TECHNICAL NOTE

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Lumbo-iliac Fixation Using Modified Galveston Technique in a Patient with Metastatic Sacral Tumor

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Lumbo-sacral junction is a transition zone between the mobile lumbar spine and immobile pelvis. Lumbosacral junction has been considered to be the most troublesome portion of the spine to be fused because of the difference in anatomical and biomechanical factors between spine and pelvis. A metastatic sacral tumor in a 57-year-old man was resected, followed by unilateral lumbo-iliac fixation across lumbosacral junction using modified Galveston technique. Rigid fixation was successfully achieved. Detailed anatomy and surgical techniques are presented.

KEY WORDS : Galveston technique · Arthrodesis · Lumbo-sacral junction.

Introduction

The goal of treatment for metastatic sacral tumor is palliative management including restoration and preservation of neurological function, prevention of neurological decline, and alleviation of pain[9,10]. Surgical resection is often required to achieve this goal[9,10]. After surgical resection, lumbo-iliac stability is often disrupted, thereby internal fixation is needed[10]. However the lumbo-sacral junction(LSJ) has been considered to be the most difficult portion for spinal fusion due to anatomical factors including inclination of sacral angle and limited contact portion for screw, and biomechanical factors including large load bearing and high mobility of the LSJ[10]. Furthermore, part of the sacrum is lost while resecting sacral tumor, consequently, restricting the anatomical space for screw placement. We hereby present a case of unilateral lumbo-iliac fixation using modified Galveston technique after removal of metastatic sacral tumor.

Case Presentation

A 57-year-old man presented with severe pain and numbness in his left leg. Fair grade motor weakness was noted in his left ankle dorsiflexion. Past medical history revealed that he had underwent lower anterior resection of his rectum for rectal cancer 5 years ago, and pathological examination demonstrated squamous cell carcinoma. He made full recovery without any medical problems and maintained healthy living until he developed pain and numbness in his left lower leg. Preo-

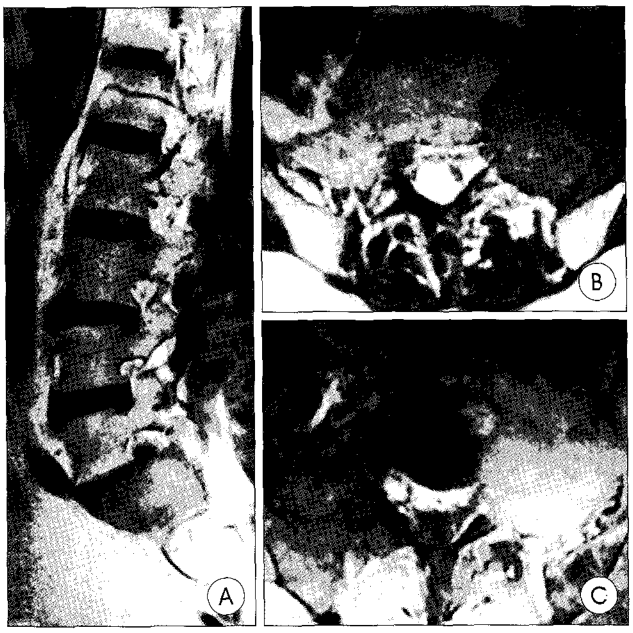

Fig. 1. Preoperative magnetic resonance image shows tumor mass infiltrating left sacral body and compressing dural sac and nerve root. A : T2 sagittal image, B : T2 axial image, C : T1 enhanced image.

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perative magnetic resonance imaging revealed a vertebral tumor infiltrating his left upper sacrum, sacral ala and sacral spinal canal (Fig. 1). Considering severe pain and weakness of left ankle, surgical resection was planned. Because the sacral lamina, left upper portion of the sacrum, and two thirds of left sacral ala had to be removed, disruption of unilateral lumbo-iliac stability was expected. Because right sacro-iliac joint was grossly intact, modified Galveston technique was considered only in his left side to provide stability of LSJ.

Operative Techniques

Following induction of general anesthesia, the patient was positioned prone on operating table with generous padding at all pressure points. Posterior midline incision was extended from L4 to S1 to expose the whole extent of the posterior spine. Laminectomy of L5 and S1 was performed. Tumor mass was found to be compressing the dural sac and the right S1 nerve root. The consistency of tumor was soft and brittle. The tumor mass was removed in a piecemeal fashion, deep into the S1 vertebral body with meticulous hemostasis, and the dural sac and the nerve root were completely decompressed. The stabilization procedures were followed. At first step, 5 pedicle screws (Diapason, Stryker Spine, NJ, USA) were placed bilaterally in the L4-5, and unilaterally in the right S1 pedicle. Then, the right ilium was exposed subperiosteally from the posterior superior iliac spine(PSIS) to sciatic notch using blunt probe and finger dissection with special care not to injure internal iliac and superior gluteal artery. The corner of PSIS was removed (Fig. 2①), and a blunt probe was inserted to confirm that the cortical tables of ilium had not been penetrated (Fig. 2②). A finger was placed on the outer table and directed to the sciatic notch. This finger could provide the guide to expect the angle and depth of screw placement (Fig. 2④). The angle of screw was directed 1.5cm[14] above the sciatic notch (Fig. 2③). The depth for the iliac part of the rod was approximately 7cm in our patient. The lumbar, sacral, and iliac portions of the rod, and the transverse plane angle between the sacral and the iliac segments of the rod were bent and fitted according to preoperative measurement on roentgenograms and computerized tomography(CT) scans. Preoperative CT scans were especially helpful in assessing the width of the ilium and determining whether intrailiac rod placement could be obtained. The rod was preoperatively bent and contoured using tube benders and a table vice, and it was again adjusted intraoperatively. The first bend was made between the spinal and sacral segments at 90 degrees (Fig. 3①). The second bend was made anteriorly between the sacral and iliac segments at 45 degrees (Fig. 3②). The third bend was laterally made between the sacral and iliac segments at 45 degrees (Fig. 3③). The flat bending irons were then used to contour the desired lumbar lordosis for the spinal segment of the rod (Fig. 3④). Additional contouring of the rod was achieved with in situ bending. The iliac segment was then inserted into the ilium with the spinal segment directed away from the back. The rod was then rotated down toward the spine into its normal sagittal alignment. The iliac rod segment was impacted and deeply seated within the ilium. Intraoperative fluoroscopy was used to confirm correct positioning. Then the screws and rods were locked and cross-

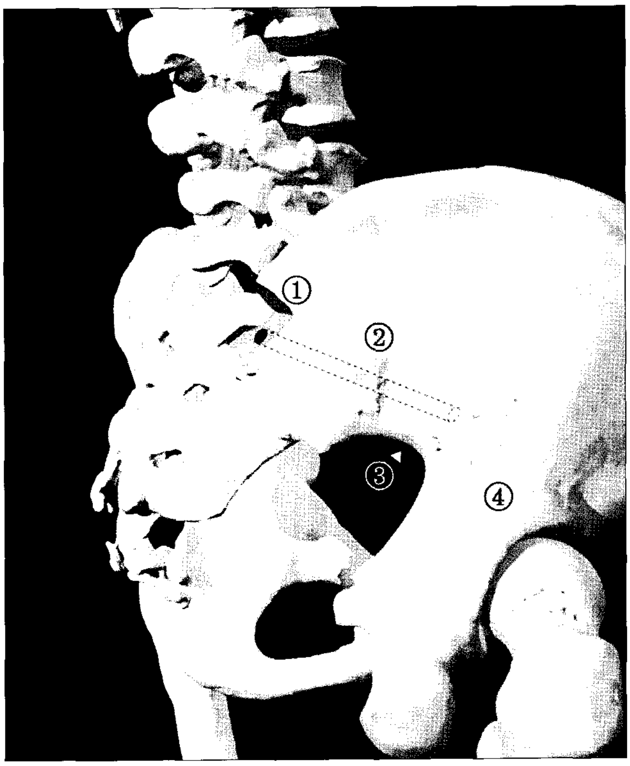

Fig. 2. Illustrative view of surgical anatomy. ① Decortications of the corner of posterior superior iliac spine for rod insertion. ② Imaginary pathway of intra-iliac rod. ③ Sciatic notch. Special caution is needed not to injure superior gluteal artery at this area. ④ Supraacetabular bone.

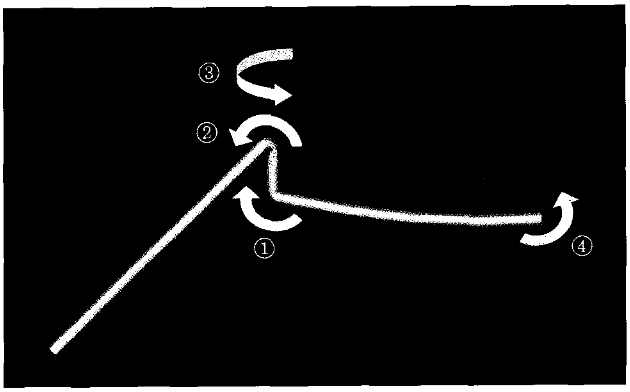

Fig. 3. Rod contouring. ① Bending superiorly between the spinal and sacral segments in 90 degrees. ② Bending anteriorly between the sacral and iliac segments in 45 degrees. ③ Bending laterally between the sacral and iliac segments in 45 degrees. ④ Bending for lumbar lordosis.

linked. Intraoperatively, the patient's right sacro-iliac joint was grossly intact, and the right sacral body was confirmed to be strong enough to maintain screw, therefore, modified Galveston technique was performed only in the left side. A combination autograft and allograft bone was placed over decorticated bone to promote arthrodesis. Meticulous hemostasis was made, and closed suction drainage catheter was placed. Skin was closed layer by layer. The patient recovered without any complications. His leg pain immediately disappeared, and motor weakness gradually improved to good grade after one month of follow-up. Pathological examination revealed squamous cell carcinoma, clinically assumed to metastasize from his bowel. Radiation therapy was executed for 3 weeks. The stability was still maintained even after radiation therapy (Fig. 4).

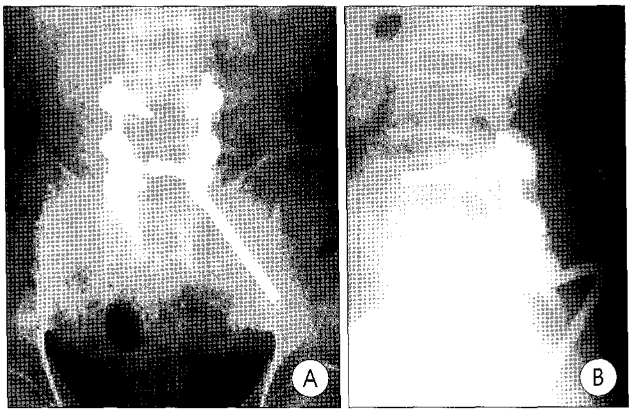

Fig. 4. Postoperative 6 months roentgenograms show that rigid fixation is well maintained.

Discussion

Tumors of the sacrum are rare, accounting for 1 to 7% of all spinal tumors[6]. The most common malignancy of the sacrum is metastatic disease. Radiotherapy is accepted as the first-line choice for most patients with metastatic spinal tumor. However, surgical resection is strongly encouraged when the tumor proves to be radioresistent or neurological condition is rapidly deteriorated[12]. En bloc tumor resection is considered to be the most effective method of achieving long-term disease control or cure[8]. But en bloc resection often leads to stability problem. Furtermore, LSJ is a transition zone between the mobile lumbar spine and a relatively fixed pelvis[10]. All the longitudinal forces delivered to the lumbar spine are ultimately transmitted to LSJ. Again, transverse forces are transmitted to pelvis through LSJ. Anatomically angular inclination of the sacrum which produces unique load bearing characteristics make the fixation procedures difficult[10]. Therefore, the most important factor in providing the successful outcome in the management of metatastatic scral tumor is how to establish stability in the LSJ. Otherwise, massive or complete resection cannot be considered due to risk of collapse in LSJ.

Various methods have been performed to provide stability in the spinopelvic joint, including sublaminar devices[11,15], sacral screw fixation[5], or iliac rod or iliac screw fixation[1-4,16]. However, sublaminar devices such as hooks, wires, or cables are not recommended, for these do not have torsional stability and extensional resistance[15]. Furthermore, sacral laminae are thin and often removed during tumor resection[15]. On the other hand, sacral screw fixation which is most commonly used in LSJ, can be used only in cases in which the fixation length is short and the sacrum is grossly intact. However, if the sacral pedicles, body, or sacral ala are destroyed by the tumor, this method is not appropriate for stabilizing lumbo-sacral joint[9,10,17]. Therefore, alternative technique to fix LSJ, bypassing the sacrum, is required when sacral tumor is so extensive that it destroyed the sacrum, or surgical resection may include the most sacrum so that sacrum cannot provide any structural base for the fixation. Authors' case has extensive destruction in unilateral sacrum due to invasion of metastatic tumor. After resection, most of sacroiliac joint was destroyed enough to lose the function of joint, and fixation of LSJ bypassing the sacrum was absolutely required.

Allen and Ferguson originally described performing a lumbar-ilium L-rod pelvic fixation to treat scoliosis, pelvic obliquity, and degenerative processes of the LSJ, which became known as the Galveston technique of pelvic fixation[1-4]. As the development of spinal screws, lumbar sublaminar wiring was replaced by pedicle screw and referred to Modified Galveston technique. Rod and screw attachment to the ilium proved to be strong enough to withstand the repeated load[13] for the rod is inserted into the strong supraacetabular bone and triangular configuration of pelvic fixation can resist the flexion-extension and rotational forces[14,17]. However, this technique is technically difficult. First, fine adjustment of rod contouring is absolutely essential to facilitate the connection of rod and screws. Secondly, operative field is narrow and deep so that manipulation of the instruments is limited[10]. We used roentgenograms and CT scans to figure out the contouring of the rod. Subsequently, contouring of major flexures of the rods was made in biomedical engineering department using torch and a table vice preoperatively, for it requires complex three-dimensional contouring of rods, and it cannot be easily achieved intraoperatively using a conventional rod bender. We believe individualized tailoring of the rode has more advantages over preformed rod for every patients has anatomical differences.

Conclusion

Lumbosacral neoplasm often leads instability of LSJ. Authors resected sacral metastatic tumor, and destroyed LSJ was successfully reconstructed by modified Galveston spinal-pelvic fixation. Six months of follow-up proved modified Galveston spinal-pelvic fixation is an effective means of stabilization techniques with significant pain relief and no neurological deterioration.

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