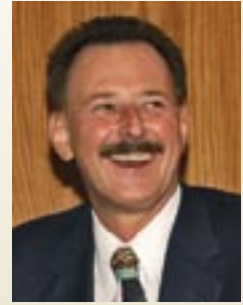


SENIOR THESIS DAY

MASSACHUSETTS GENERAL HOSPITAL

JUNE 17TH, 2005



Osgood Lecturer
Frank Eismont, MD

SENIOR RESIDENT THESIS PRESENTATIONS



James Herndon, MD, MBA

FIRST SESSION

MODERATOR: JAMES HERNDON, MD



Christopher Forthman, MD



Jesse Jupiter, MD

Acute Traumatic Elbow Instability Patterns and Characteristics

Christopher Forthman, MD

Advisor: David Ring, MD

Discussor: Jesse Jupiter, MD

Elbow fractures and instability can be broken down into several different patterns. Does the recognition of one of these patterns help one to predict the bone and ligamentous injury characteristics? As well, in these types of fracture dislocations is it necessary to repair the medial collateral ligament (MCL)? Dr. Forthman looked at 51 fracture dislocations and 4 simple dislocations to help answer these questions. Additionally he provided a detailed review of the types of fracture patterns, the anatomy of the fracture and the operative protocol for the fixation of these injuries. Ultimately it was determined that knowledge and correct identification of the fracture pattern would yield great information about the structures involved. What is more, it was found that the MCL didn't need to be repaired to ensure stability of the elbow joint.

Dr. Jupiter noted that the elbow is a unique and poorly understood joint, leading to some pessimism on the part of many surgeons with respect to these injuries. He noted that this study added greatly to the understanding of both the treatment as well as outcome of these fractures. He did question whether the knowledge gained about the fracture pattern in the OR had influenced their classification of the fractures, and suggested the need for intra- and inter-observer reliability assessments. Dr. Forthman noted that the fractures were classified solely on their radiological basis and agreed that further validation of their methods would be needed before wider acceptance.



Erik Spayde, MD



Mark Vrahas, MD

A Biomechanical Evaluation of Z-Fiber Technology in Fracture Fixation

Erik Spayde, MD

Advisor: Paul Glazar, MD

Discussor: Mark Vrahas, MD

Current methods of fracture fixation suffer from three major difficulties: traumatic insertion, large screw “footprints”, and limited points of fixation. Dr. Spayde proposed a novel technique using z-fiber technology to help overcome some of these hurdles. Z-fiber technology has already been put to great use in both the aerospace and automotive industries on account of its decreased incidence of delamination and increased strength. It is possible to fit multiple materials with z-fibers thereby obtaining these benefits. In this work Dr. Spayde looked at finite element analysis, biomechanical assays of pullout strength and cadaveric tests to compare z-fiber plates with conventional DCP plates. It was ultimately shown that z-fibers were stronger, had higher pullout strength and increased load capacity prior to failure, thus making them a possible technology to be employed in new plate design.

Dr. Vrahas observed that this was an excellent proof of concept paper but that there were still several questions that needed answering prior to human trials. For example, it is unclear how easy plate removal would be with several points of fixation. Dr. Spayde surmised that the same technology used for plate insertion could possibly be used for extraction, but agreed that more work would be needed and was forthcoming.



Raj Ahluwalia, MD



Thomas Thornhill, MD

Lesser Tuberosity Osteotomy in Total Shoulder Arthroplasty

Raj Ahluwalia, MD

Advisor: Peter Millett, MD

Discussor: Thomas S. Thornhill, MD

Total shoulder arthroplasties routinely involve taking down the subscapularis muscle from its insertion on the lesser tuberosity. However, between 60 and 65% of patients complain of some form of subscapularis dysfunction postoperatively. As well, between 3-11% have an actual subscapularis rupture, making this a difficult problem. Dr. Ahluwalia proposed that rather than releasing the soft tissue around the subscapularis or separating the muscle at its attachment, that one perform a lesser tuberosity osteotomy (LTO) – an idea that grew out of conversations between Dr. Christian Gerber and Drs. Warner and Millett. In this study a comparison was made between the biomechanical strength and the clinical outcomes of the various methods. He found that the LTO had decreased displacement and greater load to failure than other techniques. Moreover, after an analysis of 76 LTO's he found normal function in 92.5% and rupture in only 1.3%, significantly better results than reported in the literature.

Dr. Thornhill observed that the authors relied on fiberwire sutures for their osteotomy fixation and noted that fiberwire has polyethylene at its core. He questioned whether using this type of construct could lead to particle debris and loosening. Dr. Millett felt it unlikely given the distance of the sutures and knots from the joint itself.



Thomas Thornhill, MD

SECOND SESSION

MODERATOR: THOMAS THORNHILL, MD



Jennifer Cook, MD



Dennis Burke, MD

Early Acute and Late Metastatic Infections after Total Knee Arthroplasty: A single surgeon's experience after 3013 consecutive total knee arthroplasties

Jennifer Cook, MD

Advisor: Richard Scott, MD

Discussor: Dennis Burke, MD

Total knee arthroplasty techniques have gradually become refined enough that mechanical causes of failure do not dominate the discussion as they once did. As techniques have become more reliable, postoperative infection has taken on a larger role in the discussion. In her work, Dr. Cook reviewed the preoperative, intraoperative, postoperative and rehabilitation protocol of Dr. Scott over the past 19 years – an experience encompassing 3013 total knee arthroplasties. In this she draws several conclusions with respect to minimizing both early and late infections. Of the more than three thousand knees studied there were no early infections (less than 4 weeks postoperative) and only 15 late infections – a 0.5% infection rate. Given the small numbers it was difficult to draw many general conclusions, but it was clear that consistency, sterile technique and proper tissue handling were felt to be paramount in obtaining such excellent results.

Dr. Burke provided an excellent review of the current state of surgical infections in the US – as many as 500,000 per year—to help illustrate both what a large problem this is and how a 0.5% infection rate is truly remarkable. He provided some levity by tracing Dr. Cook's surgical genealogy through Dr. Scott back to both Pasteur and Lister. He did question whether the new move toward smaller incisions stood to give more problems with infection given the need to handle the tissue with more force. Dr. Cook agreed that there was likely some increased risk, but that properly placed incisions allowed adequate visualization and hence proper tissue handling.



Travis Matheney, MD



Young-Jo Kim, MD

Long-term Outcomes of Periacetabular Osteotomy

Travis Matheney, MD

Advisor: Michael B. Millis, MD

Discussor: Young-Jo Kim, MD

Hip dysplasia can lead to osteoarthritis and arthrosis of the hip. This is a particularly vexing problem in the young population, as it is not desirable to perform a total hip arthroplasty (THA) that will almost certainly one day need revision. One potential solution to this is the periacetabular osteotomy (PAO). Unfortunately, even when everything with the operation goes well, some hips progress to THA. In this work, Dr. Matheney sought to identify the factors that could determine which hips would not do well with a PAO. He looked at several factors in 160 PAO operations performed at the Children's Hospital including gender, BMI, the presence of a labral tear, and various radiographic metrics. Ultimately he found that decreased preoperative joint space width and joint congruency were most likely to indicate failure of a PAO. This work represented a unique model in the prediction of PAO failure.

Dr. Kim congratulated Dr. Matheney on this model. He cautioned that the model will need to be verified on other patient populations prior to wide acceptance. Dr. Matheney agreed that further verification would be needed.



Samantha Spencer, MD



Michael B. Millis, MD

Surgical Dislocation of the Hip

Samantha A. Spencer, MD

Advisor: Young-Jo Kim, MD

Discussor: Michael B. Millis, MD

Intra-articular lesions of the hip are notoriously difficult to treat. For example, the impingement syndrome seen in slipped capital femoral epiphysis (SCFE) can sometimes lead to other problems such as labral tears, chondral injury, rim fractures and OA. Many times this can be treated with observation, NSAIDs, or even hip arthroscopy. In her work, Dr. Spencer suggests the next step in this progression, namely the use of surgical hip dislocations to treat these lesions. She examined 19 patients who had undergone surgical hip dislocation for SCFE or idiopathic pistol grip deformity. The use of surgical dislocation allows for assessment of the anatomy as well as the dynamics of the hip. Ultimately it was shown that use of a greater trochanteric osteotomy and osteoplasty in SCFE patients had the most overall improvement in their function. It was suggested that surgical dislocation was an effective treatment given one's ability to repair labral tears, the option for osteotomy and the ability to perform osteoplasty.

Dr. Millis congratulated Dr. Spencer for her interesting and very relevant work. He inquired as to whether arthroscopy of the hip would grow to be a more effective tool in the assessment of hip pathology. Dr. Spencer answered that hip arthroscopy was still in its early stages and that it was unclear how effective it would be. For example, one may be limited in the ability to perform adequate osteoplasty or fix labral tears.



James R. Kasser, MD

THIRD SESSION

MODERATOR: JAMES KASSER, MD



Andreas Gomoll, MD



Daniel Estok, MD

A Nanocomposite Bone Cement

Andreas Gomoll, MD

Advisor: Thomas S. Thornhill, MD

Discussor: Daniel Estok, MD

Bone cement consists of a liquid and powder components. The powder components are determined, in part, by the size of the particles present in the powder. Conventional radiopacifier particles range from 1-3 μm , but go on to form aggregates that range from 50-400 μm . These aggregates allow for flaws in the matrix of cement that subsequently allow for crack propagation and ultimate failure. In this work Dr. Gomoll proposes the use of nanoparticles, those particles on the order of 100nm, for use in the construction of bone cement. He used scanning electron microscopy and x-ray scattering methods to determine that nanoparticles have an approximately 10-fold increase in covered surface area (due to decreased aggregation). Additionally, he analyzed the strength of the composite under various loading conditions and found that the number of cycles required for failure was increased over 200% with nanoparticles. It is hoped that nanoparticles can be used in bone cement to help implant survivorship.

Dr. Estok was pleased to see that the work on bone cement continues, and thanked Dr. Gomoll for his elegant study. He questioned Dr. Gomoll on whether the technique of cementing was as important as the material used. Dr. Gomoll pointed out that nanocement would provide increased strength and could perhaps make up for lacking technique so that a wider array of surgeons could obtain more consistent and better results.



Jeremy Moses, MD



Arthur Boland, MD

In-Vivo Tibiofemoral Articular Cartilage Contact Patterns Following Anterior Cruciate Ligament Rupture

Jeremy Moses, MD

Advisor: Thomas Gill, MD

Discussor: Arthur Boland, MD

ACL rupture is common among Americans, with as many as 80,000 people between the age of 15-45 suffering an ACL rupture every year. The contact stresses in the knee in ACL deficient knees can lead to several problems in the knee including meniscal pathology, chondral injuries, and osteoarthritis (OA). It is felt that the altered kinematics of the knee are the linchpin in understanding how this process occurs. In this work Dr. Moses uses a new technique to determine the contact stresses in ACL deficient knees and proposes how these may be responsible for both the acute and chronic pathology seen in this condition. Dr. Moses proposed a novel scheme whereby MRI

images were combined with orthogonal, kinematic, fluoroscopic images of the knee to determine the contact points seen in knee motion both with and without an ACL. He found that ACL deficient knees have contact points that are more lateral in the medial compartment of the knee. This, in turn, can be used to help explain many of the pathological findings with respect to OA, chondral injuries and meniscal tears found in ACL deficient knees. While the data did not demonstrate long term benefits of ACL repair with respect to OA and chondral injury, it did show improvement in meniscal tear rates.

Dr. Boland noted that Dr. Moses provided an excellent review of an extensive body of literature and complemented him on the use of this new and innovative technique. He inquired as to the feasibility of adding different degrees of freedom, for example internal and external rotation, to the schema. Dr. Moses responded that such work is already in progress.



Eric Rightmire, MD



David Lhowe, MD

Managing acute infections after open reduction internal fixation (ORIF) of fractures: Can they be treated with hardware in place?

Eric Rightmire, MD

Advisor: Mark Vrahas, MD

Discussor: David Lhowe, MD

Many orthopedic surgeons treat infection after an ORIF by leaving the hardware in place and treating the patient with suppressive antibiotics until the fracture has healed. Isolated case series and reports have claimed as much as a 95% success rate with this regimen. Dr. Rightmire sought to determine if this regimen worked well for acute infection. Additionally he sought to determine the risk factors for treatment failure and to suggest any alternate treatments in such a case. He examined 81 fractures with acute postop infections and analyzed them in terms of fracture type/classification, hardware type, and organism involved. He showed that healing of the fracture with hardware in place was only 59%, far less than that reported in the literature. Moreover he showed that of those with hardware left in after union, 34% progressed to later infection. Interestingly he showed that smokers had 4-fold higher risk of hardware failure every month.

Dr. Lhowe noted that this was a very clinically relevant investigation and that not a week goes by on the trauma service where this question isn't addressed. He recognized that studies such as this that involve heterogeneous populations, different surgeons, and no set protocol make drawing statistically significant conclusions difficult at best. He felt that this study could likely change practice habits such that many surgeons should consider removing hardware after union irrespective of supposed sterility of the fracture.



Andrew Freiberg, MD

FOURTH SESSION

MODERATOR: DR. ANDREW FREIBERG, MD



Reuben Gobezie, MD



Thomas Thornhill, MD

Proteomics Applications to the Study of Osteoarthritis-the identification of new protein biomarkers for osteoarthritis

Reuben Gobezie, MD

Advisor: Peter J. Millett, MD

Discussor: Thomas S. Thornhill, MD

Proteomics is the use of various assay methods to find the collection of proteins that are expressed in a disease state. Osteoarthritis (OA) is the most prevalent musculoskeletal disease in the US, yet there are no good serum or cellular markers heralding its onset. In Dr. Gobezie's work, a method of analyzing synovial tissue from a patient for early markers of OA using proteomic methods is proposed. In this study, samples from 20 patients each with no OA, early OA and late OA were compared with one another to find cellular biomarkers that were different in those with OA versus those with normal knees. Ultimately it is hoped that markers will be found that can help the clinician in determining the presence of OA in a patient.

Dr. Thornhill complemented Dr. Gobezie for his leadership role in taking on such a large multi-disciplinary study. He asked Dr. Gobezie to discuss some of the difficulties he encountered in taking on such a large project encompassing so many fields. Dr. Gobezie answered that the challenge in such a project was remembering that no one investigator can be responsible for everything – not everyone can run or understand every aspect of the experiments, the project truly was a collaborative effort.



Patrick McCulloch, MD



Mark A. Randolph, MD

Microfracture in a Non-human Primate Model

Patrick McCulloch, MD

Advisor: Thomas Gill, MD

Discussor: Mark A. Randolph, PhD

Microfracture is a commonly used technique in the treatment of chondral injuries. It is known that it has good results in patient outcome. However, little is known about the optimal time and course of postoperative immobilization and rehabilitation. Some work has been done with both horses and rabbits, but each suffers from its limitations, most notably that neither correctly represents the milieu seen in human bone after microfracture. In this work, Dr. McCulloch proposes the use of a non-human primate model to assess microfracture technique and ultimate healing. He uses macaque monkey knees as a proxy for human chondral injuries on the premise that these more closely mimic human knees. By comparing the

gross and histological appearance of the microfracture sites at six and twelve week intervals it was shown that incomplete healing had taken place at 6 weeks, while at 12 weeks there was good integration of the fibrocartilage. It was recommended that patients remain non-weight bearing at least twelve weeks postop from a microfracture.

Dr. Randolph commended Dr. McCulloch on his work on a difficult project with a difficult subject. He inquired as to what tissue types were filling the defect after microfracture. He suggested changes to the experimental method that could account for different tissue types. Dr. McCulloch answered that based on the stains used in the histology part of the report, mostly type I and II collagen was present in the microfracture site.



John A. Abraham, MD



John Ready, MD

The MGH Experience with Angiosarcoma: Survival Analysis

John A. Abraham, MD

Advisor: Sam Yoon, MD

Discussor: John Ready, MD

Angiosarcoma is an exceedingly rare disease with only approximately 60 new cases every year in the US. Nonetheless it is a devastating disease with abysmal survival data. However, given the small numbers of patients who present with the disease it is difficult to forward hard, fast numbers on survivorship. In this study, Dr. Abraham analyzed the MGH experience with angiosarcoma over the past three decades. He found 38 cases of angiosarcoma in that time period. He analyzed factors thought to be important in survival and ultimately found that tumor margins had a statistically significant effect on survivorship with a roughly ten-fold increased survivorship for negative margins. Tumor size, stage and grade all trended toward significant effects on survivorship. Patient age and tumor location did not seem to affect survivorship. Ultimately it was found that angiosarcoma still had overall survival of 20-35% at five years.

Dr. Ready thanked Dr. Abraham for taking on such a daunting task and providing new analysis on a rare disease. He proposed that there be a city-wide tumor registry to pool data so that rare tumors could be more easily analyzed. Dr. Abraham agreed that this was a good idea – in fact, he had already begun work on the registry and is awaiting IRB approval.