CEDARS-SINAI

ADVANCES IN ORTHOPAEDICS

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Case Study: Complex Total Knee Arthroplasty

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More than 300,000 patients a year undergo total knee arthroplasty, which has become a common method for treating severe arthritis of the knee. To reduce the risk of complications, the procedure must be performed with meticulous precision and alignment of the prosthetic components. Generally, alignment is guided on the femoral side by the intramedullary canal. The following case study, in which the intramedullary canal was unavailable due to a preoperative deformity, highlights how technology can be used to optimize outcomes in complex reconstructions.

Revisiting a war injury

A 58-year-old male was scheduled for right total knee arthroplasty based on a diagnosis of post-traumatic degenerative joint disease due to mechanical malalignment and valgus malunion of the right femoral fracture.

The femur was originally injured by an AK-47 gunshot wound in Vietnam in 1968. Multiple shrapnel fragments were left in the shattered right femur at the junction of the middle and distal thirds. Given resources available at the time, the femur did not heal in proper anatomical alignment and the patient was left with a lower extremity deformity. In 2001, X-rays revealed a nearly complete loss of the joint space with near bone-on-bone contact in the lateral compartment with further evidence of tricompartmental disease. Over the next six years, the patient was treated conservatively with medication, injections, bracing and physical therapy. When that conservative management failed, the patient opted for a total knee arthroplasty.

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Figure 1: *Preoperative AP and lateral X-rays showing loss of joint space in the knee, as well as malalignment of the femur resulting from improper healing of the original injury.*

Figure 2: *Postoperative AP and lateral X-rays after total knee arthroplasty utilizing computer navigation and fluoroscopic guidance.*

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Adult Idiopathic Scoliosis: Advanced Surgical Treatment

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Once skeletal maturity is reached, a patient with adolescent idiopathic scoliosis is defined as having adult idiopathic scoliosis. While curvature in children and adolescents is primarily treated for curve progression, pain is a much more common indication for consultation and surgery in the adult. In the adult with scoliosis, curvature accelerates degeneration – which produces back pain, radiculopathy and rigidity.

Adults with curves of less than 40 degrees rarely progress, but curves measuring 50 degrees have been shown to increase at a mean rate of one degree per year. Studies have also shown that at 75 degrees, pulmonary function may deteriorate, and at 100 degrees severe cardiopulmonary dysfunction can be seen. The spinal deformity surgeon uses curve magnitude, documented progression and pain unresponsive to conservative therapy as the indications for operative treatment.

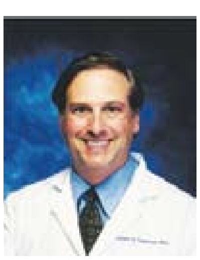
To achieve maximum surgical correction in patients with adult idiopathic scoliosis, the spine's rigidity must be addressed with judicious use of osteotomies and soft tissue release. Pedicle screw fixation has enhanced our ability to induce three-dimensional corrective forces on the spine and reduce non-union rates. The combination of these techniques has closed the gap between surgical corrections we are able to achieve in adolescent versus adult patients.

Case example

A 22-year-old male presented with progressive adult idiopathic scoliosis. Initially diagnosed as a child, he wore a brace until age 16. At age 22, scoliosis radiographs revealed a 58-degree thoracic curve and a highly rotated 44-degree lumbar curve.

A combination of posterior-only osteotomies and pedicle screw-rod fixation were used to achieve excellent curve correction, sagittal and coronal balance, and preserve two lumbar-motion segments below the fusion. One year post-operation, the patient is symptom-free and has returned to all preoperative activities.

In conclusion, new surgical techniques have enhanced our ability to manage progressive, rigid curves in adult patients with idiopathic scoliosis.



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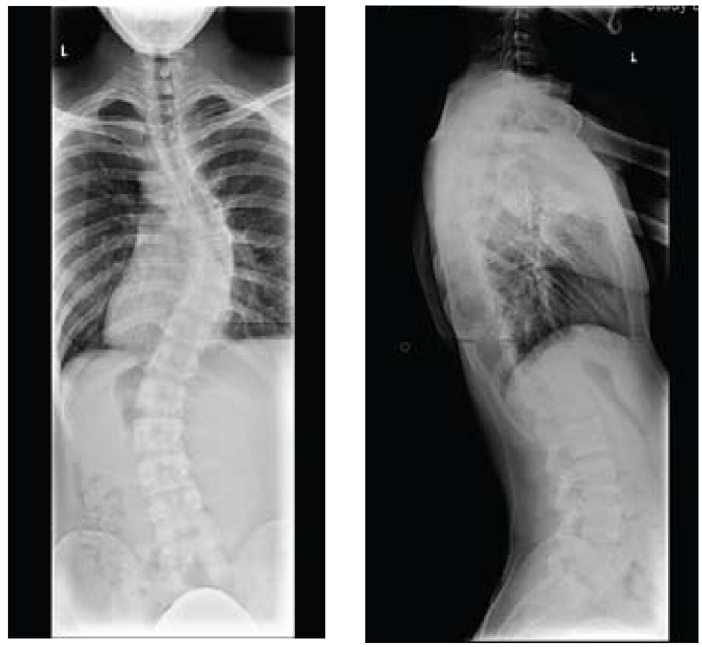


Figure 1: *Preoperative AP and lateral 36 x 14 scoliosis X-rays of triple major idiopathic scoliosis. Lateral film shows fixed thoracolumbar kyphosis secondary to disc degeneration.*

Figure 2: *Postoperative radiographs.*

Case Study: Complex Distal Radial Fracture

Stuart Kuschner, MD

The distal radial fracture is one of the most common injuries to the skeletal system, yet challenging to repair. The injury can be addressed using a variety of techniques, depending on the extent of injury. In addition, there are a wide variety of possible fracture patterns, and no single form of treatment applies to all fractures.

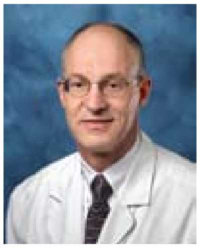
Bilateral distal radius fractures

A male in his early forties was admitted to the emergency room of a local hospital with bilateral distal radius fractures as a result of an automobile accident. He immediately underwent an open reduction internal fixation on the right side. A few months later, he presented to another physician to repair the distal radius fracture on his left side with the same procedure. However, the left side experienced a failure of surgery, which manifested as a severe ligamentous injury at the wrist. The patient then presented to Cedars-Sinai Medical Center with a radial carpal dislocation, and surgical repair was scheduled.

Surgical repair

During the surgical procedure, an incision was made in the old incision via a palmar approach. The fracture site, which had not healed, was exposed. The plate and screws, which were in a suboptimal position to support the fracture site, were removed. The internal fixation was revised by placing the plate and screws closer to the distal end of the radius to provide adequate support to the fracture, and the repair was augmented by the application of an external fixator. Intraoperative X-rays revealed secure internal fixation, reduction of the radial carpal joint dislocation and the external fixator in correct placement.

Currently, the external fixator has been removed and the patient is undergoing his postoperative rehabilitation. His prognosis is excellent.



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Left: *X-ray of radial carpal dislocation after failed surgery to repair distal radius fracture.* ***Right:*** *Postoperative X-ray showing secure internal fixation of the distal radius and reduction of the radial carpal joint.*

The OATS Procedure for Articular Cartilage Injuries

William M. Hohl, MD

Articular cartilage injuries of the knee are common among athletes and active individuals. Such injuries often reveal themselves in knee pain and swelling, or through a joint that occasionally locks or catches, which can severely limit sports, as well as daily activities.

Because articular cartilage injuries do not heal, surgical intervention is often required. A relatively new procedure, the osteochondral autograft transport system (OATS), has demonstrated some noteworthy clinical success.

Drawbacks of marrow stimulation and ACI

Historically, the primary recourse for articular cartilage injuries has been marrow stimulation using the microfracture technique. By penetrating the subchondral bone in the zone of injury with a small awl and creating microfractures that allow blood supply and cells that form fibrous tissue to fill the defect with a fibrin clot, scar tissue is able to form. Unfortunately, this fibrocartilage lacks the strength and durability of normal articular cartilage. In addition, it generally takes up to 12 months or longer for the scar tissue to mature to the point that it is tough enough to tolerate sports activity.

In another common procedure, autologous chondrocyte implantation (ACI), a patient's

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Using fluoroscopic guidance and navigation

Before surgery, it was recognized that – due to the patient's femoral deformity – the intramedullary canal would not serve as a reference during surgery. Navigation could ensure proper alignment of the components, and fluoroscopic guidance would verify the accuracy of the navigated bony cuts.

Tracking arrays for use with the navigation system were applied to the patient's femur at the time of surgery. After the anatomic landmarks on the limb were registered, the computer was used to navigate the distal femoral cut in order to create a neutral mechanical axis for the limb. Fluoroscopic guidance was utilized to verify that the distal femoral cut was perpendicular to the anatomic axis of the femur, creating a neutral mechanical axis. Soft tissues were then balanced, which included releasing the tight tissues on the lateral side of the knee, until a symmetric extension gap was created. Computer navigation then helped to establish the symmetry of the extension gap medially and laterally. A matching flexion gap was created using a cutting block, which allowed for both adjustment of rotation and anterior/posterior positioning. The bones were then prepared to accept the trial implant, and the navigation system was used to verify alignment and motion of the knee. Fluoroscopic guidance again confirmed that the computer measurements were accurate. Finally, the implant was cemented into the knee.

Post-surgery prognosis

Four months post-surgery, the patient experienced minimal pain and was walking two miles every other day with a brisk gait and a stable, well-aligned knee. His motion is zero to 115 degrees, which had improved from a preoperative range of motion from five to 105 degrees. X-rays demonstrated a well-aligned total knee arthroplasty with a neutral mechanical axis on a full-length view from the hips to the ankles. His prognosis for continued durable full function is excellent.

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Postoperative X-ray, full-length view from hips to ankles, shows a well-aligned total knee arthroplasty with neutral mechanical axis.

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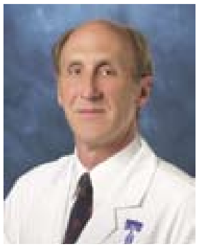
own cartilage cells are harvested from a non-injured portion of the knee during an arthroscopic procedure. The cells are expanded by cell culture in the laboratory and reintroduced into the defect several weeks later during a second procedure. However, biopsy of the site five to seven years later reveals fibrocartilage in the defect rather than articular cartilage. Research is currently underway at many laboratories around the country to perfect this procedure, including the use of special scaffolds to encourage cartilage growth, as well as growth factors that attempt to induce cartilage cells to form tissue more closely resembling hyaline cartilage.

OATS procedure promotes quick recovery

The OATS procedure, also known as mosaicplasty, is suitable for addressing focal cartilage defects no larger than 2.5 square centimeters. In this procedure, donor plugs of cartilage and bone are harvested from a healthy area of the knee via a cylindrical harvester. The plugs are transferred into the defect through an arthroscopic or small open procedure and inserted into the underlying bone of the crater. Often, multiple plugs are needed to fill the crater. While tiny spaces are left in between the plugs, the base of the plugs rapidly heals to the adjacent bone, and the defect is ultimately filled with articular cartilage rather than scar tissue. After OATS, a patient can expect to return to active sports at four months postsurgery.

The potential benefit of this procedure for athletes is demonstrated by the case of a 17-year-old female high school soccer player who presented with pain and swelling in her right knee; an MRI revealed a focal cartilage defect. A highly serious athlete, she and her family chose the OATS procedure in hopes of reducing her recovery time. The procedure was performed on an outpatient basis, and the patient was sent home with a continuous passive motion (CPM) machine and crutches for the first month. Only four months later, she was back on the soccer field playing at her previous high level.

While OATS is not without limitations (it is not suitable for addressing large osteochondral defects), its early clinical success is a promising development for the practice of sports medicine. As the procedure is more widely adopted, long-term follow-up will be essential for a full evaluation of its effectiveness.



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