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Effect of Rubber Tapping Height on Trunk Muscle Effort

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Abstract— Rubber tapping often causes musculoskeletal disorders (MSDs), especially to the Lower Back Pain (LBP). The aim of this study was to investigate the muscle effort of trunk muscle in rubber tapping. The scope of this study consisted of four male students of the Prince of Songkla University who participated in this study. The main inclusion criterions were that they must be habitually active, have no prior back complaints or pathological disorders. Surface Electromyography (sEMG) was used to record the activities both sides of muscles – Erector spinae and Multifidus - during a 20-minutes isometric contraction workout. A laboratory-based rubber tapping simulation conducted five-level working heights (lower-knee, knee-waist, waist-shoulder, shoulder-head, and over-head). Muscular effort in this study was calculated as the percentage of Maximal Voluntary Contraction (MVC). The MVC for the level of rubber tapping resulted in knee-waist, lower-knee, waist-shoulder, shoulder-head and over-head which were 63.5%, 53.7%, 46.0%, 44.6%, and 43.0%, respectively. The results indicate that the EMG increase in muscle activity levels at a low level of rubber tapping.

Keywords— Lower back pain, Musculoskeletal disorders, Electromyography, Rubber Tappers

INTRODUCTION

Work-related musculoskeletal disorders (MSDs), especially of the Lower back pain (LBP) are common among rubber tappers1, 4, 5. Rubber tapping is physically demanding work with a high frequency of twisting, bending and extension of trunk4, awkward and static postures3, 7, repetitive motion3, 7 and tapping levels2, 4.

Several reports reviewed the prevalence of LBP among rubber tappers. Rubber tappers were reported to have a high prevalence of LBP 55% at 1 month1, 52.9% at 3 months4, and 55.7%2 and 66.2% 6at 12 months.

However, there is still no clear information about the tapping level among rubber tappers. The rubber tappers limited knowledge of physical capacity affects their ability to prevent problems.

The aim of this study was to investigate the muscle effort of trunk muscle in rubber tapping .The affect of EMG with surface electrodes during rubber tapping were measured (isometric and dynamic contraction).

Methods and Procedures

Experiment Design

A repeated measures design was selected so that all interactions between the independent variables could be investigated effectively. The independent variable in this study was the working height. The working heights were the five level of Lowers - Knee, Knee - Waist, Waist - Shoulder, Shoulder – Head and Over-Head. The dependent variable was the resulting EMG signal. The control variables were Jabong knives tapping system and right hand rubber tapping.

Subject

Four male between the ages of 20 and 24 years participated .Main inclusion criteria's were they must be habitually active, had no prior back complaints or pathological disorders. Subjects were recruited from student of Prince of Songkla University. Prior to signing a consent form, all subjects were informed about the experimental procedure, potential risks and purpose of the study.

SEMG data acquisition

SEMG was taken from the following four trunk muscles: both sides of muscles – Erector spinae and Multifidus.Disposable Ag–AgCl solid–gel electrode strips of two electrodes with a circular uptake area of 1.6 cm diameter and an inter-electrode distance of 2.5 cm were used. All EMG signal recordings were carried out using a Mobi6-6b (TMS International BV,Netherlands). A band-pass filter of 20-500 Hz bandwidth and an amplifier with 19.5 times were used. The signals were sampled at a rate of 1024 Hz with 24-bit A/D resolution.

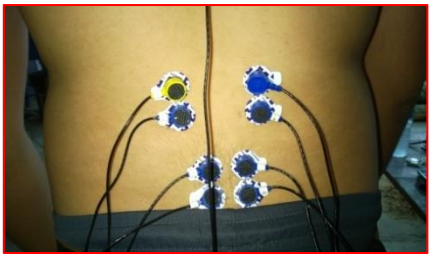

Fig.1 Surface EMG sensors location

EMG recordings

The EMG was recorded during work situations continuously for 20 minute. The participants in a series of rubber tapping's underwent isometric and dynamic contraction.

Fig.2 The simulation of rubber tapping in each of level.

EMG Analysis

In these experiments, the recorded EMG signals were analyzed using Bioproc 2 computation software. Both time and frequency domain analyses were conducted. Time domain analysis as mentioned earlier was used. There were many different time domains measured that characterize the signal. The Root Mean Square (RMS) values (in □V) of the row data was calculated.

Result

Muscle activity

The table.1 shows the result of the normalized mean values of the maximum muscle activity for difference muscles in difference height of rubber tapping.The data of EMG variables showed that the highest RMS value was (55.08 mV) for R. Multifidus with Knee-waist level. The lowest value (19.43 mV) for R.Erector spinae was at Shoulder –head level.The Fig.3 shows that difference of muscle activity in rubber tapping.It was also noticed that the R. Multifidus muscle was most active in the rubber tapping in all levels of tapping, and the Knee-waist level had the highest level of muscle activity.

Table 1 Difference of activity between the trunk muscles in rubber tapping

Level of Tapping	Muscles							
	L.Erector spinae		L. Multifidus		R.Erector spinae		R. Multifidus	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Lower-knee	39.85	3.63	34.52	4.43	35.83	5.67	45.75	4.72
2. Knee-waist	40.03	0.28	36.68	7.41	39.46	1.71	55.08	1.60
3. Waist-shoulder	21.31	1.60	21.34	6.29	20.58	3.48	40.16	3.77
4. Shoulder-head	21.35	3.23	19.82	3.74	19.43	1.72	44.78	2.25
5. Over-head	22.00	3.80	21.08	3.19	21.11	1.86	41.20	10.69

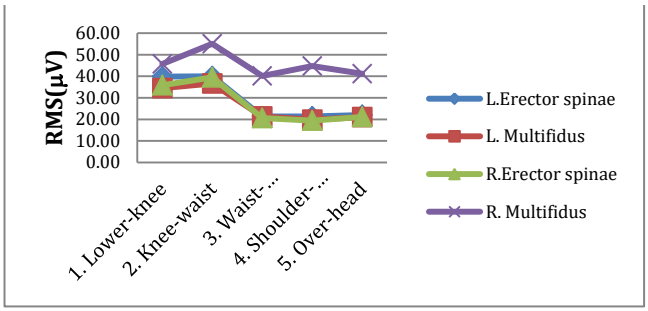

Fig. 3 Difference of muscle activities in rubber tapping

Maximum Voluntary Contraction (MVC)

The table. 2 shows the result of the comparative MVC percentages (Normalized Root Mean Square [RMS]) of trunk muscles in the levels of tapping. The MVC for a level of rubber tapping resulted in the knee-waist, lower-knee, waist-shoulder, shoulder-head and over-head were 63.5%, 53.7%, 46.0%, 44.6%, and 43.0%, respectively.

Table 2 Comparing MVC percentages (Normalized Root Mean Square [RMS]) of trunks muscles in level of tapping

Level	MVC % (Mean)	SD
1. Lower-knee	53.78	15.14
2. Knee-waist	63.57	15.55
3. Waist-shoulder	46.08	12.45
4. Shoulder-head	44.67	10.50
5. Over-head	43.02	7.82

Discussion

This study of 4 rubber tapper investigated the effects of five different level heights on lower back muscle activity and perceived exertion during a rubber tapping. Results of this study supported the hypothesis that there were differences in muscle activities and perception of exertion among different tapping heights. The findings of our present study agree with the results reported [2,4] that the association between tapping below knee level and LBP was in line with the association between tapping below waist level and LBP reported. Our study showed that lower back muscle activation levels were similar when the rubber tapping is adjusted to the Knee-waist level. As the height Knee-waist of the rubber tap, a trend of increasing EMG activities was observed, and muscle activation levels were highest when the rubber tapping was adjusted to Waist-shoulder level. These results might be due to some extent to increased trunk flexion movement, because it has been demonstrated that the

activity of R. Multifidus and R.Erector spinae muscles steadily rises as the degree of forward flexion increases, whereas the L. Multifidus and muscle is not very active in this movement. Similarly, The Maximum Voluntary Contraction (MVC) is increased when tapping in knee-waist level. This study had some limitations. Like, only a back muscle was selected, and the EMG data were recorded from a four subject. Future research should focus on defining the relationship between the EMG-moment, EMG-force and other parameters of the lower back muscle of individuals in different age groups.

Conclusion

The results of this study show that the different heights of level of the rubber tapping impact on the muscle activity in trunk muscles. Decreased level of rubber tapping height was associated with higher muscle activity levels. Therefore, in order to reduce muscle fatigue , the tapping height adjustment between waist to head level may be recommended. Further, these results could be used in rubber farmer to promote health care.

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