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Dear Colleague,

At Cleveland Clinic, innovation is in our DNA. That is why we host a national Medical Innovation Summit every year to discuss and advance it. This past year, our summit focused on innovation in orthopaedics. The themes and takeaways from the summit are recapped in the story that starts on the back cover of this issue.

As that summit made clear, healthcare innovation today means far more than new drugs and devices. Some of the most important innovations in healthcare are taking place in care delivery and informatics, and we are pleased to feature two such innovations in this issue of Orthopaedic Insights.

On page 6 we profile an exciting new project at Euclid Hospital, one of eight community hospitals in the Cleveland Clinic health system. The hospital is collaborating with the Centers for Medicare & Medicaid Services (CMS) to pilot a CMS initiative that bundles payment for hip and knee replacements by episode of care, in an effort to incentivize providers to improve care coordination, efficiency and quality. The initiative dovetailed with efforts underway at Euclid Hospital to redesign joint replacement care delivery to improve care coordination and best practices, so we welcomed the opportunity to help CMS explore this pathway to more value-based care. The effort is led by Euclid Hospital President Mark Froimson, MD, who is also one of our department’s joint replacement specialists and the article’s lead author.

Informatics innovation is the focus of the story on page 20, which reports on what may prove to be the ideal electronic health record (EHR) system: the integrated visual health record (iVHR). Co-invented by one of our orthopaedic surgeons, Wael Barsoum, MD, the iVHR assembles data from all parts of the EHR, integrates patient-reported data and displays all the information in a format that allows rapid visual assessment of patient status. The aim is to create a more intuitive and visual EHR that brings physicians a level of utility unseen to date. The iVHR is being piloted in Cleveland Clinic’s Orthopaedic & Rheumatologic Institute throughout 2013.

Of course, there’s still plenty of room for innovation in the clinical sphere, and the rest of the issue presents our department’s perspectives and activities in areas ranging from platelet-rich plasma therapy for sports injuries to soft tissue sarcoma management.

Innovation is born of change, and the changing healthcare landscape makes this an exciting time to be an orthopaedist. I welcome your comments in response to this issue and on how we can work together to advance innovation in our specialty.

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Tibiotalocalcaneal Arthrodesis: A Necessary Evil

By Ian Alexander, MD

Although tibiotalocalcaneal (TTC) fusion is often dismissed as a procedure that renders patients immobile and nonfunctional, for many individuals TTC fusion is the difference between being wheelchair-bound and being able to ambulate painlessly. I recently saw a patient in his mid-40s who had a TTC fusion for severe post-traumatic ankle and subtalar arthritis 15 years ago. When I assumed he had returned because of problems, he laughed and said he was there, at his wife’s insistence, to get permission to play softball.

INDICATIONS AND GENERAL CONSIDERATIONS
TTC fusion is most often indicated for one of the following:

• Combined ankle and subtalar arthritis
• Management of severe frontal plane malalignment due to neurological or congenital disorders, end-stage flatfoot deformity or Charcot arthropathy
• Avascular necrosis
• Salvage of failed ankle arthroplasty

The technique of reconstruction and the fixation employed depend on the amount and location of bone loss and anticipated problems with healing due to patient factors such as diabetes with neurological deficit.

My treatment algorithm is as follows: In almost all cases the lateral transfibular approach is employed, and the cancellous bone harvested from the fibula is used to augment, after joint preparation, the subtalar fusion. With an intact talus, both the ankle and subtalar joints are prepared by removing articular cartilage and subchondral bone.

TECHNIQUE OPTIONS

Fixation with three cannulated screws. Neurologically intact patients without bone loss are fixed with three long compression screws. My preference is to use cannulated, fully threaded, headless, variable-pitch compression screws. The first two screws are directed from the plantar lateral calcaneus through the talus into the distal medial tibia; these are close to parallel, with one engaging the anteromedial cortex and the other the posteromedial cortex of the distal tibia. These screws are augmented by an additional cannulated screw placed between and crossing these two, starting in the distal lateral tibia and directed into the medial talus. Figure 1 shows two views of screw placement in a patient who underwent the three-screw technique.
Fixation with a TTC fusion nail. If the patient has severe neurological compromise but no bone loss, my preference is a TTC fusion nail. I prefer nails with a valgus bend at the lower end. Although these nails are a little trickier to insert, the fact that they engage the central calcaneus (rather than just the sustentaculum), and thereby provide better fixation for distal locking screws, helps ensure optimal calcaneal fixation. These nails are particularly good in patients with advanced cavus deformity resulting from inherited polyneuropathy. In these cases, nails with a valgus bend are especially helpful in correcting hindfoot varus (Figure 2).

Fixation with a distal femoral locking plate. In cases of bone loss, especially when the talar body is lacking due to avascular necrosis or prior surgery (e.g., ankle arthroplasty), or when trauma or Charcot arthropathy has led to distal tibial deficiency, a TTC nail may provide only tenuous fixation. In these cases, multiple locked screws can gain excellent purchase in the calcaneus, which, together with a strong plate and multiple tibial screws, can provide a very stable construct. Although TTC-specific fusion plates are available, I prefer the more substantial fixation provided by distal femoral locking plates with polyaxial screws, which allow flexibility in screw positioning in the calcaneus. The bone defect can be dealt with by shortening, use of the distal fibula as a strut, tricortical iliac crest interposition grafts, a femoral head allograft or allograft chips with a bone morphogenetic protein preparation. The solution in each case is tailored to the size of the defect, host-related healing factors and availability of grafting materials (Figure 3).

Figure 2. Radiograph of a woman with bilateral disease who underwent fixation with a TTC fusion nail in the right foot while awaiting surgery on the left.

BOTTOM LINE
TTC fusion is an excellent means of correcting deformity and eliminating pain when function-retaining procedures are not an option. Multiple techniques are available to achieve a solid TTC fusion; in general, the least invasive technique should be used. Failure of TTC fusion is most often seen when the fixation modality chosen is inadequate because of bone loss or host factors that compromise healing, particularly advanced diabetic neuropathy.

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Multiple locked screws can gain excellent purchase in the calcaneus, which, together with a strong plate and multiple tibial screws, can provide a very stable construct.

Figure 3. Radiographs of a diabetic patient with Charcot arthropathy before (left) and after (right) TTC fusion. Note the extensive bone loss and subtalar dislocation in the left panel, prior to the fusion.
Redefining Care Delivery **One Episode at a Time:**
A Cleveland Clinic Hospital Pilots CMS Bundled Payments for Joint Replacement

*By Mark I. Froimson, MD, MBA; Michelle Schill, RN, BSN; Monica Deadwiler; Prashant Nayak; and Seth Vilensky, MBA*

**DELIVERY: WHERE HEALTHCARE INNOVATION IS NEEDED MOST**
Innovation is the key to making our healthcare delivery system more effective and efficient. But while we traditionally think of innovation as a new device or drug, patients tell us that is not where they see the biggest need. They want us to coordinate our care and work together to make it more user-friendly, accessible and affordable. Patients see us as working in a piecemeal fashion, each doing our jobs well but sometimes dropping the ball during care transitions. They want us to put care together — to bundle it for an episode and deliver it as one product.

Joint replacement is one of the most effective procedures in medicine, reliably relieving pain and restoring function. But with demand for joint replacement expected to continue rising significantly in the coming decades, there is concern that the associated costs will outpace the ability of our stretched system to afford this demand.

These are the two common criticisms of our delivery system today: It is costly while still failing to deliver a product that patients see as meeting their needs.

**A POTENTIAL SOLUTION**
As the Cleveland Clinic health system has looked at ways to curtail costs, we have uncovered some findings that may help address both the need for more care coordination and the need to deliver care at a lower cost. After investigating the relative cost of a joint replacement among numerous surgeons within the system, we found significant variation in cost among providers without any associated difference in quality. In fact, lower-cost surgeons actually had lower complication rates and lower readmission rates for the same procedure. When we delved deeper, we found that lower-cost surgeons were achieving this cost advantage not through the use of less-expensive implants or technology but rather through better care coordination. It appeared that better coordination was not an expensive add-on that would increase cost; to the contrary, it appeared to actually decrease cost. What an opportunity.

**REDEFINING THE EPISODE OF CARE**
One of the keys to both care coordination and cost containment involves a paradigm shift that's at the heart of our innovative approach: viewing a procedure as an entire episode of care rather than just as the surgery itself. This way of thinking makes clear that what goes on before and after the surgery can have a significant impact on outcomes, patient satisfaction and cost. In fact, the greatest variation we found in the care delivered was in the discharge disposition of our patients and in the costs incurred after they left the hospital. From surgeon to surgeon, and from hospital to hospital, a patient's likelihood of going home after surgery could vary by a factor of 10. The figure on page 7 illustrates the dramatic variation in patients’ home-going rates by surgeon quintile. That degree of variation, coupled with the significant cost difference between discharging patients home vs. to a post-acute care facility, offers the potential for significant cost savings through better patient engagement and care coordination.

**A GOOD MATCH FOR NEW CMS INITIATIVE**
The Patient Protection and Affordable Care Act of 2010 mandated the Centers for Medicare & Medicaid Services (CMS) to initiate a call for innovations in care delivery. One of these, the Bundled Payments for Care Improvement (BPCI) initiative, called for just what we had begun to develop: a program that incentivizes providers to come together and redesign care in a more coordinated and streamlined way. This program provided an opportunity to highlight our redesign efforts aimed at effectively delivering an episode of care that features optimum care coordination, patient-centeredness and shared decision-making while promoting high-quality, efficiently delivered healthcare.

To that end, Euclid Hospital, one of the community hospitals in the Cleveland Clinic health system, is collaborating with CMS to deliver innovative care under the BPCI initiative for MS-DRGs 469/470, primary total hip and knee arthroplasty. We believe that several factors have fully aligned Euclid Hospital with the BPCI initiative and prepared it to achieve the BPCI objectives: (1) our physician-led, group-model culture and strategy; (2) our operational capabilities and infrastructure; and (3) our clinical redesign initiatives and track record. A few of these factors merit additional discussion.
LEVERAGING ACCESS TO INFORMATION
Tracking outcomes and costs requires a robust infrastructure. Fortunately, the Cleveland Clinic health system has invested in market-leading electronic health records, clinical information systems, and data warehouse and metrics capabilities (outcomes tracking, reporting and monitoring) that will enable successful tracking of our redesign efforts. A notable differentiated capability is the Orthopaedic & Rheumatologic Institute’s OrthoMiDaS data warehouse and patient registry database, which allows collection of patient-reported functional outcomes for our surgical patients. Collecting these patient-reported measures enables us to understand and research the impact of our interventions on patient function and quality of life.

CLINICAL REDESIGN INITIATIVES
Our Rapid Recovery Program (RRP) for Orthopaedics has emerged from our health system’s ongoing commitment to clinical redesign and identification of best practices that lead to improved outcomes. The RRP for Orthopaedics is designed to help total joint replacement patients progress to full mobility and home-based postoperative care as efficiently as possible. The RRP directly involves the patient in making decisions about his or her own preoperative, acute and postoperative care. It promotes collaboration, coordination and cooperation among the orthopaedic surgery practice, the acute care facility and post-acute medical providers (including inpatient physical and occupational therapists), case management, home care and outpatient therapeutics.

EXPECTATIONS AS THE INITIATIVE PROCEEDS
Based on 2009 Medicare fee-for-service volumes and reimbursements as provided in claims data received relative to this project, we estimate a significant savings potential over the three-year pilot period. We expect our care delivery redesign to result in:

- Better-prepared, actively engaged patients and families, with resulting increases in satisfaction
- Elevated quality of care through best-practice modification
- Lower total cost of care as resource use is aligned more appropriately to patient- and episode-specific needs

We are excited to have an opportunity to pilot such an innovative initiative and are committed to its success, as it aligns with our fundamental values of seeking new methods to improve care delivery for the patients entrusted to us.

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Platelet-Rich Plasma Therapy: Defining Its Role in Sports Medicine

By Tony Truong, MD, and Susan M. Joy, MD

Platelet-rich plasma (PRP) injection — an emerging therapy for musculoskeletal and sports injuries — has received recent attention from reports of its use in injured elite athletes. Therapy with autologous PRP was first described more than two decades ago and has been used in a variety of medical specialties. Here we review the evolving evidence on PRP and how Cleveland Clinic Sports Health providers evaluate its potential place in therapy.

WHY PLATELETS?
Platelets play an important role in wound and soft tissue healing. At the site of injury, platelets play a critical part in mediating the healing cascade. The alpha granules within platelets contain numerous growth factors that influence important phases of healing, such as angiogenesis, cell proliferation, deposition of extracellular matrix, remodeling and maturation. Growth factors that are stimulated in the repair process and remain active during the healing phases include insulin-like growth factor-1, transforming growth factor beta, platelet-derived growth factor, vascular endothelial growth factor, epidermal growth factor and basic fibroblast growth factor. The alpha granules within platelets also contain more than 30 bioactive proteins that play a role in hemostasis, connective tissue construction and revascularization. The theory is that PRP, because it contains a hyperphysiologic concentration of platelets and growth factors, may stimulate and potentially expedite the healing process.

PREPARATION AND ADMINISTRATION
PRP is prepared by centrifuging autologous, anticoagulated whole blood. Because of the differences in specific gravity, centrifugation separates the plasma (top layer) from the platelets and white blood cells (middle layer) and the red blood cells (bottom layer) (Figure 1, left panel). The concentration of platelets in PRP is three to eight times the concentration in whole blood (Figure 1, right panel), which confers a higher concentration of growth factors.

PRP can be administered via injection, and ultrasound guidance can assist in the placement of PRP in a joint or into an area of soft tissue pathology. The risks associated with this procedure appear to be no different from those associated with other types of injection.

BASIC SCIENCE AND ANIMAL STUDIES
Numerous laboratory and animal studies published over the past two decades have assessed the use and efficacy of PRP. Basic science research has shown that application of growth factors can stimulate tenocytes. PRP may promote differentiation of tendon stem cells into active tenocytes with high proliferation rates, increased gene and protein expression, and increased collagen production.

Studies in animal models have also yielded positive results. Injection of thrombin-activated platelet concentrate into transected rat Achilles tendon resulted in a 30 percent increase in tendon callus strength and stiffness after one week. Mechanical testing done at three weeks after PRP injection demonstrated an improvement in mechanical properties, and histologic evaluation noted greater maturation of the tendon callus.
Because it has hyperphysiologic concentrations of platelets and growth factors, platelet-rich plasma may stimulate and potentially expedite the healing process.

**CLINICAL STUDIES**

Literature is emerging on the effects of PRP on chronic musculoskeletal injuries, including epicondylitis, Achilles tendinopathy, patellar tendinopathy and plantar fasciitis. To date, results have been variable and are often limited by small study sample sizes.

There have been some promising results in the literature on the use of PRP to treat chronic tendon injuries, such as lateral epicondylitis and Achilles and patellar tendinosis. One investigation of PRP for lateral epicondylitis demonstrated an 81 percent improvement in visual analog scale (VAS) score at six months and a 93 percent pain reduction over one year following treatment. Another study showed that PRP for the treatment of patellar tendinopathy resulted in improvements in VAS score, pain level and patient satisfaction as well as a greater improvement in sport activity level achieved relative to a comparator group treated with physiotherapy alone. Structural improvements may be seen on imaging (Figure 2).

PRP has also been used to treat acute ligamentous and muscle injuries, with animal studies and case reports demonstrating beneficial effects.

**REGULATION OF PRP**

PRP is approved by the Food and Drug Administration although still considered investigational. In 2010, the World Anti-Doping Agency prohibited PRP administered by intramuscular injection because of concerns that it may increase concentrations of circulating growth factors, but that decision was reversed in 2011 as there was little evidence of an ergogenic effect. Other organizations, such as the U.S. Anti-Doping Agency and the International Olympic Committee, are signatories to the World Anti-Doping Code, agreeing to implement and enforce its rules. Use of PRP has been reported frequently by other professional sporting organizations and is not currently thought to confer any ergogenic advantage.

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**Figure 2.** MRI studies of a patient's right knee in April 2011, before platelet-rich plasma (PRP) therapy (top), and in December 2012, 18 months after PRP therapy (bottom). The top images show thickening and increased signal in the proximal patellar tendon at the inferior pole of the patella with a small amount of surrounding edema. The bottom images show decreased tendon thickness and edema following PRP treatment.

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Case Study in Soft Tissue Sarcoma: Collaboration and Outcomes Collection Guide Ideal Care

By Steven A. Lietman, MD; Nathan W. Mesko, MD; David Joyce, MD; and Michael J. Joyce, MD

CASE PRESENTATION
A 62-year-old woman noticed a lump in her thigh. After the tumor did not resolve, she went to her medical doctor, who obtained a CT and referred her to one of the surgeons (S.A.L.) in Cleveland Clinic’s Musculoskeletal Tumor Center. The patient had severe claustrophobia, so she underwent MRI under anesthesia. In addition, she was noted to have a deep vein thrombosis at the area of the tumor, and an inferior vena cava filter was placed. She was started on enoxaparin but could not tolerate the injections, so she was switched to aspirin 325 mg twice daily. Based on the MRI findings (figure, page 11), her lesion was believed to be a leiomyosarcoma of the femoral vein, which was confirmed by a minimally invasive needle biopsy.

The patient’s case, tumor biopsy slides and imaging studies were reviewed in our multidisciplinary conference. Because of the tumor’s proximity to the femoral artery and the involvement of the femoral vein with the tumor, we decided to consult our colleagues in the Department of Vascular Surgery. They saw the patient preoperatively and discussed with her the need for a bypass of the femoral artery after consultation with S.A.L.

SURGERY AND SUBSEQUENT MANAGEMENT
The tumor was resected with 0.9 mm as the closest margin, and the specimen was reviewed with one of our musculoskeletal pathologists immediately after resection; our practice is to review the specimen while the patient is still anesthetized in case a...

PLACE IN THERAPY
Musculoskeletal injury and regeneration involve complex processes in which cells, growth factors and cytokines may be involved in both the destructive and the reparative phases. Emerging studies suggest potential positive effects of PRP in influencing the inflammatory cascade toward repair.

PRP is considered a relatively low-risk treatment since it is derived from the patient’s own blood. PRP injections should not replace traditional management but may be used in conjunction with a multimodal treatment plan, including relative rest and physical therapy. Future prospective controlled studies will help delineate when and how to best utilize PRP in managing sports injuries and musculoskeletal disorders.

Cleveland Clinic Sports Health is dedicated to delivering world-class care to every athlete. Several Cleveland Clinic Sports Health providers currently use PRP as part of individualized treatment for select tendon, muscle and joint injuries.

REFERENCES

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margin is positive and there is residual tumor. While the patient was still anesthetized, our vascular surgery colleagues harvested a vein from the contralateral side and anastomosed it to both sides of the femoral artery in the area of the resection bed.

In an earlier study of thigh sarcomas at Cleveland Clinic, we noted that a margin of 1 cm or more was optimal. This patient’s case was discussed postoperatively at another of our multidisciplinary conferences. Because of the high-grade nature of her soft tissue leiomyosarcoma and because the margin was 0.9 mm instead of 1 cm, radiation therapy was recommended.

**COMMENTARY: COLLABORATION, CONTINUITY ARE KEY**

This case illustrates the multidisciplinary approach that we at Cleveland Clinic believe is so important for the optimal care of patients with sarcomas. In addition to our orthopaedic oncology team, this patient’s primary care physician and our colleagues in radiology, interventional radiology, pathology, vascular surgery, medical oncology and radiation oncology all had a hand in her care. We also believe that our research and ongoing evaluation of results helped enhance her management, as a review of all the thigh sarcoma cases from our medical records led us to determine that a margin of at least 1 cm is optimal.

This combination — our systematic collection and evaluation of patient outcomes, together with the collaborative approach fostered through our multidisciplinary conferences — is a primary contributor to our Musculoskeletal Tumor Center’s local recurrence rate of less than 4 percent for soft tissue sarcomas, which is among the lowest reported in the literature. This rate was achieved in patients whose biopsy and resection were both performed at Cleveland Clinic, in contrast to the higher local recurrence rate (20 percent) that has been observed in patients who underwent biopsy at outside locations but then came to Cleveland Clinic for sarcoma resection. Because of this variance in outcomes, we encourage referring physicians to send patients with lumps or bumps to us before they biopsy them. Our experience suggests that continuity of care is an essential ingredient in the most successful collaborative care.

**REFERENCE**


**ABOUT THE AUTHORS**

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Elbow Stiffness:
A Systematic Approach to Prevention and Treatment

By Nathan G. Everding, MD; Steven D. Maschke, MD; and Peter J. Evans, MD, PhD

Although advances in basic science, rehabilitation protocols and surgical management continue to improve outcomes in patients with elbow stiffness, treatment of elbow contracture remains challenging. Management should focus on improving motion, with the goal of regaining a functional arc of motion. This article summarizes the systematic approach we follow in Cleveland Clinic’s Center for Hand and Upper Extremity Surgery to achieve that goal for as many patients as possible.

ETIOLOGY AND PREVENTION
The etiology of elbow stiffness is the basis for its classification, diagnosis, prevention and treatment. Traumatic causes of elbow stiffness include fractures, dislocations, crush injuries, burns and head injury. Elective elbow surgery results in controlled trauma to the tissues and may also be complicated by elbow stiffness. Atraumatic causes include rheumatoid arthritis, osteoarthritis, post-septic arthritis, hemophilia-associated hemarthroses, congenital contractures and congenital radial head dislocation. Bone and soft tissue ultimately provide the mechanical blocks to motion that result in elbow stiffness (Figure 1).

Prevention starts with appropriate management of the underlying disease processes to minimize joint destruction. In post-traumatic or postoperative scenarios, early motion protocols are recommended to resolve swelling, maintain motion and prevent contracture. Elbow stability is required for early motion and must be obtained before the patient is taken from the operating room.

Prevention of heterotopic ossification (HO) about the elbow is an additional concern after elbow surgery, trauma or burns. No evidence-based protocols have been defined for managing elbow HO, but the use of indomethacin, which has been proven effective for HO around the hip, has been extrapolated to the elbow. Postoperative radiation therapy for prevention of elbow HO has also been studied recently at Cleveland Clinic and is considered functionally beneficial. Following resection of elbow HO, we routinely use indomethacin and radiation therapy in patients with a past history of HO. Notably, radiation therapy should not be used acutely after fracture fixation because it has been shown to increase the risk of nonunion.

Figure 1. Thickened contracted capsule viewed during excision from a lateral approach.

TREATMENT OPTIONS
Timing, severity, patient-specific factors and underlying pathology guide selection of specific treatment protocols. Following a thorough evaluation that includes history, physical and plain radiographs, a treatment plan can be developed. If further detail of articular surface irregularities or HO is required, CT can be obtained.

Nonoperative treatment is generally considered on initial presentation in patients with minimal contractures of six months’ duration or less. Any treatment protocol should include physical or occupational therapy to optimize outcome, but additional modalities are often necessary. Nonsurgical treatments for elbow stiffness include serial casting, static and dynamic splinting, continuous passive motion, manipulation and botulinum toxin A injections.

Static progressive or dynamic splinting (Figure 2) is a quintessential component of nonoperative management, as it extends the benefits of therapy into daily life. Both methods attempt to achieve plastic deformation of the tissues, leading to remodeling and permanent lengthening. We prefer static progressive splinting because we have observed it to be associated with less discomfort and better compliance; both methods have proven effective in the literature.
We have observed static progressive splinting to be associated with less discomfort and better compliance than dynamic splinting, although both methods have proven effective in the literature.

![Static progressive elbow splint (left) and dynamic elbow splint (right).](image)

Surgery is appropriate for patients who have not achieved adequate pain relief or functional range of motion after nonoperative management or who have substantial bony blocks.

The decision to operate is based on elbow function and patient factors. Flexion contractures greater than 30° or the inability to flex the elbow to at least 130° is often an indication for surgery. Recent results regarding surgical release demonstrate favorable improvements in elbow motion and function with both open and arthroscopic techniques. All procedures must respect the close proximity of critical neurovascular structures; minimize soft tissue trauma by exploiting defined soft tissue planes and/or intervals; and allow for critical evaluation of fracture reduction, stability and intraoperative gains in range of motion.

**DETERMINANTS OF OPERATIVE TECHNIQUE**

Choice of technique for elbow release starts with determining whether the loss of motion is in flexion, extension or both and whether osteophytes or heterotopic bone contribute. All our patients receive regional neurologic blockade with additional general anesthetic, which varies by procedure and patient. Regional anesthetic is typically an indwelling supraclavicular continuous blockade with a battery pump and refillable reservoir, which has been used for three days to three weeks.

Patients who lack flexion alone have considerable contracture of the posterior band of the medial collateral ligament (pMCL). The pMCL lies on the floor of the cubital tunnel, and excessive scarring can lead to ulnar nerve compression, tethering and subsequent symptoms. If a patient cannot passively flex more than 90° to 100°, we prefer open release of the ulnar nerve and resection of the pMCL and medial joint capsule. The remainder of the release and posterior capsulectomy are then performed open through the same incision — which is safe, reliable and efficient — and the ulnar nerve is transposed subcutaneously. There is no tendon healing, so scar formation is minimal and arthroscopic release offers little advantage.

If a patient has acceptable flexion and lacks only extension, the release can be done either arthroscopically or open via the lateral column or a medial over-the-top technique. We prefer an arthroscopic release (Figure 3) of the anterior elbow to gain extension, as it avoids tendon healing and minimizes postoperative scar formation.

For patients with combined flexion and extension contractures but with more than 100° of flexion, the ulnar nerve does not require release and capsular resection alone may restore all motion; in these cases, technique (open or arthroscopic) comes down to surgeon preference. However, the surgeon should be prepared to perform an adjuvant open medial incision to resect the pMCL if adequate flexion is not achieved.

For patients with combined flexion and extension contractures with less than 90° of flexion, the preceding considerations apply, and we prefer arthroscopic release of the anterior elbow combined with open medial and posterior release of the elbow with ulnar nerve transposition. The ulnar nerve is exposed first and decompressed in the cubital tunnel and flexor forearm muscles. It is left undisturbed proximal to the medial epicondyle, as this allows the medial intermuscular septum to protect the nerve when the superior-medial portal is used. The anterior elbow is then arthroscopically released and the ulnar nerve is released proximally; the intermuscular septum, pMCL, and medial and posterior joint capsule are resected through the existing medial incision; and the nerve...
is transposed subcutaneously. Again, this avoids tendon healing and minimizes scar formation. When heterotopic bone needs to be removed, we prefer open resection only, and often simultaneous open medial and lateral approaches.\textsuperscript{3,4}

**POSTOPERATIVE CARE**

Postoperatively, the elbow is splinted in extension for 24 hours, to rest the tissues and minimize bleeding and subsequent swelling. The splint is removed and activities of daily living are commenced after placement of a compression dressing. Ice or a compression ice system is used 20 minutes every one to two hours for the first 72 hours with hand squeezing of a light compression foam block to augment venous and lymphatic return. If insurance allows, continuous passive motion for flexion-extension (and pronation-supination, if required) is begun in the patient’s home after 72 hours. After six weeks, static progressive splinting may be started to increase motion. Night splinting in either flexion or extension (to counter the larger deficit) is continued.

Based on feedback from the therapists and re-examination, we will consider manipulation under anesthesia, botulinum toxin A injection (biceps and brachialis) and intra-articular injection of a corticosteroid within the first three weeks. Exercises, splinting and therapy are maintained until a plateau is reached, with the expectation that gains can continue for up to 12 months.

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**ABOUT THE AUTHORS**

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An 18-year-old male high school football player presented after a recent anterior shoulder dislocation. He had suffered through worsening instability over the prior year, enduring five dislocations, three of which required manipulation for reduction.

He underwent 3-tesla MR arthrography for optimal intra-articular evaluation. The normal U-shaped contour of the axillary recess was interrupted, resulting in a J-shaped axillary recess, indicating injury of the anterior band of the inferior glenohumeral ligament (Figure 1). He later underwent arthroscopy (Figure 2), which confirmed humeral avulsion of the glenohumeral ligament (HAGL lesion). Open repair and an anterior stabilization procedure were performed.

**HAGL LESIONS: EASILY OVERLOOKED**

The primary role of the inferior glenohumeral ligament is to stabilize the shoulder when the arm is externally rotated and abducted at 90°. Acute glenohumeral trauma, such as subluxation or dislocation, can result in avulsion of the ligament from its humeral attachment.

HAGL lesions are a relatively uncommon cause of recurrent shoulder instability. They typically involve the attachment of the anterior band of the inferior glenohumeral ligament to the humeral neck, but posterior avulsions have also been reported. Because of the recurrent instability caused by HAGL lesions, surgical repair is usually necessary, especially in younger patients. Since HAGL lesions can be easily overlooked at diagnostic arthroscopy, preoperative imaging diagnosis is important for surgical planning. As demonstrated in this case, imaging evaluation of anterior instability is best performed with 3-tesla MR arthrography using intra-articular gadolinium.

**BRINGING HIGH FIELD STRENGTH TO BEAR**

3-Telsa MRI machines, such as the Siemens MAGNETOM® Verio at the Cleveland Clinic Sports Health facility used in this case, are currently the most powerful FDA-approved MRI scanners on the market. Such high-field-strength machines offer two to three times the field strength of other closed systems and up to 10 times the strength of open magnets. High-field-strength MRI, when coupled with advanced multichannel coils and new sequences, allows for faster imaging at higher spatial resolutions and increased signal-to-noise ratios, aiding in diagnosis of subtle or challenging orthopaedic injuries such as this patient’s HAGL lesion. For evaluation of intra-articular shoulder lesions in the patient with instability, intra-articular gadolinium contrast further increases the signal-to-noise ratio and spatial resolution to optimize diagnosis of capsulolabral pathology.

**ABOUT THE AUTHORS**

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Spinal Fusion for Idiopathic Scoliosis: Safe Return to Sports Now the Rule for Many Adolescents

By Ryan C. Goodwin, MD

Idiopathic scoliosis remains a common problem in pediatric orthopaedics. If progressive and untreated, it can lead to heart and lung compromise in adulthood as the deformity worsens. Scoliosis affects children of all ages, although it is most commonly seen in active teenage girls.

RETURN TO SPORTS A COMMON CONCERN
Spinal fusion surgery remains the gold-standard treatment for progressive curves and is best performed during the teenage years. Most spinal fusion procedures are performed via a posterior approach. Although minimally invasive techniques have been used to minimize muscle trauma, irrespective of the technique, fusion must occur before progression to full activity for the treatment to be successful. Since a large number of children who seek surgical correction are involved in athletics, safe return to sports following spine fusion surgery is often a concern for patients and parents.

FUSION CONFIRMATION IS IMPERATIVE
With the advent of segmental instrumentation — specifically, segmental pedicle screws — safe return to sports and other physical activities has become commonplace among patients with idiopathic scoliosis who have undergone spine fusion surgery. It is now routine practice to permit return to many aggressive activities such as contact sports once a solid fusion has occurred.

Since there is no specific imaging modality that will confirm a solid fusion, careful clinical examination and scrutiny of radiographs are essential to ascertain whether a solid fusion has occurred. Once the clinician has determined that a solid fusion is present — typically six months postoperatively in a healthy adolescent — sports and other aggressive activities may be resumed as tolerated.

MANAGING EXPECTATIONS
When a physician discusses return to sports in this setting, patient and family counseling is important to ensure that expectations are appropriate. Literature suggests that patients whose lowest level of fusion is at T12 or L1 have the highest percentage of full return to sports. As the fusion mass extends distally to L2 and L3, the likelihood of a return to sports decreases. Patients with fusions to L4 and below are unlikely to return to sports and activities requiring significant movement and flexibility. While return to sports after spine fusion surgery is more common in 2013 than in the past, it is important that patients and families have realistic expectations about the postoperative course, including return to sports, before undergoing the procedure.

Popular sports such as soccer, basketball, volleyball, track and swimming are all activities in which an adolescent with a successful fusion for deformity is likely to be able to participate. Activities such as ballet and gymnastics are more difficult to return to following fusion, but a high likelihood of return to full activity exists when the most distal fusion level is T12 or above. Fusion to the lumbar spine significantly decreases the rates of return to these activities that require significant flexibility.

True collision sports such as tackle football and rugby should be avoided by all post-fusion patients. Some surgeons advocate permanently excluding ice hockey as well, but many others permit participation in this highly aggressive sport after an informed discussion with the patient and family.
Images from a Scoliosis Success Story
Standing posteroanterior and lateral radiographs of a 15-year-old female patient three years after posterior spine fusion for scoliosis. She returned to tumbling (below) and gymnastics six months postoperatively.

There is a high likelihood of return to full activity when the most distal fusion level is T12 or above. Fusion to the lumbar spine significantly decreases rates of return to activities that require significant flexibility.

DESPITE SUCCESSES, NEED FOR CAUTION REMAINS
In 2013, patients who return to sports following spine fusion for adolescent idiopathic scoliosis are more the rule than the exception. Once the surgeon has determined that a successful fusion has occurred, patients can safely return to all but the most aggressive of collision sports, as tolerated. Participation in these activities has immensely improved the quality of life for many teenage patients. Caution must still be exercised, however, to ensure that a solid clinical fusion is present before allowing a return to full activity and unnecessarily putting the patient at risk. A more distal fusion level is a negative predictor of return to activity at previous levels or beyond.

ABOUT THE AUTHOR
Dr. Goodwin is Director of the Center for Pediatric Orthopaedic Surgery and a member of the Department of Orthopaedic Surgery specializing in scoliosis and spinal deformity. He can be reached at 216.444.4024 or goodwir@ccf.org.
Fresh out of Georgetown University School of Medicine in 1978, John Brems, MD, faced a dilemma. Soon after he ranked Cleveland Clinic first in the match process for his orthopaedic surgery residency, he got a call from another prominent academic medical center offering to “take him outside the match.”

The young Dr. Brems called Cleveland Clinic, explaining that he had received this under-the-table offer. “Cleveland Clinic told me to do what I needed to do, but they weren't going to break their code,” Dr. Brems recounts. “In a subtle way, that integrity impressed me more than being recruited by some other top program.”

So when Dr. Brems ended up matching at Cleveland Clinic, he decided to do his residency here and then never left the staff of the Department of Orthopaedic Surgery — until his retirement earlier this year. The story is fitting, as integrity was a watchword of the career Dr. Brems made for himself specializing in shoulder surgery over the ensuing 35 years.

“John Brems has embodied the Cleveland Clinic mantra of ‘Patients First,’” says Orthopaedic & Rheumatologic Institute Chair Joseph Iannotti, MD, PhD, a fellow shoulder specialist. “He is a superb clinician who based every decision on what he thought was in the patient's best interest. He lived that mantra every single day of his career.”

“I was fortunate to have been trained by Dr. Brems during my residency,” says David Gurd, MD, Director of Pediatric Spinal Deformity. “He is a meticulous surgeon and a very caring physician — the type of orthopaedic surgeon I strive to become.”

PUTTING A PREMIUM ON COLLEGIALITY
For Dr. Brems, the road to becoming that type of surgeon began with his own Cleveland Clinic residency, which he followed with a fellowship at Columbia-Presbyterian Medical Center in New York under the renowned shoulder specialist Charles Neer, MD.

“When I returned to Cleveland Clinic as full staff, what struck me and kept me here all those years was the collegiality, the salary-based group practice model and the reality that I could be 100 percent physician, not a businessman,” says Dr. Brems. “There were no incentives to do unnecessary procedures, and rather than competing for patients with my colleagues, we could trade them back and forth according to our respective knowledge and interests. The collegiality made possible by the Cleveland Clinic practice model was tremendously fulfilling to me.”
AN EXEMPLARY CLINICIAN-EDUCATOR
Another highlight of Dr. Brems’ career was the opportunity to train residents and fellows, including 10-year tenures as director of the residency program and inaugural director of the shoulder fellowship program (see sidebar). “I’ve always really enjoyed teaching,” he says. The sentiment was reciprocated when residents twice awarded him the department’s coveted Distinguished Teaching Award.

“I can still fix an open shoulder fracture today, 20 years since my training, thanks to the methodical approach John Brems took to this problem,” says department colleague James Sferra, MD, a foot and ankle specialist. “To call him a bit obsessive is a major understatement, but he is truly an outstanding surgeon and person.”

To explain this constructive obsessiveness, Dr. Brems turns to his beloved hobby of aviation for a metaphor. “The stereotype is that residents don’t like supervision; they want to learn by doing a technique themselves and just having it critiqued afterward. My philosophy has been that teaching surgery is like teaching someone to fly. If you tell a student, ‘Here are the keys; go practice taking off while I sit in the lodge,’ they will crash and burn every time. But if you sit in the cockpit with them, show them the technique, let them master it with you watching them, and then repeat that a few times, they’re soon ready to fly solo successfully. I found that residents appreciate the fact that teaching technique is unique and is based on a direct interest in their progression, not just on independence and checking afterward.”

Others see Dr. Brems’ educational style as further evidence of his integrity. “He was a great teacher who had a very high standard,” says Dr. Iannotti. “He always put a very high value on educating residents, and he did it in a selfless way. There can sometimes be a tendency to teach residents because they provide a service, but for John that service was incidental — it was all about their education.”

A RENAISSANCE ORTHOPAEDIST
Along with teaching, Dr. Brems spent most of his time performing shoulder replacements and rotator cuff repairs — thousands of them over more than three decades. While research was not a major focus of his career, he takes pride in his primary role in designing the Simpliciti™ shoulder replacement system, which is approved for use in Europe and is undergoing FDA review in the United States.

“I drew up the Simpliciti concept on a Cleveland Clinic cafeteria napkin and collaborated with four colleagues across the country to work out the kinks and perform extensive models and cadaver studies,” he explains. Some 158 procedures have been performed with the system in this country to date. “If approved by the FDA,” he adds, “it could be a game changer in shoulder replacement surgery.”

Dr. Brems has been an active member of the American Academy of Orthopaedic Surgeons, chairing and serving on many of its committees. He served as an oral board examiner for the American Board of Orthopaedic Surgery and remains a committee chair for the written board exam. He has published widely and served many years as team physician for multiple Northeast Ohio high school football teams.

LOOKING AHEAD
The newly retired Dr. Brems is indulging his penchant for aviation — “a passion since I was knee-high to an ant,” he says — and paying many visits to his children and grandchildren.

What advice does he have for today’s young orthopaedists? “While times change, values shouldn’t,” he says. “Although healthcare changes financially and time with patients may get contracted, that doesn’t have to contract your values in dealing with patients. Integrity is always integrity. Treat every patient as a whole person. Talk with them, have empathy with them and share their experience.”

Highlights of Dr. Brems’ Cleveland Clinic Career
- Residency, Department of Orthopaedic Surgery, 1979-1983
- Appointed to Department of Orthopaedic Surgery, 1984
- Chief, Section of Shoulder and Elbow Surgery, 1986-2002
- Director, Orthopaedic Residency Training Program, 1990-2000
- Founding Director, Shoulder Fellowship Program, 2001-2011
- Thousands of shoulder replacements and rotator cuff repairs
- Key role in development of Simpliciti™ shoulder replacement system
Every physician knows the electronic health record (EHR) is both a blessing and a curse. EHRs certainly are a significant improvement over paper-based medical records, and while they are excellent tools for storing and organizing data, a more intuitive, efficient and user-friendly interface is needed. An ideal EHR system would allow providers to assemble the complex data from all parts of the medical record, integrate patient-reported data and display the information in a format that allows rapid visual assessment of patient status.

A MORE INTUITIVE, EFFICIENT WAY TO DEAL WITH DATA

Enter iVHR, Inc., a Cleveland Clinic Innovations company, which is developing an interactive visual health record (iVHR) to extrapolate data from the EHR and present the data in a visual format. In general, iVHR will enable physicians to interact with patient data more efficiently and intuitively and to document treatment with improved accuracy and specificity. The result will be more time spent with patients and less time spent on documentation.

The use of iVHR in providers’ workflow provides widespread advantages. Not only does it free up physicians to devote more time to practicing medicine, it allows hospitals to (1) ensure that their documentation meets the Centers for Medicare & Medicaid Services’ meaningful use standards for EHRs, (2) accurately reflect the severity of patients’ illnesses and (3) minimize the risk of inaccurate documentation. Documentation produced by iVHR will contain coded diagnosis data that are continually updated according to the patient’s status and authenticated by the provider at the bedside as care is delivered. The resulting standards-compliant diagnoses can be used to generate accurate measures of patient acuity in real time, improving the quality of care delivery and facilitating true risk adjustment for the purposes of outcomes comparisons, reimbursement and research.

INTEGRATION INTO THE PHYSICIAN’S WORKFLOW

The Intelligent Intake Form component of iVHR combines patient-collected data with the functionality of the EHR. The system assembles information from patients, the EHR and physicians and then visually displays it during the patient visit while trending data from past encounters (Figure 1) as well as scores for the patient population (Figure 2). The Intelligent Intake Form also allows patient-reported outcomes to be collected electronically, rather than on paper, and to be used in Cleveland Clinic’s OrthoMiDaS patient registry. The Intelligent Intake Form is fully integrated into the EHR and facilitates implementation of a mobile patient intake process.

The patient-supplied data are entered into iVHR via validated questionnaires completed by the patient on a touch-screen tablet before the physician encounter. This allows for a comprehensive review of patient status, eliminates manual data entry and allows caregivers to review the data before entering the exam room. Self-reported health status, quality-of-life measures, assessments of functional status and complete review of systems can all be collected while the patient is in the waiting room and then be validated by the physician in the exam room. iVHR automatically scores patient-reported functional outcome and quality-of-life measures, making the scores available to the physician at the time of the visit and storing them for future use.
IMPROVED DOCUMENTATION QUALITY

iVHR, Inc., working with Cleveland Clinic’s Heart & Vascular Institute, has examined the effect of medical record inefficiency and inaccuracy on patient care, outcomes and economic performance. Together, we have developed the Problem Oriented Charting component of iVHR to evaluate and correct these inaccuracies and to present more meaningful and actionable data from the EHR to providers, payers and patients.

Problem Oriented Charting provides a path toward improvement, regardless of the starting point. The first phase of its implementation involves identifying specific opportunities for problem list adoption and improved documentation accuracy. Next, Problem Oriented Charting staff conduct education and training on integration of E&M best practices into the clinical workflow. Finally, Problem Oriented Charting offers objective measurement to reinforce good behaviors and sustained improvements.

INCREASED DIAGNOSTIC ACCURACY

iVHR’s big-picture objectives are better patient care and increased patient safety. Its Whiteboard and Predictive Algorithms components work together to achieve these goals.

The Whiteboard is an intuitive, consolidated view of all relevant clinical data to support the physician in the diagnostic process. For example, the Whiteboard may guide a physician to conclude that a 67-year-old patient with pain in the mid/upper back and chest/upper abdomen, together with narrowed space between vertebral bones as well as bone spurs and numbness in some areas, has thoracic spondylosis. Relationships between different clinical data points are visually represented on the Whiteboard, allowing validation and augmentation by the physician. Potential gaps in clinical data are highlighted for review and correction. The resulting set of correlated clinical data transfers seamlessly into comprehensive clinical documentation available to all caregivers, contributing to higher levels of care.

Through its Predictive Algorithms component, iVHR provides advanced clinical decision support by using evidence-based predictive algorithms to offer insight into how different care paths affect patient outcomes. For instance, a physician could use the Predictive Algorithms component to estimate that the length of stay for elective primary and revision hip replacement for a 73-year-old man is 3.43 days. This component draws on large volumes of EHR data and provides clinicians with intuitive feedback regarding diagnosis predicated on predetermined indicators. It also facilitates significant increases in efficiency and accuracy throughout the diagnostic and therapeutic decision-making processes. Improved documentation accuracy ensures that acuity is accurately reflected, which results in better and safer patient care. Better care subsequently has a positive impact on DRGs, acuity mix, E&M and average length of stay.

NEXT STEPS

Our aim is to develop iVHR into the ideal EHR system: a next-generation healthcare IT solution that will help the EHR work for physicians and patients alike. We are currently piloting iVHR’s Intelligent Intake Form component in Cleveland Clinic’s Department of Rheumatology. We plan to deploy the iVHR solution in other parts of Cleveland Clinic’s Orthopaedic & Rheumatologic Institute in autumn 2013.

ABOUT THE AUTHORS

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Dr. Deal is Director of the Center for Osteoporosis and Metabolic Bone Disease and serves as Vice Chair for Quality and Outcomes in Cleveland Clinic’s Department of Rheumatic and Immunologic Diseases.
Innovative to the Bone
(Continued from back cover)

most orthopaedic procedures are elective rather than imperative,” said Chris Coburn, who organized the summit as Executive Director of Cleveland Clinic Innovations.

FOUR KEY THEMES

Four factors emerged from the summit that will shape medical innovation in the coming years, noted the summit’s concluding speaker, Cleveland Clinic Chief of Staff Joseph Hahn, MD.

Proving value. Information-equipped patients and payers are ever more aware of the cost of care and will increasingly demand that providers prove the value of the care they offer. Though these demands pose new challenges, thought leaders repeatedly noted that this new way of thinking opens the door to a host of cost-reducing and system-enhancing innovations.

Quality as a given. As technology improves inside and outside the hospital, patient expectations are higher than ever and quality care is assumed to be a given. This only enhances the incentive to innovate to continually exceed patient expectations, a dynamic especially at play in joint replacement surgery.

Collaboration with industry. With the new demands noted above, collaboration with industry has become even more essential for innovation to flourish. Because physicians increasingly want greater simplicity and products that streamline care delivery, they need to interact with industry to ensure that emerging products are meeting these needs as quickly as possible. And the need for interaction is extending beyond the physician to hospital operations and IT staff, nurses, and others.

The role of data. No one can afford to ignore data any longer. While the volume of data pouring into health systems seems overwhelming, it also represents an opportunity to improve clinical and economic outcomes. Health systems must forge relationships with new companies to consolidate and analyze data while training providers to effectively use the data and implement insights gained.

DIVERSE PROGRAM, DISTINGUISHED SPEAKERS

The above factors were echoed across multiple panel discussions throughout the three-day program. A few highlights:

- **21st-Century Orthopaedics: Hands-On Perspectives from Clinical Leaders** featured insights from top Cleveland Clinic orthopaedists, including Richard Parker, MD, Chair of Orthopaedic Surgery, who cited longer component life span, interval procedures prior to arthroplasty, and intraoperative imaging to improve surgical techniques as priorities for innovation.

- **Bull or Bear Market?** pitted healthcare economists, ethicists, industry consultants and leading Cleveland Clinic surgeons against one another to debate the prospects for orthopaedic innovation in the shifting healthcare landscape.

- **Great Expectations: The Future Wave of Orthopaedic Innovation** brought together industry and clinical leaders to predict signature innovations of the coming years. Consensus formed around greater personalization in hip implants, a proliferation of smart instruments and implants, and significant advances in regenerative medicine and biologics.

“Orthopaedic surgery deals with quality of life,” said Dr. Parker. “Clearly its positive impact on quality of life has an impact on comorbidities like obesity, heart disease and diabetes treatment. This makes what we do as orthopaedists very important, particularly when we consider value-based care.”

Other segments included talks by CEOs of major device manufacturers — including Jeffrey Binder (Biomet), David Dvorak (Zimmer), Omar Ishrak (Medtronic) and Kevin Lobo (Stryker) — and three panels on sports medicine advances. The latter included famed sports medicine expert Patrick Schamasch, MD, and world-class athletes sharing how medical innovations restored them to competition.

A TRADITION OF SPOTLIGHTING INNOVATION

For the past decade, the Medical Innovation Summit has given healthcare leaders a forum to explore industry’s most pressing issues and to network with colleagues from diverse segments of the industry. Attendees at the 2012 summit came from 38 states and eight nations.

The 2013 Medical Innovation Summit, to be held in Cleveland Oct. 14-16, will focus on obesity, diabetes and the metabolic crisis. To learn more, visit clevelandclinic.org/summit.
ORTHOPAEDIC INSIGHTS SUMMER 2013

Resources for Physicians

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ABOUT CLEVELAND CLINIC
Cleveland Clinic is an integrated healthcare delivery system with local, national and international reach. At Cleveland Clinic, more than 3,000 physicians and researchers represent 120 medical specialties and subspecialties. We are a nonprofit academic medical center with a main campus, eight community hospitals, more than 75 northern Ohio outpatient locations (including 16 full-service family health centers), Cleveland Clinic Florida, Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Cleveland Clinic Canada, Sheikh Khalifa Medical City and Cleveland Clinic Abu Dhabi.

In 2012, Cleveland Clinic was ranked one of America’s top 4 hospitals in U.S. News & World Report’s annual “America’s Best Hospitals” survey. The survey ranks Cleveland Clinic among the nation’s top 10 hospitals in 14 specialty areas, and the top hospital in three of those areas.

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Innovative to the Bone: Orthopaedics Takes Center Stage at Medical Innovation Summit

Few areas of healthcare have used device innovation to improve patient outcomes and quality of life as much as orthopaedic surgery has. That’s a big reason why orthopaedics was in the spotlight at Cleveland Clinic’s 10th Annual Medical Innovation Summit, held Oct. 29-31, 2012, in Cleveland.

The summit, titled “Innovative to the Bone,” focused on challenges and opportunities for innovation in orthopaedics, offering perspectives from leading clinicians, industry executives, investors and world-class athletes. Topics ranged from the future of joint replacement to concussion management to regenerative medicine to strategies in orthopaedics investment.

“Clinicians and industry leaders continued to underscore the emerging need to prove value to patients, especially because (continued inside, on p. 22)