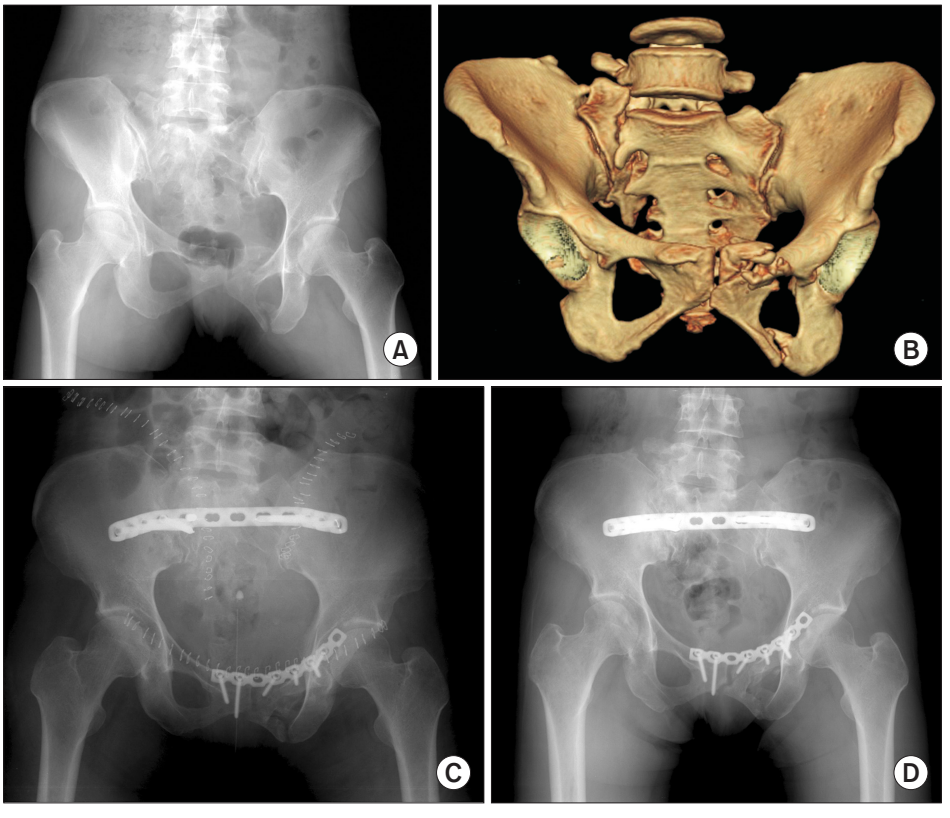

Fig. 4. Case 4. (A) Initial anteroposterior radiograph. (B) The three-dimensional computed tomography image shows nonunion through the right sacrum and the left pubic rami, with displacement. (C) The postoperative anteroposterior view shows correction of the deformity. (D) The radiograph obtained 14 months after surgery shows a well-maintained reduction.

who survives these life-threatening injuries does not usually wish to undergo further corrective surgery unless the symptoms are disabling;[7] hence, there is not much information in the literature on the management of these late complications.[8]

It is difficult to discuss malunion and nonunion separately because they commonly occur together. Hemipelvic displacement of > 1 cm and/or rotation of 15° to 20° may represent malunion because a lack of healing encompassing these parameters has been associated with diminished clinical results, although it is not always symptomatic.[4] Diagnosing nonunion may be difficult. It is difficult to visualize the fracture site because it is obscured by hardware on radiographs. Therefore, it is important that the surgeon monitors the patient over time to detect continued pain and instability and a broken or altered internal fixator.[9] Nonunion is usually symptomatic.

Pain is the most common symptom reported after fracture of the pelvic ring. It is usually perceived posteriorly in the sacroiliac joint because of instability. The pain usually worsens with weight-bearing and decreases with rest, but the anterior lesion is relatively less painful. It is important to ascertain whether the symptoms are related to pelvic malunion and nonunion rather than to other clinical conditions such as mechanical low back pain, an old neurologic injury, or dysesthetic pain of neurogenic origin.[3,7] In addition, patients do not always experience pelvic instability in the same sense as they do experience knee instability. A stress test, such as a single-leg standing radiograph or dynamic assessment by fluoroscopy, may be helpful. Occasionally, gait abnormality due to leg-length discrepancy and pelvic rotation are observed. A displaced bony fragment may cause dyspareunia, dysuria, or decreased urinary frequency. Sitting intolerance can also occur.[5,9]

Not all patients with malunion or nonunion require surgery. A decision to proceed with surgery should be made only after careful assessment of the patient and the injury. Also, patients must be informed that reconstruction is associated with complications in 20% of the patients and that surgical results are less than perfect. Indications for surgery include pain, pelvic instability, and clinical problems related to pelvic deformity, such as sitting difficulty, limb shortening, dyspareunia, and dysuria.[1-3]

Multistage reconstruction is the most common surgical treatment for pelvic malunion and nonunion. The sequence, either anterior-posterior-anterior or posterior-anterior-posterior, is chosen according to the type of initial injury and the deformities that require correction.[2] The posterior approach is typically used for the correction of translational deformity, whereas anterior reduction is best suited for correction of rotation and some translation, especially in the anteroposterior direction. Control and correction of rotational deformity can be difficult and requires excessive force when working close to the axis of rotation in the posterior pelvis without the benefit of a lever arm. The anterior symphysis is commonly approached through a Pfannenstiel incision, but sometimes an ilioinguinal approach is needed. The bladder should be protected. To stabilize the symphysis, the plating technique is used. For the pubic ramus, a combination of plating and bone grafting is the treatment of choice. For the posterior pelvis; however, a posterior approach works better because it makes it easier to obtain stable interfragmentary compression. In addition, the use of iliosacral screws or plating is useful. As the posterior release is being performed currently, it includes complete resection of the sacrospinal and sacrotuberous ligaments together for reduction of superior migration of the hemipelvis. Sometimes, the anterior approach to the sacroiliac joint is used. It is not a difficult technique to perform, but the L5 nerve root must be identified and protected because it tracks inferiorly over the sacral ala.[5]

Surgical treatment of pelvic malunion and nonunion has potential serious complications. The average duration of surgery is > 6 hours, and there is considerable blood loss. Neurologic injuries and venous thromboembolism are the most often recorded postoperative complications. In addition, vascular and visceral injuries, infections, implant failures, persistent nonunion, incomplete reduction, and residual malalignment can occur.[8] Our patients also lost a lot of blood, necessitating large transfusions. However, none of our patients experienced serious complications.

Late pelvic reconstruction is very difficult and is associated with a higher rate of complications than other orthopedic reconstructions. Prevention of pelvic malunion or nonunion is the best option, but if surgery becomes necessary, the key to successful reconstruction is thorough preoperative planning. For the best management of pelvic trauma and its consequences, additional multicenter prospective or retrospective studies should be conducted.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Pennal GF, Massiah KA. Nonunion and delayed union of fractures of the pelvis. Clin Orthop Relat Res. 1980;(151): 124-9.
2. Matta JM, Dickson KF, Markovich GD. Surgical treatment of pelvic nonunions and malunions. Clin Orthop Relat Res. 1996;(329):199-206.
3. Vanderschot P, Daenens K, Broos P. Surgical treatment of post-traumatic pelvic deformities. Injury. 1998;29(1):19-22.
4. Lindahl J, Hirvensalo E, Bostman O, Santavirta S. Failure of reduction with an external fixator in the management of injuries of the pelvic ring: long-term evaluation of 110 patients. J Bone Joint Surg Br. 1999;81(6):955-62.
5. Tile M. Fractures of the pelvis and acetabulum. 2nd ed. Baltimore: Williams & Wilkins; 1995.
6. Young JW, Burgess AR, Brumback RJ, Poka A. Pelvic fractures: value of plain radiography in early assessment and management. Radiology. 1986;160(2):445-51.
7. Mears DC, Velyvis J. Surgical reconstruction of late pelvic post-traumatic nonunion and malalignment. J Bone Joint Surg Br. 2003;85(1):21-30.
8. Kanakaris NK, Angoules AG, Nikolaou VS, Kontakis G, Giannoudis PV. Treatment and outcomes of pelvic malunions and nonunions: a systematic review. Clin Orthop Relat Res. 2009;467(8):2112-24.
9. Stover MD, Matta JM. Malunion and nonunion of the pelvis: posttraumatic deformity. In: Tile M, Helfet DL, Kellam JF, eds. Fractures of the pelvis and acetabulum. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2003. 400-8.