

46. NECK MUSCLE ACTIVITY PATTERNS AMONG NORWEGIAN MACHINE OPERATORS IN DIFFERENT BRANDS OF FOREST HARVESTERS

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Background

Several investigations have shown that the prevalence of musculoskeletal disorder is high among forest machine operators. The ergonomic designs of workplaces are important in prevention of work-related musculoskeletal disorders (1) and in the mechanized forestry, neck pain and sick leave among forest machine operators working with extremely pronated hands have been reported (2). We wanted to investigate if the ergonomic design of the harvester workplace could be related to differences in neck pain.

Our hypothesis was that different ergonomic construction of control lever in harvester brands could give exposure to different level of static muscle work, disposing for neck pain.

Material and methods

Timberjack and Valmet harvesters were chosen for the investigation. These brands show clear differences in several construction details of possible ergonomic importance. In the Timberjack harvester the control lever operation is often a combination of using small joysticks by the fingertips and a keyboard designed to be operated like a piano with the palm of the hand in a horizontal position. In the Valmet harvester most functions are gathered in large joysticks where the palm is used in a vertical position and the hand grasps around the stick and the fingers press the buttons like an accordion. The ergonomic difference between these two designs is that the hand/fingers in the Timberjack shift between a horizontal and vertical position while in the Valmet the work load will be only in the vertical position of the hand. On both vehicles the cabin can be rotated 360 degrees, but on the Timberjack the crane is installed directly on the chassis, while on the Valmet it is either in the middle or on the right side of the cabin. As a consequence of the design, the body postures for the operator in the Timberjack will involve increased twisting of the head to follow the movements of the crane, while in the Valmet no such extra movement is necessary.

From a broader study of 39 forest machine operators driving several brands of vehicles, operators driving Timberjack (n = 7) and Valmet (n = 6) were selected. Muscle activity was continuously measured during a whole working day. Surface electromyography (sEMG) was used for this purpose and the amplitude and frequency parameters in the right and left upper trapezius muscles were recorded. A period with sustained low-level muscle activity (SULMA period) is defined as a period with continuous (without interruptions) static muscle activity above 0.5% EMG_{max} for 1.6 s or longer (3). The number of SULMA periods was calculated and analyzed for both right and left neck muscles in ten predetermined intervals: 1.6 – 5 sec, 5 – 10 sec, 10 - 20 sec, 20 sec -1 min, 1- 2 min, 2 - 4 min, 4 - 8 min, 8 -10 min, 10 - 20 min, > 20 min. The number of SULMA periods was also expressed in cumulative periods above the minimum value of the already predetermined ten intervals. Discomfort/pain in the neck was rated within five categories according to the Standardized Nordic Questionnaire: 0 days, 1-7 days, 8-30 days, more than 30 days and daily (4). The scale was also dichotomized into categories with pain ≤ 30 days (0) and pain >30 days.

Results

The operators in the Timberjack showed a significantly higher number of SULMA periods with short duration in the *right upper trapezius muscle* compared to the Valmet operators (Fig. 1a). The Valmet operators had significantly more SULMA periods > 10 min duration per hour compared to the Timberjack operators (Fig 1b) in the *left upper trapezius muscle* (5). A slightly higher amount of Valmet operators reported neck pain > 30 days compared to the Timberjack harvesters (non-significant).

Conclusions

This study showed that operators driving Valmet vehicles had a significantly higher number of periods with sustained low-level muscle activity (SULMA) above 10 min duration per hour in the left upper trapezius muscle and the same tendency in the right. A higher level of static muscle activity and less muscle rest were also found among the Valmet operators in the same two muscles. This finding may be explained by the more fixed postures in the Valmet vehicle. The increased number of cumulated long SULMA periods among the Valmet operators was explained by the hand/wrist in work postures being either pronated or supinated in a vertical position during control lever operation. The higher exposure of low level muscle activity found in the Valmet brand indicate a possible higher probability of developing muscle pain in operating such kind of control lever.

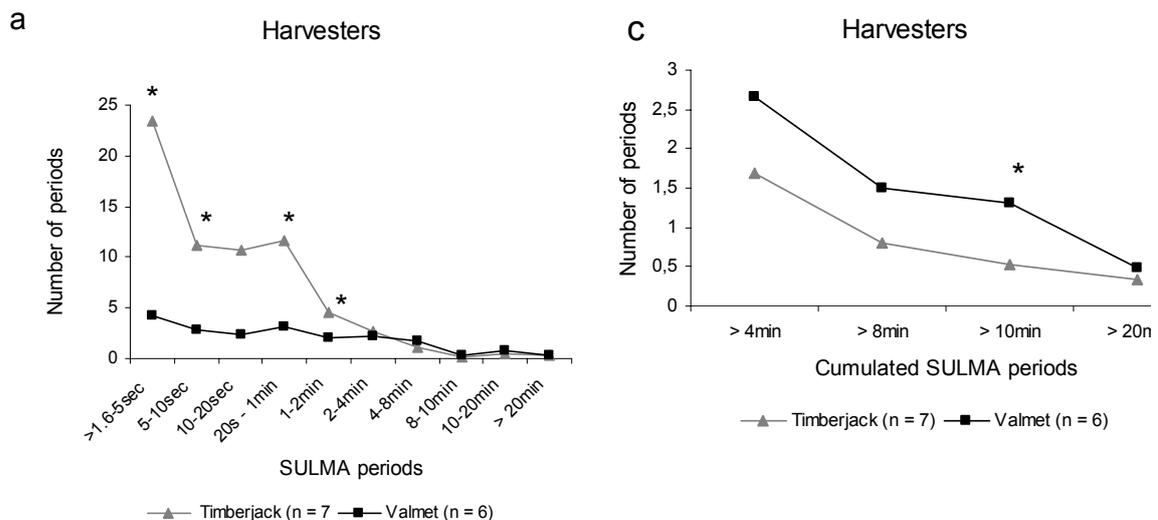


Figure 1 Mean number of periods with sustained low-level muscle activity (SULMA) in the right upper trapezius muscle among machine operators operating control levers while driving Timberjack and Valmet harvesters (a) and mean number of cumulated SULMA periods in the left upper trapezius muscle (c).

Keywords: sustained low level muscle activity, control lever, machine construction

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