Vertebral compression fractures are the most common fractures associated with osteoporosis. Approximately 700,000 osteoporosis-related vertebral compression fractures (OVCFs) occur each year in the U.S. Currently, treatment is focused primarily on prevention. When fractures occur in patients with osteoporosis, treatment options are limited to bed rest and pain medications because open surgery with implants often fails in these patients. Hence, we need new treatments that directly address both the underlying cause of OVCFs (bone loss) and the inadequate repair mechanisms when fractures occur.

We proposed to develop a therapy that exploits mesenchymal stem cells (MSCs) stimulated in vivo with parathyroid hormone (PTH) to accelerate bone repair. PTH alone can accelerate fracture repair in healthy animals by activating bone marrow MSCs. However, osteoporotic patients have either decreased numbers of MSCs, dysfunctional MSCs or both. In these patients, injection of MSCs combined with a PTH regimen could be an effective therapy for the treatment of multiple fractures. Our preliminary data in an animal model demonstrated that this combined treatment enhances MSC homing to long-bone fracture sites and leads to increased repair. Therefore, we hypothesized that an intravenous injection of MSCs combined with PTH could be effective for the treatment of multiple fractures.

Continued on page 4 (see “Adult Stem Cells”)
Soft Tissue-Sparing Total Hip Arthroplasty: The Direct Posterior Approach

Brad Penenberg, MD

Traditional total hip arthroplasty (THA) typically involves cutting or significantly stretching five to six tendons or muscles around the hip. Over the past six years, I have explored and refined a direct posterior (DP) approach to THA, which is carried out using only a single tendon release. The tendon is repaired at the end of the procedure. This approach has the potential to dramatically improve the rate of recovery and reduce complications; it also offers the surgeon a gradual learning curve.

The direct anterior (DA) approach has been of some interest over the last few years. It offers the promise of sparing soft tissue; however, it has a challenging learning curve and is not always applicable to certain larger patients, muscular patients, or patients with protrusio, varus hips or osteoporosis.

Unlike the DA approach, the DP approach offers the safety of fallback to a more extensive exposure as the surgeon gradually learns the DP technique.

Surgical technique

The DP approach is performed in the familiar lateral decubitus position. The length of the skin incision averages 10 cm but is not critical to the success of the procedure. The incision is made at the posterior corner of the greater trochanter directly over the typical location of the conjoined tendon insertion and posterior to the iliotibial band. The conjoined tendon is released as close to its insertion as possible (Fig. 1). The hip capsule is then incised longitudinally, in line with the inferior border of the femoral neck. The capsule is preserved and repaired side to side at the end of the procedure. Femoral access is “direct” in that the canal is entered beneath the carefully retracted gluteus medius muscle via the piriformis fossa. This is the identical trajectory used to insert an intramedullary nail and is atraumatic to the adjacent tissues. Acetabular preparation can be completed using a portal that is placed distal to the main incision and posterior to the upper femur. This permits an “over the top” approach in relation to the intact quadratus and other remaining short external rotators. Reaming and cup impaction can be carried out via this 8 to 10 mm “portal” (Fig. 2).

Clinical results

My colleagues and I reviewed a consecutive series of 700 total hip replacements in 675 patients* performed using the DP approach.

- Hospital stay averaged 1.5 days
- If the starting Hct was normal, 98 percent did not receive a transfusion
- 85% of patients took only Tylenol® after leaving the hospital
- 90% reported that they were comfortably using a cane within five days of surgery
- Dislocation rate was 0.4 percent at three years
- No wound problems were encountered
- No nerve injuries were identified postoperatively
- Deep vein thrombosis rate was 0.8%. No fatal pulmonary emboli.
- No postoperative activity restrictions
- 60% of patients reported driving within the first week after surgery
- Acetabular component abduction angle was between 35 and 50 degrees in all hips. There were no trochanteric fractures.

Conclusion

The DP approach to THA can achieve accelerated recovery with very low risk while not compromising component placement. Unlike the direct anterior approach, DP can be learned in a stepwise fashion that can minimize risk of complication as the surgeon learns the technique.

*Includes research conducted at Cedars-Sinai and other institutions.

Figure 1: Direct posterior THA with single tendon release and capsule preservation and repair.

Figure 2: Portal access preserves tendon attachments.
Bloodless Pelvic Fracture Surgery in the Jehovah’s Witness Population

Daniel C. Allison, MD

Displaced, unstable pelvic fractures often require precise and durable surgical stabilization in order to achieve optimal outcomes. The high-energy nature of these injuries, along with their associated vascularity, may result in substantial blood loss before, during or after the time of surgery. These injuries may prove challenging in members of the Jehovah’s Witness population, who frequently will not accept allogenic blood products. Treatment of pelvic fractures in this population requires the combined, coordinated effort of surgeons, internists, hematologists, anesthesiologists, perfusionists, social liaisons and others to deliver safe and effective care. We present two pelvic fractures in Jehovah’s Witness patients.

Case 1
A 48-year-old female Jehovah’s Witness sustained a vertical shear pelvic ring injury after a high-energy motor vehicle accident (MVA) (Fig. 1). The patient was initially managed and stabilized at an outside hospital. Surgeons at this hospital refused to operate without the patient’s consent for allogenic blood transfusion. Two and half weeks after her injury, the patient was transferred to Cedars-Sinai for definitive pelvic fracture fixation using a bloodless surgical technique. Preoperatively, the patient was optimized with erythropoietin and intravenous iron. Intraoperatively, hemodilution anesthetic technique was used, as was closed-circuit cell saver. No other procoagulants were used. Anatomic reduction of the pelvic ring was achieved with longitudinal traction and hemipelvic rotation. The crescent fragment was reduced and fixed through a mini-open technique. The pelvic ring was definitively stabilized with two percutaneous sacroiliac screws and a percutaneous retrograde superior ramus screw (Fig. 2).

Postoperatively, the patient remained hemodynamically stable with an uneventful recovery. She was instructed to use only toe-touch weight on the operative side. Against our advice, she began weight bearing with full weight without her walker at five weeks. Her fracture healed uneventfully and she resumed normal activities by eight weeks.

Case 2
A 56-year-old male Jehovah’s Witness was involved in an MVA, sustaining a right anterior column displaced acetabular fracture with an anterior roof arc angle of 11 degrees (Fig. 3). The patient was stabilized at a local community hospital and then transferred to Cedars-Sinai for definitive care. Preoperatively, the patient was optimized with erythropoietin and IV iron. Intraoperatively, hemodilution anesthetic technique and closed-circuit cell saver were used. No systemic coagulation agents were used. Anatomic reduction of the acetabulum was achieved through longitudinal skeletal traction. This reduction was definitively stabilized using partially threaded cannulated screws inserted percutaneously through the iliac wing, the supra-acetabular ilium and along the anterior column into the superior pubic ramus (Fig. 4).

Postoperatively, he remained hemodynamically stable with an uneventful recovery. He was restricted to toe-touch weight on the operative side for six weeks. The fracture healed uneventfully and he resumed normal activities by 12 weeks. At six-month follow-up, the patient is back to work with no evidence of post-traumatic arthrosis.

Discussion
Refusal of allogenic blood products is not a contraindication to the surgical treatment of unstable pelvic ring and acetabular fractures. Though the bloodless surgical treatment of these conditions requires extensive planning and coordinated care, such patients can be safely and appropriately treated with excellent outcomes.

Dr. Allison is a member of the Cedars-Sinai Orthopaedic Center.
Nonunion of Pathological Fracture Fixation

Earl Brien, MD

In June 2011, a 66-year-old male with an eight-year history of lymphoma was admitted for severe right hip pain. The patient had sustained a pathologic fracture and was diagnosed with metastatic lymphoma. He underwent intramedullary fixation followed by radiation therapy to the proximal femur. His pain persisted, and despite internal fixation, a delayed union developed. He complained of progressive pain in the hip and subsequently felt severe pain in the hip region and was unable to ambulate. He was diagnosed with a nonunion and a broken intramedullary rod (Fig. 1).

In December 2012, he underwent removal of the intramedullary rod, resection of the proximal femur and reconstruction of the right proximal femur, and total hip replacement using a constrained liner (Fig. 2). Immediately postoperatively, he ambulated with minimal pain, which improved over a six-week period.

Intramedullary fixation is commonly used for metastatic disease to the bone. In patients who sustain pathologic fracture and require radiation therapy after internal fixation, delayed and nonunion is not uncommon. Despite excellent fixation seen in this case after the initial surgery, nonunion developed. After a detailed discussion with the patient, a single procedure allowed him to ambulate without pain and resume his daily activities.

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Figure 1: Broken intramedullary rod associated with a nonunion.

Figure 2: Proximal femoral replacement using a constrained liner.

Adult Stem Cells: continued from page 1

combined with PTH administration would induce stem cell homing to vertebral defects followed by osteogenesis and defect repair. In order to test our hypothesis, we induced osteopenia in immunodeficient rats using ovariectomy and four months of low-calcium diet. Trabecular bone loss in the lumbar region was confirmed using high-resolution micro-CT scans. Next, we created multiple vertebral defects in the lumbar spine of the osteopenic rats. In parallel, human bone marrow-derived MSCs were labeled with reporter genes so they could be tracked in vivo. Rats with lumbar defects were treated either with: 1. Intravenous injection of one million labeled stem cells and daily subcutis injections of PTH (40ug/Kg body weight); 2. PTH injections only; or 3. Saline injections as a control. Cell survival and homing to the defect sites were monitored using noninvasive optical and nuclear imaging. We also monitored vertebral repair using weekly micro-CT scans.

Our results showed that ovariectomy and low-calcium diet resulted in 15 to 20 percent loss of bone mineral density and over 30 percent reduction in trabecular thickness in the lumbar vertebrae of the rats. Using optical and nuclear imaging, we could detect homing of the injected stem cells to the lumbar region of the animals a few days after intravenous delivery. Finally, vertebral defects in osteopenic rats treated with the combined stem cell and PTH therapy resulted in a two-fold increase in bone volume density two months after treatment when compared to defects treated with PTH only (Fig. 1). The vertebrae in the group of rats treated with saline did not heal after eight weeks.

This study provided initial evidence for future therapies that could be highly beneficial for the treatment of vertebral and other complex fractures, especially in osteoporotic patients. Our efforts are currently focused on analyzing the extent of stem cell homing to vertebral bone defects in animals treated with PTH. We also intend to investigate the effect of higher doses of stem cells and PTH on the repair of multiple vertebral defects in these osteopenic animals.

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