Biomechanics and Enzymatic Degradation of Two Acellular Dermal Matrices

Faleris JA, Michaelson JD, Hernandez RMC, Prado R, Moore ST, Cobb R
RTI Biologics, Inc.
jfaleris@rtix.com

Objectives: Acellular dermal matrices are commonly used for surgical repair, which can be of human or xenogenic origin [1]. Various processing methods can be used to remove cellular debris, lipids, and hair from these materials to produce an implantable material. Methods of decellularization may cause alterations to extracellular matrices and may impact the strength and enzymatic degradation of the matrix. RTI Biologics, Inc. manufactured acellular human dermis (AHD) is currently distributed for surgical implantation; RTI Biologics manufactured acellular porcine dermis (APD) was recently developed as a xenogenic dermal graft. Evaluation of *in vitro* matrix characteristics of AHD and APD were performed to compare biomechanics and enzymatic degradation properties.

Methods: AHD samples were decellularized and solvent dehydrated through the Tutoplast® process, terminally sterilized by low dose γ-irradiation, and stored dehydrated at room temperature. APD samples were decellularized without induced cross-linking, terminally sterilized by low dose γ-irradiation, and stored hydrated at room temperature. AHD (n=30) and APD (n=22) tissue samples for mechanical testing were in a dogbone configuration (3:1 gauge area); AHD was hydrated prior to testing. The sample thickness was measured with a Keyence laser micrometer, model LK-G87. Samples were uni-axial tensile tested until failure at 60 mm/min rate with an Instron, model 3366. Actuator displacement and reactive forces were recorded at 0.1 sec intervals. An F-test was used to determine statistically significant differences using Minitab 6.0 Statistical Software. An *in vitro* collagenase and trypsin assay was used to assess susceptibility to proteolysis. Randomly selected samples (n=5) were evaluated with histological staining, including hematoxylin and eosin, verhoeff van-gieson, and alcian blue. Images were captured with a Leica 1000 bright field microscope and a Q-Capture Pro 6.0 camera. The images were used to compare cellular debris and tissue macrostructure of the tissue samples.

Results: Qualitative histological evaluation demonstrated AHD and APD had comparable macrostructure, including an open porous matrix, elastin, and glycosaminoglycans. Cellular debris, residual lipids, and hair follicles were not readily visible in the AHD and APD samples upon histological evaluation (Fig 1).

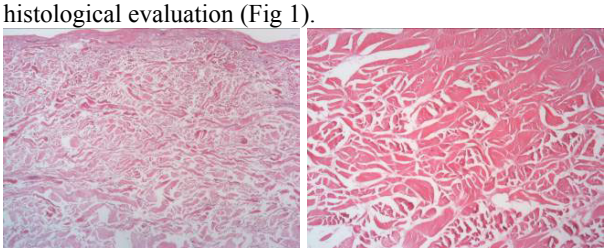

Figure 1: AHD (Left) and APD (Right), H&E, 50X mag.

The normalized load at failure of AHD and APD was 12.9 and 16.6, respectively (Fig. 2). The load at failure results did not show a statistically significant difference between the two processed tissues.

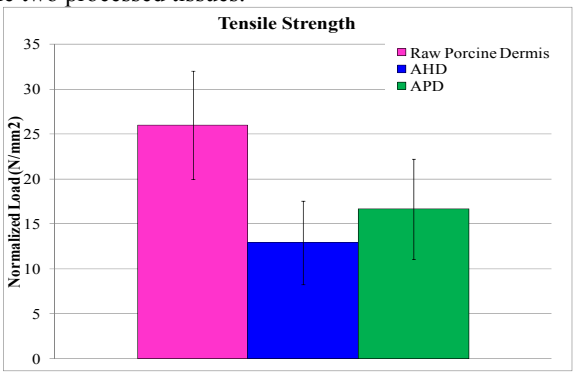

Figure 2: Load at failure normalized to cross-section area.

Results of the enzymatic degradation assay show that APD and raw porcine dermis had similar susceptibility to proteolytic activity (Fig 3). AHD had a slightly higher susceptibility to proteolytic activity, but this did not appear significant. The results of both processed dermal matrices are similar to the raw dermis until the 8 hour degradation; at this point it appears that the processed human dermal matrix had slightly higher degradation than the raw or processed porcine dermal matrices.

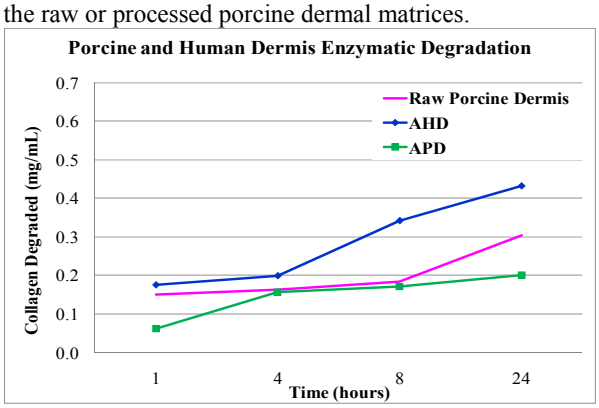

Figure 3: Enzymatic degradation of dermal tissues.

Discussion: The scope of the study performed was limited to evaluation of two processed dermal matrices of different species origin. AHD is currently used in surgical implantation with promising clinical results [2]. AHD and APD did not show significant differences with respect to mechanical properties or enzymatic degradation. AHD and APD also showed similar matrix components, which can have a significant impact on clinical outcome potential. Additional *in vivo* studies will be used to determine the biological response of AHD and the recently developed APD. The similarities between the matrices are promising.

References: 1 (Bellows CF. Expert Rev Med Devices. 2006; 3(5): 657-675)
2 (Losken A. Plast Reconstr Surg. 2009; e-pub ahead)