Piedmont Orthopedic Society

ABSTRACTS 2000

2000 HALLUX VALGUS – JUVENILE AND ADOLESCENT

J. Leonard Goldner, M.D., James B. Duke Professor Emeritus, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

Teratologic juvenile hallux valgus (JHV) was treated by plaster casts for skin stretch and subsequently by surgery. Surgical treatment included heelcord lengthening, release of the skin web and grafting, release of the adductor tendon, realignment of the extensor hallucis longus, plication of the abductor hallucis, and a translation osteotomy at the base of the first metatarsal. A closed wedge osteotomy through the base of the proximal phalanx was done for final alignment of the ray in order to maintain maximum range of motion at the MTP joint. A cohort of 51 patients was followed from 1960 through 1980. Ten patients had teratologic juvenile hallux valgus and were followed for at least seven years. Seven of the ten patients were examined fourteen years after the initial treatment and three were lost to follow up. Four of the seven had required correction of forefoot adduction by an abduction osteotomy through the cuboid and first cuneiform bones. One of the four patients had a medial translation osteotomy of the calcaneus to control progressive valgus. On an analog scale four of the seven patients had intermittent discomfort controlled by shoe adjustments, occasional limited activity from sports, and intermittent use of anti-inflammatory medications. Two of these seven patients that had been followed for longer than ten years were seen twenty-two years after the original treatment at age two and they had functional feet with minimal discomfort. A prospective study was done from 1965 through 1982. Ninety-two patients with diagnosis of teratologic juvenile hallux valgus or adolescent hallux valgus were examined. They were classified as moderate or severe. A total of 102 patients were included in this classification. Forty-one patients were operated upon with ten in the moderate category and thirty-one in the severe group. The teratologic and the adolescent group gave a total of fifty-one patients treated surgically. The remaining fifty-one of the 102 patients were not operated upon. They were classified as ten in the severe and forty-one in the moderate. Decision to operate depended on pain, progressive deformity, and difficulty fitting conventional shoes. Those indications are present currently. The outcome in the patients treated surgically was good to excellent based on maintenance of alignment of the first ray, 50° of motion at the metatarsophalangeal joint, absence of pain at the first metatarsal head, full physical activity, and use of conventional shoes. One patient required redo of the metatarsal osteotomy because of dorsal displacement of the distal metatarsal. 88% of the patients were in the excellent group, 10% in the good category, and 2% in the fair category because of intermittent pain around the sesamoids (one patient). A cohort that did not have surgery, those with severe deformities, showed progression and had persistent painful bunions as adults, but they accommodated to their deformity. Those patients with a moderate deformity showed progression to severe in about a third of the patients. The number of patients that might have had progression and underlapping of the second toe required later surgery was not determined. The nonoperative adolescents remained viable for twenty years in the moderate group. There was a high likelihood of adolescents with severe deformity requiring surgical correction by the time they were thirty years old because of pain and progressive deformity. Surgical treatment for those in the moderate group was not predictable. Early complications in the patients who had surgery were: paresthesias from dorsal cutaneous nerve irritation 7/51, all recovered within three months; skin irritation from fixation pins 11/51 without infection; pins were used in all 51 patients for stabilization of the proximal and distal osteotomies. Edema of the dorsal skin flap occurred in 4 of 51 patients without necrosis; superficial phlebitis of the leg 1/51; delayed union of osteotomy at the base of the first metatarsal in one patient. One patient required redo of the metatarsal osteotomy because of dorsal displacement of the distal end. The technique for doing the double osteotomy in the adolescent patient: a continuous dorsal incision was made from the fibular aspect of the proximal phalanx coursing obliquely across the metatarsophalangeal joint and extending proximally to the base of the metatarsal. The adductor hallucis tendon was released from the proximal phalanx and tagged for later suture to the periosteum of the first metatarsal neck after the metatarsal osteotomy was done. The fibular collateral ligament was incised. The fibular sesamoid was identified. A small exostosis on the metatarsal head was identified through a dorsal incision elevating

medial and lateral capsular flaps but not raising a three-sided flap of the abductor hallucis. The joint was not opened extensively and the dorsal and plantar capsule was not stripped in order to avoid damage to the blood supply. The contour and symmetry of the first metatarsal head and the proximal phalanx were assessed so that the articulation could be maintained where the range of motion was greatest. The base of the metatarsal was then exposed distal to the first cuneiform metatarsal joint and a transverse osteotomy was done through drill holes and with a motor saw. A 2 mm. wedge of bone was removed from the fibular aspect of the metatarsal and the proximal shaft was translated medially about 4 mm. and the distal end of the metatarsal was directed plantarward. Bone chips were placed subcortically on the medial side of the metatarsal. The skin flaps were pulled together and a percutaneous 0.062 in. pin was passed obliquely from distal to proximal across the metatarsal osteotomy site. The metatarsal was adjusted in three planes, i.e. medial displacement, flexion, and neutral rotation relative to the sesamoids and the second metatarsal head. A second percutaneous pin was then passed parallel with the first pin. Osteotomy at the base of the proximal phalanx was then done maintaining a maximum range of flexion/extension at the joint. Medial flap of the abductor tendon was pulled proximally and the lateral flap distally to maintain the alignment of the first ray. Phalangeal osteotomy was held with a 0.045 in. pin that did not traverse the joint. The tourniquet was released and the cutaneous nerves were recognized and protected. The fixation pins were held at the base with needle nose pliers and a suction tip was used to bend the pins leaving about 1 ½ cm. outside the skin. A thin rubber pad was placed between the pin and the skin. Small Penrose drains were inserted through separate incisions, the dressing pads and fluffed gauze were applied, and plaster splints were used for 24 hours. After this, plaster shoes were applied with the ankles free and weightbearing was allowed with crutches. The plaster slippers were used for four weeks after which fiberglass slippers were used for an additional four weeks. Active motion was encouraged and 2x2 pads in a thong dressing was used for an additional four weeks.

2000 CLINICALLY RELEVANT BIOMECHANICS OF CUBITUS VARUS DEFORMITY

Robert J. Spinner, M.D., Shawn W. O'Driscoll, M.D., Mayo Clinic, Rochester, Minnesota

Cubitus varus has been assessed after long term follow up. This deviation of the elbow joint may be associated with ulnar nerve dislocation, ulnar neuropathy, secondary distal humeral or lateral condylar fractures, joint ganglia, and even osteoarthritis. Represent two additional probable causes resulting from cubitus varus: snapping of the medial head of the triceps tendon and delayed onset of posterolateral rotatory instability due to elongation of the lateral collateral ligament of the elbow. Biomechanical explanation of these lesions is the medial displacement of the mechanical axis of the arm and forearm through the triceps tendon and the olecranon. Repetitive external rotation torque on the ulna caused by deviation of the mechanical axis may stretch the lateral collateral ligament complex and cause posterolateral rotatory instability of the elbow. This concept has been documented by a mathematical model that we designed that simulates the soft tissue and bony abnormalities at the distal triceps and distal humerus and the effect of this alteration on the triceps line of pull and on the moment arms. Thus, cubitus varus should be considered more than a cosmetic deformity and should be assessed relative to possible development of future pathological conditions.

2000 PIRIFORMIS SYNDROME: DOES IT EXIST

Robert J. Spinner, M.D., Shawn W. O'Driscoll, M.D., Mayo Clinic, Rochester, Minnesota

Piriformis syndrome is a highly controversial entity largely because it has few or no objective findings. Some physicians believe that the piriformis muscle is responsible for many cases of buttock pain and sciatic nerve irritation; others who recognize sciatic nerve compression by tumor, bony proliferation, or scar, do not acknowledge piriformis syndrome due to muscular compression. Proposed explanations target anatomic variations or pathologic conditions affecting the nerve or muscle, or the neighboring bone or vasculature. Many have suggested a causal relationship between certain anatomic variations of the sciatic nerve and piriformis muscle and the development of piriformis syndrome, such as a sciatic nerve or division(s) splitting the muscle or passing posteriorly.

A patient is presented with clinical features suggesting piriformis syndrome coupled with an extremely rare anatomical variation at surgery which resulted in peroneal nerve displacement by the piriformis muscle. Even the observation and correction of an anatomic variation that theoretically could result in tethering of the nerve does not ensure reversal of "piriformis syndrome" symptoms. I will review the literature and the controversy.

2000 FINANCIAL ASPECTS OF AN ORTHOPEDIC PRACTICE - A MULTI-SPECIALTY CLINIC PERSPECTIVE

Glen A. Barden, M.D., Watson Clinic, Lakeland, Florida

The Central Florida multi-specialty clinic which is used for this review included 112 physicians in 1990; 5 of these were orthopedic surgeons. The clinic has gradually grown and now, in the year 2000, has 164 physicians with 7 orthopedists, one being office-based only. The primary care/specialty physician mix is in the range of 50/50. A single hospital is used by the orthopedists, this being a Level 2 trauma center with 110,000 emergency room visits per year.

The payer mix is Medicare 46%, managed care 42%, commercial 5%, self-pay 4%, Medicaid 2% and Workers' Comp 1%.

There has been a progressive deterioration of the compensation of the orthopedists in the group in the last ten years. The average orthopedic partner in 1999 received from this practice income 77% of that which he received in 1990 and 81% of that which he received in 1997.

The orthopedists' compensation at this multi-specialty clinic, in comparison with the American Medical Group Association data from nonacademic groups of over 100 physicians, it was shown that the orthopedists in the reviewed group were working above the 90^{th} percentile in relative value units of work. Despite this, they were compensated at less than the 50^{th} percentile for the year 1999.

In the interim time between 1990 and 1999, major changes have occurred in reimbursement, with common procedures such as total hip and total knee replacements being paid at 50% of payments of several years ago. Additionally, an internal change in the formula has occurred. This has not been of benefit to the orthopedic members of the multi-specialty clinic.

The prior formula was based on production and additionally took into account longevity of the partner and certain common sharing of revenues as well as expenses. The new formula is highly oriented towards profit and loss of the individual practice. While there are advantages to the new compensation plan, as it makes every individual very oriented to direct costs and makes individuals sensitive to all costs of office and sections, it has negatives of producing a greater focus on dollars than on service to the individual patient and to community health. It also places an emphasis on self-importance and the importance of individual offices rather than a larger team approach in the multi-specialty setting.

The goals of any compensation system can be summarized as: 1) keeping it simple; 2) making it as fair as possible and; 3) balance rewarding incentives for production (hard work) and service orientation to patients as well as community.

2000 DETECTING SYMPTOMS MAGNIFICATION, OBJECTIVE DOCUMENTATION

Jose J. Monsivais, M.D., F.A.C.S., El Paso, Texas

This study describes a method of detecting symptom magnification in chronic pain patients. Patients with this problem are often ignored and they use symptom magnification to get attention. This condition has become a large social and economic problem. Because of lack of objective evidence, painful symptoms are

often termed psychosomatic. Forty-four patients were divided into three groups. All patients had chronic neuropathic pain were assessed by history and physical examination, sensory evaluation using the moving two point discrimination, vibratory and Semmes-Weinstein monofilament testing. Pain was evaluated by using a modified McGill pain questionnaire, VAS, and Wong-Baker scale. They were divided into two groups, group I consisted of 19 patients, group II consisted of 16 patients, and group III 9 patients. Groups I and III represented the typical findings of patients with peripheral nerve disorders and associated neuropathic pain over several years. The group II was the study group. Statistical analysis was done using the analysis of variance between all three groups. Group II was compared to group I and III. RESULTS: The Semmes-Weinstein monofilament test and pain scales can be used in a clinical area as a practical means of documentation in detecting symptom magnification in patients with chronic neuropathic pain. Semmes-Weinstein P<.001; Wong-Baker scale P<.05; Visual Analog Scale P<.001. CONCLUSION: Symptom magnification can be objectively documented in patients with neuropathic/neuromuscular pain who claim sensory loss and pain which is greater than that of patients with avulsion plexopathies and Complex Regional Pain Syndromes (CRPS I and II).

2000 RESULTS OF FIRST RIB EXCISION FOR THORACIC OUTLET SYNDROME: TRANSAXILLARY APPROACH

John W. Shaffer, M.D., Professor of Orthopaedic Surgery, Case Western Reserve University School of Medicine, Cleveland, Ohio

In twenty-three years of academic practice, this author reports results of thirteen first rib excisions. Most patients seen for thoracic outlet syndrome have improved nonsurgically with postural exercise. Three of twelve patients had preceding vehicular accidents with neck trauma. Two of twelve patients had prior anterior cervical fusions. Three patients had a Workers Compensation claim for neck injury. One paratrooper had prior shoulder girdle trauma and chronic upper extremity swelling and bouts of thrombophlebitis. One patient had staged bilateral rib excisions. No patient had a cervical rib.

Three patients obliterated the radial pulse with hyperabduction. All patients developed hand tingling with hyperabduction over one minute. EMG and arteriograms were sometimes instructive in selected cases, but the history and physical findings were most important in deciding if surgery was indicated. Differential Diagnosis included cervical radiculopathy, brachial neuritis, carpal tunnel syndrome, ulnar neuropathy, and reflex sympathetic dystrophy. Indications for first rib resection were: failure of a carefully supervised exercise and postural program, intractable pain, significant neurologic deficit, impending vascular catastrophe, and after successful initial treatment of subclavian vein thrombosis. No patient had surgery for symptoms present for less than one year. All patients had an extended trial of Physical Therapy.

There were no pneumothorax or infection complications. Two patients developed brachial plexitis which was felt to be due to intraoperative traction on the upper extremity needed to resect the rib through the transaxillary approach. Both patients got better during the year after surgery. Eleven of twelve patients returned to work. If this approach is to be used for first rib excision, the patient must realize that action on the plexus may result in some degree of brachial plexus impairment, which is usually temporary.

2000 THE RADIOCAPITELLAR MENISCAL COMPLEX: AN ANATOMICAL AND HISTOLOGICAL ANALYSIS

Andrew E. Caputo, MD, Alan D. Proia, MD, PhD, James R. Urbaniak, MD, Duke University Medical Center, Box 2912, Durham, North Carolina

Introduction: There are clinical reports of effective resection of symptomatic "plica synovialis" or "synovial fringe" from the radiocapitellar joint of the elbow. In fact, many standard operative procedures for tennis elbow consider the radiocapitellar arthrotomy to be a critical step. Unfortunately, this structure has no standard anatomical terminology and its pathoanatomy, possibly related to the presence of nerve endings, has not been described. The purpose of this study is to describe the normal gross and histological

anatomy of this area of the elbow and to decipher the presence of nerves within this tissue.

Methods: The elbows of 18 fresh frozen and 2 fresh cadavers were anatomically dissected to expose the capsule of the radiocapitellar joint. The circular capsular rim was divided into 5 anatomical regions for gross and histological analysis and orientation to adjacent structures.

Results: The radiocapitellar capsular rim was present in all 20 specimens, was wedge shaped (thicker peripherally, tapering centrally) and averaged 1-7mm in width. The capsular rim circled the radiocapitellar joint and was continuous with the annular ligament. Dense connective tissue, representing the origins of the extensor muscle mass, was consistently found directly adjacent to the external portion of the capsule in the 3 lateral regions. The tissue type was predominantly fibrocartilage with some fibroadipose tissue. Nerve endings were found in the peripheral portion in all regions, but most commonly lateral and anterolateral.

Discussion: The radiocapitellar capsular rim grossly and histologically resembles a meniscus type tissue with a predominance of fibrocartilage similar to the knee meniscus and the wrist triangular fibrocartilage complex. The presence of nerve fibers suggests the probability of pain directly associated with this tissue and explains the relief of pain after its resection. The juxtaposition of the origin of the extensor muscles with the meniscal complex may expand the differential for lateral elbow pain. The issue of differentiating true lateral epicondylitis from intraarticular pathology is not new, and our findings may create some renewed interest in this and the evaluation of chronic lateral elbow pain resistant to the usual modalities for lateral epicondylitis.

2000 UPDATE ON POSTERIOR TIBIAL TENDON INJURY

Robert S. Adelaar, M.D., Medical College of Virginia, Richmond, Virginia

Adult posterior tibial tendon injury pathogenesis and treatment options were presented. An evolution of treatment is evident during the past decade that currently brings us to a decision between nonoperative or operative treatment based on the physical examination. Peritalar instability, which is passively or actively correctable, aids in deciding appropriate operative or nonoperative treatment. The options for surgery, depending on the stages of posterior tibial tendon pathology, are analyzed. The present method of treating a Class III and IV posterior tibial insufficient foot and ankle include bone and soft tissue reconstruction. We use Manoli's technique which includes a medial calcaneal displacement osteotomy combined with a lateral column fusion of the calcaneocuboid joint. These osseous procedures are supplemented by either a posterior tibial tendon transfer with the flexor hallucis longus or flexor digitorum longus and/or a fusion of the talonavicular joint.

2000 CRITICAL PATHWAYS FOR GERIATRIC HIP FRACTURES

David E. Attarian, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

Purpose: To assess the impact of a critical pathway on the surgical management of geriatric patients with hip fractures admitted to a community hospital.

Methods: A retrospective review was performed on two groups of 28 consecutive geriatric patients with hip fractures admitted to a community hospital and treated by a single surgeon. The second group was managed by a consensus critical pathway while the first group was not. Data on age, sex, type of fracture, type of surgery, length of surgery, length of stay, gross hospital charges, and short term/ intermediate term outcomes were collected and compared.

Results: The demographics of the two groups were not statistically different by the Wilcoxon Rank Sum test. The outcomes up to 6 months after surgery were also similar according to the Fisher's Exact test. The second group, managed by a critical pathway, had a significantly shorter length of stay ($p < 0.001$), shorter

operative time (p< 0.001), and lower gross hospital charges adjusted for inflation (p= 0.032).

Conclusions: The critical pathway approach to managing geriatric patients with hip fractures produced substantial reductions in length of stay, length of surgery, and hospital gross charges (costs) without compromising the outcomes or quality of care in the community hospital setting.

2000 ACUTE HIP ADDUCTOR STRAINS IN PROFESSIONAL HOCKEY PLAYERS

David E. Attarian, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

Purpose: Acute hip adductor strains account for 6% to 10% of all injuries, and 40% of all muscle strains, reported in professional hockey players. Furthermore, these injuries are disabling to the player and costly to the team, causing substantial losses in man- games. This pilot study reports the findings on all acute hip adductor strains sustained by the hockey players on one National Hockey League team during the course of the 1998-99 season.

Methods: Clinical data was collected on all acute hip adductor strains suffered by players on the Florida Panthers Hockey Club from 9/98 through 4/99. Injuries that caused a player to terminate practice or competition were included. Information collected on each and every hip adductor strain included history, physical examination, radiographs, and pelvic/hip magnetic resonance scan. Injury management consisted of initial rest, ice, nsaids, and passive stretching with progression to isometric, concentric, and eccentric contraction. Skating was resumed when the rehabilitation goals of pain-free hip adductor function had been achieved. Upon return to competition, the injured player was placed on a maintenance program of hip adductor stretching and concentric/eccentric strengthening.

Results: Six acute hip adductor strains were observed in five players. Four of the strains occurred during a game; and one was a recurrent injury. The mechanism of injury in every case was a noncontact eccentric contraction of the hip adductor group as the player tried to accelerate forward. Localized pain was immediate causing an inability to continue ice skating. Five of the injuries were demonstrated by MRI; four were isolated adductor longus strains and one was an isolated adductor brevis strain. With the described rehabilitation program, the players returned to competition within 3 to 4 weeks.

Conclusions: The cases reviewed conform to previous scientific and clinical reports in that the hip adductor strains: 1) occurred as a result of a forceful eccentric contraction, 2) involved primarily the distal musculotendinous junction by MRI, and 3) involved a single muscle within a synergistic group. Predisposing factors to this injury included fatigue, previous injury, limited hip adductor off ice training, and skate boot/ poor ice interactions. A larger league- wide study has been proposed based on the findings of this report.

2000 RAM & SOME BYTES OF UNFINISHED BUSINESS

Eugene E. Bleck, M.D., Stanford University, 5 Laureldale Road, Hillsborough, California

Seven research projects to stimulate interest: (1) *Experimental heterotopic ossification*: Tissue cultures of bladder epithelium were grown successfully. The culture medium was withdrawn, clay filtered, and injected into open cell silicon sponge rubber discs implanted in the rectus abdominal sheath of beagle dogs. Ingrowth of fibrous tissue into the discs occurred, but new bone formation was not observed. (2) *Factors affecting results in club foot:* Genetic ligamentous laxity and intrauterine failure to develop certain anterior compartment muscles documented by MRI of infant legs preoperatively. Also, joint laxity testing of 853 pediatric orthopaedic patients against 642 controls showed a negative correlation in scoliosis, but a positive correlation in developmental dislocation of the hip. There is also an implication that club feet of moderate severity with good results after treatment had 3 positive laxity tests. Certain racial groups such as Asians showed less severe deformity of congenital club foot as compared with USA population which had more severe deformities. (3)*Legg Perthes disease and red cell deformation.*[2] We studied blood viscosity in Legg

Perthes patients using cone viscometer and matched controls indicated statistically less deformability of red blood cells in Legg Perthes patients than in the controls. Thus, occlusion of lateral epiphyseal vessels of the hip might account for avascular necrosis of the femoral head. (4) *Legg Perthes disease and containment treatment of femoral head*. Outcome study of 88 patients showed that 90% had coxa magna and no difference in function between varus osteotomy and orthotic treatment of the primary condition. If containment of the femoral head is associated with a large head and a small acetabulum, then one should consider an acetabular osteotomy to cover the head if, in fact, the degree of uncoverage is critical. Coxa magna can be misinterpreted as "subluxation". (5)*Origins of "idiopathic" osteoarthritis of the hip?* In young adults hip pain could be the result of femoral retroversion that occurred during adolescence. Also, there is a consideration of a lateral cap of the head found in idiopathic chondrolysis. No cause for the chondrolysis has yet been isolated even though we looked for cartilage toxins that might explain chondrolysis. (6) *Scoliosis and active correction*. We did not see success with the Milwaukee brace in paralytic scoliosis. We designed an augmented feedback TLSO that gave a vibrating signal every 30 minutes during waking hours. The patient pulled their trunk away with active muscles and the signal went off. Other trials at this form of prosthesis is justified. *(7) Missed vertebral body rim fracture following neck injury?* Flexion/extension injury of the cervical spine may show no obvious joint changes on routine x-rays. CT scan, however, may show a fracture of the vertebral body rim. If that lesion is present, the patient should be partially immobilized for several weeks during which time subjective complaints should gradually improve. If the CT is negative, then cervical sprain and subtle intervertebral disc injuries may be considered. Patients with cervical pain after an accident and with negative x-rays are frequently considered to have continued pain because of litigation. More reliable diagnostic studies such as CT scan would be helpful in arriving at a final diagnosis.

2000 TOTAL ELBOW ARTHROPLASTY AND ITS FUTURE

Donald C. Ferlic, M.D., Denver, Colorado

The high failure rate of constrained total elbow prostheses resulted in development of resurfacing prostheses. With this prosthesis, instability occurred and efforts were then directed toward developing a semiconstrained device. Early on, the semiconstrained Coonrad prosthesis modified by Morrey with the anterior flange was used to salvage a failed rigid hinged prosthesis that had loosened and to replace an unstable unconstrained prosthesis. During the past ten years, I have done 64 replacements using the Coonrad-Morrey elbow prosthesis in 61 patients. The Mayo Triceps Sparing incision was used. Forty-six of the 64 patients were in patients with rheumatoid arthritis and 9 others were revisions for other failed total elbow arthroplasties. Complications were epicondylar fracture in 5. These fractures healed without sequelae. Eleven patients showed triceps weakness even though the triceps was reattached to the olecranon with suture through drill holes. Three patients developed aseptic loosening. Two patients had initial replacement for trauma and one patient had rheumatoid arthritis. The ulnar component loosened 5 years after insertion in one patient and an infection occurred in one patient who developed septic olecranon bursa that required a free flap and antibiotics. An additional patient had a staphylococcus infection that required removal of the prosthesis eventually because of a superimposed microbacterium avian infection. A year after removal of the prosthesis, a new prosthesis was inserted. The third patient developed failure of the bearing mechanism 6 ½ years postoperatively. Thirty-two elbows followed greater than 2 years were graded by the Mayo scale. Twenty-nine patients were rated as good, one revision was fair because of pain, and two were poor although one of these patients has recently had the prosthesis reimplanted. The future of total elbow arthroplasty will depend on new prosthetic designs, avoidance of prosthetic metal sensitivity, and wear particles from both metal and from polyethylene and cement. Other complications such as infection, loosening, bone deficiencies, and instability will require additional design and emphasis on prevention of infection during operation and postoperatively. The restrained prosthesis is subject to loosening and the unconstrained prosthesis may be unstable. Efforts should be directed toward bone regeneration, methods of strengthening tendon and ligament tissue by growth factors, and use of intra-articular and systemic pharmacologic agents to modify the patients' arthritic problem. Vascularized allografts have a better future than nonvascularized. Systemic immunosuppressive medication has a long term risk. It must be used when the entire problem is balanced against the quality of life and longevity.

2000 PROMISES, PITFALLS, AND PEARLS OF PHYSICIAN PRODUCT DEVELOPMENT

Frank B. Gray, M.D., Knoxville, Tennessee

Many medical products today have been developed by or in conjunction with physicians. This is logical, as physicians frequently derive concepts in response to a need that they perceive in the clinical arena. Other motivating factors include enjoyment of the challenge, ego, enhanced professional opportunities and financial reward.

However, before proceeding, a physician should be aware of a number of potential pitfalls. These include costs, time demands, the odds against success and the potential of liability and regulatory issues.

If the decision is made to proceed, sequential steps include the idea, then a proof of principle prototype followed by a patent application. A manufacturing and distribution partner then needs to be found, a contract concluded, final production prototypes tested and approved and, clinical research done.

The odds against a commercially successful product resulting are daunting, estimated at less than one percent. However, the challenge itself can be worth the time and expense if one is willing to invest considerably in each.

2000 TO ERR IS HUMAN - HOW DO WE COLLECT THE DATA?

Stephen N. Lang, M.D., Assistant Clinical Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

The purpose of the presentation is to present and discuss issues related to the subject of "medical errors" and related data collection. This discussion was stimulated by the November, 1999, report of the Institute of Medicine, through its committee on Quality of Health Care in America. The findings and recommendations were in a report, "To Err Is Human Building a Safer Health System." The report emphasized patient safety and quality of health care in America with the focus directed toward "medical errors." The publication suggested that there may be 44,000 to 98,000 deaths each year as a result of hospital-related adverse events. This difference in numbers depended on the lack of consensus among the members of the committee that were selected to review two million records from New York State in order to determine from the records adverse events, deaths, and various complications. The highest percentage of complications were associated with pharmacologic agents. The personnel involved were nurses, resident physicians, and staff physicians as well as pharmacists and other personnel working in the hospital.

As a result of this report, the media has generated many articles that are not completely accurate relative to the errors. President Clinton initiated a call for immediate action to develop changes in the health care system that included reporting errors and development of a Federal Center for Patient Safety.

A review was done of prior research information and methods of data collection referred to in the Institute of Medicine Report. Analysis was made of the methods of data collection, the cost, the reliability, and the legal consequences of this study.

In spite of this report, there has been a significant decrease in the number of medical errors (adverse events) during the past several years based on advancements in medical information, technology and systems development. Patient/workforce education and computer utilization could greatly assist in lowering these numbers even more. Currently, no single accurate method of error data collection is available. There are various systems in place to collect information about individual and organizational activity. Improvement in and utilization of these review systems is emphasized. Cost and legal issues are the primary factors suggesting that additional governmental intervention is unnecessary. However, "raising the bar" by setting higher standards and requirements is an acceptable approach. Those participating in medical systems need

to facilitate and use data collection systems that are already present. Each hospital, clinic, outpatient unit, doctors' offices, and any other site where patient care is administered should record adverse events, report them to a designated quality care unit in the community, and make an effort to eliminate these events. Pooling of information is critical. Encouragement of reporting is essential. Reporting without individual punishment is critical.

2000 VOCAL CORD PARALYSIS FOLLOWING ANTERIOR CERVICAL SPINE SURGERY

Brian Jewett, M.D., Gregory A. Mencio, M.D., Dan M. Spengler, M.D., Department of Orthopaedics; Sean Coleman, M.D., James Netterville, M.D., Department of Otolaryngology, all at Vanderbilt University Medical Center, Nashville, Tennessee

The anterior approach to the cervical spine is commonly used for surgery of the cervical spine. In most large series of cervical spine fusions performed through the anterior approach, vocal cord paralysis (VCP) is reportedly rare. A review of the database at the Vanderbilt Voice Center from 1989 to 1999 revealed 365 patients treated for vocal cord paralysis. Forty-one of these patients sustained unilateral vocal cord paralysis following anterior cervical spine fusions. All patients, except two, had right-sided paralysis following a right-sided surgical approach. Eighteen patient underwent anterior cervical discectomy and fusion (ACDF) at C6-7, fourteen patients underwent C5-6 ACDF, four had C4-5, C5-6 multilevel ACDF, two had C3-4, C4-5 ACDF, one had C4-5, C5-6, C6-7 ACDF, and two had C5 corpectomy and fusion. The majority of patients presented with immediate post-operative hoarseness and voice fatigue, while some experienced recurrent aspirations and dysphagia. All patients were initially diagnosed with VCP by video-laryngoscopy. Twelve patients' symptoms responded to conservative treatment, fifteen improved after injection with gelfoam, and eighteen eventually required unilateral vocal cord medialization surgery to correct their deficits. Anatomic cadaveric studies published from our Otolaryngology laboratories clearly show that the recurrent laryngeal nerve is at higher risk for stretch induced injury from the right-sided approach due to its shorter recurrent anatomic course. Without knowing the total number of cases preformed in our referral population, the true incidence of VCP following anterior spine surgery remains elusive. However, in this study, symptomatic vocal cord paralysis following anterior cervical spine surgery was directly related to the right-sided approach. On the basis of this finding, we recommend use of a left-sided approach when possible for anterior surgery of the cervical spine.

2000 THERMAL ASSISTED SURGERY IN SPORTS MEDICINE

John J. Perry, M.D., Kevin P. Speer, M.D., Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

Thermal energy can be delivered with laser or radiofrequency (mono or bipolar) probes during arthroscopic procedures. Initial results with laser were associated with complications associated with lack of tactile feedback in tight confines and diminished visibility. The radiofrequency probes provide thermal energy with both tactile and temperature feedback. Early success with arthroscopic soft tissue tightening in knee and shoulder lesions has encouraged surgeons to expand its use for cartilage and ligament injuries in other joints. Only short term success rates are available for results of shoulder stabilization, meniscal debridement, and chondral sculpting. The structure of type I collagen imparts properties of ligament and tendon. Target tissue temperature for RF probes ranges between 60-70 degrees Celsius. In this temperature range, the heat labile cross-links in type I collagen triple helix are broken and the collagen fibrils assume a disorganized shortened state due to the preservation of the heat stable covalent bonds. The amount of shortening is dependent on the probe contact duration and ultimate tissue temperature. The depth of tissue penetration and the volume of shrinkage is dependent on the energy type (i.e. bipolar or monopolar), power settings used, and the duration of probe contact. Maximal tissue shortening of approximately 50% occurs at 65 degrees Celsius with exposures of one minute or more. Tissue temperatures greater than 70 degrees Celsius leads to loss of the fibrillar structure and assumption of an amorphous state. To define optimal rehabilitation protocols, the biomechanical properties of treated tissue and a subsequent recovery times need further study. Early mobilization has lead to stretching and further loss of stiffness of the tissue. In humans the cytoarchitecture of the shoulder capsule takes approximately 7 months to return to normal. Radiofrequency (RF) "coblation" has shown promise in treating unstable chondral lesions of the knee.

Histologic staining studies have recently shown RF energy to be safe for the chondrocytes and collagen in articular cartilage. Prior reports of osteonecrosis after the thermal treatment of meniscal or chondral lesions with laser are emphasized. There are reports in non-peer reviewed articles describing the use of RF thermal treatment for medial thermal plication for patellar instability, arthroscopic shrinkage of laxed reconstructed ACLs, and lateral ligament shrinkage for ankle and subtalar instability. The future of RF thermal treatment for many sports related injuries seems promising. However, to optimize patient outcome and also minimize potential complications, laboratory and clinical studies are necessary.

2000 ROTATOR CUFF DISORDERS - RESULT OF A SURVEY

David C. Urquia, M.D., Richmond, Virginia

This study is the result of a multi-questioned survey sent to the members of the Piedmont Orthopedic Society. Seventy surgeons who were treating shoulder problems responded to the survey.

Data as follows:

- 89% of respondents currently do shoulder arthroscopy.
- 11% of the total group did only open shoulder procedures.
- 72% of acromioplasties done by this group were by the arthroscopic method.
- 57% of the surgeons preferred MRI as the best preoperative study for rotator cuff assessment. 18% of the total preferred arthrograms and 25% relied on ultrasound or MRI-arthrograms.
- The depth of bone resection done during acromioplasty varied from 4-mm to 10-mm. The most common response by 35% of the surgeons was a 6-mm resection.
- 90% of respondents indicated that certain large cuff tears are not reparable by any method.
- 39% of the surgeons always did arthroscopy of the shoulder joint before proceeding with an open operation.
- 54% of the respondents used a 23-hour hold status when an open rotator cuff repair was done; 33% used direct outpatient procedures after the surgery.
- 18% of surgeons did arthroscopic cuff repairs, and 66% used "mini-open" techniques.
- Complications during rotator cuff surgery, although relatively rare, included fracture of acromion, brachial plexus injury, axillary nerve lesion, reflex sympathetic dystrophy, infection, pulmonary embolus, and synovial fistula.
- 69% of the surgeons believed that preoperative MRI was a reliable way to predict the size of cuff tear.
- Very large cuff tears that could be closed only if the arm was held in abduction, were treated by debridement of the tear with the arm at the side and no additional effort at repair. This was done by 70% of the surgeons.
- Methods of repairing massive tears such as transfer of the latissimus dorsi tendon; homologous cadaver rotator cuff graft; anterior deltoid muscle graft; autogenous strips of twisted iliotibial band. These methods were not included in the questionnaire.
- 49% of the surgeons said that symptomatic full-thickness tears must be repaired.
- Questions concerning functional outcome were not included.

Conclusions were made based on these and other survey data that we believe are relevant for the treatment of rotator cuff disorders.

1. Arthroscopic acromioplasty has become the preferred method of subacromial decompression.
2. There is no consensus on how much bone should be removed during acromioplasty.
3. There is no consensus on preferred preoperative diagnostic study for rotator cuff tears, but MRI was the most common study ordered.
4. It is debatable whether or not any preop diagnostic study can consistently predict the size and

character of a cuff tear as verified at surgery, although a majority of surgeons felt MRI would be accurate.

5. Only a small minority of surgeons perform arthroscopic cuff repair, and their results were too preliminary to judge success of arthroscopic repair compared to open techniques.
6. Not all full-thickness cuff tears are repairable by direct closure.
7. Evenly split opinions on whether all symptomatic full-thickness cuff tears should be repaired or not, versus nonoperative symptomatic management.

2000 FINANCIAL VIABILITY OF DIFFERENT ORTHOPAEDIC PRACTICES - ACADEMIC

Thomas Parker Vail, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

The mission of the academic medical center is to serve patients in the global community by providing the finest clinical integration of patient care, education, and research. A number of financial realities are affecting the ability of the academic practice to fulfill this mission. It has been stated that as many as a fourth of the countries academic medical centers will merge or declare bankruptcy within the next five years. According to the Association of American Medical College, the balanced budget act of 1997 will cost the average teaching hospital a total of $43 million and could drive up to 40% into the red. The development of academic health systems has moved forward in order to create a rationale health care delivery approach while streamlining products and services into lines of business. This approach provides the opportunity to lower costs while improving standards of care, allocating business costs over a larger revenue base, and providing economic leverage for contracting. Difficulties are encountered in the transition from a high cost infrastructure to a market cost not for profit provider with the need to subsidize academic and research missions. There is a financial burden for caring for the uninsured and a risk of "high output failure".

2000 SHORT OBLIQUE POSTERIOR HIP INCISION

Thomas Parker Vail, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

The development of less invasive techniques for common procedures throughout surgery is gaining widespread support. Specific procedures such as cardiac bypass surgery, splenectomy, ACL reconstruction, and major joint reconstruction are targeted. Minimizing soft tissue dissection has many potential advantages. Metabolic demands for soft tissue healing are decreased, as is blood loss. Patient satisfaction and cosmetic result can be improved. Advantages quickly vanish when obtained at the expense of overall procedural excellence. Over the past nine years, we have progressively decreased the size of a hip incision when using the posterior approach combined with the principles of exposure. The main features of this approach include a short posterior oblique skin incision, a L-shaped capsulotomy that respects the ilioischial ligament, elevation of the anterior hip capsule to allow anterior subluxation of the femoral shaft, and clear exposure of the acetabulum.

2000 CONSTRAINED LINERS IN HIP REVISION SURGERY

Thomas Parker Vail, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

One to two per cent of primary total hip replacements will dislocate. Of the primary total hip replacements that dislocate postoperatively, 40% of these will dislocate more than once. Up to 1% of all total hip replacements will become recurrently unstable. In order to treat hip instability, the cause must be defined. Treatment options include bracing, removal of impingement, reorientation of components, capsulorrhaphy, larger diameter femoral head, extended lip liners, increased offset liners, lengthening of the femoral neck, trochanteric reattachment or advancement, constrained acetabular liners or resection arthroplasty. Specific indications for use of a constrained liner include intraoperative multidirectional instability, neuromuscular

disease, neurologic disease, deficiency of the soft tissue, or alcoholism. The limitation of the constrained liner includes reduction in range of movement, potential for impingement, early loosening, wear with osteolysis, and the need for open reduction in the event of dislocation. The personal experience with the constrained liner is reviewed in this discussion.

2000 SURGICAL TREATMENT OF THE STIFF TOTAL KNEE ARTHROPLASTY

Thomas Parker Vail, M.D., Associate Professor, Division of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

Thirteen stiff (range of motion <70 degrees) in painful total knee replacements were revised with a posterior stabilized condylar prosthesis and reviewed after an average follow-up of 19.3 months. Prior to revision, one out of thirteen had been manipulated and three of thirteen had undergone open surgery for stiffness. Ten of thirteen knees had evidence of loosening, mal-alignment, oversized components or heterotopic ossification preoperatively. After revision, the average range of motion increased from 42.1 degrees preoperatively to 82.5 degrees postoperatively. The mean flexion contracture decreased from 13.8 degrees to 1.8 degrees. In the seven cases where the PCL was competent at revision the range of motion improved from 38.1 to 75 degrees. In the six cases where the PCL had already been sacrificed or was incompetent, the range of motion improved from 46.7 to 91.2 degrees. Five of thirteen revisions required a quadriceps snip for exposure. No quadriceps turndown or tubercle osteotomies were needed. Four of thirteen patients required closed manipulation in the first month following revision surgery. All patients had improvement in pain and were satisfied.

2000 BACTERIAL INFECTION AFTER REFINED, CLEAN, ELECTIVE ORTHOPAEDIC PROCEDURES

J. Leonard Goldner, M.D., D.Sc.(hon), Duke University Medical Center, Durham, North Carolina

An ordinary orthopaedic operating room with 25 air exchanges per hour (25 AE/Hr) shows 50-500 colony forming units/m^3 (CFU/m^3). If 10^5 bacteria are inoculated in a wound, the potential for infection is high. The number of airborne particles in the operating room is directly related to the number of bacterial colony forming units per m^3. The increased likelihood of a wound infection exists if airborne particles are not removed by ventilation, i.e. air-conditioning or laminar airflow; or, if the bacteria carried on the airborne particles are not killed before or after they enter the wound (UVC, antibiotic systemic or irrigation). Systemic antibiotics diminish wound self-infection and affect limited protection from airborne particle bacteria. Antibiotics do not affect airborne bacteria before they enter the wound but UVC or laminar airflow do. Antibiotic irrigation does diminish the number of bacteria in the wound and thereby does lessen the likelihood of wound infection. Environmental conditions do reduce the number of airborne bacteria. These include: (1) Increased air exchanges per hour. (2) Use of HEPA filters. (3) Laminar airflow. (4) Ultraviolet C light. (5) Perioperative antibiotics. (6) Exhaust headsets. Hart introduced UVC to the operating room in 1934. He noted that pathogenic bacteria increased with the number of occupants in the room and the duration of occupancy. UVC kills bacteria within three minutes at a distance of five feet at an intensity of 25mw/m^3. The occurrence of an operating room infection may be related to the number of airborne particles. There are comparisons of how colony forming units on airborne particles may be controlled and, thereby, how operating room infection could be diminished.

(1) Std. AE/Hr = 20-30 CFU/m^3.

(2) C/H (Charnley Howorth vertical airflow) = 8 CFU/m^3.

(3) UVC + Std. AE/Hr = 2.9 CFU/m^3.

Barden at the Watson Clinic followed 1,200 hip arthroplasties that were done in operating rooms initially with UVC, and later with UVC and laminar airflow. Three joint infections occurred (3/1200) with one prosthesis requiring removal. Currently, a deep wound infection is defined as such only if the prosthesis

requires removal for control of the infection. Two other patients had wound infections that were controlled without removing the prosthesis. The total infection rate was (3/1200) 0.25% with specific deep infection rate of 0.16% based on the removal of a single prosthesis from 1,200 hips. Published results worldwide vary from 0.8% to 2% deep infections. Brown, from the same Watson Clinic, followed 1,717 cardiac patients for five years who had been operated on in conventional operating rooms with UVC light, paper drapes and gowns, conventional air-conditioning, and perioperative antibiotics were used, but laminar airflow was not. Mediastinitis occurred in 0.23% and incisional infections without mediastinitis in an additional 0.12%. During that same time, published data on the occurrence of mediastinitis in cardiac patients was 0.8% to 2.0%. Brown's publication with reference to operating room infections in cardiothoracic patients did use stratified infection rates defined by the National Nosocomial Infection Surveillance Risk Index. The cumulative data from Duke Medical Center, the Watson Clinic, and several other centers using UVC show that UVC was safe for the operating room personnel and provided statistically significant protection from operating room infections in patients being operated upon for treatment of musculoskeletal conditions. REFERENCE: (1) Brown, I.W., Moor, G.F., Hummel, B.W., Marshall, W.G., Collins, J.P.; Toward Further Reducing Wound Infections in Cardiac Operations, The Society of Thoracic Surgeons, Annals of Thoracic Surgery, 1996:62:1783-9. (2) Barden, G.A.; Clinical Note in Piedmont Orthopedic Society papers, November 17, 1997

2000 PLANTAR FASCIITIS WITH NEURITIC SYMPTOMS

John S. Gould, M.D., Alabama Sports Medicine and Orthopaedic Center, Birmingham, Alabama

Pathologic changes at the origin of the plantar fascia on the medial tubercle of the calcaneus result in early morning pain on standing or walking. Orthotic devices, stretching exercises, and anti-inflammatory medication usually control the complaints. Certain patients with persistent pain also develop tarsal tunnel syndrome, which involves the posterior tibial nerve and its distal medial and lateral plantar branches. A neuropathy may not be accompanied by electrical changes if the compression or stretch is not of long standing and severe. Patients with persistent pain after two years may have a ruptured plantar fascia with a neuropathy. 104 feet in 92 patients have been operated upon. Average age was 48 years with symptoms varying from one year to ten years.

2000 TOTAL ANKLE ARTHROPLASTY: THE ASMI EXPERIENCE

John S. Gould, M.D., Alabama Sports Medicine and Orthopaedic Center, Birmingham, Alabama

Total Ankle Replacement surgery is not part of mainstream orthopaedics at the present time. The original TARS failed due to weak cement bone interface. The Alvine ankle is currently approved by the FDA. It is semi-constrained, has a polyethylene liner, and a large surface for bone ingrowth. It uses the distal tibial fibular syndesmosis fusion to include the fibula in weightbearing. Limited bone resection is necessary, the ingrowth surface on the tibial component contacts bone superiorly, medially, and laterally. Polyethylene is locked in the tray with two side columns and the talar component has a porous inferior surface that is wide anteriorly and allows axial rotation and medial-lateral translation. In an October 1988 article in the JBJS showed the results of a review by surgeons other than Alvine that showed a 4.8 year follow up with 93% satisfactory results. We have done 31 ankles in approximately two years. Several preoperative procedures were necessary to align and stabilize the foot the ankle before the prosthesis was inserted. This included 5 triple arthrodeses, 3 subtalar arthrodeses, one calcaneal osteotomy, and iliac bone graft for obtaining a syndesmosis fusion. Four tendon Achilles lengthening were done and a tibial osteotomy was performed. Complications at surgery included 2 fractures of the lateral malleolus, one fracture of the medial malleolus, a lacerated flexor digitorum communis. There were 4 anterior wound healing problems and 5 lateral wound healing problems. Postoperative immobilization for 6 weeks diminished the wound problems. Late fractures of the lateral malleolus occurred 4 times and one fracture of the medial malleolus. Three talar components have been revised. There was one long term infection. 25 of 31 have done well (good to excellent) in short term follow up less than 2 years. 30 of 31 patients currently state they are better than they were preoperatively. Surgeons who plan to use this procedure should take a formal course and follow with mini tutorials with experienced surgeons.

2000 INSERTIONAL TENDONITIS OF THE TENDO ACHILLES

John S. Gould, M.D., Alabama Sports Medicine and Orthopaedic Center, Birmingham, Alabama

Insertional tendinitis of the Achilles includes thickening of the pseudo sheath and mucoid degeneration with or without heterotopic bone formation. The retrocalcaneal bursa, if inflamed, results in increased bone and an increased prominence of the calcaneus. This insertional pathology affects middle age men and women. Nonoperative treatment is used for several months or years. The options are arthroscopic debridement of tendon, bursa, and bone. We have done this in three cases with good outcome. The open procedure is through a j-shaped incision, working under the tendo-Achilles to remove bursa and bone. An incision is made in the mid substance of the tendon to remove degenerative tendon and bone. If the bone mass is extensive, the degenerative distal tendon is detached, the proliferative bone is removed, and a V-Y lengthening of the tendon is done and reattached distally with a suture anchor. Postoperative immobilization is for two months and a heel lift for an additional 2 months. 74 procedures have been done from 1996 to 2000. The average age was 52 and duration of symptoms was 5-96 months. There were two wound healing problems and one partial rerupture. 21/24 with complete detachment did excellent, three had complications requiring redo. 69/74 patients in all groups healed satisfactory and had satisfactory results.