Original Research Paper

Volume - 16 | Issue - 08 | August - 2026 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Physiotherapy

ASSESSMENT OF HAND GRIP STRENGTH OF AFFECTED EXTREMITY AMONG PATIENTS WITH SHOULDER DISORDERS IN SITTING AND STANDING POSITION - A CROSS SECTIONAL OBSERVATIONAL STUDY.

Maithili M. Kadam BPTH, The SIA College of Health Sciences, College of Physiotherapy, Dombivli.

Dr. Donna Gaikwad* BPTH, MPTH, Associate Professor: The SIA College of Health Sciences, College of Physiotherapy, Dombivli.*Corresponding Author

Dr. Asmita Karajgi PT, PHD, DEAN, The SIA college of Health sciences, College of Physiotherapy, Dombivli.

ABSTRACT **Background:** Shoulder disorders are commonly faced musculoskeletal disorders causing pain. Response to this pain there is guarding of muscle, reduced use of limb causing shoulder girdle muscle weakness. Hand gripping is an essential activity of daily living, for which along with the intrinsic and extrinsic mechanism of the hand, shoulder girdle muscles are also being used. Weakness of these muscles might affect hand grip strength. Sitting and standing are most functional positions. Positional change results variation in hand grip strength in studies performed on normal individuals, so there is need to assess that does it give the similar results in people with shoulder disorders. **Objectives:** To assess hand grip strength of affected extremity among patients with shoulder disorders. To assess and compare hand grip strength of affected extremity in sitting and standing position among patients with shoulder disorders. **Methodology:** Permission from institutional ethical committee was obtained. 62 participants with shoulder disorders in age group of 40-74 years were included. Hand grip strength was assessed in sitting and standing position by Baseline Hand held dynamometer. **Results:** 62.9% of total participants were female and 37.1% were male with mean age (56.8±10.7) years. Maximum 93.5% of participants were Right hand dominant. Hand grip strength of affected extremity was reduced in sitting as compared with expected hand grip strength values using Wilcoxon signed ranked test, p value < 0.00001 showing extremely significant results. Hand grip strength in sitting position was compared with hand grip in standing position where no statistical significance was established with p= 0.29834.**Conclusion:** Hand grip strength was significantly reduced among patients with shoulder disorders. Sitting and standing positional change did not result in variation of hand grip strength.

KEYWORDS : Hand grip strength, Hand held dynamometer, Shoulder disorders

INTRODUCTION:

Shoulder disorders are commonly faced musculoskeletal disorders in the world[1] impacting on patients' quality of life[2]. Prevalence of which is about 51% and incidence seen most in age group of 45-64 years followed by 65-75 years[3].

Shoulder girdle is comprised of glenohumeral joint, acromioclavicular joint, sternoclavicular joint and Scapulothoracic joint. Out of which glenohumeral joint provides maximum range of motion and movements in multiple planes[4]. The glenohumeral joint is encapsulated and is surrounded by muscles like Deltoid, Rotator cuff muscles including Supraspinatus, Infraspinatus, Teres minor and subscapularis.

Variety of conditions are under umbrella term shoulder disorders like Adhesive capsulitis, Impingement syndrome, repairable rotator cuff tears, glenohumeral arthritis and many more[5].

Adhesive capsulitis is defined as tightening of glenohumeral capsule and further leading to its fibrosis as a result of inflammatory response. This capsular fibrosis and synovial hyperplasia occur by Transforming growth factor-β (TGF-β), platelet-derived growth factor (PDGF), hepatocyte growth factor, IL-lβ, and TNF-α[6]. Clinical presentation shows restriction of range of motion in capsular pattern (external rotation >Abduction >Internal rotation). Patient perceives pain beyond restriction ROM. Patient is being graded in four stages according to the clinical features. Another common condition is impingement syndrome which occurs when tissue gets entrapped in subacromial space. Due to repetitive entrapment localised inflammatory response and the pain appreciated by patient[7]. True prevalence of Glenohumeral arthritis is not found. But through radiographic evidence seen in older age group, the cartilage loss starts over the period due to insufficient hydration to the joint and lands to arthritic changes[8].

Rotator cuff tear is sequel of progressive degeneration, direct trauma or poor posture.

As patients with shoulder disorders present with clinical symptoms like guarding of limb due to pain, there is reduced use if that limb eventually leading to weakness of shoulder girdle muscles[9,10].

Grip strength is used as a measure for assessment and is being used as a prognostic indicator. Hand grip strength depends on various factors like age, gender, BMI, Dominance[11]. Generally HGS is checked and compared with opposite extremity. Commonly HGS of dominant extremity is more than that of non-dominant extremity. It is an objective index for functional integrity and its correlation is being found with DASH score[2]. HGS is needed for almost all functional activities including gross motor and fine motor movements.

Hand grip function is cumulative action of intrinsic and extrinsic mechanism of hand. In Intrinsic mechanism Hypothenar compartment, deeper opponence compartment and lumbricals are in use. Whereas in extensor mechanism long forearm flexors and extensors are in use[12]. According to the EMG studies performed, Along with these muscles shoulder girdle muscles like Supraspinatus, infraspinatus, deltoid, trapezius are activated at the time of gripping activity[13]. Hence in case of shoulder disorders where weakness of these shoulder muscles is seen, they might not be able to produce the required force for hand grip strength.

Gripping is most vital and unique activity performed by human beings in day to day life in activities such as lifting suitcase, bags, prolong writing, kneading dough etc. These daily activities are performed in different positions by people according to their work environments and personal preferences. Most used positions are sitting and standing. The study by Neelam Jadhav et al. states that hand grip strength varies with change in position in normal individuals. It also states that maximum hand grip strength was seen in standing position followed by sitting position with forearm flexed to 90 degrees[14,15]. Which justifies by the reasoning that as the shoulder position changes, plane and amount of force varies too.

Whereas in the case of shoulder disorders biomechanics is is already hampered, hand grip strength might get affected and a positional variation again may cause change in direction and amount of muscle force required for hand grip strength, Which might give results unlike the Study done on normal population.

Hence This study aims to know the effect of shoulder disorders in hand grip strength and to know the variation with sitting and standing position.

Need of the study:

Shoulder disorders is a commonly faced musculoskeletal condition by variety of age groups[1]. Due to present shoulder pathology, there is

inflammation leading to pain and further resulting in weakness of all shoulder girdle muscles[9,10]. As well due to pain there is reduced use of the limb causing shoulder girdle muscular weakness. Gripping is needed for all the ADL's and hence impaired grip affects a person's quality of life[2]. The activity of gripping is cumulative action of intrinsic and extrinsic mechanism of hand along with the activation of shoulder girdle muscles according to the EMG study performed. Shoulder pathology disturbs proximal part of kinetic chain, so it is likely to give effect on distal part function i.e. hand grip strength[16]. Hence, reduction in hand grip strength can be seen among people with shoulder disorders. The correlation between hand grip strength and shoulder disorders is crucial but limited literature review is available for the same. Hence the measurement of hand grip strength among patients with shoulder disorders is needed.

According to the various studies performed Hand grip strength shows variations with respect to change in position in normal individuals[14]. It was found to be maximum in sitting position, it is needed to know that does hand grip strength varies with positional change when assessed in patients with shoulder disorders.

AIM: To assess the hand grip strength among patients with shoulder disorders in sitting and standing position.

OBJECTIVES

- To assess hand grip strength of affected extremity among patients with shoulder disorders.
- To assess hand grip strength of affected extremity in sitting position among patients with shoulder disorders.
- To assess hand grip strength of affected extremity in standing position among patients with shoulder disorders.
- To compare hand grip strength in sitting and standing position among patients with shoulder disorders.

METHODOLOGY

This Cross Sectional study was done in 62 Patients with shoulder disorders in Musculoskeletal OPD of Institutional setting in age group of 40 to 74 years. Permission from institutional ethical committee was obtained. The demographic data of the patient along with BMI was taken and was screened for inclusion and exclusion criteria after informed consent was obtained. Patients with VAS scale: more than 7), fracture of same extremity or opposite side extremity in past 1 year, rheumatoid arthritis, ankylosing spondylitis, Post surgery patients up to 6 months, Post mastectomy patients were excluded. Verbal instructions were given to the participants. For hand grip strength measurement, Baseline hand held dynamometer was used and procedure was conducted according to American society of hand therapist. Initially patient was assessed in sitting position (Back straight, shoulders adducted and neutrally rotated. Elbow flexed to 90 degrees. Forearm in neutral position. Wrist in 0 – 15 degrees of extension and 0 - 15 degrees of Ulnar deviation). 3 readings were taken with rest periods of 1 minute between each. Then the hand grip strength was assessed in standing position. Patienwas standing with their feet approximately shoulder width apart, with a wall behind them to add stability, prevent trunk rotation and help maintain arm position. Elbow fully extended. 3 readings were taken with rest periods of 1 minute between each. The collected data was compared with normative values and the amount of affection in sitting and standing position was assessed.

RESULTS:

62 participants were included in our study, out of which 62.9%were female and 37.1% were male. The mean age of participants was 56.8±10.7 years.

- The gender wise and age wise distribution is described in following figure 1 :

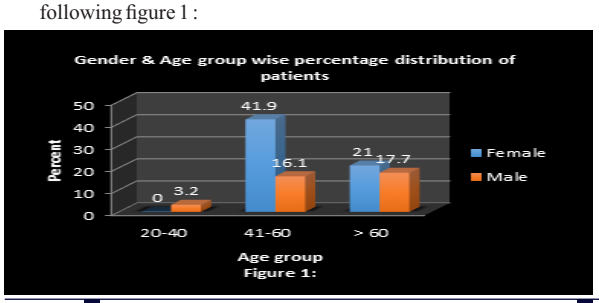


Figure 1:

In our analysis maximum number of participants were from age group of 41-60 years, out of which 41.9% were females and 16.1% were males.

Followed by age group of more than 60 years including 21% were females and 17.7% were males.

- Hand Dominance of participants was also recorded, which is explained in Table 1:

6.5% of participants were left hand dominant while 93.5% of participants were Right hand dominant.

Table 1 : Distribution of participants according to dominance
Our study includes maximum number of participants with right-handed dominant.

Dominant Side	No. of pts	%
Left	4	6.5
Right	58	93.5
Total	**62**	**100**

- Distribution of participants according to affected extremity explained in figure 2:

Left side was affected in 37.1% of participants and Right side was affected in 62.9% of participants.

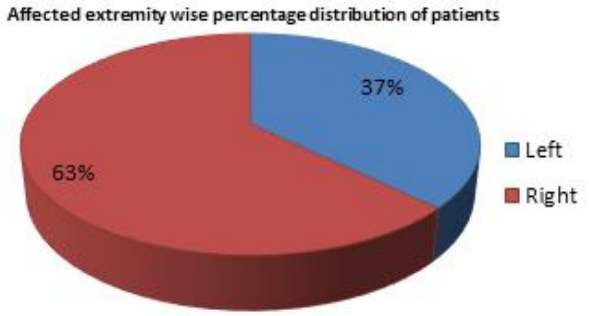
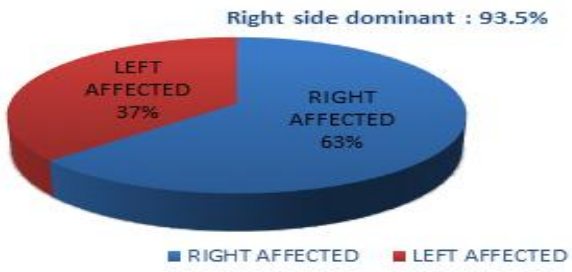


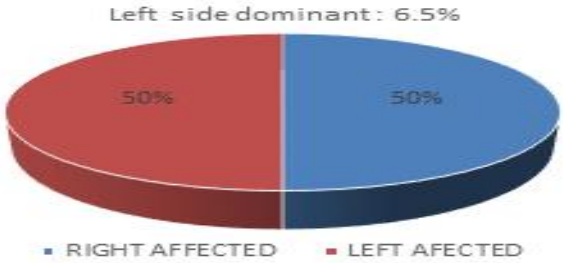
Figure 2

Maximum number of participants had affection of right hand side.

- Total 93.5% of participants were right handed dominant out of which 63% had affection of Right hand and 37% had affection of left hand.



6.5% of total participants were left handed dominant out of which 50% hand affection of right hand and remining 50% had affection of left hand.



- Adhesive Capsulitis, Shoulder impingement, Post operative rotator cuff tear were in conditions included under shoulder disorders.

74.2% participants were having Adhesive capsulitis, 24.2 % were having Shoulder impingement and 1.6% were post operative rotator cuff tear.

Table 2: Distribution of participants according to conditions

Diagnosis	No. of patients	Percentage
Adhesive Capsulitis	46	74.2
Shoulder impingement	15	24.2
Post operative rotator cuff tear	1	1.6
Total	**62**	**100**

Participants with Adhesive capsulitis were 74.2% maximum in number followed by patients with shoulder impingement.

Outcome measure:
Numerical Rating Scale
The mean NRS of participants was 4.3 ± 1.5 with P value of 0.00877

Hand grip strength:
Hand grip strength in sitting and standing position explained in Figure 3:

- Mean Hand grip strength in sitting was 14.40 ± 9.67 and Mean Hand grip strength in standing was 14.79 ± 9.93
- Expected hand grip strength was calculated for each patient by reference of normative values.

Hand grip strength in sitting was compared with expected hand grip strength values using Wilcoxon signed ranked test, p value was < 0.00001 showing extremely significant results.

Hand grip strength in standing was compared with expected hand grip strength values using paired t test. P < 0.00001 showing extremely significant results.

When Hand grip strength in sitting position was compared with hand grip in standing position it showed not significant results with p= 0.29834

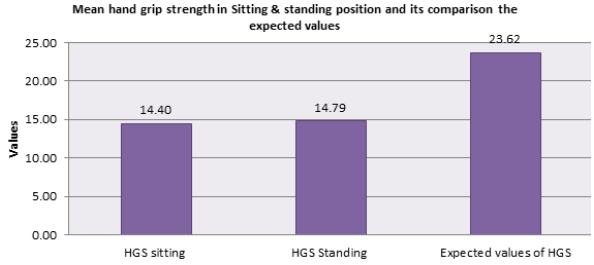


Figure 3

DISCUSSION:
This study aimed to assess hand grip strength among patients with shoulder disorder and to know variation of hand grip strength in sitting and standing position. Total 62 patients with shoulder disorders including Adhesive capsulitis, Shoulder impingement and post operative rotator cuff tear were included. Hand grip strength was taken in sitting position, neutral shoulder with elbow flexed at 90 degrees and standing position with elbow extended. The results of our study show Extremely strong correlation as hand grip strength was significantly reduced when compared with normative values. But there was no significant variation with positional change.

This study included a greater number of females than males. According to the researchers adhesive capsulitis is seen more commonly in females than in males[19]. In age group of 40-60 years where hormonal changes could also be one of the causative reasons. As well the dominant sided repetitive work can put women to be prone for shoulder impingement syndrome. Whereas non dominant extremity is often affected by Adhesive capsulitis hence patients with non dominant extremity are also included[20].

Shoulder girdle comprises of AC, ST, GH joints. Maximum ROM is achieved by Glenohumeral joint. Negative intra-articular pressure, resultant vector of gravity and rotator interval capsule are the static stabilizers of glenohumeral joint. Dynamic stability is provided by deltoid as a prime mover for flexion and abduction as well the resultant vectors of Supraspinatus, Infraspinatus, Teres minor and subscapularis[21]. Rotator cuff muscles provides this dynamic stability to glenohumeral head with passive forces of stretched capsular ligament giving dynamic centralization to glenohumeral head[22].

In case of conditions like adhesive capsulitis, Shoulder impingement and rotator cuff tear due to the present pathology surrounding shoulder girdle muscle weakness is seen[9,10]. Specifically adhesive capsulitis causes capsular thickening and fibrosis leading to restriction in range of motion, as well there is presence of pain and hence guarding of the muscles resulting in shoulder girdle muscular weakness[6]. Case report by L Hallman et al states that active muscle guarding in adhesive capsulitis is major factor of reducing ROM and causing muscular weakness. As sequel of capsular fibrosis glenohumeral ROM has reduced which is being substituted by scapulothoracic movements[9]. As the ultimate function of scapula is to keep glenoid fossa oriented for humeral head. This impaired biomechanics disturbs the 2:1 ratio of scapulohumeral rhythm.

In shoulder impingement syndrome, entrapment of soft tissue in subacromial space having repetitive action causes inflammation. As well while performing active internal rotation overly tight posterior capsule can decentralize the humeral head anteriorly causing shoulder impingement[22]. Hence producing pain and future muscular weakness. Not only the shoulder muscles like deltoid, rotator cuff muscles: Supraspinatus, Infraspinatus result in weakness but scapular stabilizers like lower trapezius, serratus anterior, subscapularis, Teres major, Teres minor, also go into weakness.

Gripping is a task widely used by human beings for activities of daily living. This is mainly performed by the biomechanically complex joint hand, that is the reason hand has largest area of motor cortex[22]. Metacarpophalangeal joint, proximal interphalangeal joint, Distal interphalangeal joint, collateral ligaments with intrinsic and extrinsic mechanics of hand are responsible for gripping activity. Hand grip strength is an indicator of whole upper limb strength, it is a diagnostic as well the prognostic tool. This unique task of gripping which can be performed only by human beings when gets affected impairs the quality of life. Results of our study showed that Hand grip strength getting affected in patients with shoulder disorders. EMG study done on supraspinatus, infraspinatus, deltoid and trapezius muscle while gripping activity, Showed significant activation of supraspinatus and deltoid below 90 degrees of flexion. According to the systematic review, increased activity of supraspinatus, infraspinatus, trapezius is seen while gripping and performing various activities requiring gripping[23]. Hence due to this direct relation, shoulder girdle muscular weakness in shoulder disorders affects hand grip strength. Activation of kinetic chain is from proximal to distal way; any distal extremity task needs activation of proximal muscles. When due to shoulder pathology kinetic chain gets disturbed, affects the hand grip strength. According to the study by Priya S. et.al. there is requirement of proximal stability to perform activities by distal extremity[24]. Here hand is the distal extremity of upper limb and for its activity we need proximal stabilization by shoulder girdle and scapular muscles. This signifies the results we have got in our study. There was extremely strong significance between hand grip strength compared with normative values in patients with shoulder disorders. Hand grip strength was significantly reduced. Central nervous system mediated overflow principle explains the correlation between hand grip strength and the strength of rotator cuff muscles in the study by Turabi et al [11]. The study by Iran Horsley et al. also states correlation between hand grip strength and strength of lateral rotator muscles is strong[25].

Study by Neelam Jadhav et al; has found variation in hand grip strength after change in position in normal individuals. The variation was seen in sitting and standing position as the plane of muscular force changes with change in position. Hand grip strength was found maximum in standing position as standing position facilitate cortical and peripheral arousal, as well synergistic effect of lower extremity synergy adds on[14]. On a physiological basis, this may be due to the increased temporal and spatial summation of the contracting muscles in the standing position [26]. Whereas in sitting there is general muscular relaxation which reduces the results. But in our study, when assessed on patients with shoulder disorders, there was no significant variation in hand grip strength of sitting and standing position. This could be because of ultimate whole shoulder girdle weakness. The change in direction and plane of muscle force did not improve hand grip strength. Whereas facilitating positional factors like cortical and peripheral arousal, lower limb synergies did not add on to the amount of grip strength.

LIMITATIONS -
The height and weight of the participants were not taken into consideration in the study for hand grip strength assessment which is limitation of our study and can be assessed further.

CONCLUSION:

- Hand grip strength was significantly reduced among patients with shoulder disorders suggestive of affection of hand grip strength among patients with shoulder disorders.
- Sitting and standing positional change did not result in variation of hand grip strength, it was reduced in the both the positions.

Clinical implication:

- We found Extremely Strong significance in hand grip strength of patients with shoulder disorders hence hand rehabilitation protocol should be added along with shoulder rehabilitation.
- Hand gripping activity being essential for ADL's and work related tasks; rehabilitation of hand since the initial phase of shoulder disorders would produce better outcomes functionally. Hence quality of life will be improved.
- Especially individual strengthening of supraspinatus muscle should also be included as maximum activation of supraspinatus muscle was seen for gripping.

REFERENCES:

1. Philip W. McClure, Lori A. Michener, Staged Approach for Rehabilitation Classification: Shoulder Disorders (STAR–Shoulder), Physical Therapy, Volume 95, Issue 5, 1 May 2015, Pages 791–800, https://doi.org/10.2522/ptj.20140156
2. MacDermid, J.C., Ghobrial, M., Quirion, K.B. et al. Validation of a new test that assesses functional performance of the upper extremity and neck (FIT-HaNSA) in patients with shoulder pathology. BMC Musculoskelet Disord 8, 42 (2007). https://doi.org/10.1186/1471-2474-8-42
3. Djade CD, Porgo T v., Zomahoun HTV, Perrault-Sullivan G, Dionne CE. Incidence of shoulder pain in 40 years old and over and associated factors: A systematic review. European Journal of Pain (United Kingdom). 2020 Jan 1;24(1):39–50.
4. Kisner
5. Gartsman GM, Brinker MR, Khan M, Karahan M. Self-assessment of general health status in patients with five common shoulder conditions. Journal of Shoulder and Elbow Surgery [Internet]. 1998 May 1 [cited 2022 May 13];7(3):228–37. Available from: http://www.jshoulderelbow.org/article/S1058274698900507/fulltext
6. Lal H, Verma SK, Smith M, Guleria RS, Lu G, Foster DM, Dostal DE. Stretch-induced MAP kinase activation in cardiac myocytes: differential regulation through beta1-integrin and focal adhesion kinase. J Mol Cell Cardiol. 2007 Aug;43(2):137-47. doi: 10.1016/j.yjmcc.2007.05.012. Epub 2007 May 24. PMID: 17583725; PMCID: PMC2039913.
7. Garving C, Jakob S, Bauer I, Nadjar R, Brunner UH. Impingement Syndrome of the Shoulder. Dtsch Arztebl Int. 2017 Nov 10;114(45):765-776. doi: 10.3238/arztebl.2017.0765. PMID: 29202926; PMCID: PMC5729225.
8. Chase B Ansok & Stephanie J Muh (2018) Optimal management of glenohumeral osteoarthritis, Orthopedic Research and Reviews, 10:, 9-18, DOI: 10.2147/ORR.S134732
9. Hollmann L, Halaki M, Kamper SJ, Haber M, Ginn KA. Does muscle guarding play a role in range of motion loss in patients with frozen shoulder? Musculoskelet Sci Pract. 2018 Oct;37:64-68. doi: 10.1016/j.msksp.2018.07.001. Epub 2018 Jul 6. PMID: 29986193.
10. Celik D. , Sirmen B. , Demirhan M. The relationship of muscle strength and pain in subacromial impingement syndrome. Acta Orthopaedica et Traumatologica Turcica. 2011; 45(2): 79-84.
11. Turabi, R., Horsely, I., Birch, H. et al. Does grip strength correlate with rotator cuff strength in patients with atraumatic shoulder instability?. Bull Fac Phys Ther 27, 1 (2022). https://doi.org/10.1186/s43161-021-00059-3
12. Movement System Impairment Syndromes of the Extremities, Cervical and Thoracic SpinesBook by Shirley Sahrmann
13. Sporrong H, Palmerud G, Herberts P. Hand grip increases shoulder muscle activity, An EMG analysis with static hand contractions in 9 subjects. Acta Orthop Scand. 1996 Oct;67(5):485-90. doi: 10.3109/17453679608996674. PMID: 8948256.
14. Neelam Manohar Jadhav et al., Grip Strength of Dominant Hand In Various Body Postures In The Age Group of 20-50 Years. Int J Recent Sci Res. 7(10), pp. 13862-13871.
15. El-Sais WM, Mohammad WS. INFLUENCE OF DIFFERENT TESTING POSTURES ON HAND GRIP STRENGTH. ESJ [Internet]. 2014Dec.30 [cited 2023Apr.5];10(36). Available from: https://eujournal.org/index.php/esj/article/view/4904.
16. Sciascia A, Cromwell R. Kinetic chain rehabilitation: a theoretical framework. Rehabil Res Pract. 2012;2012:853037. doi: 10.1155/2012/853037. Epub 2012 May 14. PMID: 22666599; PMCID: PMC3361354.
17. Stark T, Walker B, Phillips JK, Fejer R, Beck R. Hand-held dynamometry correlation with the gold standard isokinetic dynamometry: a systematic review. PM R. 2011 May;3(5):472-9. doi: 10.1016/j.pmrj.2010.10.025. PMID: 21570036.
18. Walankar P, Verma C, Mehta A. Study of hand grip strength in Indian population. Int J Health Sci Res. 2016; 6(11):162-166.
19. de la Serna D, Navarro-Ledesma S, Alayón F, López E, Pruimboom L. A Comprehensive View of Frozen Shoulder: A Mystery Syndrome. Front Med (Lausanne). 2021 May 11;8:663703. doi: 10.3389/fmed.2021.663703. PMID: 34046418; PMCID: PMC8144309.
20. Toda K (2018) Left and Non-Dominant Shoulders Were More Frequently Affected in Patients with Frozen Shoulder: A Systematic Review and Meta-Analysis. Orthop Muscular Syst 7: 258. doi:10.4172/2161-0533.1000258
21. Cynthia norkins
22. Kinesiology of the musculoskeletal system, foundation for rehabilitation,3rd edition, Donald A. Neumann
23. Nazanin Nakhaie 1, Afsun Nodehi -Moghadam 2*, Enayatollah Bakhshi 3, Razie Goghatin Alibazi 4, Maryam Habibi: Activation of Shoulder Girdle Muscles during Gripping Task: a Systematic Review of Literature April 2014
24. Priya S., Haripriya S., Trusha Pushkar Kulkarni. Correlation between hand grip strength and scapular muscle strength of affected upper extremity in female breast cancer survivors post modified radical mastectomy. International Journal of Science & Healthcare Research. 2022; 7(2): 424-430. DOI: https://doi.org/10.52403/ijshr.20220460
25. Horsley I, Herrington L, Hoyle R, Prescott E, Bellamy N. Do changes in hand grip strength correlate with shoulder rotator cuff function? Shoulder Elbow. 2016 Apr;8(2):124-9. doi: 10.1177/1758573215626103. Epub 2016 Jan 25. PMID: 27583010; PMCID: PMC4950463.
26. Karthikeyan R, Thamburaj SA, Abudaheer SK et al. Comparison of hand grip strength in different positions of shoulder with elbow in 90o flexion and 0o extension positions. Int J Health Sci Res. 2016; 6(2):245-253.