A LONGITUDINAL STUDY TO ASSESS THE FUNCTIONAL CHANGES CAUSED BY HYALURONIC ACID (HA) INJECTION (DUROLANE) IN OSTEOARTHRITIS KNEES USING VIBRATION ANALYSIS AND MAGNETIC RESONANCE IMAGING

S. Salari1, H. Wu1, C. Webber1, C.O. Fuentes2, R.A. Ogilvie2, R. Bobba2, J.F. MacGregor1, J.D. Adachi1. 1McMaster University, Hamilton, ON, CANADA, 2Hamilton Health Sciences, Hamilton, ON, CANADA

Purpose: The purpose of this longitudinal study was to assess the functional changes caused by HA acid injection into the knees of patients suffering from osteoarthritis (OA). Our hypothesis in this ongoing research project is that Durolane, a type of synthesized HA, which acts as a viscous lubricating fluid would improve the mechanical functionality of the joint and reduce friction between the articulating surfaces of the knee. This improvement would in turn result in less vibration generated by the knee during motion.

Methods: 11 patients, diagnosed with severe OA, were recruited from local rheumatology clinics. Before the injection, each patient was tested with a vibration analysis device. The patient also underwent a full anatomical MRI scan of the knee. In addition, patients were asked to complete the WOMAC pain, stiffness and functionality assessment questionnaires. After the baseline vibration recording and MRI of the involved knee, patients were injected with 3 ml of Durolane. After the injection, the patient was asked to do some mild exercise, for 10 to 15 minutes and a second vibration test was performed in the injected knee. The patient was asked to return for follow-up studies one week, 5 weeks, 9 weeks and 13 weeks after the injection. At each follow-up appointment the injected knee was tested again with sound analysis and the patient was asked to fill out the WOMAC questionnaire. At the final appointment, the MRI scan of the injected knee was repeated.

Analysis: As reported elsewhere, we have developed a vibration based statistical model of the functionality of the articulating surfaces of the knee in healthy and OA patients. By projecting vibration data from the patients injected with HA into this statistical model, we expect to identify trends of improvement after the injection followed by a gradual worsening of the knee functionality as time elapses and the injection effects disappear.

Results: To date we have performed baseline and early follow-up measurements in 4 patients. Eleven patients who will be receiving the Durolane injection have been recruited. Figure 1 shows the hypothesized results for 1 patient superimposed upon a vibration test report. We anticipate that such results will allow an objective assessment of the effectiveness of therapy in each patient.

Conclusions: We are hoping that if we get promising results from our current research, the technique can be used as a potential tool to assess the functionality of the joint and for monitoring treatment effectiveness.

THERAPEUTIC PAIN MODULATION OF OSTEOARTHRITIS OF THE L-S SPINE ASSOCIATED WITH DEGENERATIVE LUMBAR DISC DISEASE, CHRONIC LUMBAR RADICULOPATHY, MUSCLE SPASM AND FIBROMYALGIA

J.P. Figueroa. Harrington Memorial Hospital, Southbridge, MA, USA

Purpose: Osteoarthritis (OA) of the LS spine tends to present with degenerative lumbar disc disease (DDD), chronic lumbar radiculopathy (CLR), muscle spasm (M-SP) and fibromyalgia (FIBRO). Optimal treatment of this condition can necessitate multiple medications sequenced for the best clinical effect.

Methods: Traditional medical training has been to avoid opiates even if the patient’s pain level is moderate to severe and even if basic activities of daily living remain significantly impaired. This is for reasons not only of narcotic dependency and constipation but also for sleep fragmentation, anxiety and depression as well. In these instances the patient may experience unrelenting pain and have profound disturbances on their sleep cycle. Not unexpectedly the continuous disturbances in their sleep cycle can be associated with the appearance of FIBRO. Fibrositic tendonpoint’s located in the paramalar and sacroiliac regions will further compound the low back pain that the patient is experiencing.

More recently there has been an improvement in both the quality and duration of sleep associated with the use of long-acting opiates for chronic low back pain associated with osteoarthritis. These patients can typically experience FIBRO along with the associated chronic sleep disturbance of their low back pain. The intensity of this pain frequently is such that it will not allow sufficient pharmacologic sleep augmentation to occur. This results in less than desired decrease in tendopoint discomfort. Once the appropriately titrated dose of long-acting opiate has been achieved then typically a formulation such as branded tizanidine capsules can have a very beneficial effect on the patient’s sleep. Only then will there occur a reduction in fibrositic tendopoint discomfort as well as other associated fibromyalgia related symptoms such as fatigue, stiffness, headache and depression.

Interestingly, ulterior pain modulation of the lower back occurs with the diclofenac patch 1.3% (applied to the lower back of the aforementioned patients). There occurs a level of pain reduction that is beyond that which would be expected with typical oral NSAID use. While the diclofenac patch has been approved for use in low back strain it has not been investigated for complex clinical low back pain conditions as presented.

Results: The clinical case presentations demonstrate the benefit of appropriately titrated long acting opiates. Also seen is an additional degree of analgesic relief with the diclofenac patch 1.3%. Once pain has been adequately modulated only then can sleep augmentation be successfully introduced with tizanidine capsules to treat coexisting FIBRO. The clinical result is a much more optimally controlled level of pain and a higher level of function.

Conclusions: Just as in the treatment of hypertension and cancer, typically the treatment of low back pain associated with OA, DDD, M-SP and FIBRO may require the use of multiple medications. When traditional treatment methods fail to arrive at an acceptable clinical result then appropriately titrated opiates can be effective. Non narcotic diclofenac patches offer additional clinical benefit. Once pain modulation is adequately accomplished, tizanidine capsules can be used to effectively treat coexisting fibromyalgia.
the allogeneic cartilage cells were not observed. Histological analysis of the biopsy specimens rated the repair tissue as hyaline-like in 15.3%, as mixed tissue in 46.2%, as fibrocartilage in 30.8% and as fibrous in 7.7%. Conclusion: The results of this pilot study show that the alginate-based scaffold containing mature human allogeneic chondrocytes provides clinical and histological outcomes equal to those of other cartilage repair techniques.

**MUSCLE STRENGTH AND FUNCTIONAL PERFORMANCE IN PATIENTS WITH ANTERIOR CRUCIATE LIGAMENT INJURY TREATED WITH TRAINING AND SURGICAL RECONSTRUCTION OR TRAINING ONLY: A 2 TO 5-YEAR FOLLOW-UP**

E. Ageberg¹, R. Thomeé², C. Neeter², K. Gravare-Silbernagel², E.M. Roos³
1Dept of Orthopedics, Lund University, Lund, SWEDEN, 2Lundberg Laboratory of Orthopaedic Research, Göteborg University, Göteborg, SWEDEN, 3Sports Science and Clinical Biomechanics, Odense M, DENMARK

**Purpose:** To study muscle strength and functional performance in patients with anterior cruciate ligament (ACL) injury with or without surgical reconstruction 2 to 5 years after injury. Good muscle function is important in preventing early-onset osteoarthritis (OA), but the role of reconstructive surgery in restoring muscle function is unclear.

**Methods:** 54 patients (mean age at follow up 30 years, range 20–39, 28% women), out of 121 patients with ACL injury included in a randomized controlled trial on training and surgical reconstruction vs. training only (the KANON study, ISRCTN84752559), were assessed 3 years (SD 0.9) after injury with reliable, valid and responsive test batteries for strength (knee extension, knee flexion, leg press) and hop performance (vertical jump, one-leg hop, side hop). The Limb Symmetry Index (LSI, injured leg divided by uninjured leg, and multiplied by 100) value, and absolute values were used for comparisons between groups (analysis of variance). An LSI $\geq 90\%$ was considered normal.

**Results:** There were no differences between the surgical and the non-surgical treatment groups in muscle strength or functional performance. Between 44% and 89% of the subjects had normal muscle function in the single tests, and between 44% and 56% had normal function in the test batteries.

**Conclusions:** The lack of differences between patients treated with training and surgical reconstruction or training only, indicates that reconstructive surgery was not a prerequisite for restoring muscle function. Abnormal muscle function, found in about one third or more of the patients, may be a predictor of future knee OA.

**BIOCOMPATIBLE PHOSPHOLID POLYMER GRAFTING ON LINER SURFACE OF ARTIFICIAL HIP JOINTS ENHANCES THE WEAR RESISTANCE INDEPENDENTLY OF LINER CROSS-LINKING OR FEMORAL HEAD MATERIAL**

T. Moro, Y. Takatori, M. Kyomoto, K. Ishihara, K. Nakamura, H. Kawaguchi. The University of Tokyo, Tokyo, JAPAN

**Purpose:** Artificial joint replacement is approved by OARSI guidelines as the treatment of hip and knee osteoarthritis (OA) with the highest recommended strength and cost-effectiveness (OAR 2007). However, these aspirations, induced by old scientific evidence, and the suture loosening induced by wear particles from the polyethylene PE liner remains as the fatal problem limiting their longevity and clinical success, despite contractions such as cross-linking of the liner and changes of the femoral head material. We have developed a novel PE liner with the surface graft of a biocompatible phospholipids polymer, 2-methacycloxyloxyethyl phosphorylcholine (MPC), and reported that this dramatically decreased the wear production in a hip joint simulator (Nature Mat 2004). This study compared the MPC effect with those of the liner cross-linking and the femoral head material.

**Methods:** We prepared PE liners with or without cross-linking (PE & CLPE) and photoinduced grafting of MPC onto the surfaces (MPC-PE & MPC-CLPE). The hydrophilicity of the surface was determined by the contact angle of a water drop, and the friction torque was measured against cobalt-chromium alloy (Co-Cr) or alumina ceramic femoral head. The wear amount was measured as the loss of the liner weight during 5 × 10⁵ cycles of loading (comparable to 5 to 10 years of physical walking) in the hip joint simulator. The surfaces of the liners and femoral heads, as well as the wear particles in the lubricant were analyzed by confocal scanning laser and electron microscopies, three-dimensional morphometry, and XPS spectroscopy.

**Results:** The MPC grafting increased hydrophilicity to 5–6 fold and decreased friction torque to 1/5–1/10, independently of the liner cross-linking or the femoral head material. Cross-linking by itself altered neither of the. The loss of liner weight (mass) after 5 × 10⁵ cycles of loading in the hip simulator was PE/Co-Cr = 99.6, CLPE/Co-Cr = 18.9, CLPE/alumina = 14.8, MPC-PE/Co-Cr = −5.9, MPC-CLPE/Co-Cr = −6.9, and MPC-CLPE/alumina = −6.4, indicating that cross-linking caused a significant decrease of wear amount while the femoral head material little affected it. The MPC grafting abrogated the wear amount, independently of the liner cross-linking or the femoral head material. The gain of weight in the MPC-grafted liners was confirmed to be due to water absorption, since it was similarly seen in all liners with and without MPC grafting during soak without motion in the lubricant. The suppressions of the wear on the liner surface and the particle amount in the lubricant by the MPC grafting were much stronger than those by the cross-linking, independently of the femoral head material. Interestingly, the particle size from the CLPE liner was around 0.1 μm, while that from PE or MPC-grafted liners was around 10 μm.

**Conclusions:** The MPC grafting increased the surface lubricity and diminished the wear production, independently of the liner cross-linking or the femoral head material. In addition, we previously reported that MPC-grafted wear particles, even if produced, are biologically inert with respect to phagocytosis by macrophages and subsequent bone resorption. Although cross-linking also suppressed the wear, it did not alter the surface lubricity but produced submicrometer-sized particles which are known to induce more catabolic responses above than larger particles. Taken together, we believe that the MPC grafting surpasses the cross-linking of the liner and the change of the femoral head materials in extending longevity of artificial hip joints. A large-scale clinical trial is now underway.

**VARIABILITY IN DISEASE SEVERITY AT THE TIME OF PRIMARY HIP REPLACEMENT FOR OSTEOARTHRITIS**

P.A. Dieppe¹, A. Judge², S. Williams², K-P. Guenther³, W. Puhil⁴, K. Reinhofer⁴, ¹Nuffield Department of Orthopaedic Surgery, University of Oxford, ²UNITED KINGDOM, ³Department of Social Medicine, University of Bristol, UNITED KINGDOM, ²Universitätsklinikum Carl Gustav Carus, Dresden, GERMANY, ⁴Department of Orthopaedics, Ulm University, GERMANY

**Purpose:** Total hip joint replacement (THR) is a high volume, effective but expensive and irreversible intervention, used to treat people with advanced hip osteoarthritis (OA). In spite of over 40 years of experience with THR, it is still unclear who should be referred for surgery, when in the course of arthritis hip replacement should be carried out, or what the determinants of relatively good or bad patient outcomes are. The ‘EUROHIP consortium’, a multidisciplinary group of health care professionals from 20 centres in 12 European countries, is addressing these questions. As part of its work, the consortium has developed a prospective cohort of patients undergoing THR for primary OA. The purpose of this paper is to describe the variations in disease severity in this cohort, explore the relationships between clinical and radiographic measures of severity, and explore some of the determinants of the variation.

**Methods:** A minimum of 50 consecutive, consenting patients coming to THR in each participating orthopaedic centre within the EUROHIP consortium were entered into the study. Baseline data included demographics, employment and educational attainment (surrogates for socio-economic status), current drug utilisation (a surrogate for comorbidities), involvement of other joints, and handedness. In addition, each subject completed the WOMAC (Likert version 3.1) and the EQ5D (EUROQOL) questionnaires. Data collected at the time of surgery included the prosthesis used and ASA status. We attempted to obtain pre-operative radiographs from all subjects. These were read by the same two readers (PD and SW) using both Kellgren and Lawrence grading and the OARSI atlas.

**Results:** Data from a total of 1327 subjects has been analysed. The mean age of the group was 65.7 years, with a wide variation, and there were more men (53.4%) than women. Most (79%) were ASA status 1 or 2, but there was widespread use of medications, particularly for cardiovascular disease and diabetes. Reported disease duration was relatively short, being 5 years or less in 69.2%. Disease in other joint sites was common. In 1051 of the 1327 subjects (79%) good quality radiographs were available for reading and nearly all showed severe OA: the Kellgren and Lawrence grade was 3 or 4 in 95.8%. However, there was much more variation in severity assessed by the WOMAC, with many people having relatively low scores. The mean total WOMAC score was 59.2 (SD 16.1).