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Hand GRIP Muscle Fatigue

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Abstract—*Muscle Fatigue is the main cause responsible for the development of musculoskeletal disorders. These disorders can develop at any location in human body such as lower back, shoulder, arms etc. Hand gripping activity is a key activity which is intensively involved in industrial tasks as well as in our day to day activities such as climbing steps, opening and closing of containers etc. Manual Material Handling tasks in industries have hand gripping activities as key components. Due to awkward postures and load beyond the capacity of the muscles of the arm and the wrist, muscle fatigue develops during hand gripping activity which leads to musculoskeletal disorders in the wrist and arms. In this study we are showcasing the existence of hand grip muscle fatigue when the subjects are asked to exert a constant amount of force over a period of time. The trial was conducted on 40 subjects and a curve was plotted between the force exerted by the subject on hand grip dynamometer and the time. The variation of the force with time was evident from the curve indicating the presence of hand grip muscle fatigue.*

1. INTRODUCTION

Muscle Fatigue can be defined in several different ways such as subjective definitions, in terms of force, in terms of maximum endurance time (MET) etc.

1.1 Subjective Definitions

Fatigue is feeling the effects of an exercise on the body or the incompetence to continue with an exercise [1]. Fatigue can also be explained as physical or mental exhaustion that occurs due to stress, medication, overwork, or mental and physical illness or disease [2].Some researches consider fatigue as extreme tiredness resulting due to mental or physical exertion or illness [3].

1.2 Muscle Fatigue As Reduction In Force

Failure of an individual to exert a desired force is said to be fatigue [4].Inability to generate maximum force during repeated or sustained muscle contractions is also muscle fatigue [5].

1.3 Muscle Fatigue As Reduction In Maximum Endurance Time(MET)

Maximum Endurance Time (MET) is a measure of discomfort or fatigue. MET decreases exponentially with time thus showcasing muscle fatigue [6].

1.4 Muscle Fatigue As Reduction In Work or Power Output

Fatigue refers to reduction in force or power due to any physical exercise [7, 8].

2. HAND GRIP MUSCLE FATIGUE

Hand Gripping Activity is an important part of our daily routine activities such as using tools, opening containers, lifting weights etc. [9, 10, 11]. Manual handling of loads or Manual Material handling involve intensively hand gripping activity. Sufficient amount of grip strength is necessary in completing these activities [12].

91% women workers in a woolen textile factory suffer from musculoskeletal pain. In this industry hand gripping activity plays a key role [13].According to a survey carried out among 300 workers who regularly use computer at work, 50 (16.7%) respondents suffered from hand or wrist pain [14]. Another survey among 533 telecommunication employees reposts that 111 (22%) participants suffered from musculoskeletal disorders out of which hand/wrist area was the most affected (12% participants) [15].

3. SIGNIFICANCE OF REDUCING MUSCLE FATIGUE

Reduction of muscle fatigue is very significant as over a period of time it leads to musculoskeletal disorders. In Japan 1970-1971 out of 6.1 million workers of the manufacturing industry, 10117 suffered from musculoskeletal disorders [16] .About 20-25% of all expenditure for medical care ,sick leave and sickness pensions in the Nordic countries in 1991 was related to conditions of the musculoskeletal system, in which 20-80% were work related [17]. About 4% of GDP disappears in many countries due to lack of basic health and safety facilities in workplaces [18]. Musculoskeletal Disorders have huge economic costs to companies due to loss of productivity, training of new workers and compensation costs [19].

4. OBJECTIVE

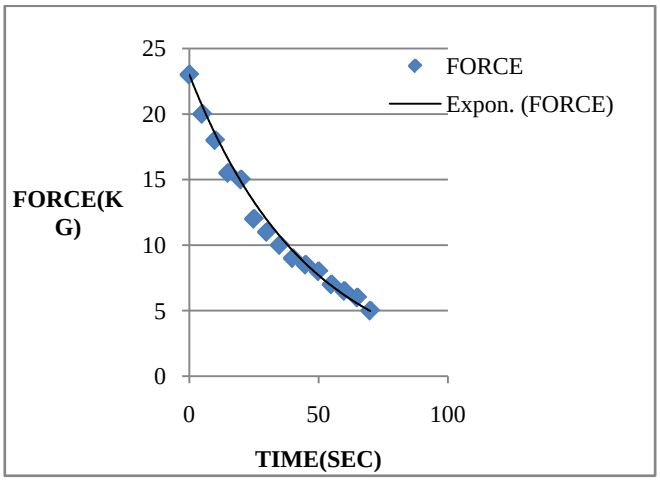
The objective of our study is to showcase the existence of hand grip muscle fatigue when the subjects are asked to exert a constant amount of force over a period of time.

5. RESEARCH METHODOLOGY

40 male subjects were chosen whose ages were in the range 18 to 20 years. The subjects were told to sit straight with the shoulder adducted and neutrally rotated, the elbow flexed at 90^{o} and the forearm and the wrist in neutral position. The trial was of 70 seconds duration. The subjects were asked to exert their maximum grip force on the hand grip dynamometer. Force readings were recorded after every 5 seconds. A curve was plotted between the force readings and the time.

6. OBSERVATION

The curve between the force and the time showcases the variation of hand grip force w.r.t time. It is seen that the hand grip force decreases exponentially with time thus indicating the presence of hand grip muscle fatigue. It is to be noted that the subjects were asked to exert constant amount of force during the trial of 70 seconds but due to the occurrence of hand grip muscle fatigue the subjects are unable to maintain constant force and thus force decreases.



The above graph shows the force readings of a particular subject. The readings are recorded after an interval of 5 seconds each.

7. DISCUSSION

The subjects were asked to exert constant amount of force because several tasks which include hand gripping activity involve exertion of constant amount of force for considerable amount of duration without any change in the awkward postures of the hand. This study showcases the existence of hand grip muscle fatigue.

REFERENCES

[1] http://www.brianmac.co.uk/musclefatigue.htm

[2] http://www.thefreedictionary.com/fatigue

[3] http://www.oxforddictionaries.com/definition/english/fatigue

[4] Enoka, ROGER M., and DOUGLAS G. Stuart. "Neurobiology of muscle fatigue." *Journal of applied physiology* 72.5 (1992): 1631-1648.

[5] Davis, Mellar P., and Declan Walsh. "Mechanisms of fatigue." *J Support Oncol*8.4 (2010): 164-174.

[6] Frey Law, Laura A., and Keith G. Avin. "Endurance time is joint-specific: a modelling and meta-analysis investigation." *Ergonomics* 53.1 (2010): 109-129.

[7] Bigland-Ritchie, B., and J. J. Woods. "Changes in muscle contractile properties and neural control during human muscular fatigue." *Muscle & nerve* 7.9 (1984): 691-699.

[8] Maughan, David, and Michael Toth. "Discerning Primary and Secondary Factors Responsible for Clinical Fatigue in Multisystem Diseases." *Biology* 3.3 (2014): 606-622.33 https://osha.europa.eu/en/publications/factsheets/73

[9] Skelton, Dawn A., et al. "Strength, power and related functional ability of healthy people aged 65–89 years." *Age and ageing* 23.5 (1994): 371-377.

[10] Dellhag, Berit, and Anders Bjelle. "A five-year followup of hand function and activities of daily living in rheumatoid arthritis patients." *Arthritis care and research* 12 (1999): 33-41.

[11] http://www.rch.org.au/uploadedFiles/Main/Content/ot/InfoSheet_E.pdf

[12] Brorsson, Sofia. *Biomechanical studies on hand function in rehabilitation*. INTECH Open Access Publisher, 2012.

[13] Metgud, D. C., et al. "An ergonomic study of women workers in a woolen textile factory for identification of health-related problems." *Indian journal of occupational and environmental medicine* 12.1 (2008): 14.

[14] Malińska, Marzena, and Joanna Bugajska. "The influence of occupational and non-occupational factors on the prevalence of musculoskeletal complaints in users of portable computers." *International Journal of Occupational Safety and Ergonomics* 16.3 (2010): 337-343.

[15] Hales, Thomas R., et al. "Musculoskeletal disorders among visual display terminal users in a telecommunications company." *Ergonomics* 37.10 (1994): 1603-1621.

[16] MAEDA, Katsuyoshi. "Occupational cervicobrachial disorder and its causative factors." *Journal of Human Ergology* 6.2 (1977): 193-202.

[17] Toomingas, Allan. *Methods for evaluating work-related musculoskeletal neck and upper-extremity disorders in epidemiological studies*. 1998.

[18] Ahasan, M. Rabiul. *Occupational health, safety and ergonomic issues in small and medium-sized enterprises in a developing country*. University of Oulu, 2002.

[19] Nunes, Isabel L., and Pamela McCauley Bush. *Work-Related Musculoskeletal Disorders Assessment and Prevention*. INTECH Open Access Publisher, 2012.