J Rehabil Med 2013; 45: 87–91

ORIGINAL REPORT

EVALUATION OF MULLIGAN'S TECHNIQUE FOR ADHESIVE CAPSULITIS OF THE SHOULDER

Gokhan Doner, PT, MSc[1], Zeynep Guven, MD[2], Ayçe Atalay, MD[2] and Reyhan Celiker, MD[2]

From the [1]Özel Academic Hospital, Nuh Kuyusu Cad Bağlarbaşı, Üsküdar and [2]Acibadem University, Faculty of Medicine, Department of Physical Medicine and Rehabilitation, İstanbul, Turkey

Objective: **To evaluate Mulligan's technique for relieving pain and improving functional capacity of the shoulder in patients with adhesive capsulitis in the stiffness phase.**
Design: **Randomized controlled study.**
Methods: **A total of 40 subjects were randomly allocated into 2 groups: (*i*) group 1 (*n* = 20) were treated with hot pack, transcutaneous electrical nerve stimulation, and passive stretching exercises; (*ii*) group 2 (*n* = 20) were treated with hot pack, transcutaneous electrical nerve stimulation and Mulligan's technique. Mulligan's technique combines the sustained application of a manual "gliding" force to a joint, with the aim of repositioning bone positional faults while enabling concurrent physiological (osteo-kinematic) motion of the joint. All cases were evaluated using visual analogue scales for pain, passive and active range of motion, Constant score, Shoulder Disability Questionnaire, and patient and therapist satisfaction at baseline, after completion of treatment sessions and at the end of 3 months of follow-up.**
Results: **Marked improvement was noted in both groups after completion of treatment sessions and at the third month of follow-up compared with baseline. The improvements in outcome measures, namely pain, range of motion, shoulder scores, and patient and physiotherapist satisfaction, were significantly greater in subjects in group 2, who were treated with Mulligan's technique.**
Conclusion: **Mulligan's technique and passive stretching exercises are both effective in reducing pain, and restoring range of motion and function. However, compared with stretching exercises, Mulligan's technique led to better improvements in terms of pain, range of motion, shoulder scores, and patient and physiotherapist satisfaction.**

Key words: adhesive capsulitis; hot pack; Mulligan's technique; shoulder pain.

J Rehabil Med 2013; 45: 87–91

Correspondence address: Zeynep Guven, Gülsuyu Mah. Fevzi Çakmak Caddesi, Divan sokak No. 1, Maltepe, Istanbul. E-mail: zeynep.guven@acibadem.edu.tr

Submitted March 3, 2012; accepted July 4, 2012

INTRODUCTION

Adhesive capsulitis leads to pain and functional disability as a result of the limited range of motion (ROM) of the shoulder girdle. Although the natural history of adhesive capsulitis is not completely understood (1), patients experience the following stages of the condition; a freezing or painful stage, followed by stiffness, frozen or transitional phase, and finally a thawing phase, characterized by increased ROM (2, 3). Treatments advocated for adhesive capsulitis include rehabilitation as the initial conservative measure, anti-inflammatory drugs, intra-articular corticosteroids, capsular distension injections, and surgical interventions in refractory cases. Various treatments, including mobilization and manipulation techniques, have been advocated for restoration of a pain-free state and normal use of the upper extremity. Manual and manipulative treatment options for this condition include high-velocity, low amplitude manipulation, end-range mobilization, mid-range mobilization, and mobilization with movement of the shoulder only and/or of the shoulder girdle (4). The rehabilitative interventions performed depend on the institution. The optimal use of common physical therapies and the frequency and timing of session criteria have not yet been established (5).

Mulligan's technique for peripheral joints combines sustained manual application of "gliding" force to a joint, with the aim of repositioning bone positional faults with concurrent physiological (osteo-kinematic) motion of the joint, either performed actively by the subject or passively by the therapist (6). It has been shown that Mulligan's technique can produce concurrent hypoalgesic effects during and following its application, as well as altering sympathetic nervous system function (7).

The aim of this study was to investigate the effects of Mulligan's technique for relieving pain and improving the functional capacity of the shoulder in patients with adhesive capsulitis in the stiffness phase compared with patients treated with conventional passive stretching exercises.

MATERIAL AND METHODS

Subjects

A total of 40 subjects with shoulder pain of at least 3 months duration, diagnosed as adhesive capsulitis in the stiffness phase according to physical examination in the outpatient clinic of the Physical Medicine and Rehabilitation Department were recruited. Adhesive capsulitis was defined as ≥ 50% loss of passive movement of the shoulder joint relative to the non-affected side, in 1 or more of 3 movement directions (i.e. abduction in the frontal plane, forward flexion, or external rotation in 0º of abduction) similar to Vermeulen et al. (8). They were examined by the same physiatrist for their suitability for inclusion in the study

 doi: 10.2340/16501977-1064

 ISSN 1650-1977

and radiological examinations were carried out accordingly. The study was approved by the ethics committee (No: MAR-YC-2007-0207). Exclusion criteria were: previous treatments other than medication, contraindications for physical therapy (infections or malignancies in the shoulder region, severe hypertension, severe cardiac failure, uncontrolled diabetes mellitus, neurological deficits, skin lesions involving the shoulder region, post-traumatic cases). Patients with coexisting neck pain and radiculopathies were also excluded.

Study design

A total of 40 subjects were randomized using a table of random numbers. They were allocated into two groups. Group 1 ($n = 20$) was treated with hot pack (HP), transcutaneous electrical nerve stimulation (TENS), and passive stretching exercises in 4 directions (flexion, abduction, internal and external rotation). Group 2 ($n = 20$) received HP, TENS and Mulligan's technique. The patients were followed for 3 months.

Treatment procedures

Hot packs were used to deliver superficial heating. HPs were used before stretching or Mulligan's technique to increase the extensibility of the collagen. The temperature was adjusted to a comfortable level for the patients throughout the treatment. Each treatment session lasted 20 min.

After application of HP, stretching was applied. Conventional passive stretching included abduction in the scapular plane, flexion with the patient in the supine position, and rotations during abduction (the degree of abduction was increased according to the patient's progress and tolerance level). Each stretch was maintained for 30 s, with 15 s rest between stretches.

TENS sessions lasted 20 min. The frequency of TENS was set to 100 Hz and pulse duration was set to approximately 0.05–0.07 ms. Patients remained in a seated position with their shoulders in a neutral position. The intensity of the current was increased to the point of observation of no contractions, but with a light tingling sensation, while ensuring the patient was comfortable.

Group 2 received HP, TENS and Mulligan's technique. Mulligan's technique was applied in flexion, elevation and internal rotation. Three sets of 10 repetitions were applied, with a rest interval of 30 s between each set. Patients were treated for 5 days per week for 3 weeks.

All cases were informed about daily care for the shoulders. They were advised to use the affected shoulder in daily activities whenever possible. All patients were instructed to perform pendulum exercises and active shoulder exercises twice a day. In previous studies concerning manual and manipulative treatments for adhesive capsulitis of the shoulder pendulum exercises were also included in addition to specific interventions (8, 9).

All cases were evaluated using a visual analogue scale (VAS) for pain, passive and active ROM, Constant score, Shoulder Disability Questionnaire (SDQ), and patient and therapist satisfaction, at baseline, after completion of treatment sessions and the end of 3 months of follow-up.

Outcome measures

The treatment outcomes used in this study were: VAS, goniometric ROM examination, Constant score, SDQ, and satisfaction of the patient and the physiotherapist. Pain during rest and during movement was evaluated separately using a 10-cm horizontal VAS line. Active and passive shoulder ROM during flexion, abduction, internal and external rotation were noted for both shoulders. Shoulder flexion and abduction were noted as 0–180º and internal and external rotation as 0–90º.

The Constant score has the benefits of including various measures, including pain, functional assessment, ROM and strength measures. Constant score has been widely used for the assessment of various shoulder disorders. It has been specifically validated for adhesive capsulitis and is currently the gold standard (10, 11). This measure has a 100-point scoring system, with 100 points being the best score (12). SDQ covers 16 items aiming to evaluate functional limitation in patients with shoulder disorders. SDQ is advantageous for use in physiotherapy units, since the items of the SDQ were generated from the routine history of the patients with shoulder disorders in physiotherapy (13). The Turkish version of the SDQ has been shown to be reliable and valid (14). It has been demonstrated previously that SDQ is a useful instrument to assess functional disability in longitudinal studies (15). In the SDQ, the best score is 0, while the worst is 100 (13).

Patient and physiotherapist satisfaction was graded as 1 = worse, 2 = same, 3 = slightly better, 4 = better, and 5 = full recovery.

Data analysis

Statistical analysis was performed with NCSS 2007&PASS 2008 Statistical Software. In addition to descriptive statistics for variables with normal distribution we used a Student's *t*-test for group comparison, variance analysis for repeated measures, and paired sample *t*-test for intragroup comparisons. Variables that were not normally distributed were analysed with Mann-Whitney *U* test for group comparison, Friedman test for repeated measures and Wilcoxon test for intragroup comparisons. For variables that were not normally distributed, Friedman test was used for repeated measures, Wilcoxon sign test was used for intragroup comparisons. For ordinal variables χ^2 test, Fischer's exact χ^2 test and McNemar test were applied. The confidence interval was accepted as 95% and a *p*-value less than 0.05 was taken as statistically significant.

RESULTS

A total of 40 patients; 31 (77.5%) females and 9 (22.5%) males, age range 43–76 years, were included in the study. The mean age of the study group was 58.90 years (standard deviation (SD) 8.77). The treatment groups were similar in terms of age, sex, involved shoulder, dominant shoulder and accompanying medical diseases ($p > 0.05$) (Table I).

Pain

In both groups, patients improved significantly in terms of pain at rest and during activity between baseline, after treatment and follow-up at third month ($p < 0.01$). Pain at rest was similar between the treatment groups at baseline and after treatment

Table I. *Baseline characteristics of the study group*

Characteristics	Group 1[a]	Group 2[b]	*p*-value
Age, years, mean (SD)[c]	58.55 (8.57)	59.25 (9.17)	0.804
Sex, *n* (%)[d]			
Female	18 (90.0)	13 (65.0)	0.127
Male	2 (10.0)	7 (35.0)	
Affected shoulder, *n* (%)[d]			
Right	5 (25.0)	10 (50.0)	0.102
Left	15 (75.0)	10 (50.0)	
Dominant shoulder, *n* (%)[d]			
Right	19 (95.0)	20 (100.0)	1.000
Left	1 (5.0)	0 (0)	
Accompanying medical disorder, *n* (%)[d]			0.490
Present	13 (65.0)	15 (75.0)	
Absent	7 (35.0)	5 (25.0)	

[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]Student's *t*-test; [d]χ^2 or Fischer's exact test. SD: standard deviation.

($p > 0.05$). However, patients in group 2 reported significantly lower pain at rest compared with group 1 at the third month ($p < 0.05$). In addition, patients in group 2 reported significantly less pain during activity after treatment and at the third month ($p < 0.01$). VAS scores are summarized in Table II.

Goniometric range of motion

In both groups, ROM during flexion, abduction, internal and external rotation improved significantly between baseline, after treatment and follow-up at the third month ($p = 0.001$). Patients in group 2 had significantly higher active and passive flexion after treatment and at the third month ($p < 0.01$), active and passive abduction after treatment and the third month ($p < 0.05$), active and passive internal rotation after treatment and the third month ($p < 0.05$). Patients in both groups had similar active and passive external rotation after treatment ($p > 0.05$), but patients in group 2 had higher external rotation at the third month compared with group 1 ($p < 0.05$). Goniometric ROM measurements are summarized in Table III.

Constant score

In both groups, Constant scores improved significantly between baseline, after treatment and follow-up at third month ($p = 0.001$). Patients in group 2 had higher Constant scores compared with group 1 after treatment and at the third month ($p < 0.01$) (Table IV).

Shoulder Disability Questionnaire

In both groups the SDQ scores improved significantly between baseline, after treatment and follow-up at the third month ($p = 0.001$). Patients in group 2 had lower disability scores after treatment and at the third month (Table V).

Patient satisfaction

In both groups patients reported better results at the third month compared with after treatment ($p < 0.05$ and $p < 0.01$, respectively). Patients in group 2 reported significantly better results after treatment and at the third month compared with group 1 ($p = 0.001$) (Table VI).

Physiotherapist satisfaction

In both groups physiotherapists reported better results at the third month compared with after treatment ($p < 0.01$). Patients in group 2 reported significantly better results after treatment

Table II. *Pain measurements at baseline, after treatment and at the third month for both treatment groups*

Pain	Group 1[a] Mean (SD)	Group 2[b] Mean (SD)	*p*-value[c]
Pain at rest			
Baseline	3.43 (1.74)	3.24 (2.19)	0.695
After treatment	1.14 (1.22)	0.75 (1.18)	0.278
Third month	0.44 (0.63)	0.20 (0.82)	0.018*
p[d]	0.001**	0.001**	
Pain during activity			
Baseline	6.93 (1.39)	7.49 (1.57)	0.189
After treatment	3.57 (1.18)	2.34 (2.15)	0.005**
Third month	2.21 (1.45)	1.03 (1.84)	0.003**
p[d]	0.001**	0.001**	

*$p < 0.05$; **$p < 0.01$.
[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]Mann–Whitney *U* test; [d]Friedman test.
SD: standard deviation.

Table III. *Range of motion (ROM) measurements at baseline, after treatment and at the third month for both treatment groups*

ROM	Group 1[a] Mean (SD)	Group 2[b] Mean (SD)	*p*-value[c]
Flexion			
Active			
Baseline	114.00 (19.30)	121.25 (17.90)	0.226
After treatment	145.25 (15.76)	159.25 (13.30)	0.004**
Third month	157.75 (18.53)	174.50 (8.41)	0.001**
p[d]	0.001**	0.001**	
Passive			
Baseline	126.50 (19.06)	133.25 (17.56)	0.251
After treatment	156.00 (16.35)	168.50 (11.70)	0.008**
Third month	167.25 (17.13)	178.00 (4.41)	0.013*
p[d]	0.001**	0.001**	
Aduction			
Active			
Baseline	89.25 (21.17)	92.30 (26.71)	0.691
After treatment	120.00 (25.95)	140.00 (30.65)	0.032*
Third month	137.50 (28.26)	167.50 (21.73)	0.001**
p[d]	0.001**	0.001**	
Passive			
Baseline	101.25 (22.17)	108.00 (19.89)	0.317
After treatment	131.00 (24.90)	150.50 (27.48)	0.024*
Third month	147.00 (26.97)	166.50 (25.39)	0.024*
p[d]	0.001**	0.001**	
Internal rotation			
Active			
Baseline	36.25 (20.70)	32.50 (11.75)	0.487
After treatment	59.75 (19.49)	72.50 (15.85)	0.029*
Third month	70.95 (18.01)	86.50 (7.45)	0.001**
p[d]	0.001**	0.001**	
Passive			
Baseline	46.50 (19.06)	43.00 (10.93)	0.482
After treatment	68.25 (16.95)	78.75 (12.55)	0.032*
Third month	77.50 (14.46)	89.00 (3.08)	0.002**
p[d]	0.001**	0.001**	
External rotation			
Active			
Baseline	29.75 (17.20)	25.50 (12.55)	0.378
After treatment	50.00 (24.65)	56.00 (23.76)	0.438
Third month	62.75 (24.89)	77.50 (18.88)	0.041*
p[d]	0.001**	0.001**	
Passive			
Baseline	39.50 (17.16)	35.00 (12.98)	0.356
After treatment	59.00 (23.09)	64.00 (21.37)	0.482
Third month	71.25 (22.70)	81.25 (15.20)	0.111
p[d]	0.001**	0.001**	

*$p < 0.05$; **$p < 0.01$.
[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]Student's *t*-test; [d]repeated measures analysis of variance.
SD: standard deviation.

Table IV. *Constant scores at baseline, after treatment and at third month for both treatment groups*

Constant scores	Group 1[a] Mean (SD)	Group 2[b] Mean (SD)	*p*-value[c]
Baseline	35.50 (17.39)	45.55 (17.39)	0.070
After treatment	64.40 (18.32)	86.15 (11.70)	0.001**
Third month	78.55 (18.96)	97.25 (3.56)	0.001**
p[d]	0.001**	0.001**	

*$p<0.05$; **$p<0.01$.
[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]Student's *t*-test; [d]repeated measures analysis of variance (ANOVA).
SD: standard deviation.

and at the third month compared with group 1 ($p=0.001$) (Table VI).

DISCUSSION

This study compared the effects of two treatment strategies; Mulligan's technique and stretching exercises. It was demonstrated that both strategies are effective in reducing pain and restoring ROM and function in patients with adhesive capsulitis in the stiffness phase. Compared with stretching exercises, Mulligan's technique led to better improvements in terms of pain, ROM, shoulder scores and patient and physiotherapist satisfaction. This is the first study to demonstrate that the 3-month outcome of the Mulligan's technique is favourable compared with conventional stretching exercises in addition to the immediate effects of the treatment. Mulligan's technique was chosen for this study because it has the advantage of increasing ROM in addition to providing analgesia. Mulligan's technique was compared with stretching because stretching exercises are the mainstay of exercises in joint limitations; however, in contrast to Mulligan's technique they lack an analgesic effect.

Manual therapy interventions, usually combined with physical therapy, have been shown previously to result favourably in terms of pain, ROM and function in various studies (8, 16, 17). We aimed to investigate the effects of a specific intervention because it becomes difficult to draw conclusions due to multiple interventions. We chose stretching exercises for comparison because Griggs et al. (18) have previously demonstrated that the vast majority of patients who have idiopathic adhesive capsulitis can be treated successfully with a specific 4-direction shoulder stretching programme. In our study, it was not possible to include a sham group since patients would easily differentiate.

Table V. *Shoulder disability scores at baseline, after treatment and at third month for both treatment groups*

	Group 1[a] Mean (SD)	Group 2[b] Mean (SD)	*p*[c]
Baseline	89.68 (12.22)	80.58 (21.32)	0.175
After treatment	55.00 (29.84)	23.35 (26.26)	0.001**
Third month	25.93 (28.33)	8.02 (22.07)	0.003**
p[d]	0.001**	0.001**	

**$p<0.01$.
[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]Mann–Whitney *U* test; [d]Friedman test.
SD: standard deviation.

Table VI. *Patient and physiotherapist satisfaction at baseline, after treatment and at third month for both treatment groups*

	Group 1[a] *n* (%)	Group 2[b] *n* (%)	*p*-value[c]
Patient satisfaction			
After treatment			
Worse	0 (0)	0 (0)	0.001*
Same	0 (0)	0 (0)	
Slightly better	12 (40.0)	1 (5.0)	
Better	8 (40.0)	17 (85.0)	
Full recovery	0 (0)	2 (10)	
Third month			
Worse	0 (0)	0 (0)	0.001*
Same	0 (0)	0 (0)	
Slightly better	8 (40.0)	0 (0)	
Better	9 (45.0)	7 (35.0)	
Full recovery	3 (15.0)	13 (65.0)	
Physiotherapist satisfaction			
After treatment			
Worse	0 (0)	0 (0)	0.001*
Same	0 (0)	0 (0)	
Slightly better	13 (65.0)	2 (10.0)	
Better	7 (35.0)	15 (75.0)	
Full recovery	0 (0)	3 (15.0)	
Third month			
Worse	0 (0)	0 (0)	0.001*
Same	0 (0)	0 (0)	
Slightly better	6 (30.0)	0 (0)	
Better	12 (60.0)	7 (35.0)	
Full recovery	2 (10.0)	13 (65.0)	

*$p<0.01$.
[a]Group 1: hot pack, transcutaneous electrical nerve stimulation (TENS), stretching; [b]Group 2: hot pack, TENS, Mulligan's technique; [c]χ^2 test.

Scaringe et al.(19) have previously used the Mulligan's technique in addition to chiropractic manipulations of the spine for a golfer with chronic shoulder, arm and neck pain. The authors have followed the patient for 29 weeks; however, they used multiple techniques, which made it difficult to delineate the specific effects of a certain treatment. In our study we included a meticulously chosen subset of patients with shoulder pain only, and investigated the effect of the technique by comparison with stretching exercises. We combined both of the interventions, Mulligan's technique and stretching exercises, with HP and TENS to eliminate pain. We did not include multiple techniques, which would have made it difficult to draw a conclusion about the effect of the particular treatment *per se*. Paungmali et al. have previously demonstrated the hypoalgesic effect of Mulligan's technique for lateral epicondylalgia (7). In addition, Teys et al. (20) stated that clinically meaningful improvements in both ROM and pressure pain threshold occur immediately after the application of Mulligan's technique in the pain-limited shoulder.

This study has certain limitations. Since Mulligan's technique is a hands-on treatment it is not possible to perform

the study in a blinded manner. And, again, since the study is about a manual treatment, the therapy is applied by the same experienced therapist. It was not ethical to use a sham group; thus the control group was also treated with conventional stretching exercises.

This study has established the immediate and 3-month effects of Mulligan's technique in patients with adhesive capsulitis. The results show that that Mulligan's technique offers advantages over conventional stretching exercises. In our study we were able to analyse the patients with adhesive capsulitis in the stiffness phase from various aspects, including pain, ROM, disability scores, and patient and physiotherapist satisfaction, after completion of the therapy sessions and in the subsequent 3-month period. The results show that Mulligan's technique offers advantages that are sustained after completion of the treatment.

The authors declare no conflicts of interest.

REFERENCES

1. Harris JD, Griesser MJ, Copelan A, Jones GL. Treatment of adhesive capsulitis with intra-articular hyaluronate: a systematic review. Int J Shoulder Surg 2011; 5: 31–37.
2. Leung MS, Cheing GL. Effects of deep and superficial heating in the management of frozen shoulder. J Rehabil Med 2008; 40: 145–150.
3. Manske RC, Prohaska D. Diagnosis and management of adhesive capsulitis. Curr Rev Musculoskelet Med 2008; 1: 180–189.
4. Brantingham JW, Cassa TK, Bonnefin D, Jensen M, Globe G, Hicks M, et al. Manipulative therapy for shoulder pain and disorders: expansion of a systematic review. J Manipulative Physiol Ther 2011; 34: 314–346.
5. Nicholson GC. The effects of passive joint mobilization on pain and hypomobility associated with adhesive capsulitis of the shoulder. J Orthop Sports Phys Ther 1985; 6: 238–246.
6. Yang JL, Chang CW, Chen SY, Wang SF, Lin JJ. Mobilization techniques in subjects with frozen shoulder syndrome: randomized multiple-treatment trial. Phys Ther 2007; 87: 1307–1315.
7. Paungmali A, O'Leary S, Souvlis T, Vicenzino B. Hypoalgesic and sympathoexcitatory effects of mobilization with movement for lateral epicondylalgia. Phys Ther 2003; 83: 374–383.
8. Vermeulen HM, Rozing PM, Obermann WR, le Cessie S, Vliet Vlieland TP. Comparison of high-grade and low-grade mobilization techniques in the management of adhesive capsulitis of the shoulder: randomized controlled trial. Phys Ther 2006; 86: 355 –368.
9. Rainbow DM, Weston JP, Brantingham JW, Globe G, Lee F. A prospective, clinical trial comparing chiropractic manipulation and exercise therapy vs. chiropractic mobilization and exercise therapy for treatment of patients suffering from adhesive capsulitis/frozen shoulder. J Am Chiropr Assoc 2008; 45: 12–28.
10. Othman A, Taylor G. Is the constant score reliable in assessing patients with frozen shoulder? 60 shoulders scored 3 years after manipulation under anesthesia. Acta Orthop Scand 2004; 75: 114–116.
11. Dupeyron A, Gelis A, Sablayrolles P, Bousquet PJ, Julia M, Herisson C, et al. Heterogeneous assessment of shoulder disorders: validation of the Standardized Index of Shoulder Function. J Rehabil Med 2010; 42: 967–972.
12. Wright RW, Baumgarten KM. Shoulder outcomes measures. J Am Acad Orthop Surg 2010; 18: 436–444.
13. Van der Heijden GJ, Leffers P, Bouter LM. Shoulder Disability Questionnaire design and responsiveness of a functional status measure. J Clin Epidemiol 2000; 53: 29–38.
14. Ozsahın M, Akgun K, Aktas I, Kurtais Y. Adaptation of the shoulder disability questionnaire to the Turkish population, its reliability and validity. Int J Rehabil Res 2008; 31: 241–245.
15. van der Windt DA, van der Heijden GJ, de Winter AF, Koes BW, Deville W, Bouter LM. The responsiveness of the Shoulder Disability Questionnaire. Ann Rheum Dis 1998; 57: 82–87.
16. Placzek JD, Roubal PJ, Freeman DC, Kulig K, Nasser S, Pagett BT. Long-term effectiveness of translational manipulation for adhesive capsulitis. Clin Orthop Relat Res 1998; 356: 181–191.
17. Roubal PJ, Dobritt D, Placzek JD. Glenohumeral gliding manipulation following interscalene brachial plexus block in patients with adhesive capsulitis. J Orthop Sports Phys Ther 1996; 24; 66–77.
18. Griggs SM, Ahn A, Green A. Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment. J Bone Joint Surg Am 2000; 82-A: 1398–1407.
19. Scaringe J, Kawaoka C, Studt T. Improved shoulder function after using spinal mobilization with arm movement in a 50 year old golfer with shoulder, arm and neck pain. Topics in Clinical Chiropractic 2002; 9: 44–53.
20. Teys P, Bisset L, Vicenzino B. The initial effects of a Mulligan's mobilization with movement technique on range of movement and pressure pain threshold in pain-limited shoulders. Man Ther 2008; 13: 37–42.