

# Fibular Strut Graft for Posterior Pelvic Ring Nonunion – a Case Report

## Pakloub zadního segmentu pánve řešený pomocí štěpu z fibuly – kazuistika

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### SUMMARY

Posttraumatic pelvic nonunions in combination with malposition are uncommon in the present-day era of modern pelvic surgery. The case describes a new surgical technique for treatment of the nonunion localized to iliosacral joint.

A 42-year-old polytraumatized male presented with a pelvic fracture (type 61-C2.3) associated with a complex acetabular fracture. The patient was treated and the pelvis stabilized according to damage control principles (external fixation and pelvic C-clamp) and subsequently definitively treated according to principles of current pelvic surgery. The posterior pelvis was stabilized by bilateral S1 iliosacral screws, however the posterior pelvic ring injury on the left side was not well reduced. The result was a nonunion formation in the left sacroiliac joint with screw loosening. Two attempts at bone grafting and repeat stabilization were done, but the nonunion did not heal. The end result was a nonunion through left sacroiliac joint with destruction of the lateral part of sacral bone. The nonunion was treated with nonvascularised autologous fibular strut graft in combination with allogenic corticocancellous grafting. The fibular graft was placed into the bone void after the removal of the iliosacral screw. Radiographically the nonunion healed completely six months after the fibular grafting and the patient had improved clinical outcome.

The described technique solves both instability and bone defect in posterior pelvic ring even in the case with low contact areas. The nonvascularised autologous fibular grafting is an effective technique for sacroiliac joint nonunion treatment even in case with large bone defect.

**Key words:** pelvis; nonunion; fibular graft.

### INTRODUCTION

Posttraumatic pelvic nonunions in combination with malposition are rare cases nowadays (9). Treatment of these cases is very challenging, especially of the posterior pelvic ring nonunions localized to sacroiliac (SI) joint.

Ebraheim et al. described the autologous fibular strut graft placed through the SI joint (3). The indication was not the instability but the pain in SI joint after the iliosacral screw placement. The stability required for healing was provided by another iliosacral screw as well as the fibular graft itself (3).

We present this case to report that fibular strut grafting can be used also in the cases with instability, bone defect and low contact areas of the nonunion. But the techniques of posterior pelvic ring stabilization and fixation of the graft have to be modified in these difficult cases.

### Case report

A 42-year-old male, driver, was brought to our trauma centre approximately one hour after a head-on collision of two cars. The polytraumatized patient was in severe hemorrhagic shock (class III) on presentation and was treated according to a standard algorithm containing a primary survey (ATLS®) and massive transfusion protocol (5). The patient went to operating theatre immediately after primary survey was performed. After the diagnostic

process was finished, the final diagnosis was a polytrauma consisting of facial (mandible fracture), thorax (bilateral multiple ribs fractures, left-sided hemopneumothorax), abdominal (left-sided diaphragmatic rupture, pancreatic and liver contusion), pelvis and extremity (femoral, humeral shaft fractures, fracture of olecranon, all on the left side) injury. The Injury Severity Score (ISS) was calculated to be 48 (8). The pelvic trauma consisted of a type 61-C2.3 pelvic fracture (AO/OTA classification) associated with a complex acetabular fracture (transverse and posterior wall) on the left side. The pelvic fracture was composed of Denis 1 transsacral fracture on the left side, sacroiliac joint lysis on the right side and all four pubic rami fractures (Fig. 1). Transverse processes fractures of L1 - L5 were present on the left. A peroneal palsy on the left side presented after the primary surgery because of L5 root damage (probably caused by trauma).

The primary surgery consisted of transverse exploratory laparotomy with suture of the diaphragmatic rupture and stabilization of extremity trauma by external fixation. Pelvis was stabilized by an anterior external fixation in combination with pelvic C-clamp due to posterior pelvic ring instability. The pelvic external fixation frame was connected with the femoral frame on the left side in order to span the left hip and stabilized the acetabular



Fig. 1. AP X-ray view showing pelvic fracture type 61-C2.3 associated with left acetabular fracture (transverse and posterior wall). Cranial displacement of left SI joint is visible.



Fig. 2. Inlet X-ray view showing nonunion formation and SI iliosacral screw loosening on the left side 4 months after the injury.

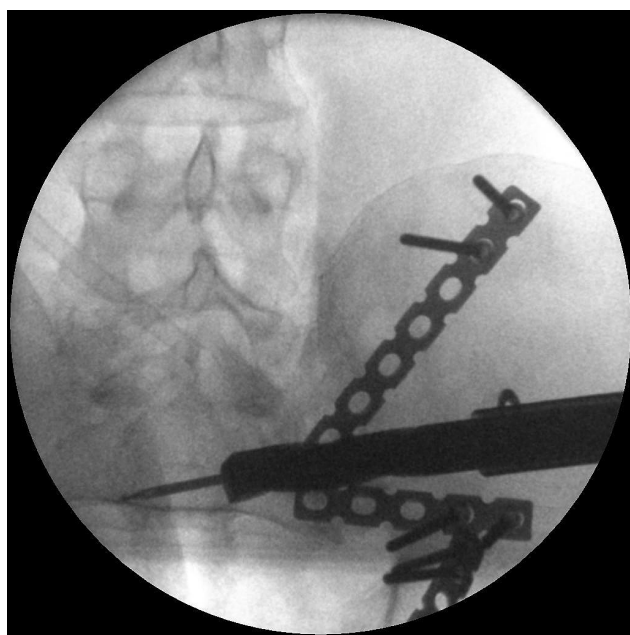


Fig. 3. Intraoperative fluoroscopy view showing enlargement of canal for the graft by cannulated 13 mm drill bit.



Fig. 4. The graft's insertion over the guide wire through the protection sleeve. Patient is in prone position, head to the left.

fracture. The postoperative course was complicated with severe acute pancreatitis secondary to the pancreatic contusion.

The pelvic C-clamp was replaced by bilateral S1 iliosacral screw placement four days later. The anterior pelvic segment plating (ORIF) was performed 10 days after the primary surgery. ORIF of the left acetabular fracture via posterior Kocher-Langenbeck approach was performed 30 days after primary surgery. The delay was caused by poor general health status of the patient. The extremity fractures were treated definitively by internal fixations. The femoral and humeral shaft fractures were treated by intramedullary nails and the olecranon fracture

by plating. All fractures healed completely except the pelvic fracture.

The posterior pelvic ring injury on the left side was not well reduced after the percutaneous placement of the S1 iliosacral screw. The displacement of more than 1 cm persisted at the fracture site of sacral ala spreading into the left SI joint. The left iliac bone was displaced posterosuperiorly in sacroiliac joint with rotation upwards of the whole left hemipelvis. The result was the nonunion formation with clear radiological and clinical signs (pain). Iliosacral screw loosening (on the left) was apparent in follow up radiographs (Fig. 2). The first revision surgery for the nonunion was done 7 months



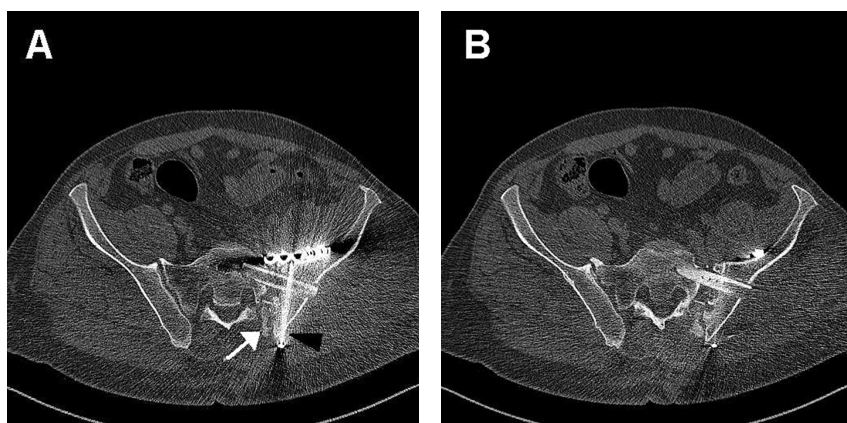


Fig. 5. CT scans showing fibular graft position; A – scan through the middle of the graft showing graft fixation by single screw (black arrow head) and allogenic corticocancellous graft in the posterior part of the defect (white arrow), B – scan through the caudal part of the graft showing the width of nonunion's bone defect and its crossing by fibular graft. The drilled small holes are visible in the middle of the graft.

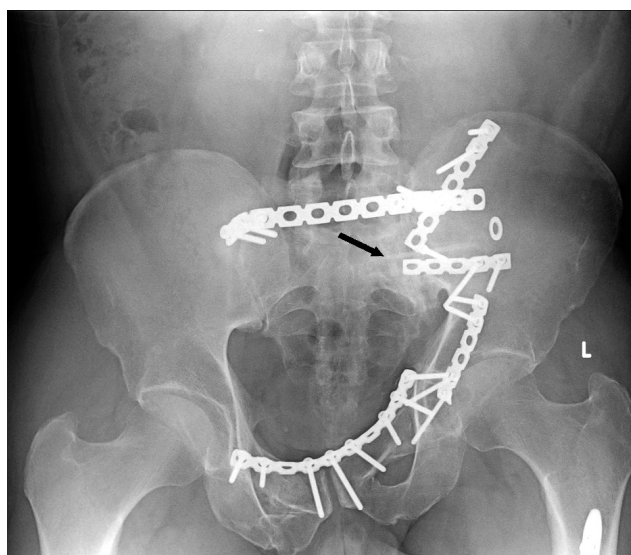


Fig. 6. AP view 6 months after fibular grafting. Nonunion is healed completely and cortices of fibular graft are still visible (cranial border of the graft is marked by black arrow).

after injury. Anterior SI joint plating with use of allogenic corticocancellous bone graft was performed. The loose S1 screw was exchanged for a longer one with good purchase and a second screw was added into the S2 segment. There was no evidence of radiographic healing and bone graft resorption was apparent over the next several months. A second revision, performed 10 months after the first, consisted of allogenic bone grafting through posterior approach in combination with compression by new S1 and S2 iliosacral screws. Neither of the revision surgeries corrected the malreduction. Unfortunately the nonunion persisted and the bone graft resorbed with loosening of the both iliosacral screws. Clinically the patient was doing poor and was unable to walk without pain and crutches. The left lower limb

was 2 cm shorter due to pelvic deformity. Sitting for more than thirty minutes was very painful. He was able to sleep only with high dose of painkillers. The pre-injury healthy active male was depressed and on antidepressive therapy. The completely loose iliosacral screws were removed 11 months after the second surgery. Removing of the screws did not improve his clinical state. The result of all previous healing efforts was a nonunion through left SI joint with destruction of lateral part of sacral bone. The width of the nonunion gap was 1.5 cm. An additional bone defect existed in the middle part of sacrum secondary to the loose iliosacral screws. The anterior pelvic segment was healed.

Autologous fibular strut grafting was performed 3 years after the injury. In the prone position the 8 cm long non-vascularised fibular graft was taken from middle part of the left fibula. The nonunion was opened through the posterior approach and all tissues including former bone grafts were removed. The sclerotic bone ends of nonunion were debrided. Through an additional incision on the lateral part of buttocks (utilizing the scar from the prior S1 screw placement) the lateral table of the iliac bone was accessed. The original canal of the S1 iliosacral screw was found using a K-wire. The guide K-wire was pushed by hand into the canal under the fluoroscopy control. The canal was enlarged using the 13 mm cannulated drill bit with the soft tissue protection sleeve from Distal Femoral Nailing System (DePuy Synthes, USA) under fluoroscopic guidance (Fig. 3). Two rows of 1.5 mm holes were created in the fibular graft. The inner end of the graft was skewed to allow smooth entry into the prepared canal. The graft was hammered over the guide wire through the protection sleeve into the canal (Fig. 4). The graft was fixed by one screw placed through it from posterior approach (Fig. 5). A allogenic corticocancellous bone graft was then used to fill the remaining defect through the posterior approach. The stability and compression forces of the posterior segment was supported by bi-iliacal dorsal pelvis plating (1).

The patient used a wheelchair for six weeks postoperatively. He then progressed to crutches for walking with gradual weigh bearing of the left lower limb. He was able to walk painlessly without crutches six months after the fibular grafting. He was able to sit and lie without pain as well. Six months postoperatively radiographs (Fig. 6) and computed tomography demonstrated union of the fracture site. His main complaint at this time was pain during movement, specifically forward bending. The dorsal plate was removed one year after the fibular grafting.

Patient's last follow-up was 5.5 years after the injury. He was using a custom-made thin brace due to the

peroneal nerve palsy and wore orthopaedic shoes because of 2 cm leg length discrepancy. His gait was painless and he ambulated without a limp. He had no lower leg pain or harvest site complications. He was no longer taking pain medications or antidepressive drugs.

## DISCUSSION

The proper management of the pelvic fracture can be affected initially by the general health status of the multiple injured trauma patient. The patient's hemodynamic instability and poor health status lead to initial use of minimal invasive technique for posterior pelvic fixation without an adequate reduction. The persisting displacement in fracture including SI joint was an important factor in the nonunion formation. Ebraheim et al. demonstrated that the contacts areas in SI joint are the lowest with superoposterior displacement, as seen in our case (2). After two failed attempts to heal the nonunion by allogenic cortico-cancellous grafting we considered more options, including corrective osteotomy of the left hemipelvis which would allow larger contact areas for nonunion healing. After consultation with foreign experts we decided to attempt to heal the nonunion first and to perform the corrective osteotomy afterwards. We were successful in healing the nonunion and no corrective osteotomy was needed because of the good clinical outcome. Mears and Velyvis published high patient satisfaction one year after pelvis nonunion surgical reconstruction (7). Many pelvic deformities can be well tolerated secondary to compensation by lumbosacral spine and the hips (7). The main complaint in nonunion cases is a pain, just as in our case (7). We resolved the pain by addressing the nonunion and patient was very satisfied with the outcome. The residual pelvic deformity did not bother him. The leg length discrepancy was compensated by orthopaedic shoes. We abandoned the intended osteotomy because of good outcome after healing the nonunion.

The problem was not only the displacement of the fracture's line involved the left SI joint, but lack of stability as well. Only one iliosacral screw into the S1 segment in combination with displacement was not be able to ensure optimal biomechanical conditions for fracture healing. The result of screw's loosening was a defect in the middle part of S1 segment and the purchase of subsequent screws into the same level was questionable. The result of all healing efforts prior to the fibular grafting was nonunion through left SI joint associated with the bone defect in the middle part of sacrum caused by iliosacral screws loosening.

The reconstruction procedure had to solve the large bone defect in posterior pelvic ring. The non-vascularised autologous fibula grafting is well-known technique for bone defects (4). The resection of the bone tumours is a common indication for nonvascularised fibula grafting in pelvic region (6). Ebraheim et al. described technique of usage of fibular graft through the SI joint replacing the iliosacral screw (3). We used the same principle of enlarging the well-positioned canal after the removal

of the iliosacral screw and pushing the graft over the guiding K-wire. We had to modified this technique because of large defect and high grade of instability in the SI joint. It was not possible to stabilize the nonunion by another iliosacral screw. Therefore, according to „three column“ theory published by Mears and Velyvis we stabilised the posterior pelvic ring by dorsal plate compressing both iliac bones to each other posteriorly (7). The disadvantage of this plate is typical pain localized posteriorly, which increases in forward body bending. Although we use the exact technique as Dolati et al. we have had to remove this plate in all our cases because of the forward bending pain (1). It is interesting that Dolati et al. removed the plate in only a few cases (1). This case confirmed our experience with dorsal plate related pain, because the pain vanished after the plate removal and the final clinical outcome was very good.

The nonvascularised autologous fibular grafting is an effective technique for SI joint nonunion treatment. According to our experience from this case we recommend this technique as suitable method for treatment of SI joint nonunion associated with iliosacral screws loosening. This technique can be performed percutaneously as well, with usage of instruments for long bones nailing. No other special equipment is necessary.

## References

1. Dolati B, Lamdorfer R, Krappinger D, Rosenberger RE. Stabilization of the posterior pelvic ring with a slide-insertion plate. *Oper Orthop Traumatol.* 2007;19:16–31.
2. Ebraheim NA, Madsen TD, Xu R, Mehalik J, Yeasting RA. Dynamic changes in the contact area of the sacroiliac joint. *Orthopedics.* 2003;26:711–714.
3. Ebraheim NA, Ramineni SK, Alla SR, Ebraheim M. Sacroiliac joint fusion with fibular bone graft in patients with failed percutaneous iliosacral screw fixation. *J Trauma.* 2010;69:1226–1229.
4. El-Sayed M, El-Hadidi M, El-Adl W. Free non-vascularised fibular graft for treatment of post-traumatic bone defects. *Acta Orthop Belg.* 2007;73:70–76.
5. Holcomb JB, Jenkins D, Rhee P et al. Damage control resuscitation: directly addressing the early coagulopathy of trauma. *J Trauma.* 2007;62:307–310.
6. Krieg AH, Lenze U, Gaston MS, Hefti F. The outcome of pelvic reconstruction with non-vascularised fibular grafts after resection of bone tumours. *J Bone Joint Surg Br.* 2010;92:1568–1573.
7. Mears DC, Velyvis J. Surgical reconstruction of late pelvic post-traumatic nonunion and malalignment. *J Bone Joint Surg Br.* 2003;85:21–30.
8. Osler T, Baker SP, Long W. A modification of the injury severity score that both improves accuracy and simplifies scoring. *J Trauma.* 1997;43:922–926.
9. Papakostidis C, Kanakaris NK, Kontakis G, Giannoudis PV. Pelvic ring disruptions: treatment modalities and analysis of outcomes. *Int Orthop.* 2009;33:329–338.

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