

Analysis of Stylus Grips for Touchscreen Tablet Computer

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Abstract

The design of handwriting instruments has been based primarily on touch, feel, aesthetics and muscle exertion. Previous studies make it clear that different pen characteristics have to be considered along with hand–instrument interaction in the design of writing instruments. This should include pens designed for touch screens and computer based writing surfaces. Hence, this study focuses primarily on evaluating grip style's impact on user comfort and muscle activity associated with hand grip while using a stylus-pen. Surface EMG measures were taken approximate to the first dorsal interosseous, extensor digitorum, and flexor carpi radialis of 3 subjects while they performed writing, drawing, and point-and-click tasks on a tablet using a standard stylus and three grip options. Subjects were also timed and surveyed on comfort level for each trial. The preliminary subjective measures indicate that the use of grips is perceived as more comfortable than standard stylus use alone. We hypothesize that EMG results that are being analyzed, will correlate with user comfort and muscle activity will transfer from increased fine muscle activity to increased gross muscle activity with grip use. Results of the study should be applicable in improving the stylus grip design of tablet computers.

Background

While the application of mobile devices in the workplace have a similar look and feel to the consumer devices already used this population, they need to be engineered differently to meet the growing demands of a work environment. Mobile devices are ideal for the mobile worker (e.g. healthcare professionals, field service engineers, educators, etc.). The variety of the use of these tools call for a combination of the intuitive handling of fingers and the accuracy of a writing instrument on the screen (Panasonic, 2013). Callewaert (1963) described a grip where the writing instrument is held between the index and middle fingers with the wrist more canted. He claimed that such a grip was superior as the muscles would be more relaxed.

Objective

This study focuses primarily on evaluating grip style's impact on user comfort and muscle activity while using a stylus-pen. For a fair observation of muscle activity in this study we observed user activity of the interosseus of the 1st metatarsal, extensor digitorum, and flexor carpi radialis while writing, drawing, and point-and-clicking on a screen and surveyed user opinions of the tasks after operation on a screen. The tasks were observed using a combination of three kinds of pen grips with a standard stylus. This study will evaluate if the use of either of these grips would be perceived as comfort or produce lower muscle activity in comparison to the use of the standard stylus without a grip.

Procedure

Phase One

- The participants completed nine randomized task trials with the stylus with no grip, stetro grip, and claw grip while their task completion times were recorded
- Participants were surveyed on perceived comfort after each trial

Phase Two

- Bilateral electrodes applied to first dorsal interosseus, extensor digitorum, and flexor carpi radialis for Surface Electromyography
- Twelve randomized task trials performed with the stylus with no grip, stetro grip, claw grip, and crossover grip, while their task completion times were recorded
- Participants were surveyed after each trial
- The collected raw EMG data was zeroed, rectified, and a section was selected for analysis

Subjects:

Phase One

Six right-handed university students (5 female, 1 male, aged 25.3 ± 1.6 years) were timed and surveyed on performance of three tasks with a stylus and two grips on a touch screen tablet

Phase Two

Three female right-handed university students (aged 26.3 ± 2.89 years) were timed and surveyed while Surface Electromyography measures were taken of 3 muscles during series of three tasks with a stylus and three grips on a touch screen tablet.

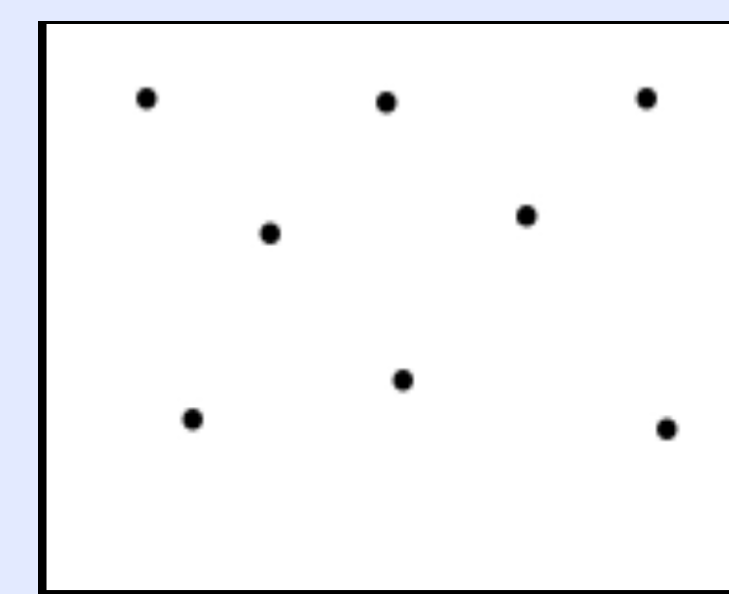
Tasks:

Writing

Wrote out the sentence "*the quick brown fox jumped over the lazy dog*" with three words per line

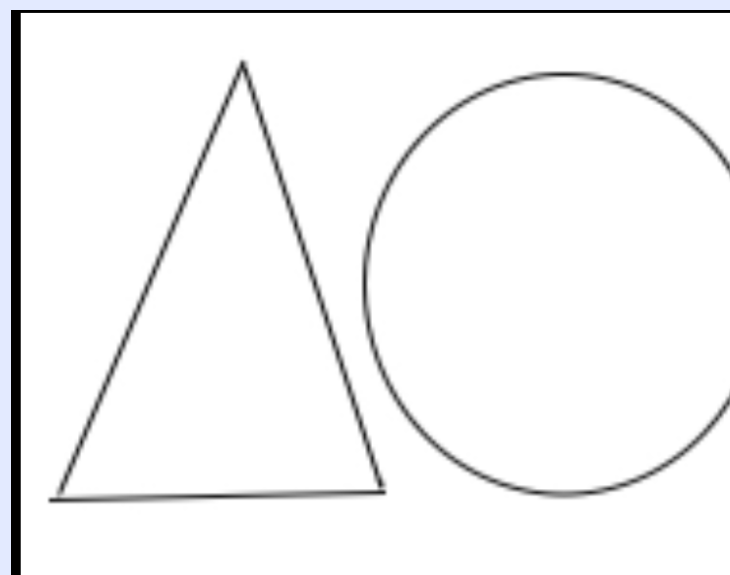
Point & Click

Clicked a series of dots in a set order on the screen



Drawing

Traced an image of a triangle and circle on the screen, with set starting and ending points



Writing Instruments:

Stetro Grip – has surface indentations which help form the tripod grip; 0.3oz in weight, 3.2 x 2.9 x 0.9in (The Write Dudes)



Crossover Grip – tripod pencil grip with an additional flap on the top to prevent fingers from crossing over; 1.8 oz, 4 x 6 in (The Pencil Grip)



Claw Grip – made of three small, flexible "finger cups" which ensure fingers remain in tripod grip; 0.8oz, 1.5 x 0.9 x 1.5in (Classic)



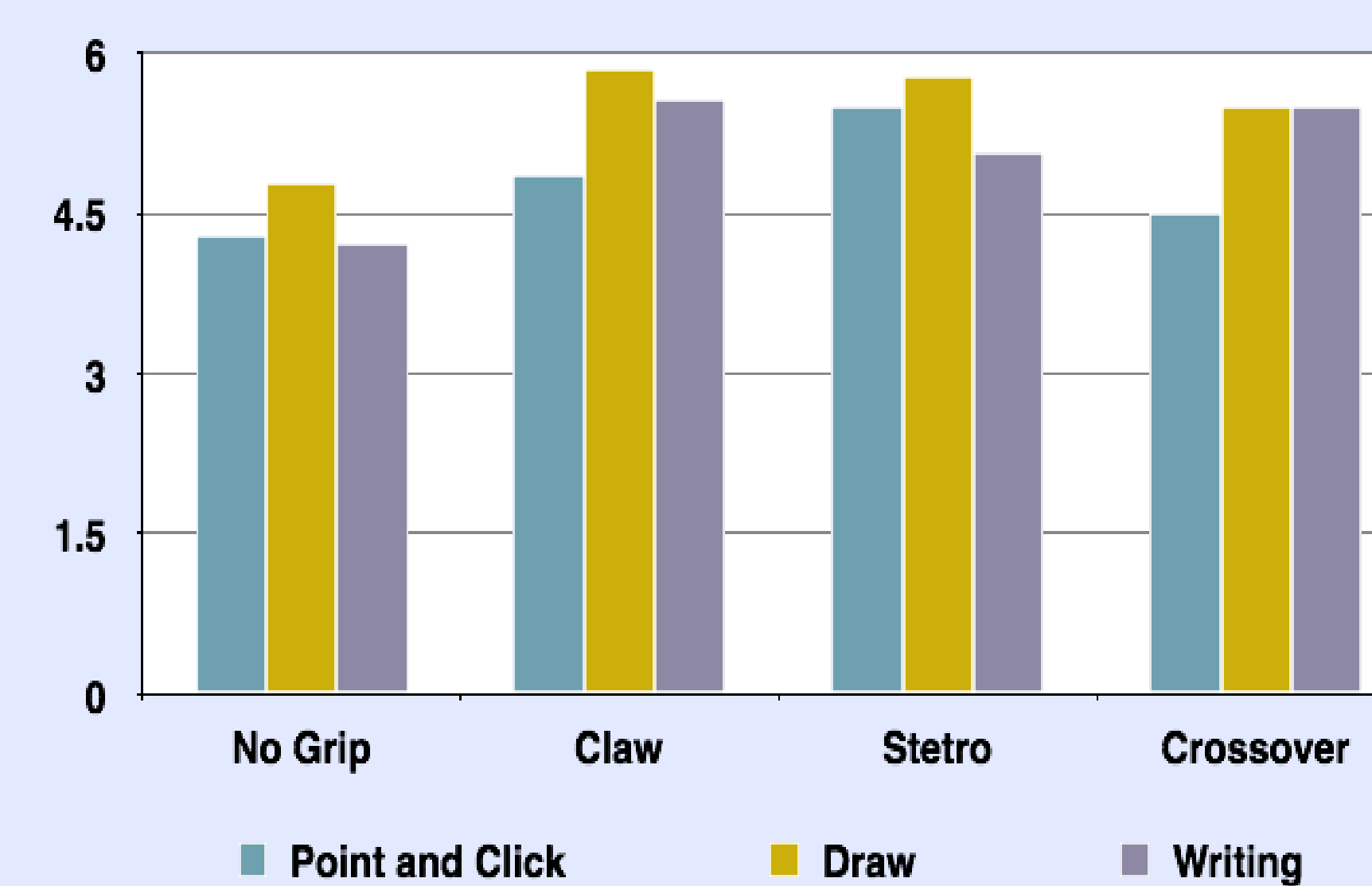
Samsung Galaxy Note S Pen Stylus – 2.6 x 5.7 x 0.6in



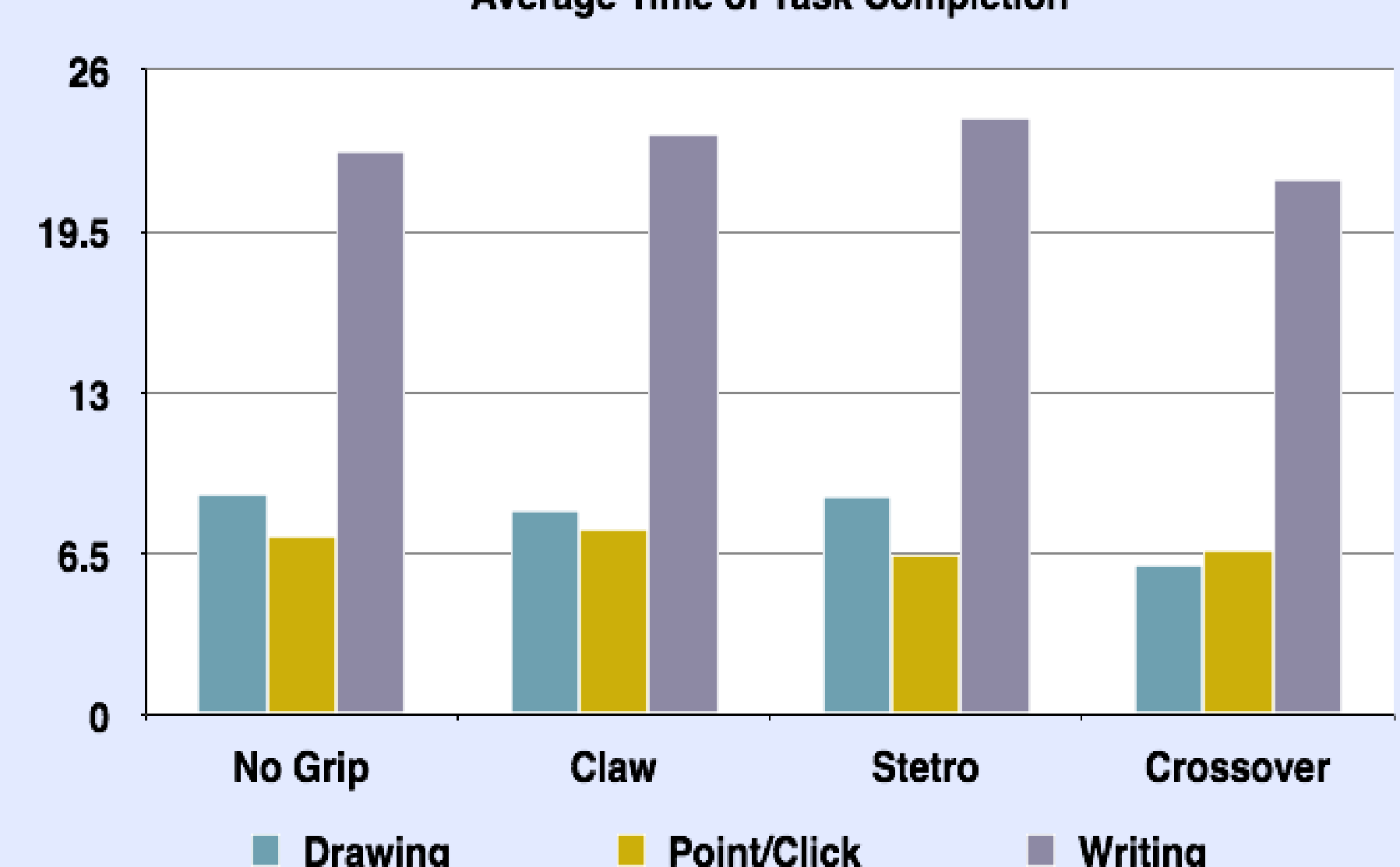
Methods

Results

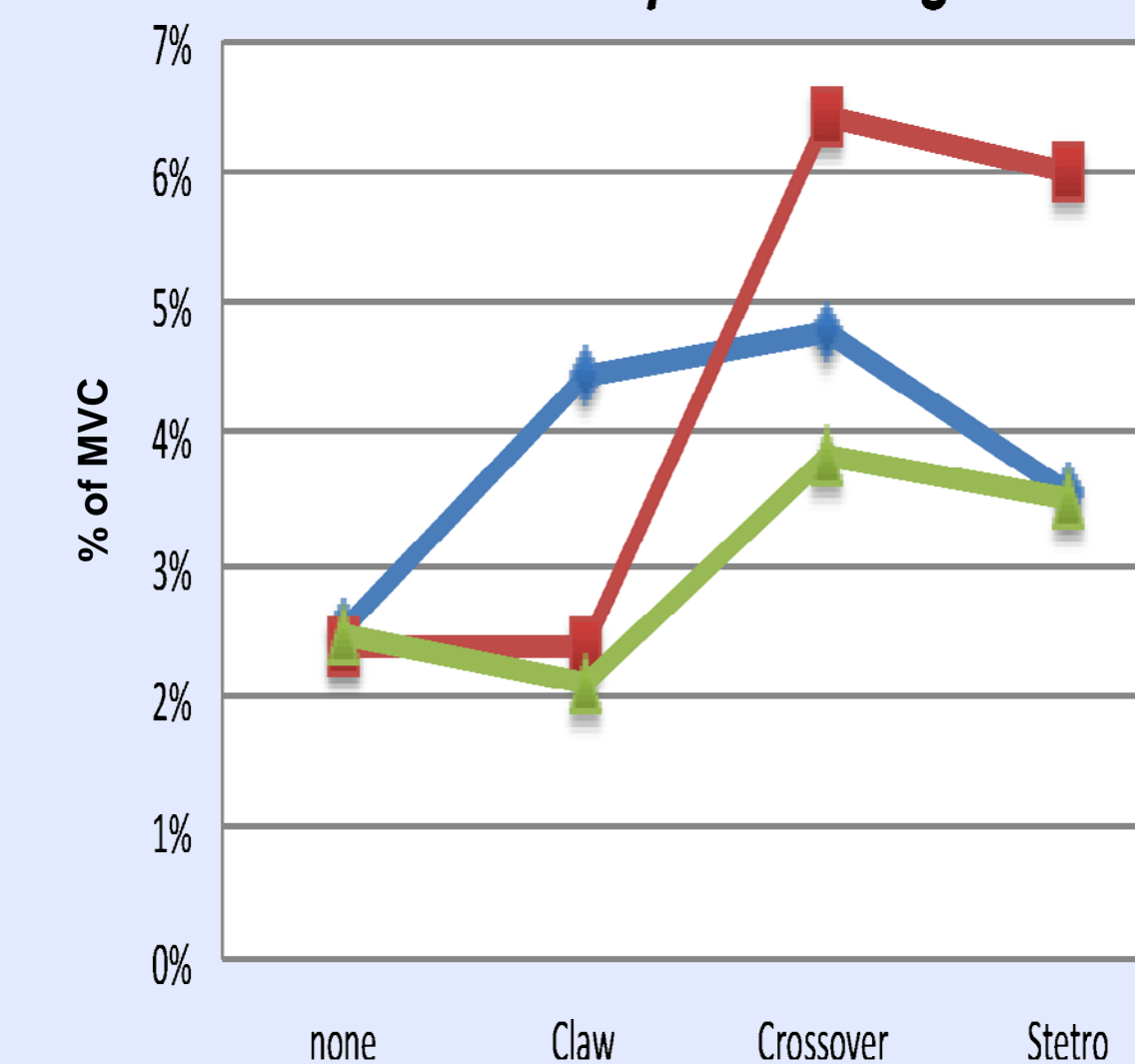
Perceived Comfort Level



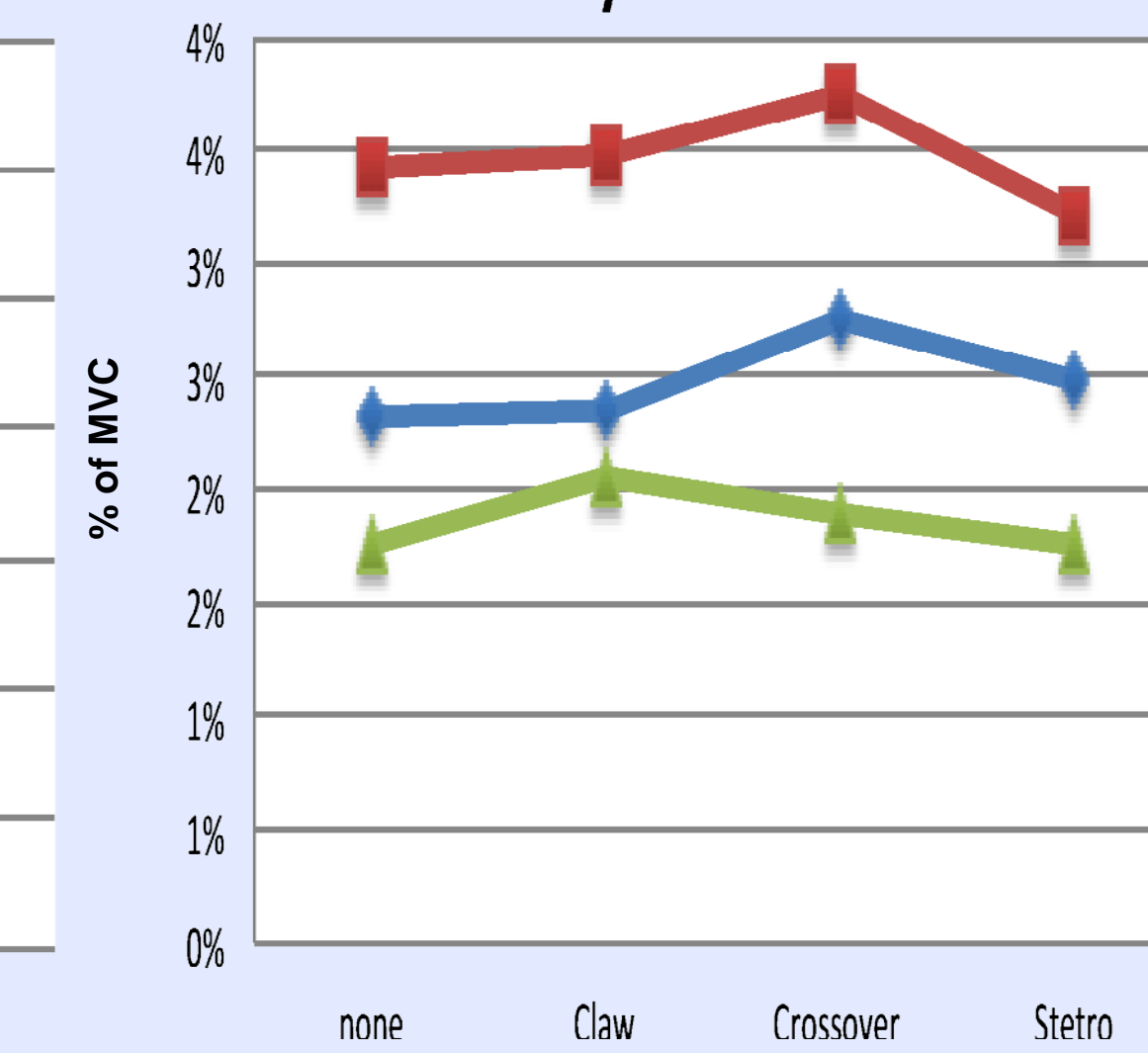
Average Time of Task Completion



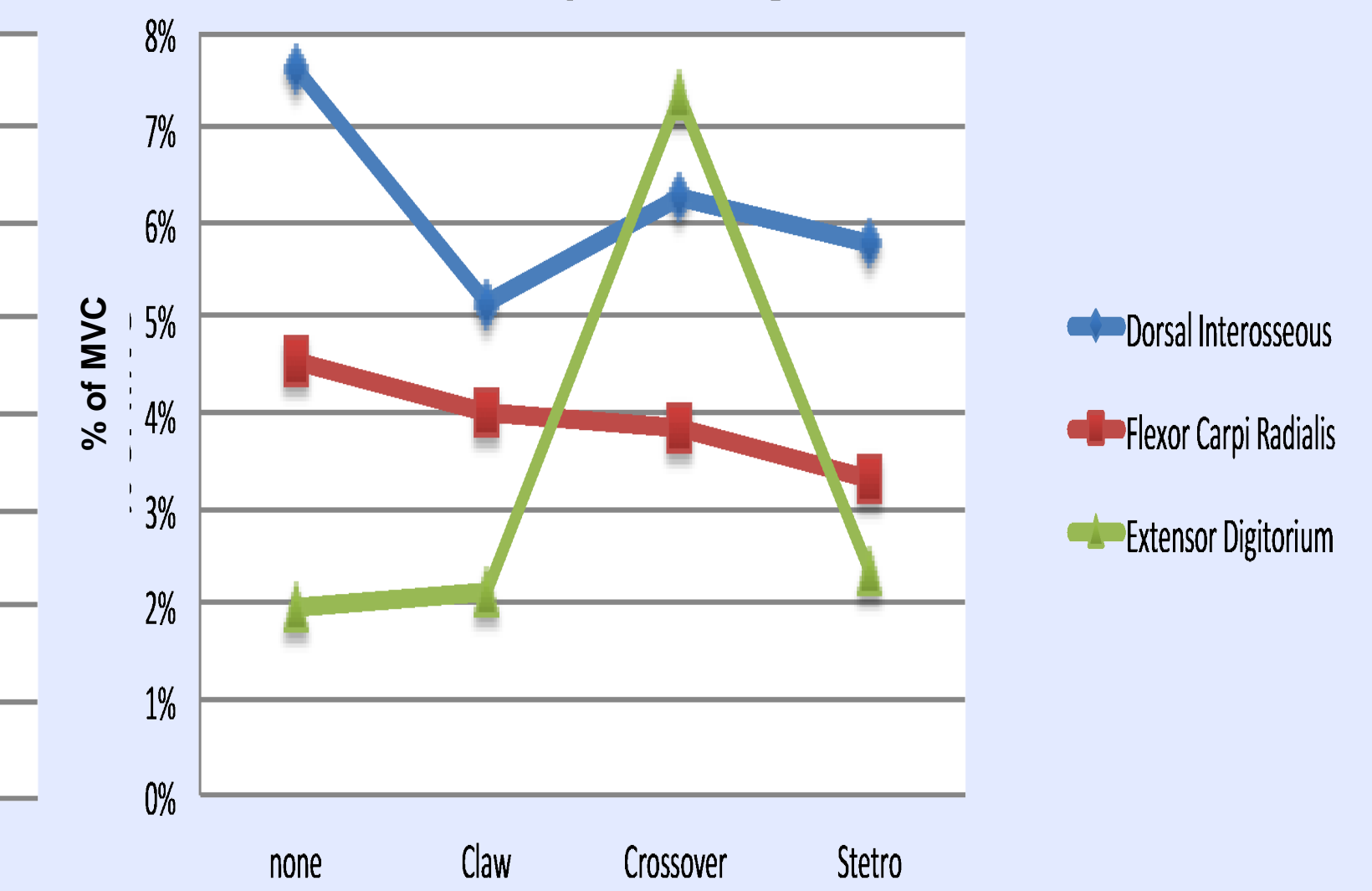
Muscle Activity of Drawing Task



Muscle Activity of Point-and-Click Task



Muscle Activity of Writing Task



Results of this study indicate that participants felt a grip was more comfortable than the stylus alone. In regards to comfort, the stetro gave the best overall results (CL=5.45) with all of the grip options considered more comfortable overall in comparison to the use of a stylus alone (CL=4.43).

The grip that produced the best results in regard to timing was the crossover grip and it took less time compared to the stylus alone. For the other grips, the task completion time was at the most one second longer than the use of a stylus alone. Therefore it could be predicted that the use of any of these grip options would not negatively impact productivity.

The claw grip was the only grip to produce lower muscle activity than the stylus alone for all tasks. The grips unanimously felt more comfortable than the stylus alone to all users. The mean EMG values had a negligible difference, which indicates that other factors may be involved in user comfort.

References

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