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EDITORIAL PREFACE

This is the *First* Issue of Volume *Four* of International Journal of Ergonomics (IJEG). The Journal is published bi-monthly, with papers being peer reviewed to high international standards. The International Journal of Ergonomics is not limited to a specific aspect of Ergonomics but it is devoted to the publication of high quality papers on all division of engineering in general. IJEG intends to disseminate knowledge in the various disciplines of the Computer Science field from theoretical, practical and analytical research to physical implications and theoretical or quantitative discussion intended for academic and industrial progress. In order to position IJEG as one of the good journal on Computer Sciences, a group of highly valuable scholars are serving on the editorial board. The International Editorial Board ensures that significant developments in Ergonomics from around the world are reflected in the Journal. Some important topics covers by journal are architectures, middleware, tools designs, Experiments, Evaluation, etc.

The initial efforts helped to shape the editorial policy and to sharpen the focus of the journal. Started with Volume 4, 2013, IJEG appears with more focused issues. Besides normal publications, IJEG intend to organized special issues on more focused topics. Each special issue will have a designated editor (editors) – either member of the editorial board or another recognized specialist in the respective field.

The coverage of the journal includes all new theoretical and experimental findings in the fields of engineering which enhance the knowledge of scientist, industrials, researchers and all those persons who are coupled with engineering field. IJEG objective is to publish articles that are not only technically proficient but also contains information and ideas of fresh interest for International readership. IJEG aims to handle submissions courteously and promptly. IJEG objectives are to promote and extend the use of all methods in the principal disciplines of Computing.

IJEG editors understand that how much it is important for authors and researchers to have their work published with a minimum delay after submission of their papers. They also strongly believe that the direct communication between the editors and authors are important for the welfare, quality and wellbeing of the Journal and its readers. Therefore, all activities from paper submission to paper publication are controlled through electronic systems that include electronic submission, editorial panel and review system that ensures rapid decision with least delays in the publication processes.

To build its international reputation, we are disseminating the publication information through Google Books, Google Scholar, Directory of Open Access Journals (DOAJ), Open J Gate, ScientificCommons, Docstoc and many more. Our International Editors are working on establishing ISI listing and a good impact factor for IJEG. We would like to remind you that the success of our journal depends directly on the number of quality articles submitted for review. Accordingly, we would like to request your participation by submitting quality manuscripts for review and encouraging your colleagues to submit quality manuscripts for review. One of the great benefits we can provide to our prospective authors is the mentoring nature of our review process. IJEG provides authors with high quality, helpful reviews that are shaped to assist authors in improving their manuscripts.

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EMG Investigations Regarding Handle Size, Grip Force and Stroke Rotation In Screw Driving

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Abstract

The present study investigated the effect of handle size (35mm and 40mm), grip type (loose grip and tight grip) and supine stroke rotation (30^0, 45^0 and 60^0) on electromyography i.e. EMG activity of forearm muscles for a screwing task in an experimental simulation. The eight participants performed the screw driving task for a 2 minutes duration (supination). The EMG activities of forearm muscles were recorded during this task. The muscles selected for EMG recording were FCR, FCU, FDS and ECRB muscles. The results showed that the flexor muscles were more activated than extensor muscles. Among giving conditions, 40mm handle size using loose grip with 60^0 stroke was most comfortable.

Keywords: Screw Driving Task, Stroke Rotation, EMG.

1. INTRODUCTION

Hand tools are of primary focus in most of the industrial occupations. The industries primarily concerned with high percentage of injuries as found in literature [1]. Approximately 9% hand tool-related injuries were found out of all WMSDs in 23 states of the United States. Among all hand tool injuries reported by Aghazadeh and Mital [2] 79% are incurred by the use of non-powered hand tools. Screw driver is one of the most important hand tool used in many industries for assembly tasks. Many researchers conducted experiments on screw driving task [3], [4] and [5] and pneumatic/ electric screw drivers [6], [7] and [8]. Continuous efforts are made by researchers to have comfortable design of hand tools with reduced risk of WMSDs e.g. Kong and Lowe [9] investigated the handle diameters and orientations for evaluating maximum torque, perceived comfort, muscle activity and finger force for a torquing task. In another study, Kong et al. [10] evaluated three different shapes of handles specifically for screw driving using subjective discomfort rating and finger force. Chang et al. [6] studied the operation of in-line pneumatic screw driver affected by wearing gloves and wrist support in terms of hand transmitted vibration and EMG activity of flexor digitorum muscle. Chang and Wang [7] reported increased hand-arm stress while operating electric screw driver, investigations were based on finger force and EMG activity of the flexor digitorum muscle. These are not all but many more studies have worked on designing tools such as screw driver, power drill etc. However none of the study except Bano et al. [11] considered the torquing stroke rotation as independent variable and evaluated the effect of this variable either on discomfort or on EMG. The experiments shown in literature asked subjects to perform exertion at specific level of forearm angle, however, none found considering exertion for the rotation duration from starting of the stroke to the end of stroke. As far as design based on ergonomic interventions are concerned, there are studies e.g. Freund et al. [12] recommended ergonomic aids in terms of newly designed screw driver for in-line use. They have also used surface EMG activity of extensor carpi ulnaris (ECU), extensor carpi radialis (ECR), flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) muscles. In general, forearm rotation was found in literature as important factor affecting performance and/or discomfort in repetitive occupational task.

In the present study it was tried to investigate the combined effect of handle size of screw drivers, type of grip force and stroke rotation on the muscle activity for the screwing task. Also in this study the findings of Bano et al. [11] had to be verified. The Null hypothesis of the present study was as follows

“there was no main and/or interaction effects of handle size, type of grip force and stroke rotation on EMG activity of forearm muscles”.

2. METHOD

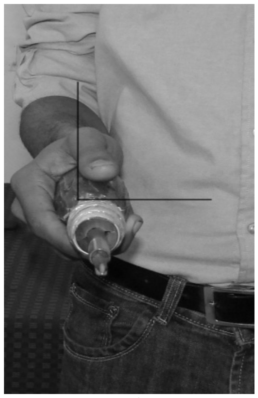
2.1 Participants

Eight male participants volunteered in this experiment. None of them were professionally user of screw driver. Their age: (μ=23years, σ=2.1years), weight: (μ=73kg, σ=6.23kg), Height: (μ=168cm, σ=4.32cm). All participants were healthy and none of them had any history of musculoskeletal injuries in the right hand. Approval was taken from ethics committee of the department to conduct this experiment on human subjects.

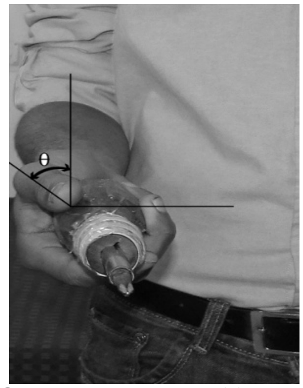
2.2 Experimental Design

A 2 (diameter of the handle of screw driver) × 2 (grip force) × 3 (stroke rotation) full factorial design of experiment was used to record an electromyographic response. The independent variables taken in this experiment were as diameter of the handle of screw driver (35 and 40 mm), type of grip force (loose and tight grip) and stroke rotation (30^0, 45^0 and 60^0). The EMG activity of four forearm muscles was recorded during the given task.

The handle sizes (35mm and 40mm) were considered in line with the studies of [4], [9] and [11]. The loose grip and tight grip were taken as the type of grip force. Loose grip was defined as to hold the screw driver without applying surface pressure on the handle with torquing exertion and tight grip was considered as with surface pressure with torque on the handle during the screwing exertion [13] and [14]. Stroke rotation used in this paper was as the rotation of forearm from neutral position during one complete stroke of screw driver. The levels of stroke rotation were in line with levels of forearm rotations considered by different researchers [4], [15], [16], [17] and [18]. Khan et al. [15] used five levels of forearm rotation (neutral, 30% and 60% of the ROM in pronation and supination) in repetitive task but forearm rotation used by O’Sullivan and Gallwey [16] was 75% prone ROM, neutral, and 75% supine ROM. Ciriello et al. [4] instructed the participant to move the handle of screw driver through 90º motion of screw driving task. Based on the above discussion in the present study 30^0, 45^0 and 60^0as levels of the stroke rotation were chosen for the experimentation (angle of stroke rotation is explained in Figure 1).



Neutral forearm



Supination rotation of forearm

FIGURE 1: Rotation of Forearm During Screw Driving.

Mogk and Keir [17] considered flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), FDS, ECR, ECU, and extensor digitorum communis (EDC) for recording EMG activities during gripping. Chang and Wang [7] evaluated the effect of the use of an in-line electric screwdriver on EMG signal of flexor digitorum muscle. Freund et al. [12] analysed the EMG activities of ECU, the extensor carpi radialis longus (ECRL), FDS and the flexor digitorum profundus (FDP) muscles in a screw driving task. Kong and Lowe [9] used EMG of flexor and extensor muscles to evaluate task performance in a maximum torquing task. Therefore, in the present study, EMG activities of FCR, FCU, FDS and ECRB muscles were recorded as a response variable to investigate the performance of the screwing task.

2.3 Experimental Setup

A wooden plate having 360 pre-tapped screw holes (15 rows x 24 columns, row distance=1inch, column distance =1 inch) was fixed on a wall at an adjustable height for screw driving task. Phillips head screws (24.24mm long with a head diameter of 8.1mm and pitch of 1.5mm) were chosen to be used in this task.

2.4 Task

The participant was asked to tighten the screws in supine rotation (clockwise) of screw driver in such a way that the participant rotated their forearm till the assigned stroke rotation was reached then adjusted to neutral forearm for the next stroke. They continued screw driving till all the threads completely entered into the dowel. The task was performed on the vertical wooden block for 2 minutes duration as shown in Figure 2 using Phillips-head screwdriver.

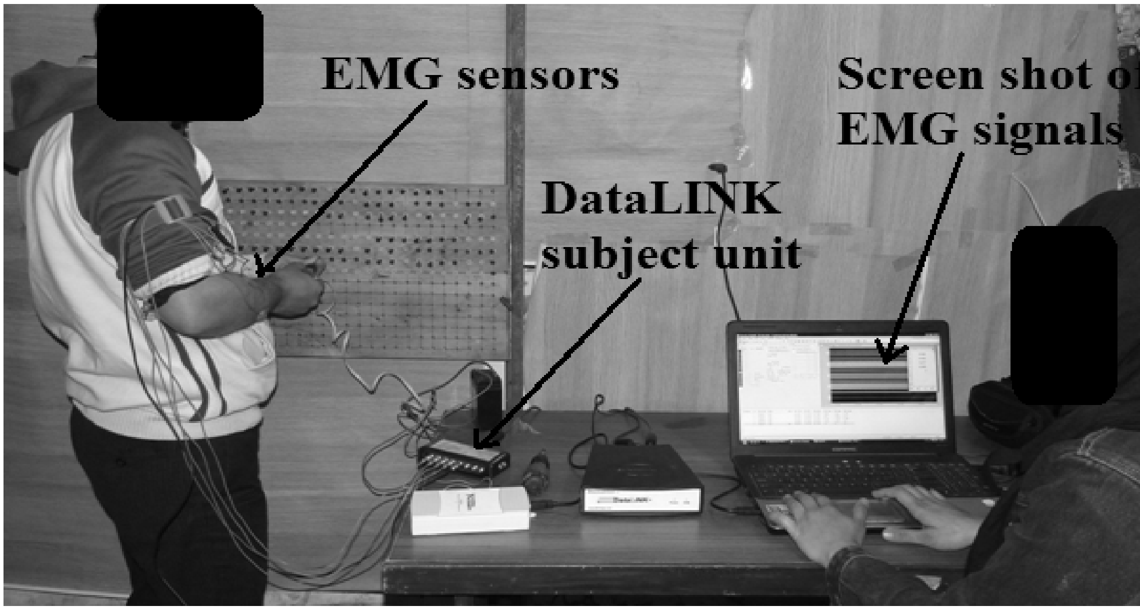


FIGURE 2: Experimental Setup.

2.5 EMG Interfacing

EMG sensors were attached to the participant as shown in Figure 3 and interfaced with the laptop through DataLINK hardware and software. The EMG signals were recorded at the sampling rate of 1024Hz using surface EMG preamplifiers (Model: SX230 EMG sensor; Make: Biometrics Ltd. UK). The pre-amplified signal of EMG was interfaced to the Laptop (HP based on Pentium Dual Core Processor) using 8 channel subject unit of DataLINK (DLK900: No. M11138 2009-09; Make: Biometrics Ltd. UK). The signals were conditioned using the filters (i.e. DC and Low frequency filters) available in the same software. The conditioned signals were recorded for further analyses.

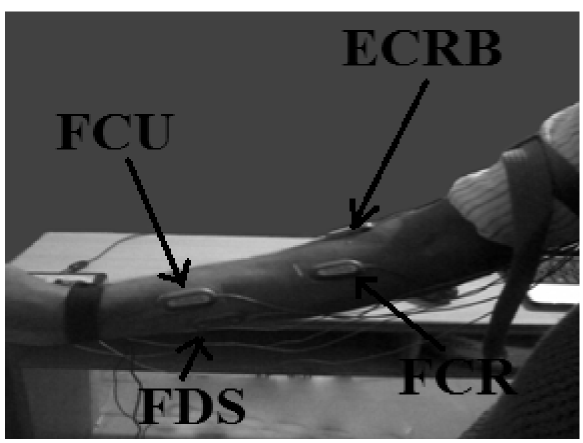


FIGURE 3: Showing EMG Sensors on Forearm Muscles.

2.6 Procedure

Participant was told about the experimental procedure and risks involved in it, they were asked to give prior consent for the experiment. Initially, EMG was recorded at rest called as minimum EMG and at maximum grip with torque called maximum EMG for each forearm muscle. The electrogoniometer was attached to maintain or control the rotation of forearm. After preliminary setting, participant was asked to stand straight in front of experimental setup to perform the task. The participant gripped the screw driver in the right hand with neutral forearm and elbow flexed at

900 keeping feet completely on the ground. For every condition participant performed screw driving for 2 minutes duration. Then the next condition was setup in a random order (unique for each participant) with a gap of atleast 2 minutes rest between each condition.

2.7 Analysis of EMG Activities

The raw data as extracted is shown in a screen shot (Figure 4). The RMS signal was obtained using the Triangle-Bartlett method of Fast Fourier Transformation (FFT). Using transformations and power spectrum analyses, mean rms and median frequency were extracted from the raw signals for further analyses. The mean rms of EMG signals, obtained, were normalised for respective condition for each subject using the formula [19] as given below:

$$\text{NEMG (\%)} = \frac{(Actual\ EMG - Min\ EMG)}{(Max\ EMG - Min\ EMG)} \times 100\%$$

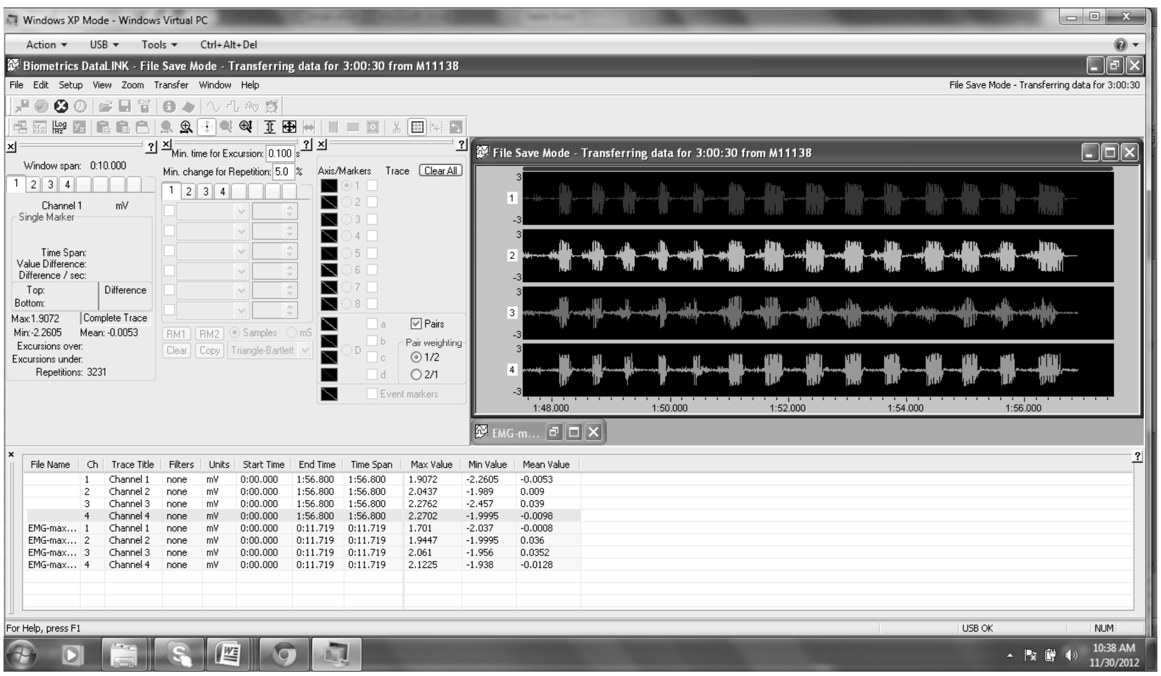


FIGURE 2: The screen shot of the EMG signal of different muscles of a treatment.

3. RESULTS

The data of normalised rmsEMG and regression of the values of median frequencies were further statistically analysed using SPSS. The data of mean for all participants of %normalised rmsEMG the EMG signals of forearm muscles (FCR, FCU, FDS and ECRB) with respect to experimental conditions were demonstrated in Table 1 and also presented in Figures 5. Also it was observed from Table 1 that the range of mean %normalised rmsEMG of forearm muscles was about 13 to 23%. The higher values of %normalised rmsEMG of forearm muscles was found at 40mm handle size with tight grip for all stroke rotations (30^0, 60^0 and 90^0). For handle size 35mm, the mean of %normalised rmsEMG was found to be maximum at stroke rotation 90^0 as compared to 30^0 and 60^0 irrespective of grip force. It was noticed that the mean of %normalised rmsEMG was found to be higher for tight grip (20.21%) compared to loose grip (16.38%), for loose grip less muscular activity was obtained. The more contribution of muscles or it can be noticed that more participation of muscles during the task was found for 40mm handle size (18.79%) compared to 35mm size (17.70%) having lesser mean value of %normalised rmsEMG voltage .of forearm muscles during the task. With respect to stroke rotation, 60^0 had minimum %normalised rmsEMG (16.93%) of forearm muscles and 90^0 had maximum %normalised rmsEMG (20.03%) that means muscles were more activated at stroke rotation 90^0 compared to 60^0 stroke rotation. Although lesser muscular activity was found for handle size 35mm and loose grip with 60^0 stroke rotation.

Handle Size, Level of grip force, Stroke Rotation	%Normalised EMG FCR	%Normalised EMG FCU	%Normalised EMG FDS	%Normalised EMG ECRB	Mean
35mm, LG, 30º	18.36	20.41	13.44	18.60	17.70
35mm, LG, 60º	19.97	12.42	11.65	11.40	13.86
35mm, LG, 90º	28.02	20.19	20.00	9.15	19.34
35mm, TG, 30º	22.46	10.91	14.64	19.79	16.95
35mm, TG, 60º	25.29	18.45	9.81	20.14	18.42
35mm, TG, 90º	21.26	17.11	18.19	25.43	20.50
40mm, LG, 30º	19.09	18.57	8.89	17.33	15.97
40mm, LG, 60º	21.51	11.76	11.92	8.24	13.36
40mm, LG, 90º	22.84	20.38	17.55	11.42	18.05
40mm, TG, 30º	28.60	25.87	16.85	12.33	20.91
40mm, TG, 60º	24.03	22.98	26.90	14.43	22.08
40mm, TG, 90º	21.00	19.76	21.02	27.68	22.36
Mean	22.70	18.23	15.91	16.33	

TABLE 1: %Normalised RMS EMG for forearm muscles at all conditions of the experiment.

Further on the data multi-variant analysis of variance (MANOVA) was performed to identify the effect of independent variables (handle size, grip type and stroke rotation) on EMG activity of four muscles (FCR, FCU, FDS, ECRB). The result showed no significant effect of any of the independent variables on %normalised rmsEMG of forearm muscles, that does not mean that there was no effect but further investigations are required.

Handle Size, Level of grip force, Stroke Rotation	Slope of MF FCR	Slope of MF FCU	Slope of MF FDS	Slope of MF ECRB
35mm, LG, 30º	-.0225	-.0350	-.0963	-.0100
35mm, LG, 60º	-.0413	.0213	-.0488	-.0213
35mm, LG, 90º	*-.0613*	*-.0825*	*-.0650*	*-.0325*
35mm, TG, 30º	-.0400	-.0438	-.0463	-.0150
35mm, TG, 60º	-.0650	-.0063	.0363	-.0313
35mm, TG, 90º	*-.0725*	*-.1150*	*-.0688*	*-.0438*
40mm, LG, 30º	-.0113	-.0225	-.0350	-.0350
40mm, LG, 60º	-.0288	.0113	-.0675	-.0450
40mm, LG, 90º	*-.0213*	*-.0463*	*-.0025*	*-.0550*
40mm, TG, 30º	-.0150	.0213	-.0238	.0050
40mm, TG, 60º	-.0300	.0038	-.0400	-.0488
40mm, TG, 90º	*-.025*	*-.1788*	*-.0375*	*-.0800*

TABLE 2: Slope of Median Frequency of all muscles for all conditions.

The calculated data of Slope of Median frequency (i.e. obtained by applying linear regression on median frequency) was shown in Table 2 and also in Figure 6. Here fatigued of the muscles were relatively calculated in terms of decrement in the median frequency of EMG signal (i.e. negative shift of power spectrum of the signal). The muscle FCR was fatigued at all experimental condition, maximum fatigue was observed for handle size 35mm & tight grip with stroke rotation 90^0. It was noticed that using handle size 35mm for loose grip with 30^0 stroke rotation, FDS muscle was fatigued (-0.0963 as slope of median frequency) during the task. FDS muscle was found fatigued at all conditions except condition i.e. handle size 35mm with tight grip and 60^0 stroke rotation. FCU and ECRB muscles were highest fatigued for the handle size 40mm with tight grip and stroke rotation 90^0. The condition, 40mm handle size at 90^0 stroke rotation with tight grip was found highly fatigued. At this condition all muscles were found fatigued but FCU & ECRB muscles were highly fatigued among all other conditions. The relatively most discomfort condition among all the test condition were at handle size 40mm with tight grip and stroke rotation 90^0; handle size 35mm with tight grip and stroke rotation 90^0; handle size 35mm with loose grip and stroke rotation 90^0; handle size 35mm with loose grip and stroke rotation 30^0 (Figure 5 and Figure 6).

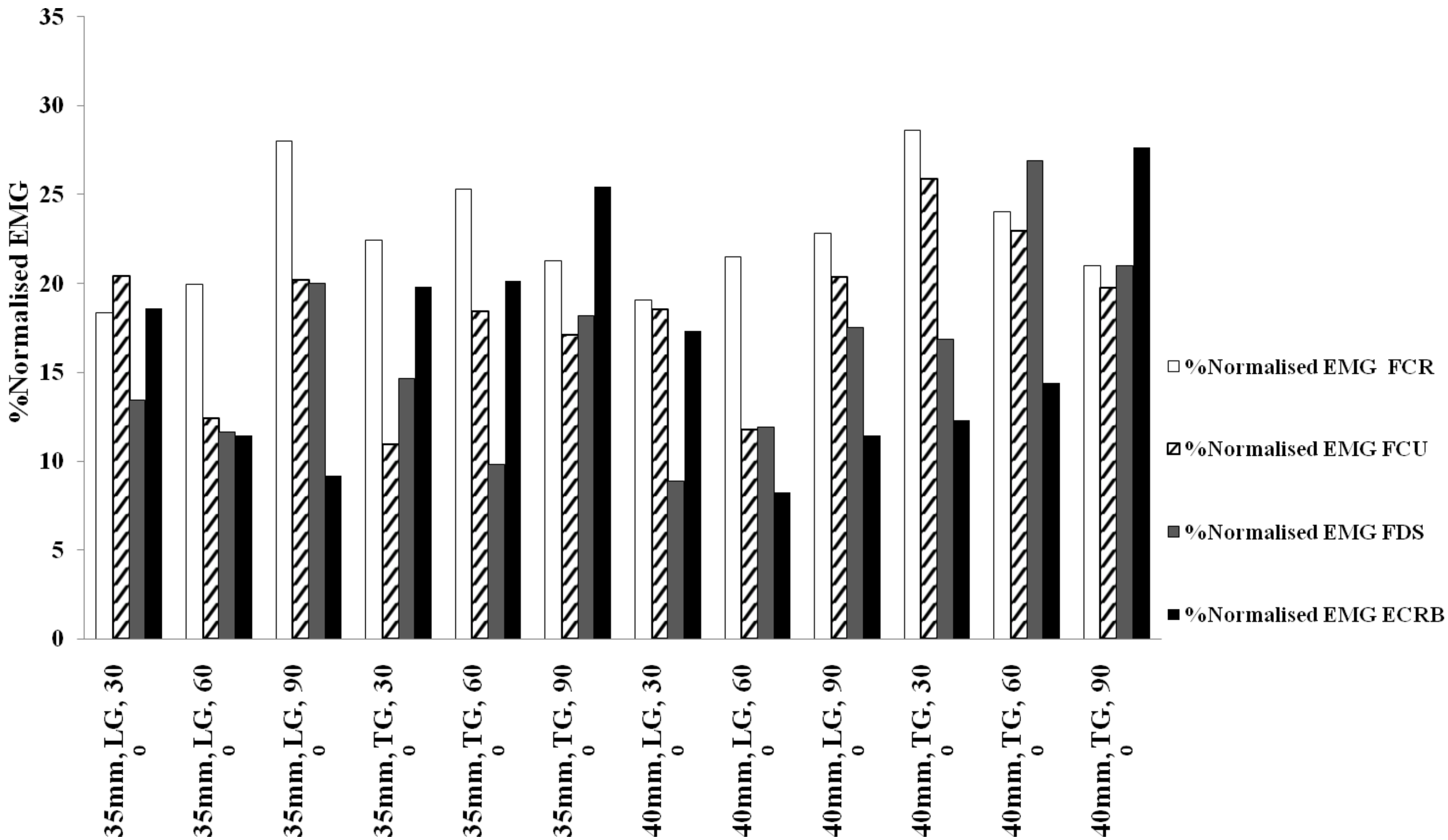


FIGURE 5: Bar diagram showing %normalised EMG of all muscles for all conditions.

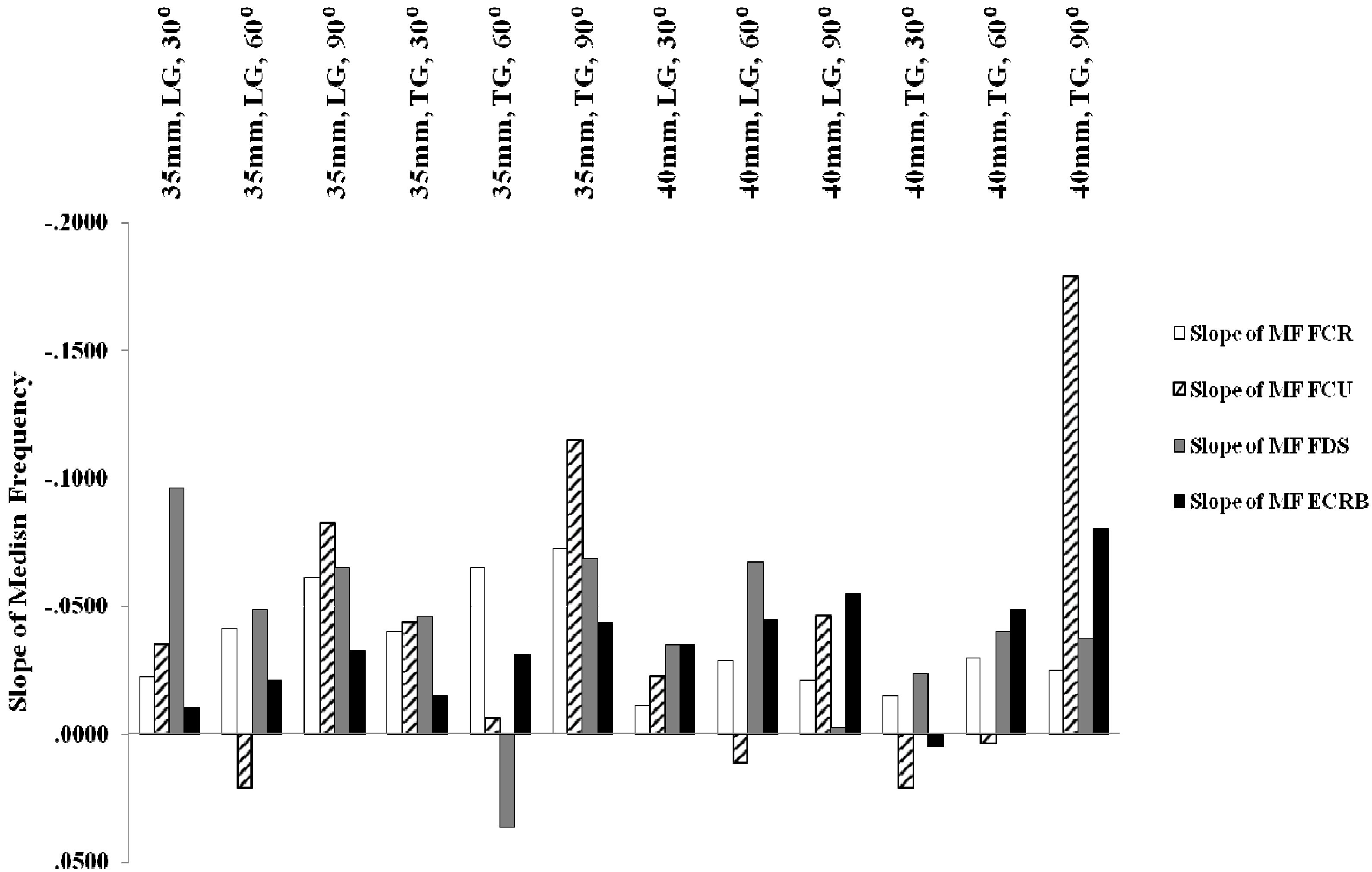


Figure 6: Bar chart showing Slope of Median Frequency of all muscles for all conditions.

4. DISCUSSION

The comparison of present study with reference to literature reviewed is presented in Table 3.

Author's Name	Purpose
Ciriello et al. 2002 [4]	To find out the maximal acceptable torque for screw driving task for different frequencies 15, 20, 25 motions /min.
Habes and Grant, 1997 [5]	For a simulated screw driving task maximum torque and EMG activities were investigated.
Dempsey et al. 2004 [3]	The effect of work height, workpeice orientation, gender and screwdriver type (phillips or flat head) were observed for productivity and wrist deviation.
Freund et al. 2000 [12]	4 different combinations of screw driver and ergonomics aids were evaluated and found that hand support and the sleeve had positive effect on subjective perception of exertion and surface texture response.
Kong et al. 2008 [10]	Screw driving task was investigated for 3 longitudinal shape, 4 lateral shapes and 2 surface material using subjective discomfort, number of screw-tightening rotations, screw-insertion time, axial screw driving force and finger contact forces.
Bano et al. 2012 [11]	In this study the effects of handle size (35mm and 40mm), grip type (tight and loose) and Stroke rotation (30°, 60° and 90°) on subjective Discomfort rating and productivity were evaluated for screw driving task.
Present study	In the present study the effects of handle size (35mm and 40mm), grip type (tight and loose) and Stroke rotation (30°, 60° and 90°) for screw driving on EMG signals of forearm muscles were investigated.

TABLE 3: Comparison of present study with the previous studies.

Electromyography (EMG) has been the major quantitative measure of muscular effort during the task. Many studies have used surface electromyography (EMG) as a tool to find the effect of task on discomfort using different parameters of EMG signals for example, normalised root mean square (RMS) of the EMG signals [5], [9], [16], [20], [21], [22], [23], [24], [25], [26], [27] and [28]; amplitude of the EMG signal [17], [29] and [30]; Median Frequency of the EMG signal [20] and [30]; and maximum voluntary isometric contraction (MVIC) [31]. Other studies have also used surface electromyography as a means to study the effects of torques and reaction forces acting on the hand during the task [32] and [33]. In line with these studies the EMG signal recorded was summarised into output parameters such as normalised RMS and Slope of Median frequency to have relative knowledge about exertion and fatigue in forearm muscles.

In a previous study conducted by Bano et al. [11] evaluated the effects of handle size, level of grip type and stroke rotation on perceived discomfort score and productivity for repetitive screwdriving task. The results of that study showed that the most comfortable holding posture of screw driver was handle size 35mm with loose grip at 60^0 stroke rotation. Also they achieved higher discomfort with low productivity when holding the screw driver with tight grip and high productivity with low discomfort for loose grip. Stroke rotation was significant on discomfort score however relatively high productive work was achieved at 60^0 and 90^0 stroke rotation as compared to 300 stroke rotation. The present study was an experiment to find out whether the EMG activity of forearm muscles may be an effective parameter to support the findings based on perceived discomfort as many previous studies have been found in literature [21], [24] and [34]. Fortunately, the findings of the present study showed that the %normalised rmsEMG of forearm muscles was minimum for both handle sizes (35mm and 40mm) with loose grip at 60^0 stroke rotation compared to other conditions. These results were similar with the findings of the previous study [11]. The contribution of the forearm muscles were less in terms of excitation of motor units (resulted in EMG amplitude) to exert the force required in the experimental task. Therefore the screwing task performed for both the handle size of the screw driver with loose grip at 60^0 stroke rotation was found to be most comfortable condition obtained for the screw driving. As we observed that at 90^0 stroke rotation, the %normalised rmsEMG was greater compared to 30^0 and 60^0 for both grip types (loose and tight) as well as for both handle sizes (35mm and 40mm).

These results also supported by the similar findings of [11] that the higher discomfort score was obtained at 90^0 stroke rotation with all levels of handle size and grip type considered in that experiment. O'Sullivan and Gallwey [16] had also reported that the significant effect of forearm rotation on forearm muscles for supination and pronation during torquing task. The present study found that Flexion muscles (FCR and FCU) were highly activated during the supination rotation of forearm. Similar increased EMG activity was found in terms of %MVE (maximum voluntary exertion) for the supination rotation in flexion muscles without grip force for both male and female subjects in the study of [17]. They have used EMG signal to identify the gripping task due to change in wrist and forearm posture. Also the present study found that the most comfortable condition was 40mm, loose grip and 60^0 for the supination rotation of forearm during the task.

One more parameter as slope of median frequency that is nothing but shift in the frequency spectrum of the EMG signal was calculated from the recorded signals of forearm muscles. In line with the findings of discomfort score of Bano et al. [11] and the normalised EMG of this study again it was noticed that 90^0 stroke rotation created relatively more fatigue to the forearm muscles as compared to 30^0 stroke rotation. If the handle size was compared the mean values of the slope of the median frequency for all muscles considered were -0.0419 and -0.0336 this for 35mm and 40mm diameters respectively. Therefore it may be said that the relative fatigue was more for 35mm compared to 40mm diameter that is in line with the discomfort profile of [11]. The normalised forearm median frequencies of EMG signals (nMF_{FA}: combined values of FCR, FCU, FDS, ECRB) for four conditions (35mm with tight grip at 90^0 stroke rotation; 40mm with loose grip at 90^0 stroke rotation; 40mm with tight grip at 90^0 stroke rotation; 40mm with tight grip at 30^0 stroke rotation) were calculated according to the following formula [21]. The above said conditions were found to be most fatigued conditions based on perceived discomfort score [11].

$$nMF_{FA} = \frac{MFe_{FCR}(i,k) + MFe_{FCU}(i,k) + MFe_{FDS}(i,k) + MFe_{ECRB}(i,k)}{MFb_{FCR}(i,k) + MFb_{FCU}(i,k) + MFb_{FDS}(i,k) + MFb_{ECRB}(i,k)}$$

where $nMF_{FA}(i,k)$: normalised MF EMG of forearm for the considered muscles, FCR, FCU, FDS, ECRB, for the experimental conditions 'i' and subject 'k'.

$MFb_{FCR}(i,k), MFb_{FCU}(i,k), MFb_{FDS}(i,k), MFb_{ECRB}(i,k)$: the task MF EMG values at experimental conditions i, FCR, FCU, FDS, ECRB respectively, for subject k at the beginning (the first 20s after starting the task) of the experimental condition.

$MFe_{FCR}(i,k), MFe_{FCU}(i,k), MFe_{FDS}(i,k), MFe_{ECRB}(i,k)$: the task MF EMG values at experimental conditions i, FCR, FCU, FDS, ECRB respectively, for subject k at the end (the last 20s before ending the task) of the experimental condition. i= 1,2......12; k= 1,2,....8.

Eksioglu [21] introduced a new parameter fatigue coefficient (CF) which indicates the degree of fatigue and reported that higher the fatigue level higher will be the value of CF.

CF = 1-nMFFA (theoretically $0 \le CF \le 1$)

However the values of CF for selected conditions were found to be very low in magnitude which was difficult to define the level of muscular fatigue. Therefore the coefficient of fatigue was not correlated with the discomfort profile [11] at this stage of findings but further investigations may give some interesting findings. In this study surface EMG electrodes were used which sometimes do not gives the exact signal of the respective muscle as it may displaced over the skin due to forearm rotation. The screw driving was a dynamic task which had cycle of exertion and rest at a specific frequency. Therefore there were less chances of developing accumulated muscular fatigue over the whole duration of task. Mostly in this type of exertion discomfort might be noticed much in the form of joint pain rather than muscular tiredness.

5. CONCLUSIONS

Study validated that surface EMG may be used as a tool for evaluating performance of repetitive tasks. It was also found that flexor muscles were more activated than extensor muscles for screwing. The higher muscle fatigue was found at 35mm than 40mm handle size. This was concluded that 40mm handle size using loose grip with 60^0 stroke rotation was found as relatively comfortable condition for screw driving.

6. SCOPE FOR FURTHER STUDIES

These investigations are very useful for the design of hand tools which are used in screw driving. Also the findings may further be investigated as per ranges of motion of forearm.

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