

Thesis Project Portfolio

Diagnostic Accuracy of the Anterior Drawer Test and Internal Rotation Test on Isolated Anterior Talofibular Ligament Injuries using Wearable Inertial Measurement Unit (IMU) Sensors

(Technical Report)

Lack of Standardization of Ankle Instability Measurement and Orthopedic Care

(STS Research Paper)

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Table of Contents

Sociotechnical Synthesis

Diagnostic Accuracy of the Anterior Drawer Test and Internal Rotation Test on Isolated Anterior Talofibular Ligament Injuries using Wearable Inertial Measurement Unit (IMU) Sensors

Lack of Standardization of Ankle Instability Measurement and Orthopedic Care

Prospectus

Sociotechnical Synthesis

Diagnostic accuracy of ankle instability is crucial to patient treatment and clinical outcomes as its evaluation determine and guide clinical decisions. To test ankle instability, a series of standardized mechanical tests, each indicating laxity of specific ligaments, are performed by an orthopedic clinician. These tests are subjectively evaluated by the degree of mechanical laxity detected by clinician discretion and expertise. Little comprehensive research on the diagnostic accuracy of these standardized tests has been completed (Croy et al., 2013; Netterström-Wedin et al., 2021). To address these concerns, I developed an objective and quantitative tool to measure ankle instability utilizing IMU wearable sensors aided with a computational program to evaluate the diagnostic accuracy of three stress tests in a research study. To indirectly estimate the impact of this technology on the standardization of orthopedic care, actor-network theory (ANT) was utilized to map the current orthopedic ecosystem surrounding lack of standardization around ankle instability testing.

Injury to the anterior talofibular ligament (ATFL), which connects the fibula to the talus, accounts for up to 73% of the underestimated two million acute ankle injuries that occur each year (Herzog et al., 2019). By clinical standards, testing of this ligament is performed through the anterior drawer test (ADT) and the talar tilt test (TTT). However, concerns regarding the diagnostic accuracy of these tests have been raised. In order to address these concerns and improve the accuracy and precision of these tests, 1) research must be conducted to discern the diagnostic accuracy of these tests and 2) an objective measurement tool must be established to achieve standardization and quantifiable assessment of instability. Therefore, the objective of the present study is twofold. We propose that utilizing the internal rotation test (IRT), rather than the ADT, will provide earlier and more precise indication of an isolated ATFL injury, and that

drawer is not changed with such an injury. We believe a positive, abnormal ADT results from more extensive ligamentous damage to the ankle, specifically conjunctive trauma to the deltoid ligament, ATFL, and other ligaments such as the CFL, rather than isolated injury to the ATFL. In alignment with our hypothesis, we expect to observe less ankle displacement from the ADT and increased ankle yaw, or inversion, angle change from the IRT in our isolated ATFL patients, and increased ankle displacement from the ADT in our more extensive ligamentous damage group.

Current subjectivity and inconsistency within ankle orthopedic measurement and care has a multifaceted social impact upon health providers, patients, and researchers. This topic is deeply rooted in the lack of standards and inability to measure ankle instability objectively. It is a problem that has been well established in literature and can be observed in medical practice. I investigated actors touched by this topic utilizing Actor-Network Theory (ANT) through sources such as online journal articles and media websites. These research methods led to the unveiling of actor relationships and constructs that further support and strengthen this claim past previous expectations regarding its immediate impact. I conclude that the climate surrounding the lack of standardization within ankle instability measurement and the ability to do so in an objective way self-perpetuates a cycle of hinderance of advancement in this field, equal access to care, adequate staffing to meet demand, and overall better care for the patient.

Working on both projects simultaneously enriched my understanding and passion for this topic while providing an opportunity to actively impact and support the need for more research and innovation in this space. Investigation of the lack of standardization and the mapping utilizing ANT had two important purposes: 1) it highlighted the multi-faceted issues and unforeseen impacts within this topic, emphasizing the need to act and indirectly estimating vast impacts if acted on, and 2) it uncovered an important missing actor, engineers, and future growth

if they are integrated to work collaboratively with ankle orthopedist. The technical project's motivation and purpose greatly benefited from the backing within the research project, and served as an opportunity in which these two actors could start the conversation and innovation within this space.

References

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