EMG COMPARISON OF TWO TYPES OF SNOW SHOVELS

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INTRODUCTION

Snow shovelling is a yearly and potentially dangerous activity for persons living in areas with heavy snow falls. Injuries to the shoulders and back are common and deaths have occurred due to overexertion and cardiac problems. Several previous studies have investigated snow shovelling but did not measure muscular activity via electromyograpy (EMG) [1,2]. Delagi et al. [3] compared two types of shovels using EMG but did not evaluate a bent-shaft snow shovel. The purpose of this study was to compare two types of snow shovels and to determine whether they induce different amounts of electromyographic activity in various muscles.

METHODS

Five male and three female subjects shovelled continuously for two minutes. The subjects shovelled a path forwards, throwing the snow in front. No twisting motion was necessary. Half the subjects shovelled first with an "ergonomic" bent-shaft shovel while the other half started with a straight-shaft shovel (Figure 1). For both shovelling conditions the same "quality" and approximately the same quantity of snow was shovelled. Sufficient rest between trials was given so subjects started each trial at the same heart rate.

Figure 1: Ergonomic and straight-shaft shovels

Subjects' EMG activity (1000 gain, >110 CMRR) were recorded from 6 sites [anterior deltoids (AD), biceps brachii (BB), erector spinae (ES), biceps femoris (BF), gluteus maximus (GM) and rectus femoris (RF)] at a sampling rate of 1000 Hz using a Bortec AMT-8 EMG amplifier. Front knee angles were recorded by a Biometrics electrogoniometer. The EMGs were rectified and integrated over the 2-minute durations of the trials. Paired-sample t-tests compared the two shovels designs (α=0.05).

RESULTS AND DISCUSSION

Table 1 holds the differences between the integrated EMGs for the ergonomic snow-shovel versus the straight shovel. Positive values indicate that the ergonomic shovel induced larger amounts of muscular activity. Also included are the p-values from the repeated-measures t-tests. Notice that there was a significant increase in the EMG activity of biceps brachii (p=0.015) but a significant decrease in the level of biceps femoris activity (p=0.034). Although not significant there was a slight decrease in gluteus maximus EMG activity (p=0.055).

Although it was expected that the activity of the back musculature would be reduced with the ergonomic shovel there was no significant change in the erector spinae EMGs.

CONCLUSIONS

The ergonomic snow-shovel significantly reduced the electromyographic activity of biceps femoris but significantly increased biceps brachii EMGs. It might be appropriate to use both types of shovels to balance the muscular workload during a shoveling task.

REFERENCES

1. Huang C, Paquet V. Kinematic evaluation of two snow-shovel designs. *Int J Industrial Ergon* **29**:319-330, 2002.
2. McGorry RW *et al*. The effect of technique and shaft configuration in snow shovelling. *Appl Ergon* **34:**225-231, 2003.
3. Degani A *et al.* A comparative study of two shovel designs, *Appl Ergon* **24:**306-312, 1993.

Table 1: Mean differences in the iEMGs of muscles and the repeated-measures t-test p-values (* = sig. at α=0.05).

	Deltoids	**Biceps Brachii**	**Erector Spinae**	**Biceps Femoris**	**Gluteus Maximus**	**Rectus Femoris**
Mean diff. iEMG (Ergo.-straight)	1.066	**4.230**	0.570	**-0.959**	-0.650	-0.661
p-values	0.284	**0.015***	0.365	**0.034***	0.55	0.206