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Ergonomic Assessment In Use Of Laparoscopic Energy Devices Under Muscle Fatigue

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Background : Physical characteristics are different among laparoscopic energy devices, and the force demand and the generated muscle fatigue are different. The aim of this study is to measure the characteristics in use of laparoscopic energy devices and to compare the change of accuracy and EMG profile after muscle fatigue.

Methods : Questionnaire for actual use of the devices was done to show the subjective feedback of the users. In the kinesiology experiment, four different devices were tested on 20 surgeons. EMG profile and accuracy (using motion capture system). A detailed analysis comparing the type of energy device and after condition of fatigue was investigated.

Results : Significant differences in scores of weight, grip strength, handle size and comfort, finger demand force and location of the trigger was noted. In the kinematic experiment, when fatigue occurred there was impairment in accuracy and precision profile especially in D3 and D4. Significant decrease in the median frequency (MDF) of flexor digitorum superficialis was measured in D2,3,4 but not in D1 ($p < 0.001$). In comparison of iEMG level, D1 was lower than the other devices ($p < 0.001$). In correlation analysis between MDF and accuracy and precision, D3 revealed coefficient as -0.58 (precision), and D4 as -0.53 (accuracy).

Conclusions : When muscle fatigue occurs, there seems to be some impairments in the kinematics (device tip error) and EMG profile in a few devices. The subjective feedback may improve the ergonomic aspects considering variables such as basic grip power and hand size. Studies of ergonomics led by surgeons would create a better device and surgical environment.

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