

THESIS DAY

WEDNESDAY MAY 15, 2002



James H. Herndon, MD, MBA



James Heckman, MD
Osgood Lecturer

SENIOR RESIDENT THESIS PRESENTATIONS



James Kasser, MD

FIRST SESSION

MODERATOR: JAMES KASSER, MD



Rahul Deshmukh, MD



Thomas Thornhill, MD

I. The Incidence and Outcome of Modular Tibial Insert Exchange in 2000 Consecutive Primary PCL Retaining Knee Arthroplasties

Rahul Deshmukh, MD

Advisor: Richard Scott, MD

Discussor: Thomas Thornhill, MD

Dr. Deshmukh retrospectively reviewed a series of 2000 consecutive patients to assess the incidence in which modular tibial inserts are advantageous to the patient. In this series of patients who all underwent a PCL-retaining total knee arthroplasty, insert exchanges were used in approximately 2% of cases with an average follow up of 8 years. Indications for exchange included polyethylene wear and instability, with a few performed incidentally. Of the patients who underwent an exchange for polyethylene wear there was a 100% survival at follow-up. Dr. Deshmukh concluded that modularity appears to have a significant benefit during re-operation with PCL retaining knee system.

Dr. Thomas Thornhill first commended Dr. Deshmukh on a well-organized presentation. He wondered if use of a cross-linked polyethylene would have any affect on the rates of wear seen in this patient population. Dr. Deshmukh and Scott responded to this comment by saying that surgeons should be cautious about the use of cross-linked polyethylene in knees. The articulation and the forces around the knee are very different from that in the hip. More studies are needed to prove its benefit in total knee arthroplasty.



David L. Scott, MD



Henry J. Mankin, MD

2. Orthopaedic Drug Design: Making Way for the Candyman

David L. Scott, MD

Advisor: Paul B. Sigler, MD, PhD

Discussor: Henry J. Mankin, MD

Dr. Scott talked about the numerous steps involved in the production of a new drug, including issues pertaining to mapping the target receptor. More specifically, Dr. Scott focused on integrins, heterodimeric receptors that mediate cell-cell and cell-matrix interactions. For example, integrins which mediate platelet activation and thrombosis have been targeted in the prevention and treatment of ischemic cardiac disease. Reopro, one such drug, has been shown to reduce the 30-day incidence of myocardial infarction and death in patients with unstable angina. Within the field of orthopaedic surgery, Dr. Scott addressed the treatment of Gaucher's disease, which is caused by a mutation in the gene encoding the glucocerebrosidase enzyme. Indeed, recombinant glucocerebrosidase can reduce the pathologic accumulation of intracellular lipids, thus leading to relief of symptoms.

Dr. Mankin commended Dr. Scott on his magnificent effort and superb science leading to this work. Dr. Mankin further informed the audience that integrin is a relatively new term. His research revealed that the term didn't actually exist before 1992 in many textbooks. Finally, he commented on the fascinating structure of the integrin and the unique nature in which it gains entry into the cell.



David Kim, MD



Thomas Gill, MD

3. Twisting and Braiding Reduces Strength and Stiffness of Human Hamstring Tendon grafts Used for ACL Reconstruction

David Kim, MD

Advisor: Charles Brown, MD

Discussor: Thomas Gill, MD

Dr. David Kim presented a biomechanical study on the effects of twisting and braiding on the tensile properties of four strand human hamstring tendon grafts used for ACL reconstruction. In this study, Dr. Kim tested gracilis and semitendinosus free tendon grafts harvested from unembalmed human cadaveric knees. Doubled gracilis and semitendinosus (DGST) grafts were either twisted or braided. The contralateral DGST grafts were tested in parallel in the control group. Dr. Kim found that twisted and braided DGST grafts had reduced failure load and stiffness as compared to parallel controls. Based on the results of this study, Dr. Kim cautions against the use of twisted or braided tendon grafts in anterior cruciate ligament replacement surgery.

Dr. Gill commended Dr. Kim on challenging accepted principles with his research. He went on to comment that graft stiffness may not necessarily correlate with better clinical outcomes, as in vitro data is difficult to extrapolate to in vivo results. He further went on to wonder how the graft fixation in this study compared to the graft fixation in the operating room.



Arun Ramappa, MD



Arthur Boland, MD

4. The Effects of Medialization and Anteromedialization of the Tibial Tubercle on Patellofemoral Mechanics and Kinematics

Arun Ramappa, MD

Advisor: Thomas Gill, MD, Dave R. Wilson, D Phil

Discussor: Arthur Boland, MD

Patellofemoral malalignment, which can cause anterior knee pain, is often unresponsive to conservative therapy. Two of the surgical techniques used to treat patellofemoral malalignment, the Elmslie-Trillat and Fulkerson procedures, are based upon tibial tubercle osteotomy and/or transfer. In this cadaveric study, Dr. Ramappa compared medialization of the tibial tubercle (Elmslie-Trillat procedure) to anteromedial tubercle transfer (Fulkerson procedure) in their effects on patellofemoral tracking and patellofemoral contact stresses. Dr. Ramappa found lower contact stresses across the patellofemoral articulation with medialization, and thus recommended that medialization be the realignment procedure of choice in appropriate patient with patellofemoral pain.

Dr. Boland praised Dr. Ramappa for his experimental design and methods. He noted that neither procedure increased the patellofemoral contact area. He suggested that future investigations should take into account patellar tilt secondary to tight lateral structures as well as malalignment in the coronal plane.



Harry Rubash, MD

SECOND SESSION

MODERATOR: HARRY E. RUBASH, MD



David Wimberley, MD



John Siliski, MD

5. The Determination of the Neutral Axial Rotatory Alignment of the Tibial Component in Extension Relative to an Anatomic Tibial Landmark in Rotating Platform Total Knee Replacements

David Wimberley, MD

Advisor: Thomas Thornhill, MD and Dr. Richard Scott, MD

Discussor: John Siliski, MD

Complications of total knee arthroplasty are often related to rotational malalignment of the femoral and tibial components. In this study Dr. Wimberley utilized the rotating platform total knee system and tried to determine where neutral tibio-femoral rotation lies, in extension, relative to the tibial tubercle. The axial rotation of the tibial insert ranged from 5 degrees internal to 10 degrees external, with a mean of 4.49 degrees external. Dr. Wimberley concluded that no correlation was identified between the amount of external rotation relative to the posterior femoral condyles of the femoral component and the axial rotation of the tibial insert. Analysis of preoperative axial alignment failed to demonstrate a statistically significant correlation with tibial rotation.

Dr. Siliski pointed out that Dr. Wimberley returned to the fundamental role of tibial component and its interaction with the femoral component. He also noted that the age of the patients in this study was approximately 10 years younger than for other similar studies, with a preponderance of males. He wondered if these two factors could somehow have influenced the results due to a selection bias.



Thomas Myers, MD



Thomas Thornhill, MD

6. Total Knee Arthroplasty using the Total Condylar III Prosthesis: Clinical Outcomes and Component Survivorship

Thomas Myers, MD

Advisor: Scott Martin, MD

Discussor: Thomas Thornhill, MD

Dr. Myers presented data determining that results of revision and difficult primary total knee arthroplasty (TKA) using constrained prosthesis are less predictable than that of primary TKA using less constrained designs. In this study, survivorship results of a consecutive series of patients who underwent primary and revision TKA using the total condylar III prosthesis, as well as the clinical outcome results employing three different health status surveys, were presented. Post-operative radiographic and prospective clinical outcome instruments were also assessed. Multivariate analysis demonstrated that TKA's revised for septic loosening and those reconstructed with structural allograft were more likely to result in early failure. Surprisingly, patients with multiple medical comorbidities and/or multiple joint involvement were not at higher risk for failure, likely secondary to low functional demand.

Dr. Rubash commended Dr. Myers for his comprehensive study of revision knee arthroplasty. He discussed the importance of considering impending failures, particularly in cases of short- to intermediate-term follow-up. Dr. Heckman similarly complemented Dr. Myers on his exhaustive investigation. He posed the question of whether the routine use of antibiotic-impregnated cement during revision surgery might reduce the number of infectious complications.



E. Ken Rodriguez, MD



James Kasser, MD

7. Dependence of Joint Morphogenesis on Limb Motion: A In-Vitro Model of Knee Morphogenesis in the Chick Embryo

E. Ken Rodriguez, MD

Advisor: Brian Snyder, MD

Discussor: James Kasser, MD

Dr. Rodriguez presented his work on an in-vitro tissue culture model of joint morphogenesis using the isolated lower extremities from eight-day old chick embryos. This model represents one of the first successful efforts at developing a viable, mechanically-stimulated, isolated embryonic joint in tissue culture. Using this novel system, Dr. Rodriguez demonstrated that in-vitro tissue cultures under flexion-extension load are viable and exhibit more progression of joint differentiation, cavitation, and intra-articular space development than similarly cultured but unloaded specimens. Together with non-invasive micro-MRI examination, this model provides a useful tool to examine how patterns of motion and load may modulate gene expression and morphology.

Though the conditions of movement encountered in-vitro versus in-vivo may differ, Dr. Kasser commended Dr. Rodriguez for his tremendous efforts in development an in-vitro model of joint development. He also pointed out that this model does a good job of combining the mechanics and genetics of limb development.



Kai Mithoefer, MD



Mark Vrahas, MD

8. Acute Compartment Syndrome of the Thigh: Clinical Spectrum and Functional Outcome

Kai Mithoefer, MD

Advisor: David Lhowe, MD

Discussor: Mark Vrahas, MD

Dr. Mithoefer retrospectively reviewed the long-term functional results of patients treated for compartment syndromes of the thigh. Physical examination, isokinetic quadriceps muscle testing, and standardized functional outcome questionnaires were utilized. Dr. Mithoefer determined that the presence of an ipsilateral femur fracture was associated with significantly increased short- and long-term morbidity, lower functional outcome scores, and persistent thigh muscle deficit on isokinetic testing. Dr. Mithoefer concluded that an ipsilateral femur fracture in the setting of a thigh compartment syndrome is associated with a poorer prognosis.

Dr. Vrahas in his discussion pointed out that the average time to decompressive fasciotomy was eleven hours. Interestingly, the time to decompressive fasciotomy did not correlate with the long-term functional outcome, perhaps due to the resistance of the thigh to compartment syndromes. Dr. Vrahas suggested that compartment syndromes associated with femur fractures may have poorer outcomes due to the higher energy of injury. Dr. Vrahas ended his discussion by noting that Dr. Mithoefer's study is the largest to date on compartment syndrome of the thigh and will make significant contribution to our understanding of this clinical entity.



Shahram Solhpour, MD



William Tomford, MD

9. A qualitative Analysis of a Novel Tissue Engineered Implant Compared to Traditional Autologous Chondrocyte Implant in a Rabbit Model

Shahram Solhpour, MD

Advisor: Julie Glowacki, MD and Tom Minas, MD

Discussor: William Tomford, MD

Dr. Solhpour compared the results of a novel type I collagen sponge embedded with autologous chondrocytes to more conventional autologous chondrocyte implantation (ACI) for the treatment of articular cartilage defects. This study showed that both periosteum and the type I collagen sponge are effective for the ACI procedure, raising the possibility of shorter, technically easier, and less morbid ACI surgery.

Dr. Tomford congratulated Dr. Solhpour for his scientific efforts and hard work. In particular, he commended Dr. Solhpour and his co-investigators for their meticulous and comprehensive histologic evaluation of autologous chondrocyte implantation in this animal model.



Upshur Spencer, MD



Fred Mansfield, MD

10. In Vivo Evaluation of Calcium Sulfate as a Bone Graft Substitute for Lumbar Spine Fusion

Upshur Spencer, MD

Advisor: Paul Glazer, MD

Discussor: Fred Mansfield, MD

Posterolateral lumbar spine fusions are associated with nonunion rates as high as 35%. In this study, Dr. Spencer utilized a rabbit model to determine if use of calcium sulfate in conjunction with electrical stimulation enhances the rate of spinal fusion. At 8 weeks following surgery, manual palpation, radiographic assessment and mechanical testing revealed a dose dependent increase in fusion rate in animals treated with electrical stimulation with calcium sulfate. However, no fusion mass in either group was graded a bilaterally complete, and no animals fused without electrical stimulation. The author's conclusion was that calcium sulfate, when used as a bone graft substitute, does not enhance spinal fusion in a rabbit model.

Dr. Mansfield led the discussion of this paper noting that the lack of increased fusion rates with calcium sulfate in this model may be due to rapid graft absorption. He proposed that future study of graft extenders may provide longer half-life and efficacy of calcium sulfate and other bone graft substitutes in spinal fusion.



J. Scott Price, MD



David Ring, MD

11. Outcome of Distal Radius Fractures Treated with the Tri-Med Wrist Fracture Fixation System

J. Scott Price, MD

Advisor: Mark Koris, MD

Discussor: David Ring, MD

Noting that extensively comminuted, intra-articular distal radius fractures are difficult to treat, Dr. Scott Price presented the early results of distal radius fractures treated with the Tri-Med Wrist Fracture Fixation System. Results of this study revealed excellent motion at the wrist when compared to the opposite side at follow-up. Using the Gartland and Werley demerit point system, the authors found that the majority of patients had good or excellent outcomes. Dr. Price's conclusion from this study was that use of a fragment specific fixation device in multiple planes can allow the surgeon to obtain improved results in complex distal radius fractures.

In his discussion, Dr. Ring applauded the merits of fragment specific fixation but cautioned against the potential complications of the Tri-Med system, including tendon rupture, symptomatic hardware, and peripheral nerve irritation. He congratulated the authors on their efforts and encouraged further investigation of long-term results.



Patrick Tyrance, MD



Stephen Lipson, MD

12. Morphometric Analysis of Lumbar Spinal Stenosis: Correlating Plain Films with Axial Imaging

Patrick Tyrance, MD

Advisor: Kingsley Chin, MD and Richard Ozuna, MD

Discussor: Stephen Lipson, MD

Citing the clinical challenges in making the diagnosis of lumbar spinal stenosis, Dr. Tyrance attempted to determine objective criteria that would aid the clinician in evaluation of these patients. In this study, a model was developed to predict the area of lumbar canal based on axial MRI images. According to this model, the ratio of the mid-sagittal length of the canal to the mid-sagittal length of the vertebral body and the interpedicular distance of the canal were both found to be independent predictors of the cross-sectional area of the canal. Dr. Tyrance also determined that patients with degenerative spinal stenosis do not demonstrate significant differences in bony morphology compared with non-stenotic patients.

Dr. Lipson pointed out that degenerative changes within the aging spine may cause radiographic changes that do not necessarily correlate with physical examination findings. As such radiographic models will inherently produce a high number of false positive results, he cautioned against the use of purely radiographic criteria in the diagnosis of spinal stenosis. In addition, he posed the question of whether the "Q ratio" would be user-friendly and practical in a busy clinical setting.



George Liu, MD



Sang-Gil Lee, MD

13. Histological Analysis of Stainless Steel versus Titanium Plating of Distal Radius Fractures in a Rabbit Model

George Liu, MD

Advisor: Sang-Gil Lee, MD

Discussor: Sang-Gil Lee, MD

Dr. Liu presented results of a histologic study comparing the effects of titanium and stainless steel plates used to fix distal radius osteotomies on tendon and muscle excursion in a rabbit model. He demonstrated that a fibrous layer formed adjacent to these plates, serving to prevent the migration of free metallic particles into the overlying tendon and muscle. As a result, there was little difference between the titanium and steel implants with respect to tendon and muscle function, as metal wear debris was concentrated in the fibrous layer. The few free particles found in the tenosynovium may be the cause of tenosynovitis, tendonitis and tendon rupture seen in patients treated with distal radius plating.

Dr. Lee pointed out that as more distal radius fractures are treated with plates, tendon rupture and adhesions to plates are becoming a frequent problem. By demonstrating metallic debris concentrated at the screw-plate interval, this study shows that the majority of debris generated is particulate in nature. Furthermore, this study suggests that metallic debris is from wear mechanisms.



Thesis presenters along with Dr. Heckman, Dr. Herndon and Dr. Barrett

Awards

The Harvard Combined Orthopaedic Residency Program would like to thank Dr. Jack Barrett for his support of the two awards presented on Osgood Thesis Day: best basic science presentation and best outcome/clinical science presentation. Dr. David Kim was selected for the best basic science presentation for his study entitled Twisting and Braiding Reduces Strength and Stiffness of Human Hamstring Tendon Grafts Used for ACL Reconstruction. Dr. J. Scott Price was chosen for the best outcome/clinical science presentation for his study entitled Outcome of Distal Radius Fractures Treated with the Tri-Med Wrist Fracture Fixation System. Congratulations to both Dr. David Kim and Dr. J. Scott Price for their excellent thesis presentations.