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Original Research Article

Assessment of Grip Strength in Different Ranges of Scaption Plane

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ABSTRACT

Background and Purpose: The importance of the shoulder in the correct positioning of the hand can be compared to the joints of a dredging machine that moves the shovel into the correct position. The function of the shovel is dependent upon the proximal joints that position it and the stability of the cab. Core scapular and trunk stability are necessary for distal function as well. Most upper extremity functional activities of daily living are rarely performed solely in pure cardinal planes. Scaption is an important movement to consider when treating shoulder pathologies because it incorporates functional movement patterns that are a part of the normal biomechanics of the shoulder complex. Alternative testing position may be useful, however, in identifying positions, which maximize biomechanical abilities.
Methodology: Grip strength was taken in 5 different ranges of scaption plane.
Results & Conclusion: The grip strength was significantly better in Scaption plane 180°, Scaption plane 120°& Scaption plane 90° in comparison to standardized position of grip strength given by ASHT (American society of hand therapists).

Key words: Scaption plane, grip strength, shoulder, scapula.

INTRODUCTION

The hand is irreplaceable when it comes to any kind of movement be it gross or skilled. The prime function of hand is grip. Grip is an action or activity of hand in moving, grasping or taking hold of an object between any two surfaces of hand, the thumb may or may not be involved. Grip can be categorized as either power grip or precision handling.

It is widely accepted that grip strength provides an objective index of the functional integrity of the upper extremity.

Grip strength is one of the many components to be considered in the examination of hand function. Grip strength is commonly used to evaluate the integrated performance of muscles by determining maximal grip force that can be produced in one muscular contraction.[1] Measurement of grip strength is an important component of hand rehabilitation as it helps establish a baseline for treatment and it is a measure of the effectiveness of therapy. [2]

Grip strength is correlated with the upper extremity function,[2] overall strength,[3] biological growth and the amount of protein reserves in the body. [4] Because of this correlation, grip strength has been measured as an objective clinical measure in variety of situations.

Shoulder elevation in the scapular (scaption) involves elevation of the humerus in an intermediate plane between pure shoulder flexion and abduction. Most upper extremity functional activities of daily living are rarely performed solely in pure cardinal planes.

Scaption is an important movement to consider when treating shoulder pathologies because it incorporates functional movement patterns that are a part of the normal biomechanics of the shoulder complex.[6] In addition, following labral repairs and reverse shoulder arthroplasty, rehabilitation protocols often dictate movement to take place in scaption because it provides the least amount of capsuloligamentous tension of the surgically repaired structures. [7,8]

Lastly, incorporation of treatment interventions in the scapular plane are often advocated; thus, it is essential that clinicians and researchers possess a reliable means to quantify scaption. The main objective of the current study is to establish the variation and comparison in grip strength in different ranges of scaption plane (scaption 90°, empty can 90°, scaption 120°, scaption 180°, scaption 45°) of shoulder with standardized position of grip strength ASHT(American society of hand therapists).

MATERIALS & METHODS

Jamar plus digital Hand dynamometer, Proforma, Goniometer (Measure scaption)

Research design: cross sectional study

Sampling method: Convenience sampling

Sample size: 150

Duration of study: 4 months

Inclusion criteria: normal individuals with no shoulder pain.

Exclusion criteria: Individuals with any musculoskeletal problem in upper quarter.

Institutional ethics committee approval was taken. Subject's consent was taken prior to the study.

Grip strength was assessed in 5 different ranges of Scaption plane i.e. Scaption 90° (Full can), Scaption 90° (Empty can), Scaption 120°, Scaption 180°& Scaption 45°.

Grip strength was also assessed in standard position recommended by ASHT (American society of hand therapists, Fess 1992). [9] The grip strength values were compared between 5 different ranges in scaption plane and standard position by ASHT.

The data thus collected was statistically analysed (Repeated measures ANOVA) for the level of significance. Instat Graph Pad was used for statistical analysis).

Fig 1: Grip strength measurement using ASHT method.

Fig 2: Grip strength measurement in scaption plane 120º (Similarly Scaption 90º, Empty can 90º, Scaption 45º and Scaption 180º was assessed).

RESULTS AND OBSERVATIONS

Table 1: Demographic Table

	MEAN	SD
Age(Yrs)	20.22	1.72
Height(cms)	162.89	7.63
Weight(Kgs)	58.86	11.82
BMI	22.06	3.56

DISCUSSION

Measurement of grip strength is an important component for hand rehabilitation.

This study has investigated grip strength at different positions of shoulder in scaption plane and standardized position of grip strength (ASHT). The results revealed that the highest mean grip strength was recorded when the shoulder was positioned in scaption plane 180° followed by scaption plane 90° and scaption plane 120° which was better in comparison with standardized position of grip strength (ASHT) **(Table No.2).**

These findings indicated that shoulder angle does affect grip strength performance. The effect of upper extremity posture of maximum grip strength revealed that the shoulder joint angle has influence on grip strength performance.

Table 2: Comparison of different Scaption ranges

	MEAN	SD	SEM	LOWER 95% CI	UPPER 95% CI	MEDIAN	P value
SCAPTION 90°	25.75	8.26	0.67	27.07	14.10	23.39	<0.0001*
EMPTY CAN 90°	24.11	7.66	0.62	22.88	25.33	22.18	<0.0001*
SCAPTION 120°	25.06	7.50	0.61	23.85	26.25	23.16	<0.0001*
SCAPTION 180°	26.09	7.74	0.63	24.85	27.33	24.46	<0.0001*
SCAPTION 45°	24.39	7.62	0.62	23.17	25.61	22.48	<0.0001*
ASHT	24.42	7.60	0.62	23.20	25.63	22.40	<0.0001*

***Denotes Extremely Significant results**

It may be speculated that the synergistic muscles of the back and shoulder may be able to act to their best advantage, when the shoulder is elevated at 180° shoulder flexion during grip. This overhead position appears to allow those proximal muscles involved to be stretched beyond their normal resting length, which would theoretically increase their efficiency for optimum exertion according to the principle of length-tension relationship. [10]

Scapular plane abduction, considered to be the plane of true abduction, Occurs when the humerus moves relative (in the same alignment) to the glenoid. [11-13] Shoulder abduction in the coronal plane is defined as movement of the humerus relative to the trunk. Abduction in each plane results in vastly different orientation and length requirements of the shoulder complex's soft tissue and articular components.

Saha and Johnston state that the deltoid and supraspinatus are in optimal alignment during scapular plane abduction and maintain this alignment through the range since no humeral rotation is required. Conversely, abduction in the coronal plane requires humeral external rotation and some degree of horizontal abduction relative to the scapula, both of which cause a twisting of the myotendinous units, thus altering an efficient origin to insertion pull. [14]

In addition, glenohumeral joint stability is improved during scapular plane abduction by maximizing glenohumeral articular contact and avoiding excessive tension of the static stabilizers. [10] The obligatory external rotation and relative horizontal abduction inherent to coronal plane motion is avoided, resulting in decreased anterior shear forces and reduced tension of the anterior-inferior capsuloligamentous complex. [15,16]

One study has directly examined the influence of the shoulder position on grip strength. Su compared the strength of the grip while the shoulder was in 0, 90 and 180 of flexion. They found that the strongest grips were obtained while the shoulder was in 180 of flexion and the elbow extended. [17] Though the results of our study was found to be similar to the study conducted by him, but the lowest mean grip strength was recorded when the shoulder was positioned in empty can 90° and scaption plane 45°. Explanation of these findings may lie in the length tension-property of muscle contraction.

Our study demonstrated variability in grip strength in scaption plane in different ranges. The findings also highlight that grip strength in scaption plane is an alternate testing position for measurement of grip.

Grip strength in scaption plane maximizes biomechanical abilities in grasping and thus this information can be useful to assist in the design of various devices and tools which requires grip strength.

This study also highlights the usefulness of scaption plane for shoulder rehabilitation purpose.

Clinical implications: Grip strength can be assessed in an alternate position i.e. scaption plane. Scaption plane can be used for various ergonomic designs and tools related to grip strength. Scaption plane can be assessed as an important outcome in shoulder pain and rehabilitation.

Recommendations: Grip strength in scaption plane can be assessed along with surface EMG in symptomatic and asymptomatic individual. Scaption plane grip strength can be assessed in various ergonomic conditions in subject with shoulder pain

CONCLUSION

The grip strength was significantly better in Scaption plane 180°, Scaption plane 120°& Scaption plane 90° in comparison to standardized position of grip strength given by ASHT (American society of hand therapists).

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