The effects of Mulligan mobilisation with movement and taping techniques on pain, grip strength, and function in patients with lateral epicondylitis

Akram Amro, MPH a,b,*, Ina Diener, PhD b,c, Wafa’ Omar Bdair, BPT a, Isra’ M. Hameda, BPT a, Arwa I. Shalabi, BPT a, Dua’ I. Ilyyan, BPT a

a Physiotherapy Department, Faculty of Health Professions, Al-Quds University, Jerusalem, Palestine
b Western Cape University at Cape Town, South Africa
c Al-Quds University, Jerusalem, Palestine

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Abstract
This experimental design study investigated the effect of a combination of Mulligan techniques and traditional treatment compared with that of traditional treatment alone in patients with lateral epicondylitis. The applied Mulligan techniques included mobilisation with movement and taping, and were aimed to reduce pain, increase grip strength, and improve activities of daily living. A total of 34 patients aged between 16 and 69 years underwent 11 sessions of a combination of Mulligan techniques and traditional treatment (experimental group, n = 17) or traditional treatment only (control group, n = 17). They were evaluated before the treatment, and after 4 weeks, using visual analogue scale, maximum grip strength, and Patient-Rated Tennis Elbow Evaluation. Analysis showed statistically significant improvement in all outcomes in both the experimental and the control groups. In addition, the mean improvement in visual analogue scale and maximum grip strength was significantly greater in the experimental group than that in the control group. This study showed that the combination of Mulligan techniques with traditional treatment leads to better outcomes in treatment of lateral epicondylitis than traditional treatment alone.

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Introduction
Lateral epicondylitis (LE) of tennis elbow, involving tendinitis of the extensor carpi radialis brevis [1,2], is the most common lesion in the elbow region. In Canada, LE is the most commonly diagnosed elbow condition and affects about 1–3% of the population at large [3]. The annual incidence of LE in general practice is four to seven cases per 1000 patients,
with a peak in patients 35–54 years of age. Dominant arm involvement is most common [1]. Men and women are equally affected [4]. LE is a form of “repetitive strain injury” [5] and is characterised by pain at the lateral aspect of the elbow, especially in gripping activities and resistance application to extensor muscles of the forearm [6–9].

Many traditional interventions have been used to treat this condition, including non-steroidal anti-inflammatory drugs [10,11]; corticosteroid injection [12,13]; cryotherapy in the acute stage, followed by heat in the more chronic stage [14]; friction massage [15]; rest [14]; ultrasound (US) [14,16,17]; acupuncture [18–20]; electrical stimulation [21]; laser [22]; counterforce bracing [23,24]; shock wave therapy [25]; lateral extensor release [15,26]; progressive strengthening; and stretching exercise therapy [27]. As Garret et al. (2000) [28] conclude that “the traditional modalities of physiotherapy fail specifically to improve the quality of collagen in tendons or bring in new vascularity to promote tissue healing,” these measures must, therefore, be used only as part of a larger treatment plan, including Mulligan mobilisation with movement technique.

MWM and taping are modern techniques developed by Mulligan for treating LE. MWM is a form of manual therapy that includes a sustained lateral glide to the elbow joint with concurrent physiological movement [29]. This mobilisation technique is often used to correct the faulty position of the elbow joint [29,30]. Miller (2000) [30] described in his case report the use of the MWM for LE as the primary modality for the correction of what Miller diagnosed as a “positional fault of the elbow joint complex mimicking a contractile element pathology of the common extensor bundle.” It was found that MWM resulted in reduced pain, improvement of pain-free grip strength (PFGS), and increased ability to tolerate resisted isometric wrist extension, and that, 2 weeks of treatment and 1-month follow-up showed full function and absence of pain.

A number of studies have attempted to compare the effect of MWM with those of other forms of interventions. Geetu and Deepak (2008) [31] found that MWM led to statistically significant improvement in strength and functional performance when compared with US treatment. There was no statistically significant difference in these two parameters, however, between those who received wrist manipulation and those who underwent Mulligan mobilisation. Bisset et al. (2005) [19] compared the effect of physiotherapy (MWM and exercise) with that of corticosteroid injection. They found that corticosteroid injection showed significantly better effects at 6 weeks, but with high recurrence rates thereafter and significantly poorer outcomes in the long term when compared with physiotherapy. Overall, there is limited evidence in supporting the superiority of the Mulligan technique over other treatment approaches.

Other researchers compared the effect of MWM against that of a control/placebo treatment. Vicenzino et al. (2001) [32] showed that PFGS values during and after intervention did not change from baseline in the placebo and control conditions, but that pressure—pain threshold demonstrated an increase after the application of MWM treatment technique. Koch and Dogra (2002) [33], on the other hand, showed that the MWM group was able to lift heavier weights than US therapy and control groups from the second week onwards. In the MWM group, grip strength increased, and most patients in this group showed complete recovery.

Taping technique is often applied after mobilisation. It is placed around the elbow joint over extensor carpi radialis muscles and is intended to reduce the load over these muscles and increase the grip strength of the hand [34]. Vicenzino (2003) [35] concluded in his research that elbow taping technique significantly improved PFGS by 24% from baseline (p = 0.028). The treatment effect was greater than that for placebo and control conditions. Vicenzino and Wright (1995) [36] applied the MWM and combined it with taping and found significant changes in pain-free grip force, pain visual analogue scale (VAS) and function, when compared with traditional treatment. In summary, there is some evidence to support the use of Mulligan technique and taping in the treatment of LE, but a further study is required to establish the clinical efficacy.

The aim of the study was to investigate whether Mulligan techniques, when used in combination with traditional physiotherapy treatment, will cause significantly better outcomes in patients with LE when compared with traditional treatment only.

Research methodology

Hypothesis

It was hypothesised that Mulligan techniques can induce significant treatment effect in patients with LE, including reduction in pain, improvement in PFGS, and ability to work.

Design

An experimental design was undertaken. The participants were allocated to either the control or experimental groups, based on their order of coming to the research. Pre and post-test were performed for both groups.

Sample

A convenience sampling method was used. All patients were recruited from all the west bank cities of Palestine, from Tulkarm in the north to Hebron in the south. All subjects had a diagnosis of LE. The inclusion criteria were (1) a patient with a medical referral of subacute LE, and (2) positive results on two or more tennis elbow tests (see later). Individuals who were complaining of lateral pain because of cervical pathologies, post-traumatic LE, or acute LE, were excluded. Informed, written consent was obtained from each participant before data collection. Anonymity and privacy was assured for each subject.

Screening

In the first session, a subjective assessment was performed, followed by an objective assessment to confirm that the subject indeed had LE, using one of the following tests—Active wrist extension test: for screening and to see what the patient may feel in functional activity (pain could indicate both muscular and joint involvement). Cozen’s test: In this test, the patient makes a fist, with the forearm in pronation and wrist radially deviated. Stabilising the
elbow with one hand, the examiner resisted the patient’s radial deviation with the other hand. The positive sign is pain over the lateral aspect of forearm. *Thomsen test*: With the shoulder flexed to 60°, the elbow extended, the forearm pronated and the wrist extended about 30°, pressure was applied to the dorsum of the second and third metacarpal bones in the direction of flexion and ulnar deviation to stress the extensor carpi radialis brevis and longus. *Resisted middle finger extension test*: With the shoulder flexed to 60°, the elbow extended, the forearm pronated, and the fingers extended, the middle finger was actively extended against resistance. *Mill’s test* or passive stretching: stretching the extensor muscles of the wrist by putting the elbow in full extension position and forearm in pronation and then flexing the wrist to get a maximum stretch. A total of 34 patients were successfully recruited to participate in this study. The subjects were assigned to the experimental or control group alternately, until we reached our target sample of 34. Table 1 shows the distribution of age and gender in the experimental and control groups.

**Intervention**

The experimental group received a combination of traditional treatment (thermal treatment, massage, and US, as well as strengthening and stretching exercises) and MWM and taping techniques. For the MWM component, the patient was placed in supine position, with elbow in full extension and forearm in pronation, the therapist stabilised the distal part of the arm, and a sustained lateral glide of the forearm was applied. The patient was then asked to make a fist as the therapist maintained the lateral glide. This mobilisation technique was done a total of 36 times. A short rest period (a few seconds) was given after every 12 repetitions.

The MWM was followed by taping, which was applied on the origin of extensor carpi radialis when the elbow is in slight flexion and forearm in pronation. At the beginning of taping, there should be a lateral gliding of the extensor muscles group, then putting the hypo fix to prevent skin irritation, and then putting the rigid leukotape tap firmly over it. The intervention in the experimental group was applied by physiotherapists who had received training by the researchers. On the other hand, the control group received the traditional treatment only. Both groups had three treatment sessions per week, for 4 weeks, and the total time for every session was about 30–45 minutes.

**Outcome measurement**

Demographic data (e.g., name, age, sex, address, occupation, side of LE, side of dominant hand) were obtained at baseline from patient interview and recorded on a data collection sheet. Patients with recurrent LE were asked about any rehabilitation treatments received previously or currently (e.g., number of sessions per week, time since last physiotherapy treatment). The following outcomes were measured immediately before treatment and immediately after termination of treatment (Table 2).

**Patient-Rated Tennis Elbow Evaluation**

It is a valid, reliable, and sensitive outcome measure [37] for rating pain and difficulties while performing functional activities. Newcomer et al. (2005) [37] found in a study of 94 LE patients that the reliability of the Patient-Rated Tennis Elbow Evaluation (PRTEE) was excellent (pain score: intraclass correlation coefficient (ICC) = 0.96; function score: ICC = 0.92; total score: ICC = 0.96).

**Visual analogue scale**

The VAS was used to assess the intensity of the pain at the time of data collection, with 10 denoting the worst pain imaginable and 0 denoting no pain.

**Maximum grip strength**

Maximum grip strength (MGS, kg) was measured by using a hand grip dynamometer. Its validity in diagnosing and evaluating progress in LE has been previously reported [38].

In addition, the subjects were asked whether they felt the treatment was effective at the end of the treatment period. The proportion of subjects in each group who thought the treatment was effective was noted.

**Statistical analysis**

Statistical Package for Social Science 17 was used for the statistical analysis. Descriptive statistics was first performed. The independent *t*-test was also used to compare the baseline characteristics between the groups. To assess the treatment effect, within-group difference in outcomes and between-group difference in change scores were analysed using independent *t*-tests. Correlation coefficients were used to assess which variables were associated with better improvements in outcomes. An alpha level of 0.05 was set for all statistical tests.

**Results**

**Subject characteristics**

Eighty-three percent of the subjects had LE and 17% had left LE. Only 6% out of the 17% had a left dominant hand. Most of the subjects in our sample (71.4%) were not active in sports, with only 2.90% playing tennis, 2.90% playing volleyball, and 8.60% playing basketball. Another 14.3% was involved in computer-related hobbies.

Forty percent of the patients had their first episode of LE, whereas 60% were recurrent-LE patients. The period since they had last complained of LE was 14.8 months on average. For those patients with recurrent LE, 46% had been treated with physiotherapy; the rest did not receive any kind of rehabilitation and had been depending mainly on medications or other alternative treatments. For those who had undergone physiotherapy treatment, the mean number of physiotherapy sessions was 10.3.

| Table 1 Distribution of age and gender among the experimental and control groups |
|------------------------------|-------------------|
|                              | Experimental | Control |
| Number of subjects, n        | 17            | 17       |
| Mean age (yr)                | 37.8          | 36.8     |
| Male/female, n               | 13/4          | 11/6     |
patients took medications to relieve symptoms associated with LE in the past. The most common type of medication used was non-steroidal anti-inflammatory drugs (54%).

**Treatment effect**

There was no significant between-group difference in any of the outcome variables at baseline \( (p > 0.0200) \). In both the experimental and control groups, significant improvement in all of the outcome variables were found \( (p < 0.05) \). Moreover, the improvement in VAS \( (p < 0.01) \) and PRTEE \( (p < 0.05) \) was significantly greater in the experimental group than that in the control group. There was no significant between-group difference in MGS change score \( (p > 0.05) \), although there was a tendency for the experimental group to improve more in MGS than the controls.

**Discussion**

We found that adding MWM and taping techniques resulted in better outcomes than traditional physiotherapy treatment alone. Our findings, thus, support the results of Kochar and Dogra (2002) [33], who concluded that MWM + US group demonstrated a 97% improvement in VAS when compared with the US and control group. Furthermore, the results are also consistent with those of Miller (2000) [30], who also found that the use of the MWM for LE as the primary modality for the correction of "positional fault" of the elbow joint is effective in relieving pain.

Our results highlighted the effect of Mulligan techniques in increasing functional activities, as the experimental group showed more improvement of PRTEE than the control group. Our results are, thus, in agreement with the findings of Geetu and Deepak (2008) [31], who found that MWM led to statistically significant improvement in functional performance. Similar findings were demonstrated by Miller (2000) [30], who showed that full function was achieved among those LE patients who received MWM. In the case study reported by Vicenzino and Wright (1995) [36], significant increase in function was also found after MWM treatment. As in most cases, pain is the main factor that limits the functional performance in patients with LE. By effectively alleviating pain, MWM also helps to improve the ability to perform daily functional activities.

There was a trend for the experimental group to improve more in MGS than the controls. However, the data did not reach statistical significance. This is in contrast with the findings in several previous studies. For example, Kochar and Dogra (2002) [33] and Geetu and Deepak (2008) [31] demonstrated that MWM induced a positive gain in muscle strength. Abbott (2001) [39] found that both PFGS and MGS increased significantly from pre-intervention to post-intervention on the affected side. Our non-significant finding on MGS may be the result of the reduced statistical power related to the small sample size. Further study with a large sample size is required to examine the effects of the experimental treatment on MGS.

The objective findings on the effectiveness of the experimental treatment were also supported by our subjective finding. Approximately 82% of the subjects in the experimental group thought that the treatment was effective versus only 16% in the control group.

**Research limitations**

One of the major limitations of this study was that the group assignment was not done randomly. The different characteristics of subjects in the experimental and control groups may create potential bias in the outcomes. Therefore, our results should be interpreted with caution. Additionally, our study may be underpowered to detect a significant between-group difference in MGS. A randomised controlled trial with a larger sample size is required to further investigate the effects of MWM in patients with LE.

Both the traditional physiotherapy treatment and the experimental treatment can induce a significant reduction in pain intensity and improvement in daily function and grip strength in patients with LE. Moreover, adding Mulligan techniques to traditional treatment is more superior to the traditional treatment alone in improving pain and daily function.

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