e-Cleveland Clinic: Remote Second Opinion Program Ideal for Selected Indications

By Jonathan L. Schaffer, M.D., M.B.A.

In early 2002, a 52-year-old American woman living in Japan had been undergoing physical therapy for degenerative cervical spine pain. Due to language barriers, she had difficulty communicating with her physician, and was concerned that her condition was not improving and could lead to significant dysfunction. Unable to return to the United States for a second opinion, she turned to her computer and e-Cleveland Clinic, a new Web-based second opinion program for patients given life-altering or life-threatening diagnoses.

The patient completed a general medical history and a condition-specific intake sheet online, then sent her medical records and imaging studies to The Cleveland Clinic. Within one day, the consult was completed by orthopaedic surgeon Isador Lieberman, M.D., and available for her review in a secure online environment. Dr. Lieberman did not recommend surgery, but suggested that she continue her physical therapy and usual activities, to maintain motion and function without significant risk of disability.

This e-Cleveland Clinic second opinion consultation provided reassurance and direction to the patient, while avoiding a costly and time-consuming trip to the United States. The patient represents a growing number of consumers who are looking for greater convenience and quality in health care through increased access to providers.

In 2000, a Pew Foundation study found that 52 million American adults, or 55 percent of those with Internet access, sought health information online, many of them seeking specific information about their own or a family member's condition.

Now, health information seekers look for even greater utility from the Web. A recent Harris Poll reported that almost all (90 percent) of online users would like to be able to communicate with their physicians online. More than two-thirds would like the ability to ask questions where no visit is necessary, make appointments, refill prescriptions and receive results from medical tests.

An earlier study by CyberDialogue, an Internet research firm, projects that by 2005, 88.3 million adults will use the Internet to find health information, communicate with affiliated payers and providers, and shop for health products, through online channels.

Like most information on the Web, the quality and usefulness of e-health resources vary greatly. As the use of online medical resources continues to grow exponentially, health care organizations have the unique opportunity to develop and offer Web-based services that meet the public's demand for convenient access to credible, quality, patient-directed health care.

Such services will simultaneously increase the efficiency of the physicians who provide them.

The Cleveland Clinic's second opinion program responds to the public's demand for quality and convenient service. Operationally, the e-visit is the same as an in-person visit. The patient is scheduled on the physician's calendar, a medical record is created, quality assurance and patient satisfaction measures are addressed, and the physician communicates with the patient's physician upon request.

In developing the e-Cleveland Clinic program, we looked to patients and physicians for input on key features and functionality. These include:

• Appropriateness of service - Remote second opinion programs work well for patients with life-threatening and life-altering diagnoses. Service should include thorough condition-specific

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Concentration of Connective-Tissue Progenitors Useful in Bone Marrow Grafting

By George F. Muschler, M.D., and James E. Fleming Jr., M.D.

Classic bone grafting techniques are used in over 1,000,000 procedures each year in the United States. Autogenous cancellous bone graft remains the gold standard for graft material. However, the harvest of autogenous bone is associated with significant cost in terms of postoperative pain, blood loss, infection, the need for a separate incision over the iliac crest, and possible fracture. Also, the amount and availability of autogenous bone may be insufficient for many clinical problems.

As a result, strategies to replace autogenous cancellous bone grafts are being sought. In the Cleveland Clinic’s Department of Biomedical Engineering and Orthopaedic Research Center, we are researching methods to optimize the biology of stem cells for clinical orthopaedic applications. Using advanced tissue-engineering technology, we hope to improve the efficacy and reduce the morbidity of clinical bone grafting.

Bone marrow contains at least two populations of stem cells. The hematopoietic stem cell produces progeny that can reconstitute all blood-cell lineages, including immune cells, red blood cells and platelets.

A less known, but increasingly well-characterized, stem-cell population is the connective-tissue progenitor cell population (CTPs), which can give rise to bone, cartilage, muscle, fat, tendon, ligament, and even cardiac muscle and neurons. As precursors of bone-forming cells, CTPs are key contributors to bone formation and repair.

A fundamental biological principle in the formation, repair or regeneration of any tissue is that the cells do all the work. No prosthetic surface, growth factor, medication or nutrient supplement can influence bone formation except through its specific effects on the activation, proliferation, migration, differentiation or survival of CTPs or their progeny.

Osteoconductive materials can provide a matrix or scaffold that facilitates the attachment, migration and proliferation of bone-forming cells. Biological stimuli from selected growth factors can be used to induce proliferation, migration and differentiation of CTPs through osteoinduction. However, optimal bone healing requires a sufficient number of CTPs, a component lacking in many complex wound sites.

Optimizing the concentration and delivery of bone-marrow-derived cells and CTPs can reduce the morbidity and increase the efficacy of clinical bone grafting. One alternative to autogenous cancellous bone grafts is to supplement allograft matrix from bone banks with aspirated bone marrow to augment the number of connective-tissue progenitors. Bone marrow can be aspirated from the iliac crest with minimal morbidity.

Work done in our laboratory has provided surgeons with guidance on optimizing the concentration of CTPs by limiting aspiration volume to 2 mL from each individual needle site. This significantly reduces dilution of these cells by peripheral blood.

However, our review of 120 consecutive bone-grafting procedures found that bone marrow grafts combining simple bone marrow aspiration with allograft matrix were not as effective as autogenous cancellous bone grafts. This was particularly true in the treatment of fracture nonunions or segmental long-bone defects. Therefore, while bone marrow aspiration has value, further improvement is needed to make this strategy useful in complex grafting procedures.

Building on these observations, Cleveland Clinic orthopaedic surgeons and biomedical engineers have pioneered methods to increase the concentration and selection of CTPs from bone marrow to enhance bone graft performance. Clinically applicable techniques for rapid concentration and selection of CTPs from bone marrow involve using the surface of an implantable porous matrix as an affinity column to which CTPs selectively attach. Composite cellular grafts enriched 4- to 16-fold in CTPs can be prepared in only 20 minutes, and have improved bone formation and spinal fusion in animal models.

Clinical trials using enriched cellular grafts to replace autogenous cancellous bone grafts are now under way in our Department of Orthopaedic Surgery. Members of the Section of Spine Surgery have evaluated 15 patients undergoing anterior lumbar interbody fusion; ongoing clinical and radiographic evaluation of this approach has been satisfactory, with no unexpected failures.

Other methods to further improve the concentration and selection of CTPs for use in regeneration of bone and other tissues are being investigated. One possibility being studied is that bone marrow aspiration from the vertebral body during pedicle-screw placement may serve as an alternative source for enriched composite bone-graft preparations.

Dr. Muschler is an orthopaedic surgeon specializing in adult reconstruction and treatment of fracture nonunions. He also heads the Orthopaedic Research Center’s Bone Biology Laboratory in the Department of Biomedical Engineering. Dr. Muschler can be contacted at 216/444-5338 or 800/553-5056, ext. 45338, or by e-mail at muschlg@ccf.org.

Dr. Fleming, a Cleveland Clinic orthopaedic resident, is the recipient of one of 12 national research awards from the Orthopaedic Research and Education Foundation that will help continue this research.
Distraction Lengthening of Lower Extremities
An Option for Pediatric Skeletal Deficiency

By Thomas E. Kuivila, M.D.

Distraction lengthening, or distraction osteogenesis, of the lower extremities is a safe and effective treatment for both unilateral and bilateral skeletal deficiency in children and adolescents.

Most leg-length discrepancies are unilateral, and congenital, developmental and traumatic etiologies are encountered. Trauma from high-energy fractures sustained in motor vehicle accidents or falls from great heights is not uncommon, and can injure the physis and disrupt growth, resulting in significant discrepancy.

Tumor resection is another cause of leg-length discrepancies. Limb-sparing surgery, removeing an intercalary segment and leaving a significant defect, can be managed either by custom implantable prostheses or leg-lengthening. Infectious damage to the physis – typically septic arthritis of the knee – can also lead to leg-length differences.

Congenital malformations such as short femur, or tibial or fibular hemimelia – all of which can be bilateral – may also result in leg-length problems. If the leg-length discrepancy is expected to be 2 to 3 cm or less at maturity, most patients do not require treatment and can manage with an orthotic device fitted for one shoe. If the difference, with or without orthotic correction, is greater than 5 cm, leg-lengthening may be indicated.

Leg-length issues resulting in abnormal gait and a limp are not only cosmetic issues, but also require higher energy consumption, a concern especially as patients age. Abnormal stress is placed on the knees and hip, particularly the “higher” hip. The pelvis shifts, providing less support of the hip and leading to long-term problems including arthritis. The tilted pelvis also forces the spine to compensate, resulting in spinal curvature. While not progressive, this scoliosis accelerates wear and tear on the lumbar spine, often causing significant back pain.

Limb equalization procedures can be performed at nearly any age, although usually not before age 4. Children should be monitored as soon as the discrepancy is noticed. Use of three data points serially (annual X-rays, X-ray or CT scanograms, and clinical measurement) can determine whether the problem is static or progressive, and allows one to predict the level of discrepancy at maturity and make appropriate treatment recommendations.

For distraction lengthening, either an Ilizarov-type (multiplanar ring) fixator or a uniplanar fixator can be employed. Great care is taken during the operative procedure to preserve the periosteum. On the fifth to seventh postoperative day, patients begin lengthening, at 25 mm per distraction, four times a day until the desired length is achieved. The regenerate bone matures over the next several months prior to fixator removal.

Even well-managed fixators have problems. Superficial pin-tract infections are common, if not ubiquitous, but are easily treated with oral antibiotics. Osteomyelitis is quite rare.

Two other safe and effective options exist for equalizing the length of the lower extremities: growth arrest and extremity shortening. Epiphysiodesis of the longer extremity may allow patients with discrepancies of less than 5 cm to achieve leg-length parity at maturity. With precise timing, usually around age 12 or 13, a Burr is used in minimal invasive fashion to ablate the growth plate, resulting in physesal closure. In addition, some patients at maturity may elect to surgically shorten the longer leg.

These procedures are less complex than distraction lengthening and permit a faster return to normal activities. But since they result in stature loss, they are often less appealing for many patients and families.

Dr. Kuivila, of the Section of Pediatric Orthopaedics, also specializes in scoliosis surgery, and pediatric and adolescent trauma surgery. He can be reached at 216/444-2741 or 800/553-5056, ext. 42741.

e-Cleveland Clinic Second Opinion Program
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Medical questionnaires, and review of original diagnostic tests and medical reports:
• Quality providers – Patients look for providers who have a demonstrated competence in their subspecialty area and are affiliated with a quality institution.
• Convenient, secure access – Patients want to request opinions 24/7; have access to a qualified nurse or physician for questions about the medical questionnaire or request process; and expect a simple, well-designed Web site that uses 128-bit encryption for security of information.
• Cost-effectiveness – This is important to patients and physicians alike. The estimated cost for a patient to obtain a second opinion from a major medical center in person is $3,500 for transportation, hotel, meals and time-off work. Estimates of the financial value of an expert online second opinion vary - from around $1.91 saved for each dollar spent on reviewing biopsies of pros- tate tumors up to $4 saved for each dollar spent on surgical opinions.
• Timeliness – Patients with urgent problems expect a timely response. The e-Cleveland Clinic service provides a second opinion in three to five days, and often in less time.
• Service should be part of the existing business – A credible second-opinion program should be a service already in existence. For more than 80 years, The Cleveland Clinic has provided second opinions; e-Cleveland Clinic is a Web expression of this same service.

When the consult is real and the visit is virtual, greater access and value are created for all concerned. Future developments will continue the integration of technology into existing health care processes, in addition to the creation of new processes that will more effectively address the clinical needs of our patients.

Dr. Schaffer can be contacted at 216/444-8960 or 800/553-5056, ext. 48960, or at schaffj@ccf.org. For more information on The Cleveland Clinic’s online second opinion service go to www.eeclevelandclinic.org.
 Managing Transient Cervical Neurapraxia in the Athlete

By Gordon Bell, M.D.

Transient cervical neurapraxia in the athlete warrants extremely careful on-field management and workup. Also called cervical cord neurapraxia, transient neurapraxia was first described by Joseph S. Torg, M.D., in 1966, based on information gathered from the National Football Head and Neck Injury Registry he established in 1975.

Transient cervical neurapraxia is characterized by paresthesia and/or weakness in the arms, legs or both. Episodes typically last a few seconds and resolve completely.

Most cases occur on the football field, following a severe collision in which the athlete’s neck is either axially loaded or forcefully extended. While no player is immune, the problem most commonly affects positions such as free safety, wide receivers and tight ends, which involve high-speed collisions and open-field tackling.

Due to Dr. Torg’s findings, “spearing,” or lowering the head and hitting an opponent with the crown of the helmet, has been outlawed by the National Football League and throughout other levels of football. Lowering the head even slightly reverses the normal curvature of the cervical spine, resulting in a straightened cervical spine that cannot properly absorb the force applied in a collision (axial loading). Vertebral body fracture with spinal cord injury can result.

Neurapraxia can occur in a normal spine. It can also be associated with any condition that results in a functional narrowing of the spinal canal, such as disc herniation, congenital stenosis, acquired stenosis due to degenerative changes, fractures, or instability due to laxity in the ligaments.

In contrast, the common “stinger” (“burner”) is characterized by numbness or electrical shock down one arm only. This is caused by either stretching or contusion of the brachial plexus, or by nerve-root compression from intervertebral disc herniation or from an osteophyte impinging on the nerve root.

When a player is down on the field with an episode of neurapraxia, the team physician must immediately immobilize the head and neck, then ensure safe transport off the field and to the hospital for evaluation. If the transient episode affects only the arms and the player walks off the field, a careful history and physical exam must be performed by the physician.

Following an episode of cervical neurapraxia, the player should be seen on an urgent basis by an orthopaedic surgeon or a spinal surgeon for evaluation. The workup should include a complete neurological evaluation and a radiographic assessment for structural abnormalities in the cervical spine. Routine cervical X-rays, flexion/extension cervical X-rays, an MRI and, in some cases, a myelogram followed by a CT scan should be ordered to determine the presence or absence of instability, fracture, spinal canal narrowing or cord contusion.

Dr. Torg believes that neurapraxia does not lead to permanent paralysis, since no player with neurapraxia from the National Football Head and Neck Registry has subsequently developed spinal cord injury. In addition, no player with permanent paralysis could recall a prior episode of neurapraxia.

However, neurapraxia indicates that a transient alteration in spinal cord function has occurred, and this cannot be ignored. Patients should be informed that after one episode of transient cervical neurapraxia, they face an approximately 50 percent chance of a repeat episode if they choose to continue playing. Should any structural abnormalities be identified, we generally recommend that the athlete not return to a collision sport.

If no abnormalities are found, deciding whether to continue playing can be difficult. At the recreational or high school levels, players and their parents know it is not worth the risk. However, at collegiate and professional levels, with scholarships, careers and financial futures at stake, players face a difficult decision. About 60 percent return to contact play, according to a 1997 follow-up study by Dr. Torg. Higher-level players may explore surgical options in order to continue playing, with a reduced risk of neurapraxia or permanent cord injury. If a patient has a disc herniation, for instance, disectomy and fusion may be considered. This lowers the player’s risk for future episodes of neurapraxia, though it does not completely eliminate it.

When observing or evaluating players involved in collision sports such as football, physicians should take that opportunity to reinforce the importance of proper tackling technique (keeping the head up during tackling). On the sidelines, physicians should bring any instances of spearing to the coach’s attention.

Dr. Bell, vice chairman of the Department of Orthopaedic Surgery, heads the Spine Surgery Section. His interests include all aspects of spinal surgery, including athletic injuries to the spine. Dr. Bell can be reached at 216/444-8126.
Early Surgery Advised for Scaphoid Fractures in the Adolescent Athlete
By Thomas R. Hunt III, M.D.

Scaphoid fractures in the skeletally immature occur most frequently during adolescence, particularly in athletes. Studies indicate that scaphoid fractures in adolescents closely resemble those of adults. In younger children, distal-third fractures, and fractures characterized as incomplete and minimally displaced, predominate, and are successfully treated by immobilization alone.

Because we believe scaphoid fractures behave similarly in teenagers and adults, our general approach to adolescents with even acute injuries in a completely ossified scaphoid emphasizes early operative stabilization.

Generally, the bone fractures at its waist, and may displace or angulate. For older children, the incidence of nonunion at least matches that found in adults. Unfortunately, the adolescent athlete’s intense motivation to compete, whether internal or external, may delay proper treatment, increasing the chance of nonunion.

Nonunion is thought to be exceedingly rare in young children, though its incidence is probably higher than that reported. Children with an established scaphoid nonunion often exhibit nearly full range of motion, with minimal discomfort.

Scattered case reports recommend nonoperative treatment for pediatric patients with scaphoid nonunions. However, in the largest retrospective review involving these injuries to date, bone grafting and internal fixation achieved healing, and restored full wrist range of motion and grip strength, in all 13 cases. Based on our substantial experience in treating this fracture in the young athlete, we support this approach.

As others have found in adults, we have noted predictable healing, and earlier functional restoration and return to sports participation in adolescents, with very low operative morbidity.

One difference we have noted between adolescent and adult patients is that teenagers more rapidly and completely regain their range of motion postoperatively, even after reconstruction of a scaphoid nonunion.

Dr. Hunt heads the Section of Hand and Surgery in the Cleveland Clinic Orthopaedic Surgery Department’s Hand and Upper Extremity Center. He specializes in the treatment of athletic injuries, complex wrist disorders caused by trauma and avascular necrosis, and arthritic deformities. Dr. Hunt can be reached at 216/445-6426, or 800/553-5056, ext. 56426, or by e-mail at huntt@ccf.org.

The Young Athlete and Anterior Cruciate Ligament Injury: Reducing Risks of Reconstruction
By Jack T. Andrish, M.D.

Anterior cruciate ligament (ACL) injuries can occur in children’s sports, and are disabling for the young athlete, with short- and long-term consequences. Surgical reconstruction is gaining favor among sports medicine knee surgeons, and new techniques reduce the potential for growth-plate injury.

The youth of North America have never before been so involved with organized sports: They are three times more likely to play them today than just 15 years ago. It is no wonder that sports-related injuries are increasing in children. Although most injuries to young athletes are bums and bruises, overuse injuries are known to increase in frequency as the level of competition increases. Even ligament injuries usually seen in the mature athlete are being recognized in the skeletally immature athlete.

The most frequent, significant acute knee-ligament injury in sports is the torn ACL. About 150,000 of these injuries occur each year in the United States alone, striking skeletally immature athletes as well as their mature counterparts.

The good news is that torn ACLs are far less common in skeletally immature athletes. A review of 1,000 patients seen for ACL injuries in our Sports Clinic revealed that just 0.5 percent were under age 12. Many of their injuries were bony avulsions from the tibial insertion, with at least some manner of healing potential through closed or open treatment.

Treatment algorithms for torn ACLs include bracing regimens and activity modification, but these nonoperative regimens are generally insufficient to allow for a safe and effective return to full sports activity. Fortunately, ACL reconstructions, which have become rather routine in the mature athlete – about 100,000 procedures are performed in this country annually – are recognized by anyone reading the sports pages as an operation with expectations for a full recovery.

Several reports support good results for intra-articular ACL reconstruction in kids. We can now perform “low-risk” intra-articular, transphyseal ACL reconstructions in young athletes by following certain principles for drill-hole size (using less than 9 percent of the cross-sectional area of the physis) and orientation (vertical vs. oblique), and by utilizing soft-tissue grafts.

To better understand treatment outcomes in skeletally immature athletes – particularly for various surgical techniques – individuals, institutions and networks of academic institutions are pooling their experiences with retrospective reviews and prospective studies.

We now know that surgical reconstruction for interstitial tears significantly improves functional recovery and also provides “protection” to the menisci. Published studies of patients followed for 10 years portray a 90 percent incidence of new meniscal tears among those with ACL-deficient knees, in contrast to a 3 to 5 percent incidence among those with ACL-reconstructed knees.

Dr. Andrish is a member of the Section of Sports Medicine and the Section of Pediatric Orthopaedics in the Department of Orthopaedic Surgery. He has a joint appointment in the Department of Pediatric Surgery, and can be reached at 216/444-2629 or 800/553-5056, ext. 42629.

X-ray at left shows a hamstring/ACL reconstruction performed in a 13-year-old girl. Two years later, meniscal symptoms prompted further evaluation. MRI at center and right provided an opportunity to view the homogenous low signal of a soft tissue graft completely filling the tibial bone tunnel in the girl at 15 years of age. Normal growth and development occurred during the two-year interval.
Osteochondral Autografts: Long-Term Outlook 
Encouraging With Careful Patient Selection

By James S. Williams Jr., M.D.

Articular cartilage injuries of the knee and ankle are clinically challenging to diagnose and treat. However, we have found osteochondral cartilage autograft transplantation to be very rewarding in select patients. While no specific age limits have been established, this procedure is best suited for younger patients—under age 40—with small (less than 2 cm) focal defects.

Articular cartilage is a unique structure that can withstand compressive and shear forces, has a low coefficient of friction, and great wear characteristics. Unfortunately, once injured, it has a limited capacity for repair.

If left untreated, full-thickness articular cartilage injuries can progress, resulting in osteoarthrosis. Traumatic injuries, in the form of ankle or knee sprains, can cause isolated or combined injuries to the articular cartilage and supporting structures of the joints. Significant disability, in the form of pain and swelling, can occur.

Diagnosis can be difficult. An MRI with special cartilage sequences may be helpful. A variety of treatments may be recommended. Nonoperative treatments include weight loss, physical therapy, anti-inflammatory medicines, orthotics, heel wedges, braces, nutriceuticals, cortisone injection, and visco-elastic supplementation.

Surgical treatments include osteochondral cartilage transplantation, arthroscopic lavage and debridement, penetration of the subchondral bone through microfracture drilling or abrasion arthroplasty, and implantation of cultured autologous chondrocytes. For patients who fail nonoperative measures, osteoarticular cartilage autograft transplantation is one surgical technique that can provide restoration of the damaged area. The advantage of this technique over others is that it is a single procedure, can be done arthroscopically, works well for small defects (less than 2 cm in diameter), heals quickly, and provides structural support.

Contraindications to this procedure include large lesions (greater than 2 cm), diffuse arthritis, uncorrelated malalignment, kissing lesions, uncorrected instability, and loss of meniscal tissue on the involved side. The technique involves harvesting osteochondral plugs from non-weight-bearing areas of the knee and press-fitting them into predrilled holes in the damaged areas of the knee and ankle. The plugs are packed tightly together to occupy as much of the defect as possible. Rehabilitation requires the use of crutches with “touch-down” weight-bearing for six weeks. Special lightweight braces that protect the transplanted area can assist in healing. A return to sports typically occurs four to six months postoperatively, depending on associated pathology and treatment.

A two-year follow-up study of patients undergoing this procedure at The Cleveland Clinic, recently presented at the American Orthopaedic Society for Sports Medicine, found patient satisfaction high, function improved, and restoration of a smooth joint surface as noted on MRI. Our overall experience with osteoarticular cartilage autograft transplantation has been rewarding. We now have some patients, more than five years out from their surgery, who continue to do very well. Based on this experience, the prognosis for long-term benefits from this procedure is encouraging.

Dr. Williams, medical director of Cleveland Clinic Orthopaedics at Euclid Hospital, specializes in sports medicine, knee and shoulder surgery, and arthroscopy, and cartilage repair/ transplantation. He can be reached at 216/692-7770.

The Cleveland Clinic Peripheral Nerve Center: 
A Multidisciplinary Approach to Patient Care and Research

By Peter J. Evans, M.D., Ph.D.

Peripheral nerve disorders vary widely in origin, but cause significant sensory and motor dysfunction. Advances in the treatment and understanding of seemingly straightforward and complex peripheral nerve disorders can only be achieved through the teamwork of experienced specialists committed to total patient care.

At The Cleveland Clinic, we have created the Peripheral Nerve Center to facilitate regular interaction among clinicians from all subspecialties treating peripheral nerve disorders. Traditionally, various subspecialists, including neurologists, orthopaedic surgeons, plastic surgeons, neurosurgeons and general surgeons, have managed patients with peripheral nerve disorders. Often, little discussion or coordination of care has taken place.

Interdepartmental cooperation and idea exchange within our new center will help to develop new clinical pathways that streamline comprehensive care, and allow us to track patient outcomes and establish “best practices.”

The center will also facilitate interaction between clinicians and the neuroscientists within the Cleveland Clinic Lerner Research Institute to stimulate basic and clinical peripheral nerve research.

The most common disorders affecting the peripheral nervous system are traumatic in nature. Acute traumatic disorders vary from blunt compression and stretch or crush injuries to sharp partial or complete transections. Chronic disorders vary from repetitive trauma or slowly compressive injuries to post-traumatic, painful, incomplete regenerative injuries.

Peripheral Nerve Center staff care both for simpler peripheral nerve disorders – such as carpal tunnel syndrome, the most common and effectively treated disorder – and less common, more complex disorders, such as brachial plexus injury. Brachial plexus injury has one of the poorest outcomes, and is much more technically complex in terms of diagnosis and surgery, as well as associated physical, psychological and social problems.

Complex operative treatments include decompression of entrapped nerves, resection of scarred nerves, and neurotomy or reconstruction of damaged segments by nerve grafting typically autografts.

Unfortunately, a myriad of factors may lead to incomplete motor and sensory recovery after reconstructive surgery or acute injury. The isolation, understanding and improvement of these factors will lead to a more complete return of peripheral nerve function.

Unlike the central nervous system, the peripheral nervous system demonstrates significant regenerative potential. Damaged axons can remyelinate, regenerate and reconnect to target organs.

The major challenges are to harness the regenerative potential of the peripheral nervous system, avoid the pitfalls of nonspecific scarring caused by the body’s natural wound-healing response, and maintain the integrity of specialized target receptors and muscles during the often lengthy time it takes for reinnervation.

Consequently, an environment rich in interaction between clinicians and basic scientists is needed to stimulate ideas and cooperation, to generate research funding, and to facilitate the implementation of translational research.

The Peripheral Nerve Center will offer a comprehensive clinical and basic science curriculum, clinical case conferences, and programmatic research meetings to help bring about further advances in patient care.

Dr. Evans, of the Department of Orthopaedic Surgery and the Lerner Research Institute, is director of the Cleveland Clinic Peripheral Nerve Center. He can be reached at 216/444-7973 or 800/553-5056, ext. 47973.
In the last decade, tissue engineering has emerged as a concept for replacing or facilitating repair of worn-out and functionally compromised tissues, including cartilage. Indeed, biotech companies are working hard to design "tissue" that can be placed into osteoarthritic joints. They are focusing mainly on how cells in engineered tissues make collagen and aggrecan, which will solve part of the problem. However, for long-term success, they will probably also need to "engineer" the architecture of the cartilage matrix, a much more difficult challenge. After all, the final structure and mechanical properties of articular cartilage are the result of eons of genetic "engineering," responding to the subtle mechanical demands that shape our bones.

Articular cartilages are remarkable tissues, critical for adult skeletal function. They protect the articulating surfaces of bones with a composite material that resists compressive skeletal loads during normal activities. They are also sculpted with smooth, congruent surfaces to match their partners on adjacent bones in articulating joints. When either of these properties is compromised, the result is impaired mobility and pain, manifest in arthritic diseases or after acute injury.

The material properties result from two macromolecules in the extensive matrix around the cells (chondrocytes). One is the protein collagen, which forms fibrillar meshworks and defines the shape and tensile properties of the cartilage. Collagen networks cannot bear weight. For example, tendons are composed almost exclusively of collagen fibrils and have excellent tensile properties, but readily buckle. These properties are ideal, however, for transmitting forces between muscle and bone into joint movements.

The other macromolecule is aggrecan (see illustration). This complex macromolecule has a large core protein divided into subdomains. Aggrecan is retained within the collagen matrix as an aggregate (hence the name) by interaction between a binding site in the core-protein and hyaluronan, a very long polysaccharide with several thousand sugar units. The strand of hyaluronan weaves into the collagen network and docks many aggrecans.

The central region of the aggrecan macromolecule contains approximately 200 polysaccharide chains of chondroitin sulfate and keratan sulfate, each with a sugar unit motif repeated up to 100 times. Each chain contains negatively charged sulfates, which makes them highly polyanionic. The aggrecan macromolecule assumes a bottlebrush structure—what the chains extended as much as possible from the core protein—to minimize interactions between negative charges.

When aggrecan molecules compress by packing the chains closer, with loss of solvent inside the domain. This increases negative-charge density, and hence the repellant forces inside the macromolecule. When the load is released, aggrecan expands to the extent allowed by the collagen network.

Aggrecan molecules, like shock absorbers, are preloaded by compression to approximately one-fifth their size. Thus, they compress far less under an equivalent load than they would if fully expanded.

Aggrecan, then, is a composite material reflecting its molecular organization. What can go wrong? Chondrocytes must maintain their matrix throughout an adult’s lifetime if cartilage function is to be preserved.

While chondrocytes continue to synthesize and remove aggrecan, once cartilage assumes its final architecture at skeletal maturity, they typically stop synthesizing and removing the collagen network. Furthermore, chondrocytes cannot repair significant tissue damage, which in the knee can result from injury to the cruciate ligament or meniscus, and predispose individuals to osteoarthritis 10 to 15 years earlier than individuals with uninjured knees. Although chondrocytes try, by reinitiating collagen synthesis and increasing aggrecan synthesis, they somehow cannot restore optimal tissue architecture.

What is this architecture? Until skeletal maturity, articular cartilages must serve two functions for smooth joint articulation and bone growth. They establish a columnar architecture in which chondrocytes arise by cell division at the outer edge, progress through a columnar zone while constructing the matrix, and undergo hypertrophy and mineralize. They are then removed by invading vasculature, and the mineralized cartilage is replaced by bone.

At skeletal maturity, the cartilage stabilizes with collagen fibrils that arrange themselves in predominantly parallel fashion around columns of chondrocytes. These then "arcade" into a meshwork at the surface, parallel to the exposed cartilage in the joint, creating a strong tensile covering for the tissue. This final tissue architecture, precisely sculpted, is ideally suited in shape and strength for the loads and motions of each particular joint.

What fails in osteoarthritis? Many factors lead to compromised function in an articular joint. Cumulative wear and tear gradually degrade aggrecan molecules. This damage can come from mechanical input, such as injury, or biological processes, such as cell death and release of proteases. If chondrocytes cannot restore aggrecan successfully, the cartilage will become more susceptible to functional demands placed upon it.

At a critical point, chondrocytes can progress from normal maintenance functions to repair functions, manifest by cell division (cloning) and reinitiation of collagen synthesis. However, they apparently cannot reconstruct normal architecture, and eventual degradation of the matrix exceeds repair with net loss of tissue, bone rubbing on bone, and pain that brings patients to their orthopaedic specialist.

Dr. Hascall, of the Department of Biomedical Engineering, is co-chairman of the Orthopaedic Research Center. He can be reached at 216/445-5676 or 800/553-5056, ext. 55676.
Such computational methods are well-established in the automobile industry to study injury mechanisms in car crashes. Computer models can predict movements and forces that occur during impacts and landings. In sports, unlike car crashes, neuromuscular control and muscle forces play an important role. Computational modeling of these neuromuscular effects is challenging, but absolutely essential to the study of sports injury mechanisms.

We have succeeded in producing computer simulations of a “cutting” movement, where the athlete runs at high speed and then steps to the left. This movement is known to put the right knee at risk for ACL injury. Computer simulations were optimized to replicate the athlete’s performance. Experiments on injury mechanisms are easily conducted by computer because repeated perturbations of movement can simulate imperfections in the athlete’s neuromuscular control. Because these injuries happen infrequently, about 50,000 repetitions are needed to produce a reasonable number of simulated injuries. Only recently have computers become sufficiently powerful to compute these large-scale simulations in a reasonable time.

Our preliminary results show the clear influence of several aspects of neuromuscular control on ACL forces. The most important variables seem to be the quadriceps activation, hamstrings activation and knee angle just before landing.

We will use the virtual athlete to predict the effects of specific neuromuscular training and to design safer shoes. We believe that, once the mechanisms are well-understood, it will be possible to protect athletes effectively against ACL injury.

Dr. van den Bogert, of the Department of Biomedical Engineering and the Orthopaedic Research Center, is interested in the areas of biomechanics, joint injury and motor control. He can be reached at 216/444-5566 or 800/553-5056, ext. 45566.

Knee Injuries in Virtual Reality

By Ton van den Bogert, Ph.D.
While the absolute number of anterior cruciate ligament (ACL) injuries is greater in men, women are two to eight times more likely to sustain ACL injuries than men competing in the same sport. Why are women more prone to injuring this important contributor to knee-joint stability, which functions as a restraint to abnormal anterior motion?

This seemingly innocuous question begs a simple answer, but continues to puzzle the curious in sports medicine. Prevailing theories seem to reach consensus only on the likelihood of a complex interaction between certain extrinsic factors (e.g., environment, coaching, playing surface, shoe-surface interface, etc.) and intrinsic factors (e.g., anatomy, biomechanics, hormones, neuromuscular activation, etc.).

Over time, female athletes have gained access to better facilities and equipment as well as fundamentally sound sport-specific instruction, but gender-specific injury rates remain disparate. How inherent knee laxity, lower-extremity malalignment and femoral intercondylar notch dimensions may predispose an athlete to ACL injury remains unclear.

Women have been shown to display different dynamic movement patterns than men. In an experiment involving a cohort of Division I athletes, female participants responded to anterior tibial translation with quadriceps contraction prior to recruitment of the hamstrings, thereby exaggerating anterior knee motion. Male participants tended to activate the hamstrings first.

The angle of knee flexion at which a maximal quadriceps contraction most endangers the ACL is often at or near full extension. In several separate investigations, women have been shown to perform running, “cutting” and landing maneuvers with significantly less knee flexion. Thus, the female athlete performing a cutting maneuver in a more upright position may react to an unexpected anterior tibial force with a quadriceps contraction that consequently jeopardizes the ACL.

Whether cyclic fluctuations in a woman’s hormonal milieu can increase her risk for ligamentous injury remains unclear. Estrogen, progesterone and testosterone receptors have been identified on the human ACL. In addition, in vitro studies of isolated ACLs subjected to various concentrations of estrogen have demonstrated decreased fibroblast proliferation and decreased collagen production. Rabbit ACLs exposed to exogenous estrogen have also exhibited lower loads to failure. Finally, research has shown certain enzymes regulating collagen tissue breakdown to be regulated by estrogen and progesterone. This may affect human ligamentous remodeling, though direct studies are still lacking.

Together, these findings suggest that physiologic changes in estrogen levels may alter the ligament’s natural ability to withstand stress. However, epidemiologic studies attempting to identify when a woman is at greatest risk for ACL injury during the menstrual cycle have yielded conflicting results.

Further research is clearly warranted to better understand the effects of estrogen on the ACL. Currently, members of the Cleveland Clinic’s Section of Sports Medicine are collaborating on a multicenter study investigating the timing of ACL injury during the menstrual cycle.

Efforts to elucidate why women are at greater risk for ACL injury should be undertaken with prevention strategies in mind. Systematic, prospective studies of female athletes at the high school and collegiate levels have demonstrated that supervised training programs designed to improve leg strength and jump-landing technique can decrease ACL injury rates in volleyball and basketball players. Emerging data suggest similar improvements in soccer players as well.

A better appreciation for the intricate interplay of known risk factors, further identification of new contributors, and refinement of biomechanical, neuromuscular and hormonal interventions will assist sports medicine physicians in caring for women striving to achieve their full athletic potential.

Dr. Susan Joy, a member of the Orthopaedic Surgery Department’s Section of Sports Health, can be reached at 216/986-4000 or toll-free at 877/440-TEAM (8326).
By Christopher L. Tisdel, M.D.

Flatfoot deformity in adults can be progressive, leading to pain, gait abnormality, footwear problems, and skin breakdown. The most common cause of an acquired flatfoot deformity is posterior tibialis tendon insufficiency (PTTI). This complex syndrome of foot deformity remains a priority for orthopaedic foot and ankle research.

The key to success in treating PTTI is to understand the complex anatomy of the acquired flatfoot and its secondary biomechanical alterations. At The Cleveland Clinic, foot and ankle surgeons, working with biomedical engineers, have developed a new cadaveric flatfoot model for research on PTTI and its surgical treatments.

PTTI was first described by Ken Johnson, M.D., in the 1980s. Stage II PTTI is characterized by degeneration and shortening of the posterior tibialis tendon (tendinosis). Weakness of the posterior tibialis is easily tested on physical examination. The asymmetric flatfoot deformity is noted by longitudinal arch collapse, hindfoot varus, and forefoot abduction (the "too many toes" sign). A stage II PTTI, however, remains a passively correctable deformity without associated foot arthritis.

Surgical treatment for stage II PTTI remains controversial. A hindfoot arthrodesis, especially when including the subtalar and/or talonavicular joints, can fully correct all foot deformity, but sacrifices complex motion in the subtalar joint.

A "stiff foot," lacking normal pronation and supination, can affect gait and may lead to ankle or intertarsal arthritis in the future (especially in younger patients). Therefore, many "motion-sparing" surgical procedures have been described for stage II PTTI, including tendon transfers, tendon-lengthening, ligament imbrication, hindfoot and midfoot osteotomies, lateral-column lengthenings, and motion-sparing intertarsal arthrodeses.

Maintaining a strong, flexible, biomechanically normal foot with correction of the deformity - the goals of these procedures - can be clinically difficult to achieve.

Several well-documented cadaveric flatfoot models have been established to document static changes on radiographs for data analysis in biomechanical studies. In these models, the posterior tibialis tendon has been sectioned or unloaded, and the talonavicular joint capsule and spring ligament complex of the medial midfoot have undergone surgical transection.

We believe complex pressure-mapping of the foot allows for more objective data collection and subsequent analysis of normal foot, acquired flatfoot and surgically corrected flatfoot conditions.

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Meniscal Transplant an Option for Post-Traumatic Arthritis in Selected Patients

By Richard D. Parker, M.D.

Meniscal transplantation (replacement or reconstruction) is gaining popularity in the treatment of patients under age 50 with early clinical and radiographic evidence of post-traumatic arthritis.

At The Cleveland Clinic, we reserve meniscal transplantation for minimally to moderately symptomatic patients with large (> 50%), irreparable tears. Until long-term outcome studies demonstrate its effect on the eventual progression of post-traumatic arthritis, we believe meniscal transplantation should be considered a salvage procedure.

Meniscal injuries can occur at any age, with the greatest frequency in the third through fifth decades. Younger people tend to injure (tear) their meniscus in athletic endeavors, while older people sustain tears from minimal insults, such as twisting while getting out of a chair or golf cart.

The main function of the C-shaped fibrocartilagenous meniscus is load transmission. The medial and lateral menisci distribute forces between the femur and tibia over a larger surface area, with the net effect of reducing the point-contact forces of articular cartilage. They aid in joint lubrication and nutrition, and the medial meniscus acts as a secondary stabilizer to anterior translation of the knee following anterior cruciate ligament injury.

The spectrum of treatment for symptomatic meniscal tears includes meniscus repair, partial meniscectomy and meniscal transplantation. Meniscus repair is advocated whenever possible, especially in young patients, because it can restore normal function in the knee.

However, the most common treatment is arthroscopic partial meniscectomy, which is also the most common orthopaedic surgical procedure. Partial meniscectomy decreases symptoms (locking, clicking, pain, swelling, etc.) associated with a meniscal tear, but is reserved for irreparable tears because it does not alter the natural history of the disease, and patients often develop osteoarthritis.

Subtotal meniscectomy is variable in its clinical outcome, ranging from years of unlimited use to deterioration and symptoms of swelling, pain and discomfort. Subtotal lateral meniscectomy often results in knee deterioration and eventual consideration for meniscal transplantation.

The medial meniscus is more frequently transplanted than the lateral meniscus because medial meniscal injuries are more common. Appropriate candidates for transplantation include patients with stable, well-aligned knees and minimal to moderate (Outerbridge Grade I-III) symptomatic post-traumatic arthritis. Those with advanced (Grade IV) changes have fared poorly in published clinical outcome studies.

Physical examination allows the experienced clinician to determine knee stability and alignment. The history should elicit detailed symptoms and the extent of past surgery. Weight-bearing radiographs, is then implanted in the knee under arthroscopic guidance. Either a bone trough (lateral) or bone tunnels (medial) are used to anchor the bony attachments, and sutures are then placed to the native meniscal rim or capsule.

The outpatient surgery involves a 23-hour stay. Patient must use crutches for four to six weeks, and undergo rehabilitation to regain motion and strength. They can return to heavy labor in three to four months, and to sports in six to nine months.

Clinical studies have demonstrated a 75 to 85 percent success rate for meniscal transplantation, defined as reduction in pain/swelling, increase in activity and delay in the inevitable progression of post-traumatic arthritis. However, until long-term studies can determine the exact reduction in the rate of progression, this procedure is not recommended for asymptomatic patients.

Dr. Parker, head of the Orthopaedic Surgery Department’s Section of Sports Medicine, specializes in arthroscopy, knee and shoulder surgery. He can be reached at 216/444-2992 or 800/553-5056, ext. 42992.
Hip Arthroscopy: An Emerging Diagnostic and Treatment Modality

By Viktor E. Krebs, M.D., and Mark I. Froimson, M.D.

Arthroscopic surgery of the hip is a relatively recent addition to the orthopaedic armamentarium. This evolving technique provides the ability to diagnose and definitively treat a variety of hip disorders that previously were underdiagnosed or required an open procedure. The minimally invasive method for visualizing and effecting change in the hip joint offers preemptive treatment for conditions leading to joint degeneration.

Although hip arthroscopy’s diagnostic capabilities have been well-established, recent advances in both instrumentation and technique have expanded its operative potential. Current indications include investigation of the hip joint for unresolved hip pain, removal of intra-articular loose bodies, subtotal synovectomy, synovial biopsy, management of labral tears, staging or debridement of chondral lesions, and treatment of synovial chondromatosis.

An alternative to the extensive exposure required for open hip arthrotomy, arthroscopy requires only two or three small incisions or portals through which instruments can be introduced into the hip joint. Rehabilitation is significantly shortened, and complications are rare.

The hip’s deep proximal location, conforming bony architecture, thick non-penetrating capsule, and proximity to critical neurovascular structures pose challenges in the application and standardization of hip arthroscopy. With dedicated instrumentation, a safer distraction apparatus, and refinements in technique, many early barriers and distractions required to create a working field for the arthroscope and surgical instruments. Distraction is accomplished using a specialized apparatus on a standard operating table. Accurate portal placement, which relies on three-dimensional understanding of the particular anatomic relationship, is critical for safe and successful access, visualization and manipulation of the joint. Lateral paratrochanteric portals allow safe, direct access to the joint along the femoral neck.

Fluoroscopic guidance throughout the procedure protects the articular surface by assuring proper distraction and instrument placement. Long, specialized scopes and sturdy cannulas and working instruments shield and traverse the soft tissue, and provide maneuverability to visualize and work within the joint.

At The Cleveland Clinic, we have performed nearly 100 hip arthroscopies to date. The majority involved removal of loose bodies or treatment of labral tears documented on MR arthrography. This represents less than 2 percent of the total number of hip procedures performed here. However, this number will increase with improved understanding of early hip disease, refinement of operative technique and better surgical instruments, and as outcomes studies demonstrate benefits in specific situations. A comprehensive, multidisciplinary approach to early hip disease and intractable pain will ensure the appropriate application of this technique to patients whom it will benefit most.

Dr. Krebs, a member of the Section of Adult Reconstruction at the main Cleveland Clinic campus, specializes in total joint replacement, revision total joint replacement and hip arthroscopy. He can be reached at 216/445-3834 or 800/553-5056, ext. 53834.

Dr. Froimson, a member of the Section of Adult Reconstruction, specializes in hip and knee replacement and arthroscopy at Hillcrest Hospital, of the Cleveland Clinic Health System. He can be reached at 440/460-8333.
Advances in Total Shoulder Arthroplasty: A New Glenoid Component

By John J. Brems, M.D.

Use of a uniquely designed ultra-high-density polyethylene glenoid component has increased the success rate, both clinically and radiographically, of total shoulder replacement in our experience. Now, although humeral head replacement was introduced in the early 1950s, total shoulder replacement with a high-density polyethylene glenoid component was not available for nearly two more decades.

After the glenoid component was introduced in 1972 by Charles S. Neer II, M.D., widespread concern developed over radiographic loosening and the potential for high clinical failure rates. Numerous authors have reported loosening rates as high as 70 percent by radiographic criteria. Fortunately, the rate of clinical loosening has been far less. Following total shoulder replacement, authors report failure rates of only 7 percent at 10 years, and 13 percent at 15 years.

The last 30 years have seen various modifications in the design of the glenoid component. Many different materials have been used in the search for a long-lasting glenoid component that does not exhibit the radiographic loosening features that may portend eventual clinical loosening and joint failure.

Orthopaedic surgeons generally acknowledge the problems of methylmethacrylate and recognize the virtues of host-bone ingrowth as the ideal mechanism of prosthetic fixation. Nevertheless, several glenoid component designs have tried to mimic the success of acetabular ingrowth into porous metal. Because of anatomic constraints in the shoulder, use of metal-backed glenoid components has been less than enthusiastic.

Encouraging early clinical and radiographic results of the Anchor Peg glenoid component, composed entirely of ultra-high-molecular-weight polyethylene, led to its approval by the FDA in 2000. Because Cleveland Clinic surgeons perform a high volume of shoulder replacements, we were instrumental in providing clinical data to the manufacturer, which led to its widespread availability at present.

The new component is designed to allow bone ingrowth into a central peg that has wafers of the plastic itself. The surgical technique and specialized instrumentation used result in meticulous glenoid preparation. Bone paste, derived from the glenoid reaming, is packed around the central peg and provides an autologous graft to enhance biologic fixation. Very small pegs at the periphery of the component allow for immediate fixation with methylmethacrylate.

Because no hardware is required for immediate fixation, as with the previous metal-backed ingrowth designs, a more anatomic placement of the joint line is possible. Fixation with methylmethacrylate also permits early motion and immediate physical therapy following surgery.

With two years’ experience in implanting this new design, our incidence of radiographic loosening has diminished dramatically. More importantly, patient satisfaction remains high, and recovery of motion and strength has been excellent.

Dr. Brems heads the Orthopaedic Surgery Department’s Section of Shoulder and Elbow Surgery. He can be reached at 216/444-8361 or 800/553-5056, ext. 48361.

Cuff Tear Arthropathy - A New Horizon

By John J. Brems, M.D.

The management of cuff tear arthropathy remains one of the most challenging orthopaedic problems. Humeral head replacement with a newly designed prosthesis may provide an effective solution.

Patients with cuff tear arthropathy are typically 70 to 80 years in age and present with an array of medical comorbidities. Unfortunately, a high percentaje of these patients present with bilateral shoulder disease and are therefore even more severely disabled. Basic personal care activities are markedly impaired, and quality of life is compromised by incessant and unrelenting pain.

In the most severe cases, humeral head replacement is performed, but cuff repair is not possible. Consequently, the humeral prosthesis ascends in the subacromial space to articulate with the acromion. Until recently, surgeons were forced to use the same-shaped humeral head prosthesis that is used for shoulder replacement in osteoarthritis.

Although most patients have less pain with their arm at rest following traditional humeral head replacement, many continue to experience a high level of pain with attempted use of their arm. The greater tuberosity of the humerus continues to articulate with the acromion when the arm is elevated.

Furthermore, with a deficient rotator cuff, the deltoid serves to pull the humerus superiorly, increasing the force of contact between the two bones. Not surprisingly, this results in increased pain and perception of a poor surgical result.

To address this problem, we are implanting a newly designed humeral head that provides an increased arc of contact between the humeral head replacement and the acromion. The arm can be abducted and elevated above 100 degrees while still having the head segment in contact with the acromion. Because there is less bone-on-bone contact, most patients perceive much less pain.

Having a less painful fulcrum, patients predictably find improvement in their ability to elevate the arm. Overall functional use for activities of daily living has also consistently improved in these patients.

The surgical procedure relies on a deltopectoral approach, identical to that used for conventional total shoulder arthroplasty. Predictably, there is rarely any rotator cuff tissue remaining, but occasionally some functional subscapular muscle may be present. This should be carefully preserved and repaired, if possible.

The proximal humerus is osteosnitzed in the standard fashion, and specialized jigs are used to prepare the humerus for the prosthesis. In the older-style head, the bone of the tuberosity is impacted on the acromion, causing pain.

With the new glenoid components, long-term fixation is enhanced by host-bone ingrowth into the central peg region. Arrow shows the extensive degree of bone interdigitating along the fins of this canine glenoid component.

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Specialty Interests:
Bone densitometry, arthrography, bone biopsies, CT, MRI and musculoskeletal radiology

Jonathan L. Schaffer, M.D.
Office: 216/444-8560
Specialty Interests:
Adult reconstructive surgery and orthopaedic research

William H. Seitz Jr., M.D.
Office: 216/639-3700
Specialty Interests:
Management of all upper extremity problems, including shoulder, elbow, wrist and hand, from congenital, arthritic, traumatic, neurologic and acquired conditions

James W. Walker, Jr., M.D.
Office: 216/692-7770
Specialty Interests:
Neural control of the hand and fingers, skeletal muscle physiology and biomechanics, neuromaging, human motor control, and neural adaptations in injuries and diseases

Christopher L. Tisdal, M.D.
Office: 216/445-2792
Specialty Interests:
Orthopaedics, foot and ankle surgery

Antonie van den Bogert, Ph.D.
Office: 216/445-6980
Specialty Interests:
Biomechanics, joint injuries and motor control

James H. Walker, M.D.
Office: 216/692-7600
Specialty Interests:
Total joint replacement and trauma

Jeffrey Lawton, M.D.
Office: 216/445-6915
Specialty Interests:
Hand and upper extremity surgery

Veronique Lefebvre, Ph.D.
Office: 216/445-0762
Specialty Interests:
Skeletogenesis, transcriptional regulation, cellular differentiation, developmental biology and molecular genetics

Isader H. Lieberman, M.D.
Office: 216/445-2743
Specialty Interests:
Orthopaedic spine surgery, minimally invasive surgery, scoliosis, spine tumors, and osteoporosis and spine fractures

Kenneth E. Marks, M.D.
Office: 216/444-2637
Specialty Interests:
Musculoskeletal tumors and joint replacement

Mary Blair Makiejczyk, M.D.
Office: 216/445-5304
Specialty Interests:
Joint replacement surgery of the hip and knee, and orthopaedic problems in the elderly
Cleveland Clinic Bone Summit 2004: “Making New Bone—Clinical Strategies for Cell-Based Bone Tissue Engineering”

The Orthopaedic Research Center, in collaboration with the Cleveland Clinic Department of Biomedical Engineering, plans to host the first Cleveland Clinic Bone Summit May 12 to 15, 2004. This four-day multidisciplinary conference will explore clinically applicable cell-based strategies for generation of new bone/ tissue, bringing clinical and basic scientists together to learn from each other.

The first half of the summit will explore rapidly evolving concepts that directly impact the design and implementation of clinical strategies for inducing new bone formation and positive bone remodeling. These involve stem cell biology, materials science, cell transplantation, mass transport processes, mechanobiology, and pharmacologic agents.

The last half of the conference will explore the practical application of these biologic principles and methods in the clinical arena, including instruction and recommendations for bone grafting for fractures and nonunions, spinal reconstruction and arthrodesis, spinal augmentation (vertebroplasty/kyphoplasty), and systemic treatment of osteoporosis.

The summit will also include workshops on selected laboratory methods, and career development and mentoring in the interface of clinical and basic research.

Clinical and basic science abstracts may be submitted for oral or poster presentation by Dec. 1, 2003.

The summit will be held at the new Cleveland Clinic Foundation International Hotel and Conference Center. For more information, please e-mail Eleanora Voelkel at voelkel@ccf.org or call 800/553-5056, ext. 53028.

A Year in Review: 2001-2002 continued from front page

The primary areas of investigation are in:
• bone structure, function and mechanobiology
• fracture healing and stem cell biology
• cartilage, skeletal development and endochondral calcification
• tendon and meniscus injury, repair and tissue engineering
• effects of nutritional supplements on chondrocyte function
• peripheral nerve injury and regeneration
• foot and lower extremity biomechanics
• gait and locomotion
• knee ligament injury and reconstruction
• disorders of the hand and upper extremity and mechanisms for their neuromuscular control
• shoulder biomechanics

A staff of 13 basic scientists and six clinician scientists, along with 10 Cleveland Clinic orthopaedic clinician collaborators and 85 other collaborators, 12 Ph.D. project scientists, 24 post-doctoral fellows, and 41 technicians and students, conducts this research.

Our resident training program received full five-year accreditation by the National Residency Review Committee after its 2002 review. In the 2001-2002 academic year, we completed the first year of the new basic science core curriculum for all residents and graduate students. During the next year, the first group of clinical residents will begin their one-year basic science research experience.

With the basic science curriculum and one-year research program incorporated into a six-year residency program for all residents, the Cleveland Clinic offers a training program unique in this country to support the development of clinician scientists in orthopaedic surgery. This aspect of our program is a key mission of our department, and will provide future leadership in the profession, and important innovations and advances in clinical care.

Philanthropy is an important foundation for the department’s educational and research efforts. For example, this past year, Mr. Stanley Zielony generously gave a gift of $1,000,000 to support our spine research and educational programs.

Gifts from individuals and industry of $463,700 were provided for research in 2001. A donor campaign to support the department’s programs will be launched in the upcoming year.

In this past year, The Cleveland Clinic has fostered collaboration with Case Western Reserve University to develop a new medical college and graduate education program. The Cleveland Clinic Lerner College of Medicine of Case Western Reserve University will enroll its first-year class in 2004. It promises to offer the majority of its medical students advanced degrees in scientific clinical and basic science investigation, as well as a four- to seven-year innovative clinical curriculum.

The Cleveland Clinic Lerner College of Medicine of Case Western Reserve University will foster the development of clinician scientists in both medical and surgical specialties, and orthopaedic surgery will participate and benefit from these new programs. Both the medical school and its graduate programs offer The Cleveland Clinic Foundation greater opportunities to expand its scientific and educational activities, and contribute to advances in medicine.

Dr. Iannotti, chairman of the Department of Orthopaedic Surgery, is co-chairman of the Orthopaedic Research Center and a member of the Section of Adult Reconstruction. He can be reached at 216/445-5151 or 800/553-5056, ext. 55151.

Coming: A New College of Medicine

The Cleveland Clinic and Case Western Reserve University (CWRU) have formed a historic partnership to train physician scientists. Beginning in 2004, the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University will train students from a national and international pool of applicants as physician-investigators, and scientists dedicated to advancing biomedical research and practice.

The National Academy of Sciences’ Institute of Medicine estimates that less than 2 percent of physicians in the United States are prepared to perform clinical research. The new college’s pioneering curriculum will prepare students for careers as clinical investigators and physician-scientists in orthopaedic surgery and other fields. Training will take place both at The Cleveland Clinic and at CWRU. CWRU will award degrees for the colleges physician-investigator program.