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Dear Colleague,

I am pleased to share with you the Spring 2011 edition of Orthopaedic Insights, which highlights our integrative approach to clinical care, research and academics.

In this issue, you will find a sampling of our latest work, including a discussion of the pathoanatomy, diagnosis and treatment of posterolateral rotatory instability of the elbow by Dr. Steven Maschke on p. 10. On pp. 4-5, we provide a roundup of recent research being done by Drs. Steven Lietman, R. Tracy Ballock, Wael Barsoum and George Muschler within the Orthopaedic and Rheumatologic Research Center, which is celebrating a decade of growth and success.

On p. 6, you can read about Cleveland Clinic’s Joint Replacement Registry, which has been developed to monitor patient outcomes, improve quality and track revisions through the collection of a variety of data elements on all primary and revisional total joint replacement procedures. We also pay tribute to the career of Dr. Alan Gurd (pp. 12-13), who in his 30 years at Cleveland Clinic has made significant contributions to the field of pediatric orthopaedic surgery. We appreciate his years of service and congratulate him on his many successes. His son, staff pediatric orthopaedic surgeon Dr. David Gurd, also provides an overview of adolescent hip dysplasia and femoracetabular impingement on p. 14.

These articles exemplify how orthopaedic surgeons at Cleveland Clinic strive to find innovative ways to continually provide better care for our patients. Our Orthopaedic Department, ranked among the top four in the nation by U.S. News & World Report, unites orthopaedic specialists, medical musculoskeletal experts, musculoskeletal radiologists, biomedical engineers to streamline the assessment and management of musculoskeletal diseases and create new opportunities for research and training.

I hope that you enjoy this issue of Orthopaedic Insights, and find the information useful in your practice. Please do not hesitate to contact us with questions or for more information on how we can help you as you care for your patients.

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Though it is clearly laudable and beyond dispute, the devil is in the details regarding how we can take what is arguably excellent healthcare and eliminate unnecessary or duplicative care, and still end up with outcomes at least as good as, or better than, they are today. And let’s face it; orthopaedic surgeons deliver excellent care of tremendous perceived benefit, so any changes offered should be certain not to impact that core fact. Nonetheless, it seems there is a rising chorus of concern that the current cost structure is untenable and efficiencies must be realized. Our task is to identify opportunities to deliver great care while utilizing fewer resources and that has been the mission of our group, the Service Line Cost Management Group.

We have convened a high-level, multidisciplinary team of physicians, nurses, pharmacists, administrators, researchers, managers and finance experts to dissect out our current process of delivering primary joint replacement surgery, with the goal of identifying process improvement opportunities that can reduce cost, improve throughput, improve outcomes, or some combination of all three. By objectively looking at each supply and process, as well as the time and personnel involved, we have been able to identify a number of variations in the historic processes of care delivery that do not seem to result in attendant outcome variation, specifically improvement in outcomes. That is, variations in input, sometimes quite disparate in resource utilization and cost, do not appear to be associated with improved quality, and as such, their value comes into question. Opportunities have been found in standardization of pulls for the OR, in rationalization of implant selection, in concurrent versus sequential processes, and in elimination of wasted steps, diagnostic tests or procedures. Key to the methodology is the transparent presentation of data to the surgeons and other stakeholders with opportunity for input throughout the various phases of analysis.

Underlying this effort is a well-stated and succinct mission statement that clearly recognizes the role of healthcare institutions in driving cost reduction and quality improvement in medicine. We have rallied our teams under the mantra that quality care derives from the intelligent application of the right care at the right time. Perhaps the most important result of our work to date is not the savings and improvement that we have already seen through this collaborative approach, but rather that we have set the stage for further work in this area, having identified that many of the methods that we use and the preferences for care delivery that we hold sacred, though effective are not inviolable. Change can be difficult, but it is attainable, if we keep the patients at the center of our decision making.

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OR Efficiency: Optimizing Use of Resources

By Mark I. Froimson, MD, MBA, Brian Thomas, MBA

The current buzzword permeating medicine today is ‘value,’ and orthopaedics is not immune to being swept up in this epidemic. Its appeal is unmistakable: the intelligent utilization of our scarce healthcare resources, mobilized effectively toward the ultimate goal of improving health related outcomes of our interventions. Stated more simply, we want to improve quality while reducing cost.
The Orthopaedic and Rheumatologic Research Center was established in 2001 with a two-part mission that remains unchanged:

• To advance the health and treatment of people with disorders of the musculoskeletal system through basic and applied research.

• To prepare future leaders, in musculoskeletal care, research and education.

Founded as an open, integrated network organization, which was grounded in an initial partnership between the Department of Orthopaedic Surgery and the Department of Biomedical Engineering, the ORRC has grown to now include 53 members representing 14 departments and centers across Cleveland Clinic. Despite recent constraints on National Institutes of Health funding, the research-funded expenditures by ORRC members has continued to increase, and in 2010 totaled more than $16 million across the institution.

While the research taking place is highly varied, crosses many department and institute boundaries, and is often technically complex, the operational model for productivity within the ORRC is relatively simple. The ORRC seeks to:

1) Mobilize and facilitate interdisciplinary teams.  
2) Develop a culture of interdisciplinary collaboration and training.  
3) Develop the infrastructure that is need to accelerate research.  
4) Respond to strategic opportunities (e.g., new grants, recruiting and clinical programs)  
5) Promote and represent ORRC investigators.  
6) Inspire commercial and philanthropic partnerships.

Each of the ORRC members contribute significantly, and create a network that is truly greater than the sum of its parts. In this issue of Orthopaedic Insights, we highlight the work of four exceptional orthopaedic surgeons making a difference for their patients every day, while also modeling the highest goals of the ORRC – developing teams that explore new knowledge and therapies while mentoring future leaders.

**STEVe LIETMAN, MD**, is Director of Musculoskeletal Oncology within ORI.  
Dr. Lietman's research group focuses on understanding the mechanisms of bone resorption and osteoclastogenesis, which may facilitate the development of novel strategies and new treatments for osteoporosis and bone tumors.  
His team has used cherubism, a rare disorder characterized by giant-cell bone resorptive tumors of the mandible and maxilla, to explore novel pathways that regulate osteoclast development and function (bone resorption). We believe that several agents we have discovered can decrease bone resorption and may improve the healing of bone defects.  

Dr. Lietman's team includes investigator Chun Fan, MD, PhD. Their group is supported by two active NIH grants: a $1.7 million R01 grant and a $600,000 K02 grant. Their work also is supported by the David C. and Debra G. Humphreys Family and Dr. Lietman is the recipient of the Orthopaedic Research and Education Foundation Career Development award.  

**R. TRACY BALLOCK, MD,** is the Director of Pediatric Orthopedics and Professor of Surgery at the Cleveland Clinic Lerner College of Medicine.  
Dr. Ballock's research group focuses on understanding how systemic hormones and local signaling networks interact to regulate the growth of long bones at the growth plates of children.  
His laboratory is funded by the NIH in a project entitled, “The Interactions Between the Thyroid Hormone and Wnt Signaling Pathways in the Growth Plate.” The laboratory also is funded by the Musculoskeletal Transplant Foundation to perform translational studies of growth plate regeneration in attempt to provide a lasting biologic solution for children whose growth plates are irreversibly damaged by trauma,
infection or irradiation.

Dr. Ballock’s team includes PhD investigators Drs. Lai Wang and Yvonne Shao, as well as third year medical student Rachel Randall, who recently was invited to speak about her research project on the molecular regulation of columnar architecture in the growth plate to many of the most accomplished cartilage researchers in the world at a Gordon Research Conference in Ventura, Calif.

Major accomplishments of the Ballock lab include the Kappa Delta Award for Orthopaedic Research from the American Academy of Orthopaedic Surgeons and the Arthur B. Huene Award from the Pediatric Orthopaedic Society of North America.

WAEL BARSOUM, MD, Vice Chairman of Orthopaedics, specializes in adult reconstructive surgery. He also serves administratively as the Chairman of Surgical Operations at the Cleveland Clinic main campus.

Dr. Barsoum’s research group focuses on clinical outcomes research, including risk factor detection and management of co-morbid factors that influence patient safety and the success of clinical therapies, clinical trials and predictive modeling, along with translational research projects using robotic and computer modeling.

Major sources of funding include the American Geriatrics Society, the Orthopaedic Research and Education Foundation, the state of Ohio Third Frontier Grant, Stryker Orthopaedics as well as several other corporate sponsors, and private donations.

Dr. Barsoum’s team includes PGY-4 resident David Joyce, MD, foreign medical graduate research fellows Alejandra Tellez, MD, Fady Yousef, MD, and Yousef Shishani, MD, postgraduate research fellows Travis Smith, DO, and Bishoy Gad, MD, third-year medical student Leonard Buller, administrative program coordinator Alison Klika, MS, research coordinator Valerie Lewis, and research assistant Caleb Szubski, BA.

Major accomplishments include receiving an OREF Research Grant, the Dennis W. Jahnigen Career Development Scholar Award from the American Geriatrics Society as well as Cleveland Clinic Innovator Awards in 2004, 2006 and 2007.

GEORGE MUSCHLER, MD, serves as Director of the ORRC and Vice Chairman of the Orthopaedic and Rheumatologic Institute and specializes clinically in adult reconstructive surgery and the treatment of fracture non-union. He also is a leading scientist and voice in the rapidly advancing field of Regenerative Medicine, from basic research through clinical application, running a lab that has received continuously federal funding since 1996.

Dr. Muschler’s laboratory includes two post-doctoral fellows, four PhD students and two master candidates. The laboratory is best known for developing rapid methods for harvest and processing of a patient’s own cells for regeneration of bone and other tissues.

Other important contributions include the development of improved automated methods for assay of progenitor cells and the development and testing of innovative bone scaffolds that enhance the survival and function of transplanted cells. More than 28,000 patients have been treated using methods that Dr. Muschler developed.

Beyond Cleveland Clinic, Dr. Muschler has served as a leader in developing successful multi-institutional collaborative translational networks. He is the founding director of Clinical Tissue Engineering Center (CTEC), an Ohio-based network. He also serves as a Co-Director of the Armed Forces Institute of Regenerative Medicine (AFIRM), a national network of more than 28 leading institutions that is funded by the Department of Defense and dedicated to the acceleration of development of improved therapies to serve wounded warriors.
The value of hip and knee arthroplasty is undeniable, particularly to the patients who are recipients of such care. Patient’s lives are restored through the reliable alleviation of pain and restoration of function. Nonetheless, despite its success in general, there is some variability in the outcomes of these procedures. Simply stated, not all joint replacement procedures end up with the same outcomes. Patients, as well as providers and payers, want to know which procedures are most reliable in general and most suitable to a particular disease presentation. Understanding what drives the reliability or variability in outcomes around these procedures is, therefore, of great interest and a high priority.

2010 Technical Direct Cost per Primary Total Hip Replacement by Surgeon & Resource Group
(De-Identified Data)
The Cleveland Clinic section of Adult Reconstructive Surgery is dedicated to providing optimum quality of care and assessing the outcomes of the procedures that we perform. Despite the fact that joint replacement surgery is widely regarded as a highly successful and effective procedure to treat end-stage arthritis of the hip and knee, it is becoming increasingly important to develop effective strategies to systematically document the quality of the care we provide. The Cleveland Clinic Joint Replacement Registry has been developed to monitor patient outcomes, improve quality and track revisions through the collection of a variety of data elements on all primary and revision total joint replacement procedures. By collecting such data, variations in outcomes can be identified that may be due to any of the factors tracked, and if it becomes apparent that outcomes are positively or negatively impacted by any specific variable, this can be verified and clinical care can be modified accordingly.

There are a large number of potential factors that may have an impact on the outcomes of joint replacement, and these can be loosely categorized into patient-related, provider-related, and implant-related factors. Although joint replacement registries often have had an implant-centered approach with a primary aim of differentiating between implants of various designs, there is increasing recognition that the effectiveness of an implant may be influenced by patient and provider differences. Patient-related variables including age, gender and medical co-morbidities can affect the performance of an implant or procedure, as can the environment or system of care offered by a surgeon or hospital system. By systematically collecting variables within each of these domains and then correlating the data from this registry with patient-reported and objective measures of procedure outcome, the relative merits of various competing strategies can be assessed.

In addition to collecting data at the local level of our hospital and health system, Cleveland Clinic recently has engaged in several collaborative endeavors that promise to leverage our data over a broader array of stakeholders, thereby improving the utility of this approach. Collaborating with a group of healthcare systems whose focus is on the efficient delivery of quality care, Cleveland Clinic is pooling its intelligence with others to help establish care pathways that are widely agreed upon as encouraging the rational application of resources for optimum outcomes. In addition, as one of 15 pilot sites for the American Joint Replacement Registry, we recently have completed our due diligence around critical areas of patient privacy and data usage that will allow us to help participate in paving the way for a national quality improvement effort. The key to success of such a broad endeavor is to clearly define the responsibilities and obligations of both the health system and the national registry to enable and encourage broad participation. Tools, procedures and methods are being developed to ensure accurate acquisition of patient and implant data that will be used to track survivorship of implants throughout the life of the implant. Similar national efforts in a number of other countries provide guidance for moving forward and have proven the utility of coordinating such efforts on a national level.

By focusing on the drivers of quality and by pooling our resources with others in the quest to identify those factors that constitute best practices for delivering joint replacements to our patients, we hope to contribute to making those key drivers of success more clearly understood and, consequently, the procedure more reliable. Clearly, this is a never ending cycle that depends on high quality, and ever-improving access to data.

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A 36-year-old male presented with left hip pain that he has been experiencing for a year, with clinical findings suggesting an intraarticular source of pain. A routine noncontrast MR exam was performed on a 3-Tesla MR machine (Siemens Verio) using multichannel surface coils over the affected hip. The images demonstrate a linear cleft of high T2 signal between the triangular-shaped acetabular labrum and the acetabular margin, indicating a labral tear (Figure 1). The normal appearing articular cartilage also is well demonstrated using the normal joint fluid as a source of image contrast without the need for intraarticular gadolinium (Figure 2).

Since outcomes for surgical treatment of acetabular labral tears are related to the status of the articular cartilage, obtaining high-quality assessment of the articular cartilage is important preoperatively. The 3-Tesla MR system has a magnetic field strength that is two to three times stronger than the standard high-field systems, allowing one to obtain images with much greater signal to noise ratios and at higher speeds. In combination with multichannel coils, newer software and new imaging sequences, this allows the acquisition of images with significantly higher resolution of small structures. The resolution and image contrast can allow evaluation of intraarticular structures without intraarticular contrast injection. The result is greater diagnostic certainty and ultimately better patient care.

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First metatarsophalangeal arthrodesis has long been considered an excellent treatment option for hallux rigidus, severe hallux valgus, failed hallux valgus surgery, failed implant arthroplasty, and previous failed arthrodesis of the first metatarsophalangeal joint. It is currently the most common procedure for arthritis of the first MTP joint. Despite the loss of motion, pain relief is predictable and most patients are very satisfied. It has a long history of excellent results, and many techniques have been described to accomplish this procedure. An ideal arthrodesis technique would be easily reproducible, achieve a high union rate and have a low rate of complications. Regardless of implant, the goals of each technique are the same: remove the diseased cartilage, preserve length of the toe and offer stable fixation of the joint.

A new implant, the Hallu-X™ Intramedullary Fusion Device, is now being used to achieve fusion. The device, developed by investigators here and at Brown University in collaboration with industry, allows better compression because the implant is placed more to the tension side of the arthrodesis and also reduces skin and hardware-related complications of a dorsal plate. This technique should theoretically reduce hardware complications and skin irritation as well as provide stable fixation and compression through the central axis of the joint. This implant, which received FDA approval in 2009, has been shown in biomechanical studies to be 1.5 times stronger than multiple screw constructs and 3.5 times stronger than dorsal plate constructs.

In order to study the theoretical benefit of this implant, a retrospective clinical study has been performed at Cleveland Clinic. Twenty four consecutive cases of first metatarsophalangeal arthrodesis using the Hallu-X system for first metatarsophalangeal fusion over a two-year period, 2008 to 2009, were reviewed. The outcomes were analyzed based on rate of radiographic union, patient’s preoperative and postoperative pain scores, and rate of complications, specifically looking for superficial and/or deep wound infections and hardware irritation, as well as hardware failure and nonunion. The average follow-up was 16 months (range five to 39 months). The most common indication was hallux rigidus. All patients had failed nonoperative management prior to surgical intervention. Postoperatively patients were kept in a cast nonweightbearing for three weeks. After the initial three weeks, progression to full weightbearing in a walking boot was achieved over the next four weeks.

Of the 24 feet reviewed, union was achieved in 23 of the 24 cases (95.8 percent). The average time to fusion was three months. The average preoperative pain score (VAS analog method, 1 to 10) was 5.92 and the average postoperative pain score was 1.72. The average reduction in pre- and postoperative pain scores was 4.2. Fourteen patients reported their score as 0 or 1 and six reported their pain as a 2. One patient had a nonunion with hardware breakage. No other complications were noted including no hardware irritation, no hardware removal, and no superficial wound infections.

These short-term results show that first metatarsophalangeal arthrodesis with use of a novel intramedullary screw technique produces excellent fusion results as well as excellent patient reported pain outcomes.

About the Authors
Dr. Arndt is a fellow in the Orthopaedic Surgery Department at Cleveland Clinic. Dr. Berkowitz is an orthopaedic surgeon who specializes in lower extremity trauma and all conditions of the foot and ankle including arthritis, tendon and ligament problems. He can be reached at 216.444.7607 or berkowm@ccf.org.
INTRODUCTION:

Simple elbow dislocations occur from a fall onto the outstretched hand with a combination of valgus stress, supination of the forearm and axial load through the elbow joint. O’Driscoll and colleagues defined a circular failure of the soft-tissues from lateral to medial. The degree/severity of soft-tissue disruption leads to a spectrum of instability from joint subluxation to complete posterior dislocation of the radius and ulna relative to the humerus. The vast majority of simple elbow dislocations (those without bony injury) can be successfully treated non-operatively with protected motion under the guidance of an occupational or physical therapist. A pain-free, stable and fully functional elbow should be expected with a modest loss of terminal extension anticipated.

RECURRENT INSTABILITY:

Recurrent instability of the elbow is uncommon following simple dislocation. When it does occur, it most frequently involves the lateral ligamentous structures as originally described by Osborne and Cotterill. O’Driscoll et al. further investigated this concept and defined posterolateral rotatory instability (PLRI) of the elbow. Biomechanical studies have defined the ulnar portion of the lateral collateral ligament (LCL), known as the lateral ulnar collateral ligament (LUCL), as the essential lesion leading to this chronic form of elbow instability. The LUCL is a thickening of the LCL complex that originates on the lateral condyle of the humerus at the isometric center of rotation on the lateral side and inserts upon the proximal ulna at the supinator crest. The LUCL both stabilizes the lateral side of the elbow and acts as a posterior buttress to the radial head.

CLINICAL PRESENTATION:

The clinical presentation and evaluation of patients with PLRI can often be vague and present challenges to arriving at the correct diagnosis. The patient will frequently have a history of one or more elbow dislocations that either spontaneously reduced or required sedation and closed reduction in the emergency room. Iatrogenic injury during surgical procedures on the lateral side of the elbow also can lead to PLRI. The patient will complain of painful clicking, snapping or catching of the elbow and a sense that the joint is sliding out of place, especially in the position of elbow extension and forearm supination. Initial clinical evaluation will reveal a normal appearing elbow with full, painless motion and minimal tenderness. Special tests for PLRI have been described, but can be challenging to perform in an awake patient. The patient’s apprehension to the maneuvers is often the best predictor and should raise one’s suspicion for PLRI. Pain and apprehension with rising from a chair using the arm rests is another easy test to help arrive at the correct diagnosis. MRI is the imaging of choice for further evaluation. Disruption of the LUCL should be evaluated as well as any marrow changes in the capitellum, possibly indicating recurrent subluxation of the radial head. Finally, an exam under anesthesia can provide the definitive evidence of PLRI (Figure 1).
TREATMENT:
Surgery is indicated in symptomatic cases of recurrent elbow instability. Repair of the soft-tissues is not possible given the chronicity of the injury, and thus reconstruction of the LUCL is required. A Kocher approach to the lateral elbow is undertaken with evaluation and confirmation of attenuation of the lateral ligamentous complex – specifically the LUCL. Reconstruction can be undertaken utilizing either autograft (e.g., Palmaris longus) or allograft (e.g., plantaris). The critical elements are to place the graft at the isometric point of the lateral elbow and tension the reconstruction appropriately. Our preferred technique is to pass the graft through converging drill holes along the supination crest and “dock” the humeral insertion (Figure 2). We tension the graft with the elbow at 90 degrees of flexion and the forearm in pronation. Incorporating the anterior limb of the graft with the anterior joint capsule is critical to help re-establish the “buttress” to the radial head (Figure 3).

Rehabilitation is undertaken with five to seven days with the elbow protected in a hinged brace, with the forearm in full pronation and initial extension blocked at 60 degrees. The extension block is relieved to 10 degrees weekly under the supervision of a therapist, and active/passive pronation and supination of the forearm is undertaken daily with the elbow at the patient’s side and at 90 degrees of flexion. Accurate diagnosis and appropriate reconstruction should eliminate recurrent instability and restore the patient’s confidence in a pain-free, stable elbow.

About the Author
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Above and Beyond

Pediatric orthopaedic surgeon Alan Gurd, MD, marked career by going extra mile

"Way back in Belfast, there was an orthopaedic surgeon and it was probably because of him that I got in orthopaedics: Bob Wilson, a marvelous man,"

IT ALL STARTED WHEN ...

Growing up in Ireland — the son of a banker, ironically — he's not sure what spurred him to choose a medical profession. There was no one in his family in medicine.

He entered the School of Medicine at Queen's University in Belfast in the 1960s and set his sights on becoming a surgeon. He did his residency in general surgery at Belfast, took his fellowship exam at The Royal College of Surgeons of Edinburgh, Scotland, and returned to Belfast for his orthopaedic residency, also obtaining a master's of surgery degree there.

It is the tale of two Bobs that led him into his specialty and, undoubtedly, laid the foundation for his future humanitarian efforts.

When asked who influenced him most in his work, he says:

"Way back in Belfast, there was an orthopaedic surgeon and it was probably because of him that I got in orthopaedics: Bob Wilson, a marvelous man," Dr. Gurd says. "The reason I went into children's orthopaedic surgery was Bob Salter."

In 1972, he was accepted to do his pediatric orthopaedics fellowship under Robert Salter, MD, at The Hospital for Sick Children in Toronto, Canada. Dr. Salter, who started his medical career as a medical missionary, was a world-reknown orthopaedic surgeon.

"He was just a fountain of knowledge," Dr. Gurd says. "I learned the principles and practice of treating children. He was a very kind, thoughtful man, so I learned how to treat families, how to talk to parents."

Soon after going back to Belfast, where he and his wife, Ruth Imrie, MD, had teaching positions at The Royal Victoria Hospital, he was called abroad again.
On the recommendation of Dr. Salter, he was invited to Cleveland Clinic by Roy Collins, MD, then chairman of the Orthopaedic Department (now the Orthopaedic and Rheumatologic Institute) to set up a section of children's orthopaedic surgery.

At that time, there were only about 50 surgeons in North America who exclusively did orthopaedic pediatric surgery, Dr. Gurd says. “I think I relate to children much better than older people,” he says. “I wasn’t interested in doing hip joints and that type of surgery.”

PRACTICING WHAT WAS PREACHED
In 1976, Dr. Gurd and his young family set out for America, making their home in a rural suburb of Cleveland.

A large percentage of his practice was managing children with cerebral palsy and spina bifida.

“Those are very challenging, because they can’t be cured,” he says. “Some of the problems that occur in children with respect to their hips and spine can be challenging also.”

He remembers being moved by many of the families’ ordeals. “Above all, you must have compassion for the children and their parents,” he says. “They often get angry with the doctor when it has nothing to do with the doctor. Not everything goes as perfectly as you hope.”

He expresses gratitude to Cleveland Clinic for allowing him another opportunity to help others — practicing for brief periods in Ethiopia, Haiti and Honduras to perform surgery, but mostly to teach.

“The first time I was in Ethiopia there was a civil war going on,” he says. “We were well-protected in the hospital, though. … If there’s gunfire going on in part of the city, you don’t go watch, you go the other direction.”

A LIFE OF RETIREMENT?
Dr. Gurd retired in 2006 after 30 years of full-time work for Cleveland Clinic. However, at age 70, he continues his Monday evening clinics.

He passed the mantle to his son, David Gurd, MD, who is a pediatric orthopaedic surgeon at Cleveland Clinic’s main campus and Willoughby Hills Family Health Center. Wife Ruth is a pediatrician at Cleveland Clinic Solon Family Health Center. The couple have three children living in Ohio.

Family time is a great release for the stress of the job, as is playing racquetball and golf. He also is active in his church and has served as team doctor for the local high school football program since 1976, another role largely taken over by David.

“I still go to every game,” he says.
Many abnormalities can occur, both with injury and congenitally, that will impact the function and alignment of the hip joint. Ideally, and in most cases, the hip ball-and-socket joint is formed by a femoral head that has a nice spherical shape covered with smooth cartilage and is matched symmetrically by the acetabulum, allowing for uninhibited motion and even distribution of weight-bearing stress. However, congenital and traumatic changes can alter this anatomy. If motion is inhibited or stresses are not evenly distributed, irritation and injury to the cartilage will occur, leading the hip down the degenerative pathway. Often times, dysplasia is identified as a newborn or young child and treated accordingly. Other times, dysplasia may not be evident until later in life, most notably in adolescence or young adulthood. The most common clinical finding is groin pain, especially with prolonged walking and activity. Radiographs are useful for diagnosis. In order to help prevent the progression to arthritis, treatment is indicated as hip dysplasia is still the main diagnosis requiring hip replacement. Nonoperative treatment does not benefit hip dysplasia. Surgery can help to gain acetabular coverage and improve the distribution of stress within the joint. A newer procedure, termed a

Preservation of the Hip Joint

By David P. Gurd, MD

Figure 1 – Drawing of a normal hip joint with the femoral head located within the acetabulum.

Dysplasia of the hip occurs when there is deficient development of the acetabulum. Less of the femoral head is in contact with the acetabulum leading to a poor distribution of stress. Point pressures develop and cartilage injury occurs, leading the hip down the degenerative pathway. Often times, dysplasia is identified as a newborn or young child and treated accordingly. Other times, dysplasia may not be evident until later in life, most notably in adolescence or young adulthood. The most common clinical finding is groin pain, especially with prolonged walking and activity. Radiographs are useful for diagnosis. In order to help prevent the progression to arthritis, treatment is indicated as hip dysplasia is still the main diagnosis requiring hip replacement. Nonoperative treatment does not benefit hip dysplasia. Surgery can help to gain acetabular coverage and improve the distribution of stress within the joint. A newer procedure, termed a

Figure 2 – A. Radiograph of the pelvis with left hip dysplasia in a 16-year-old male.

B. Improved coverage of the femoral head after a periacetabular osteotomy and screw fixation.
Ganz periacetabular osteotomy, can allow for mobilization of the acetabulum through a single incision while avoiding muscular damage and allow for early mobilization without the use of a cast. This procedure can help to alleviate the groin pain and prolong the life of the native hip joint.

Femoroacetabular impingement is defined by a bony block, either on the acetabulum or femoral head, which limits joint motion and causes groin pain. This impingement, or abutment of the bone, typically causes pain with hip flexion and adduction. This is due to the typical position of the impingement lesion and can be tested by performing an impingement test. The concern with femoroacetabular impingement is that with certain activities, this bony lesion can irritate and damage the cartilage, leading to a similar pathway of degenerative changes. Over time, groin pain is likely to worsen as the cartilage continues to be damaged. Radiographs and magnetic resonance imaging (MRI) are useful for diagnosis and defining the problem anatomically. Anti-inflammatories may diminish the discomfort, but will not prevent further damage. Physical therapy and stretching also cannot prevent this, and may even worsen symptoms. Procedures have been developed that can reshape the femoral head and/or acetabulum to recreate more normal anatomy. This will improve hip motion and diminish discomfort by removing the impingement lesion. Surgery for this can be performed both arthroscopically or open with benefits to each.

Normal and active people may have underlying changes within the hip joint that can lead to degenerative changes and pain. If left untreated, these mild pains can become debilitating pains that can limit motion and function. Due to our better understanding of these issues, newer techniques have been developed to help diminish discomfort and prolong the life of the native hip.

About the Author
Dr. Gurd is a pediatric orthopaedic surgeon with special interest in hip disorders and spine deformity. Physicians may contact him at 216.445.8001 or gurdd@ccf.org with any questions.
The Vertebral Body: a Superior Site for Harvesting Marrow Cells

By Robert F. McLain, MD

Successful spinal fusion surgery often depends on creating a solid and substantial bony fusion in the affected area. Autograft bone, the most commonly used fusion material, has traditionally been aspirated from the iliac crest, a rich source of autologous connective tissue progenitor cells (CTPs) – osteogenic stem cell precursors. The iliac crest is considered the gold standard for harvested graft material. However, iliac crest autograft harvesting is associated with considerable morbidity and chronic pain in many patients.

Within the past five years, Cleveland Clinic Center for Spine Health surgeons have pioneered an alternative source of CTPs, the vertebral body cancellous reservoir, and have found it to be an even richer source, with significant advantages over the iliac crest.

ILIAC CREST POSES CHALLENGES

Iliac crest harvesting has a number of limitations: This site is not easy to access, it may have been harvested previously and it may have relatively small cancellous volume for marrow aspiration. Moreover, iliac crest bone volume may be inadequate to complete the fusion when patients require long, extensive fusions or revision surgery after a previous graft harvest; have paralytic deformities that require fixation into the pelvic wings; or have undergone pelvic radiation. Even when autograft material is sufficient, iliac crest harvesting involves stripping the outer cover of connective tissue to get to the bone, which can be painful and debilitating and can predispose patients to serious complications. Consequently, patients are often reluctant to have bone taken from the hip.

Vertebral marrow harvesting is accessible to surgeons only during specific surgical procedures, such as instrumented spinal fusions, that depend on fusion for clinical success. The cells can be harvested from the pedicle screw site, which prevents other tissue from exposure to added trauma. Removal of the marrow progenitor cells does not compromise the mechanical integrity of the vertebral body and can be accomplished without incrementally increasing surgical risk. Because entry into the vertebral pedicle can be achieved without disrupting the facet joint or the articular tissues, it is feasible to use this point of access to harvest marrow cells for uninstrumented fusions as well.

Bone morphogenetic proteins (BMPs) present yet another option. These synthetic autograft materials do not require harvesting and are easy to use but quite costly, with a higher risk than a patient’s own cells of absorption. Vertebral marrow represents an effective compromise: It is less costly than BMPs and less painful and difficult to harvest than the iliac crest.

STUDIES SUPPORT TECHNIQUE

The Center for Spine Health was first to use a validated technique to apply vertebral body-aspirated cells in a spinal fusion. In a 2005 study conducted at Cleveland Clinic Department of Orthopaedic Surgery, (Figure 1) aspirates from the vertebral body and the iliac crest were compared. Twenty-one adults undergoing posterior lumbar arthrodesis and pedicle screw instrumentation underwent transpedicular aspiration. Cell count, progenitor cell concentration (cells/cc marrow) and progenitor cell prevalence (cells/million cells) were calculated.

Aspirates of vertebral marrow demonstrated comparable or greater concentrations of progenitor cells than the iliac crest yielded. The concentration of osteogenic progenitor cells was, on average, 71 percent higher in the vertebral aspirates compared with the paired iliac crest samples.

In a second study, (Figure 2) we determined the concentration of connective tissue osteoprogenitor cells available in sequential aspirates taken from the human vertebral body by a transpedicular route. In 13 patients undergoing lumbar surgery for degenerative disc disease or lumbar instability, with pedicle screw instrumentation as part of the procedure,
eight discrete 2.0 cc aspirations were harvested from each vertebral level using a coaxial, transpedicular technique. The results showed a viable population of CTPs within the portion of the vertebral body routinely instrumented during pedicle screw placement. Initial aspiration does not deplete the marrow reservoir along the axis of the pedicle and vertebral body traversed during pedicle screw placement. CTP concentrations are at least comparable to iliac crest levels and remain high enough during sequential aspirations to allow at least four aliquots to be harvested before concentrations decrease.

Additional studies at Cleveland Clinic have demonstrated that these cell aspiration techniques do work; when they were applied in spine fusion surgeries, the fusion was reliably obtained and robust. Patients did not have to undergo a formal iliac crest graft to achieve good results.

**STANDARD PROCEDURE**

Vertebral body harvesting has become easier with the development of an aspiration tool designed specifically for this purpose, which is safer and easier to use than a biopsy needle. With this tool, we can provide the best care with the least trauma to the patient.

Our research and experience show that autograft bone from the vertebral body works well in stimulating fusion for both routine lumbar surgery and difficult fractures of the long bone. Vertebral marrow harvesting has become standard procedure for augmenting fusion mass for spinal reconstruction at the Center for Spine Health. It takes a single-step routine and uses it for two purposes. We have not harvested the iliac crest for routine care in several years. Patients have been pleased with the results, especially given that graft site pain has been eliminated altogether.

Robert F. McLain, MD, is a spine surgeon in Cleveland Clinic’s Center for Spine Health. His specialty interests include back and neck surgery, minimally invasive disc and fusion surgery, and cervical and lumbar artificial disc replacement. He can be contacted at 216.444.2744 or mclainr@ccf.org.

Figure 3: Schematic illustration of aspiration technique. The aspiration probe is placed exactly as the usual pedicle “gear-shift” is oriented during pilot hole preparation. Under fluoroscopic control, the tip is advanced to the 30 mm mark and the initial aspiration is performed. Probe is then advanced 5 mm and rotated 180 degrees to aspirate a fresh marrow volume. Probe is sequentially rotated until the final aspiration is completed at 45 mm.
Education Experience at the Cleveland Clinic

With the rapid advances in technology and changes in healthcare, the new generation of orthopaedic surgeons faces multiple challenges, including how to meet higher patient expectations and demands for greater efficiency with fewer resources. The role of education and mentorship in orthopaedic surgery residency programs is essential in fostering the needed improvements in our profession. Cleveland Clinic has been ahead of the curve with broadening its educational approach in order to address the new challenges.

**VIEW OF THE TRAINEE**

In my training as an orthopaedic surgery resident, I have experienced the endless opportunities and resources available to enrich my education and enhance patient care. My main area of interest is adult reconstruction. Although the potential benefit of arthroplasty procedures is immense, the current limitation of resources and increased complexity of patient conditions demands improvements. At Cleveland Clinic, I have learned that I am expected to play an active role and contribute to resolving these issues. Since the very beginning of my residency, I was encouraged to use those resources to learn and conduct studies in searching for those improvements. I have been given the opportunity to be instrumental in conducting randomized clinical trials, prospective and retrospective clinical outcomes studies, and developing patient risk stratification and predictive models for clinical outcomes. Several resources have facilitated these efforts, such as the Orthopaedic and Rheumatology Research Center, a well-established patient registry that generates an immense amount of clinical data, and the invaluable expertise of the Division of Adult Reconstruction staff. This experience has given me a broader view and understanding of the new demands in orthopaedic surgery, as well as the courage to address these demands through scientific studies.

**VIEW OF THE MENTOR**

I feel strongly about working closely with residents as a mentor, as I myself benefited from several mentoring relationships during my resident training here at the Cleveland Clinic. These associations have continued on into my current roles as a clinician, scientist, and administrator, and have provided great insight and knowledge all along the way. I enjoy engaging in these opportunities as it gives me a chance to teach, as well as learn from the people I mentor. My research program currently involves not only residents, but also medical students, research coordinators, postgraduate fellows and foreign medical graduates. I have found that helping guide tomorrow’s clinicians and scientists is an exciting and rejuvenating process, in which everyone benefits.

The exceptional clinical and surgical training at Cleveland Clinic prepares residents to approach different orthopaedic conditions in a thorough manner. Overall, we believe that training at Cleveland Clinic provides residents with the tools to successfully meet future demands and even resolve challenges through scientific innovation.
John A. Bergfeld, MD, Senior Surgeon and Director of Operating Rooms for Cleveland Clinic, was honored with the 2010 Lifetime Achievement Award at the Greater Cleveland Sports Awards.

Dr. Bergfeld’s tenure includes 34 years as Director of Sports Medicine at Cleveland Clinic, and a combined 48 seasons as head team physician for the Cleveland Browns and Cleveland Cavaliers. He remains active in professional sports as a consultant for the Browns and Cavaliers and also is the team physician for Baldwin-Wallace College. He also developed and continues to host an annual awards ceremony for outstanding teams and athletes in the Cleveland Metropolitan School District.

The Lifetime Achievement Award traditionally honors an individual who has advanced sports in Cleveland through personal or career dedication and achievements.
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