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Ultrasound Versus Kinesiotaping in Relation to Scapular Stabilization Exercises in Shoulder Impingement Syndrome: A Randomized Controlled Trial

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Abstract:

Purpose: ultrasound versus Kinesiotaping to scapular stabilization exercises in pain intensity and shoulder functional ability in patient with shoulder impingement syndrome.

Methods: A randomized controlled trial study was conducted. Forty-five patients of both genders with age ranged from 18-55 years with shoulder impingement syndrome were recruited from outpatient clinic of the faculty of physical therapy, Heliopolis University from February 2023 to June 2023 and randomly assigned into three groups; control group (C), exercises for scapular stability were performed three times weekly for four weeks., and group (A), treated three times weekly for four weeks with scapular stability exercises and Kinesiotape , Group (B) ultrasound therapy and scapular stability exercises 3 times weekly for 4 weeks. Pre- and post-treatment assessment using Visual Analogue Scale, Shoulder ROM, Quick Dash and hand strength were done for all patients.

Results: Using MANOVA showed statistically significant difference ($P<0.05$) between pre- and post-treatment for group (A), (B) and (C) VAS (41.89%, 36.51%, 14.63%) respectively , QUICKDASH (40.89% , 37.41% , 27.71%) respectively. The MANOVA revealed that there was statistically significant difference between group (A), (B) and (C) in post-treatment measurements of VAS and QUICK DASH ($P<0.05$).

Conclusion: Kinesiotaping combined with scapular stabilization exercises may be an efficient method for individuals with shoulder impingement syndrome

Key words: shoulder impingement, scapular exercise, kinesiotaping, ultrasound, Functional ability, Shoulder pain.

1.Introduction:

One of the most prevalent types of pain is shoulder discomfort, which affects up to 67% of people at some point in their lives (1).

Restricted range of motion (ROM), discomfort, decreased strength, and reduced motor coordination are only few of the root causes of shoulder pain (2).

Shoulder pain may occur in one-third of people at some point in their lives, making it a frequent complaint reported by patients of all ages in routine clinical practice. Such suffering has the potential to drastically reduce one's standard of living and undermine the usefulness of the shoulder joint. Up to 65% of instances of shoulder discomfort may be attributed to shoulder impingement syndrome (SAIS), which is characterized as rotator cuff and subacromial bursa compression (3).

The shoulder joint has the greatest range of motion of any joint in the body. The flexibility of the shoulder directly contributes to its higher susceptibility to injury or other issues. Dislocations, separations, tendinitis, frozen shoulder, fractures, and dislocations are a few of them. The most crippling of these ailments is shoulder impingement syndrome (4).

According to estimates, between 30 and 86% of patients with shoulder discomfort in basic care and 36% in secondary care had subacromial impingement (5). The root causes of this subacromial impingement syndrome, according to Houglum, include Overuse or recurrent age-related alterations, pathological posture, trauma, poor vascularity, and exhaustion of the scapular and glenohumeral muscles, neuromuscular adaptations, biomechanical changes, and imbalances in the rotator cuff musculature (6). Internal or external impingement may also be caused by anatomical anomalies such as subacromial osteoarthritic spurs, acromion shape, or improper scapular positioning (7) . Loss of function and a worse quality of life are both linked to shoulder impingement syndrome (8).

Exercise and surgical procedures like arthroscopic surgical decompression are examples of conservative treatment for shoulder impingement syndrome. When treating shoulder impingement, exercise is the first line of defense (9) . Shoulder impingement syndrome may be treated conservatively with physical therapy and surgery techniques such arthroscopic surgical decompression. Shoulder impingement is most often treated conservatively with exercise (10).

Within 2 years, 60% of patients treated conservatively for subacromial impingement syndrome report improvement. Conservative treatment is effective for 70%-90% of patients suffer from shoulder impingement syndrome, according to research (11).

The efficiency of kinesio taping for the management of shoulder dysfunction and discomfort has been evaluated by a comprehensive review and meta-analysis of randomised controlled trials (12). KT helps remove edoema by rerouting exudates to lymphatic ducts, aligning fascial tissues, elevating fascia and soft tissues to provide more space above painful or inflamed regions, and activating mechanoreceptors to send a positional stimulus signal to the brain (13).

When treating rotator cuff dysfunction conservatively, therapeutic ultrasound is often combined with other treatments. When used appropriately, it may increase the temperature of protein-rich oft tissues. Increases in blood flow, vascular permeability, and local metabolism, as well as an increase in the extensibility of fibrous tissue and a reduction in muscular tension, are some physiological benefits of US (14).

2.Patients and Methods:

2.1. Study participants and recruitment criteria:

After receiving approval from the faculty of physical therapy at Cairo University's ethical committee, 45 patients of both sexes, ranging in age from 18 to 55, with a diagnosis of shoulder impingement syndrome, were enrolled in the study. Each patient signed an informed consent prior to enrollment. Participants were divided into three equal groups at random. Group I (Group A) treated three times weekly for four weeks with scapular stability exercises and Kinesiotape. Group II (Group B) ultrasound therapy and scapular stability exercises 3 times weekly for 4 weeks. Group III (control Group) exercises for scapular stability were performed three times weekly for four weeks.

Inclusion criteria: Shoulder impingement syndrome patients may be of either sex or any age between the ages of 18-55 years (15), Shoulder ache over the last 30 days. Both the Neer's impingement and the Hawkins kiennedy tests are positive (16), When bending or extending beyond 60 degrees, discomfort is felt.

Exclusion criteria: Shoulder fractures, dislocations, and operations are in the patient's history (17) , injured the rotator cuff or developed frozen shoulder (18) , Chronic neck and shoulder discomfort (19), Use of corticosteroids or other pain relievers for the treatment of neuromuscular discomfort in the upper extremities (20) .

2.2. Study Design: The research was a randomized controlled trial

After approval of the ethical committee of the Faculty of Physical Therapy, Cairo University- Egypt (NO: P.T.REC/012/004362) as well as submitted at the National Library of Medicine in the United States. (ClinicalTrials.gov Identifier: NCT05779033), All participants were required to complete a signed informed consent form.

2.3. Methods:

A four weeks program was conducted. Each patient received three sessions per week on alternate days.

Kinesiotape

Will receive scapular stabilization exercises and Kinesiotape of these muscles: The supraspinatus and the deltoideus muscles will be taped. Using methods for both mechanical correction (KT strip arms were located by stretching maximally) and muscle stimulation (KT strip arms were located by stretching slightly by 15–25 percent), a "Y" tape was applied across the deltoid muscle. In order to block the activity of the supraspinatus muscle, a second "Y" tape was placed over it (the initial point of the tape was connected to the sub acromial-greater tubercle, and it was stretched to 75% of its maximum length before being placed). Three times each week, KT treatments were administered. Tapes were always applied without extending the last three to five centimetres of the arms (23).

Ultrasound:

For 5 minutes, A 1 MHz frequency, a 1.5 W/cm2 intensity, and a continuous mode with a 100% duty cycle were utilised on a 5 cm2 area of the user's head.The patients were seated on a table and had their hands supinated with one arm on their lap. The therapist placed the US head on top of the affected region with slow circular motions (15).

Scapular Stabilization Exercises:

General Guidelines: Bring lower angle of the scapula "back and down" as you complete each exercise. Avoid raising your shoulders.

Towel slide:

Perform the anterior slide while standing next to a table and holding a towel. Return to the starting posture and extend your arms while pulling back your shoulders (24).

Scapular Clock:

Imagine yourself standing next to a table and drawing a clock on your shoulder with your hand resting on a ball. Place your scapula in the following positions: elevation (12h), protraction (3h), depression (6h), and retraction (9h)) (24).

2.4. Outcome measures:

Primary Outcome Measure:

Visual Analogue Scale for pain (VAS):

A horizontal straight line of predetermined length represents the VAS.A typical example would be a line 10cm (100mm) in length with "pain anchors" at both ends (such as "no pain" and "pain as bad as it could be"). Patients are asked to place themselves on a line with increments of 1 centimeter, where 0 centimeters represents no discomfort, and 10 centimeters represents the most excruciating pain imaginable. It's also a scale of intervals. As a result, this scale may be used to quantify pain as part of outcome assessment in clinical practice (21**)**.

Secondary Outcome Measure:

Disabilities of the arm, shoulder and hand (Quick DASH) questionnaire

The original DASH outcome measure has been condensed into the Quick DASH. In comparison with the original DASH result metric of 30 elements, there are just eleven things in the Quick DASH. Ability to do activities, tolerance to force, and the intensity of symptoms may all be assessed using the Quick DASH questionnaire. The patient's degree of severity or level of function may be assessed using the QuickDASH tool by using a 5-point Likert scale (22**)**.

3.DATA ANALYSIS:

Calculation of sample size:

In order to determine what amount of sample would be necessary for meaningful results, we ran the numbers via G*power 3.1.9 (G power software version 3.1, Heinrich-Heine-University, Düsseldorf, Germany). The sample size was determined using the following parameters: 3 groups comparing 9 main variable outcomes; F tests (MANOVA: Special effects and interactions); Type I error () = 0.05; power (1-error probability) = 0.90; effect size (f2) (V) = 0.3422819; and Pillai V = 0.5100000. 45 patients constituted an adequate sample size for this investigation (15 patients in each group).

Statistical Analysis:

SPSS version 25 was used to conduct the analysis of the current study. Descriptive quantitative data including the mean and standard deviation for age, VAS and shoulder function variables were calculated for all subjects in the study. MANOVA was used to analyze all outcomes and show differences between and within groups of pain level and QUICKDASH.

4. Results

General characteristics of subjects:

The statistical analysis reported that thers is no significant differences (P>0.05) in mean values of age (P=0.087) among Group A, Group B, and Group C (**Table 1**).

According to the gender breakdown shown in (**Table 1**), there were 9 men (60.00%) and 6 females (40.00%) in Group A, 8 males (53.30%) and 7 females (46.70%) in Group B, and 9 males (60.00%) and 6 females (40.00%) in Group C.

Table 1: Comparisons mean values of patient general characteristics among groups

Items	Age (Year)	Gender	
		Males	Females
Group A (n=15)	36.13 ±3.06	9 (60.00%)	6 (40.00%)
Group B (n=15)	35.87 ±4.03	8 (53.30%)	7 (46.70%)
Group C (n=15)	38.27 ±2.08	9 (60.00%)	6 (40.00%)
F-value	2.593	0.182	
P-value	0.087	0.913	
Significance	NS	NS	

P-value: probability value S: significant
*** Significant (P<0.05) NS: non-significant**

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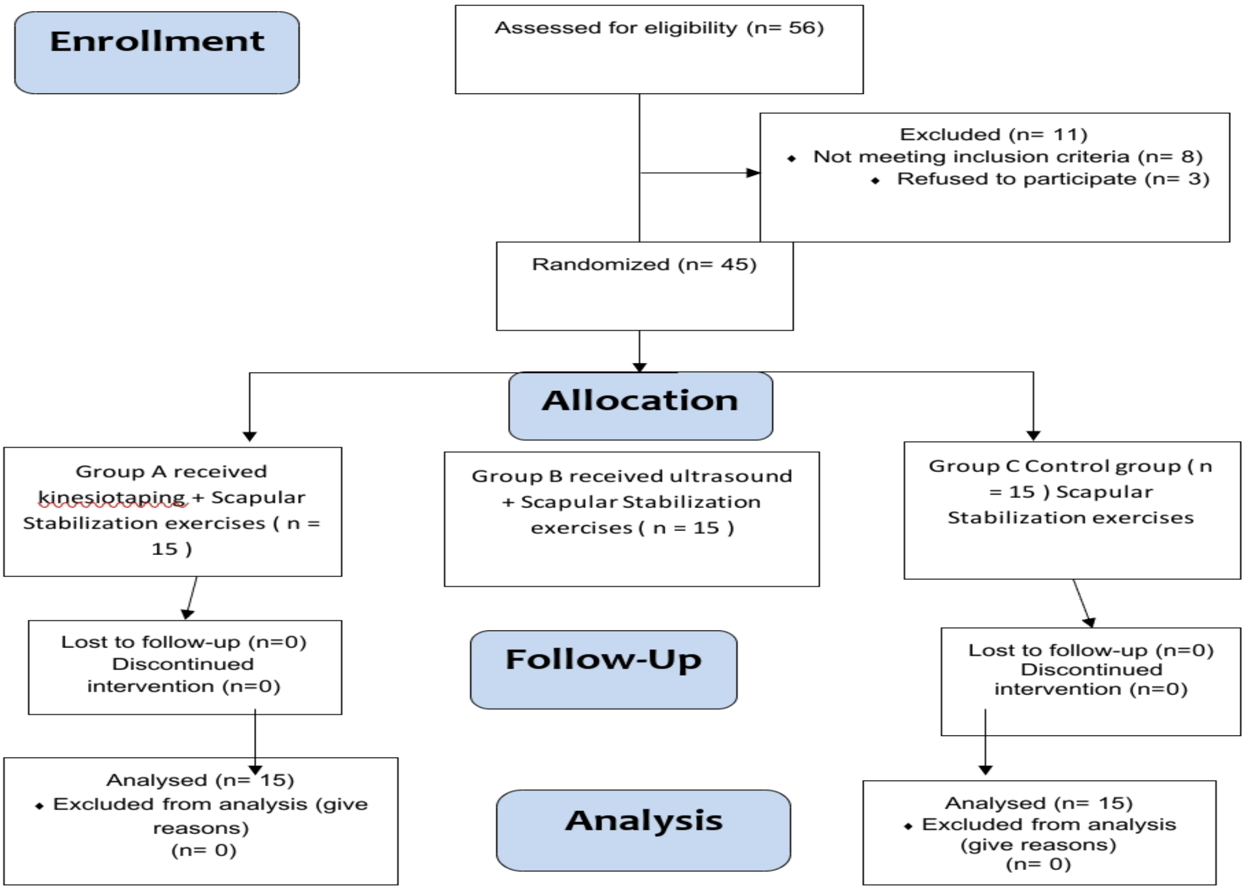

3×2 Mixed design multivariate analysis of variance (MANOVA):

1. Visual analogue scale (VAS):

Results of VAS between pre- and post-treatment within each group

The VAS scores of patients in Group A (scapular stabilisation exercises and Kinesiotape treatment) improved by 41.89 percentage points, those in Group B (scapular stabilisation exercises and Ultrasound treatment) by 36.51 percentage points, and those in Group C (scapular stabilisation treatment only) by 14.63 percentage points (control group).

Results of VAS among groups at pre- and post-treatment:

Comparison of post-treatment VAS mean differences amog groups (**Table 2**), no significant difference at pre-treatment among Groups A, B, and C. However, there was significant difference at post-treatment among groups A, B, and C.

The VAS value was highest in Group A, which consisted of the scapular stability exercises and Kinesiotape programme, as determined by the post hoc test and the mean differences between groups **(Table 2).**

2 . Quick dash

Results of quick dash between pre- and post-treatment within each group

Higher percentages of patients saw improvement in the quick-dash test after receiving scapular stabilisation exercises and Kinesiotape treatment (Group A; 40.89%), scapular stabilisation exercises and Ultrasound treatment (Group B; 37.41%), and scapular stabilisation treatment alone (Group C; 27.71%). (control group).

Results of quick dash among groups at pre- and post-treatment

Considering the effect of the tested group on quick dash, no significant difference at pre-treatment among Groups A, B, and C. The post-treatment mean SD values of rapid dash were 50.60±1.54, 4.20±3.40, and 62.60±1.84 for Groups A, B, and C, respectively; nonetheless, there was a statistically significant difference between Groups A and B (P=0.0001; P0.05).

Group A had the greatest improvement in rapid dash times (50.60 1.54), followed by Group B (54.20 3.40), and finally Group C (62.60 1.84) (**Table 3**).

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Table 2: Mixed MANOVA for the effect of treatment on VAS

VAS (Meanvalues ±SD)				
Items		Group I	Group II	Group III
Pre-management		8.26 ±0.59	8.19 ±0.53	8.20 ±0.56
Post-management		4.80 ±0.77	5.20 ±0.56	7.00 ±0.75
MANOVA overall main effect				
MANOVA effect		F-value	P-value	Significance
Group effect		24.288	0.0001*	S
Time effect		361.313	0.0001*	S
Interaction effect (group x time)		26.419	0.0001*	S
Comparison between pre- and post-treatment within each group (time effect)				
Time effect		Group I	Group II	Group III
MD (change)		3.46	2.99	1.20
Improvement %		41.89%	36.51%	14.63%
F-value		221.625	165.971	26.556
P-value		0.0001*	0.0001*	0.0001*
Significance		S	S	S
Comparison among groups at pre- and post-treatment (group effect)				
Group effect		F-value	P-value	Significance
Pre-management		0.647	0.521	NS
Post-management		50.652	0.0001*	S
Multiple pairwise comparisons between both groups				
Pairwise group effect		MD	P-value	Significance
Pre-treatment	Group A vs. Group B	0.07	1.000	NS
	Group A vs. Group C	0.06	1.000	NS
	Group B vs. Group C	0.01	1.000	NS
Post-treatment	Group A vs. Group B	0.40	0.269	NS
	Group A vs. Group C	2.20	0.0001*	S
	Group B vs. Group C	1.80	0.0001*	S

Data are expressed as mean ±standard deviation
MD: Mean difference
P-value: probability value S: significant
* Significant (P<0.05) NS: non-significant

Table (3): Mixed MANOVA for the effect of treatment on quick dash

Quick dash (meanvalues ±SD)				
condition		Group I	Group II	Group III
Pre-management		85.60 ±2.99	86.60 ±1.63	86.60 ±1.35
Post-management		50.60 ±1.54	54.20 ±3.40	62.60 ±1.84
MANOVA overall main effect				
MANOVA effect		F-value	P-value	Significance
Group effect		63.311	0.0001*	S
Time effect		457.196	0.0001*	S
Interaction effect (group x time)		48.158	0.0001*	S
Comparison between pre- and post-treatment within each group (time effect)				
Time effect		Group I	Group II	Group III
MD (change)		35.00	32.40	24.00
Improvement %		40.89%	37.41%	27.71%
F-value		784.806	529.484	39.223
P-value		0.0001*	0.0001*	0.0001*
Significance		S	S	S
Comparison among groups at pre- and post-treatment (group effect)				
Group effect		F-value	P-value	Significance
Pre- management		0.971	0.383	NS
Post-management		110.498	0.0001*	S
Multiple pairwise comparisons between both groups				
Pairwise group effect		MD	P-value	Significance
Pre-treatment	Group A vs. Group B	1.000	0.692	NS
	Group A vs. Group C	1.000	0.692	NS
	Group B vs. Group C	0.00	1.000	NS
Post-treatment	Group A vs. Group B	3.60	0.0001*	S
	Group A vs. Group C	12.00	0.0001*	S
	Group B vs. Group C	8.40	0.0001*	S

Data are expressed as mean ±standard deviation
MD: Mean difference
P-value: probability value S: significant
* Significant (P<0.05) NS: non-significant

5. Discussion:

This study compared the effectiveness of ultrasound therapy and kinesiotaping in treating patients with shoulder impingement syndrome based on the intensity of their pain severity and shoulder function.

The study's findings showed that all groups experienced statistically significant improvements in pain intensity and functional impairment, however group A experienced higher improvement percentages than group B and the control group.

Regarding the effect of kinesiotaping in subjects with shoulder impingement syndrome:

To alleviate pain or give a mechanical input for proprioception, several taping procedures include lifting the skin and subcutaneous tissues just under the surface (25).

KT helps remove edoema by rerouting exudates to lymphatic ducts, aligning fascial tissues, elevating fascia and soft tissues to provide more space above painful or inflamed regions, and activating mechanoreceptors to send a positional stimulus signal to the brain (13).

Similarly, Ghozy et al. 2020 observed that kinesio taping, when added to scapular stabiiztion exercises to treat shoulder pain and impairment, has effective role in reducing pain and function (12).

Our expectations were supported by the findings of Sikha et al. (2017), who found that the combination of traditional occupational therapy with kinesio taping significantly improved the quality of life and functional performance, in persons with subacromial impingement syndrome (26).

Another study, Effect of KinesioTaping on Kinematics of scaula in patients who suffer from Shoulder Impingement Syndrome, came to the opposite conclusion. They came to the conclusion that there are no statistically significant variations in scapular kinematics among KT scenarios ($p > 0.05$). During abduction with weight and elevation without load, lower trapezius EMG activity decreased (p 0.05 for both). This could be because kinesiotaping is the only treatment used (27).

Regarding the effect of ultrasound in subjects with shoulder impingement syndrome:

When treating rotator cuff dysfunction conservatively, therapeutic ultrasound is often combined with other treatments. When used appropriately (i.e., often enough), it may increase the temperature of protein-rich soft tissues. Increases in blood flow, vascular permeability, and local metabolism, as well as an increase in the extensibility of fibrous tissue and a reduction in muscular tension, are some of the physiological consequences of US. based on a recent study (14).

They also discovered that any changes to extracellular fluid or an in vivo condition trigger a protective response that lessens the impact on tissues, organs, and cells, and that these defence mechanisms may be at least partially to blame for the discrepancy between the outcomes of a few high-quality, randomised, controlled trials and those of in vitro US studies (28).

In a randomised controlled trial comparing TENS, interferential current, and ultrasound in addition to exercise therapy to treat shoulder impingement syndrome, Ucurum et al. (2018) observed that the use of ultrasound in addition to exercise improved shoulder impingement syndrome, which is consistent with our own findings (15).

Shanker et al.,2021, who asserted that the metrics VAS, SPADI, and shoulder ROM had a significant impact, are at odds with our findings. The results showed that group I (exercise treatment) improved noticeably more than group II (ultrasound only) in all area (5).

Regarding the effect of scapular stabilization exercises in subjects with shoulder impingement syndrome:

Modifications in the function of the scapular-stabilizing muscle are associated with the majority of abnormal biomechanics and overuse injuries affecting the shoulder girdle, elbow, and wrist. Serratus anterior and lower trapezius weakness among the scapulothoracic muscles, which are most frequently involved, has the potential to result in incorrect scapular positioning and movement, abnormal scapulohumeral rhythm, and generalised upper quarter dysfunction (29,30).

If there is scapular muscle weakness or dysfunction, the normal scapular posture and mechanics may vary. Neuromuscular performance can be hampered as a result of the scapula's inability to execute its stabilising function, and the risk of glenohumeral joint injury can also rise (31).

If the subacromial space is constrained during abduction, the local tissues, such as the supraspinatus tendon, may be impinged, which can be uncomfortable and dangerous. Therefore, it is clear that for the shoulder to function at its best, particularly for a full and pain-free range of abduction, the kinematics associated with upward rotation of the scapula are essential (30).

Our findings corroborate those of Gutierrez-Espinoza et al. from 2020, who found gradual progressive shoulder stretching and strengthening exercises for the rotator cuff and scapular muscles are the same effect for patients with subacromial impingement syndrome who are receiving conservative treatment (32).

Our findings are at odds with those of Hotta et al., 2020, who found no improvement in patients with SAPS' self-reported shoulder discomfort and disability, range of motion (ROM) or muscle strength following the addition of isolated scapular stabilisation exercises to a global periscapular strengthening protocol (24).

Conclusion:

According to previous discussions of these results and reviews of academic research associated with the current study Patients with subacromial impingement syndrome had substantial improvements in discomfort and functional ability after adding kinesiotaping or ultrasound to their scapular stability exercises.

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