

FUNCTIONAL CHARACTERISTIC OF ACHILLES TENDON MOMENT ARM LENGTH MEASURED USING ULTRASONOGRAPHY IN VIVO

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KEY WORDS: moment arm, tendon excursion, foot jump

INTRODUCTION: Moment arm is known as the perpendicular distance from the joint center to the line of pull in the muscle-tendon, and it effects the development of joint moment. Computer simulation study clarified effects of moment arm length on kinetic outputs in ankle joint(Nagano et al.,2003). However, no study have been investigated the sports specific characteristics of moment arm length and its effect of functional performance like jumping or running. The purpose of this study was to compare the moment arm length and jumping height of volleyball players and distance runners.

METHOD: Twenty-nine male students, including 11 male volleyball players (VB), 12 long distance runners (DR) and 6 controls (CON) participated as subjects in this study. Tendon displacement of medial head of gastrocnemius (MG) relative to ankle joint angle was measured using ultrasonography, and defined as a moment arm length (MA) of Achilles' tendon (Ito et al, 2000). Furthermore, they had vertical foot jump, keep extending knee and hip joint, on a force platform. Jumping height was measured from digitizing lateral malleolus. And several kinematic parameters were calculated from ground reaction force.

RESULTS: Figures the joint angle linearly, not slacking. Figure 2 represents mean MA and jumping height of VB, DR and CON. VB jumped higher than LD ($p<0.05$), regardless of no difference in MA. Moreover, although no difference in jumping height, LD had shorter MA than CON ($p<0.05$).

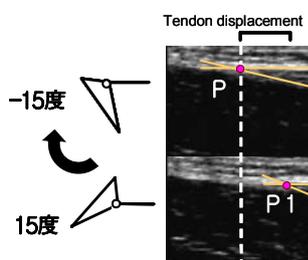


Figure 1: Longitudinal ultrasonographic image of MG during passive planter flexion.

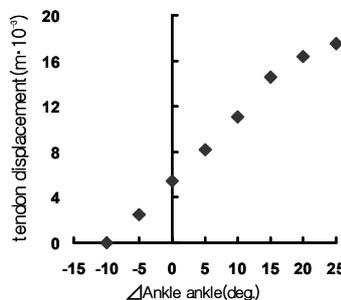


Figure 2: Relationship between ankle angle and tendon displacement

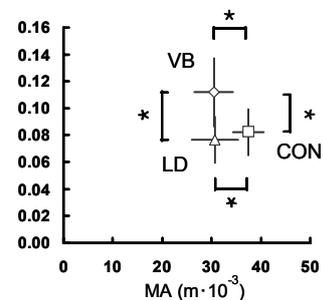


Figure 3: Relationship MA and jump height of each group

DISCUSSION: Although the longer moment arm was reported to be smaller joint moment development, power and work outputs in fast motions using computer simulation (Nagano and Komura, 2003), VB jumped higher than LD in spite of equivalent of MA. MA is thought to change corresponding to muscle force developments. So, it was to be needed measuring MA during force development accompanied with joint motion. At any case, we can analyse the muscular power development, considering moment arm length of muscle tendon complex. VB jumped higher than DR in spite of no difference in MA.

REFERENCES:

- Ito M, Akima H, Fukunaga T. (2000). In vivo moment arm determination using B-mode ultrasonography. *Journal of Biomechanics*. 33, 215-8
- Nagano and Komura (2003) Longer moment arm results in smaller joint moment development, power and work outputs in fast motions. *Journal of Biomechanics*. 36, 1675-81