

ULTRASOUND DOES NOT PROVIDE RELIABLE RESULTS FOR THE MEASUREMENT OF THE PATELLAR TENDON CROSS SECTIONAL AREA

Antonis Ekizos¹, Fyllis Papatzika¹, Georgios Charcharis¹, Sebastian Bohm^{1,2}, Falk Mersmann^{1,2}, Adamantios Arampatzis^{1,2}

¹ Department of Training and Movement Sciences, Humboldt-Universität zu Berlin, Germany;

² Centre of Sport Science and Sport Medicine Berlin – CSSB, Germany

Introduction

Analysis of the patellar tendon cross sectional area (CSA) is essential to examine adaptational effects and for injury prevention in humans. Patellar tendon CSA has been examined in previous studies to identify gender and age related differences in tendon size [Carroll et al. 2008, Westh et al. 2008] or changes after exercise interventions [Kongsgaard et al. 2007]. Ultrasound, as an economically affordable and easily applied device has been often used to measure patellar tendon CSA [Reeves et al. 2003, O'Brien et al. 2010]. Knowledge about the reliability of this method will provide valuable information about its usefulness. Therefore the purpose of the present study was to assess the reliability of the CSA measurement using brightness mode ultrasonography.

Methods

The patellar tendon CSA of fourteen participants was examined on two different days and at three different positions (proximal, medial and distal). Five trials per day were conducted in each position, replacing the ultrasound probe on every trial. The images were examined by three different and equally experienced observers. We compared the mean of the five trials in each position to examine the day, observer and position effect. Further, Bland and Altman plots, root mean square (RMS) differences and intraclass correlation coefficients (ICC) within the five trials of the first and the second day, as well as within the ten trials of both days were calculated.

Results

Significant differences ($p < 0.05$) were present between day one and day two in all three examined positions. Further, we found a significant observer and position effect ($p < 0.05$). The ICCs for all 10 trials (i.e. day one and day two) ranged from 0.249 to 0.847 with an average ICC of 0.592. The RMS differences of the CSA for day one and day 2 ranged in total from $4.5 \pm 3.5 \text{ mm}^2$ up to 16.1

$\pm 11.3 \text{ mm}^2$. The Bland and Altman plots showed that differences after interventions or between groups should be in average below 37 mm^2 or above 55 mm^2 to be important for clinical or intervention studies (figure 1).

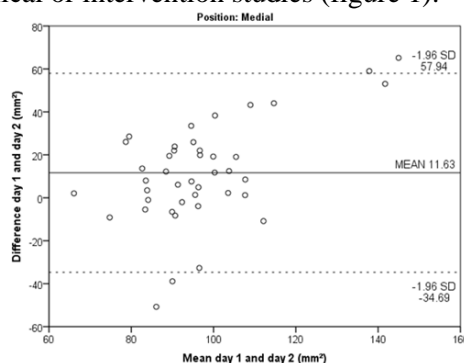


Figure 1: Representative Bland-Altman plot depicting the agreement between the measurements on day one and day two in the medial position of the patellar tendon. The figure includes the values for all three observers.

Discussion

Our findings show low reliability of the method, which is a result of the low resolution and unclear visibility of tissue boundaries in the ultrasound images. This technique is not appropriate to identify adaptational effects or differences between groups. The poor reliability of the method is not position dependent, but it is rather affected by the technical limitations of the ultrasound technique.

References

- Carroll *et al*, J. Appl. Physiol. 105:1907–1915, 2008
- Westh *et al*, Scand. J. Med. Sci. Sports 18:23–30, 2008
- Kongsgaard *et al*, Acta Physiologica 191:111–121, 2007
- Reeves *et al*, J. Physiol.-London 548:971–981, 2003
- O'Brien *et al*, J. Biomech. 43:1190–1195, 2010