SELECTED ABSTRACTS DELIVERED AT THE 9TH ANNUAL AOSPINE NORTH AMERICA FELLOWS FORUM

Consistent with EBSJ's commitment to fostering quality research, we are pleased to feature some of the most highly rated abstracts from the 9th Annual AOSpine North America Fellows Forum in Banff, Canada. Enhancing the quality of evidence in spine care means acknowledging and supporting the efforts of young researchers within our AOSpine North America network. We look forward to seeing more from these promising researchers in the future.

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Tissue-engineered total disc replacement: final outcomes of a murine caudal disc in vivo study

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Study design: Prospective cohort study.

Introduction: The intervertebral discs (IVD) of the spine are complex structures that allow mobility and freedom of movement, while conferring stability in loading situations, in addition to providing mechanical damping and shock-absorbing properties. Degeneration of the IVD occurs throughout life and is an aberrant, cell-mediated response to progressive structural failure which when associated with intractable pain often presents for surgical intervention. Current surgical options include fusion surgery or disc arthroplasty, each with specific risks and complications. Tissue-engineered (TE) strategies for repair, regeneration, or replacement may offer an alternative and potentially allow long-term improvements. Our group has in vitro, technical, and initial results with a TE total disc replacement (TE-TDR) construct.

Objective: To determine the long-term outcomes of the TE-TDR in our murine model.

Methods: The TE-TDR was constructed as previously reported with cultured ovine nucleus pulposus cells seeded in a central hydrogel with annulus fibrosus cells aligning a collagen matrix circumferentially in a complex construct. The caudal spine IVD of anesthetized athymic male rats (Hsd: RH-Foxn1rnu) underwent a microsurgical discectomy, control group I (n = 6) and control group II (n = 7) immediately underwent reimplantation of the autogenous intact IVD, while the interventional group III (n = 23) received the TE-TDR. Eleven animals were humanely killed at 4.5 months; four died and eight survived for 8 months.

Sequential high-resolution magnetic resonance imaging (7T Bruker) scans were performed to assess IVD height, hydration, and morphology. Postmortem microcomputed tomography and histology with staining for proteoglycans (Alcian blue) and collagen (Picosirus red) was undertaken. Additionally, biochemical and mechanical testing was performed on a subgroup at 4.5 months.

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Results: The IVD height with the reimplanted discs and the TE-TDR constructs was maintained at similar adjacent-control levels, there was no significant loss of height from 4.5 to 8 months, while discectomy led to a rapid collapse (**Fig 1**). Histological analysis demonstrated the presence of proteoglycans and collagen throughout the disc construct, there was some loss of distinction between the nucleus pulposus (NP) and annulus fibrosus (AF) components, and some homogeneity in collagen distribution (**Fig 2**). The newly constructed TE-TDR implants do not demonstrate significant levels of proteoglycan or collagen in the nucleus. Integration was demonstrated in the AF region. No bridging bone or bony fusion was demonstrated with microcomputed tomography (CT). Biomechanical testing viscoelastic values were similar to native disc segments at 4.5 months with a dynamic modulus only 30% stiffer. The life expectancy of the animals is the duration of this study.

Conclusions: The tissue engineered total disc replacement in this animal model, demonstrates integration and matrix production, while maintaining IVD height, construct morphology, and biomechanical function. Further studies are needed to evaluate larger and more complex TE-TDR constructs and their suitability for human use.

Fig 1 Intervertebral disc space height. Percentage of adjacent level controls.

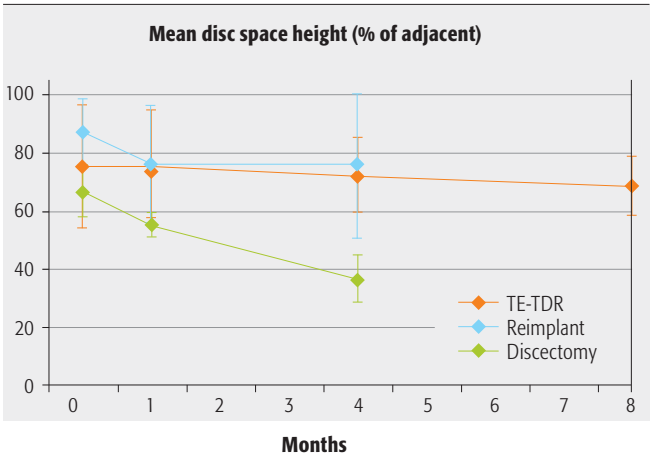

Fig 2 Representative images. **a** MRI (7T FLASH) demonstrating intervertebral disc space height with TE-TDR central. **b** MRI (7T T2) demonstrating morphology with TE-TDR central. **c** Histological sagittal section through TE-TDR (endplates upper and lower) stained with Alcian blue to demonstrate proteoglycan. **d** MicroCT demonstrating absence of bone fusion, normal paired haemal arch bones demonstrated on the left of the image.