WRITING AND USING THE COMPUTER MOUSE

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Three aspects in mice shape and function are fundamental and should be taken into account in their design, when aiming for the protection of the human hand from the misery that affects computer users nowadays (RSI, tendonitis, etc.):

First: The position the hand, fingers and forearm of the users should adopt while working with a mouse

While using a computer regular mouse, and even the "ergonomic" variety, **the hand and fingers are forced into awkward static positions for hours at a time** – and it is very relevant to stress precisely this point: the hand remains static for hours, while the user is absolutely distracted and absorbed by what the screen shows. Keeping the hand static is a situation of risk in itself. The only way to preserve the health of all anatomical structures of the human hand, fingers and forearm when immobilization (= the hand stands still) is required, is to keep them in the "Position of Function". The "Position of Function", a.k.a. "position of recovery", is the only position that will protect anatomical structures from undesired effects. It is the only position Orthopedics is allowed to use for the immobilization of the hand. Immobilizing the hand outside of this position is considered medical malpractice. There is no controversy here: it has been stated and is clearly accepted as a Law by Orthopedists, anatomists, physical therapists, hand surgeons and other "trained professionals" around the world indisputably.

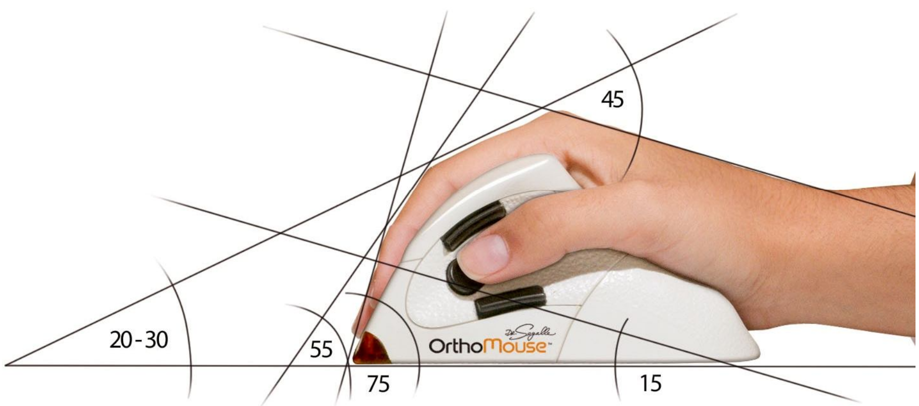

Fig 1: the hand on the OrthoMouse assumes "the Position of Function"

The only Mouse that respects this concept and therefore creates ideal conditions not only to protect the hands of the users during work but also to help them recover from injuries and pre-existing diseases is the OrthoMouse. The fact that it "allows and obliges" the hand to work in the "Position of Function" produces the same effect as good physiotherapy (which often these users have to undergo as therapy) in order to help them recover from their issues. (Fig 1).

A second concept to be introduced is that it is absolutely necessary, when using a Mouse, that **the forearm should be supported by the desk.** Otherwise, the user will need to move his hand in order to move the pointer on the screen using **his shoulder and/or elbow and/or wrist as pivot.** This results in the loss of sensitivity, as the leverage handle is very long (see Fig 2); also the structures used (shoulder/arm/elbow) do not have the capacity to provide precision, when this is exactly what is needed. This in turn produces discomfort and pains that may show as far as the neck and back of the user.

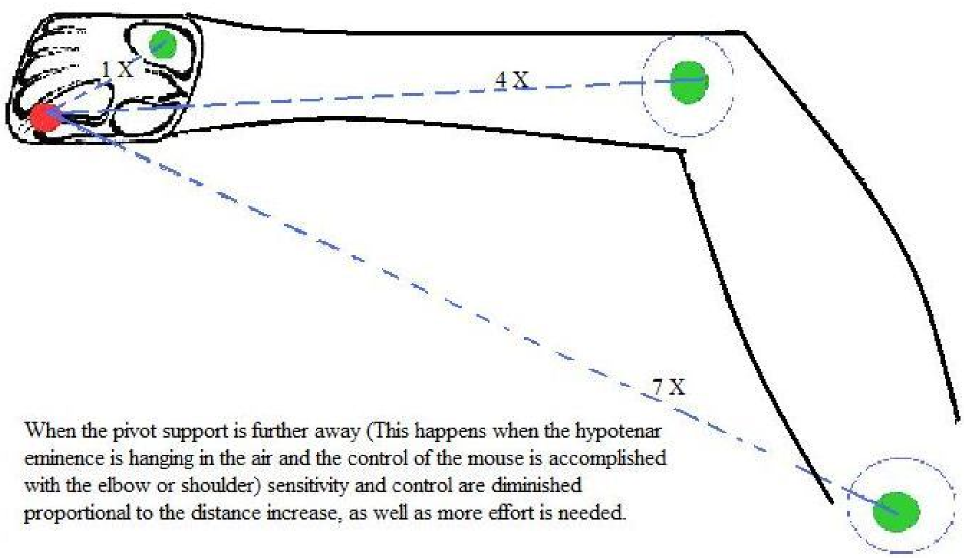

Fig 2: Leverages used for displacing the mouse when the forearm is not supported by the desk

It is a fact that users have been bombarded with erroneous and/or biased information about which postures they should adopt when using a computer. There are recommendations in the market for the use of keyboard trays, for example, keeping the keyboard at a lower level than the desk, which saves place in the workstation. Other components (including the mouse) shall be accommodated to this reality. This is equivalent to forcing someone to use a shoe smaller than his feet!

Manufacturers of other devices defend theories on “natural”, “neutral”, “rest”, “anatomic” positions and other marketing created eccentricities such as “the twisting of the forearm”. These concepts simply do not exist in specialized Orthopedics medical theory and practice.

Just to mention one example: Compared human anatomy and anthropology have described that the shape of the bones in the forearm (ulnar and radial bones) are especially bent and twisted in order to effectively accomplish the amplitude of opposite movements (supination/ pronation). This has been incorrectly called twisting, and is taken as a negative characteristic. “Excessive grip” is another unusual concept in the Physiopathology of the hand; it seems to refer to the force that the flexor muscles apply on a given object in order to “grip” it. They do not mention that the power of this group of muscles is largely superior to that of the extensors muscles, since they are part of the unconscious defensive positioning of the organism. Actually what is called “excessive grip” is more likely to occur when the hand is outside the position of function. Stress occurs more often in awkward positions, which in turn tend to produce stress, creating a vicious circle. Stress is practically inexistent when the hand assumes the relaxation that the “Position of Function” offers, while the hand is fully supported by the OrthoMouse.

Another example is the so called “Handshake grip”: this “concept” refers to the form in which the human hands come together in greeting. In this situation, each one of the hands must adapt to the position of the other in a combined effort of positional equalization that is not natural regarding the muscular forces equilibrium and it is another non-existing scientific concept.

Second: The effort that the hands and especially the fingers are prepared to handle in order to click a Mouse button

These efforts/tasks may be compared to the effort necessary in order to hold a pencil and thus relates to the act of writing.

The OrthoMouse is the only Mouse in the Market in which all buttons are located in such way that the fingers work in the “Position of Function”. (Fig. 1) This implies that the starting position of the fingers when they click is one of perfect equilibrium. The user may (and actually should!) rest his fingers upon the buttons. There is no need to be concerned with accidental clicking, as the activating force is horizontal in the case of the OrthoMouse, and the weight of the fingers is a vertical force and as such, will not activate the switch). This is how the need to maintain the fingers in the air is eliminated, and this is definitely one of the main causes of tendonitis and discomfort due to other mice.
The buttons of the OrthoMouse incorporate mechanical leverages. They multiply the force each finger applies when clicking. The activating force is minimized. At the end of the day, this preserves the user’s fingers from being tired and reduces the possibility of injuries due to effort.

The displacement of the fingers while clicking has also been minimized. The tip of the fingers rest upon the buttons and, in case of the main and right click, respectively, have to move only slightly in order to click, from their start resting position – to which they return immediately. During the assembling of the OrthoMouse, there are screws that regulate the perfect position of the buttons, so that there are no clearances, no spaces that may result in unnecessary movement or displacement of the fingers. The use of a mouse is a precision task, the OrthoMouse has been conceived as a precision tool, and corresponding care is taken in its production.

The buttons of the thumb in the OrthoMouse have replaced the scrolling wheel. Activation of the thumb’s middle button is absolutely natural. The “up” and “down” buttons have incorporated the greatest mechanical leverage effect, in such a way that the user just has to touch them to start scrolling. The thumb is being used, that is a fact. But within the movement range that occurs while using the OrthoMouse, and with the very light force to be applied, the thumb remains in safe situations at all times. This is so primarily because the start position for the thumb is that of opposition to the other fingers (as opposed to retroposition, which is common in other mice that use the thumb for clicking). From this position, small displacements of the thumb are safe.

The OrthoMouse is the only mouse upon which the hand works in “passive adaptation” – which means the hand passively rests upon the OrthoMouse and there is no need for it to do extra efforts/movements in order to operate the mouse. Upon other mice, it works in “active compensation” – the hand is in awkward position and, in order to do the expected mousing tasks, has to actively do extra effort/movements.

Third: The displacement on the desktop needed in order to reach the desired points in the screen

This is another crucial task that mice do, and it has the same principle and anatomic and functional identities as writing. This has been particularly well achieved with the OrthoMouse.

The different elements in the OrthoMouse provide several different forms and/or combined forms of grips, and this is yet another factor that influences the way the human hand uses it in terms of comfort and safety. “The effect of the actual act of gripping is that the solid is fixed in a state by what physicists call bonds. A bond is said to be *unilateral* when movement of the solid is impeded in one direction only ... The bond is *bilateral* when two movements are impeded and *multilateral* when movement is prevented in several directions” (“The Hand” by Raoul Tubiana)

With respect to that premise, specifically, *the bonds in the OorthoMouse are multilateral,* constituted by (Fig 3):

- Precision grip, formed by the thumb and the index finger in “pincer position”. (In the only perfect “opposition”).

- Grasping grip, formed by the thumb and middle finger (in opposition).

- Grasping grip, formed by the thumb and annular finger (in opposition).

- Grasping grip, formed by the thumb and little finger (in opposition).

The quantity and quality of grips offered by the OrthoMouse, and the total support of the palmar surface, make the OrthoMouse the maximum expression in sensitivity and control. “The number of pincers available determines the capacity of the hand to control an average object” (“The Hand” by Raoul Tubiana).”A good example of a mouse is a mouse which supports the hand evenly, through a larger area.” David Rempel- University of California, San Francisco, School of Medicine (Ergonomic Scientist). Information gathered in CNN News, 5 pm-11/22/99. (See Fig.3).

This is the representation of the four grips:

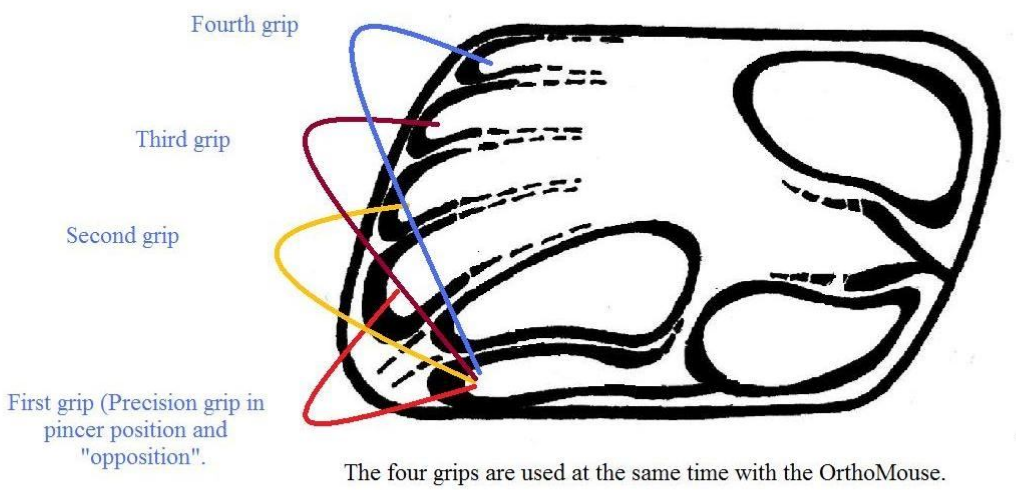

Fig. 3: Scheme of the precision and grasping grips in the OrthoMouse

Observe the way the hand grips the pencil for writing. This is another situation where the four grips are in place, and full control is provided by by the Precision Grip.

Fig 4: The grips used in writing

This is to be compared to the grasping in ordinary mice, Fig. 5:

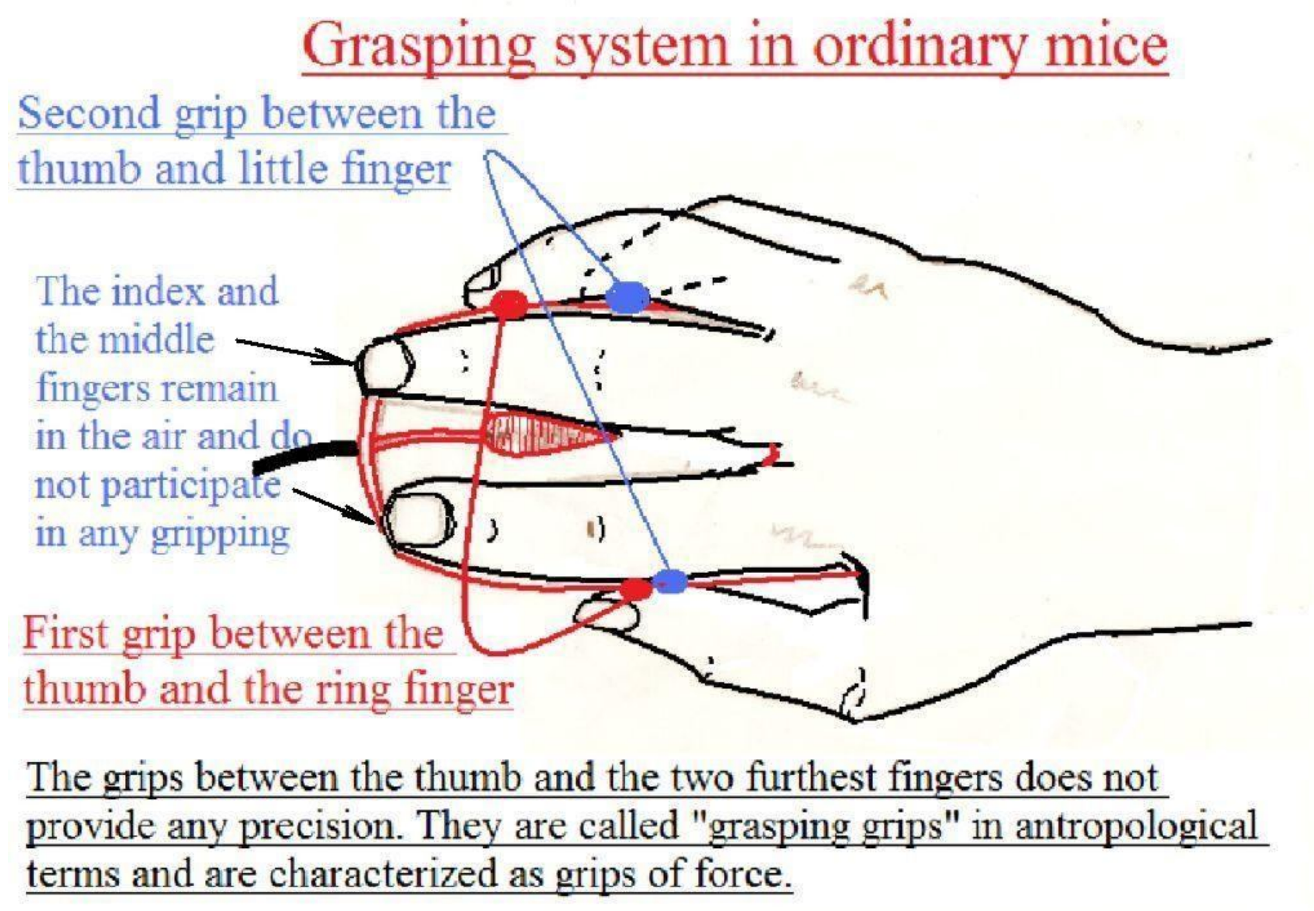

Fig 5: Grasping in Ordinary mice

Unlike most pointing devices in the market, **the OrthoMouse has the movement sensor placed in the frontal part of its base, displaced to the left frontal corner, allowing the collection of movement displacements and sensations directly from the tips of the thumb and index fingers** – which are the areas that have the highest sensitivity and precision in the human hand (Fig. 6).

This very important fact allows people to use it in way very similar to handling a pencil or a pen, and to achieve enormous precision moving the tip of the fingers in the same way he does when writing or drawing (Fig. 7). This occurs by **making a pivot with the hypotenar eminence supported by the desk (when using the small adapter) or on the posterior part of the OrthoMouse, when the medium or large adapter is in use**. It is a crucial fact because the user doesn't need to move the entire hand, or to displace the entire mouse body in order to move the pointer. He just pivots from the Hypotenar Eminence moving the forward part of his hand, where the tips of the thumb and index fingers are close to each other and in opposition.

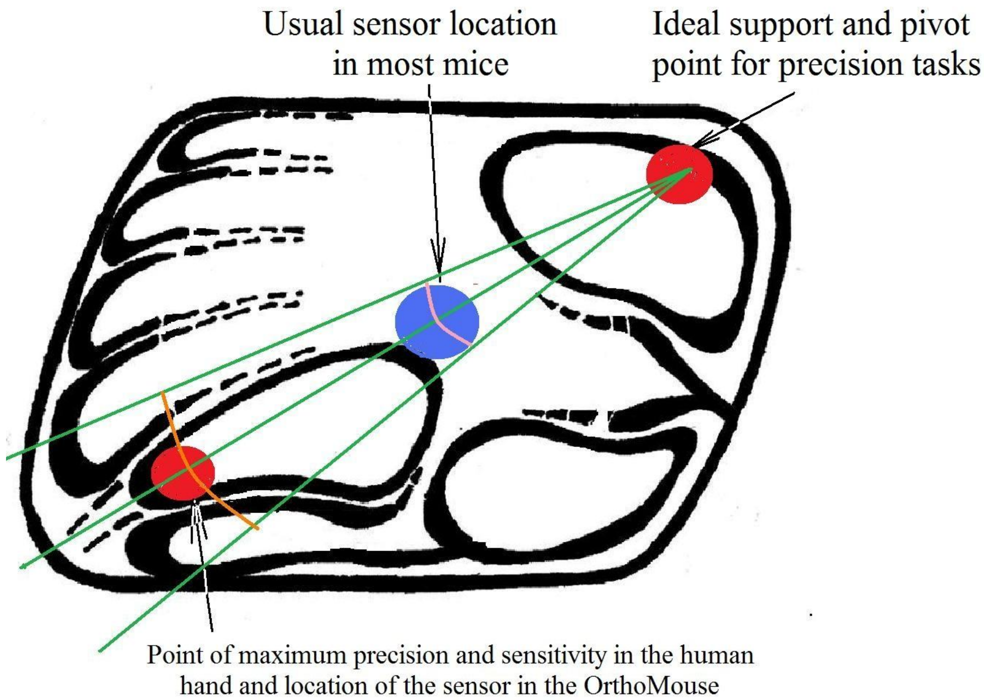

Fig. 6 - The Location of the Movement Sensor of the OrthoMouse has been carefully chosen

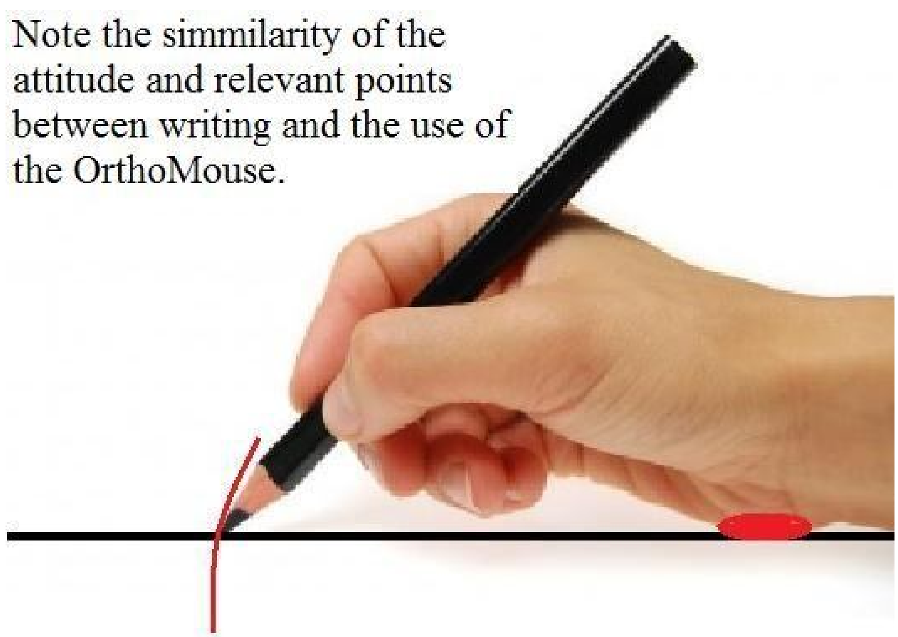

Fig. 7 - The hand while writing; the hypothenar eminence is supported by the desk.

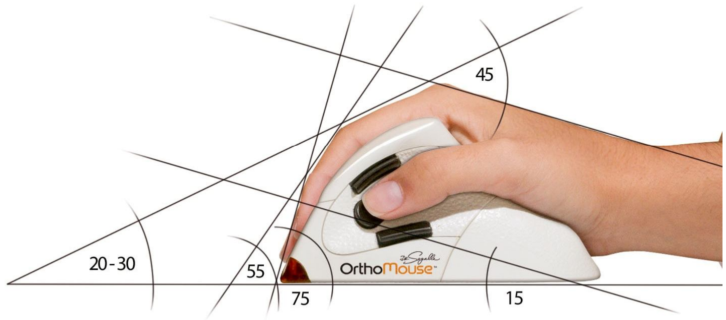

Fig. 8 - The hand on the OrthoMouse: the Hypothenar eminence is supported by the OrthoMouse.

There has been some controversy in the market as well, and some have mentioned that gripping is a risk situation for the hand. There is a clear and obvious argument favorable to gripping. The mouse is a manual tool, and one of precision. Manual tools, and specifically one that requires precision, will necessarily need gripping. And the best gripping for this situation is the precision grip, which the OrthoMouse uses. The position the hand assumes on the OrthoMouse allows gripping while the hand is relaxed and all structures are in equilibrium. A perfect solution!

The weight of the user's hand resting upon the OrthoMouse might produce, as a direct consequence, an increase in friction while displacing the OrthoMouse. This is minimized because the weight is distributed through 5 or 6 different sliding feet. The movement of the pointer is achieved mainly through the pivot from the hypothenar eminence in the posterior part of the hand, which means that only the tips of the thumb and index fingers need to move, and this movement will be smaller than when using regular mice.

We have measured the force needed to displace the forward point of the OrthoMouse while supporting weight equivalent to a human hand, on a relatively rough surface (fig 9). The result was 40g.

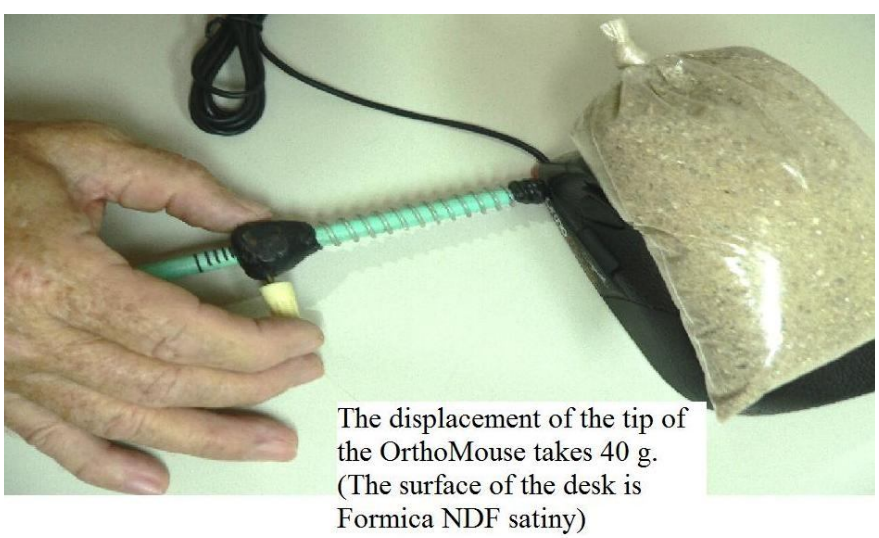

Fig 9 - Measuring the force needed to displace the OrthoMouse.

The position of the movement sensor in the OrthoMouse allows maximum sensitivity to be obtained precisely with a minimum displacement of the tip of the fingers (Fig. 6).
The OrthoMouse, handled in a way that copies the movements of writing, allows the maximum weight resulting to gravity to be concentrated almost exclusively in the back part of the hand – and the OrthoMouse is the single mouse that has been designed to anatomically support both the thenar and hypothenar eminences. These two areas are the only ones in the hand prepared to support weight or pressure. This is also why these areas in the OrthoMouse have special texture, in order to reduce sweating and involuntary displacements.

Another relevant feature is the possibility of changing the speed of the pointer in the control panel to the fastest. The precision the OrthoMouse offers makes it possible to cover the entire screen with a displacement of less than 1 cm of the OrthoMouse on the desk, to each side. Of course, reducing displacement also means reducing possible efforts that the friction over the surface may cause. Furthermore, desktop surfaces that offer less friction will also require less effort.

Thus, noticing the rise of friction in the displacements of the OM does not happen often. In case the surface where the OM is being used is more adhesive, or not smooth enough, the use of a mousepad will solve this efficiently. The mousepad thickness may vary, but it should not be thicker than 3 or 4 mm.

The need to move the wrist or even the forearm, arm and shoulder is eliminated, and these movements are common causes of diseases and pain to the users.

The scrolling functions, usually available through the scroll wheel, are another cause of suffering for mice users, since it is necessary to work with fingers in awkward positions and with unbelievably awkward movements, for which the hands were not prepared, neither anatomic nor functionally.

The OrthoMouse has incorporated these functions in three buttons, all activated by the thumb. They perform every the scrolling functions provided by the scrolling wheels, as well as a few unique features, such as continuous upwards/downwards scrolling, graduated in speed and amplitude, only by clicking a button – no need to locate the scroll bar on the screen, or to roll the wheel. These buttons are activated with minimum force, from 15 to 25g, which means at the end of the day less Kg in efforts, when compared to the rolling of the scrolling wheel, which requires the hand to work in awkward positions and with awkward movements. Its use is easier and intuitive, and after a few minutes of use the fantastic difference of this system is clearly noticeable, favoring the care of the fingers. This is often mentioned by users as their favorite feature.

The possibility of configuring six different shapes and sizes to better adapt to the shape, form and function of hands and fingers of the users: they will find a series of options available in one product. It is not necessary to choose first (and maybe miss the best option) – the user receives all pieces so that he can test which one suits him best. He may share the OrthoMouse with other users, or may even use a different set up according to the use he is making of the OrthoMouse (casual or precision use).

It is very important to understand that the way in which all human beings write nowadays is precisely the same as it has been for thousands of years, and it has been achieved after hundreds of years of adaptive evolution. This is the same attitude that should be adopted to work with a computer mouse since the functions necessary when writing/drawing are precisely the same that mice needed to perform mice functions nowadays, namely:

1. The localization of a point in writing/drawing
2. Displacements to either side from this reference point
3. Auctioning of buttons, or wheels, or balls

Each one of these actions implies in positioning the hand and fingers in ways that depend on the mouse the hand has to deal with.

Summary:

The OrthoMouse offers:

1) Correct posture, similar to the one used for writing, with the hand and fingers assuming the "position of function" and in "passive adaptation".
2) Efforts absolutely minimized (buttons are activated through levers)
3) Functions that strictly respect orthopedic laws of form and function (displacements are controlled with the tip of the fingers; they are minimized in their range and maximized in sensitivity due to the special location of the movement sensor)
4) The OrthoMouse adapts to the hand and fingers, and not the other way round
5) Additional features such as texture (anti sweat and anti sliding) and feet that slide and are anti lock

These features present the OrthoMouse as the first choice for those who wish a tool that will help them in their IT tasks while allowing them to feel comfortable and safe, and not to fear the consequences of the use of most mice (inconveniences and even diseases, sometimes very serious ones) to their personal/professional future. Such is the case of Carpal Tunnel Syndrome. This is sometimes treated by surgery. Surgeons remain recommending this practice even though the first objective of medicine is the PREVENTION before anything else, mainly if the intervention is invasive, dangerous or if it may not grant minimum results.

The significant benefits of using forearm supports (in a similar attitude as in writing) have been detailed in journals such as the British Journal of Occupational and Environmental Medicine, 18-Apr-2006*.

http://www.eurekalert.org/pub_releases/2006-04/uoc--fsr041706.php

Public release date: 18-Apr-2006
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Forearm supports reduce upper body pain linked to computer use

Providing forearm support is an effective intervention to prevent musculoskeletal disorders of the upper body and aids in reducing upper body pain associated with computer work, according to a study in The British Journal of Occupational and Environmental Medicine.

Reported in the April 18 issue, the study shows that use of large arm boards significantly reduces neck and shoulder pain as well as hand, wrist and forearm pain. "Based on these outcomes, employers should consider providing employees who use computers with appropriate forearm support," said lead author David Rempel, MD, MPH, director of the ergonomics program at San Francisco General Hospital and professor of medicine at the University of California, San Francisco.

Study findings also show arm boards and ergonomics training provide the most protective effect, with a statistically significant reduction in both neck and shoulder pain and right hand/wrist/forearm pain in comparison to the control group, who did not receive forearm support. The boards reduced the risk of incidence of neck and shoulder disorders by nearly half.

According to the authors, musculoskeletal disorders of the neck, shoulders and arms are a common occupational health problem for individuals involved in computer-based customer service work. Specific disorders include wrist tendonitis, elbow tendonitis and muscle strain of the neck and upper back. These health problems account for a majority of lost work time in call centers and other computer-based jobs. "Extended hours of mouse or keyboard use and sustained awkward postures, such as wrist extension, are the most consistently observed risk factors for musculoskeletal disorders," Rempel added.

The one year, randomized study evaluated the effects of two workstation interventions on the musculoskeletal health of call center employees -- a padded forearm support and a trackball. The forearm support is commonly called an arm board and attaches to the top front edge of the work surface. The trackball replaces a computer mouse and uses a large ball for cursor motion.

The researchers tested employees from two customer service center sites of a large health maintenance organization. Employees had to perform computer based customer service work for a minimum of 20 hours per week in order to qualify for the study. For one year, 182 participants filled out a weekly questionnaire to assess pain level in their hands, wrists, arms, upper backs and shoulders.

Participants were randomized into four groups, each receiving a different intervention: ergonomics training, training plus a trackball, training plus forearm support, or training with both a trackball and forearm support. Outcome measures included weekly pain severity scores and diagnosis of a new musculoskeletal disorder in the upper extremities or the neck-shoulder region based on physical examination performed by a physician.

The trackball intervention had no effect on right upper extremity disorders. "The trackball was difficult for some participants to use," said Rempel. "Employees with hand pain may want to try them, but they should stop if it is difficult to use."

The researchers also performed a return-on-investment calculation for the study to estimate the effects of ergonomic interventions on productivity and costs. Their calculations predicted a full return of armboard costs for employers within 10.6 months of purchase.

"Based on this study, it is in the best interest of the company and the employees to provide forearm supports and training," Rempel concluded.

In the study, the authors also outline other ergonomic-specific tasks that employees who use computers can do to relieve pain on their own. They suggest employees take scheduled breaks, maintain an erect posture, adjust chair height so thighs are parallel to the floor, adjust arm support and work surface height so the forearms are parallel to the floor, adjust the mouse and keyboard location to minimize the reach, and adjust monitor height so that the center of the monitor is approximately 15 degrees below the visual horizon.

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Co-authors of the study include Niklas Krause, MD, PhD; Robert Goldberg, MD; Mark Hudes, PhD; and Gary Urbiel Goldner, MS, from the division of occupational and environmental medicine, UCSF; and Douglas Benner, MD, occupational health, Kaiser Permanente of Northern California.

The study was supported by a grant from the Centers for Disease Control/National Institutes for Occupational Safety and Health. Rempel has done consulting work for Logitech Corporation, which markets the trackball used in this study.

*Rempel D, Krause N, Goldberg R, Benner D, Hudes M, Goldner GU. A Randomized Controlled Trial Evaluating the Effects of Two Workstation Interventions on Upper Body Pain and Incident Musculoskeletal Disorders among Computer Operators. Occup Environ Med 2006, 63(5):300-306.