UNC ORTHOPAEDICS

OrthoRaMS SEMINAR SERIES

Orthopaedic Research and Musculoskeletal Science

Thursday, December 4, 2025 12:00-1:00

Location: *Zoom Only*
Zoom Meeting ID: *988 6670 4852,* ***PW:*** *114616*

Assessing Rotator Cuff Tear Pathology: Insights from Imaging and Mechanics Into Tear Progression and Joint Degeneration

Shoulder pain is the third most common musculoskeletal complaint reported to general practitioners. Degeneration from chronic overuse is thought to be the primary cause of rotator cuff (RC) tears. RC tears occur in roughly 20% of the general population and increase in prevalence with age. Most often beginning as small asymptomatic tears, yet with time, these tears may progress in size, resulting in pain and loss of function. Non-operative treatment is initially indicated for patients with RC tears; however, this fails to relieve symptoms in 25 – 75% of patients and does not address the underlying tear. Due to repetitive damage over time and the tendon's hypo-vascularity, there is limited healing potential. Ultimately, this results in the progression of the tear, as 29% of patients will experience an increase in tear size > 5mm in just one year. Moreover, the progression of RC tears may also cause degenerative effects to the shoulder joint, with changes to muscle and cartilage health. However, there is little knowledge as to why some patients will experience tear progression and loss of function while others may not. Currently, there are no methods to evaluate the tendon's mechanical health, as there is a lack of data describing the relationship between tear severity or intrinsic degeneration and mechanical function. This dissertation aims to identify clinically relevant tear sizes based on biomechanical changes to the supraspinatus tendon and use non-invasive quantitative magnetic resonance imaging (qMRI) to assess tear severity. To identify the mechanical consequences of RC tears and a tear classification system based on biomechanical data, we first use healthy cadaveric supraspinatus tendons subjected to fatigue loading to capture the location of tear initiation and subsequent tear progression. Using tear size and biomechanical properties throughout the tendons' fatigue life, we identify key tear sizes where biomechanical changes occur. Furthermore, in a subset of cadaveric supraspinatus tendons with pre-existing RC tears, we identify the structural and mechanical changes associated with RC tears and highlight the usefulness of qMRI as an additional biomarker that can be used clinically to assess tendon health. Next, we evaluate the degeneration occurring to the humeral head, which shows alterations in composition and mechanical function, to highlight one possible effect of RC tears. Lastly, we show the usefulness of a biomechanically based classification system for RC tear size in assessing the risk of tear progression using clinical data from patients with RC tears.

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BIO

Ara Nazarian is an Associate Professor of Orthopaedic Surgery at Harvard Medical School and Vice Chair for Research Affairs in the Carl J. Shapiro Department of Orthopaedic Surgery, and the Augustus White, MD, III, PhD Chair of Orthopaedic Surgery at Beth Israel Deaconess Medical Center, where he also founded and directs the Musculoskeletal Translational Innovation Initiative. Trained in mechanical (B.Sc., Tennessee Tech) and biomedical engineering (M.Sc., Boston University), he earned a Doctor of Science in Biomedical Engineering from ETH Zürich and a Master of Medical Sciences from Harvard. He completed NIH-funded fellowships in orthopaedic biomechanics at BIDMC and musculoskeletal MRI at the Martinos Center (MGH). Nazarian's laboratory integrates biomechanics, imaging, and computation to improve fracture risk assessment, bone regeneration, and implant–tissue interfaces, with a translational portfolio supported by NIH, DoD, and SBIR partnerships, with over 200 publications. He serves on editorial boards (e.g., BMC Musculoskeletal Disorders; Journal of Biomechanics Consulting Editors) and national committees (Orthopaedic Research Society; BMES). His honors include the Blavatnik Therapeutics Challenge Award (2021), National Academy of Inventors Senior Member (2023), and election as an AIMBE Fellow (2025). A dedicated mentor, he has trained scores of physicians and engineers while advancing clinically driven innovation toward patient impact.