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# Grand Rounds from HSS

## MANAGEMENT OF COMPLEX CASES

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Each author certifies that his or her institution has approved the reporting of this case, that all investigations were conducted in conformity with ethical principles of research.

## A MESSAGE FROM THE SURGEON-IN-CHIEF

Welcome to *Grand Rounds* from Hospital for Special Surgery, a new publication presenting the management of complex cases. These reports profile highly complicated issues in bone healing, soft tissue deficiency, bony deformity and joint reconstruction. They cover the spectrum of orthopaedic disease and anatomical location. The need for multidisciplinary management is often required in these cases, including specialized radiographic imaging, pulmonary, vascular, plastic surgery and bioengineering expertise.

Each case is presented in a standardized format with follow-up data on each patient. The discussion section highlights the clinical treatment chosen and appropriate evidence-based support for the orthopaedic management. Although many of these cases are unusual and "out of the mold", they provide principles which apply to all musculoskeletal disease.

We hope you enjoy reading this premiere edition and would greatly appreciate your feedback at complexcases@hss.edu. We are considering offering an online CME credit component in future issues, and would like to know if this would be of value and interest. It is our aim that the principles presented in these special cases will be helpful in your orthopaedic practices.

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## In This Issue:

CASE 1

# Simultaneous Reconstruction of Bone and Soft-tissue Defect with the Ilizarov/Taylor Spatial Frame

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S. Robert Rozbruch, MD does have a financial interest or relationship with the manufacturers of products or services.
- Salary, royalty, honoraria: SBI
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- Institutional Education Support: Smith & Nephew

*Figure 1: The patient underwent removal of the right intramedullary tibia nail, irrigation and debridement of the draining sinus tract of the tibia, and application of temporary external fixation.*

*Figure 2: A two-ring construct with the Ilizarov/TSF (Smith & Nephew, Inc., Memphis, TN) was applied with intentional deformation to allow primary wound closure.*

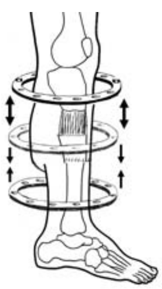

*Figure 3: An osteotomy of the proximal tibia for lengthening and addition of a proximal tibial ring were performed five weeks after the acute shortening. Gradual lengthening of 60 mm was accomplished.*

*Figure 4: At 12 months he had no deformity, equal leg lengths and no pain.*

**CASE REPORT:** A twenty-year-old man was involved in a motor vehicle accident sustaining an open (Gustilo Anderson Grade 3A) fracture of the right tibia and fibula. He was initially treated with an external fixator of the tibia and multiple irrigation and debridements of the open wound. Two weeks after the initial procedure, the external fixator was removed and an intramedullary tibia nail was placed.

Five months after the original injury, the patient presented to Hospital for Special Surgery with a persistent purulent draining sinus at the junction of the middle and distal third of the tibia. Radiographs demonstrated an infected nonunion of the distal third of the tibia and fibula and the presence of an intramedullary nail. The patient underwent removal of the right intramedullary tibia nail, and irrigation and debridement of the draining sinus tract of the tibia (Figure 1).

Vertical extension of the open pretibial wound was performed to provide exposure of the tibia. The tibia was noted to have irregular bone edges, a notable bone defect and nonviable bone which was resected. The resulting bone defect was six centimeters. The wound edges were debrided. A segment of fibula was resected at the same level of the tibial defect. The tibia was acutely shortened and deformed into recurvatum to allow primary wound closure. A two-ring construct with the Ilizarov/TSF (Smith & Nephew, Inc., Memphis, TN) was applied (Figure 2). Distal pulses were assessed and found to be stable.

Intraoperative cultures grew staphylococcus aureus and the patient received intravenous Cefazolin for six weeks. The wound healed and at three weeks, correction of deformity commenced. This occurred gradually over 40 days and was followed by axial compression at the nonunion site for one month. An osteotomy of the proximal tibia for lengthening and addition of a proximal tibial ring were performed five weeks after the acute shortening. Gradual lengthening of 60 mm was accomplished (Figure 3). The frame was removed six months after the proximal tibia osteotomy (bone healing index of one month/cm) and seven months after the acute defect shortening. The patient was protected in a short leg cast with 50% weight bearing for two weeks. At six months following frame removal, knee range of motion was 0°-130° and ankle range of motion was 20° dorsiflexion and 40° plantar flexion. At 12 months he had no deformity, equal leg lengths and no pain (Figure 4). He has a patella baja on the affected side that does not cause pain or limit knee motion. He has a normal gait and does not use any assistive devices. There has been no recurrence of infection.

**DISCUSSION:** The Ilizarov method has been described alone or in combination with soft tissue reconstruction for the management of open tibia fractures, limb shortening, deformity, joint contractures, and infections. The technique of acute shortening and intentional temporary bony deformation to facilitate wound closure, thereby avoiding a soft tissue flap is utilized in the case presented. An elliptical shaped incision closes well with shortening. It is important to avoid leaving bone exposed to avoid desiccation. A circular ring is applied orthogonal to each bone segment with wires and half-pins.

Care is taken avoid loss of pulses which would indicate arterial obstruction. If this were to occur, less shortening and deformity is accepted, even if the wound edges are not coapted. After the wound heals, a gradual correction of the deformity is performed with adjustment of the TSF struts. Compression at the nonunion follows once there is good contact and no deformity. A bifocal approach can be used to avoid limb shortening. With this approach, a tibial osteotomy for lengthening is performed outside the zone of injury. Gradual lengthening at a second level is performed by adding another circular ring and using the principles of distraction osteogenesis.

The TSF, which is particularly useful for this technique, is an evolution of the Ilizarov Frame that allows simultaneous correction of length, angulation, translation, and rotation about a virtual axis. With the TSF, a crooked frame mounted on a deformed bone can be used to gradually correct the leg deformity.

**REFERENCES:**

1. Sen, C.; Kocaoglu, M.; Eralp, L. et al.: Bifocal compression-distraction in the acute treatment of grade III open tibia fractures with bone and soft-tissue loss: a report of 24 cases. *J Orthop Trauma*, 18(3): 150-7, 2004.
2. Lerner, A.; Fodor, L.; Soudry, M. et al.: Acute shortening: modular treatment modality for severe combined bone and soft tissue loss of the extremities. *J Trauma*, 57(3): 603-8, 2004.
3. Rozbruch, S. R.; Helfet, D. L.; and Blyakher, A.: Distraction of hypertrophic nonunion of tibia with deformity using Ilizarov/Taylor Spatial Frame. Report of two cases. *Arch Orthop Trauma Surg*, 122(5): 295-8, 2002.
4. Feldman, D. S.; Shin, S. S.; Madan, S. et al.: Correction of tibial malunion and nonunion with six-axis analysis deformity correction using the Taylor Spatial Frame. *J Orthop Trauma*, 17(8): 549-54, 2003.

*References continued on back page.*

CASE 2

# Salvage of Bilateral Extensor Mechanism Failures After Total Knee Replacement

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*Figure 1: There is a palpable gap in the extensor mechanism of the knee.*

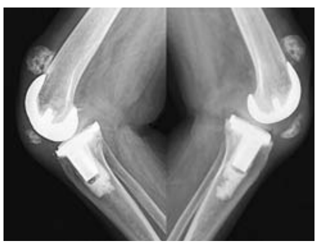

*Figure 2: Preoperative radiographs demonstrate chronic disruption of the extensor mechanism of both knees with an avulsion of the inferior pole and proximal migration of the patellae.*

*Figure 3: Intraoperative photograph demonstrating fixation of the tubercle allograft in the tibia with two titanium screws and suture of the native quadriceps tendon to graft with the knee in full extension.*

*Figures 4: Four month postoperative radiographs demonstrate intact bilateral reconstructions with stable allograft fixation.*

**CASE REPORT:** The patient is a 75-year-old diabetic woman with Parkinson's disease and osteoarthritis. Seven months prior to presentation, she underwent bilateral total knee replacements. Three months post-operatively she developed spontaneous bilateral inferior pole patella fractures with avulsion of the infrapatellar tendon and loss of extensor mechanism integrity. Subsequently, she underwent debridment and patellar tendon suture repair. Both repairs failed by the time of her one-month follow-up visit and drop-lock knee braces and conservatives measures were recommended.

At the time of presentation to Hospital for Special Surgery the patient was non-ambulatory and confined to a wheelchair. Wide palpable defects in the patellae (Figure 1) and absent active knee extension were present. The right knee had a flexion contracture of 15 degrees. Radiographs revealed widely displaced bilateral inferior pole patella fractures, with well-aligned prosthetic components (Figure 2).

Bilateral staged reconstructive procedures with extensor mechanism allografts on both knees and an isolated revision of the femoral component of the right knee to correct the flexion contracture were performed. Each knee was exposed through a midline skin incision. The quadriceps tendon was incised longitudinally, patellar fragments were excised preserving the overlying soft tissue, and the residual patellar tendon tissue was incised longitudinally and dissected subperiostially off the tibial tubercle. The femoral component on the right side was revised with an additional resection of five millimeters of the distal femur to increase the extension gap. The extensor mechanisms were constructed by localizing the tibial tubercle osteotomy to center the allograft patella over the flange of the femoral prosthesis with the knee in full extension. The tibial tubercle osteotomy was performed to create a slightly undersized bone bed and press fit the allograft tibial tubercle. Fixation was achieved with two screws on the right knee and three on the left. The allograft was tensioned with the knee in full extension and the native quadriceps tendon was over-sewn to the graft with locking non-absorbable sutures. The remainder of the native extensor mechanism was also over-sewn using absorbable sutures as part of the layered wound closure (Figure 3). Passive flexion to 30 degrees was present without excessive tension on the reconstruction.

The left knee surgery was performed one week later. Both knees were casted in full extension post-operatively for four weeks.

Hinged knee braces were placed allowing motion from 0-40 degrees. Radiographs revealed well-aligned prosthetic components, intact tubercle fixation, and good patellar tracking bilaterally (Figure 4). The patient progressed to bearing full weight.

At the present time, six months after surgery, the patient has achieved 70 degrees of flexion bilaterally and flexion continues to improve. She has no extensor lag in either knee and is ambulatory with a cane.

**DISCUSSION:** Reported rates of patella fracture after primary TKR range from 0.11% to 21%[1]. These fractures are frequently atraumatic and may be asymptomatic if the extensor mechanism is intact. Atraumatic fractures have been associated with osteoporosis, bone cysts, patellar resurfacing, post-resection patellar thickness, single central peg patella designs, posterior-stabilized femoral designs, femoral or tibial component malrotation. Factors that affect the vascularity of the patella include excessive infrapatellar fat pad excision and lateral release resulting in superior lateral geniculate artery compromise[2,3].

Management of patellar fracture after TKR is determined by integrity of the extensor mechanism, fixation of the patellar component, and residual patellar bone stock. Nonoperative treatment with short period of immobilization is indicated for minimally displaced fractures with intact extensor mechanism and patellar component. Operative treatment is reserved for fractures associated with extensor mechanism dysfunction and patellar component loosening[3].

Extensor mechanism allograft reconstruction is a salvage procedure for disruption of the extensor mechanism after TKR[4]. It is advisable to obtain allograft that matches the patellar size. If patella is oversized, wound closure can be challenging. There is no need to resurface insensate allograft patella[5].

The technique of allograft reconstruction has a significant effect on patient outcome[6,7]. Fixation of the graft with minimal tension in extension to permit 60 degrees passive flexion on OR table was routinely used at one institution, resulting in 7/7 clinical failures, a mean extensor lag of 59 degrees and mean knee flexion of 108 degrees. When the technique was modified to incorporate fixation of the graft tightly tensioned in extension, the authors obtained clinical success in 13/13 patients with a mean extensor lag 4.3 degrees and mean knee flexion of 104 degrees[6].

*References listed on back page.*

CASE 3

# Severe Early Onset Kyphoscoliosis

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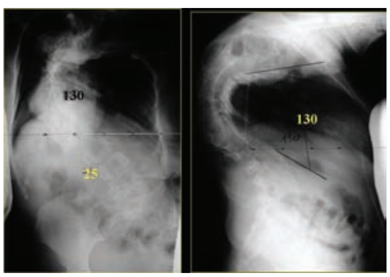
- Salary, royalty, honoraria: KZM, Depuy
- Receipt of Intellectual Property Rights/Patent Holder: KZM, Depuy
- Consulting fees: KZM, Depuy, Osteotech
- Speakers' bureaus: KZM, Depuy, Osteotech
- Supported/Contracted Research: KZM

*Figures 1A & 1B: Pre-operative photographs of the patient showing the severity of the scoliosis and kyphosis.*




*Figures 2A & 2B: Preoperative AP and Lateral X-rays show a severe and rigid scoliosis (130 degrees) and hyperkyphosis (130 degrees).*

*Figures 3A, 3B, 4A, 4B: Postoperative photographs show the balanced correction achieved in the frontal and sagittal planes.*

**CASE REPORT:** The patient was a 22-year-old female from Bangladesh who presented with severe spinal deformity since childhood. The deformity was progressive and associated with significant loss of height, shortness of breath on slight exertion, and fatigue. There was no history of an infectious process. Her physical examination was significant for a marked kyphoscoliosis (Figure 1, 2). Her trunk shift was 5 cm and the ATI was 40 degrees (8cm) for the right thoracic prominence. Neurological examination was normal. Her pulmonary function was markedly diminished with an FVC 0.96L (33%), FEV1 0.81L (34%), and FEV1/FVC 84%.

The patient underwent an anterior transthoracic fusion T4-T8, apical resection of T7-8, with an internal thoracoplasty. The surgical time was 210 minutes. Interval halo gravity traction was used following the anterior procedure for four weeks. During this period the patient developed an ARDS syndrome secondary to a left sided pneumonia and required tracheostomy. A posterior spine fushion C7-L4 with posterior arch resection of T 7-8 was performed with posterior thoracoplasy and multiple rib osteotomies. The operative time for the posterior procedure was seven hours with an EBL of 3000cc. She had no complications after the second procedure.

She is now eleven years post-op and has minimal complains of back pain. She takes no pain medications and reports improvement in her breathing. The patient has held a full time job as a secretary and is currently married with no children. Recent radiographs and photographs show preservation of correction (Figures 3A, 3B, 4A, 4B).

**DISCUSSION:** The primary goal of adult idiopathic scoliosis is to achieve the physiological spinal balance in the coronal and sagittal planes and a solid arthrodesis. Failures to achieve these objectives will often result in poor outcomes. However, the difficulty in the curve correction and the high incidence of complication are considered to exist in the surgical treatments for severe and rigid adult scoliosis.

Surgical options for the severe adult scoliosis vary in approaches and corrective techniques. They include single posterior approach and combined approach. During the reconstruction, compression/distraction, cantilever, and translational techniques with or without anterior release and resection procedures can be performed. According to the previous studies on the surgical outcomes for severe scoliosis, correction rate of the major curve and complication rate are reported to be 30 to 60% and 25 to 73%, respectively.

Several authors recommend the vertebral resection procedures for severe scoliosis from the standpoint that combined anterior and posterior procedure enable only limited curve correction.[1,2] However, to the author's knowledge, most of the previous reports on the traditional anterior and posterior spinal fusion were focused on the Harrington rod generation. In this case, final curve correction of 46% was achieved with improvement of spinal balance. This achievement was attributed by the anterior release with the removal of discs and anterior longitudinal ligaments, and facetectomies followed by the translational corrective techniques using the third generation segmental instrumentation system.

With respect to the resection procedures, Boachie-Adjei et al.[1] reported the surgical outcomes of vertebral column resection through the anterior and posterior approaches followed by the posterior instrumentation for severe scoliosis. Their study included sixteen scoliosis patients with various etiologies, and the preoperative scoliosis averaged 108° with the flexibility of 7.4%. They showed the curve correction of 43% at the follow-up.

Suk et al.[3] demonstrated the surgical outcomes of vertebral column resection by single posterior approach with the curve correction of 59% in sixteen severe scoliosis patients. Although the curve correction rate in his report is considered to be high, this was attributed by not only the resection procedure but also using thoracic pedicle screws, which can provide significant corrective forces.

The correction index in the resection procedures were 39 in Boachie-Adjei's report and 27 in Suk's report[5]. From these results, the efficacy of the combined anterior and posterior procedure in the curve correction could be considered to be no less than those of the resection procedures.

Complication rate in the surgical treatment for the adult scoliosis varies from 25 to 73%.[4] A review of patients treated by the senior author showed a complication rate of 50%. Five major complications were observed, including two implant failures, one deep wound infection and two pulmonary emboli.

*Article continued on back page.*

CASE 4

# Treatment of Massive Pelvic Discontinuity with a Custom Triflange Acetabular Component

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Mathias P. G. Bostrom, MD does have a financial interest or relationship with the manufacturers of products or services.
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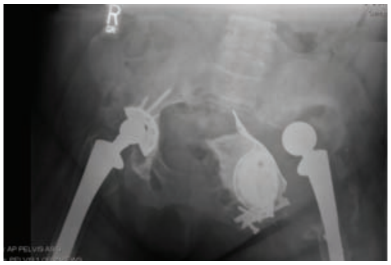

*Figure 1: Pre-operative AP radiograph*

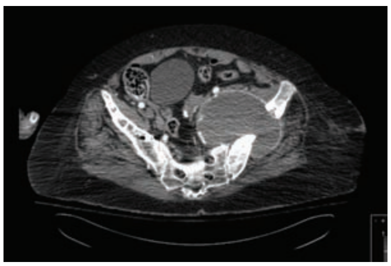

*Figure 2: CT scan demonstrating large fluid collection displacing pelvic vessels*

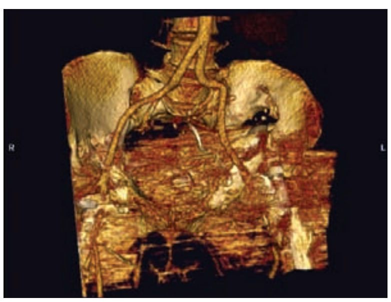

*Figure 3: 3D reconstruction of CT scan*

*Figure 4: One year post-operative AP pelvis radiograph*

**CASE REPORT:** The patient is a 62-year-old female with a 30-year history of rheumatoid arthritis and multiple failed total hip arthroplasties. Her index left total hip arthroplasty had been performed in 1988 with her first revision performed in 1999. She subsequently had four revisions with bone grafting and an anti-protrusio cage, and the last revision performed nine months prior to presentation. Her ambulation was limited to the use of platform walker in the house but due to the gross instability of her left hip she was essentially housebound. A Girtlestone resection arthroplasty was recommended due to the profound bone loss and the patient presented to Hospital for Special Surgery to explore other treatment options.

On physical examination her height was 5' 6" and she weighed 195 pounds. The patient required two assistants to transfer from her wheelchair to the examining table. Her left hip was grossly unstable in flexion. Her radiographs revealed an anti-protrusio cage with the femoral head and cage medial to Kohler's line and a significant pelvic discontinuity (Figure 1).

Due to this profound bone loss and pelvic continuity, a custom acetabulum was designed. A CT scan with custom protocol along with MR angiography and venography was performed to assess the amount of bone loss and the location of the blood vessels relative to the existing acetabular prosthesis (Figures 2 and 3). Preoperative aspiration of the left hip joint also was performed which was negative along with serum serologies including c-reactive protein and sedimentation rate which were normal.

A custom triflange prosthesis was designed with the assistance of the biomechanics department at Hospital for Special Surgery and manufactured by an outside vendor. Preoperative assessment by vascular surgery was performed due to the close proximity of the iliac vessels to the existing prosthesis.

At surgery a retro-peritoneal approach was performed by our vascular surgery team to secure the pelvic vessels. A standard posterolateral approach was then used to revise the aceatabular compoment and implant the custom component which was fixed to the ilium with multiple screws. The femoral component was not revised but the femoral head was exchanged.

After protected weight bearing for three months, the patient was allowed full weight bearing. She is now a community ambulator with a platform walker and uses a cane ambulating around her house. One year follow-up radiographs demonstrated full integration of the acetabular component (Figure 4).

**DISCUSSION:** Treatment of massive acetabular defects remains problematic and is one of the most challenging problems for the arthroplasty surgeon. Traditional techniques such as large hemispherical cups, acetabular reconstruction rings/cages and structural allografts unfortunately have a high failure rate.(ref) One attractive option is the use of a custom triflange acetabular component such as was used in this case. While the cost for these components is high and the time for the design and manufacturing these implants is long, when faced with massive bone loss this may still be the best option.

As was also seen in this case, pelvic discontinuities are often complex not only in terms of the reconstruction but also in regards to the operative exposure. Therefore, proper pre-operative planning is required. Use of multimodal imaging is critical as is early consultation with vascular/general surgery. These cases are truly multidisciplinary with important input from biomechanical engineering, radiology and vascular/general surgery.

**REFERENCES:**

1. DeBoer DK, Christie MJ, Brinson MF, Morrison JC.Revision total hip arthroplasty for pelvic discontinuity. *J Bone Joint Surg Am.* 2007 Apr;89(4):835-40.
2. Holt GE, Dennis DA.Use of custom triflanged acetabular components in revision total hip arthroplasty. *Clin Orthop Relat Res.* 2004 Dec;(429):209-14
3. Stiehl JB, Saluja R, Diener T.Reconstruction of major column defects and pelvic discontinuity in revision total hip arthroplasty. *J Arthroplasty.* 2000 Oct; 15(7):849-57
4. Berry DJ, Lewallen DG, Hanssen AD, Cabanela ME.Pelvic discontinuity in revision total hip arthroplasty. *J Bone Joint Surg Am.* 1999 Dec; 81(12):1692-702
5. Stiehl JB, Saluja R, Diener T.Reconstruction of major column defects and pelvic discontinuity in revision total hip arthroplasty. *J Arthroplasty.* 2000 Oct; 15(7):849-57
6. Gerber A, Pisan M, Zurakowski D, Isler B.Ganz reinforcement ring for reconstruction of acetabular defects in revision total hip arthroplasty. *J Bone Joint Surg Am.* 2003 Dec; 85-A(12):2358-64
7. Gul R, Jeer PJ, Oakeshott RD Twenty-year survival of a cementless revision hip arthroplasty using a press-fit bulk acetabular allograft for pelvic discontinuity: a case report. *J Orthop Surg (Hong Kong).* 2008 Apr; 16(1):111-3.
8. Chiang PP, Burke DW, Freiberg AA, Rubash HE. Osteolysis of the pelvis: evaluation and treatment. *Clin Orthop Relat Res.* 2003 Dec; (417):164-74

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# Grand Rounds from HSS
## MANAGEMENT OF COMPLEX CASES

## CASE 1 CONTINUED

**REFERENCES, CONTINUED:**

5. Gayle, L. B.; Lineaweaver, W. C.; Oliva, A. et al.: Treatment of chronic osteomyelitis of the lower extremities with debridement and microvascular muscle transfer. *Clin Plast Surg*, 19(4): 895-903, 1992.
6. Cattaneo, R.; Catagni, M.; and Johnson, E. E.: The treatment of infected nonunions and segmental defects of the tibia by the methods of Ilizarov. *Clin Orthop*, (280): 143-52, 1992.
7. Green, S. A.; Jackson, J. M.; Wall, D. M. et al.: Management of segmental defects by the Ilizarov intercalary bone transport method. *Clin Orthop*, (280): 136-42, 1992.
8. Paley, D., and Maar, D. C.: Ilizarov bone transport treatment for tibial defects. *J Orthop Trauma*, 14(2): 76-85, 2000.
9. Saleh, M., and Rees, A.: Bifocal surgery for deformity and bone loss after lower-limb fractures. Comparison of bone-transport and compression-distraction methods. *J Bone Joint Surg Br*, 77(3): 429-34, 1995.
10. Song, H. R.; Cho, S. H.; Koo, K. H. et al.: Tibial bone defects treated by internal bone transport using the Ilizarov method. *Int Orthop*, 22(5): 293-7, 1998.
11. Rozbruch SR, Weitzman AM, Watson JT, Freudigman P, Katz HV, Ilizarov S: Simultaneous Treatment of Tibial Bone and Soft-tissue Defects with the Ilizarov Method. *J Orthop Trauma* 2006; 20(3):197-205.
12. Nho SJ, Helfet DL, Rozbruch SR: Temporary Intentional Leg Shortening and Deformation to Facilitate Wound Closure Using the Ilizarov/Taylor Spatial Frame. *J Orthop Trauma* 2006; 20(6): 419-424.
13. Rozbruch SR, Fragomen A, Ilizarov S: Correction of Tibial Deformity Using the Ilizarov/ Taylor Spatial Frame. *J Bone Joint Surg Am* 88-A 2006, supplement 4, pages 156-174.
14. Rozbruch SR, Pugsley JS, Fragomen AT, Ilizarov S: Repair of Tibial Nonunions and Bone Defects with the Taylor Spatial Frame. *J Orthop Trauma* 2008; 22(2): 88-95.



## CASE 2 CONTINUED

**REFERENCES:**

1. Ortiguera CJ, Berry DJ. Patellar fracture after total knee arthroplasty. *J Bone Joint Surg (Am)* 2002;84(4):532-40.
2. Figgie HE 3rd, Goldberg VM, Figgie MP, Inglis AE, Kelly M, Sobel M. The effect of alignment of the implant on fractures of the patella after condylar total knee arthroplasty. *J Bone Joint Surg (Am)* 1989;71(7):1031-9.
3. Sheth NP, Pedowitz DI, Lonner JH. Periprosthetic patellar fractures. *J Bone Joint Surg (Am)* 2007;89(10):2285-96.
4. Springer BD, Della Valle CJ. Extensor mechanism allograft reconstruction after total knee arthroplasty. *J Arthroplasty* 2008; 23(7 Suppl):35-8.
5. Nazarian DG, Booth RE Jr. Extensor mechanism allografts in total knee arthroplasty. *Clin Orthop* 1999;367:123-9.
6. Burnett RS, Berger RA, Paprosky WG, Della Valle CJ, Jacobs JJ, Rosenberg AG. Extensor mechanism allograft reconstruction after total knee arthroplasty. A comparison of two techniques. *J Bone Joint Surg (Am)* 2004;86(12):2694-9.
7. Burnett RS, Butler RA, Barrack RL. Extensor mechanism allograft reconstruction in TKA at a mean of 56 months. *Clin Orthop* 2006;452:159-65.

## CASE 3 CONTINUED

Incidence of wound infection in the surgical treatment for adult scoliosis varies from 1 to 8% with the majority in the posterior procedures. Risk factors in the postoperative wound infections are considered to be the medical history related to immunodeficiency and nutritious status. Both cases with wound infection had no medical history related to immunodeficiency and underwent the staged procedure. In the staged surgery, the nutritional evaluation before the second procedure is mandatory, and both of these cases were also evaluated carefully.

Neurologic compromise and pseudoarthrosis are the major complications in adult scoliosis surgery, both of which were not observed in the review of 20 adult patients with severe scoliosis treated by combined anterior and posterior approach.

The incidence of neurologic compromise in scoliosis varies from less than 1% to 5%[6], Suk et al.[3] showed a postoperative complete paralysis in the report on posterior vertebral resection procedure. Bradford et al.[2] reported that three patient had neurologic compromise in twenty seven resection procedures. With respect to the incidence of pseudoarthrosis in scoliosis surgery for adults, it is reported to vary from 5 to 27%. Pseudoarthrosis is considered to be one of the risk factors for poor surgical outcomes. The functional outcome using SRS scores showed a high patient satisfaction in the author's review of his practice patients. Satisfactory functional outcomes are thought to be related to the excellent radiographic outcomes.

**REFERENCES:**

1. Boachie-Adjei O, Bradford DS. Vertebral column resection and arthrodesis for complex spinal deformities. *J.Spinal Disord* 1991; 4: 193-202.
2. Bradford DS and Tribes CB. Vertebral column resection for the treatment of rigid coronal decompensation. *Spine* 1997 22: 1590-1599.
3. Suk SL, Chung ER, Kim JH, Lee SM, Kim SS, Choi WK: Posterior vertebral column resection (PVCR) for severe rigid scoliosis. *SRS* 2004 abstract: 57.
4. Voos K, Boachie-Adjei O, Rawlins BA. Multiple vertebral Osteotomies in the treatment of rigid adult spine deformities. *Spine* 2001; 26: 526-533.
5. Bradford DS, Tay BK, Hu SS. Adult scoliosis: surgical indication, operative management, complication, and outcomes. *Spine* 1999; 24: 2617-2629.
6. Bridwell KH, Lenke LG, Baldus C, Blanke K. Major intraoperative neurologic deficits in pediatric and adult spinal deformity patients. Incidence and etiology at one institution. *Spine* 1998; 23: 324-331.