

Hand and Arm Support for Computer Workstation

Ghi-Hwei Kao and T.K. Philip Hwang

National Taipei University of Technology
No.1, Sec. 3, Zhongxiao E. Rd., Da'an Dist., Taipei City 10608, Taiwan
ghi.box@gmail.com, phwang@ntut.edu.tw

Abstract. Individuals who spend long hours leaning on the desk in tasks like writing, typing or operating a mouse often suffer from Cumulative Repetitive Stress such as Tendonitis, Carpal Tunnel Syndromes and general tissue pain. Increased instance of excessive mechanical stress in the shoulders can also be a product of improper wrist and forearm support. This study use Rapid Upper limb Assessment to examine user's working action and posture on writing, typing and mouse operation. Proposed wrist support and palm inclined plane were attached at the table edge for improving desk support structure. Users test was carried out to validate the usability of wrist support design with positive result.

Keywords: arm support, occupational musculoskeletal symptoms, working area.

1 Introduction

Improper posture is generally referred to a fixed or restricted limb position, as well as the following poor conditions:

- The over-uploaded muscles and tendons,
- The asymmetric force of Joint,
- Sustained isometric strength.

Squire (1956) pointed out that when the elbow moving on the desk for working, it should consider the whole arm interactions which include hand, upper and lower arm. When using a keyboard, the user generally adjusts his/her upper and lower arm to adapt the fingertips to the keyboard. To avoid twisted and asymmetrical positions, employed rules of normal and maximum working area were employed to define the horizontal working area that includes:

- supporting area, upper body and arm support,
- working area: visual work and data inputting work, and
- Storage area.

When working at computer workstation, the user employs his/her forearms for keyboard and mouse operation that causes the arms to be held in a support-less

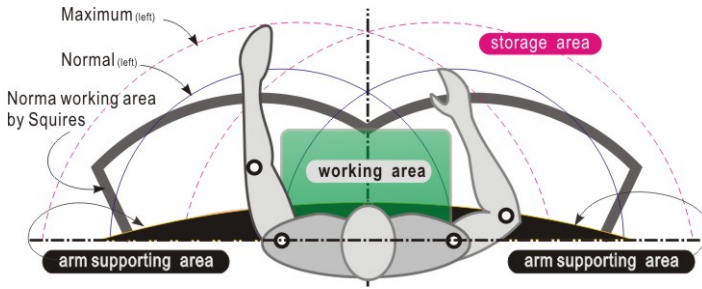


Fig. 1.

position. A lack of support leads to stress on the shoulder muscles, and an extra circulatory burden on the heart (Pheasant, 1998). Therefore, there are two areas; supporting and working areas; the body is using for computer work like typing, writing and using mouse. When using a mouse, the forearm is always resting on the desk surface. If the forearm couldn't rest on the table edge, the user's arm must move vertically and horizontally, it will be supported by the movement of the 3rd lever from the shoulder, it will make user feel pain from the shoulder stress. (Kunz, 2006).

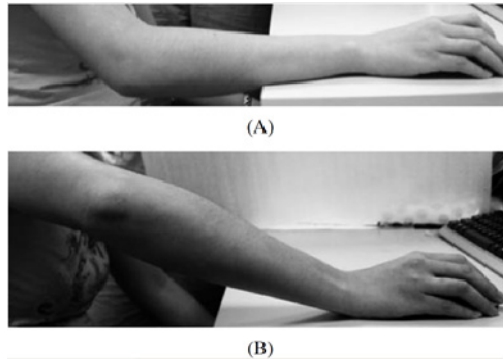


Fig. 2.

Heretofore, a lot of Ergonomics focuses on people's back and proper seating when working, people also potentially stressing or injuring on neck, shoulders and wrists. Actually, whether people are using a mouse or a keyboard, a proper wrist support is important. It not just for the wrists and helping to prevent Repetitive Strain Injury and Carpal Tunnel, but also for the shoulders, which hold a lot of tension from the awkward position. Many studies (Harvey & Peper, 1997) point out that the wrist should keep in a nature angle when typing.

Following are the gel wrist support from the market displaces pressure points and provides comfort while computing.



Gel filled wrist support. Flexible gel filling helps reduce wrist strain and discomfort whilst working on the PC.ⁱ



Hypoallergenic memory foam molds to the body's contours to provide maximum support and help relieve wrist discomfort.ⁱⁱ



Keeps wrist in ergonomically correct position. Platform can bridge desk corners and help extend desk edge.



Compact and portable Wrist Support helps prevent and alleviate mouse arm.

Many market keyboards have the ability to alter their angle with the little legs on the bottom. A wrist rest can also be found and they make them both for keyboard and on mousepads. Arm and wrist support apparatus have been designed to accommodate either the arm or the wrist, even both. Some devices are fixed on chair as an arm. Following are the resting wrists on desktop when working on the keyboard or mouse causing awkward wrist postures.

ⁱ Wrist Support with Gel, retrieve from:

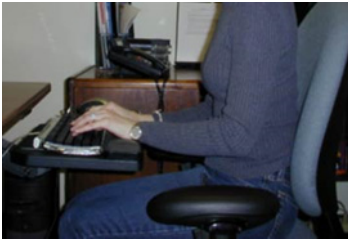
<http://www.durable-uk.com/gb/products/detail/5749/wrist-support-with-gel.html>

ⁱⁱ Memory Foam Wrist Pillow Platform I, retrieve from:

<http://www.cleansweepsupply.com/pages/item-kmw62819.html>



Positive slope of keyboard tray causes awkward wrist postures.



Position keyboard tray flat or slightly negative.

2 Design Solution

Fig 3 shows the 3 forearm positions on the desk: wrist on the edge of the desk (A), half of the forearm on the desk (B), and whole forearm on the desk (C)ⁱⁱⁱ.

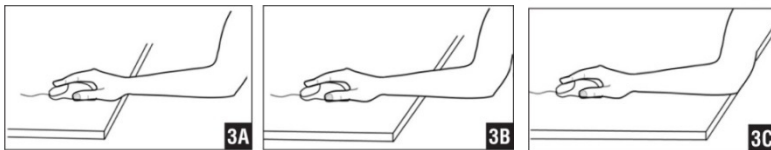


Fig. 3. Forearm positions on the desk

According to somatoscope, the limb is an open chain composed by the rotation joints which surround shoulder joint, the mechanical of limbs are the third class lever. A lever system includes a fulcrum (F), a load (R) which can be due to mass and/or resistance due to friction, and a force generating system (E) which in our case is skeletal muscle contraction. Most muscles in body are involved in Third Class Lever systems.

The way to improve the 3rd class lever force structure is to offer a support between wrist and elbow, that's the reason why people always lean their body on the table edge.

ⁱⁱⁱ Contact Pressure in the Wrist During Computer Mouse Work I, retrieve from:

< <http://www.healio.com/orthopedics/journals/ortho/%7B191a0519-bc3e-4e2b-8193-396ee88d0437%7D/contact-pressure-in-the-wrist-during-computer-mouse-work> >

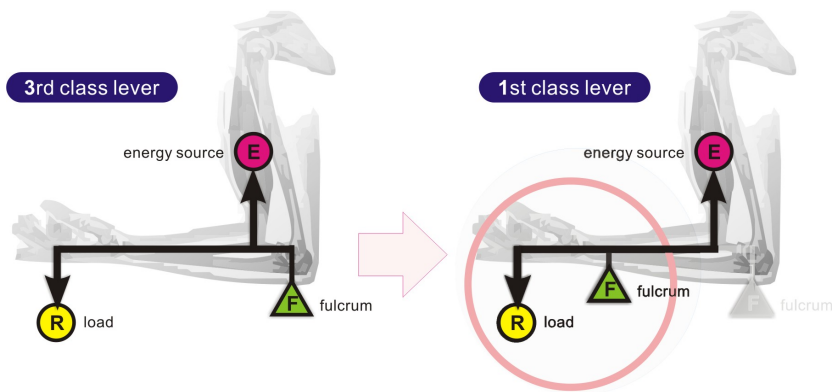


Fig. 4.

Although table edge provide forearm a support which might reduce the stress from the shoulder, but it cannot keep the arm and wrist in a nature position, because the wrist would bent up to provide the space for fingers to move, and it might cause to the Carpal Tunnel Syndromes.

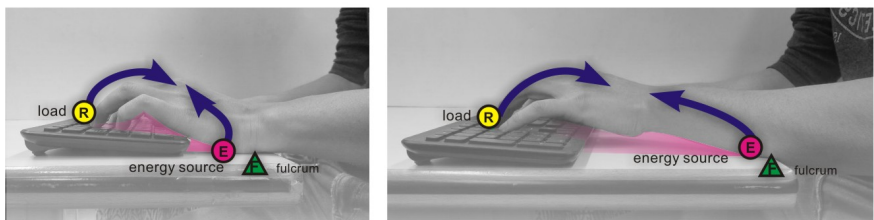


Fig. 5.

After the study, proposes a solution for this situation, the design features are as fig 6:

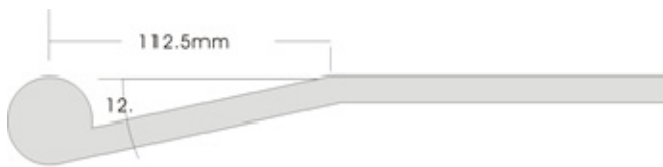


Fig. 6.

- The wrist support design provide wrist with a proper support and shift the 3rd class lever movement into the 1st class lever movement which is a better mechanical structure for user to work on table.
- A 10cm in 12 degree inclined plane for palm to rest in. It enables palm to accommodate as another support point which is closer to operating fingers than that of forearm support from table edge in traditional design. Short lever support can effectively reduce the stress from arm and shoulder.
- The positive 12 degree slope can easily adjust the hand, wrist and arm into a nature and proper way in force.

This desk edge include the flat surface for fingers tasks, a 12° inclined plane for palm rest and 2 cm cylindrical curved edges for wrist to reduce over-stretching.

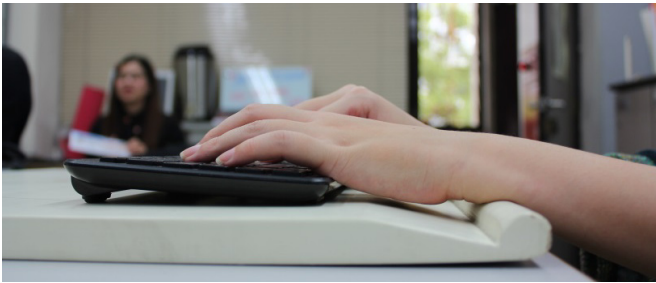


Fig. 7.

In addition to using the keyboard, and also for the use of the mouse or writing.



The advantages of this design are:

- Share the forearm load from the supporting.
- Ability to avoid unnatural upper limb.
- Reduce energy consumption.
- Better fingers typing activities.

3 Conclusion

This study aiming to provide the computer user with design of nature carpal angle and carpal posture. The findings as follows:

- A 12 degree inclined plane palm rest can offer a space for carpal flexion and extension;
- the wrists can stay nearly horizontal condition;
- carpal flexion and extension affect the degree of ulnar deviation as well as radial deviation;
- When carpal flexion and extension takes places, muscles gain more pain because they might increase the load of flexor in order to balance ulnar deviation and radial deviation.

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