

Electromyographic studies of job rotation

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Job rotation means that the worker changes between different tasks in an attempt to create variations in the work situation and to reduce the effects of harmful muscular loads associated with individual tasks. Job rotation is typically applied in assembly work in the electronic industry to reduce full workday static load. This practice is based on the assumption that, by varying tasks, the worker varies work postures and movements, hence the muscles involved, and thus distributes the load over different muscles during the workday.

The aim of the present electromyographic (EMG) examination of the load on some shoulder muscles in a number of work situations in which job rotation has been introduced was to analyze the myoelectric activity levels during the different tasks for qualitative and/or quantitative differences.

Different groups of workers were selected for the study. Assembly work with small low-weight objects in the electronics industry included telephone and telephone jack assembly, and the mounting of electronic components on printed circuit cards. The different steps in glass blowing were used to represent a more dynamic type of industrial work. Different tasks in mining work were selected to represent a heavy and dynamic type of work.

Examined groups

Telephone assembly was studied with three female workers aged 30—49 years. They normally rotated between seven different assembly tasks. These seven tasks and four other tasks were examined.

Telephone jack assembly was studied with four female workers aged 21—63 years. They normally rotated between six different assembly tasks, which were all included in the study.

The mounting of electronic components on printed circuit cards was studied with four female workers aged 21—27 years. They normally rotated between the two different tasks of mounting and inspecting/correcting the mounted circuit cards. The study involved these two tasks and an additional assembly task.

Glass blowing was studied with nine male glass blowers aged 22—52 years. The five most skilled glass blowers rotated between five different tasks, while the

remaining four glass blowers only rotated between three different tasks.

Mining work was studied with five male miners aged 22—45 years. They normally rotated between five different tasks, some being very heavy manual work and others being fairly light work such as operating scoop-loaders and drilling platforms.

Methods

Of the neck and shoulder muscles the upper, descending portion of the trapezius muscle was the only shoulder muscle examined in the three subjects assembling telephones and in the nine glass blowers. In the remaining subjects the infraspinatus muscle and the anterior portion of the deltoid muscle were examined bilaterally in addition to the examination of the trapezius muscle.

The myoelectric activity was recorded by means of disposable bipolar surface electrodes placed with an interelectrode distance of approximately 2 cm. The pre-amplified myoelectric signals were transmitted with telemetry and recorded on a multichannel tape recorder. Simultaneously with the tape recording the signals were also monitored on an oscilloscope and with an ink writer.

To facilitate a comparison of the EMG activity in a subject's different muscles and the activity in specific muscles between individuals, the electromyogram was normalized. A ratio (the percentage of reference voluntary contraction) was obtained, in most cases, in the following way: the percentage of the EMG levels recorded during the different worktasks was calculated in relation to the activity level recorded during an isometric maximum voluntary test contraction performed for each muscle in a standardized position (1).

The amplitude distribution of the RMS-detected normalized myoelectric signals obtained during the different worktasks was analyzed by means of a micro-computer (ABC 800). From the histograms of the amplitude distribution the static, median, and peak load levels (corresponding to probability levels 0.1, 0.5, and 0.9) were determined (2, 3, 4).

For each subject the histograms of the amplitude distribution for the different tasks were compared. The possibility was considered that there might be a positive physiological effect of job rotation on the muscles in those cases in which the histograms from different tasks markedly differed from each other qualitatively and/or quantitatively.

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Results

Only the results for the upper portion of the trapezius muscle are summarized in this report. From a clinical and functional point of view of anatomy this muscle has been regarded to be the most interesting of the three muscles examined. In general the results from the infraspinatus and deltoid muscles roughly corresponded to those of the trapezius muscle.

All the different tasks of assembling telephones roughly resulted in qualitatively and quantitatively the same activity levels of the trapezius muscle. Similar results were obtained for the six different tasks in assembling telephone jacks.

A marked difference in activity levels was observed between mounting electronic components on printed circuit cards and inspecting/correcting the mounted printed circuit cards. The third task, assembly work, gave approximately the same activity level as mounting electronic components.

There were some quantitative differences in the activity levels of the trapezius muscle between the different tasks of glass blowing. Qualitatively, however, the differences were not very marked.

The muscular activity levels during the five different tasks in mining work showed great qualitative and quantitative differences in muscular load between the considerably dynamic tasks of drilling, setting explosives, operating scooploaders, etc.

Discussion

The EMG examination of the trapezius, infraspinatus, and deltoid muscles during the performance of assem-

bly work in the electronic industry in at least two cases out of three showed that there were quantitatively and qualitatively only minor differences in muscular activity levels between different tasks. Job rotation for the purpose of reducing static muscular load might therefore in many cases be of limited value in "light" work situations. At the same time the results obtained from mounting electronic components showed that job rotation between mounting and inspecting/correcting might have a positive effect in the interest of reducing full workday static load. In this situation the inclusion of a third task obviously had a negative effect.

Jobs perhaps best able to benefit from job rotation could then be said to be those of a more dynamic character, requiring more real variation in muscular load. During glass blowing there were some minor differences in activity levels. Mining, on the other hand, which is a very dynamic type of work showed great differences in muscular activity. In these heavy dynamic jobs there is usually no need to reduce the static load components; instead the total amount of very heavy tasks needs to be reduced.

References

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