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Abstract

Frozen shoulder, also known as, adhesive capsulitis is a common painful condition characterized by severe loss of mobility and shoulder pain. Patients with this disease have a painful restriction of both active and passive mobility and an overall loss of shoulder movement in all planes. This experimental design study investigates the effect of combination of taping neuromuscular and traditional rehabilitation program compared with traditional rehabilitation alone in patients with frozen shoulder. The taping neuromuscular is a technique that involves the application of an adhesive elastic tape on the skin, with local and distance effects. Acting on the skin, the muscles, the venous system and the lymphatic system the taping aims to achieve six main objectives: relieve pain, normalizes muscle tension, remove the lymphatic and venous congestion, improves blood vascularization, correct joint alignment, improves the posture. Sample and method: A total of 40 patients aged between 40 and 60 years were involved in the study. Patients were divided in two groups: first group subjected of 12 sessions of combined therapy, traditional rehabilitation + neuromuscular taping (experimental group 20 patients) and a second group subjected of 12 sessions of traditional rehabilitation (control group 20 patients). They were evaluated before the treatment and after 4 weeks using visual analogue scale (VAS) for pain, and goniometric standard measures for ROM. Results Analysis showed statistically significant improvement in both the experimental and control groups. In addition, the mean improvement in VAS and ROM was significantly greater in the experimental group than in the control group. Conclusion: The study showed that the combination of taping with traditional treatment leads to better outcomes in rehabilitation of patients with frozen shoulder.

Key Words: frozen shoulder, taping neuromuscular, laser, ultrasound, mobilization
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Introduction

Adhesive capsulitis is a condition that affects the shoulder joint and is characterized by an important pain and significant loss of active and passive mobility of the shoulder. Adhesive capsulitis has an incidence of 3–5% in the general population and up to 20% in those with diabetes (Miller et al., 1996). This condition occurs mainly in people aged between 40-60 years, with a higher incidence in women. (Urwin M, Symmons 1998). It is due to an inflammatory process resulting in the formation of adhesions between the capsule, anatomical neck of the humerus and the inferior capsular recess, inducing a reduction in the volume articolare. In 1934 Codman identified a type of muscle spasm and stiffness glenohumeral coining the term "frozen shoulder"(Codman 1945), later Nevasier was the first to identify the pathology through histological and surgical examination of frozen shoulder patients. He proposed that frozen shoulder was not periarthritis, but a "thickening and contraction of the capsule, which becomes adherent to the humeral head" that he termed, "adhesive capsulitis."(Nevasier et al 1945). Although the exact pathophysiologic cause of this pathology remains elusive, there are two types identified in the literature, idiopathic and secondary adhesive capsulitis. Idiopathic ("primary") adhesive capsulitis occurs spontaneously without a specific precipitating event. Primary adhesive capsulitis results from a chronic inflammatory response to fibroblastic proliferation, which may actually be an abnormal response from the immune system. Secondary adhesive capsulitis occurs after a shoulder injury or surgery, or may be associated with another condition such as diabetes, rotator cuff injury, cerebrovascular accident (CVA) or cardiovascular disease, which may prolong recovery and limit outcomes. Patients typically describe the onset of shoulder pain followed by a loss of motion. Limitations in range of motion are flexion, abduction, and external rotation. "Adhesive capsulitis is characterized by its three stages:

The first stage: the freezing lasts approximately between 3 and 6 months and is characterized by the development of an acute and intense pain in the shoulder. The pain is usually strongest at night and during the movement where you usually associate with a sense of discomfort that radiates to the arm. Often it is not possible to identify a traumatic event that has started to pain. Unfortunately, many of these patients are treated with immobilization, which only worsens the freezing process.

The second stage is the phase of progressive stiffness that lasts from 3 to 18 months. During this stage, the rest pain usually decreases, leaving a shoulder that has limited movement. The activities of daily life are very difficult. The patient complains of difficulty doing mundane movements such as reaching the back pocket, combing hair ect.

The final stage is that of the resolution by which it takes from 3 to 6 months and is characterized by a slow recovery of the movement (Reeves 1975).

A number of treatment approaches have been recommended for the management of frozen shoulder (Bulgen et al., 1984, Green et al 1998, Carette

et al., 2003; Philadelphia Panel, 2001). There is as yet no definitive agreement on the most effective form of treatment. Initial treatment is aimed at reducing inflammation and increasing the range of movement. Different kinds of analgesic and anti-inflammatory drugs are commonly used. Most types of treatment focus primarily on restoration of mobility. Although physical therapies such as massage, heat application, laser, ultrasound, Interferential treatment, osteopathic and chiropractic technique, stretching and isometric exercise therapy is routinely prescribed, the efficacy is variable. In severe cases of restriction arthrographic distension (Rizk et al., 1994), surgical capsular release (Oglivie-Harris and Myerthall, 1997) or manipulation under anesthetic (Pollock et al., 1994) have been advocated. Controversial results are reported with manipulation under anesthesia, distension arthrography, and arthroscopic surgery.

Purpose

This experimental design study investigates the effect of combination of taping neuromuscular and traditional rehabilitation program compared with traditional rehabilitation alone in patients with frozen shoulder.

Method and Samples

This is a comparative study. Adults with a diagnosis of frozen shoulder were referred from a rheumatologist shoulder clinic. A total of 40 patients aged 40-60 years were involved in the study. The patients were treated between March and December 2013 in "Fisiomed "Centre of Rehabilitation" in Tirana Albania. They were randomly allocated into two groups: first group subjected of 12 sessions of traditional rehabilitation + neuromuscular taping (experimental group 20 patients) and a second group subjected of 12 sessions of traditional rehabilitation (control group 20 patients). All patients were fully informed of the plan and goals of treatment.

Inclusion Criteria

1. Significant pain and loss of active and passive mobility of the shoulder
2. An absence of radiological evidence of glenohumeral joint arthritis;
3. Symptoms present for at least 3 months
4. Men and woman who were willing of to participate in the study (Cyriax, 1993; Griggs et al., 2000).

Exclusion Criteria

1. Secondary adhesive capsulitis
2. Local corticosteroid injection to the affected shoulder within the last 3 months
3. Pregnancy
4. History of metastatic cancer or diagnosis of cancer within 12 months
5. Unstable angina
6. Prior shoulder surgery

The patients were assessed before the treatment (initial evaluation) and after 4 weeks (final evaluation). They completed a shoulder assessment form (based on SPADI index). The initial assessment form was compared with final assessment form. The pain was assessed by Visual Analogue Scale pain score (Costant et al 1987,Clarck P et al 2003) . Standard goniometric measurements were used to assess shoulder forward elevation (flexion), abduction, external rotation (Norkin et al 1995.)

Assessment Form
Name:
Age:
Gender: **F** **M**

Affected shoulder **L** **R**

ROM (grade)	**First group**		**Second group**	
	Initial	Final	Initial	Final
Flextion				
Abduction				
External rotation				

Initial VAS
0 1 2 3 4 5 6 7 8 9 10
No pain **intolerable pain**

Final VAS
0 1 2 3 4 5 6 7 8 9 10
No pain **intolerable pain**

Study Protocol

Each group was treated 3 times e week for 4 weeks with a total of 12 sessions. The first group received traditional rehabilitation+ neuromuscular taping the second group received only the traditional rehabilitation.

Traditional Rehabilitation of Frozen Shoulder

Both groups received traditional rehabilitation. Treatment sessions lasted about 1hour. Each session was initiated by 5 minutes of High Power Laser and 10 minutes of ultrasounds (Nykanen 2000, Donatelli et al 2004). Specific massage techniques included effleurage, cross-fiber friction, sustained pressure, and prolonged soft tissue approximation was applied to the areas of soft tissue restriction. The exercise program included ROM exercises, gentle stretching exercises in external rotation, internal rotation, cross-body adduction, and forward flexion. Exercises with the arm in more than 40° of flexion or abduction were to be undertaken with caution, we're not expected to engender substantial shoulder pain.Patients were instructed to perform designated types of shoulder exercise at home 10 times each morning, midday, and evening. The strengthening exercises were given when was noted a response of improved range of motion by both the therapist and the patient. Strengthening exercises were progressing from isometric to resist, through pain-free range of motion, when there was a notable improvement of the quality of active motion. The goals of treatment were to reduce restrictions on soft tissue mobility of the periarticular structures, to increase arthrokinematic and osteokinematic motion of the shoulder joints, improve shoulder girdle muscle strength, and to help the patient achieve improved functional use of the affected limb for their activities of daily living (Green 2000, Kelley 2009).

Neuromuscular taping NMT

The first group received a double cross fun taping 3 times a week at the end of each session. The taping was changed the next session. The taping neuromuscular is a technique that involves the application of an adhesive elastic tape on the skin, with local and distance effects. Acting on the skin, the muscles, the venous system and the lymphatic system the taping aims to achieve these main objectives: relieve pain, reduce inflammatory response normalizes muscle tension, remove the lymphatic and venous congestion, improves blood circulation, correct joint alignment, improves the posture (Blow D 2012).

Figure 1. *The Application of Neuromuscular Taping for Frozen Shoulder*

Statistical Analysis

The two-tailed paired T-test was used to find the treatment effect (increase in ROM and reduction in the pain) and to compare the ROM and the pain level between the two groups. The Pearson χ^2-test was used to find the significance of study parameters on a categorial scale between the two groups. A value of $P < 0,5$ was considered significant. SPSS 13 software was used for statistical calculation. (Bailey, 1997)

Results

The aim of the study was to evaluate the effect of combination of taping neuromuscular and traditional rehabilitation program compared with traditional rehabilitation alone in patients with frozen shoulder.

40 patients ((20 in experimental group and 20 in the control group) completed the treatment period of 4 weeks.

Table 1. *Age Distribution of Subjects Studied*

Age in years	**First group**		**Second Group**	
	No	%	No	%
40-45	5	25	4	20
46-50	4	20	6	30
51-55	7	35	5	25
56-60	4	20	5	25
Total	20	100	20	100
Mean±SD	52±8		51±6	

Table 2. *The Gender Distribution of Subjects Studied*

Gender	**First group**		**Second Group**	
	No	%	No	%
Male	7	35	8	40
Female	13	65	12	60
Total	20	100	20	100

Table 3. *Affected Shoulder of Subjects Studied*

Affected Shoulder	First group		Second Group	
	No	%	No	%
Left	7	35	8	40
Right	13	65	12	60
Total	20	100	20	100

Table 4. *Comparison of VAS (pain) between Two Groups*

VAS (pain)	First group	Second group	P value
Initia	**6,6±1,4**	**6,5±1,5**	**0,42**
Final	**2,9±1,5**	**4,2±1,2**	**0,010**
Difference	**-3,7**	**-2,3**	**-**
P value	**<0.001**	**<0,001**	**-**

Table 5. *Comparison of Initial and Final ROM in the First Group*

ROM	Initial	Final	Difference	P Value
Abduction	**79±13**	**129.5±16**	**50.5**	**<0,01**
Forward elevation	**97±14**	**148±13**	**51**	**<0,01**
External rotation	**25±18**	**54±17**	**29**	**<0,01**

Table 6. *Comparison of Initial and Final ROM in the Second Group*

ROM	Initial	Final	Difference	P Value
Abduction	**78±15**	**118.5±15**	**40**	**<0,01**
Forward elevation	**98±13**	**127±13**	**29**	**<0,01**
External rotation	**26±16**	**50±14**	**24**	**<0,01**

Table 7. *Comparison of Outcomes between the Two Groups*

	First group	Second group	P value
Abduction	**126±16**	**118±15**	**<0,001**
Forward elevation	**148±13**	**127±13**	**<0,001**
External rotation	**54±17**	**50±14**	**0.22**
VAS	**2,9±1,5**	**4,2±1,2**	**0,01**

Discussion

In our rehabilitation protocol of experimental group we preferred taping neuromuscular, which is indicated in the inflammatory response of soft tissue around the shoulder. Most of the patients with frozen shoulder had night pain, and some manual therapy techniques could be painful. The taping neuromuscular was aimed to decrease the pain and inflammatory response.

Tables 1 and 2 provides the descriptive and inferential statistical analysis of subjects age and gender. The average age of the experimental group patients was 52 years±8 (range 44-60) Table 1. 13 were women (65%) 7 were men (35%) Table2**.**The average age of the control group was 51±6 years (range 43-60) Table 1. 8 were men (40%) and 12 were women (60%)

Table 3 provides the distribution of the affected shoulder in the studied subjects.

In the experimental group 7 patients had the left shoulder affected and 13 had the right. The control group had 8 patients with left shoulder affected and 12 with the right. In both groups the majority of the patients had affected the right shoulder.

Table 4 provides the comparison of the shoulder pain lever in the two groups. In the experimental group the initial average pain lever was 6,6±1,4 and after treatment was 2,9±1,5 There was a significant reduction in pain lever in the first group ($p<0,001$). In the control group the initial average pain lever was 6,5±1,5 and after treatment was 4,2±1,2 There was a significant reduction in pain lever in the second group ($p<0,001$).

Table 5 provides the comparison of initial and final ROM in the experimental group. The initial ROM was; abduction 79±13, forward elevation 97±14, external rotation 25±18, after the treatment the ROM was, abduction 129±16, forward elevation 148±15, external rotation 54±17. There was a significant improvement of ROM in the experimental group (p value<0,01 for abduction, forward elevation and external rotation)

Table 6 provides the comparison of initial and final ROM in the control group. The initial ROM was; abduction 78±15, forward elevation 98±13, external rotation 26±16, after the treatment the ROM was abduction 129±16, forward elevation 148±15, external rotation 54±17. There was a significant improvement of ROM in the control group (p value<0,01 for the abduction, forward elevation, external rotation)

Table 7 provides the comparison of the outcomes between the two groups.

There was a significant difference in pain reduction between the experimental group and control group ($p<0,01$). There was a significant improvement in ROM of abduction and forward elevation too. There was not much difference between the experimental and control group in the external rotation ($p<0,22$). Our results find out the positive effect of neuromuscular taping as an integrative therapy and support the findings of other studies that have shown the positive effects of rehabilitation in persons with frozen shoulder (Carette et al 2003, Griggs et al, Celik et al 2010, DePalma et al 2012, Tanaka et al 2012, Vermeulen et al 2006, Kelley et al 2009, Yang et al 2007)

The main contribution of this study is to propose a 4- week combined rehabilitation program, that provides a fast improvement in shoulder pain and function. In comparison to previous studies in which exercises have been used to improve shoulder control in individuals with frozen shoulder, our results seem promising.

Limitations of the Study

The results cannot be generalized because of the small sample.
Too short duration of the study.

Conclusion

Adhesive capsulitis is a common disorder in which definitive treatment is still uncertain. The study shows that the patients with frozen shoulder can be treated successfully with traditional physiotherapy but the combination of taping with traditional treatment leads to better outcomes in rehabilitation of patients with frozen shoulder. Despite the small sample that was used study provides an efficient protocol to help the physiotherapists for rehabilitation of patients with frozen shoulder. Future studies also need to involve large numbers of patients, and measure both short-term and long-term outcomes. More research is also needed to establish a standard protocol of treatment for frozen shoulder, and to develop valid and reliable outcome measures for these conditions.

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