International Journal of Physiotherapy and Research,
Int J Physiother Res 2018, Vol 6(2):2628-32. ISSN 2321-1822
DOI: https://dx.doi.org/10.16965/ijpr.2018.102

Original Research Article

EFFECT OF DIFFERENT SHOULDER POSITION ON EMG PARAMETER OF ROTATOR CUFF AND DELTOID MUSCLE DURING EXTERNAL ROTATION EXERCISE: A CROSS-SECTIONAL OBSERVATIONAL STUDY

Radhika D. Kariya.

Assistant Professor, Harivandana Physiotherapy College, Munjaka, Rajkot, Gujarat, India.

ABSTRACT

Background: The shoulder joint exhibits the greatest amount of motion in the human body. Functional stability is accomplished through the joint capsule, ligaments and glenoid labrum, as well as the dynamic stabilization, particularly the rotator cuff muscles which maintain stability during upper extremity motion. Rehabilitation programs for rotator cuff impingement, repair surgery and athletic conditioning also emphasize strengthening of the shoulder musculature. Altered muscle recruitment will disturb normal scapulohumeral rhythm.

Purpose of study: Aim of the study is to find out effect of 7 different shoulder positions on maximal voluntary isometric contraction (MVIC) for rotator cuff and deltoid muscle.

Methodology: 50 healthy subjects (18 to 25 years) who fulfil inclusion and exclusion criteria were taken. Surface electromyography (EMG) was measured for rotator cuff and deltoid muscle during 7 shoulder exercises: prone horizontal abduction at 100° with full external rotation(ER), prone ER at 90° of abduction, standing ER at 90° of abduction, standing ER in the scapular plane, side lying ER at 0° of abduction, standing ER at 0° of abduction, and 0° of abduction with a towel roll. The peak percentage of maximal voluntary isometric contraction (MVIC) for each muscle was compared by using a 1-way repeated measures analysis of variance.

Result: Prone horizontal abduction at 100° with full ER produced greatest EMG activity for posterior deltoid (96% MVIC), supraspinatus (81%MVIC), and infraspinatus (84% MVIC) and sidelying ER produced greatest EMG activity for teres minor (89%MVIC).

Conclusion: Effect of different shoulder position will affect EMG parameter. So, result of this study will helpful to prescribe various rehabilitation programs.

KEY WORDS: EMG, Rotators Cuff, MVIC, Shoulder Joint, External Rotation.

Address for correspondence: Dr. Radhika D. Kariya, MPT in musculoskeletal conditions and sports, Assistant Professor, Harivandana Physiotherapy College, Munjaka, Rajkot, Gujarat, India.
E-Mail: radhikakaria91@gmail.com

Access this Article online	Journal Information
Quick Response code	**International Journal of Physiotherapy and Research**
	ICV for 2016 86.93
	ISSN (E) 2321-1822 | ISSN (P) 2321-8975
	https://www.ijmhr.org/ijpr.html
	DOI-Prefix: https://dx.doi.org/10.16965/ijpr
DOI: 10.16965/ijpr.2018.102	**Article Information**
	Received: 05 Jan 2018 Accepted: 19 Feb 2018
	Peer Review: 05 Jan 2018 Published (O): 20 Mar 2018
	Revised: None Published (P): 11 Apr 2018

INTRODUCTION

Functional stability of the shoulder is accomplished through the integrated functions of the joint capsule, ligaments and glenoid labrum, as well as the dynamic stabilization of the surrounding musculature, particularly the rotator cuff muscles [1]. Thus; the rotator cuff muscles play a vital role in normal arthrokinematics and asymptomatic shoulder functions [2].

Limited external rotation manifested in all shoulder pathologies like rotator cuff tear, impingement syndrome, frozen shoulder etc. External rotation is important part of all activity of daily living like combing hair, grooming, overhead activity etc. Overhead athletes requires adequate strength and endurance of external rotators [2].

As per the capsular pattern of shoulder joint,

first Limited external rotation is common manifestation in shoulder pathologies [3,4]. Findings of EMG activity of rotator cuff and deltoid muscle may be helpful to reduced the load on injured muscle and improve the strength of needed muscle while designing rehabilitation program [2].

By providing different shoulder positions, gradual progression of rehabilitation session can be arrange for affected involved muscles.

Aims of the study: To see the effect of different shoulder positions on EMG activity of rotator cuff and deltoid muscles during commonly prescribes external rotation exercises.

Objectives of the study:

1. To find out effect of 7 different shoulder positions on %MVIC for posterior deltoid muscle.

2. To find out effect of 7 differ ent shoulder positions on %MVIC for supraspinatus muscle.

3. To find out effect of 7 different shoulder positions on %MVIC for infraspinatus muscle.

4. To find out effect of 7 different shoulder positions on %MVIC for teres minor muscle.

MATERIALS AND METHODS

50 Healthy subjects who fulfill inclusion criteria were selected for the study. The entire individuals were providing informed consent and agreed to participate in the study.

Inclusion criteria: Age group: 18 to 25 years, Gender: Male and female, Willing to participate

Exclusion criteria: subjects with rotator cuff tear and traumatic injury to shoulder, Uncooperative patients, Professional athletes, Subject with cardiac, neurological, psychological condition.

Fig. 1: EMG Accessories

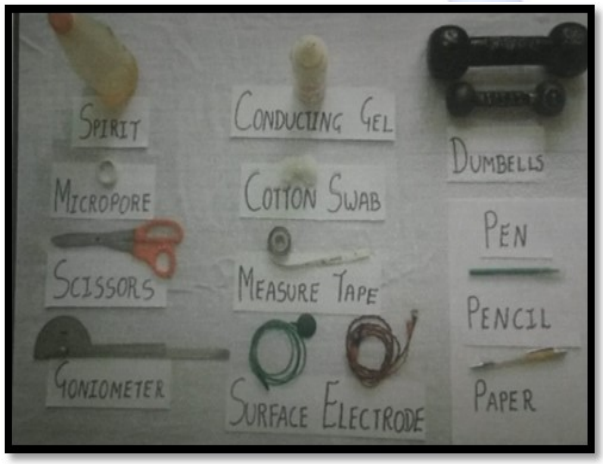

Fig. 2: EMG Machine

Subjects were oriented and explain whole procedure. Prior the testing, Age, gender and 10 RM (repetition maximum) of dominant hand (edinburgh handedness scale) calculated by the use of dumbbell weight and recorded accordingly.[2]

All the sites of electrode placements were abraded with sand paper and cleaned with alcohol to minimize the skin impedance. Surface electrodes with a 10mm diameter were placed with electrode gel medium on the target muscle by adhesive tape to assess the EMG activity.

The MVIC was taken from the dominant shoulder in the standard manual muscle testing (MMT) position for the best isolation of the targeted muscle.[2] For taking MVIC manual resistance was given by the same person for every subject.

Electrode placement

Fig. 3: Posterior Deltoid

Fig. 4 Supraspinatus

Fig. 5: Infraspinatus

Fig. 6: Teres Minor

All subjects were asked to performed following 7 different shoulder external rotation exercises with use of dumbell weight resistance [2].

Standing ER in the scapular plane, Standing ER at 0° of abduction, Standing 0° of abduction with a towel roll, Standing ER at 90° of abduction, Side lying ER at 0° of abduction, Prone ER at 90° of abduction, Prone horizontal abduction at 100° with full ER

Fig. 7: Exercise 1

Fig. 8: Exercise 2

Fig. 9: Exercise 3

Fig. 10: Exercise 4

Fig. 11: Exercise 5

Fig. 12: Exercise 6

Fig. 13: Exercise 7

3 trials for each variant were performed to allow participants to become comfortable with the testing procedure and best out 3 was use for data collection. Verbal encouragement provided to all subjects. The EMG signals were acquired and analyzed using the RMS EMG PK M-II software. % MVIC value of each muscle takes as outcome measure.

RESULT

All Statistical analysis was done by using software SPSS 14.0 version. Means and Standard Deviation (SD) were calculated .The effect of the different shoulder position muscle activity was examined using a repeated measure Analysis of Variance (ANOVA). Graph and table shows the mean and SD value of %MVIC of all muscles in all 7 different positions.

Table 1: Posterior Deltoid.

Sr. No.	Ex. No.	External Rotation Exercise	%MVIC Mean ± SD
1	7	Prone horizontal abduction at 100° with full ER	81.844 ± 17.15
2	6	Prone ER at 90° of ab74.99duction	52.170 ± 19.59
3	5	Side lying ER at 0° of abduction	44.235 ± 20.57
4	4	Standing ER at 90° of abduction	34.097 ± 16.57
5	3	Standing 0° of abduction with a towel roll	31.970 ± 15.18
6	2	Standing ER at 0° of abduction	26.920 ± 10.71
7	1	Standing ER in the scapular plane	25.006 ± 11.20

F =74.994, Ex 7 is p <0.0001 significantly different than Ex. 2 and 3 p>0.05

Table 2: Supraspinatus

Sr. No.	Ex. No.	External Rotation Exercise	%MVIC Mean ± SD
1	7	Prone horizontal abduction at 100° with full ER	96.141 ± 16.84
2	6	Prone ER at 90° of abduction	75.318 ± 19.69
3	5	Side lying ER at 0° of abduction	66.376 ± 17.35
4	4	Standing ER at 90° of abduction	52.648 ± 21.16
5	3	Standing 0° of abduction with a towel roll	45.209 ± 16.91
6	1	Standing ER in the scapular plane	40.152 ± 13.47
7	2	Standing ER at 0° of abduction	39.608 ± 13.17

F =75.274, Ex 7 is p <0.0001 significantly different than Ex. 1 and 2 p>0.05

Table 3: Infraspinatus

Sr. No.	Ex. No.	External Rotation Exercise	%MVIC Mean ± SD
1	7	Prone horizontal abduction at 100° with full ER	84.393 ± 14.49
2	5	Side lying ER at 0° of abduction	77.414 ± 17.33
3	6	Prone ER at 90° of abduction	77.369 ± 23.10
4	4	Standing ER at 90° of abduction	60.279 ± 19.08
5	1	Standing ER in the scapular plane	51.683 ± 18.10
6	3	Standing 0° of abduction with a towel roll	51.574 ± 20.05
7	2	Standing ER at 0° of abduction	47.759 ± 15.67

F = 33.210, Ex 7 is p <0.0001 significantly different than Ex. 3 and 2 p>0.05

Table 4: Teres Minor

Sr. No.	Ex. No.	External Rotation Exercise	%MVIC Mean ± SD
1	5	Side lying ER at 0° of abduction	89.049 ±16.510
2	7	Prone horizontal abduction at 100° with full ER	84.960±13.958
3	6	Prone ER at 90° of abduction	81.621±13.058
4	3	Standing 0° of abduction with a towel roll	65.762±63.657
5	4	Standing ER at 90° of abduction	58.731±18.405
6	1	Standing ER in the scapular plane	51.235±17.530
7	2	Standing ER at 0° of abduction	50.861±14.584

F = 16.573, Ex 5 is p <0.0001 significantly different than Ex. 1 and 2 p>0.05

DISCUSSION

For all 4 muscles, statistically significant differences were noted in the amount of EMG activity across the 7 exercises tested which support the experimental hypothesis. Prone horizontal abduction at 100° with full ER had greatest EMG activity for posterior deltoid, supraspinatus, and infraspinatus. Sidelying external rotation at 0^0 abduction had greatest EMG activity for teres minor muscle.

Present study result were also similar with Blackburn et al (1990), who reported significantly greater activity in infraspinatus and teres minor muscles in the Prone lying lateral rotation exercise than in the Supine lying Lateral Rotation exercise [7].

For all 4 muscles, statistically significant differences were noted in the amount of EMG activity across the 7 exercises tested which support the experimental hypothesis. Prone horizontal abduction at 100° with full ER had greatest EMG activity for posterior deltoid, supraspinatus, and infraspinatus. Sidelying external rotation at 0^0 abduction had greatest EMG activity for teres minor muscle.

Present study result were also similar with Blackburn et al (1990), who reported significantly greater activity in infraspinatus and teres minor muscles in the Prone lying lateral rotation exercise than in the Supine lying Lateral Rotation exercise [7].

Teres minor muscle contributes abduction of arm by providing the external rotation but along with subscapularis it contradict their role of elevation and work in weak adduction force which supports present study result [4].

Supraspinatus, deltoid, infraspinatus contributes abduction with external rotation by elevation of arm. So, Prone horizontal abduction at 100° with full ER position produced greatest EMG activity [4].

In present study infraspinatus MVIC 84% in Prone horizontal abduction at 100° with full ER were best position but in Michael M. Reinold et al (2007), 62% MVIC best position in sidelying external rotation [1]. This difference between both studies is due to limited sampling rate or different set up or population [1].

CONCLUSION

The exercise that produced the greatest amount of EMG activity of Teres minor was sidelying ER while deltoid, supraspinatus and infraspinatus prone horizontal abduction at 100° with full ER.

Considerations when selecting external rotation exercises may be made based on the amount of infraspinatus and teres minor activity as well as the amount of desired activity of the supraspinatus and deltoid musculature.

Limitation of study: Use of Needle electrode will provide better result, while use of surface EMG increases possibility of cross talk between

nearer muscles. Sub maximal effort by the subjects. (Effort bias). Small sample size.

Further recommendation: Large sample size, Kinesiological EMG, Activity of other shoulder and scapular muscles can also be studied, Dominant and non dominant side comparison, Study can be done with varying amounts of weights and various types of resistance like resistive elastic bands, weight cuffs, Study can be done on rotator cuff tear, frozen shoulder, other shoulder pathological conditions.

Clinical implication: Post. Deltoid muscle MVIC (81%) in prone horizontal abduction at 100°. So, rotator cuff and subacromial impingement gives disadvantage but for athletic endurance this position is best [2]. Moderate activity of all muscle were measure during various standing position which helpful for prescribing gradual strengthening rehabilitation protocol [3]. ER in the scapular plane at 45° offers functional benefit and reduced capsular strain [1]. In scapular plane positions, the muscles of the glenohumeral joint are at their optimal alignment and length-tension relationship is maintain. Which in turns to provide dynamic stabilization [1].

ABBREVIATIONS

EMG- Electromyography

MVIC- Maximal Voluntary Isometric Contraction

ER- External Rotation

ANOVA- Analysis of Variance

SD- Standard Deviation

RM- Repetition maximum

ACKNOWLEDGEMENTS

The author is grateful to staff of K. K. Sheth physiotherapy centre and staff for their support. I would like to thank all the subjects who participated in this study. Special thanks to Dr. Nirali kamani for helping me in study.

Conflicts of interest: **None**

REFERENCES

[1]. Michael M. Reinold, Leonard C. Macrina, Glenn S. Fleisig, Michael T. Ellerbu,Electromyographic Analysis of the Supraspinatus and Deltoid Muscles During 3 Common Rehabilitation Exercises, Journal of Athletic Training 2007;42.

[2]. Michael M. Reinold, , ATC1 Kevin E. Wilk,Glenn S. Fleisig, Nigel Zheng, Steven W. Barrentine, Terri Chmielewski, PT,Rayden C. Cody, Gene G. James, James R. Andrews, Electromyographic Analysis of the Rotator Cuff and Deltoid Musculature During Common Shoulder External Rotation Exercis, j Orthop Sports Phys Therapy, July 2004 34; 7.

[3]. Bryon T Ballantyne, Sally J O'Hare, Jodle L Paschal1, Mary M Pavla Smlth, Angela M Pltz Jerry F Glllon Gary L Soderberg, Electromyographic Activity of Selected Shoulder Muscles in Commonly Used Therapeutic Exercise , journal of APTA september 2014: 73:668-677.

[4]. Pamela k levangie, cynthia c norkin, a joint structure and function- a comperihensive analysis, forth edition.

[5]. Worrell TW, Corey BJ, York SL, Santiestaban J. An analysis of supraspinatus EMG activity and shoulder isometric force development. Med Sci Sports Exerc. 1992; 24:744–748.

[6]. Cain PR, MutscNer JA, Fu W, Lee SK Anterior stability of the glenohumeral joint: a dynamic model. Am J Med 1987; 15:144-148.

[7]. Blackburn TA, McLeod WD, White B, Wofford L. EMG analysis of posterior rotator cuff exercises. Athl Train. 1990; 25:40-45.

How to cite this article:

Radhika D. Kariya. EFFECT OF DIFFERENT SHOULDER POSITION ON EMG PARAMETER OF ROTATOR CUFF AND DELTOID MUSCLE DURING EXTERNAL ROTATION EXERCISE – A CROSS - SECTIONAL OBSERVATIONAL STUDY. Int J Physiother Res 2018;6(2):2628-2632. **DOI:** 10.16965/ijpr.2018.102