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Preface

This book is an edited collection of 107 papers and 39 abstracts submitted to the 6th Pan – Pacific Conference on Occupational Ergonomics. During the conference scientists from more than 30 countries come together and share their experience. It will make useful contribution to promote health and safety of workers.

Ergonomics is the science to enhance safety, health and well being of employees, as well as effectiveness, and productivity. The contents of this book represent a wide variety of the generic areas of ergonomics. In terms of coverage the book's major divisions include cognitive and psychology, work physiology, anthropometry date and application, stress and management, VDTs, material lifting, musculoskeletal injury, safety and health, work environment, workplace and products design which are performed by many people in different countries. This book gives a comprehensive picture of scientific and practical activities carried out currently in these fields of ergonomics.

We firmly believe that this conference will promote the development of occupational ergonomics. We hope that this volume will serve as valuable source of ergonomics information.

Part Seven: Musculoskeletal Injury

Part Eight: Safety and Health

Evaluating the Risk of Cumulative Trauma Disorders

Ravindra Goonetilleke, Yan Zhang, Liping Wang

Department of Industrial Engineering and Engineering Management
Hong Kong University of Science and Technology, Hong Kong, CHINA

Abstract

It is fairly well known that risk factors associated with cumulative trauma disorders(CTDs) are foree, posture, repetition and vibration. Past rescarch has evaluated the force and repetition effects and presc-nted them as an odds ratio matrix in an effort to reduce the exposure level. However, with activities such as typing or mouse usage, it is unclear how such information can be used. This paper is an attempt to evaluate surface temperature changes when using a mouse so that a quantifiable measure can be developed for the prediction of CTDs. In this study, a computer "game" was programmed. Ten participant performed the experiment. The task was to click on "buttons" that appeared on the screen as fast as possible for a period of five minutes. The skin surface temperature at the wrist was measured using a commercially available infrared camera. The results show that the temperature increase in the wrist area is proportional to the mouse click speed and the druation. These results may be further explored in relation to developing a model for heat generation at the wrist area and thereby quantify the risk of CTD.

Key words: Carpal tunned syndrome(CTS), Repetitive kering, Repetitive strain injuries(RSI), Cumulative trauma disorders(CTS)

Introduction

Injury and disorders in the workplace are commonly known as CTDs or repetitive strain injuries (RSI). The incidence of CTDs has been increasing since 1980, especially with computer-users[1]. Generally, computer-users hold the mouse and use the index finger to click the mouse. It is well known that the risk factors associated with CTD are force, posture, repetition and vibration[2]. Studies such as Silverstein et al.[3] have evaluated the force and repetition effects and presented them as an odds ratio matrix in an effort to reduce the incidence of CTDs. However, with activities such as typing or mouse usage, it is not very practical to use the odds matrix in the prediction of CTS. There is a great need for methodologies that quantity the relationship of risk factors in relation to musculoskeletal disorders[4].

Spielholz et al.[5] states "The lack of well-defined exposure assessment methods still plagues the field of ergonomics". When the muscles and tendons work over long periods of time, the temperature in the active areas can increase and may indicate the probability of potential injury. The objective of this paper is an attempt to quantify the changes in temperature in the wrist area when exposed to differing clicking speeds with the long-term goal of using surface temperature variations as an assessment of exposure levels.

Methods

1. Participants

A total of ten participants were tested. All the participants were Hong Kong Chinese females. All subjects used their right-hand to operate the mouse.

2. Stimulus

The stimulus was a computer "game". The experimental program was coded in Delphi 5.0. Each subject had to position the mouse crusor on a 19 × 19 pixel button when it changed color and were required to click on each such button as fast as possible. When the subject clicked on the button, the button changed color from red to blue. The rate (speed) at which the buttons appeared was an independent variablewith four levels (1.7, 2.2, 2.7, and 3.2 buttons per second). The number of buttons for the four speeds was different. There were 17(rows) × 30(columns) or 510 buttons for the rate of 1.7 buttons pr second, 22 × 30 (= 660) buttons for the rate of 2.2 buttons per second, 27 × 30(= 810) buttons for the rate of 2.7 buttons per second, 27 × 36(= 972) buttons for the rate of 3.2 buttons per second.

3. Materials and Apparatus

The program was run on a Pentium 200 MHz PC with a Microsoft mouse v2.0 in the Microsoft Windows 98 environment. The approximate force required for the left mouse click was 1.5 N. A Sony SF17 multiscan color monitor with a screen resolution of 800 × 600 pixels was used for the experiment.

A FLIR systems ThermaCAM PM525 infrared camers was used to determine the temperature changes in the wrist area.

4. Experimental task and design

Each participant was tested on all four speeds and the order of testing was random. Prior to each test, the subject was given a practice trial to get acquainted with the button speed. Each trial lasted 5 minutes.

All participants were asked to click on the buttons as fast as possible while keeping their hands and forearms in a comfortable posture. The experimenter recorded a thermal image of the participant's wrist using an infrared camera every minute during this period. At the end of a trial, each participant was given a 20-minute break. Thermal images were also taken at 1-minute intervals during the first 5 minutes of this break period. The participant proceeded with the next trial after the break. This procedure was repeated for all four trials.

Results and analysis

The descriptive statistics of the ten participants are shown in table 1. The temperature increase for each speed is shown in Figure 1.

Since each trial lasted 5 minutes, the Analysis of Variance was performed for the first 5 minutes and another for the 5 minutes during the break. A duration (5) * button speed(4) ANOVA showed significant main effects and interaction effects during the first five minutes. A post-hoc Student-Newman-Keuls test showed that there is no difference in temperature over the first five minutes for the rate of 1.7 buttons per second. But, at other speeds there were significant differences in temperature after the first minute. In contrast, there were no significant differences among the 6, 7, 8, 9 and 10-minute(break time) temperatures. A simple-effects ANOVA showed that there were no significant differences in temperature between the speeds of 1.7 and 2.2 buttons/second over the first 5 minutes of the test.

Table 1 Descriptive statistics of participants

	Mean	*SD*	Min	Max
Age	21.8	0.92	21.0	24.0
Height(cm)	160.4	6.58	149.2	173.1
Weight(kg)	49.7	6.93	41.2	63.4
Right-hand circumference(cm)	14.0	0.66	13.3	15.5
Initial wrist temperature (degrees Cclsius)	28.1	0.87	27.1	29.6

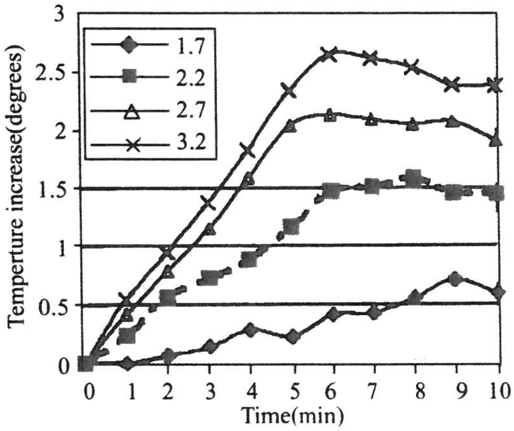

Figure 1 Temperature increase in wrist for each botton speed

Discussion and Conclusions

Figure 1 shows that wrist temperature, increases over time and also varies with the clicking speed. Another observation is that the wrist temperature increases even after activity has stopped indicating that there is a lag associated with the surface temperature. However, the change that occurs after the activity has stopped is not significant. This experiment is relatively short (5 minutes) but temperature variations are evident with changes in finger activity. As the speed increases there appears to be a linear increase in temperature over the task duration. However, it is not reasonable to assume that there will be a continuous increase. We hypothesize that the increase will flatten-off after some duration. The temperature at this point may be an upper bound that should not be exceeded if one is to avoid the incidence of CTDs. Further work is needed to model these relationships so that the results may be used in a real world setting.

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