Correlation between the Hand Grip Strength and the Shoulder Rotator Cuff Function

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Abstract

Aim of the Study: To know if there is correlation between handgrip strength and shoulder rotator cuff function.

Materials and Method: total of 60 healthy, male volunteers with no history of shoulder, upper limb or neck injury comprised the study group. The mean (SD) age was 20 ± 0.64 years (range 20 years to 25 years). Grip strength (measured with hand grip dynamometer) and lateral rotator strength (measured with Manual Muscle Testing) was measured at neutral, 90abduction, and 90abduction with 90external rotation.

Results: The correlation test reviled that there is significant correlation between handgrip strength and lateral rotator cuff function in neutral and 90° abduction and lateral rotation. While it showed negative correlation between in 90° abduction position.

Conclusion: This cross-sectional study concluded that there is positive correlation between neutral and 90° abduction and negative correlation in 90° abduction position.

Keywords: *hand grip, lateral rotator strength, rotator cuff, shoulder, hydraulic hand held dynamometer*

Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. (1) Shoulder pain could occur due to may factor including psychosocial work environment and physical load. That might cause Inability to work, loss of productivity, and inability to carry out household activities which can be a considerable burden to the patient as well as to society. (2) Optimal rotator cuff function requires strong healthy rotator cuff muscles, tendons and bony attachments, normal capsular laxity, an even curve of the coraco-acromial arch, a thin synovial bursa and coordinated co-contraction of the cuff muscles acting in force couples (3) In addition to the obvious biomechanical factors of arm posture and hand load, gripping and cognitive effort have also been shown to increase shoulder load and the risk of injury.(4) The rotator cuff muscles function dynamically as secondary stabilizers by contracting in a coordinated and synergistic way to hold the humeral head throughout abduction. Internal rotation strength is primarily the result of the subscapularis, pectoralis major, latissimus dorsi, and teres major; the contribution of each of these is dependent upon shoulder position. (5) Due Repetitive micro trauma and eccentric overload, resulting in muscle-tendon injury. Subtle instabilities of the gleno-humeral joint may cause impingement within the sub-acromial space.(6)Due to the repetitive micro trauma to the articular site of the rotator cuff might cause the tendon to become compressed between the superior posterior glenoid rim and humeral head.(2) Disruption of this complex mechanism predisposes to a cycle of movement impairment and tissue pathology, leading

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to anterosuperior migration of the humeral head and subsequent impingement of the sub acromial structures under the coracoacromial arch.[3] It has been estimated that rotator cuff problems, including impingement and associated rotator cuff tendonitis and bursitis, account for nearly one-third of physician visits for shoulder pain complaints. If not alleviated, impingement can progress to tears of the rotator cuff tendons. [7] Manual muscle testing was developed by Lovett and described by Wright' in 1912. This technique has been revised, advanced, and promoted, resulting in several methods from which to choose. [8]

Manual Muscle Testing is an attempt to assess the maximum force a muscle is capable of generating maximum force generated depend greatly on the function and the size of the muscle. The force produced by the muscle can be classified according to the grades given in the Kendall and Kendall muscle testing and function. [9] The MMT would be used to assess the strength of glenohumeral rotation in different patient and different shoulder position. Measurement of the handgrip strength is used during rehabilitation to compare the normal values or to compare the dominant with non-dominant limb. [10] Hand muscle activity, mainly gripping, is an essential part of kinesiology many work- and sport-related activities which can contribute to upper limb disorders. Stabilization of the glenohumeral joint by the Supraspinatus and Infraspinatus rotator cuff muscles is an essential for hand grip activity. [11]while changes in arm posture, hand loading and shoulder angular velocity have all been shown to affect shoulder muscle activity, they have done so under constrained conditions. [12] The hand has to be able to undertake extremely fine and sensitive movements and must also be able to perform tasks which require considerable force. The ability to grip and manipulate an object may be one of the most important functions of the hand, and any deterioration in this ability can impair activities of daily living. [13] Hand grip strength measurement is useful in the assessment of individuals who suffering from impairments in daily life tasks, measurement of the integrity of upper extremity function, and effectiveness of hand rehabilitation procedures. [14] The hand grip strength can be measure by the dynamometer. The person has to squeeze the hand around the dynamometer and the static force is measured. The force is usually measured in kilogram and pound. The grip strength can be measured quantitavely using a hand dynamometer and that would provide objective index of the functional integrity of hand as well as the upper extremity. [15] The comparison between the hand dynamometer and isokinetic dynamometer is moderate and hand dynamometer is inexpensive. Hence it is preferred. [16] The handgrip strength can be checked with the hydraulic dynamometer the reliability values of test-retest ($0.58 \leq ICC \leq 0.97$) and inter-rater ($0.60 \leq ICC \leq 0.98$). [18] Manual muscle testing is a clinically useful tool for checking manual muscle testing. [19] Previous study claim strong correlation between grip strength and lateral rotator strength at all position for both left and right hands. That study show that grip strength can be reliably used to assess the function of the lateral rotators of the shoulder in normal individuals. [10] Population studies have reported that in musculoskeletal pain, shoulder pain is the most frequently reported pain. Shoulder pain is often presented together with other pain symptoms and is considered to have multifactorial causes and symptoms. [19] Where most common shoulder disorder is shoulder impingement in primary care. [20] And it is seen in several studies that after the sub acromial impingement there would be presence of weakness or suboptimal recruitment of rotator cuff muscles. [21], [22] Shu-Wen Wu et al. found that the grip strength depends upon the factors like gender, age, palm length, grip position, and grip span. The grip strength can be used to recognize the overall strength of the upper limb. [8]

Methodology

Materials and Method :SOURCE OF POPULATION- The volunteer were taken from Uka Tarsadia University. **Study Design**- This is a cross-sectional study. **Sample Size**-60. **Study Population**-50 male volunteer participated in the study. **Material Used**- Pen ,Consent Form , Plinth ,Hydraulic hand held dynamometer (SH5001) (reliability- 0.99)[17] , chair. **Incluscion Criteria**- Gender- male, Healthy male ,Age- 20-25year, Manual Muscle Testing- grade 4 and 5. **Exclusion Criteria**-Manual Muscle Testing- Grade-1, 2 and 3 History of shoulder pathology History of wrist pathology History of elbow pathology **Outcome Measure-** The grip strength would be measured using hydraulic hand held dynamometer (SH5001) (reliability-0.99) [17]

And the rotator cuff strength would be measured using manual muscle testing. **PROCEDURE-** The present study was be initiated once the clearance obtained from the institutional committee of ethics of the Shrimad Rajchandra of physiotherapy, where in a total of 50 subject who were be found satisfying all the inclusion criteria were included. Detailed information of the procedure was given to the each subject and as a formality towards the willingness to be a part of the study they were told to sign a written consent. After taking a written consent all the patient were asked to rest on plinth or chair. All test were performed in a well-ventilated room. Then the assessment of rotator cuff strength was started firstly, Assessment of rotator cuff strength: Lateral rotation would be tested by a manual muscle testing (MMT). **SHOULDER EXTERNAL ROTATION:** Position of the patient: patient should lie in side line. With the arm supported on the trunk and elbow flexed. A towel should be placed between the arm and the trunk. Position of therapist: standing at the back of therapist at the level of waist. One hand is used to give resistance over the forearm, as near the wrist as possible. Another hand supporting the elbow to provide the counter pressure at the end range. Test- patient moves forearm upward through the range of external rotation. Instruction to patient- "raises your arm. Hold it. Don't let me push it down." Therapist may need to demonstrate the desired motion. Position of the patient: prone with the head turned to the test side. Shoulder abducted to 90. With the arm fully supported on the table; forearm hanging vertically over the edge of the table. Place a folded towel under the arm at edge of the table. Position of the therapist: Standing at the test side at the level of the patient waist. One hand is used to give resistance over the forearm, as near the wrist as possible. The other hand support the elbow to provide the counter pressure at the end of the range. Test- patient moves forearm upward through the range of external rotation. Instruction to patient- "raises your arm to the level of the table. Hold it. Don't let me push it down." Therapist may need to demonstrate the desired motion. Assessment of the hand grip: The grip strength was measured by using hand held dynamometer (SH5001 (0.99) [10].The participants were asked to complete 5 second of maximum contraction in three position: Neutral, 90* abduction and external rotation. The wrist was kept in neutral and elbow at 90* flexion in all the position. The participants were sitting on the chair comfortably with arm supported on the chair. Each arm would be tested three times in each arm position and verbal encouragement. An average would be taken of these three scores. 1 minute rest time would be given to recover from each contraction.

Data Analysis and Result

Statistical Analysis

Table:1: Demographic data of Volunteers (n=60)

	MEAN±SD
AGE	20 ± 0.64

1 Shows descriptive statistic of age for all volunteers

Table : 2 Pearson correlation of neutral, 90 degree abduction and external rotation

	Neutral	**90 degree abduction**	**External Rotation**
R Square	0.01997	0.031618	0.088925
P value	0.01*	0.05**	0.02*
r value	0.14	0.17	0.29
DF	59	59	59

Table :2: above table shows descriptive result for clinical measure of handgrip strength and manual muscle testing

*Correlation is significant and is less than 0.05

**Correlation is not significant

There is an positive correlation between handgrip strength and lateral rotator cuff function in neutral. (P< 0.05).There is an negative correlation between handgrip strength and lateral rotator cuff function in 90̊ abduction position. (P= 0.05). And positive correlation between handgrip strength and lateral rotator cuff function in 90̊ abduction and external rotation position. (P< 0.05).

Discussions

Hydraulic Hand Held Dynamometer and Manual Muscle Testing were used. And the correlation between the outcomes were analyzed by using Pearson

coefficient. Data were normally distributed parametric test were used. And correlation between outcomes were analyzed by using Pearson coefficient that is shown in table.2.Previous studies found that and have published data of grip strength values between the sexes show that males have higher peak strength. The peak strength occurs in the fourth decade in both sexes and undergoes a similar gradual decline. [23] Several studies have shown a positive correlation between hand gripping activity and rotator cuff muscle activity in line with the findings of the present study. [24-26]

Kwasniewski compared bilateral rotator cuff strength in patients with a unilateral hand or wrist disorder using a hand held dynamometer and found that a there is statistically significant decrease in increased external rotation strength. Kwasniewski also stated that it was unclear if there was a causal relationship. [27] Similarly, There was alterations in muscle activity patterns have been documented in the presence of shoulder dysfunction with the activity of some shoulder muscles increasing, whereas others decrease when gripping is added to shoulder movements. [4, 25] The strong positive correlation found between the two variables in the present study in both hands is in agreement with the findings of Mandalidis and O'Brien [16] who investigated the relationship between isometric grip strength and isokinetic strength of the shoulder stabilizers. This relate with the concept of shoulder stabilizer activity increasing during handgrip actions shown in previous studies. [12, 25] Sporrong et al.28 found that the electromyography activity of rotator cuff musculature increased significantly during isometric handgrip tasks, particularly in positions of shoulder flexion/abduction, and that biceps brachia activity also increased during handgrip. It has been suggested that this may cause changes in activity of the shoulder muscles and potentially changes in 'internal loading' of the shoulder.[12], Walaa and Walaa [14] also found that hand grip strength correlated with body position.

Limitations: The discrepancy of the result of this study might be caused due to 4 and 5 grade were taken due to which there might be variation. And also due to limited population exposure.

Conclusion

The study showed a positive correlation of handgrip and lateral rotator cuff function in the neutral and 90° abduction with external rotation position. But failed to show positive correlation in 90° abduction position.

Conflict of Interest – No**.**

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Ethical Clearance – Obtained by The Institutional Committee of Ethics of The Shrimad Rajchandra College of Physiotherapy.

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