Piedmont Orthopedic Society

ABSTRACTS 2001

2001 VIDEO ASSISTED THORACOSCOPIC SPINAL INSTRUMENTATION

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Traditional spinal instrumentation for scoliosis involves a posterior approach to the spine. Deformity correction depends upon the severity of the deformity and the flexibility of the spine. In addition the morbidity of the posterior approach may be significant because of the significant amount of muscle stripping required. Anterior thoracoscopic approach to the spine began less than ten years ago. At first the VATS approach was used for anterior release and fusion. This approach has been extended to include anterior instrumentation and fusion. Technically this procedure is performed through 3 or 4 ports in the chest. The pleura is split longitudinally and then the discs are removed. The segmental vessels are cauterized in the midline. Screws are next inserted into the vertebral bodies. The rib head is used as a guide for the cannulated screw placement. A guide allows accurate placement of the guide wire, which is inserted with the use of fluoroscopic visualization to be certain that the wire is directed parallel the vertebral endplates. The guide wire must not penetrate beyond the middle of the vertebra. The vertebra is tapped with an appropriately sized tap, which also does not penetrate beyond the middle of the vertebra. Fluoroscopic visualization is used to be certain that the guide wire does not advance through the vertebra. The tap is removed and the appropriate length screw is inserted over the guide wire again making certain that the guide wire does not advance. After all screws are inserted a rod of appropriate length is inserted into the chest and inserted into the lowest screw. A set screw is inserted to lock this in place. The rod is then inserted into the next screw and the procedure is repeated. Bone graft is taken from the exposed ribs and is inserted into the disc spaces. Each vertebra is compressed to the next below and the set screw is maximally tightened. This is repeated until the procedure has been completed. Postoperatively a brace is worn for 3 months. Results have shown significant curve correction which to date has been over 70%. Complications have been rare, however, two have been seen that have resulted from guide wire penetration. One case published by others recorded a tension pneumothorax secondary to guide wire penetration of the down lung. We have also experienced an anterior infection that was the result of guide wire penetration of the esophagus.

2001 CORROSION ON SPINAL IMPLANTS

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INTRODUCTION - Modular spine implants are frequently used as an aid to obtaining fusion. Corrosion is known to occur between modular components of different materials and different surface finishes when in a biologic environment. This study was performed to assess corrosion in spine constructs of a variety of materials and surface finishes.

METHODS - Spinal implants manufactured by a variety of companies were retrieved from twenty-two patients and subjected to failure analysis. The devices were examined for mechanical damage and corrosion using stereomicroscopy with some specific regions subjected to scanning electron microscopy.

RESULTS - Stainless steel implants (n=19) had either polished-finished rods and fixation components (n=8) or matte-finished rods with polished components(n=11). The polished-finished components had been implanted from 1-8 years with only 1 mechanical failure. Most implants exhibited fretting damage and corrosion in the interconnecting regions and screw plate interfaces. The matte-finished components had been implanted for 0.5-1.5 years with 3 mechanical failures. Significantly higher frequency and intensity of corrosion was noted in these implants compared to the polished-finish implants. Corrosion damage was consistent with those commonly observed in mechanically-assisted crevice corrosion phenomena. Ti64 implants (n=3) had been implanted 1-2 years with 1 mechanical failure. No general corrosion was evident on these components.

DISCUSSION - Modular spine implants made of stainless steel with rigid interconnections were found to have corrosion as early as 6 months after implantation. Those implants with semi-rigid interconnections (such as Harrington rods with hooks) and those made of titanium did not demonstrate significant corrosion. Corrosion was more extensive in those implant constructs with rigid interconnections that combined polished components with matte finished longitudinal components. Long term effects of corrosion are unclear and minimization of corrosion seems justified. Selection of modular components with similar materials and surface finish may help the surgeon minimize corrosion.

2001 INDICATIONS FOR INTERBODY CAGES
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A personal series of 27 patients undergoing basket type interbody cages between 1997 and 2000 was reviewed. Seventeen cages were placed via an anterior retroperitoneal approach, six by a lateral retroperitoneal approach and four by laminectomy and facetectomy posteriorly. Single level surgery was done in 19 patients and two levels were done in 8 patients. The majority of patients were women with narrow and collapsed L5-S1 disc spaces. Patients presented with recurrent low back pain, limited range of lumbar motion, and normal neurologic examination. Provocative awake discography with CT and an appropriate control level was done by an experienced radiologist. Autogenous iliac crest bone was used to pack the cages. Complications included a tear of the left common iliac vein, a single unstable anterior Ray cage at L4-L5, a retropulsed posteriorly placed BAK cage at L4-L5, and an L5 neuropraxia. Eleven patients had interbody cages done for failed previous laminectomies and discectomies, 8 had degenerative discs with positive provocative discography, 3 had disc resorption, 2 degenerative disc disease above a solid fusion, and 3 patients had other diagnoses. Results were good in 21, fair in 3, and poor in one. One patient was lost to follow-up. Cages are an evolving technology. Patient selection is paramount. Complications can be disastrous. Experience with anterior approaches and mobilization of the vena cava and left common iliac vein is necessary. Cages should be avoided in patients with spondylolisthesis, instabilities, previous abdominal and pelvic surgery, and those with more than two level disease.

2001 PUDENDAL NERVE ENTRAPMENT: MORE THAN JUST A PAIN IN THE BUTTOCK
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The evaluation of patients with chronic pelvic pain is extremely difficult and is in a state of evolution. Pudendal nerve entrapment has emerged as a neurologic explanation for some of these cases, especially in patients with a history of bicycling or males diagnosed with chronic prostatitis, despite an evaluation not suggestive of inflammation or infection. Although pudendal nerve entrapment remains a controversial entity, it is thought to be due to compression and/or stretching of the nerve in the interligamentous space between the sacrospinous and sacrotuberous ligaments and in Alcock's canal or stretching over the sacrospinous ligament during hip flexion. Patients may present with a combination of severe pelvic and perineal pain, coupled with perineal sensory abnormalities, motor impairment (e.g., urethral sphincter, ischiocavernosus muscle) and autonomic dysfunction (e.g., irritable bladder, penile/scrotal retraction, abnormal sweating). Symptoms are aggravated by sitting, reduced when standing or by sitting on a toilet seat, and are usually absent when recumbent. Since physical examination, urologic evaluation, imaging and routine neurophysiological testing are often normal or nonspecific, the diagnosis of pudendal nerve entrapment remains largely a clinical one; however, hyperalgesia or hypalgesia may be noted in the pudendal distribution and the use of the distal motor latency of the pudendal nerve has been effective in several reports. Treatment is based on perineal hyperprotection (e.g., using a sitting pad designed to suspend the perineum), avoidance of exacerbating activities (e.g., hip flexion), pain management and CT-guided serial corticosteroid injections. Based on a large European surgical experience with this entity, in the past year we performed neurolysis with sectioning of the offending ligaments in 8 patients (15 sides) who failed nonoperative treatment but who had transient relief with the steroid injections. Preliminary results in our small surgical series at 6 –12 month follow-up varied from mild or moderate relief in 7 patients (13 sides) to complete relief in 1 patient (2 sides). All patients expressed gratitude for the intervention even when variable symptoms persisted. Ejaculatory pain was consistently reduced. We believe that compression of the pudendal nerve can explain the symptoms in a subset of patients with chronic pelvic pain, and that improved neurophysiological testing will help establish the diagnosis and select patients who would benefit from surgical decompression.

2001 DEROTATION SIGN FOR THE PERIOPERATIVE DIAGNOSIS OF SIGNIFICANT

PARTIAL-THICKNESS ROTATOR CUFF TEARS, DAVID E. ATTARIAN, M.D., DUKE UNIVERSITY MEDICAL CENTER, DURHAM, NORTH CAROLINA

The purpose of this study was to describe and evaluate a simple perioperative test (the derotation sign) that differentiates significant (grade 3) partial-thickness and small full-thickness rotator cuff tears from insignificant (grades 1 and 2) partial-thickness rotator cuff tears and intact rotator cuffs. A study was performed on 123 patients who underwent shoulder arthroscopy for chronic, symptomatic rotator cuff disease, each of whom was subjected to a derotation test under general anesthesia. Specifically, the glenohumeral joint was rapidly distended with fluid just prior to arthroscopy; and one of three possible observations was made: 1) the arm internally rotated only, 2) the arm initially rotated internally and then externally rotated (positive derotation sign), or 3) the arm did not rotate at all. Arthroscopic findings were then correlated with the derotation test. Forty-one shoulders demonstrated no arm rotation with the derotation test; all had rotator cuff tears greater than 2 cm in size. Forty-two shoulders with impingement and no rotator cuff tear, as well as 23 shoulders with grade 1 or grade 2 partial-thickness rotator cuff tears showed internal rotation only. Seventeen shoulders had a positive derotation sign; all of these had either a grade 3 partial-thickness or a small full-thickness (< 1cm) rotator cuff tear. The derotation test was useful in the perioperative differentiation of functionally intact rotator cuffs from those with significant tears. The derotation sign was specific for the diagnosis of grade 3 partial-thickness and/or small (<1 cm) full-thickness rotator cuff tears.

2001 THE USE OF ULTRASOUND FOR THE EVALUATION OF FOREARM INTEROSSEOUS MEMBRANE DISRUPTION
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Purpose – the treatment of injuries to the interosseous membrane remains a challenge. Recognition of radio-ulnar dissociation associated with radial head injury is important especially if radial head excision is planned. A reproducible, accurate method to diagnose interosseous membrane injuries does not exist. The purpose of this study is to evaluate the effectiveness of ultrasonography to detect interosseous membrane injuries.

Methods – nine pairs of cadaveric forearms were assigned to one of two groups. In group one, each forearm was approached through a dorsal approach to create a laceration through the central third of the interosseous membrane. In group two, each forearm was approached dorsally with the interosseous membrane left intact. A dynamic ultrasound study was performed via a HDI 3000 Sonogram with a 12MHz transducer on all eighteen forearms. Each dynamic study was assessed by a radiologist and in addition four representative static images of the central third were further evaluated by two other radiologists. All three radiologists were blinded to which forearm had the interosseous membrane tear.

Results – two of three observers achieved 100% accuracy in detecting which forearm of each pair had central third interosseous membrane defect. One observer incorrectly interpreted the reading in one pair of forearms for an overall accuracy of 96%.

Conclusions/Significance – this study confirms the ultrasonography is an accurate examination for sectioned forearm interosseous membranes in cadavers. Its accuracy, relative low cost, and reproducibility could make it useful in evaluation forearms with documented radial head fractures with the possibility of concomitant interosseous membrane injury. Though its routine use needs to be substantiated by further clinical studies, our findings document that ultrasonography should be a useful clinical technique for detecting interosseous membrane injuries.

2001 OUTREACH TO THIRD WORLD COUNTRIES:
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Orthopaedic outreach missions to developing countries can provide valuable and gratifying experiences to medical students, residents, private practice and academic orthopaedic surgeons. Although it requires a "leap of faith" to leave one's practice and strike out into a developing country, the dividends paid by needy and grateful patients more than compensate for time gone. Practice in developing countries requires patience, ingenuity, resourcefulness, a sense of humor, and creativity. It is devoid of litigation, unnecessary paperwork, compliance, or compensation issues. Most orthopaedic surgeons will find volunteering their time and skill refreshing and rewarding.

There are a myriad of sending organizations that can be utilized when considering volunteer work

abroad. These include some that are religiously affiliated, including World Medical Mission (www.samaritanspurse.org), CURE International (www.cureinternational.org), as well as many that are not religiously affiliated, including Orthopaedics Overseas (www.hvousa.org) and Healing the Children (www.healingchildren.org). Many of these organizations assist in making travel arrangements and welcome families on mission trips as well.

2001 ORTHOPAEDIC OUTREACH TO THIRD WORLD COUNTRIES – NEPAL
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A new volunteer program through Orthopaedics Overseas, Inc., has been opened in Nepal, a mountainous country between China and India. Two sites are available for prospective volunteers, each of which is affiliated with a residency training program. Volunteers with general or subspecialty interest in adult orthopaedics will be integrated into the teaching program at the Tribhuvan University Teaching Hospital in Kathmandu, while pediatric subspecialists will work with the team at the Hospital and Rehabilitation Centre for Disabled Children in nearby Banepa. Volunteers will work with the residents and attending staff in the clinics, on ward rounds, and in the operating room. Both programs have clinical indications conference, during which interesting cases within the volunteer's area of expertise may be presented. Our hosts would also appreciate several lectures from each volunteer. Both residency programs are less than four years old, and are in the process of developing a formal curriculum. Volunteers may play a significant role not only in the day to day activities, but also in shaping the overall development of these teaching programs.

2001 ORTHOPAEDIC OUTREACH – OPERATION WALK: CUBA
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On June 3, 2000 a team of orthopaedic surgeons, anesthesiologists, nurses, surgical technicians, physician assistants, and physical therapists from California and Indiana, under the sponsorship of Operation Walk, departed from Indianapolis International Airport for Havana, Cuba. The mission: to perform much needed total joint replacements for patients from all over Cuba. The team operated out of the Frank Pais Orthopaedic hospital in Havana, which has over 600 beds and serves as the national orthopaedic and trauma hospital. Over one hundred patients were screened. All had complex, end-stage arthritic joints or prior joint surgery requiring complicated revision surgeries. Approximately 70-75 patients were selected as operative candidates. Over a course of three and one half days of operating, 67 total joints were placed in over 60 patients. The team operated 12 to 14 hours a day using 8 operating rooms so that 4 rooms were running at all times. Our caseload was limited by the number of prostheses available for implantation. All medicines and supplies used during the week, from the prostheses down to band-aids, were taken to Cuba by the team. These supplies were donated from various companies and hospitals from the United States. We used no Cuban supplies whatsoever so that we would not deplete their already limited or nonexistent supply. The team worked with Cuban physicians and nurses during the operations. This provided an important additional benefit in the form of shared education and knowledge. The response by the Cuban people, patients, and hospital staff, was overwhelming. This cannot be exemplified any better than the closing farewell ceremony during which the American and Cuban flags flew side-by-side.

2001 ORTHOPAEDIC OUTREACH TO THIRD WORLD COUNTRIES – GUATEMALA
WILLIAM C. ANDREWS, JR., M.D., LYNCHBURG, VIRGINIA

This paper is a report on the experiences of three Orthopedic Surgeons and their surgical team, who make an annual trip to South or Central America. The group screens approximately 250 patients at the hospital and performs approximately 120 procedures per trip. All patients are children or teenagers and the procedures range from club feet to congenital hip dysplasia, congenital hand deformities, spine, congenital pseudarthrosis of the tibia, malunions, etc. -- the entire constellation of pediatric orthopedic problems. Post operative followup is performed by local volunteers. The paper reports on this group's observations, methods, and future plans.

2001HIP ARTHROSCOPY IN THE DIAGNOSIS AND TREATMENT OF INTRACTABLE HIP PAIN
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The painful hip frequently represents a diagnostic and therapeutic challenge. Numerous intraarticular and extraarticular entities do cause pain about the hip. The first step in diagnosing hip pain is to differentiate between intraarticular and extraarticular causes.

Fortunately the majority of disorders of the hip are readily diagnosed utilizing standard examination and radiographic techniques. A subset of intraarticular disorders exists, however, that escapes diagnosis with standard modalities. These include labral tears, loose bodies, synovial disorders and chondral defects. Hip arthroscopy allows for direct visualization of the intraarticular pathology thereby aiding in the diagnosis and treatment of these disorders.

Labral tears and chondral defects are the most common disorders encountered during hip arthroscopy. Labral tears occur most commonly in the anterior-inferior labrum in this series. The tears were almost always interstitial and fibrillated. There were no known cases of labral detachment from the bony acetabular rim. Treatment involves debridement of the torn tissue back to a stable base. Success rates in isolated tears approach 90%. Dysplasia and degenerative changes in the articular cartilage decrease the likelihood of a successful result.

Chondral defects also most commonly occurred in the anterior acetabulum and were frequently associated with labral tears. This labral tear-chondral defect complex is termed the “watershed lesion”. Treatment involves debridement to a stable cartilaginous rim. In cases with exposed bone, the bony base was drilled to attempt to enhance fibrocartilage formation. Results were best when the chondral defect was isolated to the anterior acetabulum. For cases with diffuse acetabular degenerative changes or those with femoral head chondromalacia, the results were far less predictable and generally poor. Loose bodies only occurred in cases with femoral head chondral defects.

Other potential indications for hip arthroscopy include treatment of synovial disorders, infection, ruptured ligamentum teres, early osteoarthritis, assessment of painful total hip replacements and avascular necrosis. There is little published data on these indications. Treatment of early symptomatic osteoarthritis in young patients with mechanical symptoms appears to be an attractive treatment option based on limited experience.

Complications from this procedure include nerve injuries, chondral damage, vascular injury and instrument breakage. Fortunately these are rare and did not occur in any cases in this series.

Overall, hip arthroscopy represents a safe technique in experienced hands, and represents the most effective means of diagnosis and treatment of many intraarticular disorders.

2001 EARLY RESULTS OF HIP ARTHROSCOPY FOR ACTIVE LEGG-PERTHES DISEASE (THE DUKE EXPERIENCE)

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Hip pain is common in patients with active Legg-Perthes disease (LPD), but surgical treatment for this pain is controversial. In this study, we assess the early results of hip arthroscopy for the treatment of pain and mechanical-type symptoms in patients with active LPD. Four arthroscopic procedures were performed in four patients with chondromalacia of the femoral head (3), synovitis (2), loose body (1), labral tear (1), unstable chondral flap of the femoral head (1), and acetabular chondromalacia (1). All patients experienced relief of pain and mechanical symptoms, improved gait, and increased activity at two-week follow-up. No complications occurred. We believe that hip arthroscopy is a minimally invasive, low risk procedure that effectively provides relief of pain and mechanical-type symptoms in patients with active LPD.

2001 HIP ARTHROPLASTY AND THE DIRECT LATERAL APPROACH- REVISITED

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Every surgical approach has related risks and benefits; the purpose of this study was to examine postoperative morbidity and mortality specific to the direct lateral approach for arthroplasty of the hip in a community setting. A retrospective review of 327 hip arthroplasties performed by one surgeon at one community hospital from 1991 to 1997 was performed. Cases that specifically utilized the direct lateral approach described by Hardinge were identified; and each case was examined for surgically related complications, including infection, dislocation, sciatic nerve palsy, altered gait, and death. The direct lateral approach was used in 202 elective primary total hip arthroplasties (average age 66.5, average follow up 3.1 years), 34 bipolar arthroplasties for fracture (average age 76, average follow up 2.5 years), 33 unipolar arthroplasties for fracture (average age 83, average follow up 1 year), and 58 total hip revisions (average age 71, average follow up 2.6 years). The primary total hip group had 1 deep infection, 3 dislocations, 2

transient/ 1 permanent sciatic nerve palsies, 8 new Trendelenburg gaits, and 1 postoperative death secondary to ischemic stroke. The bipolar group had no infections, no dislocations, no sciatic nerve palsies, 2 new Trendelenburg gaits, and no deaths. In the unipolar group, there was 1 superficial infection, no dislocations, no sciatic nerve palsies, and no postoperative deaths within 90 days (8/33 had died by one year). The revision group had one late infection, 11 dislocations, 1 transient/ 1 permanent sciatic nerve palsy, 8 new Trendelenburg gaits, and no deaths. In the community setting, the direct lateral approach for hip arthroplasty, particularly for primary total hips and hemiarthroplasties for fracture, has a very low complication rate. In reviewing the pertinent literature, the morbidity and mortality after the direct lateral approach, especially for hemiarthroplasty of the hip, may be lower than that associated with the posterior approach.

2001 PIEDMONT ORTHOPEDIC FOUNDATION GRANTS FROM 1963 TO 2001

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Ninety-six grant requests have been funded through the Piedmont Orthopedic Foundation between 1963 and 2000. The projects funded resulted in thirty-six publications directly related to these grants. A greater number of presentations and publications were subsequently related to the original or follow-up grants from the Piedmont Orthopedic Society.

The grant recipients were either Residents or Fellows in the Duke Orthopaedic Resident Program. The abstract included the purpose of the project, the material and methods, as well as the results and a discussion. Each Resident had a faculty mentor in order to assist with the substance of the topic. The advantages of these Piedmont Foundation Grants were: (1) a structured program within the Duke Resident/Fellowship program that provided an incentive for each Resident to initiate a clinical or laboratory project as soon as the Resident entered the program; (2) rapid completion of the review process by the Scientific Committee; (3) initiation of the project within a few days or a few weeks after the project outline was submitted for consideration.

The funded projects cover a wide variety of musculoskeletal conditions that range from basic research to clinical applications through clinical observations and patient outcomes.

A review of the content of the funded grants shows a direct relationship between the results of the experimental projects and the application of those concepts to clinical management of patients. Several Duke faculty members involved in this method of funding research projects have observed the far reaching association of these pilot project grants not only with completion of a designated research project, but also early application of the results to the clinical practice of orthopaedic surgery. The alumni of the Duke Orthopaedic Residency Program have generously supported the Piedmont Orthopedic Foundation in order to assist current Residents and Fellows in supplementing their education.

2001 UPDATE ON ORTHOPAEDIC SURGERY IN MORBIDLY OBESE PATIENTS

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Morbidly obese patients--those who have twice body weight to height—represent almost 10% of all total knee replacements in my practice from 1988 to 2000.

These patients were evaluated for co-morbid conditions as well as operative and postoperative complications and compared to normal weight patients. Outcome criteria included Hospital for Special Surgery evaluation, infection, thrombophlebitis, and patient satisfaction. There was no significant difference in the two groups. We concluded that the morbidly obese did present technical problems of exposure and wound closure but did not have statistically greater complications than the normal weight control group.

2001 CLINICAL APPLICATION OF CERAMIC CERAMIC BEARINGS

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The primary factor limiting the long term duration of total hip replacements is wear related osteolysis and the implant loosening resulting in loss of fixation of cemented and uncemented implants. Linear wear rates of chrome cobalt femoral heads on ultra high molecular weight polyethylene are in the range of 0.1 mm per year and higher, resulting in a significant amount of volumetric wear debris. Because of these constraints on the long term success of total hip replacement, alternative bearing surfaces are being investigated. These include metal on cross linked polyethylene, ceramic on ultra high molecular weight

polyethylene, metal on metal, and ceramic on ceramic. This session will focus on the latter.

Ceramic was first used in total hip replacements by Pierre Boutin in France in 1970, using an alumina cup and ceramic ball attached to a metal stem. Early efforts using ceramic bearing surfaces were limited by the design of the femoral component and limitations in the material processing of the ceramic. Many of these early efforts were associated with results that were inferior to conventional total hip arthroplasty with metal on polyethlyene articulations. These included catastrophic failure of the femoral head or liner through fracture, or chipping of the implants leading to third body wear situations.

Since that time, continued clinical use in Europe, combined with further improvements in the manufacturing and testing of implants has lead to a renewed interest and clinical trials in the United States. These improvements include significant reductions in grain size of the ceramic particles, proof testing of implants, and improved tolerances with the trunion and the femoral head taper.

Advantages of ceramic/ceramic articulations are extreme hardness, ability to be highly polished, surface wettability, very low wear rates, good lubrication characteristics, and the ability to use larger diameter femoral heads to improve stability. Potential disadvantages are the increased cost, remote risk of fracture, limited range of neck lengths because skirted necks are not an option.

Currently ceramic/ceramic articulations are not approved by the FDA, although there are at least three Investigational Device Exemption studies presently underway with early follow up on modern femoral components and ceramic/ceramic articulation. These include the Osteonics, Wright Medical, and Smith and Nephew Systems. Although the preliminary results are encouraging, it is too early to determine if this technology will result in a true paradigm shift to hard/hard bearings as a solution to the wear problem.

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2001 PHYSICIANS WITH AVASCULAR NECROSIS OF THE FEMORAL HEAD: MANAGEMENT WITH FREE VASCULARIZED FIBULAR GRAFTING

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Since avascular necrosis of the femoral head is irreversible and often progressive, surgical management is the mainstay of therapy in symptomatic cases. Multiple surgical options have been described including: endoprosthetic replacement of the femoral head, core decompression, resurfacing of the femoral head, femoral osteotomies, and free vascularized fibular grafts. In patients greater than fifty years of age, endoprosthesis placement is a favored treatment. However, in younger patients, preservation of the femoral head for as long as possible is a goal, as endoprosthesis placement in this group will usually require at least one revision within their lifetime.

The purpose of this study was to compare the results at one institution of free vascularized fibular grafts for the treatment of osteonecrosis between (1) physicians and (2) a control group of the population at large. A second purpose was to determine how compliant physicians were when asked to follow another physician's instructions.

Physicians treated for stage II, III, and IV avascular necrosis of the femoral head included a treatment period from 1986 to 1999. The control group consisted of the entire population of patients treated with a free vascularized fibular graft from the onset of the senior authors' experience, which ranges from 1979 to 1999. A total of 21 physicians (32 hips) were treated: 10 stage II, seven stage III, and fifteen stage IV. The control group had a total of 1,402 patients: 254 with stage II disease, 237 stage III, and 911 stage IV. All patients were followed for a minimum of two years. Each patient in the physician group completed a written survey regarding duration of non and partial weightbearing. Activity history, diet, and weight control were stressed in this survey. The endpoint for failure was a recommendation of or conversion to total hip arthroplasty.

Results – a total of twenty-one physicians (32 hips) were treated for avascular necrosis of the femoral head. The control group consists of 1,402 patients. When compared with the senior author's entire experience treating stage II, III, and IV avascular necrosis, the physician group displayed a high degree of compliance during the immediate postoperative period ($p<0.05$). In addition, the overall rate of conversion to total hip arthroplasty was significantly lower in the physician group (6.25%) than in the control group

(15.5%). Exercise, weight control, and diet were all emphasized in our instructions to physicians and in our survey of the results.

Conclusion – the difference in incidence of total arthroplasty conversion for osteonecrosis may be related to one or more factors including extensive non and partial weightbearing, diet, weight control, and exercise. Further evaluation of failure in both groups with regard to these factors may lead to a better understanding of the reasons for progression of avascular necrosis of the femoral head.

2001 THERMAL LASER ENERGY IN ORTHOPAEDIC SURGERY – THE SHOULDER AND KNEE

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Thermal energy has been used in surgery, primarily for hemostasis. With increased popularity of the laser, thermal energy was used for shrinkage as well as ablation. The composition of ligaments and capsule includes polypeptide chains in a triple helix configuration. This collagen with heat may have extended confirmation under increased tension. The molecular structure of collagen may be denatured by changing collagen from crystalline structure to an amorphous state. The hydrogen bond reacts to heat and alters the intramolecular and the intermolecular linkage. Fiber length contracts and increases in diameter. The results of the application of heat depend on multiple variables including exposure time, the maximum temperature, tissue hydration, collagen architecture, and mechanical stresses. The cellular response includes fibroblast migration, inflammatory reaction, increased vascularization, and alteration of tissue strengths. Tissue action varies according to the temperature applied. Cell death occurs at 45°C. Protein denaturation occurs from 40°-70°C. Collagen denatures at about 60°C. Nerve damage occurs at a temperature greater than 70°C. Vaporization occurs at 100°C.

The laser systems may be CO_2, Nd:YAG, Ho:YAG, and Excimer. The dynamics and changes depend on power density, spot size, duration of application, and zone of necrosis. Radiofrequency (RF) may be monopolar which requires an electrode tip and grounding pad. This method is less affected by tissue thickness and temperature of irrigating solution. Temperature control may be on the probe tip (Oratec). Bipolar (Miteck and Arthrocare) provides energy between two points on the probe. The advantages are shorter path via the conductive irrigating solution, less depth of penetration, less current required, limited effect on collateral tissues, and limited effect on thicker tissues. Clinical applications about the shoulder are laser assisted capsular shift, acromioplasty, and ablation of specific tissues. Treatment patterns vary. There are several clinical studies by Fanton, Andrews, Savoie, and Colosimo.

2001TEMPORAL EFFECTS OF RADIOFREQUENCY-GENERATED HEAT ON CANINE ARTICULAR CARTILAGE

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PURPOSE: Radiofrequency (RF)-generated heat has been used clinically for treatment of articular cartilage defects. Recent in vitro studies have reported that RF treated articular cartilage results in loss of chondrocyte viability. The temporal response of chondrocytes and its extra-cellular matrix to RF generated heat has not been reported. The purpose of this study is to evaluate the effects of RF-generated heat on chondrocyte viability and components of the extracellular matrix over time.

METHODS: Ten canine proximal humeri were obtained immediately after euthanasia performed for reasons unrelated to this study. All dogs were clinically and grossly free of shoulder disease. The articular cartilage of the humeral head was templated into 6mm diameter sections. Sixty sections were then randomly assigned to one of three groups: Group 1. Control (no FR treatment); Group 2. Central static 3 second RF treatment; and Group 3. “Brush stroke” RF treatment over entire section. RF heat was delivered with a commercially available arthroscopic probe using a bipolar generator with settings corresponding to 90 watts of power. The sections were then harvested and cultured in separate wells at 37°C. Explants were harvested at days 0, 5, 10, and 20. Liquid culture media was collected every 4 days. Explants and liquid media were assessed for glycosaminoglycan (GAG) content, collagen content, metal methylprotease-3 (MMP-3) release, and MMP-13 immunoreactivity. Each explant underwent modified Mankin histology scores. Statistical analyses were performed by multivariate analysis of variance with significance at $p<0.05$.

RESULTS: Significant differences with Mankin scores were noted in both RF treated groups when compared to the control group. Significantly lower amounts of GAG release into the culture media was noted in the “brush stroke” group when compared to the control group. However, at 20 days there was an increase in GAG release from the RF treated groups when compared to controls. Immunohistochemical

analysis showed no qualitative differences of matrix collagen staining but revealed more intense MMP-3 content and MMP-13 release in the RF treated chondrocytes. There were no differences in GAG content or collagen content in any group at any time.

DISCUSSION: Articular cartilage is a dynamic tissue that responds to insult in a variety of ways over time. This study suggests that bipolar RF-generated heat can cause immediate histologic damage to canine articular cartilage in vitro. Future studies are necessary to see if these changes in chondrocyte viability and metabolism are permanent. Further, these findings need to be compared to the human clinical setting.

2001 INTRADISCAL ELECTROTHERMAL THERAPY (IDET)" – A SYMPOSIUM

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The purpose of this presentation was a general review of indications and techniques for an IDET procedure. Scientific background of the procedure was presented, as well as the pathophysiology of degenerative disc disease.

The only indication for this IDET procedure is discogram-proven discogenic low back pain. It is not to be used for radiculopathy or herniation of the nucleus pulposus; or spinal stenosis; or for segmental spinal instability.

The technique for prone lumbar discography was presented. This is a prerequisite of any therapeutic IDET procedure.

The latest results in the literature were presented, including review of the October 2000 article by Saal and Saal of 62 IDET patients with discogenic LBP. These results demonstrated statistically significant improvement in pain and functional scales.

Drawbacks to IDET were presented. These included the need for two separate procedures on different days (discogram, followed by IDET), the expense of the catheter itself, relatively long recovery times with restricted activities over three months, and the difficulties with local insurance companies approving payment for the procedure.

IDET is considered a reasonable, minimally-invasive treatment option for patients who wish to attempt to avoid surgical fusion of lumbar spine.

2001 PIEDMONT SOCIETY SURVEY – THERMAL ENERGY TECHNIQUES IN ORTHOPAEDIC SURGERY

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Survey forms were mailed to all active physician members of the Duke Orthopaedic Piedmont Society, recording their collective experience with new technology thermal energy techniques for shoulder, knee, and spine.

A total of 43 surgeons responded. Of these, twenty-two (22) had personal experience with shoulder thermal procedures, twenty (20) with knee, and one (1) with spine (IDET).

Surgeons listed specific applications with shoulder, knee, and spine. For shoulder, these included: multi-directional instabilities, posterior instabilities, anterior instabilities, impingement, secondary impingement. For knee, these included: debridement of adhesions, chondroplasty, meniscal tear ablation, ACL graft shrinkage, ACL partial tears, chronic MCL laxity, lateral release, medial plication. For spine, the only application is discogenic LBP.

A survey of specific complications revealed only shoulder-specific events, none for knee or spine to date. These included – Shoulder: "Absent Capsule Syndrome", Brachial Plexopathy, axillary neuritis, Axillary nerve palsy, arthrofibrosis. Recurrent shoulder instability after thermal capsular procedures ranged from 2.5% to 40% among the responding surgeons. Although a majority of respondents (29) still see office patients with lumbar spine problems, only six surgeons perform interbody fusions. General comments from selected surgeons were also presented, including an educational letter from Dr. J. L. Goldner.

2001 BIOMECHANICAL COMPARISON OF THE PROXIMAL OBLIQUE METATARSAL OSTEOTOMY VERSUS THE PROXIMAL CRESCENTIC AND CHEVRON OSTEOTOMIES

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The proximal oblique metatarsal osteotomy (POMO) has been proposed as an alternative technique for correction of metatarsus primus varus in hallux valgus surgery. In order to compare biomechanical characteristics of the POMO with the crescentic and chevron osteotomies, two groups of fresh frozen human cadaver first metatarsal matched pairs were prepared and tested. The metatarsals were

osteotomized, stabilized, and mechanically tested to failure in cantilever bending on an Instron materials testing machine. For pairs in Group I (n+8), the mean moment-to-failure values were 3304(±1518 SD) N-mm for POMO, and 1301 (±844 SD) N-mm for proximal crescentic osteotomy ($p<0.001$). For pairs in Group II (n=8), the mean moment-to-failure values were 6087 (+3977 SD) N-mm for POMO, and 1784 (+1173 SD) N-mm for proximal chevron osteotomy ($p=0.007$); similar differences in stiffness were also noted. On average, crescentic and chevron osteotomy specimens transferred moment at only 39% and 29% of that transferred through the POMO specimens, respectively. Similarly, the crescentic and chevron osteotomy specimens were on average only 33% and 21% as stiff as the POMO specimens, respectively. Our data indicated that the POMO offers a clear biomechanical advantage in terms of stability and prevention of hallux elevatus.

2001 THE FLOATING KNEE REVISITED

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The "floating knee" was first described by Blake and McBryde in 1974[(1)] and 1975[(2)]. These ipsilateral fractures of the femur and tibia were classified as Type 1 involving both shafts, Type 2-A involving the knee joint, and Type 2-B involving the hip and/ or the ankle joint. Complications were frequent, i.e. delayed or nonunion and permanent disability was the norm. Eleven patients were reviewed from 1996 to 1998 at the Medical University of South Carolina and contrasted in demographics, treatment, complications, and outcomes with the earlier series from 1958 to 1971. Five (5) of the eleven patients involved the immature skeleton.

The patients with "floating knee" from 1958 to 1971 had a length of stay (LOS) of 57 days for those with earlier surgery and 153 days for those with later surgery. There was delayed treatment of any type in the 1996 to 1998 patients and an overall length of stay of 20.2 days. Seventy-five percent of the bones from the 1996-1998 patients had ORIF primarily compared to fifteen percent in the 1958-1971 patients. The primary treatment was traction and casting at that time. Fifty percent of the bones in the 1958-1971 patients were open and four patients died. There were no deaths in the 1996-1998 patients.

The 1958-1971 patients had a 44.6 percent nonunion rate of the bones involved compared to nine percent (2 of 24 bones) in the 1996-1998 patients. Similarly, the complication rate was 65 percent in the 1958-1971 and 21 percent in the 1996-1998. There were still problems in 1996-1998, including one osteomyelitis, one flap necrosis, and one compartment syndrome in these eleven patients. Ligamentous injuries continue to occur and must be suspected following internal fixation.

Associate injuries with vascular complications, joint involvement, and soft tissue trauma with secondary post-op infections continued to limit good outcomes. Type 1 floating knees generally do well without long-term functional disability. Type 2 floating knees uniformly have permanent problems.

Operative stabilization of at least one fracture has become rule rather than the exception in the immature skeleton with ipipsial damage and/or over growth being common.

In summary[(3)] the similarities and changes as we revisit the "floating knee" include:

(1) the patients are still mostly young multiply injured males with high velocity trauma
(2) many of these patients are fatalities presenting to the level one trauma emergency room as "DOA"
(3) there are still high complication rates but reduced from 65% to 25%
(4) delayed and nonunions are reduced from 45% to 10%
(5) outcomes with significant disability are improved from 65% to 30%
(6) there is better and more aggressive trauma team approach with earlier bone fixation, better fixation systems, quick mobilization, ISS and
outcomes quantitation
(7) safety restraint systems, retrievable logistics, and intensivists and subspecialty care are now available
(8) further reduction of the complications and long term disability are:

(a) prevention of multi-trauma at the venue of injury by improving that environments are safety measures

(b) universal and immediate rotary or fixed wing retrieval of the poly trauma patient with early access to a level one trauma center

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2001 THE AGILITY ANKLE: AN EARLY EXPERIENCE

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Ten patients had a total ankle replacement and were followed for a range of four to 24 months with a mean follow-up of 13.4 months. The primary diagnosis was osteoarthritis in two ankles and post-traumatic arthritis in eight ankles. Eight out of ten of the patients had prior surgical procedures.

All patients had a minimum of six months of conservative therapy including non-steroidals, walking aids, intraarticular injections and AFO bracing. Each patient was provided with the option of an ankle fusion or an ankle arthroplasty. After discussions regarding the risks and benefits of arthroplasty, ten patients agreed to proceed with an ankle replacement.

Each patient had an ankle replacement with the Agility Ankle (DePuy); components consisted of a titanium tibial component, polyethylene insert and chrome cobalt talar component. The procedure included fusion of the distal tib/fib syndesmosis. Three out of seven patients had Achilles tendon lengthening and two of ten patients required hardware removal prior to proceeding with ankle replacement.

Postoperatively each patient spent one night in the hospital for pain control. Weightbearing as tolerated was begun during a range of two to six weeks.

To date, there have been no infections and no revisions. There were four intraoperative complications, two of which involved distraction malleolar fractures and two involved pin failure of the external fixator system. An additional complication was a minimally displaced lateral malleolar fracture that occurred after a patient fell.

Two scoring systems were used to score each patient: (1) The American Orthopaedic Foot and Ankle Society, Ankle Hindfoot Clinical Rating System. The postoperative score range was 46 to 100, the mean score was 85. Seven out of ten patients scored greater than 90 on this rating system. (2) The Foot Function Index System was also used. This is a patient visual analog scale relating to pain, disability, and activity limitation. Unlike the Ankle Hindfoot Clinical Rating System, the higher number reflects a greater amount of pain, disability, and loss of function. The average preop rating of all patients was a 71, the average postop rating was 18.

This is an early follow-up of a small number of patients who underwent a total ankle arthroplasty. Despite the level of complications which were minor, ankle arthroplasty combined with a fusion of the syndesmosis is a reasonable alternative to ankle fusion in a low demand patient.

2001 FREE VASCULARIZED FIBULAR GRAFTING IN THE MANAGEMENT OF FEMORAL NECK NONUNION IN PATIENTS UNDER FIFTY YEARS OF AGE

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Purpose. The incidence of nonunion and osteonecrosis after femoral neck fracture has been well documented. In older patients, implant arthroplasty is an acceptable treatment for these problems. However, in the younger population alternatives to implant arthroplasty are favored in order to preserve the femoral head. Surgical treatments for nonunion of the femoral neck include osteotomy, nonvascularized bone grafting, muscle-pedicle bone grafting and vascularized bone grafting. This study was done to examine the results of free vascularized fibular grafting as a treatment for nonunion of the femoral neck in patients under fifty years of age.

Materials and Methods. Between 1984 and 1998, twenty-two consecutive patients had vascularized bone grafting for nonunion of the femoral neck after failed internal fixation. Diagnosis of osteonecrosis was based on clinical and radiographic study. Mean age of the patients was 28.7 years (range eleven to 49). There were thirteen males and nine females. Mean interval between internal fixation and free vascularized fibular grafting was 18.3 months. The average follow-up to date is 84.7 months (twenty-nine

to 195 months).

The surgical technique involves a two-team approach for preparation of the hip and harvest of the ipsilateral fibula on its peroneal vascular pedicle. The hip is exposed through an anterolateral approach. Reaming and coring of the femoral neck results in correction of the neck shaft angle. The fibular graft is impacted across the nonunion site through the bed of cancellous bone into the subchondral bone of the femoral head. The fibula is transfixed laterally with a three millimeter C-wire. The microvascular anastamosis with the ascending branch of the lateral femoral circumflex vessels is attached to the pedicle. Supplemental fixation was performed with cannulated cancellous screws placed parallel to the fibular graft.

Results. Twenty of twenty-two nonunions healed after the first reconstructive surgery. Two patients required additional procedures for union; one had iliac crest bone graft four months postoperatively and the second had a muscle-pedicle graft six months after the initial reconstructive procedure. The average time to union for all patients was 9.9 months (range 3 – 23 months). Progression of osteonecrosis of the femoral head occurred in 13 of 22 patients. However, successful long-term salvage of the femoral head was achieved in twenty of twenty-two patients, with an average Harris hip score of 78.9. Four patients required hardware removal or exchange because of intraarticular migration with no long-term clinical sequelae.

Discussion. Rates of complications, such as nonunion and osteonecrosis, after femoral neck fractures in young patients have been reported to be as high as 86%. Treatments such as osteotomy, muscle-pedicle bone grafting, nonvascularized bone grafting and vascularized bone grafting have reported variable results. Based on the results reported in this study, vascularized fibular bone grafting compares favorably with a high union rate (91% initially, 100% following secondary procedures) and successful long-term salvage of the femoral head in 91% of the patients. Free vascularized fibular bone grafting is a reasonable option for treatment of femoral neck nonunion.

Key Words*:* Free vascularized fibular grafting, osteonecrosis, nonunion, femoral neck fractures.

2001 THE NATURAL HISTORY OF FAILURE OF ALL-POLYETHYLENE PATELLAR COMPONENTS IN TOTAL KNEE REPLACEMENT

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The patellar component of total knee replacement is the most frequent source of non-septic complications after total knee arthroplasty. The purpose of this study was to review the radiographic mechanism of failure and associated factors in the loosening of an all-polyethylene patellar component following total knee arthroplasty. 4,583 cases of Anatomic Graduated Components total knee replacements were performed at our institution over the past fifteen years. All available postoperative radiographs were reviewed and knees with loose patellar components identified. Loosening was defined as global radiolucency or migration of the component. Specific radiographic features associated with loosening were categorized. There were 180 cases (3.4%) of loose all-polyethylene patellar components. The mean time to loosening was 2.6 years (+/- 1.75 yrs). Of these only 15 required revision for a revision rate of 0.3%. Five distinct radiographic features were found to be associated with failure. The incidence and time until the appearance of each radiographic changes were recorded for the 183 loose patellar components: (n, incidence; mean time to appearance) (1) Bone-cement radiolucency: n=174, 96.7 %; 1.4 years (2) increased density: n= 118, 65.6%; 1.8 years, (3) trabecular collapse of the bone: n=160, 88.9%; 2.3 years, (4) patella fracture and fragmentation: n=133, 73.9%; 2.5 years, and (5) lateral subluxation of the residual patella bone: n=146, 81.1%; 2.9 years. Lateral retinacular release was associated with an increased rate of patellar loosening (p=0.0004). In conclusion, loosening of the all-polyethylene patella component is an avascular process strongly associated with lateral retinacular release and infrequently requires revision surgery. The failure mechanism including the radiographic features and progression of failure are described.

2001 UALITY SURGICAL SOLUTIONS (QSS): A PHYSICIAN CONTROLLED MICROECONOMIC MODEL

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The United States healthcare delivery system is facing yet another cost control crisis. Annual healthcare expenditures (HCE) are growing at a 6.5% annual rate and total healthcare cost may be 2.2 trillion by 2008. HCE makes up 16% of the GNP and if unchecked, may rise to 30% by 2030. We also have 43 million uninsured persons in the United States at the present time. There is an ever tighter HMO market which denies patients choice of physicians and services while consuming one-third of the premium dollars to support an ever burgeoning administrative and profit cost. Unless physicians act quickly and decisively,

we may lose all autonomy and join the rest of the world under total government control. A paradigm shift is needed desperately in most United States medical markets and Quality Surgical Solutions (QSS) was formed to help meet this challenge.

QSS is a physician-controlled network of independent surgeons from multiple specialties in Kentucky including large urban to small rural practices formed in 1997 as a limited liability corporation (LLC). All members are owners and stockholders in the company. The mission of QSS is to maintain and improve the quality of surgical outcomes while significantly decreasing the cost of medicine particularly while functioning in an even tighter managed care environment. Business partnering has been established at local and regional hospitals and recently a relationship with United Healthcare has begun with the goal to maximize quality of care while decreasing the cost of its delivery. Future plans include expansion of surgeons, specialists, procedures and relationships with hospitals and insurance companies within and outside Kentucky.

At this time over 9,300 procedures have been entered into the database with extremely low morbidity (1.2% complication rate) and mortality (0.04% mortality rate). The majority of procedures encompass general surgery; but ENT, urology, and orthopaedics are represented. Costs are controlled by using protocols based on clinical and published data. Thirty-seven (37) different procedures are currently being analyzed using various parameters such as LOS (length of stay), use of pre-op testing, pharmacy savings, use of home health and various other methods. Significant savings have been obtained and one hospital estimated that if all their staff surgeons behaved as QSS surgeons, one million dollars per quarter (3 months) could be saved on 1,000/cases/month.

SUMMARY: Quality Surgical Solutions (QSS) is a physician-controlled organization comprised of various surgical specialists that strive for patient safety and patient education while improving the patient/doctor/hospital and insurance company relationship at lower cost.