evaluation of forces applied on selective joints and muscles of drivers of MF285 and MF399 tractors

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Abstract:
In this research, the imposed force on three muscles including: Gastrocnemius muscle, Trapezius muscle and Quadratus lumborum muscle during clutching of the tractor driver during clutching has been studied. The number of sample people was assigned 30 and the research was conducted on two domestic tractors: MF285 and MF399. The measurements were performed by using an algometer and the values were measured as 437.2 N and 317.2 N, respectively. The angle of knee location in these two tractors at the one side knee more level was significantly different. The decrease of pain threshold after 30 seconds and 60 seconds clutching and 60 seconds rest after clutching in MF285 tractor in all three muscles were more than MF399. The decrease of pain threshold in the force of clutching for MF285 tractor some modifications is required. This is regard the force transfer joint between the pedal and clutch pedal, clutching can be replaced with the one made of cast iron.

Keywords: algometer, ergonomic, muscle, operator, tractor

Introduction:
Agriculture is one of the important sectors in developed industrial countries and developing industrial countries. Hence an adequate attention should be paid to the practice of ergonomic measures and changes of activity in agricultural practices in order to reduce work-related accidents and illnesses that result in improved living conditions and increased productivity. According to the International Labor Organization about 2.3 million people die each year due to accident or illness in the workplace every year. Latest estimates based on 2003 data indicate that 337 million occupational accidents and 160 million work-related illnesses occurred in the world each year. According to a study by the European Commission in 2000, more than four percent of gross domestic production (GDP) is wasted in terms of accidents and illness in the world (Niu, 2010). One of the jobs in the agriculture, particularly related to the clutching of different machines and different devices, are tractor drivers. Although studies have been done on the condition of the tractor driver and the problems of the drivers, including difficulties of working conditions, yet these segments of society are in relatively poor health. Moreover, the adversity of their job are affected by geographical location, climatic condition, individual characteristics and the type of machine. It is extremely dangerous to investigate these research working conditions on different machines and in different geographical areas. About 85 percent of the world’s total farms have two or three tractors that are classified as small farms, according to the World Bank definition. The average ownership level of agricultural land in Iran is also relatively small (less than half the world’s average and Pardaz-pour, 2011). For example, the average ownership level of the farms in Guilan province is 1.9 acres and that of Gorgan is 0.8 hectares (Nikhāh et al., 2013a). Driving tractor in small farms and doing the agricultural activities within such farms are more dangerous and if no doubt in such circumstances, physical problems and the fatigue of the driver are the main concerns. So paying attention to any of these equipments in highlighting and identifying the causes of drivers’ physical problems is effective. According to the report of Agriculture Mechanization Development Center, 2012. Considering the issues, the aim of this study was to investigate the forces acting on driver’s three muscles including Gastrocnemius, Trapezius and Quadratus lumborum among during clutching of MF285 and MF399 tractor drivers in order to investigate and fit the clutch of the tractors with the driver's health condition.

Methods:
Using the Cochrane method the sample size was set at 30 people. The research was conducted in the first half year of 1992 at Agricultural Faculty of Ferdows University of Mashhad. In this study, the effect of the independent variables such as BMI index, height, weight, angle of knee, ankle and hip angle on reducing the pain threshold as the dependent variable was examined.

Investigations were performed on three muscles Gastrocnemius (in calf area), trapezius and Quadratus lumborum (in back area). (Gastrocnemius muscle in upper neck line). Measurements were performed by an algometer for each person on each muscle. The pressure force was set at 60 Newton. The measurements were taken after 30 seconds of clutching and after 60 seconds of rest (Fig. 1). The more reduce of pain threshold indicates that clutching has been had increase effective. Moreover, the decrease of pain threshold was showed lesser effect of clutching on operator’s muscles. In all drivers, the selected muscles on the left side (clutch side) have been tested and measurements were performed with appropriate intervals between the same experimental data. Data were analyzed by using Software JMP.

Conclusions:
The results showed the average pressure threshold on Quadratus lumborum muscle after clutching 30 seconds, 60 seconds and resting 60 seconds for the MF285 tractor is more than the MF399 tractor. However, the only difference in reducing muscle pain threshold after clutching 60 seconds in two tractors was significant at the five percent level. The decrease of pain threshold during and after in clutching muscles is given in Fig. 2. Results indicated that Quadratus lumborum muscle has decreased pain threshold at the clutching force after clutching 30, 60 seconds and 60 seconds of rest after clutching, and clutching in this muscle was more effective in decreasing the pain threshold. However, based on the formal studies, this muscle when bending forward (flexion) and the rest did not be related and in some activities that can be done either manually by farmers, the waist area have been reported as the common musculoskeletal disorder (Ohja et al., 2012; Nikkhāh et al., 2013b). The second muscle was Quadratus lumborum muscle. This muscle plays a key role in plant flexibility (component that is engaged in clutching) (Kendal et al., 1993). Trapezius muscle affected by the reduced pain threshold during and after the clutching less than the other two muscles. As it is seen in Fig. 2, it was seen the pain threshold after the clutching 30 seconds in Quadratus lumborum muscle was lower than after 60 seconds clutching, reducing pain threshold and its amount. After resting for 60 seconds after clutching, the diminished pain threshold is still more than the former threshold after clutching for 30 seconds, but it was shown significant reduction than reduced pain threshold after clutching 60 seconds and it appears that a little rest leads to related changes. This shows that the average reduction of pain threshold after 60 seconds clutching is the highest amount and then reduction of pain threshold after 30 seconds and rest of the muscle. This suggests that the topographic muscle than other muscles become close to its original relatively faster and it affected less than the entered pressure during clutching.

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