Hip Arthroplasty Revision with Severe Protrusio and Acetabular Insufficiency

Guy Paiement, MD

Thanks to increases in longevity, many joint replacement patients will now live long enough and remain sufficiently active for their prostheses to require revision surgery after becoming loose. The development of osteoporosis in such patients, however, creates a challenge for the orthopaedic surgeon. Acetabular component revision arthroplasty in patients with poor bone stock requires experience with both joint replacement and acetabular fracture fixation. The following case illustrates the difficulties of such a procedure in a patient with acetabular insufficiency.

Case presentation

In 1997, a thin, 86-year-old woman reported malaise, an abdominal mass and difficulty walking to a general surgeon, who quickly referred the patient to orthopaedic surgery. She underwent a total hip replacement in 1997 that did well until 2007, when she had a revision of both components. She did quite well post-revision until she was allowed to walk bearing her full weight. At this time, she presented at Cedars-Sinai reporting pain on standing and walking, progressive right lower extremity shortening, abdominal discomfort and a mass in her abdomen. At this time, the patient was living independently in a one-story, single-family house with her healthy husband, a retired pathologist. She was understandably very concerned about the abdominal mass.

Neurovascular examination was normal for both lower extremities. The right lower extremity was shorter by 5 cm, kept in external rotation and painful on mobilization. Initial radiological evaluation (AP, iliac oblique, obturator oblique) revealed that the anterior column of the acetabulum and most of the quadrilateral space could not be visualized, but the posterior column seemed intact. The acetabular cup had disengaged from the femoral head and migrated cephalad, medially and anteriorly past the pelvic brim (Figure 1). The so-called firm abdominal mass turned out to be the acetabular cup, easily palpable in the right lower abdominal quadrant.

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Figure 1A and B: AP pelvis and iliac oblique showing that the acetabular cup has disengaged from the femoral head and migrated past the pelvic brim.
Congenital scoliosis is a spinal deformity caused by dysfunctions in embryonal vertebra development that cause lateral deviation and rotation of the spinal column. One or more malformed vertebrae may occur in any part of the spine, and these may be congenitally anomalous formation defects, segmentation defects or combined forms of vertebral anomalies. Severe deformities can diminish lung capacity, put pressure on the heart and result in premature death, or simply cause severe imbalance of the spine.

**Improved surgical procedures**

Hemivertebra, in which an extra piece of vertebra causes the curvature, is the most typical cause of congenital scoliosis spine deformation. Corrective options include fusing in situ (without correction) or resection of the anomalous vertebral body and fusing the affected part of the spine. In the past, this was a highly invasive procedure that required opening a patient both anteriorly and posteriorly to find the piece of bone and excise it from both sides for a correction.

During the past decade, several techniques for localized correction of hemivertebra have been introduced. These less invasive procedures have proven especially effective when performed early. Dr. Jürgen Harms, Medical Director of Orthopaedics and Spinal Column Surgery at Klinikum Karlsbad-Langensteinbach in Germany, pioneered a technique of hemivertebra resection by a posterior-only approach, allowing for removal from a single small incision. Over the past six years, surgeons at Cedars-Sinai have performed many such posterior hemivertebra resections.

**Benefits of early intervention**

Early intervention in congenital scoliosis prevents the development of severe local deformities and secondary structural changes in patients with expected deterioration. Posterior resection of the hemivertebra allows for corrective surgery to be performed on children as young as one year. In a very young patient, a short fusion is possible and achieves an excellent correction of the main curve. The result is normal growth in the unaffected parts of the spine.

**Case study**

An 18-month-old girl presented with a clear congenital scoliosis. Her X-rays showed a 45-degree kypho-scoliotic lumbar curve with a hemivertebra on the left side between L1 and L2. This curve put the patient out of balance and was noted to have progressed.

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An incision was made from the spinous process of T12 to L3. The lamina from L1 to L2 were exposed and 3.5 mm pedicle screws were inserted into L1 and L2 on both sides. A stabilizing rod was inserted on the right side. The hemilamina was then resected, exposing the dura and pedicle. The exiting nerve root was carefully protected. The top of the pedicle was opened, and a curette was utilized to remove the cancellous bone from the pedicle and hemivertebrae. The walls of the pedicle and hemivertebrae were then resected with rongeurs and curettes while protecting the dura. A second rod was inserted and closure of the defect was gently performed, correcting both the scoliosis and kyphosis.

Postoperatively, the patient was maintained in a thoracic lumbosacral orthotic brace for three months.

A recent follow-up with the patient, now age seven, confirms a complete correction of the deformity and normal growth. Her overall balance is excellent and there has been no further progression of her curve. She has no pain, excellent mobility of her lumbar spine and participates in many sports and activities.

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Duplex ultrasound examination revealed that both the iliac artery and vein were located behind the cup, displaced but not kinked. The right ureter was not visualized.

Surgical planning was especially important in this case, since the removal of the acetabular cup could be very difficult and fraught with dangerous complications if one used a posterior or an anterior approach. The patient was put supine and a right ilioinguinal approach with the leg draped free was used—allowing excellent access to the anterior column and the pelvis above its brim. The cup was found lateral to the medially displaced iliacus muscle and neurovascular structures. The anterior column was then bridged with a 3.5 mm titanium reconstruction plate anchored to the superior pubic ramus and the inner iliac wing (Figure 2).

The incision was closed in a standard fashion with a drain left under the iliacus muscle. The patient was then repositioned in a left lateral decubitus position on a peg board table, and prepped and draped for a standard posterolateral approach. The femoral component was found to be solidly fixed and the posterior column in continuity, with good bone stock over the dome. A large trabecular metal cup was then inserted, resting on the posterior column and dome and pressing on the anterior titanium plate. The cup was secured in proper position with screws in its posterior superior quadrant.

Both femoral and sciatic nerves were functioning normally postoperatively, and the patient did not develop postoperative complications. She was kept touch-down weight-bearing for 12 weeks, followed by progressive weight-bearing as pain allowed.

At her six-month follow-up visit, the patient was not taking any pain medication, was full weight-bearing with a mild abductor lurch for which she was using a cane. Radiographs showed that the cup had not moved and there was suggestion of bony ingrowth over the dome and a bony shell medially (Figure 3).

**Figure 2:** Obturator oblique view of the right hip shows the plate bridging the anterior column and well-anchored on the superior pubic ramus and the ilium. A large trabecular metal cup was inserted through a posterior approach.

**Figure 3:** Radiograph at six-month follow-up shows prosthesis is located and has not migrated. There is suggestion of bony ingrowth over the dome and new bone formation over the cup.
Stem Cells from the Intervertebral Disc: Do They Vary in Degeneration?
Zulma Gazit, PhD

Degenerative disc disease is known to be an aberrant, cell-mediated functional degradation of the tissue in response to progressive structural failure that has been linked to aging, genetics, inadequate metabolite transport, loading history, smoking and other environmental factors. Despite decades of research, a fundamental, multidisciplinary mechanistic understanding of disc degeneration is lacking and, consequently, robust clinical therapies which target the underlying causes rather than the symptoms are still in the earliest stages of development.

Stem cells have been found in numerous adult tissues including bone marrow, adipose tissue, central nervous system, heart, muscle and more [1-5]. It is widely accepted that adult stem cells maintain the homeostasis of the tissue they reside in and also play a major role in regeneration following injury. There are some indications that in certain pathologies, resident stem cells lose some of their ability to proliferate and differentiate. These effects could lead to the loss of tissue homeostasis and its ability to regenerate itself. For example, osteoporosis may be related to changes in the differentiation potential of stem cells, especially from the bone marrow. Mesenchymal stem cells isolated from osteoporotic patients show an increased abnormal differentiation pattern towards adipocytes [6]. Thus, there is a possible link between changes in stem cell differentiation and the unbalanced bone homeostasis seen in osteoporosis.

We have recently shown that resident stem cells exist in the intervertebral disc, even in its degenerated state [7]. Therefore, we asked whether the process of disc degeneration affects stem cells, which reside in the nucleus pulposus, and prevents them from regenerating the disc tissue. Using a recently awarded National Institute of Arthritis and Musculoskeletal and Skin Diseases RO3 grant, we intend to investigate whether resident intervertebral disc degeneration affects the number and differentiation potential of stem cells that reside in the nucleus pulposus. Specifically, we will compare stem cells isolated from healthy and degenerated discs of mini pigs. We have already established a disc degeneration model (Fig. 1) in which the nucleus pulposus tissue is separated from the annulus fibrosus, and stem cells are isolated from the healthy and degenerated discs.

The results of this study could be the first step in understanding why resident stem cells do not reverse the degenerative process within the disc — and may indicate possible routes for future therapies aimed at producing disc regeneration. If disc stem cells are found in very low numbers in the disc, exogenous introduction of stem cells from other sources, such as bone marrow or adipose tissue, could be beneficial for disc regeneration. However, if disc stem cells do maintain some differentiation potential, they might be induced to regenerate the disc by the delivery of certain genes, proteins or small molecules.

The study described above is conducted by Dr. Gazit in collaboration with Drs. Wafa Tawackoli, Gadil Pelled, Dan Gazit and Hyun Bae, all at Cedars-Sinai.

References