

**BIOMEDICAL & VETERINARY SCIENCES
GRADUATE PROGRAM**



ANNOUNCES

The Doctor of Philosophy Seminar
and Examination of

Ibtesam M. Rajpar

**"Tendon Regeneration: Roles of Growth Factors and
Phenotypic Diversity in Vitro Culture"**

Friday January 25, 2019

12:00 PM

VMIA 220

Bio



Ibtesam (Sam) hails from one of the busiest metropolitan cities and the commercial capital of India, Mumbai. She first arrived in the States in August 2010 and shortly thereafter received her Master of Science degree in biotechnology from Georgetown University in May 2011. Following graduation she spent a year at the University of Virginia researching influenza viruses using *S. cerevisiae* as a model system for cloning viral replication proteins. In August 2012, Sam joined Dr. Jennifer Barrett's regenerative medicine lab at the Equine Medical Center in Northern Virginia. Before commencing her PhD journey in the same lab in August 2014, Sam was already involved in collaborative research projects on platelet rich plasma and tendon tissue engineering using equine decellularized tendon scaffolds. For her PhD project, Sam has applied the principles and knowledge of growth factors and tendon differentiation from her pre-PhD research to develop a benchtop assay for the rapid evaluation of stem cells lines for tendon treatments. After her PhD, Sam plans to continue her academic training as a post-doc in regenerative medicine.

Funded by

Interdisciplinary Graduate Education Program in Regenerative
Medicine at VT

Office of Research and Graduate Studies

Lay Language Abstract

Tendons are fibrous, elastic bands of collagen that connect muscles to bones and are essential to movement and proper functioning of the skeletal system. Weight-bearing tendons like the Achilles in humans and superficial digital flexor tendons in horses are particularly prone to damage and degeneration with overuse and/or aging. Bone marrow-derived stem cell treatments have shown promise in the reduction of pain and inflammation, and restoration of native tendon structure and function in cases of severe tendon injuries. However, the roles of stem cells in tendon healing, particularly their ability to transition to cell types native to tendon and integrate with an environment distinct from their own is unknown. 3D culturing of stem cells in isolated and sterile environments has enabled us to identify and understand the biochemical and mechanical signals that trigger stem cell transitions to tendon cells in tendons, but currently available 3D culture systems are complex and inefficient. In this dissertation we have developed a cost-effective and high throughput 3D culture system to assay the potential of stem cells to form tendon cells and composite tendon-like tissues. Toward this, we have also optimized the effects of known tendon proteins on the tendon fate in 3D culture of stem cells.

Like most adult tissues, the tendon encompasses an in-house repository of stem cells. Tendon stem cells are primarily responsible for the inflammatory and reparative responses to injury. Recent evidence suggests that tendon stem cells are diverse in character, and differ from each other in their ability to form cells and tissues of fat, bone and cartilage. In this work, we provide evidence that tendon stem cells are also differently committed to forming tendon tissue, and moreover that significant inter-relationships among gene expression patterns in these cells directly contribute to cultural diversity.

In sum, our results provide novel insight to the roles of stem cells in tendon healing, particularly their response to subtle changes in their biochemical environment, and the contributions of individual cells in a milieu to a holistic reparative response.

Publications

1. **Rajpar I**, Barrett JG. Optimizing growth factor induction in 3D culture of mesenchymal stem cells. Manuscript in review, 'Journal of Tissue Engineering'

2. Youngstrom DW, **Rajpar I**, Kaplan DL and Barrett JG. A bioreactor system for in vitro tendon differentiation and tendon tissue engineering. J Orthop Res. 2015; 33: 911-8.

3. **Rajpar I**, Barrett JG. Heterogeneous differentiation and quantification of lineage-specific markers in tendon stem cells. Manuscript in preparation

4. **Rajpar I**, Barrett JG. Optimization of platelet-rich plasma for equine tendon healing. Manuscript in preparation

Presentations

1. Barrett JG, **Rajpar I**. "Heterogeneous differentiation and quantification of lineage-specific markers in tendon stem cells" Orthopaedic Research Society Annual Meeting, Austin, TX, February 2019

2. **Rajpar I**, Barrett JG. "Optimizing growth factor induction of tenogenesis in mesenchymal stem cells" Gordon Research Conference on Musculoskeletal Biology & Bioengineering, Andover, NH, August 2018

3. **Rajpar I**, Barrett JG. "A three-dimensional tenogenesis assay for the facile evaluation of mesenchymal stem cells" Annual Research Symposium of the VMRCVM, Blacksburg, VA, March 2018, '17, '16

4. **Rajpar I**. "Gene expression analysis of tendon markers in a mechanoactive environment using real-time qPCR" BMVS Graduate Student Seminar Series at the VMRCVM, Blacksburg, VA, April 2017

5. **Rajpar I**, Barrett JG. "Development and optimization of a high-throughput tenogenesis assay for applications in tendon research" Tissue Engineering and Regenerative Medicine International Society Annual Meeting, San Diego, CA, December 2016

6. **Rajpar I**, Barrett JG. "Synergistic growth factor effects on the tenogenic differentiation of mesenchymal stem cells" Gordon Research Conference on Musculoskeletal Biology & Bioengineering, Andover, NH, August 2016

7. Barrett JG, **Rajpar I**. "Platelet rich plasma: Optimization of cellular attributes directly correlated to superior therapeutic efficacy" North American Veterinary Regenerative Medicine Association Annual Meeting, Monterey, CA, June 2015

8. **Rajpar I**, Barrett JG. "Recent developments in platelet rich plasma for orthopaedic applications" Resident Seminar Series at the Marion duPont Scott Equine Medical Center, Leesburg, VA, April 2015

9. Youngstrom DW, Barrett JG, **Rajpar I** and Kaplan DL. "Cultivation of functional tendon graft material in a novel bioreactor" Tissue Engineering and Regenerative Medicine International Society Annual Meeting, Washington, D.C., December 2014

Awards and Academic Achievements

VT Equine Racing Fund Internal Research Grant award, Co-PI, 2017

Graduate Student Assembly travel award, 2016

Tissue Engineering and Regenerative Medicine International Society travel award, 2014

Examination Graduate Committee

Major Advisor:

Jennifer Barrett, PhD, DVM, Diplomate ACVS, Diplomate ACVSMR
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