

ORIGINAL RESEARCH

IJPHY

MULLIGAN MOBILIZATION IS MORE EFFECTIVE IN TREATING DIABETIC FROZEN SHOULDER THAN THE MAITLAND TECHNIQUE

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ABSTRACT

Background: Patients with frozen shoulder suffer from significant pain and progressive limitation of shoulder active and passive movements. Such clinical problems are primarily treated conservatively. Physical therapy is an integral part in treatment of frozen shoulder. Rehabilitation may include various manual mobilization techniques in order to relieve pain and restore mobility and function. Therefore, this study aimed at comparing the effects of two different mobilization techniques (Mulligan Mobilization with Movement and Maitland end range mobilization) on improving shoulder pain, function and mobility in patients with diabetic frozen shoulder.

Methods: Thirty patients were randomly and equally distributed into two groups: (1) Mulligan group receiving mobilization with movement, and (2) Maitland group receiving end range oscillatory mobilization. Treatment was given 3 times per week, for 6 consecutive weeks. Patients were evaluated before and after treatment with regards to shoulder pain severity and functional disability using the Shoulder Pain and Disability Index as well as for shoulder flexion, abduction, external and internal rotation range of motion using a digital level inclinometer.

Results: Patients in the two groups showed significant improvement in all the measured variables over the treatment period ($p < 0.01$), however, patients who received the Mulligan technique showed greater improvement ($p < 0.05$). Between group comparisons showed that patients in the Mulligan group significantly improved than those in the Maitland on all measured variables ($p < 0.05$), except for the internal rotation range of motion ($p > 0.05$).

Conclusion: Mulligan and Maitland end range mobilization are effective in decreasing shoulder pain and dysfunction as well as in increasing shoulder mobility in all directions. However, the Mulligan mobilization is more effective when treating patients with diabetic frozen shoulder.

Keywords: Mobilization; Mulligan; Maitland; Diabetic frozen shoulder; Adhesive capsulitis; Shoulder pain.

Received 2nd September 2015, revised 15th September 2015, accepted 29th September 2015



www.ijphy.org

DOI: 10.15621/ijphy/2015/v2i5/78238

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INTRODUCTION

Frozen shoulder or “Adhesive capsulitis” is commonly seen in middle-aged individuals; particularly women and diabetic patients.¹ It affects 2–5% of non-diabetic population and 10–20% of patients with non-insulin dependent diabetes mellitus.^{1,2} Patients typically suffer from significant pain and progressive limitation of shoulder active and passive movements.^{3,4} Physical therapy is the cornerstone in preventing the development of shoulder capsule contracture and restoring shoulder motion.^{4,7} Common therapeutic approaches include exercises and manual glenohumeral mobilization. The most popular mobilization techniques used for this purpose are Maitland and Mulligan mobilization. Although these two techniques improved pain and restored function and mobility in patients with idiopathic frozen shoulder, yet Mulligan technique was

superior.^{8,9} However, to authors’ knowledge, the effects of these techniques on pain, function and shoulder range of motion (ROM) in patients with diabetic frozen shoulder have never been compared. Thus, this study aimed at comparing the effects of the two mobilization techniques on diabetic frozen shoulder pain and dysfunction and shoulder active ROM. It was hypothesized that Mulligan technique would have a better outcome in terms of joint pain, ROM and function.

METHODS

This study was carried out at an outpatient clinic setting. All procedures were done in accordance to and were approved by the local ethical Committee.

Subjects

Thirty patients diagnosed with diabetic frozen shoulder were eligible to participate in this study based on inclusion and exclusion criteria (Table 1).

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none">• Diagnosed with diabetic frozen shoulder• Had a painful and stiff shoulder for at least 3 months• Their age ranged between 45 and 65 years old• Had diabetes mellitus type II for at least five years that was controlled at the time of conducting this study	<ul style="list-style-type: none">• The affected shoulder operated on• Any type of arthritis (such as rheumatoid arthritis) affecting their upper extremities• Developed a painful stiff shoulder after a severe trauma to the upper extremity• Previous fractures or dislocation of the affected shoulder complex• Rotator cuff tendinitis or rupture• Previous Intra-articular steroid injection, or surgical release

Procedures

First, patients were interviewed and assessed against the inclusion and exclusion criteria. Then, eligible patients who agreed to participate in the study signed an informed written consent.

Assessment procedures

Assessment was done at baseline and six weeks later (end of the study period). For shoulder pain and dysfunction, an Arabic translated and validated version of the Shoulder Pain And Dysfunction Index was used.¹⁰ Each item was scored on a 10-points scale, and a total percentage was calculated. Higher scores on the subscale indicate greater pain and greater disability.¹¹ The lowest possible total SPADI percentage score is 0% indicating no disability; and the maximum possible score is 100% indicating total disability.¹² SPADI was chosen as a primary outcome measurement in this study because of its appropriateness to the symptoms experienced with shoulder capsulitis.¹³ In addition, it has content validity, good construct validity,^{12,14,15} internal consistency,¹² and test-retest

reliability.¹⁶ The SPADI has been shown to correlate negatively to shoulder ROM and is sensitive to clinical changes.^{15,17} A 10-point change on the SPADI has been identified as the minimal clinically important change needed to be confident that a change has actually occurred.¹⁴

Also, shoulder active range of flexion, abduction, internal and external rotation was measured using a digital level inclinometer¹⁸ (HUSKY, 2455 Paces Ferry Rd, Atlanta, GA 30339, USA;). This inclinometer has an accuracy of $\pm 0.029^\circ$ for level, while the accuracy of digital display is $\pm 0.1^\circ$ for level and $\pm 0.2^\circ$ for all angles.¹⁸ Measurements were done three times and an average was calculated and used for further statistical analyses.

Treatment procedures

Patients were randomly assigned using sealed envelopes into one of two treatment groups: Mulligan and Maitland group. Each group included 15 patients who received shoulder mobilization, three times a week, for a total treatment period of 6 weeks. In addition, patients in the two groups

received pendulum exercises in all directions for 5 minutes. All patients were given the same instructions and encouragement to practice pendulum exercises at home, and to participate in daily activities within pain limits.

Mulligan mobilization

The mobilization technique used was done as described by Mulligan, (2004).¹⁹ Briefly, therapist applied passive accessory glide as the patient moved the arm actively in the desired direction within a pain free range. The mobilization was done in three sets of ten repetitions in each direction.

For shoulder abduction, therapist applied a posterolateral gliding force over the head of the humerus, while patient actively abducted his arm. For shoulder flexion, the therapist applied a posterolateral glide as patient flexed his shoulder. For shoulder internal rotation, therapist applied an inferior shoulder glide and stabilized the scapula as the patient internally rotated his shoulder, and adducted his upper arm. As the therapist pushed the shoulder into adduction in this way, the head of the humerus was distracted laterally. Therapist hand in the axilla acted as a fulcrum.

Maitland mobilization

Therapist applied Oscillatory end-range Maitland mobilization grade III or IV. *Grade (III) refers to a large amplitude movement performed at the level where tissue resistance is encountered or up to the limit of the available range whereas grade (IV) implies a small amplitude movement performed into tissue resistance.*

The therapist applied oscillatory caudal glides to increase shoulder abduction, and posterior glide to increase shoulder flexion and internal rotation. To increase external rotation, an anterior glide was applied.

Statistical Analysis

Statistical analysis was done using SPSS for windows, version 21 (SPSS, Inc., Chicago, IL, USA) with the significance level set at $p < 0.05$. Unpaired t-test was used to compare the demographic characteristics at baseline between the two groups. Repeated Measures ANOVA test was used to compare flexion, abduction, internal and external rotation ROM as well as the total SPADI score between and within the two groups. Bonferroni correction was done to adjust for the repeated comparisons. All data are presented as means \pm standard deviation.

RESULTS

A total of 30 male and female patients participated in this study. The mean age for patients in the

Mulligan group was 54.8 ± 5.85 years, while it was 53.4 ± 5.23 years for those in the Maitland group. The fasting blood glucose level was 128.46 ± 13.01 and 132.26 ± 8.92 mg/dl for the Mulligan and Maitland patient groups, respectively. Between group comparison showed non-significant difference regarding age and blood glucose level ($p > 0.05$).

Shoulder pain and dysfunction (Table 2, Figure 1):

At baseline, patients in the two groups showed non significant difference in SPADI score (mean difference = $2.9 \pm 2.2\%$; $p = 0.19$; 95% CI: 1.60 - 7.30). At the end of treatment period, the SPADI score of patients in the Mulligan group significantly decreased compared to that of patients in the Maitland group (mean difference = $16.40 \pm 5.90\%$; $p < 0.01$; 95% CI: 4.40 - 28.40). Within group comparisons showed that patients in the two groups significantly improved over the treatment period ($p < 0.01$). For patients in the Mulligan group, total SPADI score improved by $68.80 \pm 3.70\%$ (95% CI: 61.20 - 76.40), whereas that of patients in the Maitland group improved by $49.50 \pm 3.70\%$ (95% CI: 42.01 - 57.10).

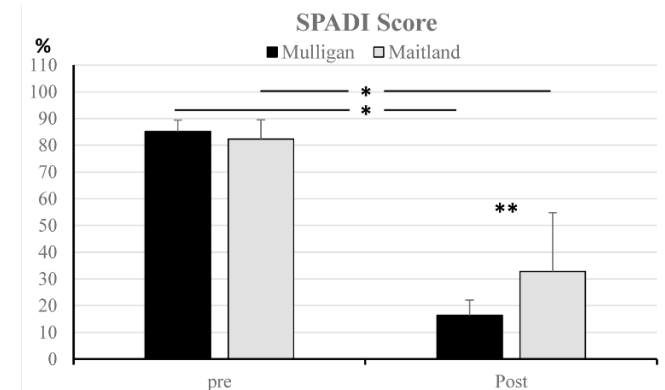


Figure 1: SPADI shoulder pain and dysfunction score. There was a significant improvement in the Mulligan and Maitland patients groups over the treatment period (*, $P < 0.05$), however, the Mulligan showed a more significant improvement than the Maitland group by the end of treatment (**, $p < 0.05$)

Range of motion (ROM) (Table 2, Fig 2-3):

At baseline, shoulder ROM in all directions was not significantly different between the two groups ($p > 0.05$). Post-treatment, the ROM significantly increased in patients in the Mulligan group compared to that of patients in the Maitland group ($p < 0.05$); except for the internal rotation ROM ($p > 0.05$). Within group comparisons showed significant improvement in all measured ROM at the end of treatment period compared to baseline ranges ($p < 0.01$).

For shoulder flexion ROM (Fig 2), patients in the the Mulligan significantly improved by $24.91 \pm 9.69^\circ$ compared to those in the Maitland group ($p = 0.02$; 95% CI: 5.05 – 44.77). Over the treatment period, patients in the Mulligan group improved by $91.54 \pm 5.23^\circ$ ($p < 0.01$; 95% CI: 80.81 – 102.26), whereas those in the Maitland group improved by $66.58 \pm 5.23^\circ$ ($p < 0.01$; 95% CI: 55.86 – 77.31)

For abduction ROM (Fig 2), patients in the Mulligan group significantly improved by $21.84 \pm 9.02^\circ$ ($p = 0.02$; 95% CI: 3.36 – 40.32) compared to those in the Maitland group. Over the treatment period, patients in the Mulligan group improved by $94.34 \pm 5.89^\circ$ (95% CI: 82.27 – 106.41), whereas those in the Maitland group improved by $71.39 \pm 5.89^\circ$ (95% CI: 59.32 – 83.46).

For external rotation ROM (Fig 3), patients in the Mulligan group had a significantly greater range than that of the Maitland group by $10.56 \pm 4.14^\circ$ ($p = 0.01$; 95% CI: 2.08 – 19.04). By the end of treatment, patients in the Mulligan group improved by $59.28 \pm 5.31^\circ$ (95% CI: 48.42 – 70.16), while those in the Maitland group improved by $48.30 \pm 5.31^\circ$ (95% CI: 37.43 – 59.17).

For internal rotation ROM (Fig 3), patients in the Mulligan and Maitland groups showed a non significant difference (mean difference = $1.91 \pm 2.52^\circ$; $p = 0.46$; 95% CI: 3.26 – 7.08). However, over the treatment period, the Mulligan group significantly improved by $23.87 \pm 1.68^\circ$ (95% CI: 20.42 – 27.31) and those in the Maitland group improved by $21.83 \pm 1.68^\circ$ (95% CI: 18.38 – 25.27).

Table 2: The mean \pm standard deviation for ROM and SPADI scores of the two groups. * indicates significant difference (p -value < 0.05)

Variable		Mulligan	Maitland	Mean Difference	P-value	95% CI	
						Lower	Upper
SPADI	Baseline	85.15 \pm 4.24	82.30 \pm 7.21	2.9 \pm 2.2	0.19	1.60	7.30
	Post	16.36 \pm 5.68	32.76 \pm 22.02	16.40 \pm 5.90	<0.01*	4.4	28.40
Flexion	Baseline	52.74 \pm 10.51	52.78 \pm 12.73	0.04 \pm 4.27	0.99	8.69	8.77
	Post	144.28 \pm 22.23	119.36 \pm 30.27	24.91 \pm 9.69	0.02*	5.05	44.77
Abduction	Baseline	39.46 \pm 15.55	40.57 \pm 19.69	1.11 \pm 6.48	0.86	12.16	14.39
	Post	133.80 \pm 22.27	111.96 \pm 26.91	21.84 \pm 9.02	0.02*	3.36	40.32
External Rotation	Baseline	24.57 \pm 11.16	25.01 \pm 14.14	0.43 \pm 4.65	0.93	9.10	9.96
	Post	83.86 \pm 6.38	73.30 \pm 14.72	10.56 \pm 4.14	0.01*	2.08	19.04
Internal Rotation	Baseline	45.60 \pm 6.01	45.73 \pm 5.44	0.13 \pm 2.09	0.95	4.16	4.42
	Post	69.46 \pm 6.61	67.56 \pm 7.21	1.91 \pm 2.52	0.46	3.26	7.08

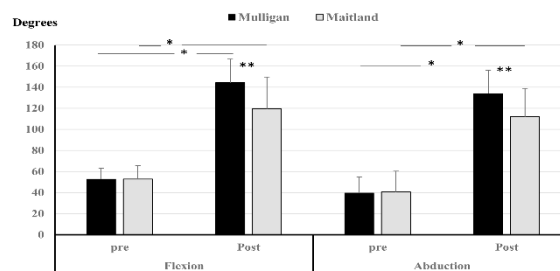


Figure 2: Shoulder Flexion and Abduction ROM. There was a significant improvement in the Mulligan and Maitland patients groups over the treatment period (*, $P < 0.05$), however, the Mulligan showed a more significant improvement than the Maitland group by the end of treatment (**, $p < 0.05$)

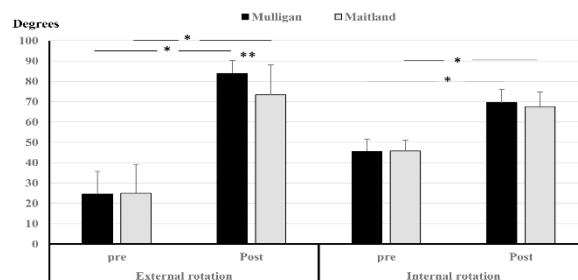


Figure 3: Shoulder Internal and external rotation ROM. There was a significant improvement in the Mulligan and Maitland patients groups over the treatment period (*, $P < 0.05$). For external rotation range, the Mulligan group showed a significant improvement than the Maitland group at the end of treatment period (**, $p < 0.05$). For the internal rotation range, no differences were found between the two groups ($p > 0.05$)

DISCUSSION

The purpose of this study was to compare the effects of Mulligan versus Maitland end range mobilization on shoulder pain and dysfunction as well as shoulder flexion, abduction, internal rotation and external rotation ROM in patients with diabetic frozen shoulder.

For shoulder pain and dysfunction, it was hypothesized that Mulligan would significantly improve shoulder pain and dysfunction than Maitland technique. This hypothesis was accepted as evident by significant pain alleviation and improvement in shoulder function in patients who received the Mulligan technique compared to those who received the Maitland technique. It should be emphasized that patients in the two groups showed significant improvement by the end of treatment.

The mechanical stimulation associated with mobilization is believed to induce pain relief by a direct stimulation of the dorsolateral periaqueductal grey (dPAG) region of the brain; which gives off descending pathways that influence inhibitory interneurons at the spinal level.^{20,21} It also, indirectly alleviates pain by improving synovial fluid circulation and washing out of pain metabolites.²³ However, the superior effect of Mulligan technique could be attributed to correction of positional faults and restoration of joint arthrokinematics, which in turn permits pain free motion.²⁴⁻²⁶ Furthermore, the active participatory nature of this technique stimulates proprioceptors and inhibits pain.²⁷

Regarding shoulder dysfunction, the improvement in shoulder function seen in patients within the Mulligan group could be a direct effect of pain relief associated with technique, which encouraged patients to use their affected arms in activities of daily living.

For shoulder motion, It was hypothesized that Mulligan mobilization would significantly improve shoulder range compared to Maitland technique. This hypothesis was accepted for all shoulder motions except for internal rotation. This finding could be explained that patients receiving the Mulligan's mobilization felt more comfortable than those received the Maitland mobilization during application due to adjustment of moving articular surfaces and restoration of shoulder kinematic.²⁸ This is expected to reduce tension and trauma of neighboring soft tissue structures such as the capsule and ligament complex which are rich in mechanosensitive pain receptors. Such comfort and its associated pain relief could have encouraged the patients to actively move the shoulder in all directions. On the other hand,

Maitland end range mobilization technique stretches joint capsule,²³ which may be reflected more on passive rather than active ROM.

The results of the current study are in agreement with that of Shrivastava et al. (2011),⁸ who compared the two mobilization techniques in 20 patients with idiopathic frozen shoulder and obtained similar results with regards to pain, function and shoulder motion. It should be emphasized that in this study it was not clear whether patients with diabetic frozen shoulder were included or not. Furthermore, patients were given active exercise and stretching beside the mobilization. Also, the current results are consistent with that of Kazmi et al. (2013),⁹ although their results are not clear as the mean difference was only given and no p-value was declared.

On the other hand, current results are in disagreement with that of Goyal et al. (2013) who compared pain, function and active as well passive ROM after 3 weeks of receiving end range mobilization, Mulligan and combined mobilization techniques.²⁹ No differences were found at this period between Mulligan and Maitland except for external rotation range. However, the disagreement could be attributed to the short treatment duration of three weeks. By this time, shoulder kinematic changes start to appear with the use of Mulligan technique,²⁸ and are expected to continue improving afterwards.

Despite the significant effects evident by the results of this study, a few limitations exist. These include short follow up duration. Future studies are encouraged to investigate whether the superior effect of Mulligan will persist over longer period of time or not. Furthermore, this study assessed only active ROM, which is influenced by perceived pain and muscle strength. Future studies are encouraged to measure passive ROM, which reflects soft tissue flexibility.

CONCLUSION

Based on the results of current study, there is evidence supporting that Mulligan mobilization technique is superior to Maitland technique in relieving pain and improving shoulder function and active ROM in patients with diabetic frozen shoulder.

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Citation

Aliaa Rehan Youssef, Ahmed Moursi Ahmed Ibrahim, & Khaled ElSayed Ayad. (2015). MULLIGAN MOBILIZATION IS MORE EFFECTIVE IN TREATING DIABETIC FROZEN SHOULDER THAN THE MAITLAND TECHNIQUE. *International Journal of Physiotherapy*, 2(5), 804-810.