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Creation of false pedicles and a neo-pelvis for lumbopelvic reconstruction following en bloc resection of an iliosacral chondrosarcoma with lumbar spine extension

Technical note

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En bloc resection with negative tumor margins remains the principal treatment option for control or cure of primary pelvic chondrosarcomas, as current adjuvant therapies remain ineffective. Iliosacral chondrosarcomas with involvement of the sciatic notch are sufficiently challenging tumors. However, when there is concomitant lumbar extension requiring resection of the pedicles to maintain negative surgical margins, transpedicular screw fixation is not possible, making reconstruction of the lumbopelvic junction extremely challenging. A patient with an iliosacral chondrosarcoma with lumbar spine extension is presented in this report to illustrate a novel lumbopelvic spinal construct. Following combined external pelvectomy and hemisacrectomy with contralateral L3–5 hemilaminectomy and ipsilateral pediculotomy, bicortical transvertebral body screws were substituted for the missing pedicles, resulting in the creation of "false pedicles," which were further supplemented with an autologous vascularized fibular strut graft from the amputated lower limb and applied to the lateral aspect of the vertebral bodies. The creation of false pedicles allowed for a robust reconstruction of the lumbopelvic junction, including maintaining pelvic ring integrity with a "neo-pelvis", creating a functional load-bearing construct adequate for early mobilization and ambulation. The biomechanical dynamics of this unique construct are also discussed.
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Key Words • **chondrosarcoma** • **lumbopelvic reconstruction** • **pelvectomy** • **en bloc resection** • **vascular bone graft** • **oncology**

Presently, en bloc resection of chondrosarcomas remains the mainstay of treatment, as current adjuvant therapies remain ineffective.[1,3,5,10,11] Primary malignant sarcomas involving the lumbar spine, sacrum, and pelvis are rare but challenging tumors usually requiring complex surgical solutions. Local invasiveness, close proximity to abdominopelvic viscera, nerves, and blood vessels of the lumbosacral region, and the need for en bloc resection to prevent local recurrences, as well as the biomechanical demands for a successful lumbopelvic reconstruction, render successful surgical treatment a problematic and challenging compromise. Extension of the tumor to the posterior elements of the lumbar spine poses an additional problem because the resection of lumbar pedicles necessary to preserve the en bloc principles compromises the strength and stability of the spinal construct that must bear the combined forces transmitted through the reconstructed "neo-pelvis" during weight bearing and ambulation.

In this report, we present an evolution of a previously described technique[12] to address the problem of reintegrating the reconstructed neo-pelvis with the surgically destabilized lumbar spine as a functional load-bearing construct and unit when en bloc resection of the lumbopelvic tumor compromises the pedicles necessary for successful bone fixation.

Illustrative Case

Presentation and Examination. A 30-year-old postpartum woman was referred to us for evaluation of persistent low-back and hip pain. Lumbar paraspinous and right hip/buttock pain was progressive, with numbness radiating to the posterior right thigh and sole of the right foot. Clinical examination confirmed a palpable bone mass beneath the right paralumbar and gluteal musculature. Her neurological examination was normal, but her gait was marked by a subtle right lower extremity limp.

Pelvic radiographs and CT revealed a large lytic lesion with reactive bone formation centered within the right sacral ala (Fig. 1). Magnetic resonance imaging confirmed the presence of an extensive lytic bone lesion arising within the right sacral ala, eroding the sacroiliac joint and adjacent bone, with extension into the pelvis and the adjacent soft tissues overlying the dorsal sacrum and lumbar spine from L-3 to the sciatic notch inferiorly (Fig. 2). The tumor also extended through the anterior neural foramina on the right side from S-2 inferiorly, but the spinal canal and foramina above that level were not involved. Computed tomography–guided needle biopsy confirmed a low-grade chondrosarcoma according to the histopathological results. Additional imaging studies for staging revealed no evidence of metastatic disease. Considering the natural history of chondrosarcoma, the absence of metastatic lesions, and the ineffectiveness of adjuvant chemotherapy or radiation therapy, an oncological en bloc resection was proposed as the optimal treatment for maximal disease-free survival. Following informed consent, the patient agreed to proceed with en bloc resection and reconstruction for her iliosacral chondrosarcoma with lumbar spine extension.

Surgical Planning. A skilled multidisciplinary team, including spine oncological surgeons (neurosurgery and orthopedic), plastic surgeons, surgical oncologists, and anesthesiologists, was assembled to plan and perform this staged procedure. Although extensive, the tumor was believed to be amenable to en bloc resection after close review of detailed diagnostic images. However, en bloc resection would require L3–S1 hemilaminectomy, unilateral ligation of L3–S1 nerve roots, division of the right L3–S1 pedicles, unilateral plexectomy, and external hemipelvectomy and hemisacrectomy, with sacrifice of the ipsilateral leg. Those procedures would be followed by reconstruction of the lumbar spine, spinopelvic junction, restoration of pelvic ring integrity, and repair of the large soft tissue defect. Postoperative immobilization and support with a custom spinopelvic orthosis extending to the left thigh would be followed, once postoperative swelling subsided, by intensive rehabilitation and fitting of a custom computer-interactive prosthesis to allow full weight-bearing assisted ambulation.

To facilitate the complexity of this bone reconstruction and its biomechanical demands, a preoperative sawbone model (Pacific Research Laboratories, Inc.) was constructed, demonstrating the bone defects following the reconstructed spine and lumbopelvic junction, and the restored neo-pelvic ring with vascularized bone grafts and complex spinal instrumentation. The extent of the required bone and soft-tissue dissection with the anticipation of massive blood loss and replacement required close monitoring and coordination between the anesthesiology team and the blood-bank pathologists. Preoperatively, a prophylactic inferior vena cava filter was placed, and complete bowel preparation was performed in anticipation of the required colostomy. The planned surgical procedures, aided by neurophysiological monitoring, computer-assisted image guidance, and intraoperative fluoroscopy, proceeded in 3 stages: prone (posterior approach), supine (anterior approach), and "floppy" lateral (combined anterior and posterior approach), respectively.

Stage 1: Posterior Approach. A posterior midline incision was made from the thoracolumbar junction to the tip of the coccyx. The left posterior elements of the lumbar spine and sacrum were exposed by subperiosteal and paraspinal dissection, while superiorly, above the tumor mass, the spine was exposed bilaterally. An infrared localizer was placed at L-1 and spinal registration performed for subsequent computer-assisted image guidance. Utilizing intraoperative fluoroscopy and image guidance, pedicle screws were placed at right L-2 and left L-2 through left S-1. Two iliac screws were placed on the left iliac bone. Left hemilaminectomies were performed from L-3 through to S-1, exposing the spinal canal and its contents while preserving the spinous process and right lamina at each level. A left-sided double rod construct was then used, with the medial rod connecting L-2 to S-1, while a second rod was contoured for lateral placement from L-2 to the superiorly placed left iliac screw.

Then working obliquely in the spinal canal from left

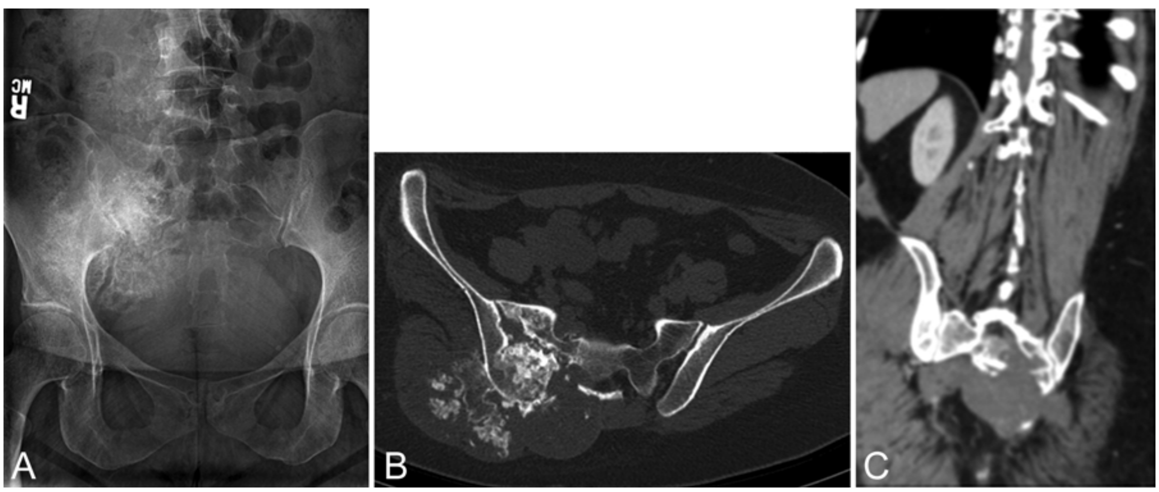

Fig. 1. Pelvic radiograph **(A)** and CT scans **(B and C)** reveal reactive bone formation centered in the region of the right sacral ala. Axial (B) and coronal (C) views revealed a partially calcified soft tissue mass with areas of lysis and reactive bone formation involving the right sacroiliac joint.

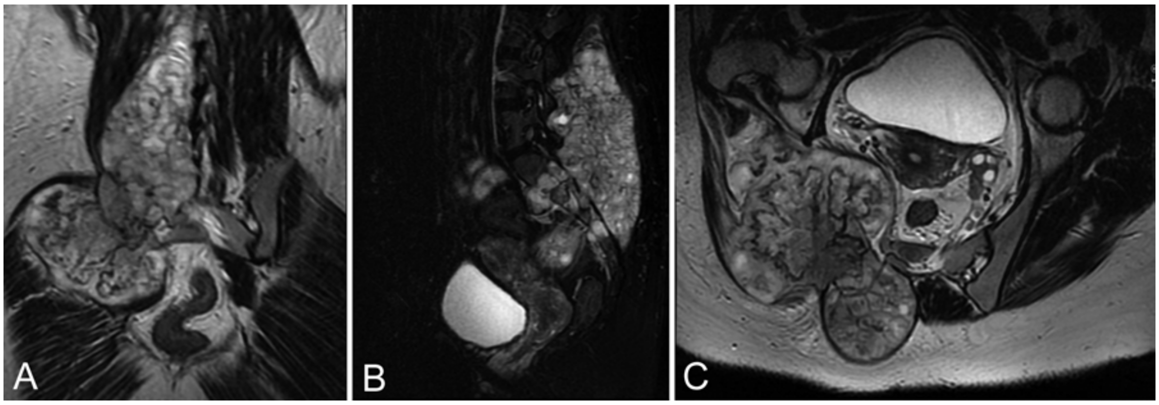

Fig. 2. Coronal **(A)**, sagittal **(B)**, and axial **(C)** T2-weighted MR imaging of the lumbosacral spine and pelvis reveals a mixed-intensity mass centered on the right sacral ala with unilateral extension superiorly to the lumbar spine. The mass involves the sacroiliac joint and extends through the sciatic notch.

toward right, the dura and it contents were gently retracted to expose the contralateral spinal nerves on the right from L-3 caudally. Each nerve root was isolated, double ligated, and transected sequentially from L-3 to S-2. The thecal sac was then ligated and transected below the exit of the S-2 roots and then gently rotated medially, and the right pedicles transected with curved osteotomes sequentially from L-3 through S-1 (Fig. 3). This was followed by an incomplete posterior midline hemisacral osteotomy from S-1 to the coccyx. This posterior bone release required extensive dissection of the epidural venous plexus, resulting in continuous blood loss throughout the prolonged dissection despite meticulous use of bipolar cautery and hemostatic agents. With the support of anesthesiology and multiple transfusions, the patient remained hemodynamically stable with acceptable coagulation parameters, despite a blood loss of 35 liters. At this point, the incisions were closed, and the next surgical stages were postponed until the following day, allowing an additional 12 hours for physiological resuscitation and observation. During this time the patient remained intubated under mechanical controlled ventilation in the surgical intensive care unit. A postoperative CT scan of the lumbar spine and pelvis was performed to determine screw placement and for assisting image guidance during Stage 2.

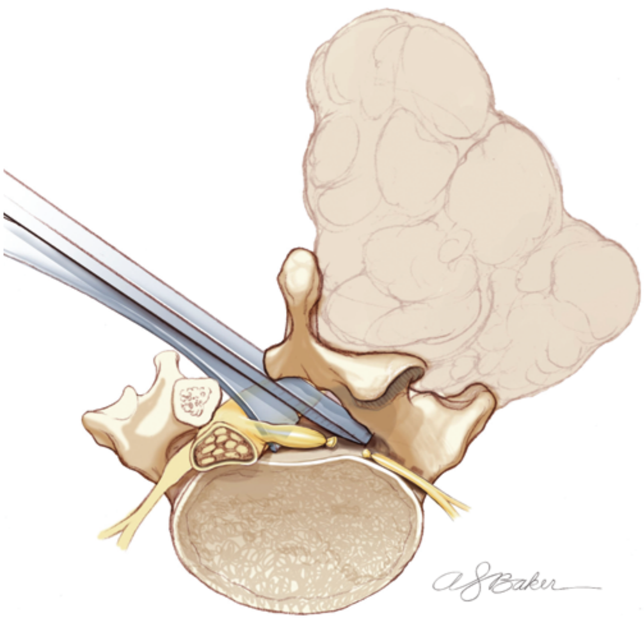

Fig. 3. Schematic showing the oblique approach across the midline (left to right) for nerve root ligation (L3–S1), medial retraction of the thecal sac, and a pediculotomy from L-3 to S-1. © Ohio State University. Published with permission.

Stage 2: Anterior Approach. Multiple surgical teams performed simultaneous surgeries during this second stage to further dissect and mobilize the tumor anteriorly and create the combined soft-tissue flaps and vascularized bone grafts needed for complete reconstruction of the surgical defect. Although described sequentially, these surgeries proceeded simultaneously to minimize the operative and anesthetic time as well as blood loss.

The surgical oncology team performed an upper midline laparotomy to identify and isolate the transverse colon, which was then transected and brought through a defect in the left upper abdominal wall, then tacked in place and covered with moist lap pads prior to closure of the midline incision. The end colostomy would be matured during the final portions of the following third stage.

Simultaneously, two plastic surgery teams initiated dissection of the large musculocutaneous anteromedial and lateral thigh flap based upon the superficial femoral artery, combined with creation of vascularized fibular and femoral bone grafts based on the popliteal and profounda femoris vessels, respectively. This large composite flap encompassed almost the entire thigh. The fibular flap was raised by skeletonizing the soft tissues while preserving the peroneal vascular pedicle proximally and included the popliteal artery and vein. Similarly, after identification of the profounda femoris vessels, the adjacent femur was isolated, skeletonized, and transected, preserving its vascular pedicle. Ultimately, two independent vascularized bone grafts were produced, joined only by a long vascular pedicle that extended from the bifurcation of the femoral vessels.

Stage 3: Lateral Approach. Following completion of Stage 2, the patient was then repositioned in a "floppy" left lateral decubitus posture, allowing simultaneous approaches to the pelvis, spine, and tumor bed from both anterior and posterior aspects. Orthopedic oncological surgeons initiated an ilioinguinal dissection through the pelvis combined with reopening and extension of the first stage posterior approach to further dissect the significant posterior iliac mass extending through the sciatic notch. From the anterior approach, with assistance of the surgical oncology team, the abdominal musculature was dissected free of the ilium down through the right groin. The external iliac vessels were identified and mobilized proximally to the bifurcation of the common iliac artery and vein into its internal and external branches. The right internal iliac artery and vein were then ligated distally, and transected. The peritoneum and viscera were then gently swept medially and padded for protection, while further retroperitoneal dissection exposed the sacrum and coccyx, carrying the approach toward the obturator ring and to the acetabulum. The lumbosacral junction was then palpated to identify the L5–S1 disc anteriorly. The pubic symphysis was disarticulated to mobilize the inferior portions of the tumor. Simultaneously, posterior dissection through soft tissue and musculature, while preserving a wide margin adjacent to the tumor, combined with the previous spinal osteotomies, resulted in mobilization of the superior and lateral aspects of the tumor.

The posterior spinal incision was reopened and the neurosurgery team registered the spine for computer-assisted image guidance. The previous posterior partial midline sacral osteotomy initiated during Stage 1 was re-identified, and using image guidance, was completed anteriorly through the midline sacrum with extension through the right half of the L5–S1 disc space. The retroperitoneal dissection was carried superiorly and laterally along the previously osteotomized right pedicles of L-3 to S-1, lysing the remaining soft tissue attachments and freeing the superior pole of the tumor mass. Inferiorly, once the remaining attachments to the rectum were dissected, it allowed delivery of the tumor and marginal tissue (including the right hemisacrum, coccyx, iliac wing, and acetabulum with proximal femur) as an en bloc specimen.

Reconstruction of the lumbopelvic junction was then initiated. With the aid of fluoroscopy and image guidance, bicortical screws were placed transversely through the vertebral bodies of L-3, L-4, and L-5, and linked with a lateral rod. A secondary screw was placed through the transected right L-3 pedicle, and a long bent rod placed to span the right L-2 and L-3 pedicle screws and then curve across the midline to engage the inferiorly placed left iliac screw. The previously placed left double-rod construct, transferring axial stress inferiorly to the superiorly located iliac screw and ilium, was similarly linked with cross-connectors. The two double-rod constructs were then linked with additional cross-connectors. The vascularized fibular strut was then rotated into position just anterior to the right double-rod construct and secured in direct contact with the right lateral aspect of the L-3, L-4, and L-5 vertebral bodies, completing the modification of our previously described technique.[13] The integrity of the residual pelvis was then restored when the trimmed vascularized femur graft was dovetailed into the L5–S1 interspace adjacent to the prepared bone surfaces of the inferior right half L-5 endplate and hemitransected S-1 body. This junction was stabilized with a cancellous lag screw extending through the graft into the L-5 body, and the distal end of the femur was secured to the ischiopubic remnants with cortical screws, anticipating that solid fusion would rapidly occur at both sites. This transverse screw “false pedicle” and graft spinopelvic reinforcement stabilized the junction of the reconstructed neo-pelvis to the vertebral elements of the lumbar spine in the absence of the resected right-side pedicles. The technique is schematically summarized in Fig. 4.

The resection bed and cavity were copiously irrigated with bacitracin saline and pulsatile lavage prior to decortication of the exposed cortical bone over the preserved hemisacrum and residual posterior spinal elements. Then, a mixture of autologous (ground calcaneus) and allograft bone chips (Musculoskeletal Transplant Foundation) supplemented with β-tricalcium phosphate (Vitoss, Orthovita) was used as an onlay graft to create arthrodesis. Multiple deep and superficial drains into both anterior and posterior operative sites were inserted. The large anteriorly based musculocutaneous flap previously harvested was then rotated to fill the large soft-tissue void within the resection bed, which was then closed in multiple layers (Fig. 5). The end colostomy was then matured.

Postoperative Course. Following a total of more than

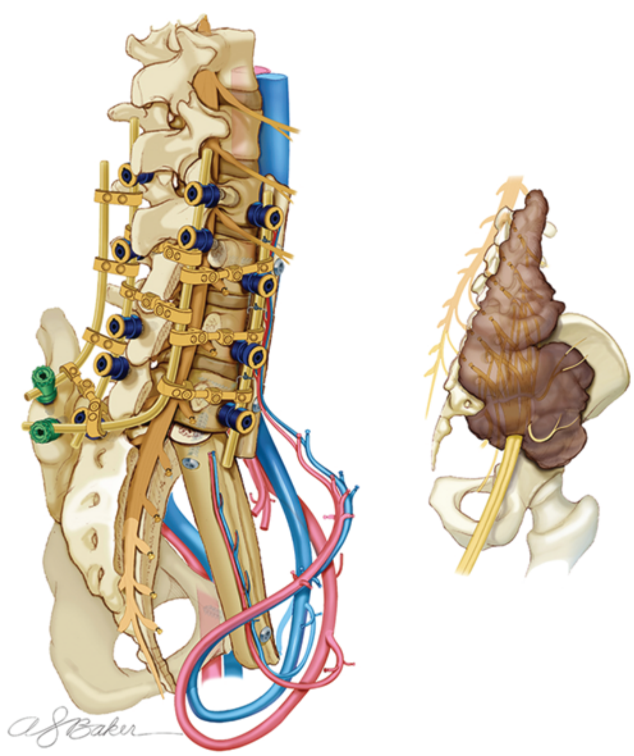

Fig. 4. Schematic of the reconstructed lumbopelvic junction. Bilateral double-rod constructs with connectors and cross-links attached to the left ilium. To enhance fusion, the vascularized femur graft was fixated between the L5–S1 disc space and the ischiopubic remnants while the vascularized fibular strut was placed anterior to the right double-rod construct and secured in direct contact with the L3–5 vertebral bodies. **Inset** shows en bloc resection of the tumor. © Ohio State University. Published with permission.

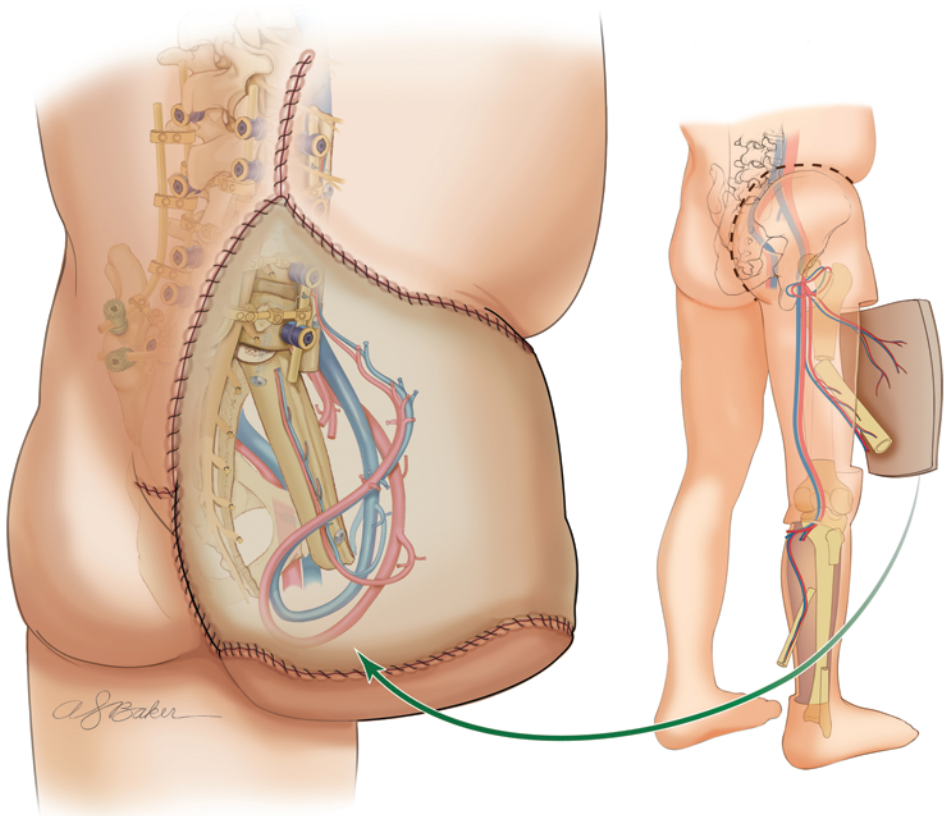

Fig. 5. Schematic showing harvesting of the composite tissue flap for closure of the large soft tissue defect following reconstruction of the lumbopelvic junction. The large anteriorly based musculocutaneous flap previously harvested from the ipsilateral amputated limb was rotated to fill the resection bed and provide closure. © Ohio State University. Published with permission.

40 hours in the operative suite over 3 days, and a cumulative blood loss of 56 liters, the postoperative course in this patient was noted by multiple anticipated management issues that were addressed without significant complications. These issues included hemodynamic and pulmonary issues related to the massive blood loss and resuscitation, anemia, prevention of coagulopathy, deep venous thrombosis, pressure decubitus ulcers, wound breakdown, transient ileus, neurogenic bladder, and nutrition. Prolonged wound drainage related to delayed hemorrhage within the resection site and anemia required additional transfusions. Scattered areas of superficial wound breakdown quickly healed with appropriate wound care and adequate oral nutrition once the transient ileus resolved. Persisting urinary retention required a prolonged indwelling Foley catheter until adequate wound healing allowed transition to intermittent catheterization. Neurogenic bladder was accompanied by a *Pseudomonas aeruginosa* urinary tract infection that responded to appropriate antibiotic treatment. Neurologically, the patient complained of temporary dysesthesias involving the left S-1 distribution that resolved with mobilization, with no motor impairment of her left lower extremity noted. Mobilization with partial weight bearing was initially limited to allow unimpeded wound healing. A postoperative CT scan confirmed the reconstruction, with an intact spinal construct. By postoperative Day 12, the patient was ambulating with the aid of a walker and right hindquarter support sling under the direction of physical therapy.

As suggested by the prior needle biopsy, the tumor proved to be a conventional-type Grade I chondrosarcoma. Despite apparent en bloc resection in which no gross tumor was evident at the margins, microscopic disease was present within cancellous bone along the medial sacral margin. All remaining margins were negative for tumor infiltration.

Reoperation. Given the relatively focal area of microscopic residual tumor, reoperation to extend the sacral resection margins was discussed, and the patient elected to proceed with the proposed repeat surgery, which at that point was 3 weeks following the initial major resection. All the remaining cancellous bone within the hemisacral remnant was removed by curettage. Fragments from the deepest curettage were forwarded for frozen section analysis, which revealed no evidence of tumor. The bone defects within the proximal left sacrum were filled with β-tricalcium phosphate (Vitoss) and the femur and fibular grafts sequentially replaced and secured with bone screws. The patient tolerated the repeat surgery well and resumed mobilization, exercise, and gait training with physical therapy within 48 hours. Unimpaired wound healing and progressive increase in exercise and ambulatory tolerance allowed transfer to intensive inpatient rehabilitation by postoperative Day 36. At the time of transfer to a rehabilitation facility, all incisions were well healed, all drains were removed, and her spinopelvic construct appeared intact.

Reoperation Postoperative Course. At 24-months follow-up the patient remains cancer free, requires intermittent urinary catheterization, and has minimal cutaneous sensory loss in her distal S-1 dermatome with normal motor function. Her construct showed completed bone arthrodesis (Fig. 6A and B). Although her latest imaging revealed disconnection of the rod across the midline that attached to the inferior iliac screw, the patient remains asymptomatic with no back pain and ambulates with a quad cane (Fig. 6C and D). Due to financial constraints, the patient is still waiting to be fitted for her custom-built right leg prosthesis and to begin prosthetic-aided gait training.

Discussion

Although malignant primary osseous tumors of the spine are relatively rare (< 0.2% of all cancers), their management is typically associated with significant morbidity and mortality.[15] Chondrosarcoma, the second most common malignant bone spine tumor, is more prevalent in males (2:1) with a higher incidence in middle-aged adults.[16] Despite the fact that most chondrosarcomas are low to intermediate grade, their locally invasive character usually results in high recurrence rates and death due to recurrent or progressive disease unless aggressive surgical treatment is pursued.[9] Among the 282 chondrosarcoma patients within the Surveillance, Epidemiology, and End Results (SEER) database, surgical treatment was associated with a 6-fold increase in survival when compared with biopsy or nonsurgical treatment.[3] In addition, further analysis confirmed this overall survival advantage after resection regardless of age, presence or absence of metastases, and extent of local tumor invasion.[13] Therefore, because inadequate surgical margins are associated with shorter survival, poorer local tumor control, and relapse or progression, the goal of resection of the tumor in "one piece" with tumor-free margins must be pursued. By reducing the risk of recurrence in both primary and metastatic spinal tumors, en bloc resections yield 5-year survival rates ranging from a baseline of 50%–70% up to 100%.[5,18] If tumor infiltrates the posterior musculature or sacroiliac joint at the time of initial surgery, en bloc remains the optimal resection technique, although the risk for local tumor recurrence is increased.

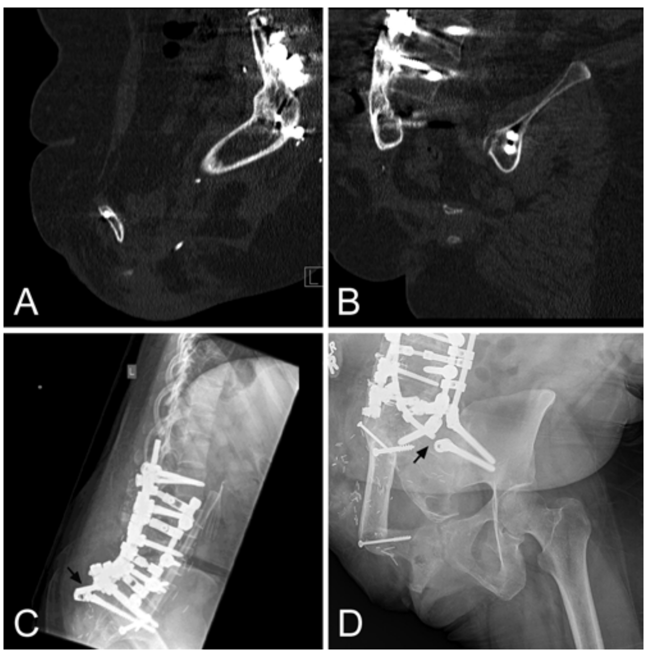

Fig. 6. Postoperative imaging following lumbopelvic reconstruction at 2-year follow-up. Sagittal CT scans **(A and B)** show bone arthrodesis. Lateral **(C)** and anteroposterior **(D)** plain radiographs reveal a rod disconnection across the midline *(arrows).*

Creation of False Pedicles for Reconstruction of the Lumbopelvic Junction

Following combined external hemipelvectomy and hemisacrectomy, failure to integrate and adequately stabilize the lumbopelvic junction usually results in loss of spinal alignment, yielding a poor functional outcome.[14] Furthermore, reconstruction following lumbopelvic dissociation requires a robust instrumented construct capable of withstanding significant torsional and shear stresses. In this patient, the superior portion of the tumor involved the right paraspinal musculature and overlay the lamina of the adjacent midlumbar spine, which added another level of surgical complexity. En bloc resection principles required the spinous processes and lamina adjacent to the tumor to be excised as part of the tumor-free margin. Following detailed analysis of the neuroimaging, the senior author (E.M.) designed a unique surgical construct that not only maintained the principles of en bloc resection, but also allowed for robust reconstruction of the lumbopelvic junction and restoration of pelvic ring integrity, so that the combined forces generated during weight bearing and ambulation were equitably distributed to the remaining lumbar pelvic skeleton.

The creation of false pedicles using transverse bicortical vertebral body screws as substitutes for the resected L-3, L-4, and L-5 pedicles, supplemented with an autologous vascularized fibular strut graft, allowed for a robust reconstruction of the lumbopelvic junction and connection to the restored stable pelvic ring (neo-pelvis). The anterior location of the transverse body screws, besides acting as points of purchase for the lateral vertebral rod and vascularized fibula graft, also connected with the right posterior rod, thereby providing both anterior and posterior column stability. In addition, the creation of the left-sided double rod construct linked via multiple cross-connectors to the opposite rod resulted in transference of axial stresses throughout the construct, while preventing torsional stress across the midline inferiorly to the iliac screws in the remaining left ilium. This unique spinal construct resulted in stability across the lumbopelvic junction sufficient to allow full weight bearing and ambulation.

A late disconnection of the rod across the midline that was attached to the inferior iliac screw at the 2-year mark was noticed on routine follow-up imaging. A long, rigid, multisegmental fixed moment arm has a tendency to load the distal aspect of the construct, which may lead to construct failure. We are unsure of the reason for this late disconnection, but postulate that significant rotational torque at the inferior iliac screw-rod junction (point of maximal stress) may have resulted in the rod loosening as the cross-connector between the 2 iliac screw rods remains intact. In retrospect, a design to evenly distribute the loads so that no one part of the spine or construct is placed under stress was required. However, the patient remained asymptomatic with complete bone fusion noted.

Use of Autologous Vascularized Bone Grafts and Creation of the Neo-Pelvis

When the ilium is preserved, stability of the lumbopelvic junction may be predicted by the extent of sacral resection.[9] Following combined external hemipelvectomy and hemisacrectomy with complete dissociation of the mobile lumbar spine, a robust instrumented reconstruction of the lumbopelvic junction and restoration of the pelvic ring are needed to provide additional rotational and translational stability sufficient for subsequent weight bearing and ambulation.[14,19]

Although some suggest reconstruction of the osseous pelvic ring may not be necessary following sacral resections,[1,18] we believe restoring the biomechanical stability of the lumbopelvic junction with restoration of pelvic ring integrity is necessary to allow for early ambulation and maximize functional outcome, thus preventing delayed complications such as progressive scoliosis, wound complications, vascular thrombosis with occlusion, visceral obstruction, or chronic pain.[7,8,17,21]

The vascularized femoral graft harvested from the amputated limb and secured across the gap between the residual L-5 and S-1 vertebral bodies and the remaining ischiopubic arch restored a stable pelvic ring, thus creating the neo-pelvis. The neo-pelvis was then linked to the strengthened spinal construct at the lumbopelvic junction with rods extending to 2 large left iliac screws.

Following en bloc resection of an iliosacral sarcoma with or without lumbar extension, all reconstructive goals can be met with a combination of a carefully designed spinal construct and tissue transfer (composite flap) from the amputated limb. Vascularized autologous bone grafts harvested from the sacrificed limb may help to restore pelvic ring and lumbopelvic junction integrity.[4] In addition, these bone grafts offer superior biological and mechanical properties, such as increased cell viability, diminished creeping substitution into necrotic areas, and prevention of extensive bone loss or remodeling. Thus, incorporation of vascularized bone grafts maintains structural stability, reduces infection rates, and accelerates graft consolidation.[20] Careful dissection and preservation of the vascular pedicles during rotation and implantation avoids microsurgical anastomosis and interpositional vascular grafts. This technique eliminates both the need for microsurgery and the risks of failed anastomosis or thrombosis.[11] Consequent to these advantages, vascularized autologous bone grafts salvaged from the amputated limb are now only used by our team for lumbopelvic reconstruction to secure and maintain pelvic ring integrity and to enhance structural fusion between the neo-pelvis and the lumbar spine.

Lastly, adequate soft tissue coverage and closure following extensive resections may also be problematic. Skin, subcutaneous tissue, and muscle from the anterior and posterior thigh of the amputated leg may be sufficient to repair the large tissue defect remaining after tumor resection. When autologous tissues are insufficient or closure presents a risk for pelvic visceral herniation, acellular dermal matrix may be used to create a pelvic barrier to aid or support myocutaneous flaps,[6] although a myocutaneous rectus abdominis island flap is preferred.[2] Our technique provides a generous musculocutaneous flap from the anterior, lateral, and posterior thigh based on the same vascular pedicle that supports the vascular bone grafts incorporated into the bone lumbopelvic reconstruction.

Conclusions

The report describes a novel reconstructive technique to reinforce the stability of the lumbopelvic junction after extensive resection of an iliosacral sarcoma with lumbar extension requiring the sacrifice of lumbar pedicles. The creation of false pedicles with use of bicortical transverse body screws provides a strategy to enhance the biomechanical stability of the lumbopelvic junction by structurally integrating the reconstructed neo-pelvis with the residual lumbar vertebrae in the absence of pedicles required for spinal fixation.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Mendel, Boehmler, Mayerson. Acquisition of data: Mendel, Scharschmidt, Schmidt, Mayerson. Analysis and interpretation of data: Mendel, Scharschmidt, Schmidt, Boehmler, Mayerson. Drafting the article: all authors. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Administrative/technical/material support: Mendel, Mayerson. Study supervision: Mendel.

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