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ORIGINAL ARTICLE

Effectiveness of Novel Noxipoint Therapy versus Ultrasound Therapy for Pain Relief and Functional Activity in Tennis Elbow

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ABSTRACT

Background: Tennis elbow is a common musculoskeletal condition of elbow in which the extensors muscles of the wrist are affected. The pain occurs in the elbow joint and can also be seen in the wrist joint. Literature reported that tennis elbow occurs due to the overuse of the muscle and the tendons causing inflammation.

Objective: To evaluate the Effectiveness of Novel Noxipoint Therapy vs Ultrasound Therapy for Pain relief and Functional activity in Tennis Elbow.

Materials and methods: A total of 30 patients (both male and female, age group between 18 to 45years) with tennis elbow were recruited from rgu campus. The subjects were randomly divided into two groups (groups A and group B). Both groups comprising 15 patients each in a group. The informed consent forms were received from each patients before participating in the study. In group A, each patients received noxipoint therapy for a total of 10 sessions for 5 weeks. In group B, each patients received ultrasound therapy for a total of 10 sessions for 5 weeks. The pain intensity (NPRS) and Functional disability (PREE) were the outcome measures assessed at the baseline and 10 th session of the intervention.

Result: Both the treatment were effective in reducing pain and improving functional disability but there is no significant differences between the two treatments ($p>0.05$).

Conclusion: Noxipoint therapy and Ultrasound therapy is beneficial for persons with chronic tennis elbow. This study showed enhancement of both the groups when pain and functional activity of elbow were evaluated after the intervention

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period, utilising the NPRS and PREE to score. However, there wasn't any significant difference when both the modalities were compared. Therefore, both Noxipont therapy and Ultrasound therapy are suggested to improve functional activities and lessen pain.

KEYWORDS:

• Disability • Tennis elbow • Noxipoint Therapy • Pain • Ultrasound therapy

INTRODUCTION

The condition known as tennis elbow or lateral epicondylitis is brought on by excessive usage of the muscles and tendons that come from the lateral epicondyle, which is also where the long extensor tendons for the hand and forearm share their origin. The primary structure implicated in tennis elbow is thought to be the tendon extensor carpi radialisbrevis. The tendon extensor carpi radialisbrevis is considered to be the key Tennis elbow's underlying structure. It is also referred as tendonosis, and seen to be occur in regular tennis players and those who are involved in repetitive gripping or wrist extension activities where forced wrist extension occur.[1] Severity ranges from from mild discomfort to excruciating to persistent painand degenerative changes appear to be seen within the tendons.[2] (Pain is characteristically exacerbated by resisted extension of the middle finger and also by extension of the wrist). Pain in tennis elbow can travel from lateral aspect of elbow to the forearms and wrist. Pain and weakness can make it difficult to shake hands, grip objects, turn a doorknob or even holding a cup thereby affecting the functional activities, the movements of the arm results in shearing forces[1] and studies shows that 1-3% of adult population is affected and most prominent in the dominant arm[3] it is caused by chronic overuse or repetitive injury, which results in microtears or degeneration of the extensor tendon which is present around lateral epicondyle.[4]

Tennis elbow or lateral epicondylitis is a condition of elbow that is due to the overuse of muscle and tendons which originate from the Lateral epicondyle the common origin of the long extensor tendons for the forearm and hand. The tendon extensor carpi radialisbrevis is considered to be the key structure involved in tennis elbow. It is also known as tendonosis, and seen to be occur in regular tennis players and those who are involved in repetitive gripping or wrist extension activities where forced wrist extension occur.[1] Severity ranges from slight tenderness to severe to continuous pain and degenerative changes appear to be seen within the tendons.[2] Pain is characteristically exacerbated by resisted extension of the middle finger and also by extension of the wrist. Pain in tennis elbow can travel from lateral aspect of elbow to the forearms and wrist. Pain and weakness can make it difficult to shake hands, grip objects, turn a doorknob or even holding a cup thereby affecting the functional activities, the movements of the arm results in shearing forces[1] and studies shows that 1-3% of adult population is affected and most prominent in the dominant arm[3] it is caused by chronic overuse or repetitive injury, which results in microtears or degeneration of the extensor tendon which is present around lateral epicondyle.[4]

Standard noninvasive treatments include physical therapy (PT) and analgesics. The prescription of analgesics such as opioids, which provide temporary relief from chronic pain, has increased rapidly in the past two decades, along with proportional increases in analgesic abuse and addiction. Effective noninvasive nonpharmacological remedies are highly desirable, as healthcare costs and drug abuse are mounting.[5,6]

Ultrasound therapy is one of the electro-physical agent in current clinical practice used to treat patients with pain, improve circulation and heal tissue. It works on principle of reverse piezo electric effect in which electrical energy is transformed into mechanical energy with the help of quartz crystal present in the ultrasound treatment head. Ultrasound therapy uses a crystal sound head to transmit acoustic waves at 1 or 3 MHz and amplitude densities between

0.1 watts/cm^2 and 3 watts/cm^2. With the help of ultrasonic waves this therapy delivers energy to deep tissues which brings about thermal and non-thermal physiological changes. It can be provided in two modes, continuous or pulsed, Continuous ultrasound delivers non-stop ultrasonic waves throughout the treatment period; while in pulsed ultrasound, the delivery is intermittently interrupted.[7,8]

Novel Noxipoint therapy (NT) utilizes electrical stimulation where electrodes are placed on "Noxipoints", intensity should be able to elicit soreness/dull pain but not sharp pain and brief stimulation, was found to restore function and relieve pain in patients with chronic pain.[6] Both noxious (painful) and innocuous segmental stimulation reduce chronic pain but noxious stimulation was found to be significantly more effective. This is in agreement with Melzack (1975), Melzack *et al.* (1980) who showed that in chronic pain patients, segmental noxious stimulation, with TENS or ice cube induced significant pain relief.[8]

Analgesic effect is induced by two possible mechanisms by activation of Aδ and C fibers. Nociceptive or painful input conveyed via the spinoreticular and spinomesencephalic tracts trigger inhibitory centers in the medulla and pons (e.g. nucleus raphe magnus and periaquaductal grey), which in turn activate descending pathways producing synaptic inhibition of nociception in segments from which the nociceptive input was generated. In the NT Patient are adviced to take rest and it is a critical component as it is related to cell remodeling and regeneration effects of NT which indicates about Skeletomuscular cell repair mediated by myosatellite cells.

As novel noxipoint therapy and ultrasound therapy is effective in pain reduction so in this study we will assess which therapy is more effective in pain reduction in tennis elbow condition and where it will improve the functional activity of the patient.

MATERIAL AND METHODOLOGY

32 patients Aged 18 to 45 years diagnosed with tennis elbow were included in the study based on the Inclusion and Exclusion Criteria. Study was carried out in the OPD of the University. Approval for the study was taken from the institutional Ethical Committee as per the ethical guidelines for biomedical research on human subjects RGU/IEC HR/BPT/2024/13. Patients were divided into two groups using the Chit method of Randomization. Patients were divided into two Group A containing 16 subjects received Noxipoint Therapy and Group B containing 16 subjects received Ultrasound Therapy. 10 treatment sessions for the period of 5 weeks were given where each session lasted for 20 mins. Before Treatment Assessment were taken using NPRS for pain and PREE for Functionality. The patient went through the treatment procedure for 5 weeks. After 5 weeks the post intervention assessment were taken using VAS & PREE. The results were compared.

INCLUSION AND EXCLUSION CRITERIA

Patients of age group 18 to 45 with history of chronic Tennis elbow for more than 1 to 3 months also patients who had restricted range of motion were selected in the study.

Exclusion criteria included:

1. Traumatic bone Iniury
2. Recent Fracture of elbow
3. People who have a skin allergies
4. Phobia from electric stimulation
5. People who have Metal Implants
6. Pain in the Area other than elbow
7. Radiating pain with pin prickling sensation
8. Recent tumours
9. History of cardiovascular disease

ASSESSMENT PARAMETERS

Base line data Pre NPRS (Numerical Pain Rating Scale) for pain and PREE (Patient related elbow evaluation) for Functionality were measured. The treatment procedure for 5 weeks and after 5 weeks the post intervention assessment were taken using NPRS AND PREE.

METHODS

Ultrasound treatment procedure and technique

- Before starting treatment a consent form was given to patients and benefits and risks of procedure including sensations

expected during procedure were explained to the patients.

- They were positioned (Sitting or lying) with additional pillow support comfortably and assessed thoroughly. Time and intensity was kept at '0' before switching on power. Patients were also instructed to report any excess heat or pain.
- Gel was applied to skin and surface of transducer. US head was moved in overlapping circular pattern and rate of transducer movement is 3-4cm sq. Dose of US was 1w/cm^2 with frequency of 1MHz in continuous mode, 1MHz was chosen due to its increased penetration depth. The duration of treatment was 20 minutes (with an rest interval of 1 to 2 mins at 10 mins) Excluding the preparation time and the interval time.

NT treatment procedure and technique

Patient was treated for 30 mins. patient was asked to comfortably sit or lie supine on the couch. By Palpating the attachment points of each muscle group and soft tissue in the pain area and identifying the points sensitive to pressure (termed Noxipoints).

A muscle group or soft tissue were identified as a target when Noxipoints appeared on both of its attachments. A three-dimensional Noxipoint Navigation System was provided to help the NT therapist locate Noxipoints during the treatment. The stimulation pads were precisely placed at the skin surface locations of the pair of Noxipoints corresponding to the impaired muscle/tissue for approximately 4 minutes per application. A new pair of target Noxipoints was identified for the next pad placement and stimulation after each application. The positioning and tuning of each patient's stimulation was approximately 2-4 minutes, as each patient were reacting differently. 5 to 6 stimulation were performed.

Patient with severe pain will be asked to wear brace after the treatment. After every session a 3 day break was given for patients, for moderate to severe pain, patients were asked to use braces or splints to reduce movement of the joints. (Settings For NT, mode: burst, pulse frequency: 1-3hz, pulse duration: 50 to 300 milliseconds, application time 4 mins, intensity: 30 to 120 mA)

STATISTICAL ANALYSIS AND RESULTS

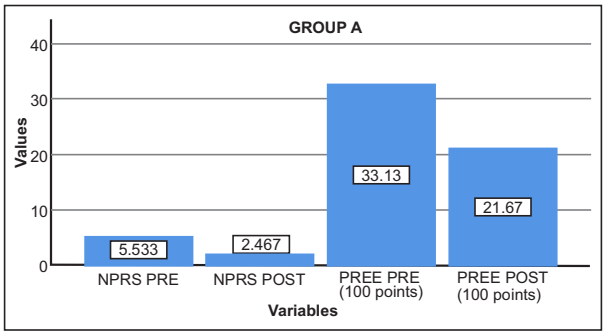
Group A

Frequency and Percentage of Gender

Table 1: Gender distribution for Group A

Gender		
Gender	**Frequency**	**Percent**
Female	6	40.0
Male	9	60.0
Total	15	100.0

Descriptive Statistics: Bar Diagram:



Graph 1: Group A bar diagram of pre and post-test

Normality Test:

Table 2: Tests of Normality

Tests of Normality				
	Shapiro-Wilk			
	Statistic	df	p value	Remark
NPRS Pre	0.955	15	0.599	NS
NPRS Post	0.942	15	0.407	NS
PREE Pre (100 points)	0.909	15	0.131	NS
PREE Post (100 points)	0.877	15	0.052	NS

NS-Not Significant: here the shapiro-wilk test was performed to check normality. we have seen that p values are greater than 0.05, so we can conclude that the data follows the normality assumption at 5% level of significance and hence we have to use parametric test for the analysis.

Analysis:

Table 3: Paired Sample Test

Paired samples Test							
	Paired Differences			t	df	P value	Remark
	Mean	Std. Deviation	Std. Error Mean				
NPRS Pre - NPRS Post	3.067	0.799	0.206	14.869	14	0.000	***
PREE Pre (100 points - PREE Post (100 points)	11.467	3.603	0.930	12.326	14	0.000	***

***Significant at p<0.001

Here we can see that p values are less than 0.05, so we will reject the null hypothesis and accept the alternative at 5% level of significance. Hence conclude that there is significant difference between pre-post values of NPRS and PREE values.

Group B

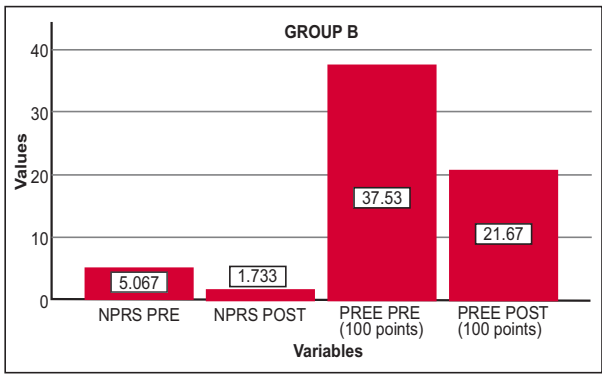
Frequency and Percentage of Gender

Table 4: Gender distribution of Group B

Gender		
Gender	Frequency	Percent
Female	5	33.3
Male	10	66.7
Total	15	100.0

Descriptive Statistics

Bar diagram:



Graph 2: Group B outcome measures pre and post interventions

Normality Test:

Table 5: Test of Normality

Tests of Normality				
	Shapiro-Wilk			
	Statistic	df	p values	Remark
NPRS Pre	0.932	15	0.293	NS
NPRS Post	0.888	15	0.063	NS
PREE Pre (100 points)	0.923	15	0.217	NS
PREE Post (100 points)	0.943	15	0.422	NS

Here the Shapiro-Wilk test was performed to check normality. We have seen that p values are greater than 0.05, so we can conclude that the data follows the normality assumption at 5% level of significance and hence we have to use parametric test for the analysis.

RESULT

Table 6: Paired samples Test

Paired sample test							
	Paired differences			t	df	p value	Remark
	Mean	Std. Deviation	Std. Error mean				
NPRS Pre - NPRS Post	3.333	0.900	0.232	14.349	14	0.000	***
PREE pre (100 points) - PREE post (100 points)	16.667	7.148	1.846	9.030	14	0.000	***

***Significant at p<0.001

Here we can see that p values are less than 0.05, so we will reject the null hypothesis and accept the alternative at 5% level of significance. Hence conclude that there is significant difference between pre-post values of NPRS and PREE values.

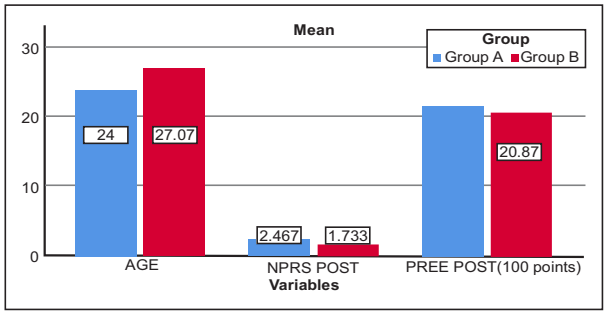
ACROSS THE GROUPS

Descriptive Statistics:

Table 7: Post intervention Statistical values Across the Groups

Report				
	Group	**Age**	**NPRS Post**	**PRTEE Post (100 points)**
Mean	Group A	24.00	2.47	21.67
	Group B	27.07	1.73	20.87
	Total	25.53	2.10	21.27
Minimum	Group A	19	0	8
	Group B	19	0	8
	Total	19	0	8
Maximum	Group A	37	6	36
	Group B	40	3	39
	Total	40	6	39
N	Group A	15	15	15
	Group B	15	15	15
	Total	30	30	30
Std. Deviation	Group A	4.158	1.727	10.801
	Group B	7.186	0.884	8.911
	Total	5.975	1.398	9.738

Bar diagram:



Graph 3: Bar diagram of Mean Post intervention datas across the Group

Normality Test

Table 8: Tests of Normality across the group

Tests for Normality					
	Group	**Shapiro-Wilk**			
		Statistic	df	Sig.	Remark
Age	Group A	0.770	15	0.002	**
	Group B	0.819	15	0.006	**

**Significant at p<0.01

Here the Shapiro-Wilk test was performed to check normality. We have seen that p value is less than 0.05, so we can conclude that the data does not follow the normality assumption at 5% level of significance and hence we have to use non-parametric test for the analysis.

And we have already performed the normality check for NPRS and PREE, which is not significant.

Analysis:

Table 9: Age across the Groups

Test Statistic			
	Mann-Whitney U	**p value**	**Remark**
Age	89.500	0.336	NS

NS - Not Significant

We have seen that p value is greater than 0.05, so we accept the null hypothesis at 5% level of significance and conclude that there is

no significant difference between AGE across the groups.

Table 10: Independent sample test post intervention data across Groups

Independent Sample Test						
	t- test for equality of means					
	t	df	P value	Mean difference	Std. error difference	Remark
NPRS Post	1.464	28	0.154	0.733	0.501	NS
PREE Post (100 points)	0.221	28	0.826	0.800	3.615	NS

NS-Not Significant

We have seen that p values are greater than 0.05, so we accept the null hypothesis at 5% level of significance and conclude that there is no significant difference between NPRS post values and PREE post values across the groups.

DISCUSSIONS

Tennis elbow or lateral epicondylitis is a condition of elbow that is due to the overuse of muscle and tendon, the common origin of the long extensor tendons for the forearm and hand. In tennis elbow the underlying pathology appears to be an area of degenerative change within these tendons. There is a wide spectrum of severity ranging from slight tenderness to severe, continuous pain. Pain is characteristically exacerbated by resisted extension of the middle finger and also by extension of the wrist.[1]

The purpose of this study was to evaluate the effectiveness of Noxipoint therapy versus ultrasound therapy in reducing pain and improving functionality in tennis elbow patients.

The study included 30 subjects, between the ages of 18 to 45. They were distributed randomly into two groups to undergo different treatment protocols. Group A underwent Noxipoint therapy and Group B underwent Ultrasound therapy.

Noxipoint therapy (NT), a novel therapy utilising electrical stimulation characterised by precise electrode placement (on "Noxipoints"), intensity and submodality-specific settings (eliciting soreness/dull pain but not sharp pain) and brief stimulation, was found to substantially and persistently restore function and relieve chronic pain in a large cohort of chronic pain patients over the past decade.[9]Both noxious (painful) and innocuous segmental stimulation reduce chronic pain but noxious stimulation was found to be significantly more effective. This is in agreement with Melzack (1975), Melzack *et al.* (1980) who showed that in chronic pain patients, segmental noxious stimulation, with TENS or ice cube induced significant pain relief. In NT there is Activation of Að and C fibers can also induce analgesic effect by way of two possible mechanisms. Nociceptive or painful input conveyed via the spinoreticular and spinomesencephalic tracts trigger inhibitory centers in the medulla and pons (e.g. nucleus raphe magnus and periaquaductal grey), which in turn activate descending pathways producing synaptic inhibition of nociception in segments from which the nociceptive input was generated.[5,2]

Ultrasound therapy is a type of electrotherapy that is used in physical therapy to treat patients with pain, promote tissue healing and improve circulation. Ultrasound therapy works with the principle of reverse piezo electric effect in which electrical energy is transformed into mechanical energy with the help of quartz crystal present in the ultrasound treatment head.

Lehmann suggests that the desirable effects of therapeutic heat can be produced by US. It can be used to selectively raise the temperature of particular tissues due to its mode of action. Among the more effectively heated tissues are periosteum, collagenous tissues (ligament, tendon & fascia) & fibrotic muscle. If the temperature of the damaged tissues is raised to 40-45°C, then a hyperaemia will result, the effect of which will be therapeutic. In addition, temperatures in this range are also thought to help in initiating the resolution of chronic inflammatory states.[7-9]

Age distribution: In the study mean age of the participants ranged from 18 to 45 years. Statistical analysis of the same revealed no statistical significance between all the two groups, this indicates that the value in both

the groups were homogenous in nature. In the study the mean age is 25.53.

In group A, Noxipoint therapy group we saw that p values are less than 0.05, so we rejected the null hypothesis and accepted the alternative hypothesis at 5% level of significance. Hence conclude that there is significant difference between pre-post values of NPRS and PREE.

Similarly, in Group B, Ultrasound Therapy, the p values are less than 0.05, so we rejected the null hypothesis and accepted the alternative at 5% level of significance. Hence conclude that there is significant difference between pre-post values of NPRS and PREE values. Lehmannsuggests that the desirable effects of therapeutic heat can be produced by US. It can be used to selectively raise the temperature of particular tissues due to its mode of action. Among the more effectively heated tissues are periosteum, collagenous tissues (ligament, tendon & fascia) & fibrotic muscle. If the temperature of the damaged tissues is raised to 40-45°C, then a hyperaemia will result, the effect of which will be therapeutic.

The result of the study reveals that, they show effects individually but when both the groups are compared with each other on the basis of reduction in pain and improvement in functional activity both of them showed similar results. We have seen that p values are greater than 0.05, so we accept the null hypothesis at 5% level of significance and conclude that there is no significant difference between NPRS post values and PREE post values across the groups.

Thus, my study rejects the alternate hypothesis and accept the null hypothesis. Therefore my conclusion of the study is that there is no significant differences between Noxipoint therapy and Ultrasound Therapy in pain reduction and improving functional ability in chronic Tennis Elbow patients.

CONCLUSION

Noxipoint therapy and Ultrasound therapy is effective in patients suffering from chronic tennis elbow. This study showed improvement in both the groups when pain and functional activity of elbow were assessed following the intervention period, utilising the NPRS and PREE to score. However, there wasn't any significant difference when both the modalities were compared. Therefore, both Noxipont therapy and Ultrasound therapy are recommended for reducing pain and improving functional activity.

LIMITATION

- Study sample is small.
- Short Study Duration.
- Study was only performed on Chronic Tennis elbow and not on Acute Tennis elbow.

Future scope of the study:

- Study can be performed on large population.
- Duration of the study can be increased to find out the long term effects.
- A study can be performed on Acute Tennis Elbow Patients.

Conflict of Interest: None

Funding information: None

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