Zimmer® Collagen Repair Patch for Patella Tendon Donor Site Repair in a Dog Model

Hali Wang, PhD,[3] Mei-Shu Shih, DVM, PhD[2], Steven A. Martinez, DVM, MS,[1] Kelly Hughes[1], Jian Q. Yao, PhD, MBA[3]
[1]From College of Veterinary Medicine, Washington State University, Pullman, CO, [2] MDS Pharma Services, Bothell, WA. and [3] Zimmer Orthobiologics, Inc., Austin, TX.

Statement of Purpose: Donor site morbidity such as anterior knee pain is one of the most common problems after anterior cruciate ligament (ACL) reconstruction with bone-patella tendon-bone (BTB) graft[1]. The causes can be quadriceps weakness, joint instability, bony defect, ruptures of the patellar tendon and patellar fractures. Means of decreasing the incidence of these potential forms of morbidity at the BTB graft harvest site would have significant potential clinical benefits. The *Zimmer* Collagen Repair Patch (a crosslinked acellular porcine dermal patch; APD) has proven to be biocompatible and efficacious as a collagen matrix to be incorporated into host tissues[2]. It holds promise to enhance healing and repair of connective tissues. The primary goal of this study was to evaluate, in a canine model, the fate of the APD patch post-implantation and potential benefits of an APD patch for the repair of BTB donor site. The repaired sites with APD patches were compared with non-repaired defect sites. The evaluation focused on biomechanical strengths and the histological evidence of the integration of APD patches to host tendinous and bony tissues.

Methods: All procedures were approved by the Animal Care and Use Committee at Washington State University. Twelve male purpose-bred mixed breed hound dogs (18-25kg) were used in this study. All dogs were randomized for treatment/control and surgery order. Each dog was operated on the right hindlimb. The common practice of removing the middle one-third of patella tendon[3] was modified to explore the capability of healing of tendon by the APD patch. Therefore, a strip of patella tendon equivalent to 1/3 of the total width was isolated from the lateral side of the patella tendon[4]. A plug of bone was cut from the patella and tibial crest at the insertion of the patella tendon using an oscillating saw and small osteotome. The treatment group then had a piece of APD patch contoured to fit the defect and anchored into place using 2 simple interrupted sutures anchored by drilling bone tunnels (1.1mm diameter) in the patella and tibial crest. The graft was then apposed to the surrounding soft tissues using a continuous 2-0 suture of polypropylene. The control defect made in the tendon was left unsutured. All dogs were humanely euthanized at 24 weeks post-operatively.
Biomechanical testing was performed to evaluate tensile strength in a longitudinal direction using an Instron 4500 model retro-fed to 5500 device (Norwood, MA) at an increment load of 6 mm/min, recording values just past peak strength, leaving specimens intact for histological testing. Specimens were then embedded in paraffin and stained with hematoxylin and eosin. All sections were examined under transmitted and polarized light microscopy for tissue and cell reactions, tendon healing and repair. Statistical analysis was performed using one-way ANOVA with paired analysis for between group comparisons. Significance was reported at $p < 0.05$.

Results: There were no statistically significant significances between treated and control groups undergoing biomechanical testing (load, stiffness, energy, and extension).
In the control, 4 of 6 specimens showed the remaining patella tendon had similar thickness as that of the contralateral tendon while the other two were about two-fold thicker. The dimension of the patella tendon with the implanted patch was on average about twice the size of the control. The growth of tendinous tissues over the implanted patch was easily noticeable. The implanted patch remained relatively unscathed in 4 of 6 implanted patella tendons, which was also identifiable by the holes of suture threads. The four relatively intact patches were embedded in the newly formed tendinous fibers and separated by a thin layer of fibrous connective tissue and small numbers of macrophages. The accumulation of macrophages was not more than that around the absorbable sutures. There was neovascularization in the septa deep toward the center of the patch and re-population of tendinocytes and tendinous fibers (Figure 1) at the periphery of the patch. Meanwhile, the medial side of the pre-existing patella tendon showed relatively normal appearance.

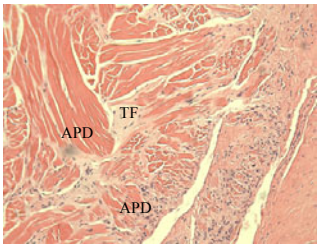

Fig. 1. The invasion of tendinous fibers (TF), light pink, containing tendenocytes can be appreciated in the superficial layer of the patch (APD). H & E, 200X.

Conclusions: No inflammatory reaction to the APD patch was identified. Newly formed tendinous tissues around the APD patch were infiltrating the periphery of the patch, and the blood supplies reached deep toward the center of the patch. The APD patch can be beneficial for tendon repair in general.

References: [1] Kartus J et al. Am J Sports Med. 2000;28:328-335. [2] Nicholson GP et al. J Shoulder Elbow Surg. 2007 Sep/Oct;16: 184S-190S. [3] Jarvinen M et al. Ann Chir Gynaecol. 1991;80:134-140. [4] Park MJ et al. In Orthop, 2001;25:35-39.