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Short term effect of mill's manipulation and tyler's twist exercises on pain and functionality among tennis elbow patients- an experimental study

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Abstract
Background: Tennis elbow is defined as a painful condition affecting the tendinous tissue of the lateral condyle of the humerus leading to loss of functional efficiency of the affected upper limb. Mainly the inflammation occurs in the origin of the extensor muscles (mainly extensor carpi radialis affected more). Prevalence of the tennis elbow is approximately 1% to 3% in general population and it rises 19% to 50% among the tennis player and it is equally affected in men and women and mainly occurs in the dominant arm and increased with age peak in between the age of 30 to 50 years. Tennis elbow is diagnosed by special test such as Mill's test or cozen's test. Mainly the sign and symptoms including the pain, swelling, ecchymosis, increased tenderness on palpation over lateral epicondyle and reduced grip strength and functionality. Primary outcomes were pain and functionality. Secondary outcome was grip strength. In this study pain was measured by VAS, functional performance was measured by PRTEEQ and grip strength was measured by JAMAR handheld dynamometer and. In this experimental study conventional treatment was same in both groups. Additionally, Group A received the Mill's Manipulation and Group B received the Tyler's Twist exercises. As there is a lack of evidence available comparing the Mill's Manipulation and Tyler's Twist exercise for subacute and chronic tennis elbow, by conducting this study we focused over additional techniques to a conventional protocol, which could be more beneficial from clinical context.
Objective: To evaluate the effectiveness of the Mill's Manipulation and Tyler's Twist exercises combined with conventional treatment for improving pain by using VAS, grip strength by using hand held dynamometer and functional performance by using PRTEEQ in patients with subacute and chronic tennis elbow.
Methods: In the present experimental study, total thirty-two patients with subacute and chronic tennis elbow with age between 20-50 years were included.16 patients were included in each group. Both groups received conventional treatment, in addition group A received Mill's manipulation and group B received Tyler's twist exercises. Patients were evaluated pre- intervention (0 week) and post- intervention (4 week) for Pain (by means of VAS), grip strength (by means of JAMAR handheld dynamometer) and functional performance (by means of patient rated tennis elbow evaluation questionnaire (PRTEEQ) Gujarati Version). Statistical analysis was done by using SPSS 20 version. Significance level was set at $p \leq 0.05$.
Result: 32 patients were enrolled in study and randomized in group A and group B. Mean age of patients in group A was 40.25 and group B 46.68. The sample size of this study was small ($n < 50$). So, the Shapiro wilk test was applied to check the normality of data. Based on the normality testing of the baseline of VAS, grip strength and PRTEEQ was measured by parametric test (Independent t test). Based on results of normality of within group comparison was done by parametric test (Paired t test) and based on normality of post-pre scores, between group analysis for VAS and PRTEEQ was done by parametric test (independent t test) and between group analysis of grip strength was measured by non-parametric test (Mann Whitney U test). The result of this study states that there is improvement in VAS, grip strength and PRTEEQ after and before treatment in both groups. But there are no significant differences between both groups for VAS, grip strength and PRTEEQ after treatment.
Conclusion: This study concludes that Mill's Manipulation as well as Tyler's Twist exercises both are effective along with conventional treatment for subacute and chronic tennis elbow. It also concludes both are equally effective for subacute and chronic tennis elbow. So, therapist can choose either one from both as an adjacent treatment along with conventional treatment for subacute and chronic tennis elbow to obtain better clinical result.

Keywords: Tennis elbow, conventional treatment, Mill's Manipulation, Tyler's twist exercises, VAS, Grip strength, PRTEEQ.

Introduction

Tennis elbow is characterized by inflammation over the common origin of wrist extensor muscles (mainly extensor carpi radialis). [1, 2] The prevalence of tennis elbow varies from approximately 1% to 3% in the general population and it rises to 19% to more than 50% among the tennis players. [2] the tennis elbow is equally common among men and women, occurs more frequently among whites and in the dominant arm and increased with age, peak in between the age of 30 and 50, with a mean age of 42 it seems to occur equally among blue-collar and white-collar workers. [2]

Tennis elbow is diagnosed by a special test such as cozen's test or mill's test. Mainly sign and symptoms including the onset of pain is usually gradual, adhesion between the tendon and the inflamed periosteum and repetitive

microtrauma leads to inflammation over the lateral epicondyle of the humerus, ecchymosis, increased tenderness on palpation mainly of the lateral epicondyle, and lateral forearm, grip strength may be decreased and affect the joint function. [2,3] Mill's manipulation for tennis elbow is a treatment in which one thrust over the elbow joint and generally single thrust per session is given as a treatment. [4] Tyler's twist exercises are the therapeutic eccentric exercises by using the flex bar hold and by various treatments in wrist full flexion non-involved side extension and dosage about 10-15 repetitions per session sets. [5,6]

As there is less evidence available showing effectiveness of Mill's Manipulation and Tyler's Twist exercise as well as there is a lack of evidence available comparing the Mill's Manipulation and Tyler's Twist exercise, by conducting this study we can focus on additional techniques to a conventional protocol. So, the need of the study is to compare the effectiveness of Mill's Manipulation and Tyler's Twist exercises for subjects with subacute and chronic tennis elbow. By conducting this study we can provide a better additional protocol among Mill's Manipulation and Tyler's Twist exercises, which one will be more beneficial in a clinical context for early recovery of subacute and chronic tennis elbow. So, the significance of this study is to compare the pain intensity, grip strength, and functional prognosis among Mill's Manipulation and Tyler's Twist exercises in subacute and chronic tennis elbow.

Methodology

Study Design: Experimental study

Study Population: Patients with subacute and chronic tennis elbow.

Sampling Method: Purposive sampling.

Study Duration: 1 year.

Sample Size Calculation: Prior conducting main study a pilot study was conducted for 1 month to find out the prevalence of tennis elbow patient by effect size of one of the outcomes. In pilot study examiner found 12 subjects of the subacute and chronic tennis elbow, out of total OPD of 250 patients. Mean of the grip strength of group A = 29.5 and group B =33.75. and standard deviation of grip strength group A= 2.51 and group B=3.77 respectively. Effect size of grip strength was calculated by using G* Power software version 3.1.9.4 which was 1.32. So, total sample size was found 32. So, in both the groups 16 samples were included randomly by lottery method.

Study Setting: SPB Physiotherapy college and other Physiotherapy clinical OPDs of Surat.

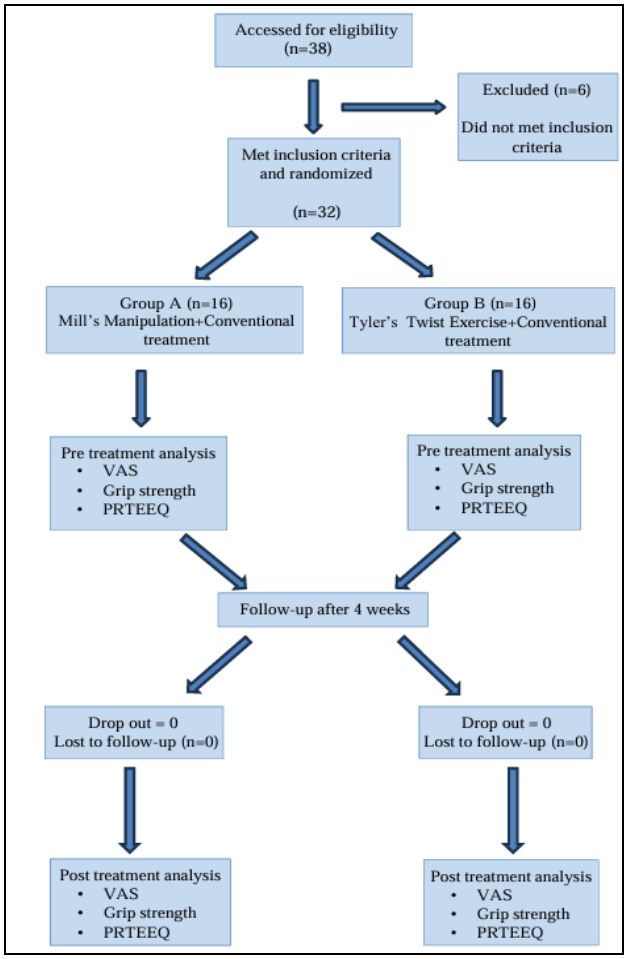
Selection Criteria

Inclusion criteria

1. Patients with positive Mill's or Cozen's test. [4]
2. Both males and females between 20 to 50 years of age. [4]
3. Lateral elbow pain with hand gripping. [6]
4. Tenderness on palpation over the lateral epicondyle of the humerus. [6]
5. Patients who understand the Gujarati or English language.

Exclusion criteria

1. Patients on medication or have undergone through any surgery for the elbow. [7]
2. A recent steroidal injection for the same condition, within last 3 months. [4]
3. Patients diagnosed with elbow pain due to any reason other than tennis elbow like osteoarthritis of the elbow joint, myositis ossification, radial tunnel syndrome, radio humeral bursitis, joint effusion, hypermobility of elbow joint. [6]
4. Patients with rheumatoid arthritis. [7]
5. Patients with neurological deficiency. [4]
6. Patients with osteoporosis. [7]



Outcome measures

Primary Outcomes

1. Pain intensity was measured by VAS.
2. Functional performance was measured by PRTEEQ.
3. Secondary Outcomes:
4. Grip strength was measured by a JAMAR handheld dynamometer.

Intervention

Group A: Mill's Manipulation+Conventional Treatment Conventional Treatment: The conventional treatment for the tennis elbow is as follow:

1. **Ultrasound:** for the swelling and pain. [8] Patient Position: Patient was in sitting position on treatment table were Patient's arm rested over the pillow. Site: lateral epicondyle of the elbow over ECRB tendon. Dosage: 0.8 w/cm2. Mode: Pulsed Pulse ratio: 1:1 Frequency: 1 MHz Time: 5 minute/ sessions.

2. **Strengthening exercises:** for wrist flexors and extensors muscles. Patient Position: Patient was in sitting position, forearm rested on treatment table and wrist at the edge of treatment table. (Forearm was supinated for wrist flexor muscles and pronated for wrist extensor muscles). Dosage: 10 rep/ session and 3 sets. Progressively use the free weight by using dumbbells according to patient's 10 RM.
3. **Stretching:** of ECRB tendon: Patient Position: Patient was in sitting position on stool with forearm pronated, wrist flexed, and ulnar deviated. Dosage: 30 sec hold and 3 rep/session.

Mill's manipulation

Deep transverse friction massage: Patient was in sitting position on treatment stool. Patients in Group A received 10 minutes of deep transverse friction massage immediately followed by a single application of Mill's manipulation. For deep transverse friction massage, the patient was positioned comfortably with the elbow fully pronated and in 90˚ of flexion. After palpating the anterolateral aspect of the lateral epicondyle of humerus, the area of tenderness was mapped by therapist. Therapist applied deep transverse friction with the side of the thumb tip with pressure was applied in a posterior direction on the teno-osseous junction. Then therapist applied the deep transverse friction massage for 10 minutes after the numbing effect has been attained, to prepare the tendon for Mill's Manipulation. [4]

Group B: Tyler's Twist Exercises+Conventional Treatments

Conventional Treatment: The conventional treatments was same as above mentioned in group A.

Tyler's twist Exercises

Patient position: standing position.

↓

Patient was instructed to grasp the flex bar in the involved (Right) hand with maximum wrist extension.

↓

Patient was instructed to grasp the flex bar with un-involved hand (left) hand.

↓

Patient was instructed to twist the flex bar by flexing the un-involved (Left) wrist while holding the involved (Right) wrist in extension.

↓

Patient was instructed to bring the arm in front of body with elbow extension while maintaining twist in flex bar by holding with un-involved (Left) wrist in full flexion and involved (Right) wrist in full extension.

↓

Patient was instructed to untwist the flex bar slowly by allowing involved wrist in to move in to flexion. i.e., eccentric contraction of the involved wrist extensors muscles.

Dosage: each eccentric wrist extensor contraction holds for 4 seconds, 15 repetitions/ session and 2 sets/session. 30 sec rest period between each set, 3 days per week (up to 4 weeks). [5, 6]

Statistical analysis:

Statistical analysis was done using SPSS version 20.00 Software. This study included age, VAS, Grip strength, and PRTEEQ quantitative variables and gender as qualitative variable. Patients baseline characteristics were compared to check homogeneity between intervention groups. The sample size of this study was small So, the Shapiro wilk test was applied to check the normality of data. Based on the normality testing the baseline of VAS, grip strength and PRTEEQ was assessed by parametric test (independent t test). Based on result of baseline assessment of within group comparison was done by parametric test (paired t test) based on normality of post-pre scores, between group analysis for VAS and PRTEEQ was done by parametric test (independent t test. And between group analysis of Grip strength was done by non-parametric test (Mann-Whitney U test).

Result: Total 38 patients were assessed for eligibility. 6 patients were excluded because they did not meet inclusion Criteria. 32 patients were enrolled in the study and randomized to one of the treatment groups by lottery method (16 in group A and 16 in group B).

Table 1: Mean Age and Gender distribution in Group-A and Group-B

		GROUP A	GROUP B
AGE (MEAN)		40.25	46.68
GENDER	MALE	4	5
	FEMALE	12	11
TOTAL		16	16

Here in **Table-1** shows the male and female distribution as well as mean age among group-A and group-B

Table 2: Table of Normality by Shapiro wilk test

OUTCOMES	STATISTICS (df)	SIGNIFICANCE (p)
AGE	.962	.321
GENDER	.565	.000
VAS (PRE)	.979	0.783
VAS (POST)	.937	.060
VAS (POST-PRE)	.947	.120
GRIP STRENGTH (PRE)	.906	0.09
GRIP STRENGTH (POST)	.898	.006
GRIP STRENGTH (POST-PRE)	.888	.003
PRTEEQ (PRE)	.953	0.178
PRTEEQ (POST)	.913	.013
PRTEEQ (POST-PRE)	.973	.582

Table-2 suggest that p value of Normality for gender is 0.00 which is <0.05 that indicates data was not normally distributed. So, baseline of gender (Table-3) was assessed by non-parametric categorial variable. i.e., chi- square test. For other data p value is >0.05. So, baseline of pre-treatment VAS, grip strength and PRTEEQ of both the groups was done by parametric test (independent t test).

Table 3: Pre Treatment baseline scores in Group-A and Group-B by independent t test

OUTCOMES	p VALUE
PRE VAS	0.021
PRE-grip strength	0.972
PRE-PRTEEQ	0.938

Table-3 shows the baseline p value of pre treatment of VAS(p=0.021) is<0.05. Which indicates baseline of VAS in group A and group B is not same. p value of pre treatment of grip strength (p=0.972) and PRTEEQ (p=0.938), which is >0.05. That indicates baseline is same in group A and group B.

According to Table-2 normality value pre treatment VAS (p=0.783), grip strength (p=0.09) and PRTEEQ (p=0.178) indicates normal distribution. So, within group comparison (Table-5) was done by paired sample t test (parametric test)

Table 4: Within Group comparison of Group-A by paired sample t test

VARIABLE	GROUP A (PAIRED SAMPLE T TEST)		
	PRE-INTERVENTION (Mean ± SD)	POST INTERVENTION (Mean ± SD)	P VALUE
VAS	6.5250 ±1.601357	2.1937±2.1937	0.000
GRIP STRENGTH	11.15273± 11.15273	21.937 ± 10.65129	0.000
PRTEEQS	45.3125± 6.92550	13.2500± 3.37639	0.000

Table-4 shows p value for within group comparison of VAS (p=0.00), grip strength (p=0.00) and PRTEEQ (p=0.00). Here, p value is <0.05. That indicates there is significant difference between pre and post treatment VAS, grip strength and PRTEEQ in group A.

Table 5: Within Group comparison of Group-B paired sample t test

VARIABLE	GROUP B (PAIRED SAMPLE T TEST)		
	PRE- INTERVENTION (Mean ± SD)	POST- INTERVENTION (Mean ± SD)	p VALUE
VAS	5.7188± .85652	2.3688 ±.95758	0.000
GRIP STRENGTH	34.0000±8.92188	40.1250± 8.96568	0.000
PRTEEQ	45.5625± 10.57651	16.0625± 5.43407	0.000

Table-5 shows p value for within group comparison of VAS (p=0.00), grip strength (p=0.00) and PRTEEQ (p=0.00). Here, p value is <0.05 that indicates there is significant difference between pre and post treatment VAS, grip strength and PRTEEQ in group B.

Table 6: Normality values Pre-Post by Shapiro wilk test

OUTCOMES	Significance
VAS (POST- PRE)	0.120
GRIP STRENGTH(POST-PRE)	0.03
PRTEEQ(POST-PRE)	0.582

Table-6 shows normality value of post-pre treatment of VAS (p=0.120), grip strength(P=0.03) and PRTEEQ (P=0.582). So, based on that between group analysis of VAS and PRTEEQS was measured by parametric test (independent t test) as p value is >0.05. Between group analysis of grip strength (p= 0.03) was done by non-parametric test (Mann Whitney U test) as per p value is <0.05.

Table 7: Between group comparison of VAS and PRTEEQ by independent t test

OUTCOME	SIGNIFICANCE
VAS(POST-PRE)	0.06
PRTEEQ (POST-PRE)	0.285

Table-7 shows between group comparison of VAS and PRTEEQ score by using independent t test. VAS (p=0.06) and PRTEEQ (p=0.285). So, the p value is > 0.05 that indicates there is no statistical difference in VAS and PRTEEQ between group A and group B.

Table 8: Between group comparison of grip strength by Mann Whitney U test

Outcome	Significance
Grip Strength	0.071

Table-8 shows between group comparison of grip strength score by using Mann Whitney U test. p value of grip strength (p=0.071). So, p value is > 0.05 that indicates there is no significant difference in grip strength between group A and group B.

Discussion

The primary goal of this study was to determine the effect of Mill's Manipulation and Tyler's Twist exercise on pain, grip strength and functional performance in patients with subacute and chronic tennis elbow pain, as well as compare the effect of Mill's Manipulation and Tyler's Twist exercises for pain, grip strength and functional performance in patients with subacute and chronic tennis elbow.

Total 32 patients with subacute and chronic tennis elbow were included. Inclusion criteria were male and female aging between of 20- 50 year with subacute and chronic tennis elbow patients were randomly allocated in two

groups with 16 patients in each group: group A received (Mill's Manipulation+ Conventional physiotherapy) and group B received (Tyler's Twist exercise + Conventional physiotherapy) for 3 days a week, up to 4 weeks. Pre and Post intervention assessment was carried out by using VAS, grip strength and PRTEEQ. Grip strength was measured by JAMAR handheld dynamometer. Gujarati version of PRTEEQ was used for functional performance.

As Table-4 shows within group comparison of Group-A for all three outcomes. As the p value (p=0.000) for VAS, PRTEEQ and grip strength which is <0.05 showing significant result, we can conclude the Tyler's Twist exercise is effective in case of tennis elbow for pain, functionality and grip strength. As Table-5 shows within group comparison of Group-B for all three outcomes. As the p value (p=0.000) for VAS, PRTEEQ and grip strength which is <0.05 showing significant result, we can conclude the Mill's manipulation is effective in case of tennis elbow for pain, functionality and grip strength. As Table-7 shows between group comparison of VAS and PRTEEQ score by using independent t test. VAS (p=0.06) and PRTEEQ (p=0.285). So, the p value is > 0.05 that indicates there is no statistical difference in VAS and PRTEEQ between group A and group B. Table-8 shows between group comparison of grip strength score by using Mann Whitney U test. p value of grip strength (p=0.071). So, p value is > 0.05 that indicates there is no significant difference in grip strength between group A and group B.

Mill's manipulation shows significant improvement in reducing pain, improving functionality and grip strength. This technique shows result in increased pain free-grip as a sympathetic nervous system response as indicated with measures of skin conductance and blood flux. The previous evidences have indicated that the central nervous systems may play a role in pain inhibition following the joint manipulation. [7]

Tyler twist exercise program is basically targeting the eccentric muscle group. As eccentric contractions require the muscle to work against a force, in this case the coiled bar. Eccentric exercise may also provide neuromuscular benefits through central adaptations of both agonist and antagonist muscles; therefore, tennis elbow exercise may provide both structural and functional benefit during tendinopathy rehabilitation. Tyler's Twist exercise by using a Flex Bar, provides isolated eccentric training for ECRB, which was chronically inflamed. This is to improve the collagen alignment, tissue healing despite some evidence that the therapeutic levels of eccentric exercise may increase collagen synthesis. It produces positive results when applied during later stages of healing and improves pain, grip strength and functional performance. The Tyler's twist exercise promotes an emphasis on home based inexpensive treatment as compared to clinically based use of more expensive devices. [5]

According to present study both the treatment is equally effective for pain, grip strength and functional performance in subjects with subacute and chronic tennis elbow. So, therapist can choose any one of them according to feasibility. As Mill's Manipulation technique requires precise manipulative skill for delivering the thrust. Although it is less time consuming. Whereas Tyler's Twist exercise does not require any specific skill but it is time consuming compare to Mill's Manipulation. Both the techniques are inexpensive with better result, so therapist can choose any one of them according to his or her preference.

Conclusion

This study concludes that Mill's Manipulation as well as Tyler's Twist exercise both are effective along with conventional treatment for reducing pain, improving functionality as well as grip strength among subacute and chronic tennis elbow. It also concludes both are equally effective for subacute and chronic tennis elbow. So, therapist can choose either one from both as an adjacent treatment along with conventional treatment for subacute and chronic tennis elbow to obtain better clinical result.

Limitations and future scope of the study

- In this study sample size was limited and, in this study, only subjects aging between 20-50 years were included. In future study can be performed over different age group and larger sample size.
- In present study, short term effect was checked. In future comparison of immediate effect and long-term effect can be done.
- In present study base line of VAS was not same in both the groups. This limitation was due to random allocation. It might have intersected the result of between group comparison of VAS. In future study this intrinsic factor can be controlled.

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