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Calcaneal tendon shear modulus of professional runners is different from recreational runners?

Maria Clara A. Brandão[1*], Lino de A. Matias[1], Mariana S. Pinto[2], Liliam F. De Oliveira[1,2].

[1] Physical Education Graduation Program, UFRJ, Rio de Janeiro, Brazil.

[2] Biomedical Engineering Program, UFRJ, Rio de Janeiro, Brazil.

mclara.ufrj@gmail.com

Background, Motivation and Objective. The calcaneal tendon (CT) has an important function in the transmission of the strength of the triceps sural muscles, and during running it undergoes overloads and continuous stresses (1). The variation of the mechanical properties of the triceps sural directly affects the efficiency of locomotion and increases the predisposition to new lesions. (2,3). About 25 to 50% of runners are injured, in most cases due to the accumulation of repetitive cycles with small overloads (4). A variety of intrinsic and extrinsic factors have been blamed for the development of these types of lesions (5). The calcaneal tendon has been investigated through imaging methods due to high of the high incidence of injuries motivated, in some cases by repetitive stress and changes in mechanical properties during the training and aging processes(6). The elastographic technique of supersonic shear imaging (SSI) is an imaging technique, which is based on the tissue perturbation at different depths through the emission of high-intensity acoustic forces (push), followed by estimated the propagation velocity of shear wave (c_s) for the calculation of the shear modulus (G): ($G = \rho . c_s^2$) (7). Studies using SSI verified an increase in G of CT of the elderly (8), however, not study was found using the SSI technique to analyse the CT of runners. The aim of the study is to compare shear modulus of professional runners and recreational runners.

Methods. Twelve men for the group of professional runners and nine men for the group recreational runners. The inclusion criteria were practice running as regular physical activity for more than 3 years, the anthropometric characteristics of the participants are presented in Table 1. The study was approved by the Ethics Commite of HUCFF (Nº 127/13 and 570.945). Acquisition of the elastographic image was acquired through Aixplorer V.9 (Supersonic Shearwave Imaging, Aix-en-Provence, France), with linear transducer 4-15MHz. For the acquisition of the two elastographic images in the right limb, the runners was positioned in ventral decubitus on the stretcher, with the feet pending and the ankle relaxed, the transducer was positioned longitudinally in 2 cm from the distal insertion (fig 1). The G analysis was done by means of the custom routine in the MATLAB. Statistical analysis was performed test -T student in the STATISTICA 10 (StatSoft Inc. Tulsa, Ok, USA) and for reliability of the intraclass correlation coefficient (ICC) estimates from SPSS 20 (IBM SPSS Statistcs Visualizador, Armonk, NY, EUA). The level of significance was $\alpha = 0.05$.

Table 1. Anthropometric characteristics of the runners.

	Recreational runners	Professional runners
Age (years)	34.22 ± 13.01	22.25 ± 3.36
Weight (Kg)	79.22 ± 10.59	65.41 ± 4.89
Height (m)	1.76 ± 0.07	1.74 ± 0.08
Training volume (km/week)	30 a 50	100 a 120

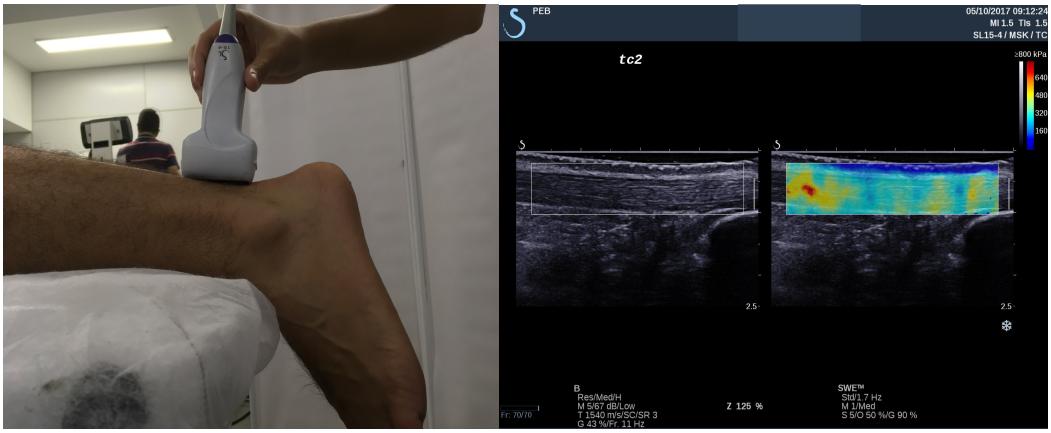

Figure 1. Transducer positioned in calcaneal tendon and elastography image.

Results. The mean G values to CT for the professional runners were 163.65 ± 23.25 kPa and for the recreational runners of 136.53 ± 40.53 kPa. There was no significant difference for the mean values of G between the professional and recreational runners groups (α = 0.06). The ICC was 0.87 and 0.81 for professional and recreational runners, respectively, classified with good correlation (9).

Discussion and Conclusions. Studies using different methodologies have verified that the CT has changes in its mechanical properties after to suffer stimulation (10). Although there is not significant difference between the G of the professional and recreational runners, it is observed that the mean values of the professionals tend to be higher. Data from the literature indicate a tendon hypertrophy after strength training, as there is evidence that remodeling and collagen increase occur in this structure (11). We conclude that although there is not significant difference, G of professional runners tends to be greater than recreational. Future studies with a larger number of runner athletes, with subgroups of specific training, can identify the adaptive differences in the properties of the CT of runners.

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Keywords. Elastography, Shear Modulus, Supersonic Shear Wave, Calcaneal Tendon, Runners.