

Ergonomics Today

Background, Purpose and Hypothesis

In recent years, our work environment has been confronted by a new problem related to the unnecessary static work and the forces acting on the body. Ergonomics, the science that deals with all these problems, studies human capabilities in relationship to work demands.

To date, there is little information on how much the ergonomic equipment helps reduce repetitive motion injuries.

Using three scenarios, the goal of the trial is to minimise the muscle contraction and to quantify the amount of impact each variable has on the muscle contraction, which ultimately will reduce the repetitive motion injuries.

Procedure

Variables

- Desk height Low /high
- Tool design: keyboard normal/ ergonomic
- Tool aids: with wrist support / without
- Temperature (15C) low/high (25C)
- Job design /rotation computer/ X-Box (gaming system)
- Vibration with/ without

Materials

- Muscle activity gauge (Myo III)
- electrodes
- ergo-keyboard, normal keyboard
- wrist support pad
- thermometer
- sample typing test
- computer
- Xbox, Xbox Controller
- Subjects

Method: The Design of Experiment (DOE)/ Regression

The first study involved one subject working at a computer; several variables that interact with each other were used to see which reduced the muscle contraction the most.

This experiment used the Design of Experiments, a factorial approach in which several

variables (factors) are studied simultaneously in a balanced manner (table1). The experiment based on a **CONTRAST MATRIX**, which provides the most efficient combination of variables with the minimum trials. Using this method, it was determined that 16 trials were needed. (Table 2) To interpret the results two methods were used the **Design of Experiments** and **Regression**. Design of Experiments and Regression are two forms of statistical modelling that try to evaluate the relationship between the dependent variable: voltage and other independent variables: keyboard, wrist support, temperature and desk height.

Three measurements: max, min and average voltage readings were obtained while using MYO III device. Each trial was repeated 5 times and an average of the results were calculated to minimise the errors during the trials.

The second study compared the muscle contraction while working on a computer versus playing on a gaming system. In this study, the experiment was broken into time increments spent with the equipment. First the subject spent an hour on the computer typing and then spent an hour on the gaming system. A **rotation** was applied to see the gradual onset of muscle contraction. Therefore, the subjects spent 30 minutes on the computer, 30 minutes on the gaming system, then another 30 minutes on the computer and finally the last 30 minutes on the gaming system. The experiment was repeated 3 times, and the results averaged. I did this study with ten different subjects each in the same controlled environment.

In my third study, the experiment was to compare muscle contraction while playing on the X-box. *One trial used the controller with vibrations and the second trial used the controller without vibrations. The Myo III was used to measure the maximum, minimum and average voltage, three times per trial. This experiment was done with ten subjects.*

Results

In the first study, both methods (Regression and Contrast Matrix) used to analyze the data indicated that the temperature had the biggest effect when typing on the computer. The colder the room, the higher the muscle contraction was. The second largest factor was the keyboard. An ergonomic keyboard would cause less strain and lower muscle contractions when used compared to a normal keyboard. The desk height had very small effect. (Table 3) The wrist support had no effect on muscle contraction, even when interacting with other variables it had minimal effect. Between interactions only two variables had a significant effect on the subject, the highest was the interaction of the temperature and keyboard. The other that stood out, was the interaction between the desk height and keyboard.

In the second study, the results indicated that breaking up the time spent at the computer and x-box minimized the muscle contractions. By spending 30 minutes on the computer, 30 minutes on the gaming system, then another 30 minutes on the computer and finally the last 30 minutes on the gaming system the muscle contractions and voltage readings were reduced by 27%. All subjects' results had a reduction of between 25 to 29%.

Finally in the third study, the voltage readings proved that it is more ergonomically healthy to not use the vibration on the x-box controller. Using it can increase muscle contraction by 50%. For all subjects, the vibrations increased muscle contraction in a range of 50 and 59%.

Conclusions

For the user to be ergonomically healthy and most efficient the temperature should be around 21 to 23°C. Any lower temperature could result in higher muscle

contractions which make the user more vulnerable to injuries and any higher temperatures would decrease work efficiency. The interaction between low desk height and keyboard type had no significant impact on muscle contraction, but the low desk with ergonomic keyboard causes less strain on muscle activity. One hypothesis was that the wrist pad would have an effect; but the results shown that the wrist support pad had no impact mainly because during typing the correct position of the hand is straight in the air. The main function of the pad is to support the hand during resting periods of the typing process. By breaking up the time spent at the computer and x-box the user could reduce the affect each activity has on muscle contraction. This can be generalized by planning how much time to spend at the two activities. By doing this and taking breaks, to stretch and let the muscle rest, before starting a new activity, a user can be most ergonomically healthy. Finally, the third study's results proved that vibration is a major factor in affecting muscle contractions. Whatever the user may be doing that involves even a small vibration can be harmful in the long run.

Attachments

Diagram 1

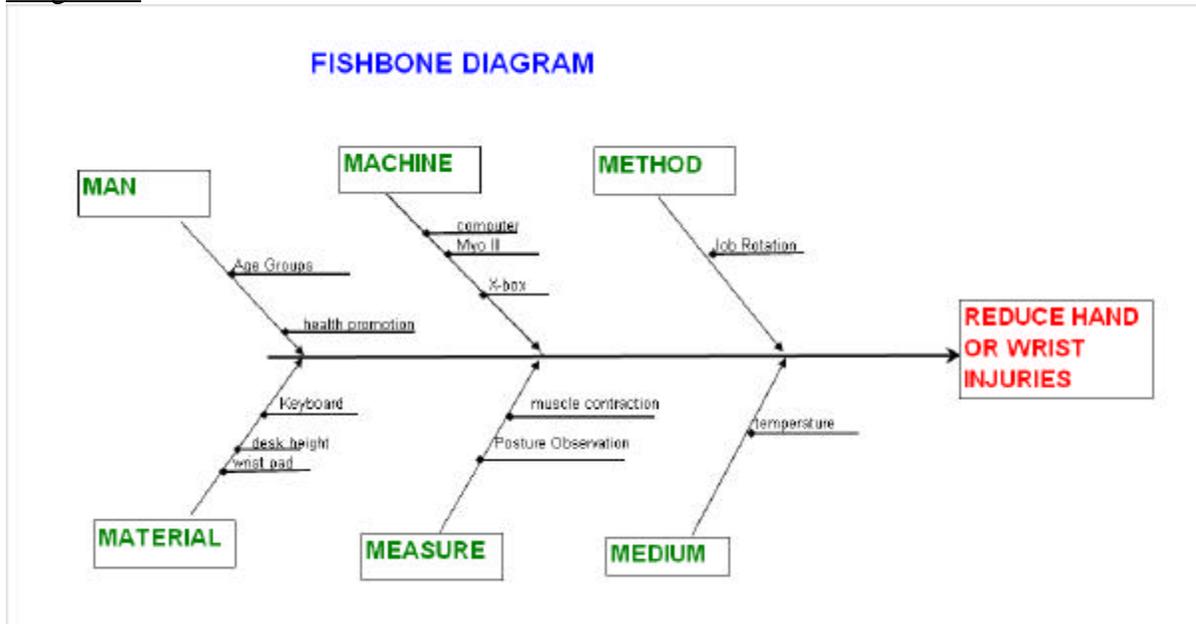


Table 1

#	Variables	Symbol	Constructive Solution	
1	Wrist support pad	W	With	Without
2	Desk height	D	High	Low
3	Keyboard	K	Ergonomic	Normal
4	Temperature	T	High	Low

Sign(+)

Sign (-)

Table 2

Trial #	Wrist support pad	Desk height	Keyboard	Temperature
1	With (+)	High (+)	Ergonomic(+)	High (+)
2	Without (-)	High (+)	Ergonomic(+)	High (+)
3	With (+)	Low (-)	Ergonomic(+)	High (+)
4	Without (-)	Low (-)	Ergonomic(+)	High (+)
5	With (+)	High (+)	Normal (-)	High (+)
6	Without (-)	High (+)	Normal (-)	High (+)
7	With (+)	Low (-)	Normal (-)	High (+)
8	Without (-)	Low (-)	Normal (-)	High (+)
9	With (+)	High (+)	Ergonomic(+)	Low (-)
10	Without (-)	High (+)	Ergonomic(+)	Low (-)
11	With (+)	Low (-)	Ergonomic(+)	Low (-)
12	Without (-)	Low (-)	Ergonomic(+)	Low (-)
13	With (+)	High (+)	Normal (-)	Low (-)
14	Without (-)	High (+)	Normal (-)	Low (-)
15	With (+)	Low (-)	Normal (-)	Low (-)
16	Without (-)	Low (-)	Normal (-)	Low (-)

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