Constrained Postures and the Design of Keyboard for VDT Work

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I. Introduction

Recently much attention is directed to the VDT (Visual Display Terminal) workstation design to prevent physical discomforts and pain among office workers.

The keyboard design with the parallel arrangement of the rows is more than 100 years old. The so called QWERTY arrangement of the keys, which was developed by Sholes, has been recommended as the standard key arrangement in many ergonomic guidelines around the world. The standard keyboard requires an extreme constrained posture of the hands and arms, and even a static postural effort of the neck and trunk. A new concept of keyboard design should be ergonomically guided by keyboard operating postures which are characterized by the keyboard as well as relevant workplace dimensions.

II. A new ergonomically designed keyboard

The split keyboard which has the two halves being located on inclined surfaces to provide forearm-hand support was developed by Grandjean *et al.* (1981) and Nakaseko *et al.* (1985). A final model of the split keyboard is shown in Fig. 1.

Fig. 1 The final model of the splitkeyboard

In a systematic experimental study comprising 51 female subjects (average age: 25 years (18-46 years), average body height: 166cm (158-173cm)), the adjustable split keyboard models were compared with two standard keyboards with or without forearm-hand support. The results disclosed a clear preferred setting of two half keyboards with an opening angle of 25°, a lateral inclination of 10°, a frontal inclination of 8°, a distance of 9.5cm between the keys "G" and "H", a hand-configured design of the keys, and a large forearm-hand support (26cm from home row to front edge). Using adjustable tables and chairs, the split keyboard with large forearm-hand support allowed a backwards leaning posture, which is associated with a lowered pressure inside of the intervertebral discs and with a decreased muscle activity in the back (Andersson *et al.* 1974).

From these two laboratory studies with trained and skilled typists the following results were obtained:

1. Preference

From the subjective evaluation concerning physical discomforts, pain, and keyboard operation, 78% of the 51 subjects preferred one of the split keyboard models. More than two thirds of these subjects preferred the split keyboard with large forearm-hand support.

2. Reduced ulnar abduction and pronation of the hands

Especially, the opening angle of the two half keyboards was an important factor to reduce the ulnar deviation of the hand from 20° to 10°. Lateral and frontal down-inclination of each half of the split keyboard reduced an extreme pronation of the hands, for which an usual pronation angle is 80°-90° when using the standard keyboard. Both of the

Fig. 2 Median values of rating feeling as "relaxed" or "tense" which recorded during the task

reduced effects decreased the risk of discomforts and pain in the forearms and hands.

3. Reduced subjective tension during the task

In comparing the successively changes of the subjective feeling of the two split keyboard models and the standard keyboard, a distinct difference of subjective tension was found at round 15 min after the task as shown in Fig. 2.

4. Split keyboard-guided backwards leaning posture

The split keyboard with large forearm-hand support had effects that the trunk leaned more backwards. This was associated with the larger shoulder-key distance of 44cm and the more opened elbow angle of 97°.

Fig. 3 shows that the preferred keyboard levels are quite high, compared to the ergonomic standards or recommendations for typing and VDT work. On the other hand, the seat heights above floor were no significant differences among the keyboard models. It is suggested in this respect that the preferred postures are related to office furniture dimension in addition to body dimensions.

5. Forearm and hand support required keyboard operation

When using the standards keyboard, the following keyboard operating postures are often observed: The operators sit close to the table and keep their

Fig. 3 Comparison of mean values and standard deviations of the preferred seat and keyboard heights

arms in the air as well as in a lower position. The pressure load of rested forearm-hand on the support was obviously higher in the large support condition (average pressure load: 39N) than in the small one (19N) as shown in Fig. 4. For both of the split keyboard models, the pressure load was nearly steady during the typing task while the load for the standard keyboard with large forearm-hand support gradually increased from 27 to 40N.

III. References

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Fig. 4 Mean values of exerted pressure by forearm-hands on the support

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