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MAOA AWARD ABSTRACTS

FIRST PLENARY SESSION

2. BMP 14 Gene Therapy Effectively Increases Tendon Tensile Strength in a Rat Model of Achilles Tendon Injury

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Dr. Bolt is the recipient of the Dallas B. Phemister, MD Physician in Training Award.

INTRODUCTION: Bone morphogenetic proteins (BMPs) are being used clinically to enhance bone formation in a variety of clinical settings. BMP 14 induces neo-tendon formation when injected ectopically, and we examined the effects of adenovirus-mediated expression of BMP 14 on Achilles tendon healing in a rat model. Many analogous clinical situations involving tendon injury could benefit from similar biologic augmentation.
METHODS: Ninety male Sprague-Dawley rats underwent complete transection of the Achilles tendon, followed by immediate surgical repair. Each animal then received either an intrasubstance injection of adenovirus expressing BMP 14 or a mock virus expressing green fluorescence protein (GFP). Sham control animals received no injection. Thirty animals were sacrificed at 1, 2, and 3 weeks after surgery. Tendons were sent for histology and biomechanical testing.
RESULTS: Two weeks postsurgery, the BMP 14-treated tendons exhibited a twofold increase in tensile strength and showed less gapping than either GFP or sham control groups ($p < .01$). Although BMP 14-treated tendons were stronger on average with less gapping at both 1 and 3 weeks postsurgery, load-to-failure measurements were not statistically significant. Histologic evaluation revealed no ectopic bone or cartilage formation in the BMP 14 groups and no inflammation of the tendons in any of the adenoviral groups.
DISCUSSION: We have demonstrated that adenovirus-mediated BMP 14 effectively improves tendon healing in this rat Achilles injury model. This effect of BMP 14 was statistically significant at 2 weeks after injury. Thus, our data suggest that BMP 14 gene therapy accelerates tendon healing above that of recombinant protein used in a similar model and may be more effective for clinical applications.

4. Percutaneous Reduction and Fixation of Displaced Intra-articular Calcaneus Fractures

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Dr. DeWall is the recipient of the E. W. Johnson, Jr., MD Physician in Training Award.

PURPOSE: The optimal treatment of displaced intra-articular calcaneal fractures (DIACF) is controversial. This is a retrospective cohort study to assess the initial results of percutaneous reduction and fixation (PC) in comparison to a concurrent control group treated with open reduction and internal fixation (ORIF).
METHODS: Between 2000 and 2004, 76 DIACF in 71 patients were treated operatively at a single institution by two surgeons with one of two methods. ORIF was performed through an extended lateral approach and fractures were fixed with plates and screws (27 fractures in 27 patients). PC was through small incisions with indirect manipulation, and the reduction achieved was secured with screws alone (49 fractures in 44 patients). Patient demographics, fracture characteristics, and complications were compared on all fractures at a minimum of 4 months follow-up. A total of 71 fractures (26 ORIF/45PC) had sufficient x-rays to be included in the radiographic analysis.

RESULTS: The patients and the fractures in the two groups were not significantly different. Radiographic measures of fracture reduction and maintenance of reduction at healing were not significantly different between the groups. Deep infection (operative drainage and/or IV antibiotics) occurred in 5/27 of the ORIF group and 0/49 of the PC group ($p = .004$). The incidence of minor wound complications was 8/27 in the ORIF group and 4/49 in the PC group ($p = .02$). The need for secondary operations including late subtalar fusions (1/27 and 2/49) and hardware removal (1/27 and 7/49) were not significantly different ($p = .71$ and $p = .25$, respectively).
CONCLUSION AND SIGNIFICANCE: The results of this study suggest that PC minimizes complications, while achieving and maintaining reductions as well as ORIF. The strength of this initial study of PC is the inclusion of a concurrent control group allowing comparison of outcome measures. However, the results should be interpreted with caution because of limited patient numbers, short follow-up, and undetected confounding factors.

SECOND PLENARY SESSION

92. Evaluation of Gene Expression in Slipped Capital Femoral Epiphysis Utilizing Laser Capture Microdissection and RT-PCR

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Dr. Scharschmidt is the recipient of the Carl L. Nelson, MD Physician in Training Award.

BACKGROUND: Slipped capital femoral epiphysis is a poorly understood condition that impacts adolescents. Its consequences can be severe, even in cases where there is early recognition and treatment is implemented. Prior studies have suggested that the etiology may be related to abnormal collagen comprising the growth plate cartilage, but no investigations have analyzed collagen on a molecular level in the affected tissue. This study evaluates expression of collagen-specific mRNA from growth plate chondrocytes of patients suffering slipped capital femoral epiphysis. The work utilizes laser capture microdissection (LCM) techniques followed by real-time polymerase chain reaction (RT-PCR) to determine if a change or abnormality in collagen gene expression may be involved in the weakening of the epiphysis, a characteristic of the pathology.
MATERIALS AND METHODS: This study is IRB-approved. Study specimens were obtained from core biopsies of epiphyseal plates in surgical patients undergoing repair of slipped capital femoral epiphysis. The core biopsies are part of the routine surgical procedure and would normally be discarded. Following surgical removal of the tissues, samples were placed in RNA later to maintain RNA integrity of component cells. Specimens were prepared for LCM, in which individual or several chondrocytes were selected for analysis from specific regions of fresh-frozen, ethanol-fixed, and stained tissue blocks. Single or small groups of cells were identified and their total RNA was extracted. The RNA was DNase-treated and subjected to RT-PCR. Primers developed specifically for the genes of interest (types II, IX, X, and XI collagen and others) are being utilized to evaluate expression levels.
DISCUSSION: This study is the first to measure collagen gene expression utilizing LCM followed by mRNA analysis with RT-PCR for physeal chondrocytes from slipped capital femoral epiphysis. With these techniques, correlation of spatial location and gene expression of the cells can be made to provide greater insight into this pathology and a more complete understanding of growth plate biology in general.

THIRD PLENARY SESSION

97. The Effects of Intra-articular Hyaluronic Acid Injection on Percentage of Chondrocyte Apoptosis After a Blunt Cartilage Injury in the New Zealand White Rabbit

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Dr. Matlock is the recipient of the Edward D. Henderson, MD Physician in Training Award.

BACKGROUND: Articular cartilage has little ability to repair itself after an injury. It is well documented that a blunt cartilage injury leads to chondrocyte apoptosis and that chondrocyte apoptosis may progress to arthrosis. If this progression from injury-induced chondrocyte apoptosis to arthrosis could be altered, the significant morbidity associated with posttraumatic arthrosis could be positively affected. The purpose of this study was to determine the effect of intra-articular hyaluronic acid injection on the percentage of chondrocyte apoptosis after a blunt cartilage injury in the New Zealand white rabbit.
METHODS: Rabbits received an acute articular cartilage injury to both patellae using a drop-tower apparatus. Immediately after the injury, one knee was injected with hyaluronic acid and the other knee was injected with saline and served as the control. Terminal dUTP nick end labeling staining was used to determine the percentage of apoptotic cells in each group.
RESULTS: The patellae in the injured control group treated with saline showed a chondrocyte apoptosis percentage of 20.2%. Those injured patellae in the group treated with hyaluronic acid had a chondrocyte apoptosis percentage of 4.7%. This difference was statistically significant ($p = .026$).
CONCLUSIONS: Intra-articular injection with hyaluronic acid after a blunt articular cartilage injury seems to significantly decrease the percentage of apoptotic chondrocytes. Hyaluronic acid may be useful as a chondroprotective agent to alter the natural history of a blunt articular cartilage injury.

POSTERS

38. Serum and Breast Milk Levels of Methylmethacrylate Following Surgeon Exposure During Arthroplasty

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Dr. Linehan is the recipient of a 2006 poster award.

INTRODUCTION: Although pregnant personnel are encouraged to leave the operating room during mixing and application of polymethylmethacrylate (PMMA), there is no information regarding the safety of exposure to methylmethacrylate (MMA) fumes for breast-feeding females. The objective of this study was to evaluate the relative risk to breast-feeding females of MMA inhalational exposure during arthroplasty.
METHODS: Two breast-feeding surgeons had blood samples drawn immediately after exposure to MMA during eight arthroplasty procedures, with 17 breast milk samples collected immediately after completion of the procedures, and at 6, $6 + n$ (variable), and 24 hours. Two healthy breast-feeding females without exposure to MMA served as controls. All samples were analyzed for MMA using a previously published head space gas chromatography (GC) protocol.
RESULTS: The GC protocol detected MMA at levels as low as 0.5 ppm. No serum or breast milk sample demonstrated evidence of MMA at that level, nor did any surgeon sample assay higher than the control specimens. Serum and milk samples spiked with MMA yielded the analyte peak as expected, evidencing no interference from either matrix.
DISCUSSION: This is the first study to demonstrate that MMA is not detectable in serum or breast milk following inhalational exposure during arthroplasty. Breast-feeding females can safely use their breast milk after such exposure. Furthermore, prohibition of exposure to PMMA during pregnancy should also be reconsidered, given virtually undetectable serum levels.

41. Experience With a Hydroxyapatite-Coated Titanium Plasma-Sprayed Implant at 15–18 Years

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Dr. Berend is the recipient of a 2006 poster award.

The debate about benefits of hydroxyapatite (HA) in primary total hip arthroplasty (THA) continues with advocates reporting early improvements in pain and function and enhanced

fixation. Others have reported no significant difference in long-term outcomes with application of HA to an already proven fixation surface. We previously reported more rapid clinical improvement with an HA-coated tapered titanium implant. This study reports the long-term follow-up data on 192 consecutive THAs in which a standard femoral stem or a HA-coated stem was implanted.

Between 1987 and 1990, 192 consecutive primary THAs were performed using a single stem geometry. All were tapered, proximally porous-plasma-sprayed (PPS) titanium. In 61 THAs, the proximal PPS surface was hydroxyapatite. In 129, the PPS surface was titanium. Survivorship was evaluated using Kaplan–Meier and log-rank tests. Harris hip pain and total scores were calculated.

At average 11.6 years follow-up, one stem (non-HA) was revised for aseptic loosening. No significant differences were noted in any variable including pain scores, HHS, stem revision, or the incidence of acetabular liner or cup revision for polyethylene wear or loosening. Survivorship of non-HA stems with aseptic loosening as the end point was 99.2%. Survivorship of HA stems was 100%.

Long-term outcomes of proximally PPS femoral stems are excellent regardless of HA application. No long-term benefit or detriment is noted by its application to this design. With the current trend towards rapid recovery and shortened hospital stay, the use of HA may warrant reinvestigation.

Long-term outcomes of proximally porous-plasma-sprayed tapered titanium femoral stems are excellent regardless of hydroxyapatite application.