HandShoe Mouse Ergonomische Publikationen

Press (English)

The Importance of palmar support when using a mouse
Drs. ing. Paul C. Helder
(Published in Ergonoma Magazine, 2015-41)

Präsentationen

Prävention von Schmerz & Beschwerden May 2016
Drs. ing. Paul C. Helder
"Anatomie zeigt mehr als das, was von einem rein Ergonomischer Perspektive gesehen wird"

Evolution of the Computer Mouse – Prevention of Pain & Discomfort-2014
Drs. ing. Paul C. Helder
"Presentation slides of Ergo Expo Webinar 2014"

The implications of anatomy with regards to Ergonomic Aspects
Drs. ing. Paul C. Helder
"Why should Fingers, Hands and Arms be supported"
Presentation during Health and Wellbeing @ Work, 4-5 March 2014, Birmingham, UK.

Human Factors in Ergonomics
Drs. ing. Paul C. Helder
"Sources of Neck, Shoulder, Arm and Hand Complaints"
Presentation during Health and Wellbeing @ Work 5-6 March 2013, Birmingham, UK.

Research

Effects of the use of a special computer mouse : The HandShoe Mouse
van Zwieten, Koos Jaap; Schmidt, Klaus; Helder, Paul; Lippens, Peter; Zoubova, Irina & Zinkovsky, Anatoly (2011) In: Varzin, S.A.; Taraskovskaya, O. (Ed.). HEALTH – THE BASE OF HUMAN POTENTIAL : PROBLEMS AND WAYS TO SOLVE THEM. 6th ANNUAL ALL–RUSSIAN RESEARCH AND PRACTICAL CONFERENCE WITH INTERNATIONAL PARTICIPATION. Proceedings of the Conference,p. 236-241. [Paper – cat: A2]

Summary:

Biomechanical research has shown that a palm supporting surface provides a better solution to prevent neck, shoulder, arm and hand complaints. For example in view of the reduced or possible absence of grip forces a computer mouse design according to this concept is to be preferred. An additional point of attention is the angle of the supporting surface. This angle can have a significant (negative) effect on muscle tension for example in the "neutral (900 supination) or handshake position".

Clinical Biomechanics

Publication by professor Han-Ming Chen et al in Clinical Biomechanics 22, 2007, 518-523 (PDF 396 Kb)
"The effect on forearm and shoulder muscle activity in using different slanted computer mice"

Summary:

Background information on how to work in a comfortable position is provided, for example the positive effects of a slanted mouse (palm supporting area at an angle of 25° or 30°).
Forearm and shoulder muscle activity will reduce in this position.
Increasing the slanted angle will result in a larger wrist extension and thus higher muscle activity.
Working with hand and forearm at a suitable slanted angle provides a more neutral hand position, so forearm and shoulder muscle activity will be reduced.
This paper also addresses possible sources of carpal tunnel pressure (CTP).

Effects of forearm and palm supports on the upper extremity during computer mouse use.
Onyebeke LC, et al. Department of Environmental Health, Harvard School of Public Health, 677 Huntington Avenue, Boston, MA 02115, USA.
Applied Ergonomics 2013 Sep 18. pii: S0003-6870(13)00158-0. doi: 10.1016/j.apergo.2013.07.016.

Summary:

The use of forearm and hand support is associated with less shoulder muscle activity and shoulder torsion while palm support is associated with less wrist extension. This type of support also results in lower applied forces to the mouse body. Participants reported less musculoskeletal discomfort when using a support.
It should be noted that some aspects addressed in this paper must also be looked at from the perspective of findings by other researchers presented in this overview of publications.

Assessment of the musculoskeletal load of the trapezius and deltoid muscles during hand activity.
Publication by Danuta Roman-Liu, et al. Department of Ergonomics, Central Institute for Labour Protection, Warsaw, Poland. INTERNATIONAL JOURNAL OF OCCUPATIONAL SAFETY AND ERGONOMICS 2001, VOL. 7, NO. 2, 179–193

Summary:

This study addresses the upper back and shoulder muscle loads (Trapezius and Deltoid).
Tasks which require a certain amount of precision have a specific effect from a muscle load perspective such as:
1. precision tasks require accuracy of movement and thus result in higher muscle tension
2. higher muscle tension also results from stress and or difficulty / complexity of tasks.

It is therefore important to realize that hand activities have a significant effect on the Trapezius muscle (not Deltoid). On the other hand, not supporting the forearm will have an effect on the Deltoid muscle to stabilize the arm.

J Electromyogr Kinesiol.
Publication by B. Visser and J.H. van Dieën 2006 Feb; 16(1):1-16. Epub 2005 Aug 15.
"Pathophysiology of upper extremity muscle disorders"

Summary:

The negative effect due to low intensity tasks like working with a computer mouse is a source of complaints. The force generated at sub-maximal levels engages only a fraction of the muscle fibers available, motor-units (MUs), and may cause damage of these MUs, the so called ''Cinderella hypothesis''.
Due to corresponding impaired local blood flow this may also lead to a restriction of metabolite (residual substances from cellular processes) removal in the muscles. Key-factor for damage is the duration of this type of continuous muscle activity. Experiments confirm this continuous activity in Trapezius muscle as well as Extensor muscles in the forearm when using a computer mouse.

Chirurgie de la main 26 (2007)255-277

Publication by Marc Soubeyrand, Clarisse Lafont, Renaud De Georges, Christian Dumontier "Pathologie traumatique de la membrane interosseuse de l'avant-bras Traumatic pathology of antibrachial interosseous membrane of forearm"

Summary:

The forearm bones which connect wrist and upper arm (Humerus) are not parallel.
The bone at the little finger side or Ulna is straight while the other bone, the Radius, is arched.
During rotation of the hand and forearm the distance between these 2 bones therefore varies.
With this, the tension in the connecting sheath (fibers) between these two bones, the interosseous membrane (IOM) also varies.
The images included in this paper clearly show the effect on the IOM as a result of rotation of the forearm (Fig 1 and 5).

Health – the base of human potential: problems and ways to their solution 2010

Publication by prof. K.J. van Zwieten et al. Fifth all Russian Scientific-Practical Conference with international participants, Materials of the conference. p. 303-308.
"Interosseous membrane (IOM) extreme tautness in forearm neutral position, evident from in vitro anatomical observations, strongly
suggests unwished effects on fingers and thumb long muscles, during repetitive tasks in vivo"

Summary:

The interosseous membrane (IOM) connected to both forearm bones (Ulna and Radius) has a significant effect on pain receptors (proprioception- and pain-registering organs). The IOM is in some positions lax and in others extremely taut for example in the so called "neutral or handshake position". Why is this of importance?
The long muscles of the fingers, especially index finger and thumb originate from this membrane and therefore effect the tension in this sheath and its connection to Ulna and Radius.
Loads exerted by these muscles are therefore super imposed on the already taut membrane.
This so-called "neutral" position is therefore a possible source of muscular and other damage during longstanding repetitive movements of thumb and fingers and cause pain.

14th Euron PhD Days. p. 62-63

Publication by F. Narain and prof. K.J. van Zwieten et al.
Publisher: Prof. Dr. Harry Steinbusch, Director, European Graduate School of Neuroscience (Euron)
"*Devices to prevent repetitive strain injuries should take into account bony characteristics determining the behaviour of the interosseous membrane (IOM) in supination, neutral position, and pronation of forearm and hand"*

Summary:

Preliminary studies of the interosseous membrane (IOM) entailed anatomical specimens of the forearm. To simulate movements, true to life samples supple enough to simulate the behavior, were used.
The so called neutral position of the forearm entails the Ulna (bone) with opposite the arched curvature of the Radius (bone). This creates the largest distance between these bones, causing the IOM to be taut. In the opposite position, pronation (Ulna and Radius crossed) the IOM borders approach each other, causing the membrane to become lax.
It is significant to note that these characteristics of Ulna and Radius cause the IOM to be either lax or taut and thereby possibly cause different proprioceptive neural signals.
The use of vertical computer-mice in a "handshake" position should therefore be re-

evaluated in view of the observed IOM tautness demonstrated in this study.

PhD thesis by Dr F. Narain

University of Hasselt, Faculty of Medicine and Life Sciences, Diepenbeek, Belgium

"Foot inversion and eversion in stance and swing of the gait cycle of the hind limb of the opossum (Didelphis marsupialis) some comparative-anatomical and functional-morphological aspects"

Summary:

Lower arm and hand muscles – reference

Functions of some finger joints while handling the PC mouse, and their possible relevance for computer aided learning

VAN ZWIETEN, Koos Jaap; Hotterbeekx, An; Thywissen, Carlo; Helder, Paul; LIPPENS, Peter; SCHMIDT, Klaus; ZOUBOVA, Irina; Piskùn, Oleg; Varzin, Sergey & Zinkovsky, Anatoly (2010) .
In: Auer, Michael E. & Schreurs, Jeanne (Ed.) Academic and Corporate E-Learning In a Global Context. p. 1098-1101. [Conference paper – cat: C2]

Summary:

Finger use while handling a computer mouse can have a detrimental effect on the joints. Switching requires significant movement of – and corresponding forces exerted in the index finger and thus tendons, in particular the Proximal Interphalangeal (PIP) joint.
A stabilized arch of the moving finger is realized by means of flexor – and extensor tendons. The functional demand of such a stabilized arch can be met by designing a pre-shaped computer mouse to prevent disorders.

Finger Proximal Inter Phalangeal (P.I.P.) Motion : Joint Surfaces and Ligamentous Geometries Are Interrelated
van Zwieten, K. J.; Schmidt, K. P.; De Munter, S.; Kosten, L.; Hotterbeekx, A.; Lippens, P.L.; Adriaensens,
P.; Lambrichts, I. & Geusens, P.P. (2011).
In: Varzin, S.A.; Taraskovskaya, O.Y. (Ed.). HEALTH – THE BASE OF HUMAN POTENTIAL : PROBLEMS AND WAYS TO SOLVE THEM. 6th ANNUAL ALL – RUSSIAN RESEARCH AND PRACTICAL CONFERENCE WITH INTERNATIONAL PARTICIPATION. Proceedings of the Conference, 24th – 26th November, 2011, St. Petersburg State University, St. Petersburg State Polytechnic University, St. Petersburg, Russia, ISSN 2076-4618, p. 231-236.

Summary:

Why should fingers be supported and critical loads prevented?
The Proximal Inter Phalangeal (PIP) joint is a significant joint in the action required to operate key board and mouse switches. It is not a simple hinge, it is complicated and thus critical (rheumatoid arthritis and or osteoarthritis).
For example the analyses of PIP joints has shown that bands holding the joint together consist of inelastic fiber bundles. These bundles serve to connect the two articulating bones which make up the PIP joint i.e. the proximal phalanx´s head and the middle phalanx´s base. It may therefore be concluded that a stabilized arch as support relieves finger loads.

Possible morphological substrates in the pathogenesis of rheumatoid arthritis in human finger joints
K.J. van Zwieten, I. Lambrichts, B.S. de Bakker, L. Kosten, S. De Munter, P. Gervois, P.

Adriaensens, K.P. Schmidt, P. Helder, P.L. Lippens – Amsterdam, Hasselt-Belgium, Rotterdam

***Summary**:*

It is of importance to realize the significance of the function of our joints and thus the possible negative effects due to overloading. This paper sheds new light on the possible sources of rheumatoid arthritis in human finger joints. The joint's "wear and tear" are well recognized as contributory factors.

Noninvasive photoacoustic tomography of human peripheral joints toward diagnosis of inflammatory arthritis

Xueding Wang, David L. Chamberland and David A. Jamadar
Department of Radiology, University of Michigan School of Medicine, Ann Arbor, Michigan 48109, USA, Division of Rheumatology, Department of Internal Medicine, University of Michigan School of Medicine, Ann Arbor,
Michigan 48109, USA OPTICS LETTERS / Vol. 32, No. 20 / October 15, 2007

Summary:

This study indicates the importance of new technologies for early diagnosis of inflammatory joint disorders and accurate monitoring of disease progression and response to therapy.

The Proximal Interphalangeal Joint, Anatomy and Causes of Stiffness in the Fingers

K. Kuczynski, Edinburgh, Scotland
From the Department of Anatomy and Orthopaedic Surgery, University of Edinburgh
The Journal of Bone and Joint Surgery, vol.50 B, no. 3, August 1968, p. 656-663

Summary:

This paper addresses the various joints of our fingers and mentions that some are rather complex and more susceptible to injury; especially the Proximal Inter Phalangeal (PIP) joint, used extensively to operate key board and mouse switches. The study was undertaken to find out more about the anatomy of the PIP joint and its liability to stiffness and to determine whether any particular position for immobilization might prevent complication. For example an arched (support) position is preferred.
Note: a stabilized arch can be realized by designing a pre-shaped computer mouse.

Health conference St. Petersburg, Nov.2009

Publication by prof. K.J. van Zwieten et al.
"Hand Positions in scrolling, as related to PC-workers' dystonia and treatment of dystonia by means of vibrostimulation and external shock waves therapy"

Summary:

In this paper the subject of moving from the wrist and its detrimental effect is addressed. For example, moving the wrist sideward (wrist snap), gradually leads to some enlargement (increased volume) of wrist flexor muscles at the elbow, which in some cases may cause ulnar nerve compression and thus damage in this region.

Russian Scientific Practical Conference, Nov. 2008

Publication by prof. K.J. van Zwieten et al.
"Lower arm and hand muscles in focal dystonias – some anatomical and therapeutic aspects"

Summary:

The study addresses the various motions when handling a computer mouse and its corresponding muscle combinations. For example when one shifts the hand (palm downwards) to move a computer mouse over a desktop, repeating these movements frequently, the muscles of trunk, shoulder, upper and lower arm may become irritated (RSI). Furthermore, a slightly bowed finger, in a stabilized (unsupported) position, essential for finger movements to operate a key board and a regular mouse, may result in muscular imbalances and eventually lead to RSI.

Department of Dermatology; a Department of Orthopedics; Izzet Baysal University, 14280 Golkoy Bolu, Turkey
Publication by Goksugur N. et al in J Am Acad Dermatol. 2006 Aug; 55(2): 358-9
"A new computer-associated occupational skin disorder: Mousing callus"

Summary:

The paper describes a condition called mousing callus with a patient who had been using a computer mouse for many hours a day during an extensive period of time. This resulted in a thickening of the skin at the little finger side near the wrist due to pressing down of the hand on the desktop and working from the wrist.

Department of Dermatology, Baylor College of Medicine, Houston, Texas 77030, USA
Publication by Lewis A.T. et al in J Am Acad Dermatol. 2000 Jun;42(6):1073-5
"computer palms"

Summary:

In this study the effect of pressure and shear is described for example due to leaning forward and resting on the hand palms. Long term, although less excessive pressure may lead to an increase of blood flow to skin tissue and possibly irritation. Examples are presented of the ulnar surfaces being affected.

Department of Occupational Dermatology Academic Hospital Free University, Amsterdam, The Netherlands
Publication by Vermeer M.H. et al in J Am Acad Dermatol. 2001 Sep;45(3):477
"Mouse fingers, a new computer-related skin disorder"

Summary:

Here a case of fingertip irritation is reported. The patient operated the computer mouse with his right hand in which the palmar side of the affected fingertips made contact with his mouse pad. Apparently the repetitive friction, pressure, and shear between the finger and the mouse pad led to the development of his eczema.
Note: a palm supporting computer mouse which prevents skin contact in accordance with the above is therefore to be considered.

TBV 14, nr.6, july 2006
Dutch publication by Helder, P.C., Snijders, C.J., Krullaards, R.L.
"Result of the use of a hand supporting computer mouse by patients with neck and shoulder complaints". (in Dutch).
English summary at the bottom of this page.

Summary:

Results of the field study show the significance of the introduction of a hand palm and finger supporting computer mouse. Various evaluated options resulted in a computer mouse body shape which proved to provide relaxation in the kinetic chain consisting of fingers, hand, forearm, arm, shoulder and deep neck muscles.

Results were promising as absenteeism was significantly reduced with the introduction of this mouse in the daily operating environment of administrative staff.
A reduction of excessive gripping and pinching as well as hovering of the fingers was noted.
The supporting body of the mouse allowed for a relaxed hand and finger position.

HandShoe Mouse Patents

The HandShoe Mouse is patented all over the world. Here is a link to our US HandShoe Mouse patent (US8098229)

and to another US HandShoe Mouse patent US7212191.

Here is another link to our European patent 1896927