Articular cartilage has limited healing capacity, due in part to poor vascularity and innervation. We originally developed a scaffold-free tissue-engineered construct (TEC) derived from autologous synovial membrane mesenchymal stem cells (MSCs) and demonstrated their safety and efficacy following implantation for cartilage repair at 2 years postoperatively in our earlier study. The present study aimed to further investigate clinical outcomes and MRI findings at 5 years post-implantation. An observational first-in-human study limited to 5 cases was approved by the Ministry of Health, Labor, and Welfare of Japan. Five patients (age 28 - 46 years old) with symptomatic knee chondral lesions (1.5 - 3.0 cm2) on the medial femoral condyle, lateral femoral condyle, or femoral groove were enrolled in this study. Synovial MSCs were isolated from arthroscopic biopsy specimens and cultured to develop a TEC that matched the lesion size. The TECs were then implanted into chondral defects without fixation and assessed up to 5 years postoperatively. The patients were clinically evaluated using a visual analog scale (VAS), Lysholm, Tegner, and Knee injury and Osteoarthritis Outcome Score (KOOS) scores. An MRI evaluation was also performed for morphologic and compositional quality of the repair tissue at 5 years of follow-up. All clinical scores were significantly improved from the preoperative evaluation to the 2- and 5-year follow-ups and the results were stable over time. The MRI evaluation showed cartilage defects filled with newly generated tissues with good tissue integration to adjacent host cartilage over time. The cartilage thickness and surface smoothness of the repair cartilage were maintained out to 5 years postoperatively. The MOCArT 2.0 Knee Scores were maintained high at 5 years, although the total points decreased slightly. The present results highlighted the efficacy and feasibility of this procedure, showing good clinical outcomes and MRI findings with stable results at midterm follow-up. Thus, an autologous scaffold-free TEC derived from synovial MSCs could be used for regenerative cartilage repair via a versatile and simple implantation procedure. On the other hand, further follow-up will be needed to assess the quality change in repair tissue.

Category: Knee - Cartilage

The Safety and Efficiency of the Osteo-Core Plasty Technique for Treating Painful Bone Marrow Lesions in the Knee Joints

Abstract ID#: 21922
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Summary: The Osteo-Core Plasty technique provides efficient and safe treatment for subchondral bone lesions of knee joint at two years follow-up

Data: Background: The subchondral bone is a critical joint element and is considered an integral part of the osteochondral unit. In fact, it provides nutrients to the avascular cartilage, therefore participating in the healing process while also providing firm support and shock absorption to the cartilage. Subchondral bone pathology is seen as a bone marrow lesion (BML) on MRI and is visible in different pathologies, including knee osteoarthritis (OA). BML if not treated, accelerate osteoarthritic changes in the joint. Treatment options for subchondral bone lesions are still limited and no gold standard has been established. Osteo-Core Plasty is a minimally invasive treatment for subchondral pathologies to prevent the progression of OA. It consists of 2 parts: decompensation of bone marrow to decrease intraosseous pressure, and the administration of bone marrow aspirate concentrate to enhance healing potential and bone autograft to provide supportive tissue. Purpose: To report the clinical outcomes and safety of Osteo-Core Plasty for treating symptomatic BMLs in the knee at a 2 years follow-up. Methods: 24 patients (mean age 53 ± 17 years) with symptomatic BML of the knee treated with the Osteo-core Plasty technique were included and followed prospectively for an average of 2.5 years. Patients were recruited from 2017 to 2021. Each patient was evaluated before the surgery and at 2 years using the Knee Injury and Osteoarthritis Outcome Score (KOOS): symptoms, pain, activity of daily living (ADL), sport, and quality of life. Results: All patients showed a significant improvement at final follow-up, compare to the initial state, with KOOS scores all significantly improved: symptoms (p = 0.0065), pain (p = 0.0003), ADL (p = 0.0063), sport (p = 0.0014), and quality of life (p < 0.0001). Median [IQR] KOOS symptoms improved from 48.00 [36.25 - 68.00] to 85.50 [61.75 - 100.0], KOOS pain 51.50 [39.25 - 67.75] to 90.50 [69.25 - 100.0], KOOS ADL from 51.50 [40.00 - 79.50] to 90.00 [62.00 - 100.0], KOOS sport from 27.50 [15.00 - 48.75] to 75.00 [26.25 - 100.0], KOOS quality of life from 30.00 [25.00 - 43.00] to 72.00 [44.00 - 100.0]. No serious adverse event was observed during the study. Conclusions: This study provides evidence of the efficacy and safety of the Osteo-core Plasty technique in treating painful BMLs in the knee joints at a 2 years follow-up.

Category: Knee - Cartilage

Long Term Outcomes and Survivorship Of Autologous Chondrocyte Implantation for Femoral Condyle Articular Cartilage Defects In The Knee

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Summary: The results of this study demonstrates that ACI is a procedure that preserves the native knee with long-term graft survival of 74.4% and maintenance of functional improvements in 51.2% of patients at 20 years following treatment for isolated femoral condyle articular cartilage lesions

Data: INTRODUCTION There has been an accumulation of high-level evidence demonstrating good clinical outcomes for the use of Autologous Chondrocyte Implantation (ACI) in articular cartilage repair in the knee over the short and mid-term. Evidence, however, remains limited. The aim of this study is to report the long-term outcomes and identify predictors of success and failure following ACI for isolated femoral condyle articular cartilage defects in the knee.

METHODS Study participants consisted of a cohort of patients treated with ACI for unipolar isolated defects of the femoral condyle. Patients were identified from the inhouse prospectively maintained ACI database. Each patient underwent a 2-stage procedure to reconstruct a chondral lesion using expanded chondrocytes (Ossell, Oswestry, UK). Kaplan-Meier survival analysis was performed, and clinical outcome was determined using the modified Lysholm score. Mixed multilevel modelling was used to identify predictive factors. RESULTS The study population consisted of 29 males and 12 females with a mean age of 36.6 years (SD 8.95, range 18-52). All patients had a single chondral defect of the distal femur with 30 lesions on the medial femoral condyle (MFC) and 11 on the lateral femoral condyle (LFC). The median defect area was 4.38cm2 (IQR, 2.3-6.0) with the largest defect measuring 15.5cm2. The mean number of cells implanted was 3.01 x 106 cells/cm2. The average follow-up time was 11 years (SD 5.03) with a maximum follow-up of 20 years post-ACI. The mean pre-operative Lysholm score was 42.9 (SD 17.3, 11-74). Improvement in clinical outcome scores were found to peak at year 7 with a mean score of 61.0 (SE 3.31). The biggest increase in Lysholm score was achieved in the first year with a mean increase of 16.7 (SE 4.10, p<0.05). Mean Lysholm scores at 15 and 20 years post-ACI were 59.7 and 57.1 respectively. Functional improvement was maintained in 65.7% (95% CI, 52%-83%) at 10 years and 51.2% (95% CI, 35%-75%) at 20 years. Mixed multilevel modelling identified an inverse relationship between total number of cells implanted and Lysholm score. For every extra 1 million cells implanted, the Lysholm score at 12 months decreased by 3.9 (95% CI, 0.7-7.1). Eight patients (19.5%) were considered to have failed with a conversion to total knee arthroplasty at a mean time of 8.1 years (SD 3.15) following ACI. Survival at 20 years was 74.4% (95% CO, 60%-91%) with maintenance of the native knee for which treatment was initially sought. CONCLUSIONS ACI is a procedure that preserves the native knee with long-term graft survival of 74.4% and maintenance of functional improvements in 51.2% of patients at 20 years. In addition, the total number of cells implanted rather than cell seeding density influenced the clinical outcome of patients in this study, with increasing cell number having a negative effect on clinical outcome.

Category: Knee - Cartilage

Evidence-Based Machine Learning Algorithm to Predict Failure Following Cartilage Preservation Procedures in the Knee

Abstract ID# 22922
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Summary: Our study finds that machine learning algorithms may be used to compare the risk of failure of specific patient-procedure combinations in the treatment of cartilage defects of the knee.

Data: Background: Many treatment options exist for focal cartilage defects of the knee. There is, however, a lack of evidence-based methods to determine the optimal treatment of these injuries. Purpose: To develop machine learning algorithms to predict failure of surgical procedures that address cartilage defects of the knee and detect the most valuable variables associated with failure. Study Design: Case-control, Level of evidence, 3. Methods: A single institution prospectively collected database of cartilage procedures was queried for procedures performed between 2000 and 2018. Failure was defined as revision cartilage surgery and/or knee arthroplasty. One hundred and one preoperative and intraoperative features were evaluated as potential predictors. The dataset was randomly divided into training (70%) and independent testing (30%) sets. Four machine learning algorithms were trained and internally validated. Algorithm performance was assessed using area under curve (AUC) and the Brier score. Local Interpretable Model-agnostic Explanations (LIME) was utilized to assess the optimized algorithm fidelity. Results: A total of 1091 patients who underwent surgical procedures addressing cartilage defects in the knee with a minimum of 2-years of follow-up were included. The most common procedure was chondroplasty (n=560; 51%) followed by osteochondral allograft transplantation (n=306; 28%), microfracture (n=150; 14%), autologous chondrocyte implantation (n=39; 4%), and osteochondral autograft transplantation (n=36; 3%). The mean follow-up was 3.5±2.8 years. The mean age was 40.5±15 years. There were 205 (18.8%) patients who failed at final follow-up. The Random Forest algorithm was found to be the best performing algorithm, with an AUC of 0.765 and a Brier score of 0.135. The most important features for predicting failure following surgical procedures addressing cartilage defects of the knee were symptom duration, age, body mass index (BMI), and lesion grade. LIME analysis provided a patient-specific comparison for the risk of failure of an individual patient being assigned various types of cartilage procedures. Conclusion: Machine learning algorithms were accurate in predicting the risk of failure following cartilage procedures of the knee, with the most important features in descending order being symptom duration, age, BMI, and lesion grade. Integrated human and machine learning decision-making may improve patient selection and bring about the new era of patient-tailored evidence-based clinical care.

Category: Knee - Cartilage

Osteochondral Allograft Transplantation Using Dowell Technique for the Treatment of Steroid-Associated Osteonecrosis of the Femoral Condyles: Arthroplasty-Free Survival at 5 and 10 Years

Abstract ID: 22975

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Summary:
Steroid-associated osteonecrosis of the femoral condyles treated with dowell OATS technique has 88%, 85%, 60% arthroplasty-free survival at 5, 8, 10 years. Data:
Introduction Steroid-associated osteonecrosis of the femoral condyles is a known complication of long-term or high dose steroid exposure. This is not infrequent situation for patients with inflammatory conditions such as Lupus or Ulcerative Colitis and in patients with malignancies such as leukemia requiring bone marrow transplant. Historically, osteonecrosis was a contraindication for osteochondral allograft transplantation (OATS), however, recent evidence has indicated OATS maybe a durable treatment option. While results using the shell OATS technique has been reported in the steroid-associated osteonecrosis population, there is a dearth of information on the long-term survival for the newer dowel OATS technique. The aim of this study was to retrospectively analyze survival of OATS using the dowell technique for the treatment of steroid-associated osteonecrosis of the femoral condyles. Methods: Institutional database was queried to identify eligible patients between 2006 and 2020. Inclusion criteria included diagnosis of aseptic or secondary osteonecrosis of the distal femur, osteochondral allograft transplantation surgical treatment, dowel OATS technique, and history of steroid use for a medical condition. Exclusion criteria included previous cartilage restoration or arthroplasty surgery and incomplete records. No age criteria were used to exclude patients. Patient charts were reviewed for demographic details, information about underlying pathologic condition and steroid exposure, surgical details, and revision OATS or conversion to arthroplasty. Primary outcomes were arthroplasty-free survival and revision-free survival. Results: 27 knees in 25 patients with an average age of 27.6 years (range 16-59 years) were identified with an average follow up of 6.2 years (range 0.7-22 years). Medical conditions included 10 malignancies (5 post-bone marrow transplant) and 13 autoimmune diseases. Distribution of osteonecrosis of the femoral condyles included 1 isolated medial condyle, 5 isolated lateral condyles, 21 medial and lateral condyles. All patients underwent dowel OATS technique. Patients received on average of 2.2 grafts (range 1-5 grafts) with an average combined graft area of 6.67 cm² (range 1.5 to 20.4 cm²). 10 patients had concomitant procedures and 10 patients had supplemental graft fixation. Arthroplasty-free survival was 88%, 85%, 60% at 5, 8, 10 years. Revision OATS or arthroplasty-free survival was 81%, 77%, 55% at 5, 8, 10 years. Graft failures included 1 revision OATS at 7.7 years secondary to cartilage delamination and 4 conversions to total knee arthroplasty at 1.6, 1.9, 8.7, 9.5 years. Conclusions: Osteochondral Allograft Transplantation is an acceptable and durable treatment option in patients with steroid-associated osteonecrosis with 88% arthroplasty-free survival at 5 years and 60% arthroplasty-free survival at 10 years. Future studies should capture patient reported outcomes and investigate factors leading to arthroplasty conversion such as age at time of OATS, etiology of osteonecrosis, extent of osteonecrosis.

Category: Knee - Cartilage

Osteochondritis Dissecans Lesions of the Posterosateral Femoral Condyle: Choosing the Optimal Surgical Approach

Abstract ID: #23216

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Summary:
Depending on location, anterior-based and posterosilateral surgical approaches can both be effective for the treatment of posterosateral OCD lesions, however, both approaches have their advantages and disadvantages. Effective, reproducible surgical approaches for operative management of lateral femoral condyle lesions have not been described. The aim of the study was to characterize reliable surgical exposure techniques for lateral femoral condyle OCD lesions. Methods This was a study of surgical approaches involving fresh whole-body cadaveric specimens (12 knees from 6 cadavers). All knees underwent a series of surgical approaches to evaluate the percentage of the articular surface that could then be adequately visualized. This included assessing the percentage of overall exposure of the lateral femoral condylar articular surface, as well as the percentage of exposure of the posterior region of the lateral femoral condyle articular surface (region encompassed by a line extending along the posterior cortex of the femur and its intersection with the femoral articular cartilage to the posterior articular chondral border of the femur). The following approaches were examined: lateral parapatellar, medial parapatellar with patellar eversion, lateral parapatellar with tubial tubercle osteotomy (TTO), medial parapatellar with TTO, posterosilateral, and a posterior. Buried Kirschner wires were used to fluoroscopically demarcate the extent of exposure of the articular surface permitted by each surgical approach. One-