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Effect of Mulligan's mobilization with movement and eccentric exercises for lateral epicondylitis in recreational tennis players

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Abstract

Introduction. Recreational tennis players often have been documented to suffer from lateral epicondylitis (LE). There is a lack of evidence on the effects of Mulligan's mobilization with movement (MWM) and eccentric exercises in recreational tennis players with lateral epicondylitis. Aim of Study. To find the effect of Mulligan's MWM along with eccentric exercise on grip strength and functional disability in recreational tennis players for lateral epicondylitis. Material and Methods. Thirty subjects based on the inclusion criteria were recruited through referrals. The experimental group underwent Mulligan's MWM along with eccentric exercise and the control group intervention comprised solely of eccentric exercise program 3 sessions a week for 4 weeks. Grip strength using Hand Held Dynamometer and functional abilities using Patient Rated Tennis Elbow Evaluation (PRTEE) were measured. Data were analyzed using SPSS 16.0 with descriptive and inferential statistics at 5% level of significance. Results. Analysis demonstrated statistically significant improvements for both outcomes in both the experimental group and the control group. Improvements for both dependent variables were greater for the experimental group. Conclusions. The administration of Mulligan's MWM along with eccentric exercise was found to be more effective than eccentric exercise alone to increase grip strength and functional abilities in recreational tennis players with lateral epicondylitis.

KEYWORDS: lateral epicondylitis, mobilization, eccentric, mulligan, recreational tennis.

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Introduction

Tennis has become very popular in the past few years as a recreational sport/hobby [6]. Lateral epicondylitis can be a bothersome injury for a recreational tennis player. Recent studies suggest that the relevance and incidence of lateral epicondylitis in recreational tennis players are comparatively higher than in elite players [4, 11]. The probable reasons may be connected with the use of a flexed wrist position immediately before the ball impact [2] and/or the single-handed stroke used by recreational players associated with faulty mechanics, which adds up to increased extensor activity [23]. These faulty mechanics transmit excessive shock impact force from the racket to the elbow joint in such players [28]. When the pattern of muscle activation and joint mechanics were observed in both recreational and experienced players using kinematic data in combination with a computer model, substantial eccentric contractions of the extensor carpi were discovered. This is probably the reason for repetitive microtrauma leading to lateral epicondylitis [23]. The incidence of this condition was reported in 39.70% in a study of 500 tennis players indicating a "mis-hit" jerky shot with backspin [8] as one of the contributing factors to lateral epicondylitis. The risk is increased 3- to 4-fold in players who play about 2-3 hours per week [8, 20].

Many conservative treatment options in physiotherapy have been proposed for the rehabilitation of patients suffering from lateral epicondylitis. Nevertheless, the

effectiveness of these treatments is largely unknown [10, 30] and remains somewhat of an enigma. The conservative physiotherapy treatment of lateral epicondylitis includes exercise, manipulation, massage, acupuncture, taping, ultrasound, orthotic devices, activity modification and rest [3]. Among all the manual therapies used around the globe, Mulligan's mobilization with movement (MWM) is presently acquiring tremendous recognition. The technique of Mulligan's MWM involves a glide or translation applied in a perpendicular direction towards the plane of the affected movement, which is being performed during the glide. This allows the painful joint to be moved freely without any pain or disablement [26]. On the other hand, eccentric exercise training focuses on braking or slowing down the elongation process of a muscle, which provides a challenge for the muscle leading to increased muscle strength, quicker healing and improved metabolic rate. Eccentric exercises are suggested to have beneficial effects in rehabilitating sportspersons, older adults, and patients by altering their muscle properties and performance [14].

An exceptional number of studies suggest the utilization of Mulligan's MWM as a remedial approach for this condition [9, 15]. Furthermore, for the same condition a good amount of studies have been performed on eccentric exercises as well [3]. No evidence is documented to date regarding the isolated application of such techniques in patients or individuals who play tennis as a recreational sports activity. A novel study is required to support and establish the clinical efficacy of these techniques for recreational tennis players with lateral epicondylitis. This study is aimed to investigate the effects of Mulligan's MWM on functional outcomes in recreational tennis players with lateral epicondylitis when compared with eccentric exercise.

The objective of the study was to find the efficacy of MWM along with eccentric exercise on grip strength, pain and functional disability in recreational tennis players with lateral epicondylitis.

The Null hypothesis was that there will be no significant difference in grip strength, pain and functional ability following MWM along with eccentric exercise in recreational tennis players with lateral epicondylitis. An alternative hypothesis stated that there will be a significant difference in grip strength, pain and functional ability following mobilization-with-movement along with eccentric exercise in recreational tennis players with lateral epicondylitis.

Material and Methods

This was a pre- and post-experimental study design. The study was approved by the institutional ethical committee (IEC). After obtaining the ethical clearance from the IEC, the study was conducted. The procedure of the study was explained and the interested participants were recruited after obtaining their written informed consent. Recreational tennis players from various tennis academies, hospitals and clinics around Bangalore were approached. Participants between 18 to 45 years of age were diagnosed with lateral epicondylitis based on positive Mill's test and Cozen's test, with symptoms persisting for more than 6 weeks with complaints of local tenderness distal to the common extensor origin at the elbow. In addition, the participants were required to have a full extension range of movement in the affected elbow as a requirement for the assessment and treatment purposes. Individuals with a history of recent trauma of upper limbs, elbow immobilization, administration of steroid injection in the past 6 months, recent administration of platelet-rich plasma containing growth factors, diagnosis of cervical radiculopathy, upper thoracic outlet syndrome, rheumatoid arthritis, myositis ossificans, carpal tunnel syndrome and which had taken physical therapy of any sort in the past 6 months were excluded from the study. Furthermore, individuals with any history of occupation-related pain were ruled out.

The sample size was estimated using the mean difference and SD of an outcome measure PRTEE from previous literature. With a mean difference of 42 and 26.2 with standard deviation of 15.1 and 21.7 for 2 groups, considering type 1 error at 0.05 and power of the study at 95%, the sample size was 27, with n1 = 13 and n2 = 14 [1, 25]. During the participant recruitment procedure 50 interested patients volunteered and were screened. A total of 30 participants were selected based on the inclusion and exclusion criteria. Thus the final sample size was 15 in each group. The mean duration of symptoms in the participants was around 3 months. After obtaining informed consent they were allocated to one of the two groups (experimental group and control group) using simple random sampling. The participants were unaware of their allocation to treatment groups. The socio-demographic data (name, age, sex, occupation, address) of the participants were obtained and recorded at baseline.

Assessment of pain and the level of disability/function was performed using PRTEE and pain-free grip strength was determined using a calibrated Jamar hand-held dynamometer. The recordings were done before commencing the treatment and then after the fourth week. PRTEE is a reliable, sensitive and reproducible tool to assess chronic tendinopathy in the tennis-playing

population. The PRTEE scores in 78 tennis-playing LE patients showed excellent internal consistency and reliability (pain subscale = 0.94; function-specific activities subscale = 0.93; function usual activities = = 0.85) [24]. For the pain-free grip strength assessment the patient sat comfortably with the arm held at the side along with shoulder adduction and neutral rotation, the elbow flexed to 90 degrees [5], the forearm in a neutral position and the wrist between 0-30 degrees of extension and between 0-15 degrees ulnar deviation. The maximal grip readings (in kilograms) were noted with pain-free maximum contraction. The patient was encouraged to squeeze as tightly as possible for 3-5 seconds. More than one trial was provided and an average of 3 repetitions was recorded with a pause of about 15 seconds between each trial to avoid the possible effect of muscle fatigue. The experimental group received Mulligan's MWM followed by eccentric exercise. For MWM the patient was in the supine position with the arm placed by the side with sufficient abduction to allow the therapist access to the medial side of the upper limb. The elbow was placed in full extension and the forearm in pronation. It was ensured that the participant had a reproducible aggravating action (comparable sign) before applying glide. Then, the patient was asked to grip a dumbbell during the glide. The stabilizing hand of the therapist was placed at the distal part of the arm, whereas the gliding hand was placed over the medial surface of the ulnar side just distal to the elbow joint line. While the patient started performing flexion and extension of the wrist, the therapist applied a laterally directed glide across the elbow joint. After the glide had ended; the patient had to release the grip. The glide was applied and sustained for approximately 30 seconds, during which the patient was asked to perform the previously painful movement up to 10 times. The process was repeated only if there was a substantial relief of pain during the application of the technique along with no latent pain immediately following the treatment technique [16]. It was done for three sets with a 30-second rest in between each set. After this therapy the patient took a rest for 15 minutes and then received eccentric exercise training.

For eccentric exercise the participant was seated in a chair with forearm support on the armrest/adjacent table in pronation with the wrist in full extension. The patient was instructed to slowly lower the dumbbell by flexing the wrist of the affected arm downwards for a count of 30. The weight of the dumbbell was initially 0.5 kg or 1 kg. With the uninvolved arm the wrist was returned to the starting position. Patients were given instructions to continue to perform the exercise even with mild discomfort and they could stop performing the exercise if their pain worsened or became disabling. Patients who could perform the exercise without minor discomfort/pain were allowed to add the load using free weights; this increment was based on the patient's 10 repetition maximum (RM). Each session included 3 sets of 10 repetitions; a 1-minute rest interval was given between each set [7]. The control group intervention comprised solely eccentric exercises for the wrist extensors. The application guidelines for the treatment were the same as those given for the experimental group. Both the groups received a total of 12 sessions divided into 3 times a week for a month.

Statistical analysis

The statistical analyses were performed using the SPSS 16.0 software for Windows. Descriptive and inferential statistical analysis was used. Significance was assessed at a 5% level. The paired t-test was used to find the significance between pre- and post-treatment measurement values of PRTEE and pain-free grip strength for the experimental group and control group. The unpaired t-test was used to compare the effectiveness between the groups.

Results

A total of 30 patients (21 men and 9 women) were recruited to this study. The mean age of the participants was 32.93 (SD = 7.30) in the experimental group and 31.80 (SD = 7.60) in the control group. The demographic details are summarized in Table 1. The baseline values of clinical and demographic variables for both groups were found to be similar (p = 0.66). A majority of the participants (65%) were office employees who work most of the time on computers/laptops.

The comparisons of improvements between the groups and within the group are shown in Table 2 whereas the figurative comparisons are presented in Figure 1 and

Table 1. Baseline characteristics of participants

Baseline characteristics	Experimental group (N = 15)	Control group (N = 15)
Age*	32.93 (7.30)	31.80 (7.60)
Male#	11 (73.33%)	10 (66.66%)
Female#	4 (26.66%)	5 (33.33%)
PRTEE*	66.00 (14.26)	64.86 (14.81)
Grip strength*	16.93 (3.26)	17.40 (2.29)

Note: PRTEE – Patient Rated Tennis Elbow Evaluation
Data presented as * Mean & Standard Deviation; # total number & %.

Table 2. Treatment effects within and between groups

Parameters	*Pre-test	*Post-test	Mean difference	#p-value
		Experimental group		
Grip strength (kg)	16.93 ± 3.26	22.60 ± 2.55	33.49%	p < 0.05
PRTEE	66.00 ± 14.26	31.20 ± 8.40	52.72%	p < 0.05
Change in PRTEE subscales post-test	pain		50.48%	
	function (i) special activities		54.32%	
	function (ii) usual activities		56.31%	
Parameters	*Pre-test	*Post-test	Mean difference	#p-value
		Control group		
Grip strength (kg)	17.40 ± 2.29	21.33 ± 2.12	22.58%	p < 0.05
PRTEE	64.86 ± 14.81	38.26 ± 9.46	41.01%	p < 0.05
Change in PRTEE subscales post-test	pain		43.34%	
	function (i) special activities		42.05%	
	function (ii) usual activities		37.19%	
Experimental group vs control group	PRTEE			p < 0.030
	Grip strength			p < 0.000

Data presented as *Mean & Standard Deviation; p is significant at p < 0.001

Figure 2.The intra-group comparison for PRTEE in the experimental group treated with MWM and eccentric exercise demonstrated a decrement of pain and functional disability scores by 52.72% with a t-value of 11.904 and p-value of 0.05, whereas the decrement in the control group treated with eccentric exercise alone was 41.01% with the t-value of 12.760 and p-value of 0.000. Thereafter, the inter-group comparison of PRTEE scores yielded a t-value of 2.228 and a p-value of 0.030. The intra-group comparison for pain-free grip strength in the experimental group treated with MWM and eccentric

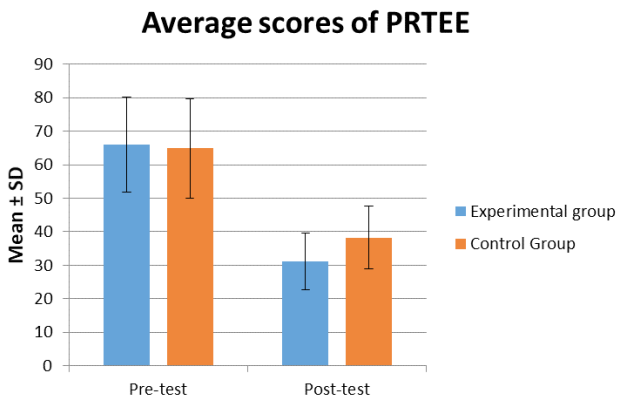

Figure 1. A comparison of pre-treatment and post-treatment scores of Patient-Rated Tennis Elbow Evaluation (PRTEE) between the two groups. The decrements in post-treatment scores indicate the decrement in patients' pain and level of disability

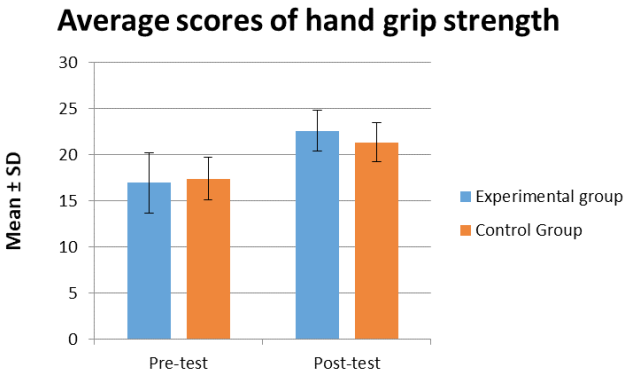

Figure 2. A comparison of pre-treatment and post-treatment scores of hand grip strength/dynamometry (HHD) between the two groups. The increment in post-treatment scores indicates the increment in patients' pain-free grip strength

exercise demonstrated increment of the grip strength by 33.49% with a t-value of 17.770 and p-value of 0.000, whereas the increment in the control group treated with eccentric exercise alone was 22.58% with the t-value of 15.840 and p-value of 0.000. Thereafter, the inter-group comparison of pain-free grip strength yielded a t-value of 4.290 and a p-value of 0.000. The in-depth look at the subscale scores of PRTEE showed that the experimental group achieved a 50.48% decrement in pain, a 54.32% improvement in special activities function and a 56.31% increment in usual activities function, whereas the control group achieved a 43.34% decrement in pain, a 42.05% improvement in special activities function and a 37.19% increment in usual activities function.

Discussion

The purpose of this study was to evaluate the effect of Mulligan's MWM and eccentric exercises on grip strength and functional disability in recreational tennis players. All 30 participants completed the 4-week training. Overall, the participants (> 95%) of both the experimental and control group demonstrated improvement in PRTEE and pain-free grip strength scores ($p < 0.05$). After analyzing the data between both groups it was found that the experimental group, which received MWM along with eccentric exercise, garnered statistically better outcomes ($p < 0.05$) than the control group, which received eccentric exercise alone; the p-values for PRTEE and pain-free grip strength were 0.030 and 0.000 respectively. Therefore, training with Mulligan's MWM and eccentric exercise resulted in better outcomes than eccentric exercise alone. Interestingly, other authors who applied Mulligan's MWM along with other treatment approaches have attained similar results. A study on the effects of MWM on grip strength, function and pain in LE found that MWM is a promising intervention for improving grip strength (hand grip dynamometer), function (PRTEE) and pain relief (VAS) [1]. A study on various physiotherapy regimens for LE concluded that Mulligan's MWM when applied with other therapeutic modalities such as ultrasound, eccentric and concentric exercises, showed positive gains in muscle strength [13]. Similarly, another study utilizing MWM techniques and cryotherapy demonstrated significant improvement in grip strength and functional performance in patients with lateral epicondylitis [22]. Another study evaluated the effects of an MWM treatment on tolerance to repeated applications showed initial hypoalgesic effects similar to spinal manipulations and concurrent sympathoexcitation in chronic LE with an improved pressure pain threshold and pain-free handgrip strength [18].

The % of the mean difference in the PRTEE score in the experimental group was 52.7%. MCID of around 37% from the baseline score was mentioned as 'much better' or 'completely recovered' for the PRTEE scores [21]. Hence the intervention with MWM and eccentric exercises were beneficial in improving the studied clinical manifestations.

The MCID for grip strength is 19.5% and in the present study MWM and eccentric exercise intervention showed 33.5% of the mean difference. This further signifies the effect of the combined techniques and their functional implications [12].

The mechanism behind Mulligan`s MWM may be neurophysiological, as it provides some tactile response along with compressive stimuli to soft tissues [29]. The afferent nerve activity resulting from these tactile or compressive stimuli may influence the spinal cord neurons inhibiting nocioperception and the motor neuron pool. Thus it may provide a way to retrain the spinal cord circuitry by allowing the patient to experience repetitive pain-free motion, which may help to switch off maladaptive spinal cord circuitry, re-establishing normal levels of nocioperception and motor neuron pool excitation [17]. This provides an alternative to the theories offered by Mulligan which place a positional fault or block of the joint as the source of the dysfunction in lateral epicondylitis [16]; Mulligan assumed that a repositioning of the joint accompanied by joint motion restores the positional fault of the joint [26].

Studies conducted previously on the utilization of eccentric exercises have well-established results regarding the improvement of grip strength in LE patients. Studies demonstrated similar results with eccentric exercise as concentric exercise for LE patients [7, 19]. A review suggested the incorporation of eccentric exercise as a multimodal therapy for chronic LE, which is supported by the present study as well [3]. Studies suggest that eccentric loading exercises assist with tendon injuries by stimulating the collagen cross-linkage bridge formation and its alignment, leading to improved tensile strength [27].

This study was conducted for 4 weeks and no further follow-ups were conducted. Another potential limitation might arise because of a few participants who had been using a tennis elbow brace for symptomatic relief before the treatment, which might have resulted in a bias. Since the participants recruited in the study suffered from the chronic stage, because of which they might have avoided functional activities with the affected limb. This possibly results in the weakness of neighboring muscles as well as the wrist flexors, elbow muscles, and

shoulder muscles; therefore, no certain information was obtained on the effect of the neighboring weak muscles on the condition.

There is a warranted need for future RCTs with a larger sample size and tennis-specific return-to-sport rehabilitation, correction of the faulty techniques and exercise prescription. Also, the inclusion of radiological investigations such as ultrasound, MRI and EMG for diagnostic or prognostic information might provide data on physiological changes. Future studies may also be performed on occupational-based cohorts who encounter this condition while playing recreational tennis.

Conclusions

In this study both groups showed a significant response to the treatment protocol. However, a significant increase in functional ability and grip strength was obtained with Mulligan's MWM along with eccentric exercise with 12 sessions. Mulligan's MWM and eccentric exercise incorporated into multimodal treatment regimens can demonstrate multiplied improvements in lateral epicondylitis. Furthermore, the collaboration of the physiotherapist(-s) with sports trainer(-s) can help in preventing the occurrence and recurrence of this condition by focusing on proper stroke mechanics, sufficient warm-up exercises, appropriate racket weight, correct grip size, and sports specific exercise planning.

Conflict of Interests

The authors declare no conflict of interest.

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