EFFECTS OF REPETITIVE WORK ON DISCOMFORT AND PERFORMANCE DURING COMPOSITE TASKS

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INTRODUCTION

Precision work has been associated with certain musculoskeletal disorders that develop when some muscle fibers do not rest. The level of task precision might impact the development of such disorders. During short tasks people moved a probe repetitively between a Home and precision target. The activation of the descending trapezius increased and the kinematics of the forearm and wrist changed with increased task precision (1).

Additional information about the impact of precision work on the extremities required understanding how and why movement patterns change during longer duration work. During a recent experiment participants performed repetitive tapping tasks for seven minutes. These tasks were preceded and followed by Composite Tasks where work was at three levels of precision. It was hypothesized that movement patterns would change after seven minutes of repetitive work and affect performance on subsequent tasks. People's performance on the Composite Tasks and their responses to discomfort surveys are described below.

METHODS

During Main Tasks participants, who had been trained in all work administered, repetitively tapped with a probe, between a Home and a precision target for seven minutes. Main Tasks were in two layouts to elicit movements in either the scapular or sagittal planes. Targets of 48 mm, 19 mm, 10 mm, and 3.2 mm diameter created no, low, medium, and high precision conditions. Composite Tasks elicited movements in the same place as the intervening Main Task, and were performed before and after each Main Task. Composite Tasks required tapping between the Home and a ray of disks in a predefined sequence for 45 seconds. Two high precision, two medium precision, and two low precision disks were on the ray. Discomfort surveys were administered before the Main Task and after the later Composite Task. Breaks were provided after later Composite Tasks. Nine participants worked in the sagittal plane only, eleven worked in the scapular planes, and nine worked in both the scapular and sagittal planes.

RESULTS AND DISCUSSION

Discomfort increased significantly during work on the Main Tasks ($P = 0.027$). The level of precision during the Main Task significantly impacted discomfort ($P < 0.001$), with high precision work leading to greater discomfort than other work. A statistically significant interaction between precision and Task Unit Number ($P < 0.001$) occurred since discomfort ratings increased greatly with Task Unit Number after high precision work, whereas discomfort ratings after work at lower levels of precision were not sensitive to Task Unit Number. The significant interaction reveals that high precision work exacerbated residual discomfort even after breaks. Errors, or the number of deviations from the pre-defined sequence, increased after work ($P = 0.043$). Errors did not depend on precision ($P = 0.712$) or Task Unit Number ($P = .960$). The time to make Home to target movements declined significantly after repetitive work ($P < 0.001$). The change in timing impacted Phase II ($P < 0.001$), with these movements requiring 0.478 seconds after work whereas they required 0.517 seconds before work. The timing of Phase I movements were not significantly affected after work ($P = 0.131$). Declines in the times to reach each disk in the Composite ray were similar ($P = 0.973$). The Main Task's precision barely impacted the time necessary for Phase II movements ($P = 0.103$). Post-hoc analysis revealed that Phase II movements were faster after low precision work than after high precision work, with times required after medium and no precision tasks were intermediate between those two.

Results show that changes to movement patterns occurred after repetitive work. The Phase II movement iteratively corrected for differences in the position of the probe and the target, and practice on this movement might have affected its timing. Practice on the proprioceptive Phase I might also have affected Phase II. If the spatial endpoint from the Phase I movement was repeatedly optimally located to reduce the need for corrective actions, the average Phase II time would have been shortened. Since Phase II movements were shortened by approximately 0.04 seconds for all target precision levels a common learning effect, not one sensitive to the target's precision, was impacting Phase II. Additional data, already collected, will provide more information about the development of Phase I and Phase II trajectories.

REFERENCES

(1) Shyhalla, K. (2003). Wrist and forearm movements while homing in on precision Targets. Proceedings of the 47th Annual Meeting of the Human Factors and Ergonomics Society, Denver, Colorado, September 13-September 17, 2003. Human Factors and Ergonomics Society, Santa Monica, California.

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