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NOTES

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Health Risks of Mouse Use

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The introduction of the computer into the workplace has had widespread and varied effects on the way work is done. There are as many as 80 million computers in use in the United States today (OSHA, 1991). The increased use of computers has also had varied health effects on computer users. As software has evolved, there has been a shift toward more use of electromechanical pointing devices—i.e., the mouse and the trackball. Indeed, some programs involve more use of the mouse than the keyboard. Mouse use can account for up to two-thirds of computer operation time, depending on the task and the software (Johnson, et al., 1993). Unfortunately, as mouse use has increased, so have pains and injuries in the upper extremities of computer users.

There are several names for pains and injuries caused by computer use, including computer-related disorder (CRD), cumulative-trauma disorder (CTD), repetitive-strain injury (RSI), and upper-extremity musculoskeletal disorder (UEMSD). Together these disorders account for half of all work-related injuries in office settings. These injuries are also costly; studies estimate that the cost to business is more than $4 billion per year in lost productivity, medical claims, lost time, and replacement training (Harvey and Peper, 1997). In addition, according to claims data from the Liberty Mutual Group, the number of computer-related medical claims is increasing (Fogleman and Brogmu, 1995). Therefore, it is critical that both workers and businesses learn about the potential problems computers can pose and how to avoid them.

A previous edition of Facilities Planning and Management Notes, Preventing Carpal Tunnel Syndrome in Computer Users (vol. 1, no. 4), was devoted to carpal tunnel problems and keyboard design. The latest research indicates that workstations designed to address problems related to keyboard use may not meet the needs of mouse users. Mouse users are especially at risk for shoulder, upper arm, lower arm, and hand injuries. This edition gives information, based on the latest research, on how to avoid serious pain and injury related to mouse use.

Five main risk factors

To avoid pain and possible injury caused by using a mouse, computer users should become aware of the major risk factors. According to recent research, the major factors are:

1. Force. The greater the force required to properly use the mouse, the greater the chance of pain and injury. There are three sets of force:
   - 1) forces to grip the mouse (this grip causes tension in the forearm);
   - 2) forces to move the mouse (arm movements that increase shoulder tension if the arm is abducted);
   - 3) finger forces to press the button (in wrist extension, this increases force inside the carpal tunnel).

2. Awkward, static, and constrained postures. If a position is uncomfortable, it may cause problems. Excessive use of a mouse (or keyboard) in an uncomfortable position can lead to serious pain or injury. Posture problems resulting from mouse use include “skating” the mouse with lateral flicks of the wrist (ulnar deviation causes increased force inside the wrist).

3. Repetition. Excessive repetition of any motion in using the mouse can lead to serious pain or injury.
4. Lack of adequate rest breaks or time for soft tissue recovery. It is critical for computer users to take breaks and allow muscles to flex and relax while operating a mouse for long periods. Users commonly become so immersed in their task that minor muscular discomfort or tension is undetected until the task is over. Also, minor pain sometimes is ignored until it becomes a serious injury. Either way, continued strain to the muscles from mouse use can be very harmful.

5. Stress. Stress leads to general tension, which can induce and aggravate any of the previously described risk factors related to mouse use.

What the research indicates

Studies have examined the health risks related to mousing. Most research indicates that adjustable and flexible mouse pad orientation is the most practical and effective way of providing a wide range of users with optimal comfort and reduced risk of injury. Many computer users understand the importance of using a well-designed, ergonomically correct computer workstation. The placement of the mouse is also important. Recent research indicates that a separate mousing structure will allow the user flexibility in placing the mouse. A separate mousing structure has been found to be superior to placing the mouse on the desktop or on a conventional keyboard tray (Shaw and Hedge, 1996). Although the stress on the forearm and hands is approximately the same, a separate, adjustable mousing structure provides benefits for the elbow and the shoulder.

Choosing a separate mousing structure is not a simple matter because here are a variety of models, each claiming to be ergonomically superior and beneficial to the user's health. A recent study compared several ergonomic mouse tray models: the two-tier design, the sliding design, and the ringed design (Paul and Nair, 1996). The two-tier design and the sliding design were found to be superior to the ringed design.

The two-tier design locates the mouse pad structure two inches above the keyboard. It can be swiveled above the numeric 10 key pad on the keyboard or it can be placed farther away. This design greatly reduces shoulder abduction. This design provides the best mousing posture.

The sliding design holds the mouse on a platform underneath the computer support surface. This platform can be swung out to the right or the left of the keyboard and, thus, is adjustable to individual needs. If this mousing structure is placed at about the same level as the keyboard, however, increased wrist extension and shoulder abduction can result (Shaw and Hedge, 1996).

The ringed design has been less successful. It has an eight-inch extension to either side of the keyboard that can also be swiveled inward at an angle of 45 degrees. The attempt was to bring the mouse pad closer to the user's body, but this arrangement requires considerable accuracy in switching from keyboard to mouse. Also, because the mouse is on the same platform as the keyboard, wrist extension is increased.

A fourth design was also tested, but research constraints prevented the results from being generalized beyond the testing situation.

Other research has examined the use of wrist supports and trackballs. One study found that the use of a wrist support while mousing reduces the amount of wrist extension (Damann and Kroemer, 1996). Another study found significantly lower muscle tension when the workstation was set up so that the worker could use a trackball placed in a neutral position (Harvey and Peper, 1997). But wrist extension can occur with trackball use as well (Hedge and Ng, 1995).

The mousing station and the keyboard should not be considered separate isolated units. The interplay and complementary design of the mouse and keyboard are important. For example, some products designed to correct problems related to keyboard use may exacerbate problems with mouse use. "Ergonomic" split keyboards may reduce ulnar deviation, but there is no evidence that split keyboards reduce wrist extension or that they are effective in promoting significantly better hand or body posture. The resulting wider keyboard may unintentionally lead to an increase in wrist and shoulder tension when used with a mousing device (Harvey and Peper, 1997).

What to look for

1. An adjustable height and position and mouse tray that is independent of the keyboard tray. This is often separate from the keyboard unit. Look for a tray that can accommodate right- or left-handed users.

2. A mouse that allows for a variety of grips. Recent designs have attempted to duplicate the natural architecture of the human hand. Mousing with slightly curled fingers has been found to be preferable to holding fingers straight.

3. A mouse that is easy to hold. Recent designs offer gentle shapes that are wider in the back and taper toward the front. Also, the less pressure required to activate the button, the better.

4. Adjustable mouse ball acceleration. This allows each user to find an optimal speed and reduces strain from overuse due to inappropriate speed levels. Speed levels are usually handled in the software, so it is recommended that users set their own software defaults for appropriate tracking speed and clicking speed.

5. A touchpad or touchpad–mouse combination. A touchpad can reduce stress on the user's wrist.
Posture

The mouseing structure you use should permit the least amount of wrist extension. Note the difference in Figure 1 in the amount of wrist extension for using a mouse on a lowered platform compared to using a touchpad on a sloped palm rest.

Figure 1

Wrist extension for mouse on lowered platform vs. touchpad on sloped palmrest

See Figure 2 for the optimal mouse position for a person seated at a workstation. The area with the diagonal lines is the safe zone for positioning the mouse.

Figure 2

Optimal Mouse Position
(Karlqvist et al., 1996)

- Surveyed 542 CAD workers
- Right-hand side complaints most frequent
- Maximum complaints—shoulders (36%), elbow (17%), wrist (13%)
- More complaints among women than men
- Zone of optimal mouse position (diagonally shaded) for a seated person

Figures 1 and 2 courtesy of Professor Alan Hedge and the CUErgo website—http://www.ergo.cornell.edu
Conclusion

Computers are a dominant part of today's lifestyle and today's workplace, especially. Researchers are seeking to understand how computer users can be efficient and productive and, at the same time, remain free from pain and injury. Because much of today's software requires using electromechanical pointing devices, such as a mouse, businesses and computer users need to know as much as possible about how to use such devices safely.

Businesses and organizations that purchase computer equipment should remember that a range of people will use the equipment and that flexibility is important to accommodate individual needs. Computer users need to know that the mouse structure should work in harmony with the keyboard and be flexible enough to fit their needs. But even with the most ergonomically correct system, users should be aware of potential dangers. When working at a computer, they need to find a comfortable position to keep strain at a minimum and reduce muscle tension. And they should take minor breaks to avoid the build-up of tension. By paying heed to these concerns, a computer user can prevent pain and injury related to using a mouse.

References


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