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CORRELATION OF FUNCTION RELATED TESTS WITH SPADI AND FIT-HaNSA IN PATIENTS WITH SHOULDER PATHOLOGIES

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ABSTRACT

The aim of the study was to determine the correlation between function related tests (hand to neck, hand to scapula and hand to opposite scapula) with SPADI and FIT-HaNSA in patients with shoulder pathologies.

It was a cross sectional study, in which based on inclusion and exclusion criteria the patients were selected by randomized chit method. The study was carried out in 44 patients with shoulder pathologies within the age group of 20-60 years of age. The mean age and SD were: ± 43.39 and ± 10.7 respectively. The outcome measures of the study were function related tests, SPADI and FIT-HaNSA. The tests were performed in random order.

The results of the study showed significant positive correlation between each of components of the function related tests and SPADI (Spearman's correlation test: hand to neck r = 0.6, p = 0.001; hand to scapula r = 0.67, p = 0.001; hand to opposite scapula r = 0.43, p =0.003). There was no significant correlation between each of the components of function related tests and FIT-HaNSA (Spearman's correlation test: hand to neck r = -0.07, p = 0.6; hand to scapula r = -0.14, p = 0.3; hand to opposite scapula r = -016, p = 0.29).

Thus it can be concluded that function related tests and SPADI have association with each other and can be used in shoulder disability evaluation to enhance the assessment. However, function related tests have no association with FIT-HaNSA, but these tests can be used together to evaluate different aspects of shoulder like disability and endurance of sustained activity respectively.

Keywords: Function related test, SPADI, FIT-Hansa, Shoulder pain

INTRODUCTION

Urwin M et al, determined that shoulder pain is the second most common musculoskeletal complaint existing in general practice centers and shoulder region is the third most common area of musculoskeletal pain in community[1,2] . The common causes of shoulder pain includes frozen shoulder or adhesive capsulitis, rotator cuff injuries, impingement syndrome, supraspinatus tendinitis, acute bursitis, acromioclavicular joint [AC] diseases like AC joint sprains and degeneration, degeneration of shoulder, shoulder instability, [3] fractures like clavicle fracture, neck of humerus fracture[4], shaft of humerus fracture[5] . A study conducted by **A. J .K Ostor et al** showed that the shoulder disorders mainly lead to reduction in general health status which they have measured using both shoulder specific and generic measures. The rotator cuff lesions with or without impingement is the most common complaint. It has been proven that soft tissue disorders are common and are much disabling for the patients. [2]

A. J .K Ostor et al found that shoulder or neck disorders are the most frequent causes of inability to go to work. They observed that rotator cuff tendinopathy is the most common disorder i.e. 85%, followed by signs of impingement-74%, acromioclavicular joint disease-24%, adhesive capsulitis-15% and referred pain-7%. On the shoulder pain and disability index (SPADI) they calculated mean disability subscale score to be 45 (95% confidence interval 41 to 50) and the mean pain score to be 58 (95% confidence interval 53 to 62) where 100 is the maximum score. Using the Short Form 36 Health Survey (SF-36) the difference between normal population and those with shoulder pain was significant in six of the eight domains. The domains were marked for emotional role, physical function and physical role, evaluating the general health status. [2] Shoulder complaint had the most impact on quality of life in younger age group as compared to older. In that same study with shoulder pain patients of age group from 18 to 87 years, they found the mean age was 57 years in 10 weeks follow up. The right shoulder was affected most (n=72 i.e. 55%) followed by left side (n=50 i.e. 38%) and both shoulders (n=9 i.e. 7%). [2]

After the age of 30, progressive degeneration commonly occurs in supraspinatus tendon of rotator cuff which progresses with age, ultimately rupturing the tendon in elderly, as studied in cadaveric shoulders. [6]

Repeated activities or stress on shoulder is most common reason for onset of symptoms leading to increased tendency of soft tissue diseases in manual workers. So with some degeneration, in active middle aged individuals, there is more possibility of symptomatic diseases as compared to less active elderly individuals with more degeneration. [6, 7, 8]

The prevalence of specific disorders and nonspecific regional arm pain was studied by **Karen Walker-Bone et al.** The specific disorders (44.8%) were higher than nonspecific regional arm pain (24.7%). Site-specific prevalence rates were as follows: shoulder tendinitis 4.5% among males and 6.1% among females; adhesive capsulitis 8.2% among males and 10.1% among females; lateral epicondylitis 1.3% among males and 1.1% among females; de Quervain's disease 0.5% among males and 1.3% among females; other tenosynovitis of the hand or wrist 1.1% among males and 2.2% among females. [9]

Shoulder pathology has great impact on quality of life and it was seen that only 59% of [10-13] shoulder problems resolve within 12 months.[14] Therefore, it is necessary to have reliable and valid methods to assess the risks, severity and outcome for patients with shoulder pathologies. [10]

The shoulder complex is made of clavicle, scapula, humerus and sternum bones and glenohumeral, acromioclavicular, sternoclavicular and scapulothoraxic joints. Subacromial region is also included in anatomical description of the joint. The mobility of the joint is obtained by coordinated, synchronous motion of all the joints in the shoulder complex along with elbow and hand motion for wider mobility. [15]

Adhesive capsulitis is commonly known as frozen shoulder. It is caused due to inflammation of synovial surface of capsule of joint, capsular ligament, periarticular tendons and bursae or biceps tendon sheath. [15] Causes can be primary or idiopathic or it can be after the rheumatoid arthritis, osteoarthritis, any fracture, trauma or joint dislocation. [15]

With extreme mobility of the shoulder, the stability is endangered. [4] Instabilities of shoulder joint mainly caused due to static or dynamic factors-rotator cuff weaknesses are the dynamic factors and static factors are

damage to anterior capsule, glenohumeral ligament and glenoid labrum. The types of instabilities [subluxation or disloations] are anterior, posterior and inferior. [3] The most common shoulder dislocation is anterior dislocation i.e. 95% followed by posterior and then inferior [3]

Rotator cuff pathology includes spectrum of pathologies like tendinitis, subacromial bursitis, impingement syndrome, partial or full thickness tears. Impingement symptoms are elicited primarily due to the coracoarcomial arch intruding on rotator cuff, sub acromial bursa, or bicep tendon. [3]

Sub-acromial bursitis is inflammation of bursa mainly secondary to injury, impingement, overuse of the muscle, or due to calcium deposits. [3]

Bicipital brachii tendinitis: the causes of bicipital tendinitis are due to primary impingement or tear of rotator cuff. It may be associated with shoulder laxity, instability, or traction overhead tendinitis. Biceps brachii rupture or injury are mainly caused due to repetitive overuse during rapid overhead movements of shoulder abduction, external rotation, and elbow flexion and supination activity [3]

AC joint injury are common in athletic or repeated activities. The joint has to bear great level of stress as this joint form the main articulation suspending the upper limb from the trunk. [3] .

Clavicle fracture: is mostly caused by direct fall on shoulder, direct trauma over the clavicle like road traffic accident or fall on an outstretched hand. The sites of fracture are at the junction of middle and outer third of clavicle, which accounts for 85%, 5%, at medial end of clavicle and about 10% at lateral end. [4]

Proximal humerus fracture: caused due to fall on outstretched hand and blow on lateral side of arm. Classification with respect to site of proximal humerus is anatomical neck, greater tuberosity, lesser tuberosity, shaft or surgical neck of humerus. [4]

The Shoulder Pain and Disability Index (SPADI) is a self-report questionnaire developed by **Kathryn E. Roach et al** which measures the pain and disability of the patients with shoulder pathology. The SPADI comprises of 13 items in two subscales: pain (5 items) and disability (8 items); originally items are in the form of visual analogue scale. [16, 17,18,19] Subscales together produce a total score ranging from 0 which is best to 100 which is worst. Greater the score, greater the pain and disability. To obtain the total score the sub scores of pain and disability are averaged. SPADI is shoulder joint specific self- report questionnaire. [16]

Functional Impairment Test-Head, and Neck/Shoulder/Arm (FIT-HaNSA) test is a self-reported questionnaire also measures functional outcomes. To assess the shoulder pain and disability from the patient's perspective, a number of self- reported measures has been used. The various self-report outcomes include quality-of-life measures, joint-specific pain/disability measures, and regional measures. However, in some studies the relationship between self-reported disability and actual physical impairment or functional performance is moderate. [10]

FIT-HaNSA test of performance, developed by **Joy C. MacDermid et al**, is a valid and reliable test. The advantages of FIT-HaNSA are to test the multiple functions of the shoulder and neck and assessment of endurance over a longer period of time. It also assess the performance during tasks that shows the various aspects of upper limb gross motor functions like placing or reaching objects at different heights and overhead sustained work. [22] The standing position was incorporated, as most of functions are performed in standing. It consists of three tasks 'Waist up', 'Eye down' and 'Overhead work'. The patient is made to perform theses task for maximum of 300 seconds. Depending on the endurance, capacity and disability of the patient the tests will be terminated early. [10, 22]

The validity of FIT-HaNSA is greater than the hand held dynamometer which tests the isometric strength. FIT-HaNSA provides the information of physical status in mild to moderate shoulder disorders. Reliability obtained was excellent, in both small and broad samples. [10]

The study also provided the validity of FIT-HaNSA in evaluating shoulder disability, and also an acceptable test retest reliability [10] The FIT-HaNSA ICC value scores were 0.97 for the patients and 0.91 for the controls.

The FIT-HaNSA also discriminates amongst the subgroups with different severity of shoulder disorders. [22]. Based on the study by **Prajyot Kumta et al** there was high level of correlation and they estimated convergent validity of FIT-HaNSA with self –report questionnaire. [22] These studies are recommend the use of FIT-HaNSA in various shoulder conditions to test the functional performance of the patients.

There are three components in the function related test. .They are, **hand to neck, hand to scapula and hand to opposite scapula**. The patients with shoulder pathologies are made to perform each task in standing position. The function related tests mimics the activities of daily living. Intra-tester and inter-tester reliability of the function related tests (weighted k) varied from 0.83 to 0.90. [25]

Jing lan Yang et.al stated that the functional outcome measures are primary tools to test effectiveness of interventions of patient with various shoulder pathologies. [42-44] The function related tests basically test individual capabilities.[25] .The study concluded that the function related tests are easy for the patients with shoulder pathologies to administer and understand. It is also suggested that these tests are straightforward for the patients to perform. It is also easy for the investigator to interpret the results. Since this test is reliable, it can be incorporated in clinical practice for evaluating patients with shoulder pathologies. It has been recommended that the tests can be used for enhancing the patient's self- reported functionality.[25] Hence it is essential to carry out a study correlating the efficacy of function related tests with SPADI and FIT-HaNSA in patients with shoulder pathology.

NEED FOR STUDY

The three function related tests are easy, inexpensive [25] and does not require special equipment. It is an outcome measure to assess function of shoulder objectively [42]. It is easy for the examiner and patient to understand and to interpret the results. To our knowledge no study has been conducted to see whether there is any association between the three function- related tests and other outcome measures.

Hence this study has been undertaken to determine the association between the three function-related tests and SPADI a self –report questionnaire and FIT-HaNSA a performance test.

AIM AND OJECTIVES

Aims:

To study the correlation of function related tests with SPADI and FIT-HaNSA in patients with shoulder pathologies.

Objectives:

•To determine the correlation of each of the function related tests (hand to neck, hand to scapula and hand to opposite scapula) with SPADI in patients with shoulder pathologies

•To determine the correlation of each of the function related tests (hand to neck, hand to scapula and hand to opposite scapula) with FIT-HaNSA in patients with shoulder pathologies.

MATERIALS AND METHODOLOGY

Study design: Cross sectional study

Sample size: 44

Pilot study was conducted on 10 patients with shoulder pathologies and sample size was calculated using formula

[Formula- sample size=$4x\ (SD)^2 / (L)^2$](26)

SD-Standard deviation, L-allowable error.

Type of sampling: Simple random sampling

Sample source: Tertiary health care center

Duration of study: 18 months

Inclusion criteria:

- Males and females in the age group of 20-60 years with unilateral shoulder pain
- Restricted active range of motion of affected shoulder.

Exclusion criteria:

- Patients with history of pain in elbow, wrist, hand within the preceding 2 months.
- Patients with neurological, metabolic, endocrine, infective, malignant, rheumatoid disorders.
- Patients who cannot stand for more than 15-20 minutes.
- Patients with cervical disorders like cervical spondylosis, cervical spondylolithesis, cervical PIVD (with and without radiculopathy).

Materials used:

a) SPADI self-reported questionnaire (Shoulder Pain and Disability Index) [annexure-4]

b) FIT-HaNSA unit (fig. 5)

c) Metronome

d) Nuts

e) Bolts

f) Three 1 kg containers

g) Stop watch

h) Goniometer

i) Pen

j) Measuring tape.

(Fig. 1)

Materials and tools

Study Procedure

Methodology:

The study was approved by institutional ethics committee prior to the commencement. It was carried out in a tertiary heath care center. Based on inclusion and exclusion criteria the patients were selected by randomized chit method. The patients fulfilling the criteria and voluntarily participating were explained the procedure and purpose of the study. Written consent was taken from the patients. The diagnosis of the patients were done by the orthopedic surgeon and physiotherapist based on the history, physical examinations, special tests and radiological investigations. A case record form was filled for every patient (annexure-5) which consisted of dominance, diagnosis, range of motion of the affected shoulder by goniometer and pain on VAS. The patients were then asked to perform the function related tests (hand to neck, hand to scapula and hand to opposite scapula), 3 subtasks of FIT-HaNSA and to fill the SPADI questionnaire. These tests were carried out in random order. About 15-20 minutes of break between each tests was given to avoid carry over of symptoms.

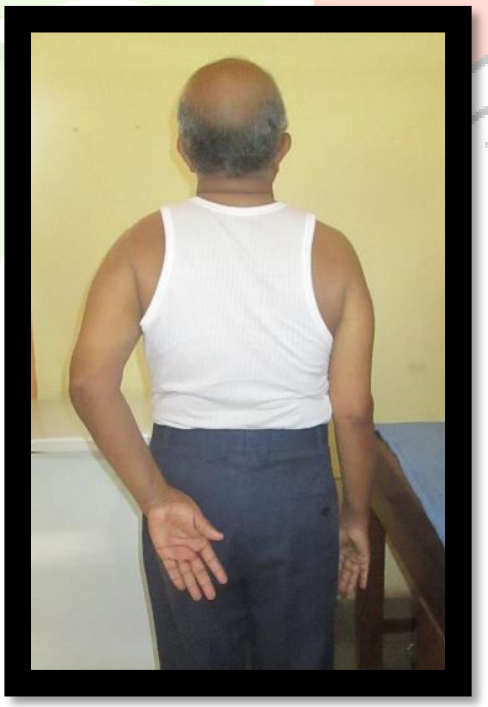
Function related tests. [25, 27]

The patients were explained and shown how to perform the function related tests. For the hand to neck test, patients were asked to place their hand on posterior aspect of neck. The instructions were given in the language that could be best understood by the patient. The instructions given to the patients were “Try to place your hand of the affected side behind your neck”. (fig. 2)

(Fig. 2)

Hand to Neck

For the hand to scapula test, the patients were asked to place their hand on posterior aspect of the back to reach the opposite scapula from behind. The instructions were given in the language that could be best understood by the patients. The instructions were "Try to keep your affected hand on back and try to reach up as to touch your opposite shoulder blade**". (fig. 3)**



(Fig. 3)

Hand to scapula

For the hand to opposite scapula test the patients were asked to place the hand across the body to reach on the opposite scapula. The instructions were given in the language that could be best understood by the patients. The instructions given were "Try to touch your opposite shoulder by placing affected arm across the body".

(Fig. 4)

Hand to Opposite Scapula

The patients were assessed only once and one trial was given on unaffected shoulder to asses if the patients understood the tests. Then the patients were graded accordingly. Hand to neck and hand to scapula both tests have 5 grades, scoring from 0 to 4, in increasing order of disability. Hand to opposite scapula test has 4 grades, scoring from 0 to 3, in increasing order of disability. Between each tests about 15 mins of breaks were given to avoid carry over of the symptoms.

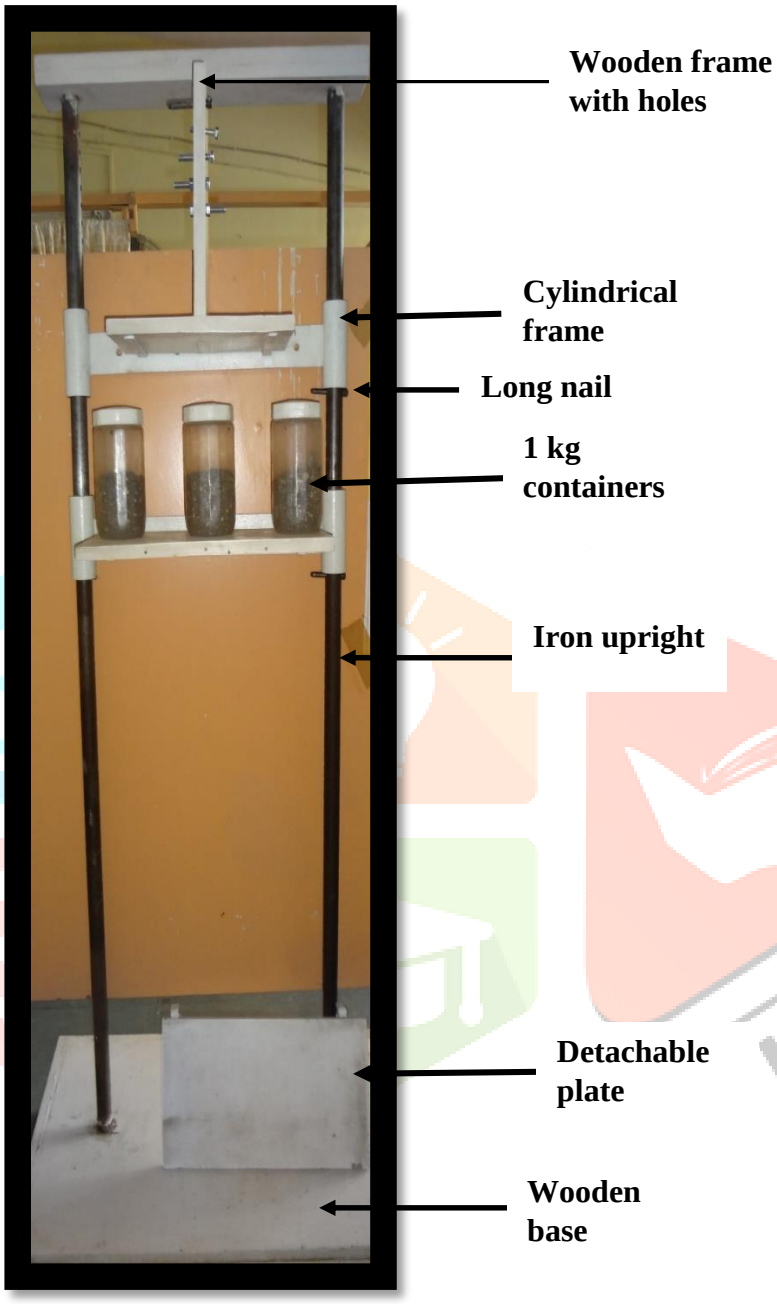
FIT-HaNSA unit:

The FIT-HaNSA unit was made by Evolve Enterprise.

- The FIT-HaNSA unit consists of 2 cylindrical iron uprights, 6 feet tall.
- The iron uprights stand on a wooden base of dimensions 82.5 cm X

  55.5cm X 17 cm.
- Holes are drilled into the uprights 1.5 cm apart.
- Two cylindrical frames connected to each other through an iron plate are attached to the uprights. These frames can move up and down the uprights and can be fixed at any desired level with long nails.
- Two detachable wooden shelves were constructed (44cm X 23.5 cm). These are to be attached to the steel plate during task performance. The wooden shelves have marking at the center and markings at 10 cm on either side of the corner.
- One attachable shelf was constructed with holes drilled into it allowing a dexterity task to be performed (using nuts and bolts) with arm raised above the head.

- Three 1 kg containers (jars) filled with black sand, a metronome, stopwatch and nuts/bolts were also part of the unit.



(Fig. 5)

FIT-HaNSA unit

The range of motion (ROM) of shoulder required to carry out the FIT-HaNSA tests were as follows:

Task 1: approximately 30 degrees flexion and 5-10 degree abduction.

Task 2: approximately 80 degrees flexion and 15 degree abduction

Task 3: approximately 120 degrees flexion, 30 degrees abduction and 30 degrees of external rotation.

If a patient did not have adequate range of motion to perform a particular task, the time for the task was recorded as zero.

The FIT-HaNSA test includes 3 subtasks, and the duration required for each tests are 5 mins i.e. 300 seconds.

Task 1: Waist Up (fig. 5) [10]

With the affected arm, the patient had to lift the three 1 kg containers one at a time, between a shelf at waist level and a shelf 25 cm higher, at a speed of 60 beats per minute, controlled by a metronome (first beat- grab, second beat – lift and place).Measuring tape was used to adjust the shelves.

Each patient was give one trial with the non-affected arm to develop synchrony between lifting and placing the containers to the beats of metronome. To help the patient, investigator gave commands along the beats like with first beat- "grab" and the patient grabbed the container then with second beat- "lift and keep". The patients were asked to perform the task for 5 mins. The task was stopped if the patient felt pain and discomfort and when patient was unable to carry out the task.

(Fig. 6)

Waist up

Standing position:

The patient was asked to stand with feet apart, flat on the ground. With elbow tucked to the side and flexed around 90 degree.

Order and Placement of Containers:

One shelf was placed at patient's waist level and another 25 cm above it. The three 1 kg containers were kept 10 cm apart in line with markings on the shelves.

The patient lifted the container right in front of him i.e. the container closest to the affected side to be tested and then the distant one. When all the containers were kept on above shelf then the containers were moved back to the lower shelf.

Task 2: Eye Down

With the affected arm, the patient had to lift the three 1 kg containers one at a time, between a shelf at eye level and a shelf 25 cm below that, at a speed of 60 beats per minute, controlled by a metronome (first beat-grab, second beat – lift and place). The patient had to perform the task for 5 mins. The task was stopped if the patient felt pain and discomfort and when patient was unable to carry out the task.

Standing position:

The patient was asked to stand with feet apart, flat on the ground. With elbow tucked to the side.

(Fig. 7)

Eye down

Task 1 and 2 instructions to the patients:

All the instructions were given in the language best understood by the patients. The instructions were "I would like you to move all the three containers up/ back down following the beat of the metronome (60 beats per minute). If you feel any discomfort, pain or out of cadence or cannot carry out the task let me know, the test will be stopped. The time of completion of the task are 5 mins once you complete the 5 mins you will be informed and rest of 30 seconds will be given before the next task."

Task 3- Overhead Work

Using both arms, the patient repeatedly screwed and unscrewed bolts (nut was held while the standoff was turned) in the three holes in the plate simulating overhead work.

Pattern: The bolt in notch 1 (top) moves down to notch 2. The bolt in notch 3 (bottom) moves up to notch 1. The bolt in notch 2 moves down to notch 3.

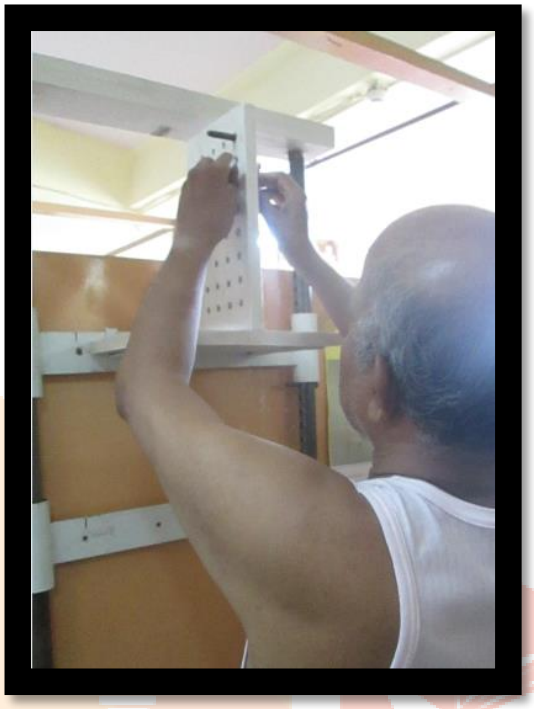
This pattern was repeated for 5 mins. The task was stopped if the patient felt pain and discomfort and when patient was unable to carry out the task.

Standing position

The patient stood with feet apart on the ground. When the patient's hands are held up, the elbows should be bent.

Instructions for patients:

All the instructions were given to the patients in the language best understood by them. The instructions were "Screw and unscrew the bolts by staying in the middle three holes. Do not twirl the screw. If you drop a bolt, keep your hand up in the same position and I will give another bolt so you don't have to bring your hand down". The investigator always had two or three extra bolts.



(Fig. 8)

Overhead work

Test stopping criteria. The task termination criteria were

- The patient himself/herself stops and states it is too painful to continue it
- The patient is severely off pacing to the extent that they are unable to complete one repetition of the movement within 2 beats of the metronome.
- The patient substitutes using trunk/whole body movement.
- The examiner believes that the patient is at risk of injury if task were to be continued.

About 30 seconds rest was given in between the task for adjustment and arrangement of shelves.

Scoring

Time was measured using stop watch

Task 1 (waist up)/300 sec X 100%

Task 2 (eye down)/ 300 sec X 100%

Task 3 (overhead work)/ 300 sec X 100%

Total score = Mean of Task 1, Task 2, Task 3

The Shoulder Pain and Disability Index (SPADI):

The Shoulder Pain and Disability Index (SPADI) was developed to measure shoulder pain and disability. The SPADI contains 13 items that assess two domains; a 5-item subscale that measures pain and an 8-item subscale that measures disability, zero being the best score and 100 the worst score.

Scoring of the SPADI:

Total Pain Score: _____/50 x 100 = _____%

Total Disability Score: _____/80 x 100 = _____%

Total SPADI Score: ____/130 x 100 ____ %

If a patient did not answer all the questions, then it was divided by number of the items answered.

The patients were asked to fill the SPADI questionnaire either the English or Hindi version depending on the language best understood by the patients. The Hindi version of SPADI was face validated by three experts in the field. It took less than 5 minutes for the patients to fill the questionnaire.

RESULTS AND ANALYSIS

Data Analysis: The data was entered using Microsoft Office 2013 and analysed using Primer of Biostatistics software and GraphPad Prism 6 version.

Normality was assessed using the One – Sample Kolmogorov – Smirnov Test.

Hence, the following Statistical Tests of Significance were applied:

I. Spearman's Correlation Test for the correlation between SPADI and each test of function related tests (hand to neck, hand to scapula and hand to opposite scapula) in patients with shoulder pathologies.

II. Spearman's Correlation Test for the correlation between FIT-HaNSA and each test of function -related tests (hand to neck, hand to scapula and hand to opposite scapula) in patients with shoulder pathologies

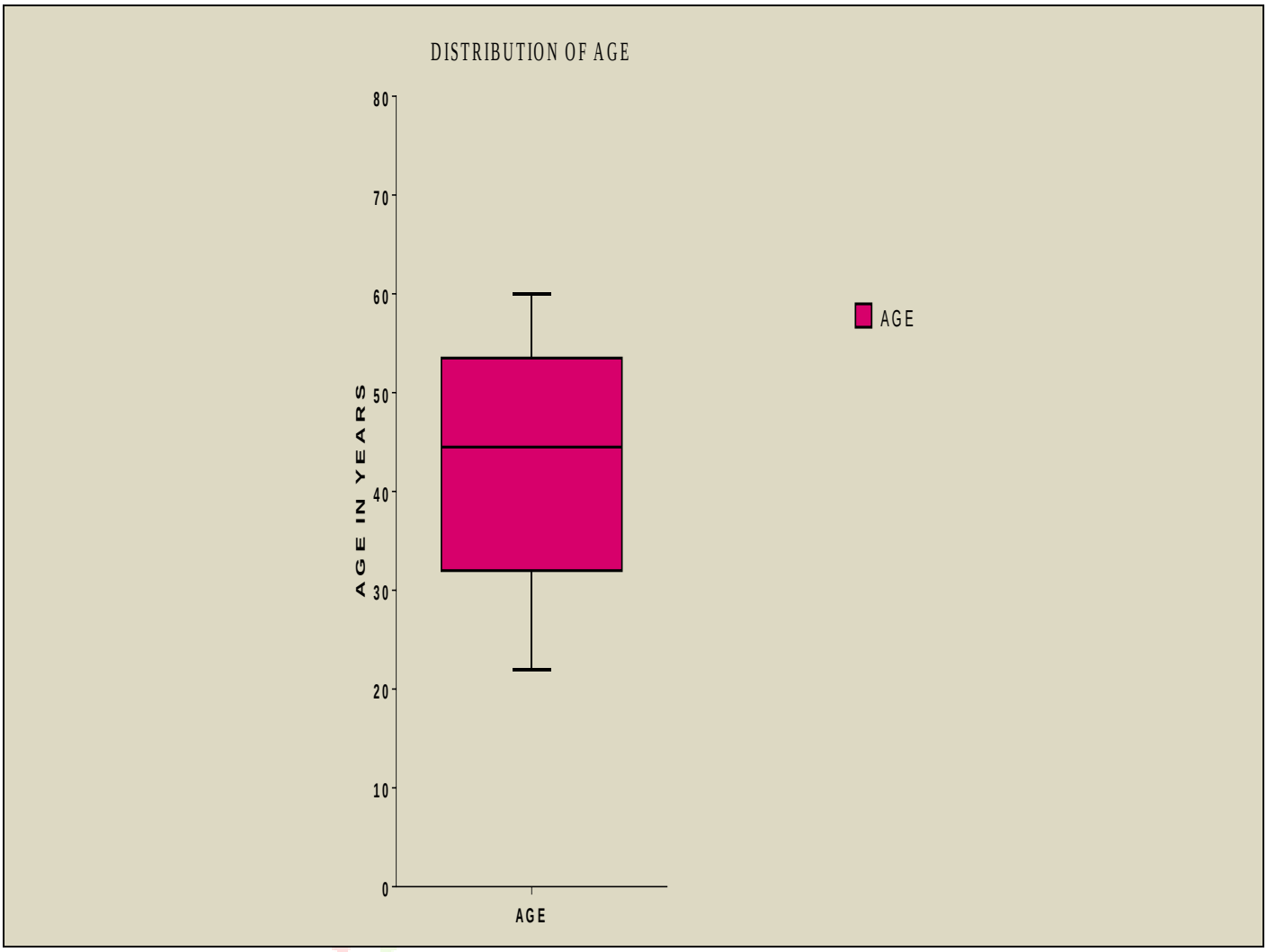
P value less than 0.05 was considered as statistically significant

The data obtained was quantitative and continuous in nature hence graphical representation was done using box plot, pie chart and scatter plot.

DISTRIBUTION OF AGE

Number of patients	Mean	SD	Minimum	Maximum
44	43.39	10.7	22	60

Table No. 1: Descriptive Statistics of Demographic Data:

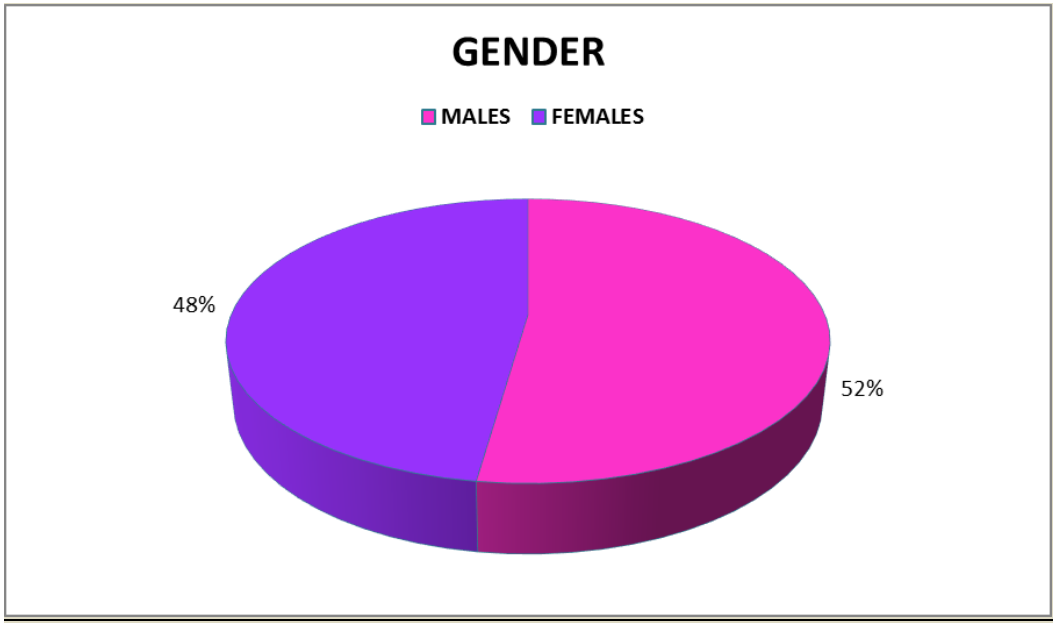


Inference:The above graph shows descriptive statistics of distribution of age

GENDER

Gender	Frequency	Percentage %
Male	23	52
Female	21	48
Total	44	100

Table no. 2: Number of male and female patients.

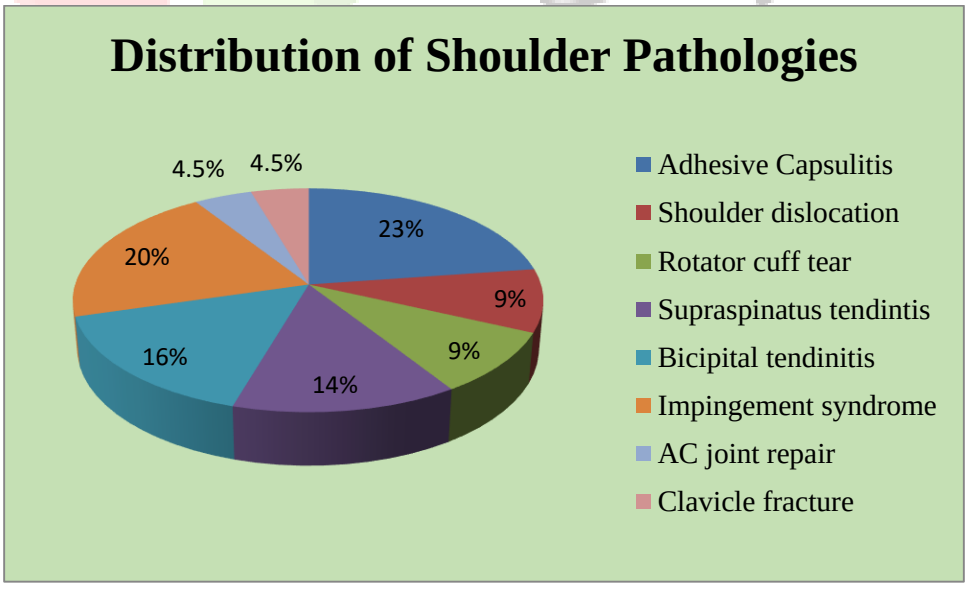


Inference: The above table and graph show number of male and female patients.

DISTRIBUTION OF SHOULDER PATHOLOGIES

Pathologies	Frequency	Percentage %
Adhesive capsulitis	10	23
Shoulder dislocation	4	9
Rotator cuff tear	4	9
Supraspinatus tendinitis	6	14
Bicipital tendinitis	7	16
Impingement syndrome	9	20
AC joint repair	2	4.5
Clavicle fracture	2	4.5
Total	44	100

Table no. 3: Distribution of shoulder pathologies.



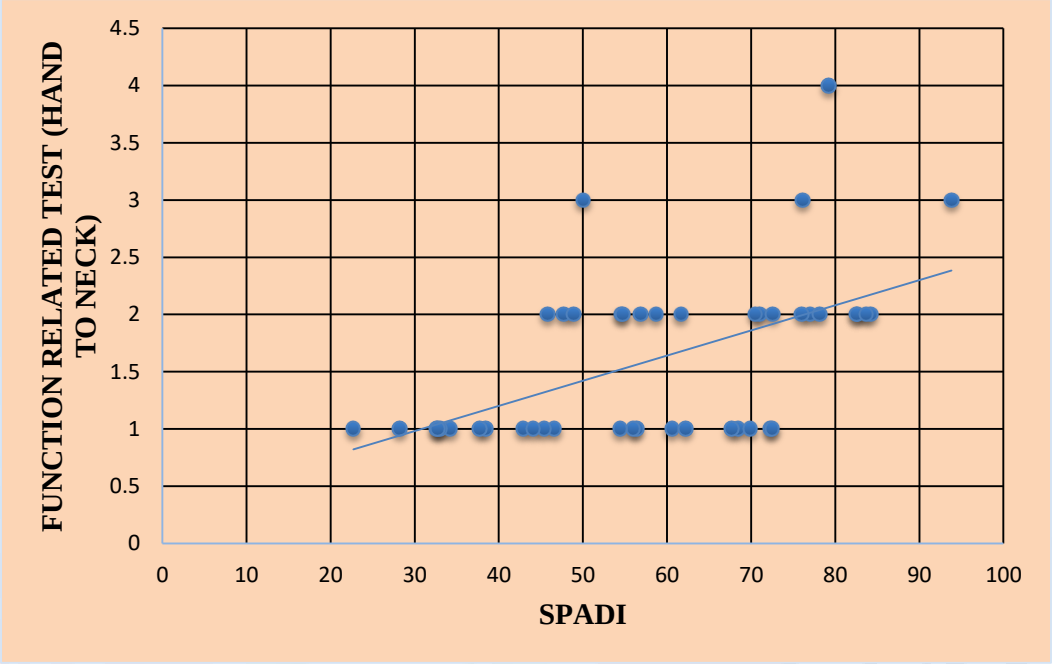
Inference: The above table and graph show distribution of shoulder pathologies.

Analysis of Correlation between SPADI and the Hand to Neck Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r= 0.6	0.001	Significant*

* Correlation is significant at p>0.05

Table No. 4: Spearman's Correlation Coefficient for correlation between SPADI and Hand to Neck Test of Function Related Tests



Graph No. 4: Scatter Plot representing the Correlation between SPADI and Hand to Neck Test of Function Related Tests

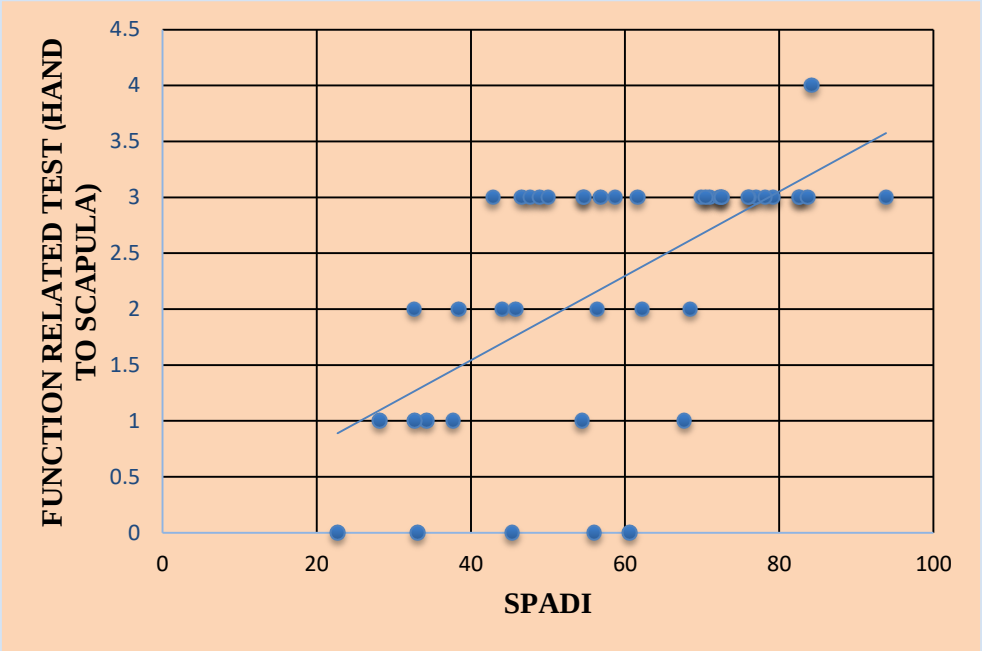
Inference: The above table and graph show that there is a significant positive correlation between SPADI and Hand to Neck Test of Function Related Tests.

Analysis of Correlation between SPADI and the Hand to Scapula Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r = 0.67	0.001	Significant*

*Correlation is significant at p>0.05

Table No. 5: Spearman's Correlation Coefficient for correlation between SPADI and Hand to Scapula Test of Function Related Tests



Graph No. 5: Scatter Plot representing the Correlation between SPADI and Hand to Scapula Test of Function Related Test.

Inference: The above table and graph show that there is a significant positive correlation between SPADI and Hand to Scapula Test of Function Related Tests

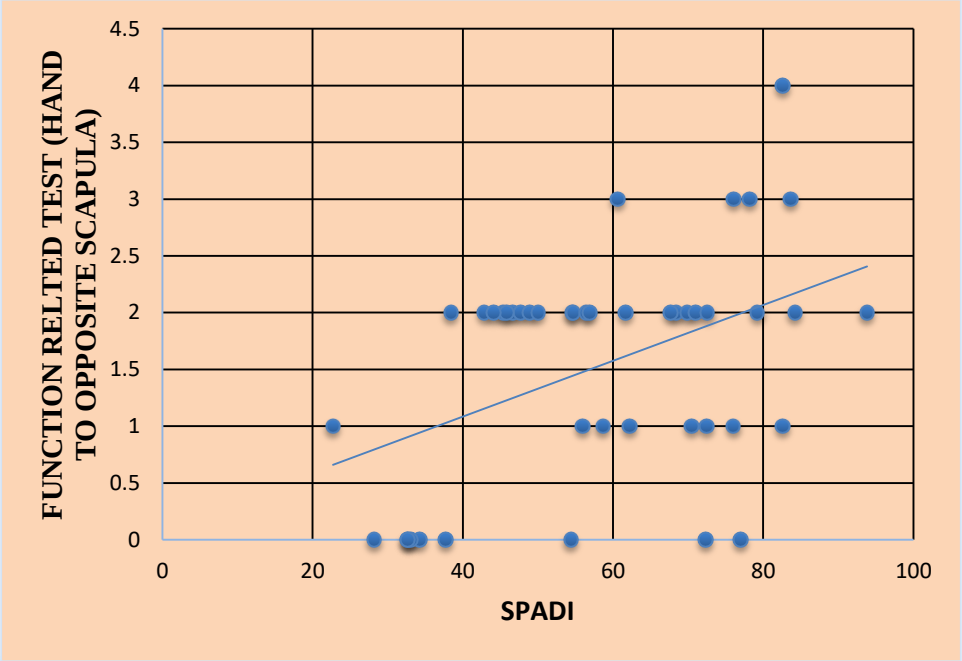
Analysis of Correlation between SPADI and the Hand to Opposite Scapula Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r = 0.43	0.003	Significant*

* Correlation is significant at p>0.05

Table No. 6: Spearman's Correlation Coefficient for correlation between SPADI and Hand to Opposite Scapula Test of Function Related

Tests



Graph No. 6: Scatter Plot representing the Correlation between SPADI and Hand to Opposite Scapula Test of Function Related Tests

Inference: The above table and graph show that there is a significant positive correlation between SPADI and Hand to Opposite Scapula Test of Function Related Tests

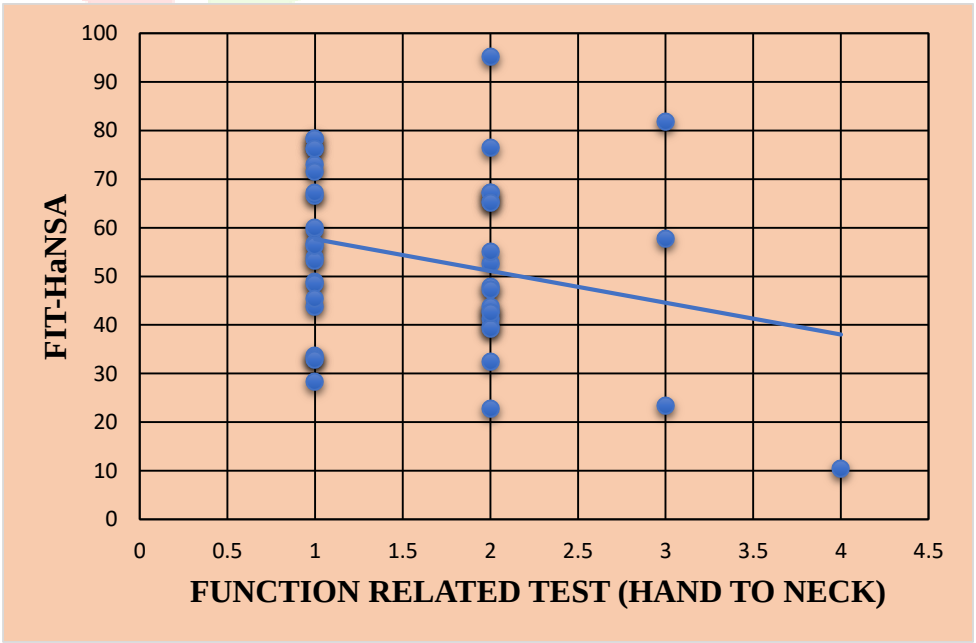
Analysis of Correlation between FIT-HaNSA and the Hand to Neck Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r = - 0.07	0.6	Not Significant*

*Correlation is not significant at p<0.05.

Table No. 7:

Spearman's Correlation Coefficient for correlation between FIT-HaNSA and Hand to Neck Test of Function Related Tests



Graph No. 7: Scatter Plot representing the Correlation between FIT-HaNSA and Hand to Neck Test of Function Related Tests

Inference: The above table and graph show that there is a negative correlation

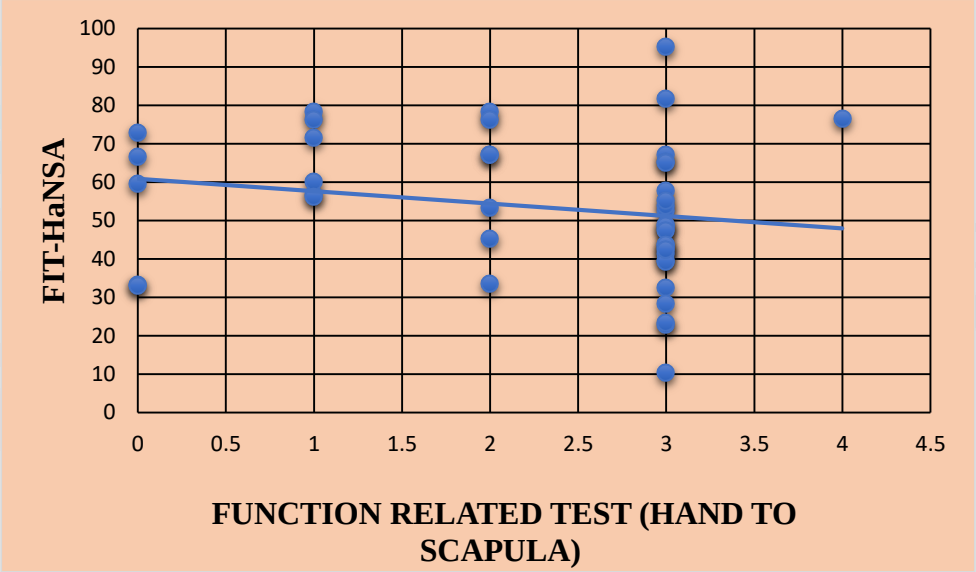
between FIT-HaNSA and Hand to Neck Test of Function Related Tests but however this correlation is not statistically significant

Analysis of Correlation between FIT-HaNSA and the Hand to Scapula Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r = -0.14	0.3	Not Significant*

*Correlation is not significant at $p<0.05$.

Table No. 8: Spearman's Correlation Coefficient for correlation between FIT-HaNSA and Hand to Scapula Test of Function Related Tests



Graph No. 8: Scatter Plot representing the Correlation between FIT-HaNSA and Hand to Scapula Test of Function Related Tests

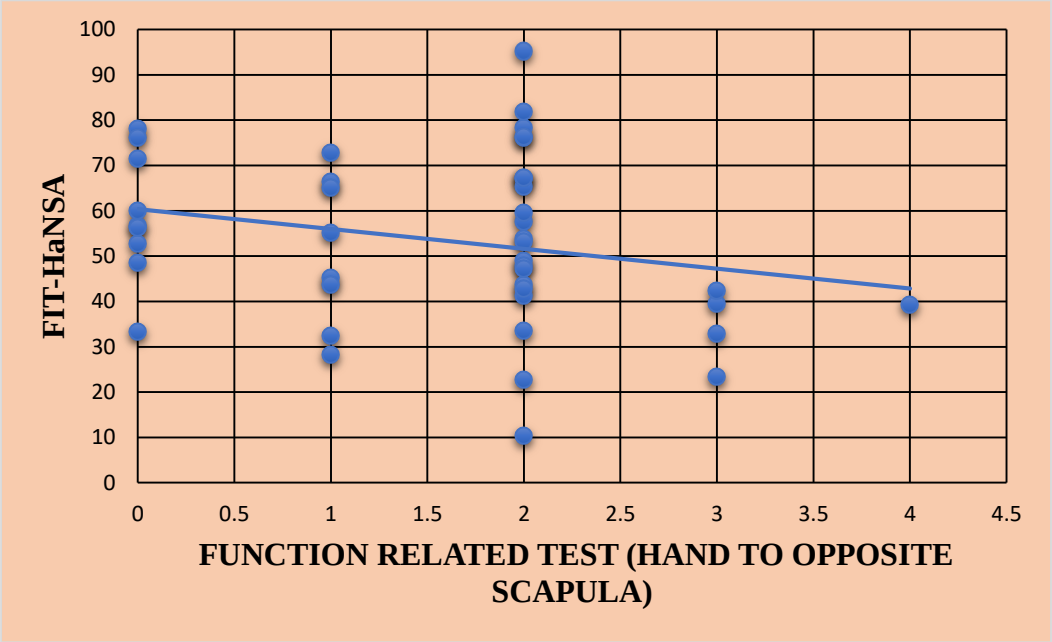
Inference: The above table and graph show that there is a negative correlation between FIT-HaNSA and Hand to Scapula Test of Function Related Tests but however this correlation is not statistically significant

Analysis of Correlation between FIT-HaNSA and the Hand to Opposite Scapula Test of the Function Related Tests

Correlation Coefficient	p value	Significance
r = -0.16	0.29	Not Significant*

*Correlation is not significant at $p<0.05$.

Table No. 9: Spearman's Correlation Coefficient for correlation between FIT-HaNSA and Hand to Opposite Scapula Test of Function Related Tests



Graph No. 9: Scatter Plot representing the Correlation between FIT-HaNSA and Hand to Opposite Scapula Test of Function Related Tests.

Inference: The above table and graph show that there is a negative correlation between FIT-HaNSA and Hand to Opposite Scapula Test of Function Related Tests but however this correlation is not statistically significant.

DISCUSSION

The objective of the present study was to determine the correlation of each of the function- related tests (hand to neck, hand to scapula and hand to opposite scapula) with SPADI and with FIT-HaNSA in patients with shoulder pathologies.

The study consisted of 44 patients with shoulder pathologies, (52%) males and (48%) females, within the age group of 20-60 years .Descriptive statistics of the demographic data, as illustrated in table number 1, showed mean age of ±43.39 and SD ±10.7 with minimum age 22years and maximum 60 years.

The patients included in this study consisted of: 23 % of adhesive capsulitis (n = 10), 9 % of shoulder dislocation (n =4), 9 % rotator cuff tear (n =4), 14% of supraspinatus tendinitis (n = 6), 16% of bicipital tendinitis (n = 7), 20 % of impingement syndrome (n =9), 4.5% of AC joint repair (n = 2) and 4.5% of clavicle fracture (n = 2).

The patients who fulfilled the inclusion and exclusion criteria were made to randomly perform FIT-HaNSA, function -related tests as well as fill the SPADI questionnaire.

The results of the study were:

- There was positive significant correlation between SPADI and each of the function- related tests (hand to neck, hand to scapula and hand to opposite scapula)
- There was no significant correlation between FIT-HaNSA and each of the function- related tests (hand to neck, hand to scapula and hand to opposite scapula)

SPADI and Function-Related Tests:

According to the table numbers 4, 5 and 6, the study demonstrated statistically significant low to moderate correlation between SPADI and each of the function- related tests.

Correlation between SPADI and hand to neck test, (r =0.6) and SPADI and hand to scapula test (r = 0.67) show moderate correlation. Correlation between SPADI and hand to opposite scapula, (r = 0.43) show low correlation. [28]

The findings suggested that as the score of SPADI increases the score of each of the function-related tests also increases and vice versa, showing positive correlation between the two outcome measures.

On examination, patients with shoulder pathologies complained of pain and restricted range of motion. The disability caused due to shoulder conditions provide an important measure to test prognosis and response of the therapy. So there were many outcome measures developed to assess the disability of shoulder in literature. [29]

P Croft, et al (1994) [29] developed a disability questionnaire. One of the objectives of their study was to assess the correlation of restricted range of motion of shoulder with disability. They concluded that the more restricted the range of motion the higher the level of disability. They observed restriction of abduction and rotation movements. Thus, the authors concluded that there could be a possibility that the activities of daily living of the patients were more dependent on abduction and internal rotation movements. They even examined the strength of the patients' shoulder muscles which showed low association with disability. However, the correlation between muscle strength of shoulder and disability was not statistically significant due to pain and restricted range of motion (ROM). They suggested that disability of shoulder is common in relation to shoulder pain and restricted shoulder ROM.

Jing-lan Yang, et al (2006) [25] determined that functional outcomes are usually used as the primary measures to examine the effectiveness of treatments in various shoulder pathologies. They concluded that function-related tests are reliable and could be used in clinical practice to assess reduced function of the shoulder. Also, they stated in their study that each function-related tests were reflection of combination of shoulder range of motions.

For the hand to neck test the patient had to place the hand behind the neck. The test consisted of shoulder flexion, external rotation and abduction movements. This test assessed the activities of daily living such as using arm for combing hair, to reach, pull, or hang an object overhead etc.

For the hand to scapula test the patient had to take the hand behind to reach the opposite scapula. This test consisted of shoulder extension and medial rotation movements. This test assessed the activities of daily living such as, using the arm for tasks related to personal care etc.

For the hand to opposite scapula test the patient had to place the hand across the body to keep it on opposite scapula. This test consisted of shoulder horizontal adduction movement. This test assessed the activities of daily living such as, using the arm to reach across the body to get a car's seat belt etc.

These test movements placed the shoulder in functional active range of shoulder. So as mentioned, each function-related tests were related to combination of shoulder range of motions. Therefore, each of the function-related tests used, challenges the patients differently.

The above study suggested that different aspects of shoulder functions were measured by each of the function-related tests. There was excellent correlation in between each of the three function related tests. Therefore they can also be used independently depending on different shoulder conditions.

The function- related tests exhibited strong intra-tester and inter-tester reliability and therefore can be used in clinical practice to test reduced function or disability of the patients with various shoulder pathologies.

Mannerkorpi et al (1999) [30] used only hand to neck and hand to scapula tests to assess performance while evaluating the status of shoulder dysfunction in patients with fibromyalgia when compared with healthy subjects. The researchers found better reliability for the hand-to-scapula test than hand to neck test, as one of the investigators could not discriminate between the score from 0 to 1 for the hand to neck test. Although they used only two components of the function- related tests, but they concluded that function- related tests are reliable assessment tool to assess the dysfunction of shoulder.

SPADI as a questionnaire used for self-assessment of symptoms and function of patients with shoulder pathologies. [31,32]

In the study by **Einar Kristian Tveitå et al (2008)** [21] they assessed the active and passive scores of shoulder ROM in four different directions along with SPADI at baseline and at follow up. For all patients the scores for four directions were combined to produce overall measures of active and passive ROM. They used a gravity-dependent goniometer, also called an inclinometer (Cybex Electronic Digital Inclinometer, EDI 320 from Cybex Inc, Ronkonkoma, NY) to measure ROM. They found a strong association between SPADI and active range of motion (ROM) than passive ROM.

In the above study they also found stronger association for disability subscale than the pain subscale of SPADI. Thus from this it can be estimated that SPADI assessed the functional disability in patients with shoulder conditions. However, they had also determined that if both SPADI and ROM were used as outcome measures in patients with shoulder pathologies to assess treatment effect, SPADI is a better prognostic tool as compared to ROM.

Both SPADI and function-related tests were outcome measures which assessed disability and dysfunction in patients with shoulder pathologies. These both tests are joint specific. SPADI had stronger association with disability subscale as compared to pain. SPADI had good correlation with active ROM of shoulder and function-related each tests were combinations of shoulder movements which were reflection of activities of daily living. There was strong relation between disability of shoulder and restricted range of motion of shoulder. Hence these could be the possible reasons for significant positive correlation between SPADI and the function- related tests.

As suggested by **Jing-lan Yang, et al (2006)** [25], self-report measures could be used in addition to function-related tests to assess the patients with shoulder pathologies. Therefore, in accordance with the same authors, SPADI could be used along with function-related tests to assess patients with shoulder pathologies.

FIT-HaNSA and Function-Related Tests:

According to the table numbers 7, 8 and 9 the study determined no statistically significant correlation between FIT-HaNSA and each of the function-related tests.

Joy C MacDermid at el (2007)[10] mentioned in their study that for the optimal shoulder function, strength and stability should co-exit .Muscles of shoulder provided stability, mobility and function, so strength of muscle groups were one of the key outcome measures to evaluate shoulder conditions.

The FIT-HaNSA test consisted of 3 subtasks that simulated activities of lifting and sustained overhead work, which were usually carried out at workplace or for the household work. FIT-HaNSA was developed in such a way that it could test endurance of shoulder and could differentiate between individuals with different degrees of shoulder function, with different task difficulty depending on shoulder pathology of patient.

The above cross-sectional study indicated that the FIT-HaNSA had excellent test-retest reliability in patients with shoulder disorders. The study also provided preliminary evidence regarding the expected relationships and convergent validity of the FIT-HaNSA with selected self-report measures and objective outcomes in these patients. The FIT-HaNSA was able to discriminate between different levels of severity of the shoulder pathologies. Hence, it can be attributed that FIT-HaNSA was the test that could be used to assess performance in patients with less severe to most severe shoulder problems.

In accordance to above study, in the present study the first task was simplest and determined the overall endurance load on the shoulder joint. The second task was most challenging especially for the patients with shoulder impingement. And third task included sustained overhead activity which patients found difficult to perform if the ROM were restricted.

Prajyot Kumta et al (2012) [22] described FIT-HaNSA as a performance test of upper extremity which consisted of repetitive task that comprised of shoulder reaching and static posture. They also mentioned that self–reported measures were dependent on patients' insight and might not relate with assessment carried out by therapist or clinicians. It was utmost necessary for the clinicians to suggest patients, as to whether a particular patient could resume their work. So the performance based tests were essential to make decisions regarding the return to work. In the study Shoulder Pain and Disability Index, isometric shoulder strength, and shoulder range of motion were tested at baseline and repeated 2 to 7 days later. They concluded that there was a high level of association of FIT-HaNSA with DASH and SPADI, and a moderate level of association with active shoulder ROM and strength in patients with shoulder pathologies.

Jean-Sébastien Roy et al (2009) [33] had carried out a study to understand the association between impairments and functions in individuals without any shoulder problems. They assessed relations within the self-reported function (shoulder disability scales), range of motion, isometric rotational strength, or upper limb functional performance (FIT-HaNSA) in persons without any upper limb pathology. A low correlation found between self-report disability and strength/range of motion in the unaffected subjects attributed that there was lack of disability reported by all subjects without any pathology with normal variations in strength and motion of shoulder. They summarized that range of rotational motions and FIT-HaNSA had no correlation. As in the asymptomatic subjects the rotational ranges were more than what was required i.e. minimum medial rotation required in tests were 32 degrees and external rotation of about 38 degrees. However, unfortunately they did not assess shoulder elevation i.e. flexion, scaption or abduction ranges .These shoulder elevation movements would have had greater impact on the FIT-HaNSA. They concluded that FIT-HaNSA required optimum shoulder muscle endurance and joint range of motion to perform the three different types of task. Hence, FIT-HaNSA contained tasks more related to muscle endurance than to muscle strength.

Jing-lan Yang,et al (2006)[25] claimed that during the development of function-related tests, endurance, fatigue, and movement efficiency were not considered.

Function-related tests were assessed by examiner only once and graded accordingly. But FIT-HaNSA test was carried out for longer period i.e. five minutes for each task.

The conclusions drawn from the above studies suggests that FIT-HaNSA assesses sustained multi-level kinematics of movements, which were measured during the development of FIT-HaNSA[10]; while function related tests are based on the clinician's judgment of function and these function related tests do not measure endurance, fatigue and movement efficacy.[41 There was no association between rotational ROM of shoulder and FIT-HaNSA test, but function related tests consist of shoulder rotation movements. These could be the possible reasons for the result obtained from the present study, which estimated that function-related tests had no statistically significant correlation with FIT-HaNSA.

On analyzing the results obtained from the present study, it can be concluded that while each of the function related tests correlates with SPADI, it does not correlate with FIT-HaNSA.

LIMITATIONS

- The study was conducted in one geographical area
- Emotional and motivational status during the tests were not considered

SUGGESTIONS AND FUTURE SCOPE OF THE STUDY

- A multi centric study with larger sample size and considering both males and females should be undertaken. Gender differences should be studied in details.
- Reliability of the function-related tests was carried out, hence validity and responsiveness of the tests could be undertaken in shoulder conditions.
- Pre and post intervention based assessment of the function-related tests in patients with shoulder conditions should be evaluated which will be helpful for prognosis and for effective treatment protocol.

CONCLUSION

The following correlations were observed:

- There was significant positive correlation between SPADI and each test of function- related tests (hand to neck, hand to scapula and hand to opposite scapula)
- There was no significant correlation between FIT-HaNSA and each test of function- related tests (hand to neck, hand to scapula and hand to opposite scapula)

Hence, it can be concluded that if function-related tests scores are increased or decreased the score of SPADI will also increase and decrease respectively for the patients with shoulder disorders.

CLINICAL IMPLICATIONS AND APPLICATION

As there was significant positive correlation between each of the components of function- related tests and SPADI, both can estimate similar interpretations of the result for the disability or dysfunction in patients with shoulder disorders. Hence, both the tests can be used together to enhance the assessment of the patients.

There was no significant correlation between each of the components of function- related tests and FIT-HaNSA. However both of these tests should be used for assessing the patients. The reduced functionality or disability of shoulder which is tested by function- related tests and endurance and performance based test of upper limb for repeated sustained functionality which is assessed by FIT-HaNSA. Both can be considered during evaluation of the patients as they both assess different aspects of impairments.

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