ISB 2015

Injury

ISB 2015-1216

HAMSTRING SHEAR MODULUS IS ALTERED PRIOR TO STRAIN INJURY: A CASE STUDY

Matthew Q Salzano[*1], Erica A Bell[1], Jamie E Hibbert[1], Patrick M Rider[1], Zachary J Domire[1]

[1]Kinesiology, East Carolina University, Greenville, United States

Preferred Presentation: Oral Presentation

If your abstract is not accepted as an oral do you wish to be considered for a poster?: Yes

Clinical Biomechanics Award: Yes

David Winter Young Investigator Awards: Yes

David Winter Award - presentation Preference: Oral

Emerging Scientific Award sponsored by Professor J De Luca: No

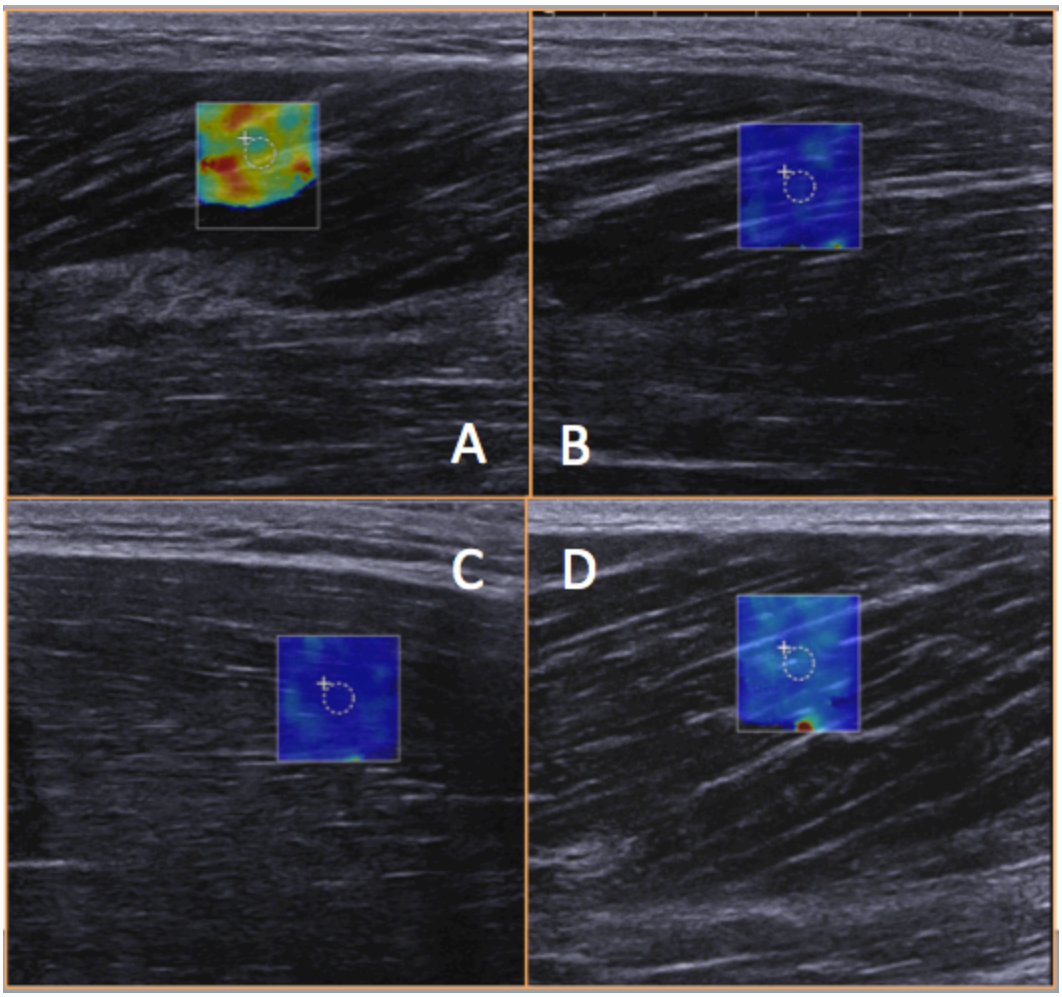
Promising Scientist Award sponsored by Motion Analysis: No

Introduction and Objectives: Hamstring strains are among one of the most common sports-related muscle injuries. They are the most common injury during track and field competitions [1,2]. Over the course of a season, approximately20% ofa teamincurs hamstring injuries [3]. Though these injuries are common, the mechanism of injury is unknown. They often occur under high speed/ force movements, like sprinting [4]. It is also thought that hamstring strains, in regards to sprinting, occur as a result of the eccentric contraction during the terminal swing phase [5]. Though it is likely that it is not the force that causes the hamstring injuries to occur but it is the strain the muscles undergo during these movement that causes the damage [6]. However, the forces and strains in the muscle at the time of injury do not seem sufficient enough to cause injury [7]. It is possible that hamstring strains occur due to the accumulation of microdamage, similar to the mechanism behind stress fractures in bone. The purpose of this study is to prospectively track hamstring shear modulus over the course of a season in elite track athletes to determine if muscle material properties are altered prior to the occurrence of strain injury indicative of accumulated microdamage. We hypothesize that material properties will be locally altered prior to strain injury.

Methods: Ten elite sprinters (5 males, 5 females) are being tracked throughout the 2014-2015 track season. All subjects read and signed an informed consent form approved by University IRB. Previous injury history and leg dominance were recorded for each athlete. At this time, one athlete incurred a grade 1 strain in his right hamstring one-week post scans, allowing for a case study examination. Ultrasound lastography data was taken on 18 sites per athlete: proximal, middle, and distal portions of the biceps femoris long head (BF), semitendinosus (ST), and semimembranosus (SM) in each leg using an Aixplorer SuperSonic Imagine. Shear modulus measurements were taken with a 3 mm diameter region of interest from the middle of the scan area. Three measurements were performed at each site and the means are presented.

Results: Before scans, 3 male and 3 female athletes were found to have no history of hamstring strains. Of the remaining athletes, both females had history in both hamstrings, one male had history in his right and the other had history in his left. One of the non-injured male athletes strained his right SM one-week post-scans (S009). The athlete indicated his strain was close to the middle portion of the muscle, adjacent to the location of the middle SM measurement site. Table 1 shows his SM shear modulus measurements compared to the 3 other non-previously injured SMs. S009's distal portion was comparable to the distal portions of the 3 healthy subjects. The middle portion of S009 was ~2.5-3x higher than the middle portions of the other subjects, while the proximal region was also markedly higher. Figure 1 shows the picture of the Q-box of the mid-belly for the right BF, ST, and SM for S009 and the mid-belly of a healthy SM from a representative athlete (S007). The mid-belly of the injured SM contains more yellow and red than the other sites, indicating increased stiffness.

Figure:



Caption: Figure 1. Elastography comparisons between the mid-bellies of S009's SM (A), BF (B), ST (C), and S007's SM. The spectrum of blue to red designates low modulus to high modulus.

Conclusion: While only one subject is used as comparison, the evidence is strong to support that muscle material properties are altered prior to strain injury. These results also support our hypothesis that material properties are altered locally between and within muscles. Increased modulus seen in the injured subject could be for a number of reasons. One possible explanation is the swelling due to edema [8]. Another possibility is that the injured site was not directly measured, and the increased modulus is a result of increased tension as a result of nearby disruptions in ECM. Further investigation will reveal if this is unique to this athlete or universal. The ability to track hamstring shear modulus over the course of a season to determine strain risk would go far in the prevention of hamstring injuries.

Table:

	S009	S004	S007	S008
Distal	16.0	15.4	13.7	16.2
Middle	51.1	17.4	21.5	17.3
Proximal	36.4	21.2	12.1	12.5

Caption: Table 1. SM shear modulus (in kPa) in the right SM for the injured subject (S009) and 3 healthy subjects

References: [1] Opar et al., *Scand J Med Sci Sports,* 24(4):254-259, 2013.
[2] Edouard et al., *Clin J Sport Med,* 24(5):409-415, 2014.
[3] Ekstrand et al., *Am J Sports Med*, 39(6):1226-1232, 2011
[4] Askling et al., *Am J Sports Med*, 35(2):197-206, 2007
[5] Schache et al., *Gait Posture,* 29(2):332-338, 2009.

[6] Lieber et al., *J Appl Physiol (1985),* 74(2):520-526, 1993.
[7] Noonan et al., *Am J Sports Med,* 22(2):257-261, 1994.
[8] Howell et al., *J Physiol,* 464:183-196, 1993

Disclosure of Interest: None Declared