Temporomandibular Joint Meniscus Reconstruction with an Extracellular Matrix Scaffold

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Introduction
Temporomandibular joint (TMJ) disorders are common and often involve either a spatial dislocation or a structural defect of the enclosed fibrocartilaginous meniscus. Meniscectomy is indicated in cases where the meniscus is irreparably damaged or prohibits smooth movement of the condyle. A number of alloplastic materials and autograft tissues have been used to replace the meniscus following meniscectomy, but results have been less than satisfactory. An ideal graft material for the replacement of the TMJ meniscus would provide a substrate for tissue in-growth, prevent degenerative changes of the condyle and fossa, and be implanted and attached to peripheral tissues without the morbidity of tissue harvest.

Materials and Methods
A device consisting of particulate extracellular matrix (ECM) derived from porcine urinary bladder (urinary bladder matrix; UBM) was encased within sheets of UBM to provide an resorbable “pillow” of interpositional material and an anchoring site while mimicking the shape and size of the canine TMJ meniscus. The device was implanted in canine models of unilateral and bilateral meniscectomy and the remodeling of the devices was assessed at time points of 3 weeks, 1, 2, 3 and 6 months. The unilateral model included meniscectomy and replacement with a UBM device. The bilateral model included meniscectomy and replacement on one side with a UBM device, leaving the contralateral side devoid of a meniscal substitute. Gross morphologic examination, histologic and immunohistochemical evaluation, and mechanical testing were performed.

Results
Gross morphologic examination showed that the UBM test article remodeled over time and was replaced by a structure that closely resembled the native TMJ disc by 6 months post-implantation. No disc formation was observed in the untreated side. There were no obvious pathologic changes in the articulating surfaces of the fossa or the condyle in those joints treated with the UBM device, whereas the untreated contralateral sides showed pathologic changes of the articulating surfaces of the fossa and condyle and ankylosis.

Histologic examination showed that the UBM device was rapidly replaced by predominantly collagen type I, the organization and density of which increased with time. Additionally, growth of native musculotendinous tissue into the device was observed at peripheral attachment sites. Immunohistochemistry showed that the device was initially infiltrated by a large number of mononuclear macrophages. By 3 months post-implantation, mononuclear macrophages were no longer observed, and the device was populated by a small number of spindle shaped cells resembling those found in the native meniscus. Blood vessels were observed within the remodeling device at early time points. The number and size of the vessels decreased with time and resembled those found in the native meniscus by 6 months post-implantation. Compression testing showed that the maximum stress, equilibrium stress and tangent modulus of the UBM device were 2-3 times higher than observed for the native meniscus, while the percent relaxation was found to be similar. The mechanical properties of the implanted ECM device changed during the remodeling process and were more similar to those observed for the native TMJ by 6 months post-implantation.

Discussion and Conclusions
We conclude that the UBM device represents an effective scaffold for the reconstruction of the TMJ meniscus following meniscectomy.

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Disclosures
The authors have nothing to disclose.