



The Goldtouch Ergonomic Mouse

An Overview of Design

*How the Mouse Design Provides
Optimal Ergonomic Benefits*



Proprietary Statement

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Purpose

Repetitive Stress Injuries (RSI's) are affecting an increasingly larger percentage of the workforce. RSI injuries can range from minor discomfort, tingling fingers, sore wrists, stiff neck and tennis elbow to serious disabilities and everything in between. RSI has become a significant cost of doing business and a diverse range of companies representative of a broad base of industries are confronting the root of the problem by implementing preventative repetitive stress initiatives.

The results of some of these initiatives, as discussed in this paper, are very compelling and the companies involved represent today's leaders in this field. As will be discussed in this paper, the heart of the solution to RSI related issues is in the selection of the right tools for work; specifically, the keyboard and mouse. Study after study will demonstrate that the adjustable, split keyboard design, and ergonomic mouse and mousing platform is at the center of the solution.

It will also be shown that the Goldtouch mouse design has shown to be superior to its competitors in not only in reducing the causes of RSI, but also in increasing employee overall productivity.

Background

Direct workers' compensation costs in the United States for ergonomics-related injuries are estimated at \$30.9 billion, according to the 2008 Liberty Mutual Workplace Safety Index. The Index captures only the direct workers' compensation costs of these disabling injuries. When indirect costs are considered, which are estimated by experts to be anywhere from two to five times direct costs, the true cost to USA businesses is at \$61.8 to \$154.5 billion.

Cost Reductions with Repetitive Stress Interventions:

Surgical treatment for carpal tunnel syndrome is the most frequent surgery of the hand and wrist with 463,637 releases annually. Almost half of the carpal tunnel cases result in 31 days or more of work loss. According to the US Department of Labor, Occupational Safety and Health Administration (OSHA), repetitive strain injuries are the nation's most common and costly occupational health problem affecting office workers.

In addition to the financial advantages the results of ergonomic interventions have had a positive impact on:

- Work-related musculoskeletal discomfort
- Job control
- Business process efficiency
(*time and costs*)
- Communication and collaboration
- Ergonomic climate
- Environmental satisfaction

Introduction

The Goldtouch mouse is an improved pointing device with ergonomic features. The mouse design allows an operator's hand to remain in a relaxed position in as near a state of repose as possible while operating the pointing device. The shape of the pointing device reduces several of the known high-risk postures during use.

Computers are usually equipped to use a mouse for controlling the movement of the cursor. Computer mice employ mechanical, optical, laser or other means to control the displacement of a cursor on a computer screen. By moving the mouse across a flat surface along two axes, the cursor is proportionally moved across the computer screen. Mouse usage is coming under increasing scrutiny because while providing the computer user with considerable flexibility over the motion of the cursor on the computer screen, extended or repeated use of the mouse can result in severe physical strain. This physical strain develops because, for the hand, even the smallest of postural shifts can increase or decrease stresses on the hand and fingers. Previously, mice were designed without sufficient consideration for the best postures of the fingers, wrist and forearm. The reported number of mouse over-use-related injuries is increasing and in some industries the injury rates rival and even surpass those of keyboard related injuries. These injuries are collectively referred to as repetitive stress injuries (RSI).

The Issues

The areas of the body most vulnerable to injuries are the soft tissues of the fingers, wrists and shoulders. More specifically, the index finger and its knuckle joint, the tendons responsible for extending and flexing the two button fingers (index and middle) and the muscles of the shoulder which abduct, support and are responsible for extension and flexion of the arm during mouse usage. Excessive wrist extension, particularly when associated with radial and ulnar deviation, is also linked to long term tendon and nerve damage. Additionally, many current mouse designs provide no position for the user to rest the hand without removing the hand from the mouse and the concomitant return of the hand to the mouse. This constant activation of the shoulder muscle and joint is extremely harmful and can lead to long-term damage.

Index finger abduction in normal mice results from the combination of several factors. The need to grip the mouse with the ring and little fingers in opposition to the thumb, effectively tethers the ring finger to the side of the mouse. Consequently the movement of the index finger is greatly restricted and forced into a state of continual abduction as a consequence of the linkage to the ring finger. This configuration also forces the thumb and ring and little fingers into constant contraction. Additionally, by necessity, the ring finger is placed on the side of the mouse and can't be moved to what would be a natural position because of the possibility of actuating the right button. This position causes a myriad of problems including:

Restriction of the movement of the index finger to the left button, which necessitates pronation of the entire forearm to accomplish.

Restriction of the movement by the fingers and a limitation on the range of fine control. This necessitates a shift of movement activation from the fingers to the wrist and shoulder.

The right button position on conventional mice doesn't allow alternative grip positions with the ring finger thereby exacerbating the strain imposed on all fingers.

Excessive pronation of the forearm while using conventional mice is almost unavoidable. The low position of left button combined with tethering the ring finger to the right side of the mouse forces excess pronation. Usually, the left button slopes away to the left exacerbating the problems.

By providing only one position for thumb placement with no alternative, pronation is necessarily enforced.

The width of the mouse and the placement of the left button exacerbates the problem further by placing stress on the ring finger's joint and its tendons. To worsen the situation, the index and middle fingers are either in constant extension in readiness to actuate the button or levering at the joint to depress the button, thereby forcing the muscles of the two fingers into a state of either constant contraction or constant repetitive motion. This causes stress of the tendons and muscles in the forearm.

Attempts to Solve

There have been several attempts to solve these problems. Mice have been designed with palm knobs and enlarged square ends. These designs, however, aggravate the above identified problems. The thumb and ring finger are brought into constant contraction and require the continual extension of the index and middle fingers over the activating buttons causing stress of the tendons in the forearm. As with other mouse designs, the ring finger is necessarily placed on the side of the mouse, leading to the myriad of problems outlined above.

Additionally, pronation of the hand is increased. By elevating the palm, the left stretch of the forefinger is increased and more reach is required thereby necessitating increased pronation. While these designs may provide some hand support, there is no finger extensor relief and they restrict fine finger control.

Alternatively, mice have been designed which support the entire hand, but don't provide the normal detrimental grip. These designs have a variety of shortcomings as well. They take away fine finger control thereby requiring all fine movement to occur at the wrist or shoulder. These pushing, pulling and lateral side-to-side movements are generated at the wrist or shoulder. Continual use of such devices could lead to injuries to these two vulnerable areas. These mice also are difficult or impossible to use in an intermittent fashion due to the necessity of gripping, positioning, removing and returning the operator's hand, and may lead to decreased productivity in some applications.

Lastly, some mice have been designed to have specific hand shaped ergonomics. While these mice provide comfortable positions in which to rest the hand, it is difficult to use these mice in the usual intermittent fashion with just the fingers. The pivot point, or anchor, for mouse designs such as these is no longer the wrist as found in conventional

mice, therefore fine control is reduced. This design also shifts much of the fine control initiation to the shoulder, again creating the possibility of long term damage to the shoulder. Such specific hand shaped mice also will not accommodate a variety of hand sizes, necessitating the production and marketing of an excessively large variety of sizes in both left and right hand configurations. These designs generally lack proper surfaces for mouse movement using just the fingers.

Summary of Goldtouch Design

In view of the foregoing disadvantages inherent in many known types of computer mice now present in the market, the present invention relates to an improved ergonomic pointing device that in one realization includes a computer mouse. Neutral hand posture, also known as the position of "repose," is the most relaxed and unstrained position for the hand. In this position, little muscle activity is present in the hand, wrist or forearm. The position of repose for the hand is with fingers slightly cupped and a little splayed, with the thumb forming a "c" shape with the index finger. The amount of pronation varies within individuals but should be in the range of 10 degrees to 45 degrees from the horizontal. This position is easily observed in a weightless environment, for example, while the hand is relaxed and suspended in a bath or swimming pool. Accordingly, a general purpose of the present invention, which will be described subsequently in further detail, is to provide a new and improved ergonomic computer mouse which places the hand in as near a state of repose as possible while manipulating the mouse and simultaneously improves finger mobility. The shape of the improved ergonomic mouse reduces several of the known high risk postures during mouse use and allows the continual shifting of postures so as to reduce the effect of continuous repetitive motion due to the unloading of vulnerable muscles, joints and tendon groups. This shape also provides a resting position for the hand, reducing stress in wrist extensors and finger extensors.

The shape of the improved ergonomic mouse is such that the pronation of the wrist and hand can be reduced from 0 degrees from the horizontal, wherein the plane defined by the face of the operator's palm is nearly parallel to the surface the mouse is resting upon, to approximately 80 degrees from the horizontal, wherein the same plane is nearly perpendicular to the surface upon which the mouse rests. This shape, which allows the reduction of pronation, also allows the hand, and the entire forearm to rest on the desk surface thereby alleviating the pressure usually exerted on the wrist. Shoulder abduction and contraction of the shoulder muscles are minimized and the forearm muscles responsible for pronation may be relaxed entirely. The shape allows the fingers to curl comfortably and be supported rather than requiring the finger extensors to be held in a constant state of contraction, thus reducing the tension of the tendons.

Accordingly, objects of this invention that are addressed by an improved ergonomic mouse include:

1. Providing better, less stressful, finger placement;
2. Allowing hand release by providing the ring finger with alternative resting and grasping surfaces while avoiding activation of the right button;
3. Allowance for decreased pronation of the wrist and hand;

4. Allowing greater range of finger movement by releasing the ring finger from the tethered position encountered when using conventional mice;
5. Improved design for hand and finger relaxation, control and movement; and
6. Allowing natural curvature of fingers, thereby reducing or eliminating finger extension stresses.

Additional objects of this invention include providing a mouse that allows resting the operator's hand on its side while using the mouse; providing a pen grip for very fine and relaxed control; providing button positions that allow their activation in line with finger travel; reducing load on the operator's entire limb; providing a correct pivot (anchor) point to control mouse movement; reduction or elimination of the static load on the fore and middle fingers (extensors) normally encountered while using conventional mice; providing a hand position in which the ring finger opposes the thumb muscle (thenar eminence) while allowing for a resting position of the hand on top of the mouse, thereby facilitating relaxation of the wrist extensors and finger extensors while decreasing pronation by approximately 25 degrees and in the range of 20 degrees to 30 degrees.

To achieve these goals, the improved computer mouse provides an ergonomically correct design. Many current mice are generally too narrow and necessarily require the thumb, ring and little fingers to hold the mouse while extending the fore and middle (button) fingers in anticipation of actuation. The improved ergonomic mouse allows a wider, more relaxed grip in the normal mouse position than experienced with poorly designed mice and provides for an even more relaxed grip in alternative positions made possible by the design thereof.

The following description of the improved ergonomic mouse relates to a mouse for right handed use. It is understood by that will be adapted for left-handed individuals by making a mirror image of the mouse described.

The Details

The ergonomic mouse raises and supports the fingers (medial phalanx support) under the index finger joint (knuckle) and slopes away toward the little finger. The improved ergonomic mouse incorporates two negative slopes over approximately the rear two thirds of the mouse. One slopes the mouse down longitudinally from front to back and the other slopes the mouse laterally from side to side. The negative lateral slope may be from left to right or from right to left depending on whether the mouse is for a left or right handed user. The two negative slopes provide a small rear right corner which allows for a low approach while still supporting the fingers at the proximal phalanges. This low approach combined with the 20 degrees to 30 degrees lateral elevation reduces the stress of supporting the wrist in a position of extension. The negative slope from the left side to the right side also improves the grip and reduces pronation. This support cups the fingers into a naturally unstressed position, a position which is very similar to natural hand posture which is readily observed when resting the forearm on a desk surface. By allowing this shape to be maintained in all grip positions the fingers are allowed to actuate the buttons in a trigger finger action rather than levering the metacarpophalangeal joint (knuckle). This is quite different from the usual mouse designs which raise the palm of the hand and force simultaneous extension and contraction of the finger extensors.

The improved ergonomic mouse incorporates several unique features that aid in reducing the stress of the fingers and wrist. For the thumb there is a contoured smooth surface extending from the forward bottom section of the mouse to change grips from the normal position or with the hand resting on the mouse to the most comfortable grip wherein the operator's hand is rested on its side (on little finger) and cupping the mouse in a supported resting posture on the desk surface. The mouse or other surface can still be used in the usual manner with the wrist resting on the desk and the fingers achieving the mouse movements. This usage is still better than the normal mouse.

The design of this-mouse also allows a fine pinch or pencil grip at the front left corner and left button while in the side rested position. This position also reduces wrist extension and finger extension while relaxing the entire limb and decreasing shoulder abduction.

Other features aiding in stress reduction include a straight, flattened surface for the ring and little fingers on the right side, opposite the thumb; a section on the front upon which the ring finger can rest and against which the ring finger can push the mouse in against the palm; a smooth rounded palm surface to create a grip triangle with the ring, little finger and the surfaces in contact with the muscles of the thenar and hypothenar eminence to control the mouse within and around the palm of the hand. Also, by allowing the mouse to be gripped between the thumb (thenar eminence) and the ring finger, the thumb and little finger are released from gripping the mouse. Many computer mice enforce a hand position requiring the thumb to be in nearly the same plane as the palm of the hand. In stark contrast, the improved ergonomic mouse separates the thumb from the fingers and allows the thumb to position itself in opposition to the fingers allowing for the relaxation of the thumb flexors and adductors. This results in the "c" formed by the thumb and the forefinger.

Some improved ergonomic mouse configurations in accordance with the present invention also allow alternative grips, each of which is beneficial to the user in

comparison with the grips provided by conventional mice. One position for holding the mouse is the "normal grip", whereby the user approaches the mouse from the top, grasping one side with the thumb in opposition to the ring and little finger grasping the opposite side. Normal button actuation is achieved with the fore and middle fingers. However, as discussed above, the low approach provided by the improved ergonomic mouse combined with the proximal phalangeal support reduces the stress of supporting the wrist while the stress of constant extension of the button fingers is decreased by the curvature of the front surface. Alternatively, the mouse may be gripped by resting the hand directly on the mouse in a cupped comfortable position. This cupped position allows the hand to rest on the mouse without activating the buttons because the support provided by the phalanx support bears the weight of the fingers and hand rather than the extensor muscles and tendons. This resting position facilitates relaxation of the wrist extensors as well as the finger extensors while reducing pronation of the hand by approximately 20 degrees to 30 degrees in comparison with typical mice.

Some mice have too large a palm knob that requires more reach and greater left stretch of the index finger thereby increasing pronation. Other mice lift the hand so that it's supported by the mouse itself. Either design is potentially injurious as each transfers the origin of all fine movements from the fingers and wrist to the elbow and shoulder. In contrast, the pivot point for mouse control for the improved ergonomic mouse is either the heel of the hand when the mouse is gripped in the normal position or the side of the hand when the user's hand is resting on the side. Establishing the pivot point for mouse control at either location benefits the user by eliminating the transfer of fine movements to the shoulder. These design features facilitate the reduction of the load in the entire limb of the operator, thereby minimizing the strain and stress of mouse usage. Additionally, the overall curvature of the mouse is such that the hand grips it in alignment parallel with the cursor movement.

The buttons, of which there can be 1, 2 or 3 depending on the need of the operator, are positioned such that the ring and middle fingers can press the buttons in all grip positions without lateral movement. The ring finger is also able to rest on a surface next to the right button if so desired. In this position, the ring finger can provide alternative grip, opposing the palm of the hand and also the thenar eminence.

The buttons are positioned to allow easy and perpendicular actuation from all grip positions. The slope of the buttons is shaped so as to allow a relaxed rather than extended posture. This is accomplished by moving them closer to the ring finger and by having a greater negative slope of the buttons reducing finger extension and allowing a cupping of the hand. Most importantly, releasing the ring finger from its normal position dramatically reduces stresses on the index finger in abduction and extension normally encountered during mouse use. The release of the ring finger can also bring about a 50 to 100 percent improvement in the range of mouse movement, thus allowing greater fine control of the mouse without transferring the movement to the wrist or shoulder or both.

Reduced static load on the finger buttons is achieved by providing phalanx support and the curved shape of the mouse that allows unstressed cupping of hand rather than the continuous stressful extension of fingers.

Conclusion

Repetitive Stress Injury (RSI) is a common problem as people spend longer hours on their computers at work, on the Internet, texting, and gaming. It has been proven over and over that a good part of the reason for these injuries is the poor ergonomic design of many computer mice. Even those users who feel no discomfort today could be a ticking time bomb because the damage from RMI tends to build over time, starting as minor discomfort that barely registers, eventually resulting in a minor to serious injury.

It is imperative that companies take a more proactive stance in mitigating risks. The workforce continues to change drastically, as manufacturing jobs are replaced by computer-driven services and applications. More of us work at a computer, and increasingly from a remote or home office environment, where the lack of a uniform and ergonomically-engineered workspace leaves little opportunity for reducing risks from unnatural postures. Because the workforce is being placed into these static, hazardous positions for hours at work, followed by hours of personal computer use at home, the threat of RSI's is real and universal.

The Goldtouch mouse delivers the right solution for individuals or corporate users in a global workforce. It is never too late to understand how the right tools for work can empower a workforce, and protect employer and employee from financial and personal loss.

Goldtouch can help you choose the right solutions through our experienced staff and access to leaders in the industry.

In addition, we can show you clear benefits and achievable benefits with our ROI tools.

To learn more about Goldtouch solutions and how easy they can be deployed at your organization, contact Goldtouch at 512-259-5688 or email sales@goldtouch.com. Quantity discount programs are available.

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