

from work involving repetitive motion by selected worker and case characteristics 1997—U.S. Department of Labor—Bureau of Labor Statistics April 1999

[0022] REF3: *Computer Related Symptoms: A Major Problem For College Students* page 2 of 6 statistical graph **FIG. 1: Discomfort Intensity Rating For Each Body Part**—Erik Peper, Ph.D. and Katherine H. Gibney Institute for Holistic Healing Studies, San Francisco State University Sep. 4, 1998

[0023] REF4: *Pointing Device Summary*—Pete W. Johnson, Ph.D. University of California, San Francisco and University of California, Berkeley Ergonomics Program Jul. 18, 1994

[0024] REF5: *Computer Workstation Self-Audit Checklist* page 3 of 4, paragraph 1—Pete W. Johnson, Ph.D. University of California, San Francisco and University of California, Berkeley Ergonomics Program Jul. 18, 1994.

[0025] REF6: *Ergonomic Guidelines for Arranging a Computer Workstation—10 Tips for Users* Professor Alan Hedge, Ph.D., M. Erg. S., A. F. B. Ps. S. Cornell University—Department of Design & Environmental Analysis Ergonomics Research Laboratory Feb. 6, 1999.

[0026] REF7: *Hand/Wrist Basics—Ten Things You Should Know About Hand and Wrist Pain* Chris Grant, Ph.D., Certified Professional Ergonomist—F-One Ergonomics Ann Arbor, Mich. September 2000

[0027] The growing occurrence of computer-related conditions such as repetitive stress injury (RSI), tendinitis, bursitis and carpal tunnel syndrome is a serious problem. If not remedied, these injuries to the hands, wrists, arms and shoulders can become permanently debilitating. According to the Bureau of Labor Statistics (BLS), repetitive motion disorders in American office workers have doubled between 1987 to 1997. (See REF1) In 1997, over 11,000 people were reported to have missed work due to computer-related ailments. (See REF2) However, the number of unreported cases and workers who endured the pain on the job is likely much higher than that figure. Unfortunately, office workers are not the only group of computer users at risk.

[0028] The growing requirement for students to use computers is also taking a toll. A recent study conducted by Dr. Erik Peper, Ph.D. of San Francisco State University indicated that 30 percent of the university's students suffer from intense hand and wrist discomfort as a result of using computers for schoolwork.(See REF3). Additionally, the BLS suspects that home computer and Internet users are at risk for similar problems, but as yet no data is available.

[0029] Public awareness of computer-related injuries is growing. This awareness is emphasized by a recent government drive to reduce RSI in the workplace, including those related to computer use. In 1996, the Occupational Safety and Health Administration (OSHA) established a standard requiring employers to minimize recurrent repetitive stress problems at work (including office work). On the state level, California has passed laws to increase employer responsibilities further, and several other states have followed suit.

[0030] It is well known that using a computer mouse causes a large proportion of the repetitive stress injuries among computer users. Public concern about mouse-related injuries has spurred a new market in ergonomically alterna-

tive pointing devices. New government pressures on employers is also fueling this market growth. As a result, Internet and retail stores are promoting a variety of "ergonomic" pointing devices. Most of these devices represent only minor variations of conventional designs, however, and are of limited benefit to computer users subject to repetitive stress injuries.

[0031] Ergonomic Problems Associated with Pointing Devices

[0032] The nation's leading experts in computer ergonomics recognize several major pointing device problems that contribute to repetitive stress disorders. Although some of these problems overlap, they can generally be attributed to eight different ergonomic factors. These eight factors include arm/wrist movement, device placement, small muscle/tendon movement, joint position, small exertions, muscle tension, body posture and localized pressure. The following subsections describe each factor as it relates to popular pointing devices.

[0033] 1. Arm/Wrist Movement

[0034] Pete W. Johnson, Ph.D., of the University of California at Berkeley and the San Francisco Ergonomics Lab in Richmond has found that conventional mouse use causes shoulder pain and injury in computer users. He attributes the distress to the repetitive arm movements that slide the mouse around the mouse pad. Dr. Johnson has found that shoulder problems are reduced with the use of stationary pointing devices such as trackballs. (See REF4 at page 2)

[0035] 2. Device Placement

[0036] The placement of a pointing device relative to the user is recognized as an important factor in computer ergonomics. Professor Alan Hedge, Ph.D., of Cornell University's Department of Design and Environmental Analysis Ergonomics Laboratory emphasizes the need to keep the pointing device in a comfortable, convenient location. He says it is important in the prevention of repetitive stress disorders to keep the wrist straight and the arm close to the body. (See REF6 at pages 3 and 5). Additionally, Dr. Johnson has found that repetitive stress problems are reduced when the device is operated near the centerline of the body and no higher than the keyboard. He warns, however, that many computer workstations do not provide a safe space in which to operate the device. (See REF5) Overreaching for a poorly located pointing device is a common problem among computer users, he notes. Unfortunately, nearly all mice and trackballs are desktop devices that are operated on whatever surface the work area allows. Ideally, the hands should rest easily in the lap as much as possible.

[0037] 3. Small Muscle/Tendon Movement

[0038] Some devices that minimize arm and wrist movement do so at the expense of the small muscles and the flexor and extensor tendons that work the fingers. Typical trackball devices are arranged so that the thumb or forefinger (also known as index finger) must make a kicking motion to rotate the ball and send the cursor vertically across the screen. With this kicking motion, joints are repeatedly over flexed, applying undue stress and friction to tendons and joints. Dr. Johnson discourages the use of thumb-oriented trackballs for this reason. (See REF4 at page 2). Kicking also requires the