Changes in muscle resting tension, architecture and spinal reflex after hook treatment in healthy subjects

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1. Introduction

The diacutaneous myo-aponeurosis technique is an instrument-based technique (hook treatment) used on patients suffering from pains of inflammatory or traumatic origin affecting the locomotor system (Ekman 1972). The purpose of this study was to investigate a possible effect of hook treatment of the triceps surae. Mechanical and neural parameters were recorded to try to identify the underlying mechanisms of the muscular relaxation perceived by therapists following the application of this technique (Veszely et al. 2000).

2. Methods

The treatment consisted of 10 min of hook treatment performed on the medial gatrocnemius, the lateral gastrocnemius, the soleus, the peronaeus longus and peronaeus brevis, the Achilles tendon (margo lateralis and margo medialis). The experiments were carried out on the triceps surae of 36 healthy adults and the parameters were also recorded in a control group.

The maximum ankle dorsiflexion was recorded before and after hook treatment. The measurement of the tension produced by the triceps surae and the other tissue components opposing the dorsiflexion of the ankle was obtained by measuring the changes in passive tension at different angles ( - 10°, 0°, +10°, +20°, +30°, +35°, maximum tolerated by the subject) before and after hook treatment (Figure 1). The slope of the passive torque-angle curve from +20° to +35° was used to estimate passive stiffness.
Figure 1. (a) Change in the passive torque (Nm) produced by the plantarflexor muscles as function of the ankle angle before (---) and after (-•-) 10 min of hook treatment. Isolated data correspond to maximum ankle range of motion and the corresponding mean maximum passive tension before (○) and after (•) 10 min of hook treatment. (b) Change in the relation between the fascicle length (mm) and the ankle angle (°) before and after hook treatment.

Two parameters were measured from each MG ultrasound scan: muscle fascicle length and pennation angle. The muscle fascicle was defined as a clearly visible fibre bundle lying between the two aponeuroses (superficial and deep) by using a public domain image program (Scion image). Pennation angle was determined as the angle between the fascicle and its insertion on the deep aponeurosis. The fascicle length (Lf) was measured along a fibre bundle from the superficial to the deep aponeurosis. Before and after hook treatment, the maximum H reflex ($H_{\text{max}}$) and motor responses ($M_{\text{max}}$) were recorded in neutral position (0°). Ten responses, elicited at 5 s interval, were averaged. The tendon reflex (T reflex) was recorded before and after hook treatment and two sets of 10 responses were averaged. The $H_{\text{max}}/M_{\text{max}}$ and $T_{\text{max}}/M_{\text{max}}$ ratios were computed.

3. Results and discussion

Ten minutes of treatment significantly improved the range of motion of the ankle joint by $8.2 \pm 5.1\%$ ($P < 0.01$). The results indicate a reduction in passive tension at $+35^\circ$
dorsiflexion of 8.6 ± 13.0% \((P < 0.01; \text{Figure 1})\) and a decrease in the index of stiffness by 9.6 ± 9.4% \((P < 0.05)\). In addition to these results, MG fascicle length increased from 75.0 ± 7.6 to 78.9 ± 9.4 mm \((P < 0.05; \text{Figure 1})\) and pennation angle decreased from 16.9 ± 2.1 to 15.8 ± 1.4° \((P < 0.05)\) at 35° dorsiflexion after hook treatment. Although the amplitude of the Hoffman (H) reflex was not statistically modified after hook treatment, the tendon (T) reflex was found to be significantly reduced by 27.2 ± 2.8% \((P < 0.001)\) immediately after the treatment. No significant differences occurred in the control group.

4. Conclusions

This technique is effective in reducing resting tension of the triceps surae in healthy subjects. The different behaviours of the reflex response (H and T) and the increase in the muscle-tendon unit compliance may have been due to an alteration of the spindle sensitivity (neural adaptation) brought about by the diacutaneous myo-aponeurosis technique and/or a change in the compliance of the tendinous structure (Guissard and Duchateau 2004) that transmits the tendon tap (mechanical adaptation).

References


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Figure 1. (a) Change in the passive torque (Nm) produced by the plantarflexor muscles as function of the ankle angle before (- - - - - -) and after (-•-) 10 min of hook treatment. Isolated data correspond to maximum ankle range of motion and the corresponding mean maximum passive tension before (○) and after (•) 10 min of hook treatment. (b) Change in the relation between the fascicle length (mm) and the ankle angle (°) before and after hook treatment.