A NEW MODEL OF OSTEOCHONDRAL TRANSPLANTATION IN THE RABBIT

Nhat M. To1, Amir A. Jamali2, Christopher J. Salgado2
1Department of Orthopaedic Surgery, UC Davis Medical Center, Sacramento, CA; 2Department of Plastic Surgery, Cooper University Hospital, Camden, NJ

nhat.to@ucdmc.ucdavis.edu

Introduction: Treatment of osteochondral lesions with articular cartilage repair modalities is an area of ongoing investigation. Fresh osteochondral allografts (FOCA) are one particularly long-standing and successful treatment option for such lesions (1-4). However, this technique is limited by the short duration of chondrocyte viability as well as diminution of chondrocyte anabolic activity and cartilage mechanical properties during prolonged storage (5). We devised a new animal model of FOCA involving the entire trochlea analogous to large fresh allografts used clinically at our institution (1). We had three goals for this animal model: 1) To reflect the clinical problem and surgical treatment, 2) To allow histological comparisons of various storage options over a large relative surface area, 3) To have a high rate of healing at the host/graft interface, 4) To be durable in an active animal and require no immobilization and 5) To be cost-effective. -p-We hypothesized that the rabbit trochlear allograft model would meet these requirements and would be well-suited for experiments on various storage protocols for osteochondral tissue as well as in the development of tissue-engineered osteochondral constructs in the future.

Materials and Methods: Four New Zealand White (NZW) skeletally immature female rabbits (1.8-2.3kg) and four Dutch Belted (DB) male skeletally mature rabbits (3-5kg) underwent two stage operation with a two week intervening storage period. The animals were given IM injection of ketamine, butorphanol, and xylazine (35/0.02/5 mg/kg) as well as Baytril (5 mg/kg). The left leg was prepared and draped and a medial parapatellar 4 cm arthrotomy was performed. After the patella was retracted laterally, the entire trochlea was resected with a variable 1.5 to 4-mm thickness using a 1cm blade oscillating saw (Stryker, Kalamazoo, MI) and immediately placed in 12 cc tissue culture media (Dulbecco's Modified Eagle Medium/Ham's F12, Invitrogen). The wound was closed in a standard fashion after confirmation of normal patellar tracking. Post-operative pain management with Buprenex 0.025 to 0.05 mg/kg was given. After two weeks, the animals underwent an identical procedure on the contralateral right knee. The stored grafts were implanted into the recipient site of the trochlea of either the same animal (autograft)(n=1) or a different animal (allograft)(n=7) of different strain or same strain. A 22-gauge steel wire passed through 3 to 4 drill holes with a 1.0mm diameter at the corners of the graft recipient site was used as the sole method of fixation. The animals were euthanized at 2, 4, and 6 weeks after the transplant. The distal femora were harvested and the graft-host interface analyzed by μCT. The distal femora were fixed in formalin, and decalcified in 15% EDTA pH 7.4. The grafts were then embedded in paraffin, sectioned to thickness of 6 microns, and prepared on to microscope slides. The tissue slides were then stained with hematoxylin & eosin (H&E), Safranin-O, and scored using a Modified Mankin's cartilage scoring system at 20X in an Olympus BH-2 light microscope (Olympus America Inc., Center Valley, PA).

Results: Comparison of the Modified Mankin Score showed no significant difference in histology between the DB to NZ grafts and the NZ to DB grafts (p = 0.288) (Figure 1). Further comparison between the Modified Mankin Total Scores of grafts harvested at 2, 4, and 6 week interval after transplantation showed no significant difference (Figure 2). Host/graft healing was assessed in two DB and two NZ rabbits at 2 weeks and 4 weeks. At both time periods there was complete healing at the graft site with bridging trabecular seen more commonly at the four-week mark.

Discussion: A number of animal models have been developed for analysis of articular cartilage lesions and the success of various treatment modalities. Many of these involve large animals such as the goat, sheep, dog, or horse and show similar responses to human articular cartilage injury response. The use of large animals in research on cartilage injury and treatments can be cost-prohibitive. Based on our clinical experience with trochlear allografts in humans, we have established a new model of fresh osteochondral allografting in the rabbit trochlea. The advantages of the model are the relative ease of the procedure, the low rate of surgical complications, low rate of infection, low rate of post-operative discomfort, and the relatively large articular cartilage surface area and host-graft bone interface available for analysis.


Acknowledgements: Supported by NCRR UL1 RR024146.

Poster No. 1057 • 54th Annual Meeting of the Orthopaedic Research Society