

A Kinesiology Study On Muscle Fatigue When Using Laparoscopic Energy Devices

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Background : Physical characteristics are different for each laparoscopic energy equipment, and the force required for use and the muscle (upper limb muscle) fatigue generated are different, which is thought to affect the accuracy of surgery. The aim of this study is to measure the force required to use laparoscopic energy devices and compare the change of accuracy and EMG profile after muscle fatigue. A detailed analysis comparing the type of energy device and between men and women was investigated.

Methods : Four different laparoscopic energy devices were tested on 20 surgeons, currently performing laparoscopic surgery. The experiment was set up in a kinematic laboratory and measured the EMG profile (10 individual muscles in the arm) and accuracy when using the devices with a motion capture system. A detailed analysis comparing the type of energy device and between men and women was investigated. Furthermore, a questionnaire of the subjective aspects of ergonomics in each devices was performed.

Results : As a result of the questionnaire study, there was a significant difference in the force required for each instrument clamp and the instrument handle on the measure of comfort when operating the button. ($p=0.01$) As fatigue occurred, it was confirmed that the user's accuracy was lower in instruments with larger handles and more force required to clamp, which showed a more pronounced difference in female subjects with smaller hands. In addition, among several instruments, those with smaller handles and less force to use showed less complaining of subjective discomfort even after fatigue occurred.

Conclusions : We identified that when fatigue occurs, there is objective functional impairment and subjective complaints in the use of different laparoscopic energy devices. Instruments that accept improvements in ergonomic aspects considering variables such as basic grip power and hand size should come out, and surgeons should also participate in the experiment and actively intervene.

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