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Effect of Mulligan's Pain Release Phenomenon on Ted in Subjects with Subacute Lateral Epicondylitis

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Introduction: Lateral Epicondylitis is a overuse syndrome usually seen in people who perform repeated extension and supination movement of elbow against resistance. Tissue Extensibility Dysfunction (TED) is a term which suggests apparent tightness of the muscle which has occurred due to spasm, lactic acid accumulation, inflammation or over use.
Need of The Study: Many Studies involving manual therapy with different techniques have already demonstrated manual therapy is effective in reducing pain in subjects with lateral epicondylitis. Very few studies have focused on Mulligan's Pain Release Phenomenon (PRP) which is established to reduce pain and improving range of motion. Also, there is dirth in literature related to tissue extensibility dysfunction occurring in subacute variant of tennis elbow and the effect of PRP on TED. Hence this study is been undertaken.
Methodology: A total of 50 sample size was randomized into 25 per group. Group A consisted of Conventional therapy and Group B consisted of Conventional therapy with Mulligan's PRP. Outcome measures were noted pre therapy and on the 7th day that is post therapy and results were tabulated.
Results: The results declare that pain (0.05 and 0.001), grip strength (0.001, 0.001) and disability (0.001, 0.001) showed significant improvement in the scores in both the group whereas muscle stiffness (0.341 and 0.001) significantly improved only in Group B.

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Conclusion: Mulligan's Pain Release Phenomenon technique can be used to treat Subacute tennis elbow effectively and is known to reduce the muscle stiffness along with pain and disability and improving strength.

Keywords: Pain release phenomenon; tissue extensibility dysfunction; lateral epicondylitis.

1. INTRODUCTION

Lateral humeral epicondyle serves as the origin point for the Common extensor tendon. In total there are 5 superficial tendons which originate from the same point are; supinator, extensor carpi radialis brevis, extensor digitorum communis, extensor digiti minimi and extensor carpi ulnaris [1]. Overuse injury is a common condition which imposes Stress on various muscles like Trapezius, wrist flexors, Back extensors. Common extensors of the wrist also undergo Stress injury with pain and inflammation stages which is usually called as lateral epicondylitis [2]. Lateral epicondylitis was first described by Dr. Runge in 1873. Dr. Runge stated that lateral epicondylitis is basically a tendinosis that affects the common supinator-extensor tendons at the lateral epicondyle [3]. The most commonly affected muscle is extensor carpi radialis brevis (ECRB) [4].

Tissue Extensibility Dysfunction: [5] Most favorable elbow function requires ample of muscle extensibility, joint play of radiohumeral and ulnohumeral joints along with muscle play. In Lateral Epicondylitis the presence of inflammation of the common tendon decreases the mobility of the elbow joint due to pain. A study demonstrated as the chronicity of the tennis elbow increases, the incidence of radial head hypomobility increases [6].

A Recent prevalence study demonstrated that the prevalence of tennis elbow in desktop users was 26% and right elbow was dominantly involved 58% among students, 48.8% in office workers and 46% among bankers. Location of symptom was more prominent in right elbow compared to left with individual working on computer for 4-6hours per day [7]. Another study showed lateral epicondylitis affects between 1% and 3% of the population with age range 35 to 55 years, with an equal gender distribution [8]. Incidence of lateral epicondylitis varies with population, age and gender.

Also, Tennis elbow leads to changes in wrist biomechanics and pain either at the common origin or sometimes may radiate down to wrist on movement. ECRB has an exclusive contact with radius owing to its anatomical origin; its, abrasion against the lateral edge of the capitellum during excessive elbow motion causes pain [9]. The reason for this may be that, the common muscle involved in tennis elbow is extensor carpi radialis brevis which acts as a dynamic stabilizer of the wrist while the elbow is in motion [9]. Lateral epicondylitis is generally a work related or sport related pain disorder usually caused by extreme quick, monotonous, repetitive eccentric contractions and gripping activities of the wrist [8].

Classification of lateral epicondylitis is done on basis of duration: acute= 0-<4weeks, subacute= 1month-3months and chronic >3months [6].

Dr. Nirschl's described 7 stages of lateral epicondylitis as follows:

I: Mild pain after exercise <24h, II: Pain after exercise >48h, III: Pain with exercise, IV: Pain that alters ability to exercise, V: Pain caused by heavy ADL's, VI: Pain caused by light ADL's, intermittent rest pain and VII: Constant pain at rest, interferes with sleep [10].

These stages depend on the beginning of pain within the individuals suffering from lateral epicondylitis relating to exercises and daily activities performed.

Subjects with Tennis elbow complain of pain over the outer aspect of elbow joint which is typically increased by activities which require wrist supination and/or extension either with resistance or without resistance. This condition hampers the individual in performing daily activities due to weakness induced within the common extensors and inflammation of the same thus causing high disability score in worst condition. As the field of Physiotherapy is advancing, many recently invented therapies have come to research publications like Mulligan Mobilisation, Cyriax, Graston's, Jade stone, (as conventional treatment takes a longer duration) showing effect on reduction of pain in lateral epicondylitis thus increasing range of motion [11]. Very few authors have demonstrated the

effect of Mulligan's PRP technique in reduction of pain, disability, and improving and strength of Common extensor tendon. But, there is paucity of literature regarding Pain releasing phenomenon has an effect of improvement of Tissue Extensibility Dysfunction the common extensor origin as well or not. Thus, this study is been undertaken. The objective of the study was to determine effect of mulligan pain release phenomenon on Tissue Extensibility Dysfunction in subjects with chronic lateral epicondylitis.

2. METHODOLOGY

This study is a experimental study with pre-post analysis design. The study consisted of 50 sample size. Sample size was estimated using the following formula [12];

2.1 Formula

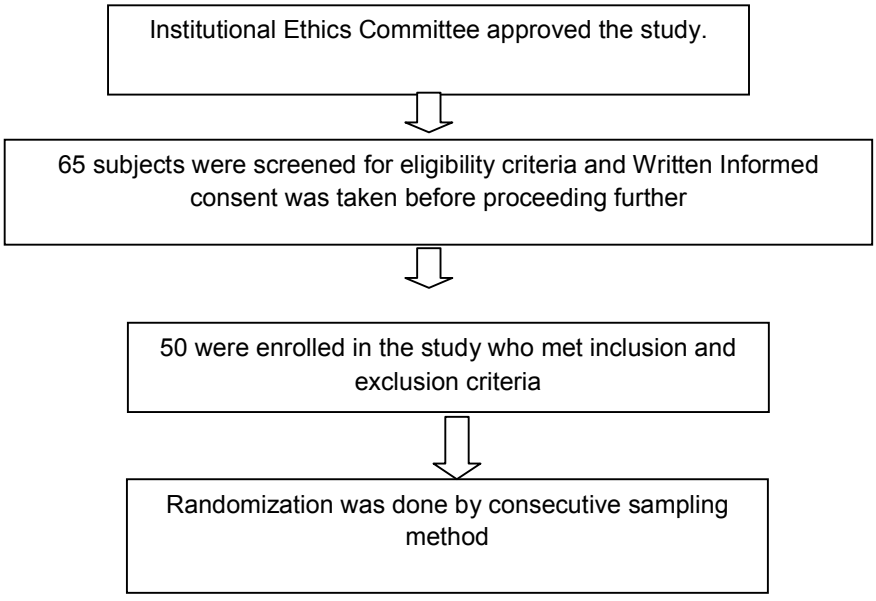
$$n = SD_A^2 + SD_B^2 \times (Z_{1\text{-alpha}/2} + Z_{1\text{-beta}})^2 / (X_A - X_B)^2$$

Using power 80%

The study was conducted in Physiotherapy OPD of Dayananda Sagar University-College of Physiotherapy. Based on the inclusion and exclusion criteria, the subjects were recruited in the study. The inclusion criteria for the study was: Subjects diagnosed with lateral epicondylitis: with positive Maudsley's test, Subacute lateral epicondylitis: <3months, Both male and female participants willing to participate under the study, Subjects with age range: 20-40 years. The exclusion criteria of the study was Acute Lateral epicondylitis, Subjects with Elbow and around elbow fracture, Subjects with ligament injury around Elbow joint, Any Neurological conditions, Any open wound around the area of elbow, Hypersensitive skin, skin allergies, Hypersensitive skin, Diagnosed subjects with malignancy, Diagnosed subjects with skin disease, Subjects diagnosed with systemic illness, Traumatic injury to the elbow joint.

2.2 Outecome Measures

1. Numerical Pain Rating Scale: It is a 10 point type scale used for assessment of pain. The scale ranges from zero to ten, where zero indicates no pain and ten indicates worst possible pain [13].
2. Sphygmomanometer: A device generally used to measure blood pressure, can also used to measure grip strength [14].
3. PRTEE scale: It is a 15-item questionnaire which is designed to measure forearm pain and disability in subjects with tennis elbow. The subject is supposed to rate the level of pain and disability experienced from 0 to 10 and it consists of 2 subscales: pain subscale and function subscale. The scoring of each subscale is out of 50 which mean pain is scored out of 50 separately and function is scored out of 50 separately [15].
4. Myotonometer: Detects the amount of muscle stiffness [16].



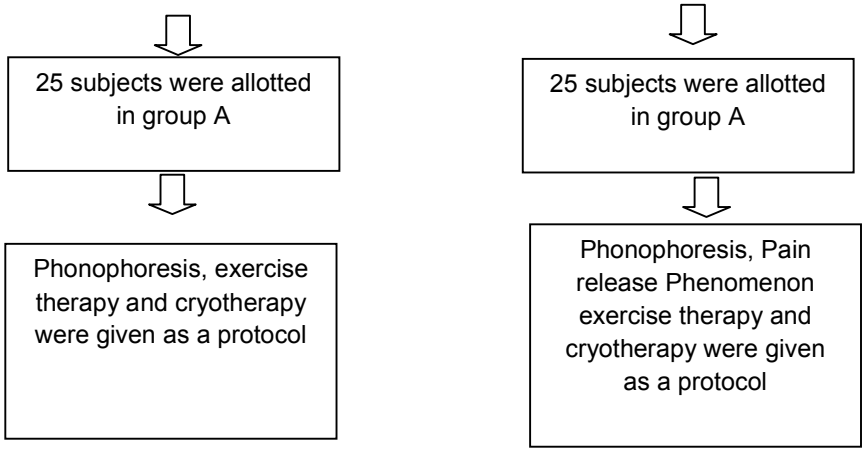


Chart 1. Procedure: Cosort flow chart

Demographic details and Outcome measures were noted down pre-intervention. Subjects were randomly allocated into the two groups by envelope method. The treatment allocated to that particular group was delivered. Post treatment outcome measures were noted down after one day and at the end of the therapy seven days. The data was collected and statistically analyzed.

2.3 Outcome Measures

Both the groups were diagnosed by Maudsley's test [17] before the commencement of the study. NPRS scores [13] were chocked down for pain assessment and by giving a scale and asking the subject to measure the pain scoring at the moment. To measure the gip strength SPHYGMOMANOMETER device was used First, subject is made to attain high sitting position with elbow in ninety-degree flexion and forearm in mid-prone position. The cuff is rolled into a cylinder shape as comfortable for the patients grip. The cuff is then inflated to 20mmHg, and the subject is asked to apply maximum grip force to the cuff. The gauge needle deflecting indicates the subjects applied pressure. Reading was taken thrice, mean of which was calculated as final reading [14] PRTEE: A hundred and fifty score disability scale was used to determine the level of disability felt by the subject pre and post intervention [16] Lastly The Fascia mobility was assessed by Myotonometer [17].

2.4 Treatment Approaches

2.4.1 Group A

1. Phonophoresis: Subject was made to be in sitting position with elbow bent to 90 degrees and forearm was in midprone position on the pillow. Diclofenac gel was used in the present study for phonophoresis with ultrasonic parameters: 3MHz frequency, 0.8W/cm^2, for 5 minutes [18].
2. Cryotherapy: Subject in comfortable position with elbow extended and forearm in mid-prone position, ice pack was given for 15 minutes [19].
3. Strengthening Exercises:
   Subject was asked to do following exercises after the treatment given according to allotment of the group.

   - Against gravity wrist extension
   - Against gravity wrist flexion
   - Against gravity wrist rotation with stick
   - Pressing hand against wall
   - Twisting a towel.

Each exercise was done ten times for five sets each with a rest interval of 10 seconds in between each set [20].

2.4.2 Group B

In addition to above mentioned protocols Pain release phenomenon (PRP) was delivered as well. The Pain Release Phenomenon Technique (PRPS) is a technique pioneered by Brian Mulligan for management of Pain. There are

different types of Pain release Phenomenon as follows;

i. Stretch PRP: here the affected muscle is eccentrically contracted.
ii. Contraction PRP: affected muscle is concentrically contracted.
iii. Compression PRP: the affected joint surfaces are compressed together
iv. Distraction PRP: affected joint surfaces are distracted away from each other.
The types of PRP are performed along with pertained duration of hold time by the
therapist. And always painful PRP technique is chosen for the treatment. 28-29
In the present study stretch PRP technique was used which provoked pain stimuli and was maintained for 15-20 seconds.

Image 1: The amount of manual force applied in this technique follows two principles:

A. Pain must not exceed 4 on NPRS: the manual pressure while inducing stretch should not cause exceeding pain to the subject. If the subject experiences more pain after one set of PRP then the force exerted was too much. If the pain immediately reduced to zero immediately after therapy, then the force exerted was very less. The therapy eventually will show poor result. Thus, the force exerted must be so that pain should not exceed more than 4 or reduce to 0 immediately after therapy.
B. Pain must not attain level 0 on NPRS immediately after 20 seconds of the sustained pressure: the pain nearing zero immediately after therapy suggests that pressure exerted was very light, thus may lead to less effective therapy [21].

Fig. 1. Ultrasound and Stretch PRP therapy

3. DATA PRESENTATION, ANALYSIS, RESULTS AND INTERPRETATIONS

The results of the present study were analyzed in requisites of pain, disability, grip strength and fascia mobility using outcome measures like NPRS, Sphygmomanometer and PRTEE scale and Myotonometer. Inter and intra group differences were compared to evaluate the effectiveness of treatment protocol given to Group A and Group B.

3.1 Statistical Analysis

Probability values of less than 0.05 were considered statistically significant with 95% confidence interval and values of less than 0.00001 as highly significant.

3.2 Demographic Data: Gender Distribution

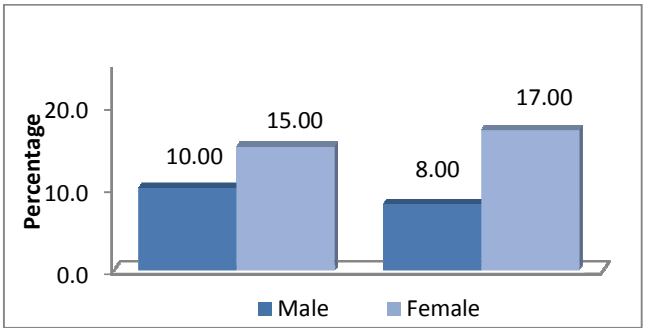
Both groups were gender matched with p=0.2471. This suggests that both the groups were homogenous with respect to gender.

3.3 Dominance

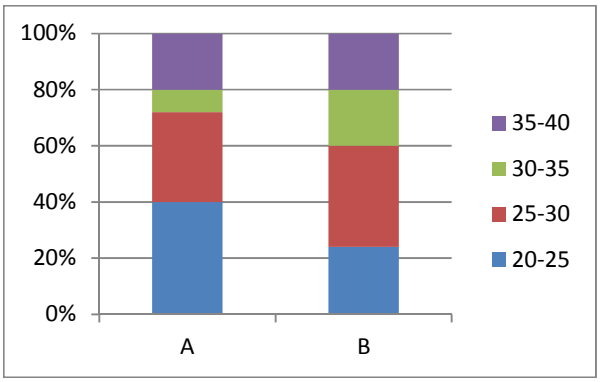
Total percentage of subjects whose dominant hand were affected were 58% among which 13 were in group A and 16 were in group B.

3.4 Data for Normal Distribution

The analysis of the data under the above table indicates that all the parameters follow the normal distribution hence, parametric tests were used, Unpaired t test was used to analysis between group data and paired t test was used to analyze within group data.



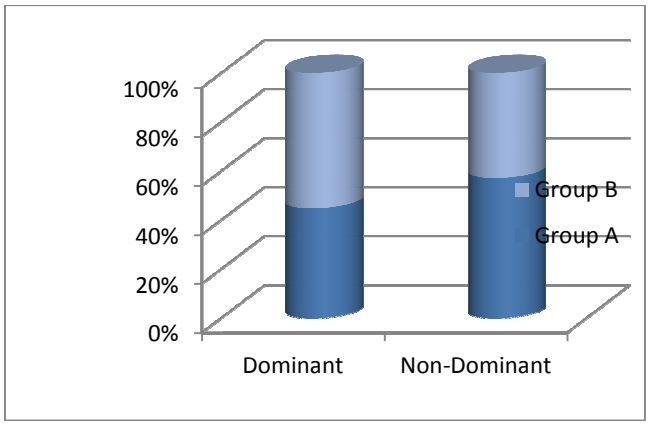
Graph 1. Distribution of male and female



Graph 2: Distribution of age

Table 1. Comparison of dominance in two study groups A and B

Dominancy	Group A	%	Group B	%	Total	%
Dominant	13	52	16	64	29	58
Non-Dominant	12	48	9	36	21	42
Total	25	100	25	100	50	100



Graph no.3. Comparison of

3.5 Outcome Measures

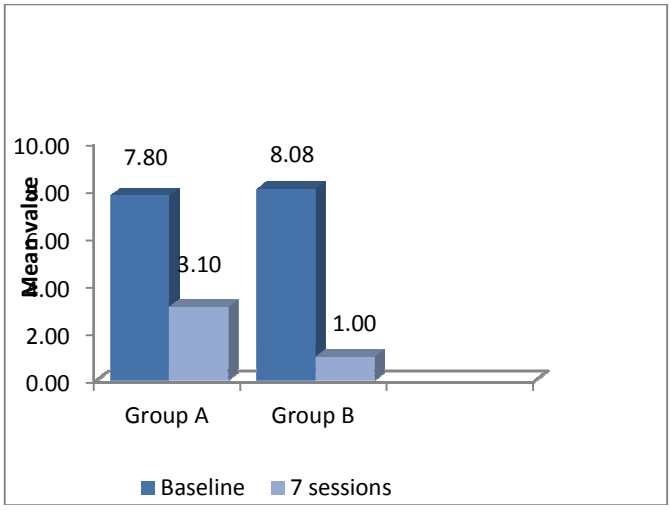
3.5.1 NPRS (for pain)

Table 2. Within Group analysis

	Group A	Group B
Pre test MEAN± SD	7.8±1.26	8.08±0.921
Post test MEAN± SD	3.01±1.017	1.020± 0.147
p	0.05*	0.001*

Table 3. Between group analysis

Time	Groups	MEAN± SD	p Value
Pre test	Group A	7.8±1.225	0.123
	Group B	8.08±0.9967	
Post test	Group A	2.080±1.017	0.05*
	Group B	1.440± 0.711	



Graph 1. Between Group analysis of NPR

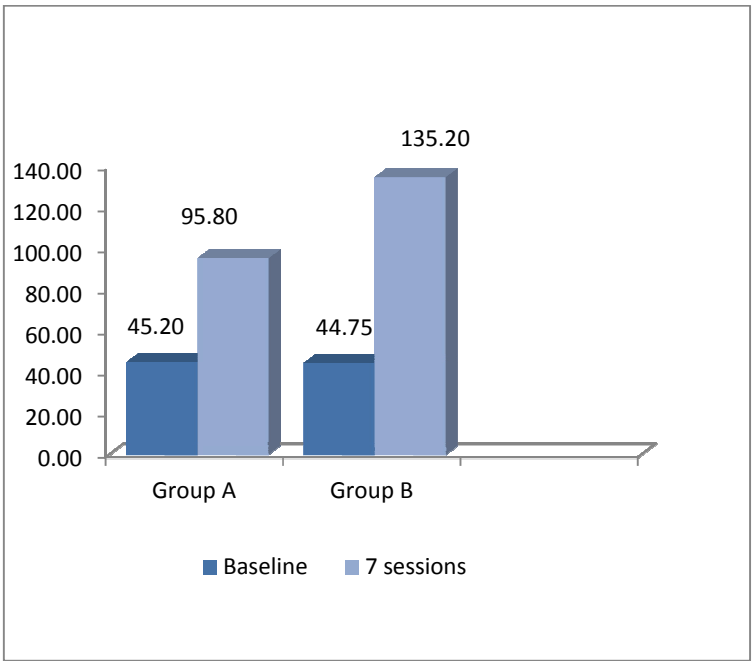
3.5.2 Grip strength

Table 4. Within group analysis

	Group A	Group B
Pre test MEAN± SD	45.20± 16.297	44.720± 21.648
Post test MEAN± SD	95.80± 29.89	44.720± 21.648
p	0.001*	0.001*

Table 5. Between group analysis

Time	Groups	MEAN± SD	p Value
Pre test	Group A	45.20± 16.297	0.9298
	Group B	44.720± 21.648	
Post test	Group A	95.80± 29.89	0.101
	Group B	135.2± 38.823	



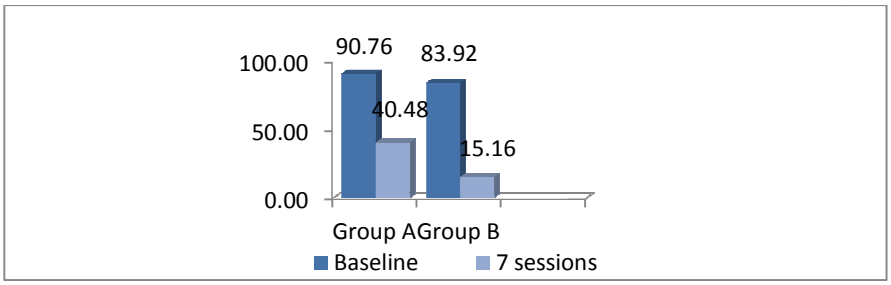
Graph 2. Between Group analysis of Grip Strength

Table 6. Within group analysis

MEAN± SD	Group A	Group B
Pre test	90.76±10.713	83.92±16.768
Post test	40.68± 8.496	15.16± 8.479
p	0.001*	0.001*

Table 7. Between group analysis

Time	Groups	MEAN ± SD	p Value
Pre test	Group A	90.76±10.71	0.0921
	Group B	83.92± 16.768	
Post test	Group A	40.0.48± 8.496	0.0001*
	Group B	15.16± 8.479	



Graph 3. between group analysis of PRTEE score

Table 8. Within group analysis

MEAN± SD	Group A	Group B
Pre test	60.76±9.312	55.92±16.768
Post test	61.68± 7.210	49.16± 9.100
p	0.341	0.001*

Table 9. Between group analysis

Time	Groups	MEAN± SD	p Value
Pre test	Group A	60.76±9.312	0.591
	Group B	55.92±16.768	
Post test	Group A	61.68± 7.210	0.0001*
	Group B	49.16± 9.100	

3.5.3 PRTEE score

The present study showed significant improvement in both the Groups; the Between analysis demonstrated there was no difference between the Group A and Group B post therapy, thus demonstrating no significant difference between the effects of therapies.

3.5.4 Muscle tone

The present study showed significant improvement only in the Group B; the Between analysis demonstrated there existed the difference between the Group A and Group B post therapy, thus demonstrating the significant difference among therapies.

4. DISCUSSION

The current experimental trial was carried out to study the quantitative efficacy of pain releasing phenomenon on Tissue Extensibility Dysfunction in subjects with subjects with Subacute lateral epicondylitis.

In the present study, age and gender demonstrated showed no statistical difference in both the groups. The average age of subjects was 25.63 ± 2.12 years in group A, and 27.47±1.62 in group B. Studies have demonstrated the age and incidence have a converse relation. Younger the age more the incidence of lateral epicondylitis and more prominently in female population [2]. The current study shows the same results as the previous studies suggesting that age and gender is an imperative risk factor for incidence of tennis elbow. In the current study, considering the dominant side involvement, 58% were complaining dominant side pain and 42% had non-dominant side complaints. Thus, the results of the present study conveys that; dominant hand is more commonly affected compared to non-dominant side.

The result of the present study suggests that pain release phenomenon in combination with conventional rehabilitation protocol was significant in reducing pain, improving grip strength and decreasing disability score on PRTEE scale. Within group NPRS scores were analyzed and were remarkable in both the groups. Subjects who had received Pain release phenomenon had more reduction in NPRS scores. A Study conducted by Lad R. et al., on Pain Release Phenomenon demonstrated reduction of pain in subjects with De Quervain's

tenosynovitis post Pain release Phenomenon. The reason given behind was Pain release phenomenon reduces the pain by releasing endorphins and encephalins neurotransmitters; which causes pain inhibition. Definite disappearance of Neuronal plasticity that is central sensitization towards chronic pain occurs if the nociceptive input is decreased thus causing pain reduction, this theory can be correlated with PRP as it works with identical principle on creep effect. This can be the reason for significant reduction in pain in subjects who have received PRP as the management in addition to traditional therapy [22]. A greater reduction in pain was seen post intervention which proves the efficacy of the Pain release phenomenon given along with conventional intervention. This may be possible due to the above mentioned PRP mechanism or by creep effect of PRP.

Literatures have supported the effects of progressive strengthening programs on pain and functional status in subjects with lateral epicondylitis. Few authors have demonstrated the effect of progressive strength training performed with rubber bar in open Kinematic Chain position in subjects with Tennis elbow [23], Study conducted by Kibler et al [24]. to established the effects of progressive strengthening programs on pain and functional status in subjects with lateral epicondylitis. This strengthening program was performed using the rubber bar in open Kinematic Chain position. The greater enhancement in outcome scores showed the efficacy of this functional training protocol. Strength training in the advised in the present study consisted of exercise against gravity; which is a type of open kinematic chain exercises that resembles position attained and required in Activities of daily Living. This rehabilitation approach in the present study justifies the improvement in grip strength in both the groups [23].

The reason for this may be elaborated as; the overuse injury causes pain in the tendon or muscle which causes decrease in the efficacy of muscle in doing its action. Mere reduction of pain and inflammation will not correct the muscle dysfunction which has occurred in tennis elbow. Advising the subject to perform strengthening exercise becomes mandatory as the overuse muscle is a weak muscle, strengthening becomes very important in order to avoid re-injury of the same muscle. Also, wrists flexors and extensors are two joint muscles that is elbow and wrist joints. Thus stated in introduction (ECRB is a dynamic stabilizer of the wrist) strengthening the wrist stabilizer and elbow mover becomes mandatory while talking about tennis elbow. This rehabilitation approach in the present study justifies the improvement in grip strength in both the groups.

Conventional therapy in the present study had more impact on muscles around the elbow joint, particularly the supinators and extensors of forearm. Upgrading wrist extensors strength at the completion of intervention demonstrated the weakness of these muscles which is one of the major attributable factor to muscle dysfunction rather than pain in the cases of lateral epicondylitis [25]. Interpretation can be that, subjects within age group between 30-60 years perform maximum functional activities than their mid to older counterparts leading to muscle dysfunction making them prone to develop tennis elbow.

Every muscle and its tendon have proprioceptors. The muscle spindles are a major source of joint proprioceptors along with other soft tissues. As daily activity or work increases, muscles tend to become weak and sometimes undergo shortening. According to Janda's approach short muscles are stronger when compared to weak muscle but weaker when compared to normal muscle group. Reduced muscle activation causes reduction in joint proprioception as a result of decreased functional activity because of the abnormal muscle pattern. This muscle dysfunction leads to overuse of certain group of muscle which worsens the condition which leads to overuse of muscle. Also, when there is decrease in proprioceptors there is increase in the number of nociceptors. This is one of the major reasons for functional disability along with pain in individuals suffering from tennis elbow [25]. Therefore Pain release phenomenon given along with strengthening exercises in the present study resulted in greater muscle activation particularly the extensor carpi radialis brevis. Sensory feedback via the stretch mechanism induced via pain release phenomenon facilitated elbow joint mechanoreceptors thus; modulating and activating the muscles around elbow joint [25].

In order to reduce functional disability individuals with extensor carpi radialis brevis weakness compensate with abnormal motor recruitment pattern while performing daily activities which leads to increased tension on other wrist extensors. Subjects in the current study were

managed with strengthening protocol. It was noted that subjects had no obscurity in daily activities like wringing the towel (one of the component of PRTEE scale) after the intervention. This suggests that upgrading the strength of the wrist extensors minimizes the compensatory muscle recruitment pattern in greater functional efficacy in these individuals.

Barratt et al [26] proposed that lack of gliding of the tendon may be the reason for pain leading towards disability in tennis elbow. Because of development of adhesions present between the tendons due to overuse of these musculature leads to decrease gliding. Reduction in gliding leads to muscle imbalance and further aggravation of pain and in addition to weakness consequencing in disability and further symptoms of tennis elbow. Hence, there is a need for the proper proprioceptive training protocol.

According to Janda's approach the increased tone in the muscle is due to adhesions formed between the fascia and the muscle, increased formation of knots and bands within the muscle. This increased tone in the muscle will lead to restriction in fascial gliding thus causing pain during muscle contraction. In the present study, the Fascia mobility scores increased in experimental group, suggesting that only PRP was beneficial in increasing the fascial gliding in subjects with lateral epicondylitis. PRP techniques help in inducing the interfibral stretch within the muscles which helps in smooth gliding of the fascia over the muscle thus; reducing pain during daily activities.

The present study had various limitations like Less intervention duration, Specific occupation wasn't taken into consideration, Heterogenous population and smaller sample size. These limitations can be overcome by various measures like utilizing A population specific to certain occupation, Longer period of time, A follow up study may be done, Study can be conducted on Acute and sub-acute lateral epicondylitis, taking a considerate sample size, seniority in work activity, risk factors and relapse of the condition.

5. CONCLUSION

The current study concludes that; Pain release phenomenon in subacute LE patients has shown significant improvement with respect to pain, weakness, disability and muscle stiffness. Tissue extensibility dysfunction occurs with most of overuse syndrome. Extensibility of muscles, tendons and fascia covering it becomes very vital when movement should occur smoothly. If gliding of any one of the above is hampered, definitely there is restriction in the movement. The Mulligan's Pain Release Phenomenon demonstrated significant reduction in muscle stiffness as the hold of stretch was for 10 seconds and the stretch was performed repeatedly. Thus, the study suggests that PRP is effective in treating LE.

CONSENT

Before recruitment of the sample in study, written informed consent was taken from each subject and the techniques were described in brief to each individual.

ETHICAL APPROVAL

Before commencement of the study Ethical approval was taken from Institutional Ethics Committee approval of DSU.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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