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Lumbosacral Fixation (Synthes)

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Highlights

In patients suffering from instability of the lumbosacral junction, internal fixation is often indicated. In the case of primary tumors, removal of the entire sacrum is suggested to maximize the potential for a cure. When patients present with metastatic disease, a surgeon's goals are to arrest neurological decline by reinforcing stability and to alleviate pain. The lumbosacral junction is a uniquely challenging surgical location in that it is both the most load-bearing section of the spine and the interface between the mobile spine and the fixed pelvis. These and other biomechanical considerations make the lumbosacral junction the most difficult region of the spine in which to obtain a solid fusion.[1,2]

In situations of minimal instability wherein short segments of the sacrum require fixation, simple use of sacral pedicle screws may be sufficient; however, more complex instrumentation schemes are necessary for the fixation of multiple levels. With these more complex cases, the integrity of pedicle screw purchase is frequently compromised by either biomechanical factors or invading neoplastic activity; therefore, it can be advantageous to bypass the sacrum altogether by using a technique of lumbar-ilium fixation that was first described by Allen and Ferguson, and has been come to be known as the Galveston technique of pelvic fixation.[3–6]

Indications and Relative Contraindications

Indications for lumbosacral fixation include:

- Total sacrectomy
- Severe lumbar-pelvic instability due to destruction of S1 from trauma, tumor, or infection (Fig. **147–1**)
- Long thoracolumbosacral fixation for scoliosis placing the patient at high risk of instability at the lumbosacral junction

Relative contraindications include:

- Severe osteoporosis
- Pelvic instability due to disruption of the pelvic ring
- Limited iliac crest bone stock due to previous autologous bone harvesting
- Resection of the sacroiliac joint

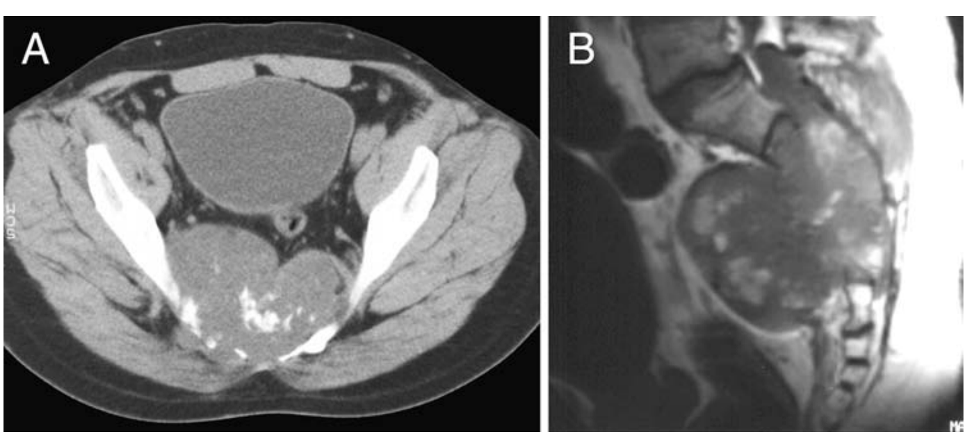

FIGURE 147–1 Preoperative axial computed tomography scan (left) and magnetic resonance image (right) revealing a sacral chordoma.

FIGURE 147–2 Synthes Click'X polyaxial screw.

Description of System Components

- 7-, 8-, and 9-mm-diameter iliac screws (7 to 10 cm long)
- T- or L-shaped connectors
- Polyaxial pedicle screws (Click'X system from Synthes; Paoli, PA) (Fig. **147–2**)

Operative Techniques

Preparation and Positioning

Patients undergo endotracheal intubation, and upon successful commencement of anesthesia are positioned

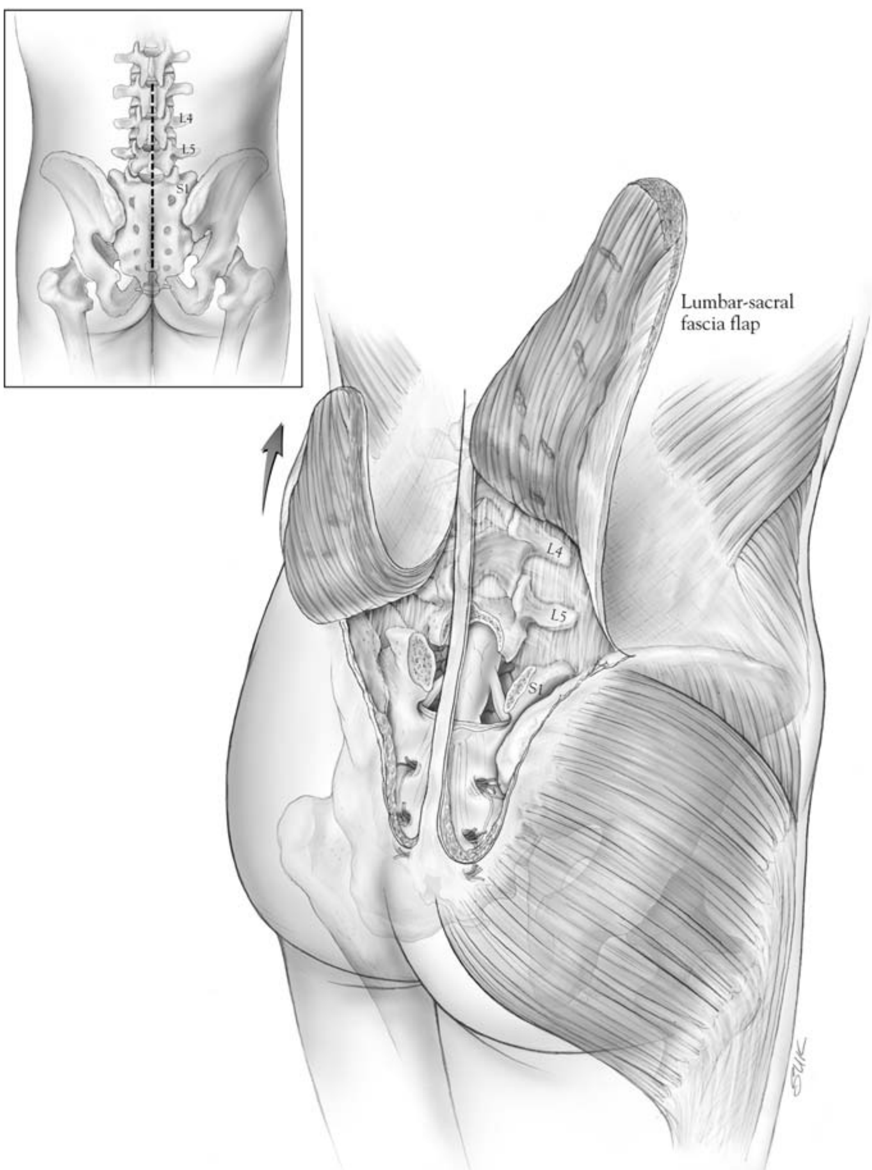

FIGURE 147–3 The posterior exposure of the sacrum, medial ilium, and lumbar spine. The lumbosacral fascia/muscular flap is lifted off of the sacrum and retracted cephalad and laterally.

prone on gel bolsters with padding applied to ensure that all pressure points are adequately protected.

Exposure

A midline incision exposes the dorsolumbar spine and sacrum, with bilateral lumbosacral flaps resected laterally and cephalad so as to provide wide lateral exposure without risk of retraction-related complications (Fig. **147–3**).

Treatment of Tumors

In cases of primary tumors, an anterior approach is performed so as to mobilize the vessels of the pelvis and to stabilize the anterior portion of the spine.[7] Anterior mobilization is achieved through an L5–S1 anterior diskectomy and partial ventral sacroiliac osteotomies. The second stage, posterior tumor resection and lumbosacral stabilization, is performed several days after this first stage is completed.

In the case of metastatic disease, tumors were removed in accordance with standard neurosurgical techniques. Upon complete resection and neural element decompression, the surgeon can focus on spinal stabilization.

Modified Galveston Technique

We have achieved lumbosacral stabilization through pelvic fixation using a modification of the Galveston technique.[3–6] These modifications include the use of pedicle screw fixation instead of sublaminar wiring, providing more security, a shorter fixation length, and increased rigidity. The use of pedicle screws also accommodated patients in whom tumor resection necessitated laminectomies, and the use of rigid crosslinks between the rods augmented torsional stability.

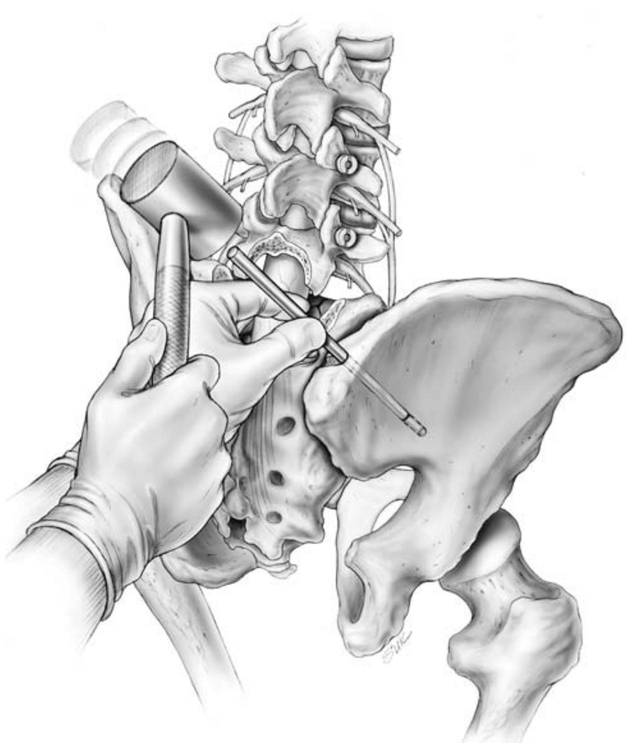

FIGURE 147–4 A 6-mm pilot rod tapped into the cancellous portion of the ilium to create a path for the contoured rod.

Stabilization Technique

Using intraoperative radiography to confirm positioning, lumbar pedicle screws are inserted using standard techniques. Then a high-speed burr drill is used to make a 6-mm hole into the cortex of the medial posterior iliac crest at the S2–S3 level. The purpose of the hole is to allow the surgeon to tap a 6-mm pilot rod into the ilium to create a path for the contoured rod (Fig. **147–4**). The pilot rod is directed 1.5 cm above the sciatic notch and between the two cortices of the ilium. Once the correct trajectory is achieved, the pilot is tapped in with a mallet to a depth of 6 to 9 cm. The pilot rod is then removed, and a malleable template rod is inserted so as to mimic the contours of the anatomy. Upon removal, the malleable rod serves as the model for the contouring of a 6-mm titanium rod, which is subsequently bent using tube benders and a vise (Fig. **147–5**). The correctly contoured rod is then inserted and attached to the previously placed lumbar pedicle screws. Finally, crosslinks are placed between the rods[8] (Figs. **147–6** and **147–7**).

Use of Iliac Screws and Rod for Pelvic Fixation

Pilot holes are drilled in the posterior iliac crest similar to that described in the Galveston technique. The iliac crest is then cannulated using a pedicle finder directed above the sciatic notch and hip joint. An 8- to 10-cm-long, 8- to 9-mm-diameter iliac screw is subsequently inserted. The screw head is fully burred below the iliac crest to avoid any skin irritation. An appropriate 6-mm titanium rod is then cut to the appropriate length and is attached to the screws with top-loading nut/collar complex. T-shaped connectors are loaded onto the transverse rod prior to fixation. Pedicle screws in the lumbar spine are then connected to a contoured rod and are attached to the T-connector with top-loading screws. The bone graft is then applied in the usual fashion.

Additional Instrumentation for Complete Sacrectomy

Patients suffering from malignant neoplasms involving S1 and S2 are candidates for en bloc resection of the sacrum. To reconstruct the pelvic ring, a threaded rod is placed through the lateral to medium ilium, through an

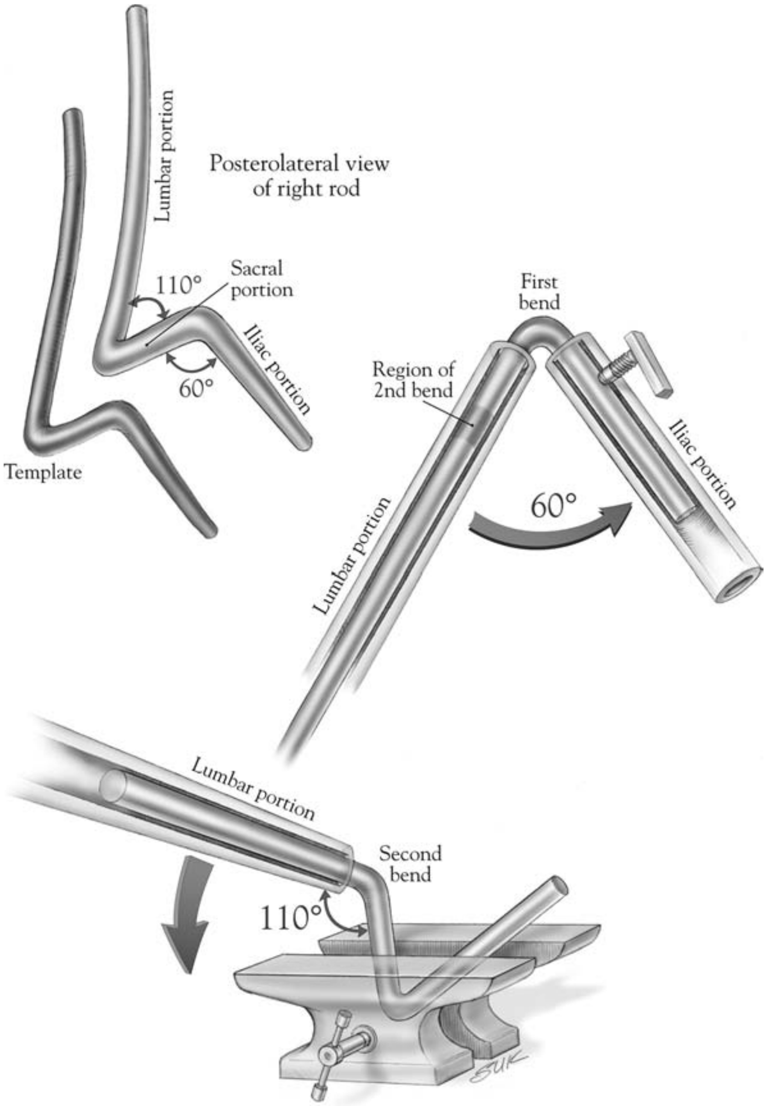

FIGURE 147–5 Bending of the rod with a vise. **(A)** The final shape of the spinal-pelvic rod matches the template rod. **(B)** The tube benders are used to create the sacroiliac bend of ~60 degrees. **(C)** The table vise is used to stabilize the sacral and iliac segments of the rod, and an ~110 degree bend is created between the lumbar and sacral segments.

allograft (femoral or tibial), and then to the opposite medial to lateral ilium. Locking collars ensure that the rod will not migrate. So as to allow for arthrodesis, autograft, allograft, and demineralized bone matrix are used upon decorticated bone segments. When needed, closed suction drainage catheters are placed. Due to significant soft tissue resection-related deficits, a rotational flap closure may be optimal.[8]

Postoperative Care

Immediately following the procedure, patients are transferred to the surgical intensive care unit; they are transferred to the neurosurgical ward the following day. Rehabilitation should be provided on an inpatient basis as needed, stemming from the benefits of early mobilization (in those patients not undergoing complete sacrectomy).[8]

Procedural Complications

- Flat back syndrome: To ensure satisfactory preservation of lumbar lordosis, the patient should be positioned on the Jackson table. Proper contouring of the lumbar rod is critical to re-create lordosis. After removal of the sacrum, lumbar screws should be placed under compression to restore lumbar lordosis.
- Rod fracture: This is a relatively common problem given a high degree of malunion in this region, particularly in total sacrectomy cases. Replacement of the rod may be necessary and is usually satisfactory to offer pain relief.

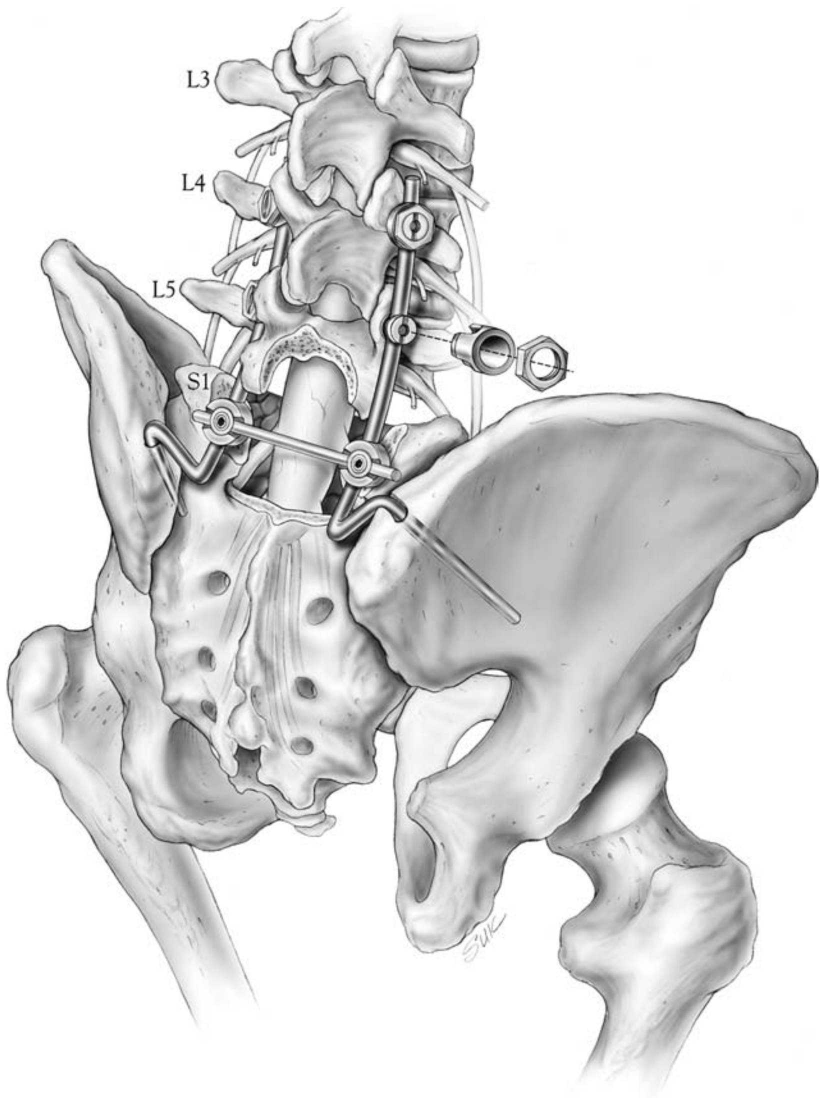

FIGURE 147–6 The spinal-pelvic fixation.

- Wound complications: Care for preservation of the blood supply to the paraspinal muscles is critical to avoid wound complications. If necessary, plastic surgical closure should be arranged in advance.[8]

Discussion

Due to various anatomical and biomechanical considerations, primary and metastatic neoplasms of the lumbosacral junction pose a complex problem for surgical management. Whether the goal is to resect the entire sacrum (as in primary tumors) or to provide palliation (as in metastatic tumors), spinal-pelvic stabilization is often required to ensure appropriate stabilization of the lumbar-pelvic region. The literature reports evidence that the use of sacral pedicle screws in conjunction with rods projecting into the ilium provides the most rigid construct, maximizing pullout resistance while increasing torsional stability.[2,9–11]

The largest series of patients with spinal-pelvic fixation was performed by our group and exhibits a 31% solid bone fusion rate, with partial fusion in 23% of patients. Considering the existence of neoplastic disease and radiotherapeutic stresses, these fusion numbers are more than satisfactory. Surgical treatment of neoplasms to the lumbosacral junction will ultimately be effective in relieving pain, restoring ambulatory capacity, and restoring or protecting neurological status.

Drawbacks to this technique of internal fixation are centered around the difficulty of contouring the rod in three dimensions, a procedure that is described by Allen and Ferguson.[3] We recommend that surgeons practice the rod contouring procedure in a cadaveric spine prior to use in the operating room.

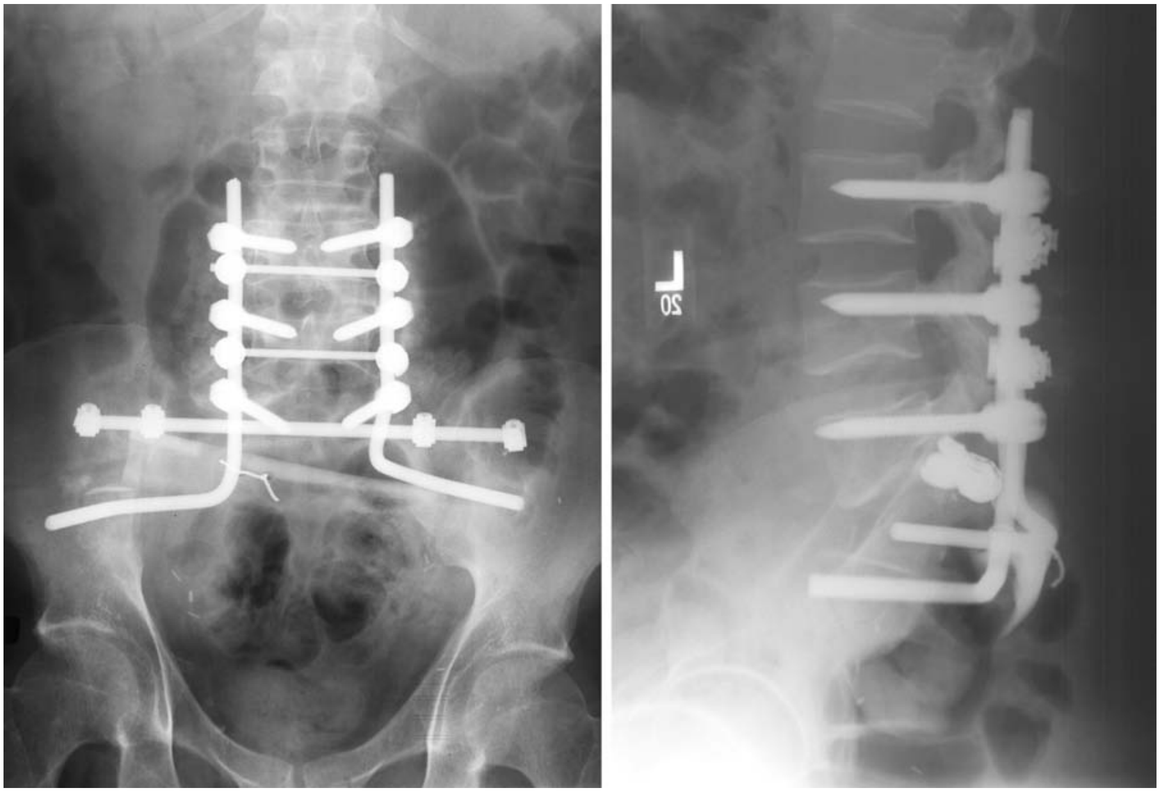

FIGURE 147–7 Postoperative x-ray of the construct.

Use of iliac screws simplifies the procedure considerably. Fusion rates are much higher in patients with scoliosis and degenerative disk disease. New advances in fusion promoters (e.g., bone morphogenic protein) are likely to improve fusion rates in this biomechanically challenging region.

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