Neck Shoulder Arm Hand and Finger Complaints
the Positive Effects of
the use of a special computer mouse

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Wednesday March 6, 2013

www.handshoemouse.com
Fit for Work

Musculoskeletal Disorders in the European Workforce

- 40 million workers in Europe are affected
- Repetitive Strain Injury (RSI) costs, €2.1 billion per annum

for The Netherlands only

* An increase in incidence of RSI is noted
* Fit for Work Musculoskeletal Disorders in the European Workforce, September 2009

www.fitforworkeurope.eu
Contributing factors are

- static forces
- repetitive strains
- awkward postures
- environment, various sources of stress
Fundamental and Field Research shows relaxation in neck, shoulders, arms, hands and fingers can be realized.
Irritation of Muscles

Some causes

- moving the wrist sideways
- hovering of hand and fingers
- over extension of the wrist
- excessive pronation and supination
- gripping and pinching
Irritation of muscles in forearm

Ulnar deviation, moving the wrist sideways

Extensor Carpi Ulnaris Muscle

Publication

Hand Positions in scrolling, as related to PC-workers' dystonia and treatment of dystonia by means of vibrostimulation and external shock waves therapy by prof. K.J. van Zwieten et al. (2009)
Irritation of muscles in forearm

Hovering of hand and fingers

Extensor Digitorum Muscle
Irritation of muscles in forearm

Excessive pronation and supination
Supination towards vertical and behaviour of the Interosseous Membrane (IOM)

A near to vertical supination angle

Objects force hand and forearm in a strained position, Ulna and Radius determine the behaviour of the Interosseous Membrane.
Behaviour of Ulna and Radius

Behaviour of the Interosseous Membrane

- maximum pronation, Ulna and Radius crossed, IOM lax
- supination, Ulna and Radius partly follow each other’s curvatures, leaving the IOM undulated and lax
Behaviour of the Interosseous Membrane

Ulna and Radius in plane, IOM taut

Publication

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 by prof. K.J. van Zwieten et al. (2010)
Relaxed hand position

Publication

The effect on forearm and shoulder muscle activity in using different slanted computer mice by prof. Han-Ming Chen et al. (2007)
Cinderella Effect

It is not a fairytale
EMG data from Fundamental Research

Proto type

Regular mouse

EMG values show the level of muscle activity
Exertion of static forces

1. extensor carpi radialis longus (red line)
2. extensor carpi radialis brevis (yellow line)

- tonic muscles act continuously
- special motor units (type I muscle fibers) control lesser forces

EMG measurements executed by IDEE University of Maastricht
Recommendation

Prevent the Cinderella Effect

Prevent exertion of unnecessary static forces

- over 4% Minimal Voluntary Contraction (MVC) already causes irritation

- repetitive movements result in discomfort

Be aware to keep EMG values low

Publication

The effect of increased tension

Deep Neck Muscle Tension

Reduction of space between first rib and clavicle bone
Compression of Arteries, Veins and Nerves

Nerves from Brachial Plexus

Costoclavicular Gate
Possible result

- pain, discomfort
- numbness
- tingling
- pins-and-needles
- obstruction of flow
Recommendation

**Objective should be a low EMG and MVC value**

Relaxation may result in:

- improved blood flow in arms and hands
- enhanced comfort and health

**Publication**

Forearm support and slanted forearm position

Forearm support

Trapezius muscle and other muscles in the kinematic chain

Extensor Digitorum Muscle
The effect of forearm support and slanted arm angle

- supination at ~ 25° leaving the IOM lax
- Pronator Teres muscle and Upper Trapezius muscle activity decrease
- hand support provides relaxation of Extensor Digitorum muscle
- relaxation of Extensor Carpi Ulnaris muscle

Publications

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 by prof. K.J. van Zwieten et al. (2010)

The effect on forearm and shoulder muscle activity in using different slanted computer mice by prof. Han-Ming Chen et al. (2007)
Significance of supporting fingers

Intense use of fingers

- key board and mouse switches
- fingers remain elevated
- joint is not a simple hinge, it is more complicated

Proximal Inter Phalangeal (PIP) Joint
Proximal Inter Phalangeal Joint

The following structures could be identified, research ongoing

Publication

Finger Proximal Inter Phalangeal (P.I.P.) Motion: Joint Surfaces and Ligamentous Geometries Are Interrelated by prof. K.J. van Zwieten et al. (2011)
Stabilised Arch

Mouse body should support fingers

- extensor and flexor tendons
- 4-bar linkage system in ligaments of PIP joint

4-bar linkage system

Transverse section PIP Joint - modified after Wang et al.
4-bar linkage system of PIP joint
It is easy to imagine to damage this vulnerable joint.

A damaged structure leads to a disturbed function – disease.
Stabilised Arch

Mouse body should support fingers

not like this

like this
Supporting hand and fingers protects against disorders

Publications

Functions of some finger joints while handling the PC mouse, and their possible relevance for computer aided learning by prof. K.J. van Zwieten et al. (2010)

Finger Proximal Inter Phalangeal (P.I.P.) Motion : Joint Surfaces and Ligamentous Geometries Are Interrelated by prof. K.J. van Zwieten et al. (2011)

Noninvasive photoacoustic tomography of human peripheral joints toward diagnosis of inflammatory arthritis by prof. Xueding Wang et al. (2007)

The Proximal Interphalangeal Joint, Anatomy and Causes of Stiffness in the Fingers by prof. K. Kuczynski et al. (1968)
Summary

- RSI is a significant cost for society
- recent research shows positive and promising intervention results
- major sources of complaints are identified
- fitting hardware solutions can be provided
- influence of stress on “up time of staff” is noted
Reactions and Questions

Thank you, Paul Helder
The effect on forearm and shoulder muscle activity in using different slanted computer mice
by prof. Han-Ming Chen et al. (2007)

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
by prof. K.J. van Zwieten et al. (2010)

Hand Positions in scrolling, as related to PC-workers' dystonia and treatment of dystonia by means of vibrostimulation and external shock waves therapy
by prof. K.J. van Zwieten et al. (2009)

Pathophysiology of upper extremity muscle disorders
by B. Visser and J.H. Van Dieën (2006)

Functions of some finger joints while handling the PC mouse, and their possible relevance for computer aided learning
by prof. K.J. van Zwieten et al. (2010)

Finger Proximal Inter Phalangeal (P.I.P.) Motion : Joint Surfaces and Ligamentous Geometries Are Interrelated
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The Proximal Interphalangeal Joint, Anatomy and Causes of Stiffness in the Fingers
by prof. K. Kuczynski et al. (1968)

Effects of the use of a special computer mouse: The HandShoe Mouse
by P.C. Helder et al. (2011)

Result of the use of a hand supporting computer mouse by patients with neck and shoulder complaints. (text in Dutch)
by P.C. Helder et al. (2006)
Abstract in English http://www.handshoemouse.com/research-2.html

Reference www.handshoemouse.com/publications.html