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Original Research Article

Comparative Efficacy of Wrist Manipulation, Progressive Exercises and Both Treatments in Patients with Tennis Elbow

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ABSTRACT

Background: Tennis elbow is an overuse injury of common Extensor tendon of wrist which occurs due to repetitive micro trauma. Although the uses of Wrist Manipulation and Progressive Exercises have been established as suitable treatment methods separately in Tennis Elbow Patients in terms of pain relief and rapid restoration of function, but the benefit of one over the other has not been exclusively explored and also the combined efficacy of Wrist Manipulation and Progressive Exercises is yet to be established. Therefore, the aim of the study is to compare the efficacy of Wrist Manipulation versus Progressive Exercises versus both together to improve Pain, Grip Strength and Functional Disability of Tennis Elbow.
Methods: Both gender (n = 90), age 30-65 years, presented with Chronic Tennis Elbow were selected based on inclusion and exclusion criteria and randomly allocated into 3 groups. All groups received treatment for total duration of 6 weeks. The outcome measures were assessed using 101 Numerical Pain Rating Scale, Jamar Hand-held Dynamometer and Patient Rated Tennis Elbow Evaluation to measure difference between pre and post intervention Pain intensity, Grip Strength and Functional Disability of Tennis Elbow.
Result: ANOVA was used to compare the difference among three groups. The level of significance was set at critical F-value >4. Within group analysis showed significant improvement over elbow Pain and Functional Disability after 6 weeks of intervention who received combined of wrist manipulation and progressive exercise program.
Conclusion: This study concluded that both group showed improvement in Elbow Pain, Grip Strength and Functional Disability in Tennis Elbow patients. However it was found that the Group who received combined treatment showed better improvement than the group of Wrist Manipulation and group of Progressive Exercises.

Key words: Tennis Elbow, Wrist Manipulation, Progressive Exercises program, 101 NPRS, Jamar hand held dynamometer, PRTEE.

INTRODUCTION

Tennis Elbow is a painful musculoskeletal condition, which provides significant challenges to the healthcare industry. [1]

Tennis elbow is a syndrome characterized by an insidious onset of elbow pain brought on by wrist extension with pronation or supination and aggravated by gripping. [2]

The most commonly affected structure is the origin of the *Extensor Carpi Radialis Brevis* (ECRB) but up to 50% of patients will also have degeneration of the *extensor digitorum communis*. Although the pathology was initially thought to be tendinitis, it is now known as tendinosis

with degeneration characterised by the presence of dense fibroblasts, vascular hyperplasia and disorganised collagen. [3]

Tennis Elbow is a chronic overuse injury of the extensor tendons of the elbow, which occurs due to repeated micro trauma to the ECRB tendon. [4]

Tennis Elbow affects 1-3% of the population, only 5% of all patients seen are recreational tennis players. [5] 75% of Tennis Elbow patients are symptomatic in their dominant arms. [6,7]

Although the syndrome has been identified in patients ranging from 12 to 80 years old, there is a prevalence of 19% increase in 30 to 60 years old population, it predominantly occurs in the fourth and fifth decades. [7-9] Male and female prevalence rates are reportedly equal. [10]

Pain arising from Tennis Elbow may be acute or insidious. In cases with a more acute onset, there is often a recent change in mechanical load, technique or equipment. The severity of pain ranges from minor in a specific situation, to more severe pain with disturbed sleep. Pain is aggravated by gripping activities, from more forceful gripping during industrial work, to gripping during trivial daily activities such as gripping the milk bottle in the fridge and the tooth brush. The most painful position is with straight elbow and the second most painful position is with the elbow in maximal flexion. Stiffness may occur after keeping the elbow in the same position for a longer period of time; especially after sleeping or carrying load. [11,12]

The orthopedic clinical examination of Tennis elbow is simple and can be conducted with the help of Mills' test- A passive stretch of the extensor tendons produced by full elbow extension, forearm pronation, wrist flexion and ulnar deviation and Cozen's Test- Resisted extension of the wrist performed with the elbow and wrist fully extended and pronated reproduces the pain on the lateral side of the elbow with. A positive test for Tennis elbow is indicated if the induced pain is reduced and the grip strength is increased when the muscles of the proximal forearm are compressed. [13]

Wrist manipulation, Strengthening Exercises and Stretching the Wrist Extensors had been effectively used to treat patients suffering from Tennis Elbow. Manipulation is thought to cause muscle relaxation and free the motion segments that have undergone disproportionate displacement or are felt to be hypo mobile. Wrist Manipulation has a direct effect on the articular surface, modulation of nociceptive afferent transmission to the central nervous system is influenced. [14]

Active rehabilitation program may be effective in the treatment of chronic Tennis Elbow. Stretching may improve the tissue healing in damaged connective tissue and strengthening the attachment of the Wrist Extensors might increase the tolerance to repetitive movements.

Progressive exercises can promote healing without traumatisation of soft tissues. The progressive exercise includes slow soft tissue stretching and slow and repetitive movements for strengthening of soft tissues. The whole program exercises muscles, tendons, ligaments and osteotendinal insertions. [15]

Wrist Manipulation and Progressive Exercises have been established as suitable treatment methods in treating Tennis Elbow Patients, but the benefit of any one combination over the other has not been exclusively explored. Hence this study has been undertaken to evaluate whether there is any additional benefit of the combined effect of Wrist Manipulation and Progressive Exercises in patients with Tennis Elbow.

MATERIALS AND METHODS

This study was randomised clinical trial conducted in the physiotherapy department of Nopany Institute of healthcare studies (NIHS) and other physiotherapy clinics in Kolkata between June 2015 to December 2015, all the procedures were carried out after obtaining approval from Institutional Human Research

Ethics Committee considering the protection of rights of patients and safeguarding their welfare. All the patients were informed about the procedures that would be carried out and the patients who agreed signed an informed consent form. Patients were free to withdraw their participation without prejudice.

Patients of both genders (n=90) aged between 30-65 years, who presented with symptoms persisting more than 6 weeks, tenderness over the lateral epicondyle, pain with gripping, passive wrist flexion and resisted wrist extension, positive Cozen's test and Mill's test [16] were included for the study. At the start of the study, all 3 group were homogeneous (p>0.05) in relation to age, weight, height and BMI. The criteria of patient exclusion consisted of patient with history of Rheumatoid arthritis, Degenerative arthritis, Polyarthritis, Carpal tunnel syndrome, Peripheral neuropathy, Radial nerve entrapment, Space occupying lesion over the affected area, Cubitus Valgus and Varus deformity, patient on NSAIDS, systemic and local corticosteroids or analgesic within 3 days of study participation. Baseline measurements of Pain intensity, grip strength and functional disability were measured by 101 NPRS, Jamar hand held dynamometer and Patient-Rated Tennis Elbow Evaluation questionnaire (PRTEE). Group A (n=30) received wrist manipulation, Group B (n=30) performed progressive exercise, Group C (n=30) received both wrist manipulation and progressive exercise.

Outcome Measures:

101 NPRS is advantageous for quantifying the pain intensity. It is valid, reliable and appropriate for use in clinical practice. The 101 NPRS were translated into Zulu to determine the concurrent validity of the Zulu translation of the English numerical pain rating scale 101. The Zulu translation of the scale that was tested revealed a high level of correlation (p= 0.001). NPRS have good sensitivity and generated data than can be statistically analysed. [17]

The Jamar dynamometer is useful for handgrip strength testing and measurements. A Spearman Construct validity testing was performed to determine validity of the Sphygmomanometer compared with the Jamar dynamometer produced a 0.75 correlation. [18]

PRTEE is a 15-item questionnaire designed to measure forearm pain and disability in patients with lateral epicondylitis. The PRTEE allows patients to rate their levels of tennis elbow pain and disability from 0 to 10, and consists of 2 subscales: Pain and function. It is high on reliability, validity, and sensitivity in chronic Tennis elbow patient. The pain (ICC = 0.89), function (1CC=0.83), and the total (ICC = 0.89) scores all demonstrated excellent reliability. [19-21]

Methods

Wrist Mobilization

Patient: The patient sat on a chair with his/her affected hand resting on a table with palmer aspect of hand facing downwards.

Technique: Facing the patient's affected side therapist gripped the patient's scaphoid bone between the thumb and index finger. Therapist's grip was more strengthened by placing the thumb and index finger of his/her other hand on top of them. The therapist then extends the patient's wrist dorsally at the same time the scaphoid bone was manipulated ventrally. Wrist Manipulation was performed 15 times for 20 sets, twice weekly for total 6 weeks duration. [22]

Figure 1 Wrist mobilization in neutral position

Figure 2 Wrist mobilization in extension position

Patients received Progressive Exercises for 6 weeks.

The exercises started with slow fist-clenching, resisted wrist movements and wrist rotations with a stick, followed by movements against a band and two-way resisted wrist rotations and pressing hands against a wall. The final step included occupational training program like twisting a towel, compressing a soft ball, transferring buttons from cup into another. Every exercise period ended with stretching exercises were performed for 30 seconds.

Progressive Exercise:

Figure 3 Progressive exercises

Figure 4 Occupational training

The exercises were performed 4-6 times daily at home. Each exercise included 10 repetitions in 2-3 sets. Post intervention assessment period for Pain intensity, grip strength and functional disability were done after six weeks training. [15]

RESULT

STATISTICAL ANALYSIS

Analysis of variance was used to compare significance difference in 101 Numerical Pain Rating scale (101 NPRS), Jamar Hand-held dynamometer and Patient Related Tennis Elbow Evaluation (PRTEE) within groups. Analysis of variance was used to compare the difference among the three groups changes in pre-intervention and post-intervention scores of elbow pain, grip strength and functional disability. The level of significance was set at critical F-value >4 and the analysis were performed using the SPSS version 21.0

Comparison of effectiveness among Group A, Group B and Group C in pain scores (101 NPRS), Grip Strength (Jamar Hand-held dynamometer) and Functional Disability (PRTEE) in pre and post-intervention.

101 NPRS is used to measure the Elbow Pain. If pain decreases, the value of NPRS will decrease.

Table 1 Comparison of 101NPRS

Analysis of Variance			
Source of Variation	**df**	**Sum of Sq.**	**Mean Sq.**
Between	2	1015.717	507.8583
Within	87	271.0083	3.115038
Total	89	1286.725	14.45758

Method	df	F-Value	Probability
Anova F-test	(2, 87)	163.0344	0

The difference among base line and post intervention elbow pain with Group A, Group B and Group C were measured by Analysis of Variance. The calculated F value (163.0344) is greater than critical F-value (4, found in F-table). The difference was found to be statically significant (critical F-Value >4)

Comparison of effectiveness among Group A, Group B and Group C increasing Grip Strength (Jamar Hand-held dynamometer) in pre and post-intervention

Jamar Hand-held dynamometer is used to measure Grip Strength. If Grip Strength increases, reading of Jamar Hand-held dynamometer increases.

Table 2 Comparison of Grip Strength

Analysis of Variance			
Source of Variation	**df**	**Sum of Sq.**	**Mean Sq.**
Between	2	420	210
Within	87	2980.5	34.25862
Total	89	3400.5	38.20787

Method	df	F-Value	Probability
Anova F-test	(2, 87)	6.1298	0.0032

The difference among base line and post intervention grip strength Group A, Group B and Group C were measured by Analysis of Variance. The calculated F value (6.1298) is greater than critical F-value (4, as found in F-table). The difference was found to be statically significant (critical F-Value >4).

Comparison of effectiveness among Group A, Group B and Group C decreasing Functional Disability (PRTEE) in pre and post-intervention

PRTEE is used to measure the Functional Disability. If the Functional Disability decreases, the value of PRTEE will also decrease.

Table 3 Comparison of PRTEE

Analysis of Variance			
Source of Variation	**df**	**Sum of Sq.**	**Mean Sq.**
Between	2	601.1556	300.5778
Within	87	711.0667	8.17318
Total	89	1312.222	14.74407

Method	df	F-Value	Probability
Anova F-test	(2, 87)	36.7761	0

The difference between base line and post intervention functional disability with Group A was measured by Analysis of Variance. The calculated F value (36.7761) is greater than critical F-value (4, as found in F-table). The difference was found to be statically significant (critical F-Value>4).

From the above tables, it is clear that Group C (combination of wrist manipulation and progressive exercises) showed more improvement in elbow pain, grip strength and functional disability.

DISCUSSION

The findings of the study support that there is significant difference within pre and post intervention scores of elbow pain, grip strength and functional disability in Group C. This study supports the alternative hypothesis that there is significant difference in elbow pain, grip strength and functional disability using wrist manipulation and progressive exercises.

The mean difference in elbow pain scores of Group C patients (wrist manipulation and progressive exercise) is higher than Group B (progressive exercise) and Group A (wrist manipulation) patients at the end of 6 weeks. Statistically there is a significant difference (critical F Value= 163.0344) in elbow pain in Group C patients (wrist manipulation and progressive exercise). This indicates that wrist manipulation and progressive exercises were the most effective intervention in reducing Pain in patients with Tennis Elbow. Our study supports the findings by Struijis et al, who have also shown in their study that wrist manipulation is more effective method to decrease elbow pain. [14] Goyal et al has also shown in their study that wrist manipulation is most effective method to decrease pain and increase grip

strength. Wrist manipulation consisted of extending the subject's wrist dorsally at the same time the scaphoid bone is manipulated ventrally. Pain reduction may be due to mechanical effect of wrist manipulation and modulation of nociceptive afferent transmission to the central nervous system. [22] Paungmali et al, found similar results with improved pain-free grip, pressure pain threshold, and sympatho-excitation following mobilization with movement. [23] According to Rompe, mobilization is thought to produce sensory input sufficient to recruit and activate descending pain inhibitory systems that result in some or all of the pain relieving effects. [24]

The mean difference in the Grip Strength of Group C patients (wrist manipulation and progressive exercise) is higher than Group B (progressive exercise) and Group A (wrist manipulation) patients at the end of 6 weeks. Statically there is significant difference (critical F value= 6.1298) in the grip strength among Group A, Group B and Group C patients with Tennis Elbow. This indicates that combination of wrist manipulation and progressive exercises were effective intervention methods. Pienimaki et al [15] has also shown in their study that progressive exercises are more effective to decrease pain, increase grip strength and improve patient's ability to work. The slow, repetitive wrist and forearm stretching, muscle conditioning and occupational exercises which is a more intensive program to promote patients' daily living and ability to work.

The mean difference in the Functional Disability scores of Group C patients (wrist manipulation and progressive exercise) is higher than Group B (progressive exercise) and Group A (wrist manipulation) patients at the end of 6 weeks. Statically there is a significant difference (critical F value= 36.776) in functional disability scores in Group C Patients (wrist manipulation and progressive exercise). This indicates that wrist manipulation and progressive exercises were effective intervention in decreasing the Functional Disability in patients with Tennis Elbow

The advantages of wrist manipulation are the potential effectiveness over the short term and the ability for the patients to maintain his or her daily activities without restrictions. [25] Tipton et al say that exercises increases the forces being transmitted to ligaments, tendons and bones which help to maintain and increase the strength and functional capacity of these structures. [26] Strengthening the damaged attachment of wrist extensors results in better repetitive wrist movements performed by the patients. Stretching minimizes excessive internal strain to the tendon by optimizing tissue extensibility during stressful activity. According to Stasinopoulous et al both strengthening and stretching are the main components of exercise program because tendon must have flexibility along with strength. [27]

Patients who were treated with combination of Wrist Manipulation and Progressive Exercises reported improvement in Pain, Grip Strength and Functional Disability score.

Positive effects of exercise program for tendon injuries may be attributable to lengthening of muscle tendon unit by stretching and strengthening exercise which could achieve loading effect within muscle tendon unit along with hypertrophy and increased tensile strength of the tendon.
It may also improve collagen alignment of the tendon and stimulate collagen cross-linkage formation, both of which improve tensile strength. [28]

CONCLUSION

The result of the study shows that combination of wrist manipulation and progressive exercises were effective in improving elbow pain and functional disability related to Tennis Elbow. However no statistically significant improvement in the Grip strength was found among the three groups. Hence we can conclude that combination of wrist manipulation and

progressive exercises were better treatment method in reducing elbow pain and functional disability in patients with Tennis Elbow.

Limitations of the Study and Future Recommendations

Wrist Manipulation is cost effective treatment method. Future research with larger sample size is recommended. More effective exercise program to improve the grip strength should be included. Inclusion of long-term follow up sessions post 6 weeks of treatment should be considered. The exact mechanism by which it works is poorly understood hence future studies are recommended to understand the exact physiology by which it works.

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