Comparative Study of the Effectiveness of the use of the Universal tennis elbow splint compared to elbow brace in treatment of Lateral Epicondylitis

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Abstract :

Background: Lateral epicondylitis is a serious condition affecting 1 to 3% of adult population between the age group of 30 to 50 year old. This group represents the working force and tennis elbow causes debilitating pain and patients are unable to perform the affected limb functions of lifting or holding anything. The main cause for tennis elbow is the tendinopathy of the extensor carpi radialis brevis muscle (ECRB). There are multiple treatment measures to relieve the pain and bring back the function of the limb to normalcy as early as possible. The elbow brace is used to reduce the expansion of the ECRB and thereby reducing the symptoms of tennis elbow. It was hypothesized that wrist splints would reduce the activation of the ECRB muscle and thereby will reduce the symptoms of the tennis elbow. Streek et al performed a study using the wrist splint with 20-30 degrees extension and mentioned in limitations the changing the degree of extension may improve outcomes as compared to elbow braces. On that hypothesis we used a brace with only 5-10 degrees of extension. **Aims:** 1) To study the symptomatic and functional outcome of the elbow brace. 2) To study the symptomatic and functional outcome of the wrist splint. 3) To compare the symptomatic and functional outcomes between the wrist splint and the elbow brace. **Material & Methods:** The patients included in the study were divided into Group A receiving the wrist splint and group B elbow brace. The patient rated tennis elbow evaluation score (PRTEE), grip strength and pain visual assisted (VAS) score on the day of enrolment and 6 weeks after using either the elbow brace or wrist splint was noted. We used Mann-Whitney U test to calculate P-value intergroup and for P-value intra-group we used Wilcoxon's signed rank test. **Results:** Group A distribution of median 6 weeks PRTEE score improved significantly compared to median baseline PRTEE score (P-value$<$0.001). The VAS score, grip strength and improvement in PRTEE score at 6 weeks is relatively better in Group A compared to Group B, however the difference did not reach statistical significance (P-value$>$0.05). **Conclusion:** The use of wrist splint significantly improved the symptoms of the tennis elbow. The outcome is comparable to use of tennis elbow brace. The outcome is not statistically significant if compared between the two groups.

Key words: Tennis elbow, Lateral epicondylitis, Wrist splint, Forearm braceof Right knee. Right knee was straightened

Introduction

Lateral epicondylitis prevalence is 1 to 3% in adult population.[1] It commonly occurs in age between 35 to 55 years with equal gender distribution[2]. It is a degenerative disorder of the tendons responsible for wrist extension and supination.[3] The commonly affected tendon is of the extensor carpi radialis brevis (ECRB) muscle as described by Cyriax.[4] Repetitive injury or overuse of the tendon leads to micro tears at the insertion site near the lateral epicondyle. These micro tears heal with fibroblast hypertrophy, disorganized collagen and vascular hyperplasia leading to tendinosis.[5] If not treated it may lead to rupture of calcification in the tendon.[6]

The clinical presentation is pain along the lateral aspect of the upper forearm and localized at lateral epicondyle. The diagnosis is made mostly through history and clinical examination.[7] The pain is more on dorsiflexion of the wrist and activities involving gripping or lifting of the objects. Various tests have been described in the literature like the Mill's test and Maudsley's test which provocate the pain and thereby confirm the diagnosis.[8] It has been shown that lateral epicondylitis causes diminished grip strength.[9]

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70 to 80% of all patients improve by conservative management including rest.[10] Physiotherapy modalities like electrocorporeal shock wave therapy and manipulations help reduce symptoms.[11] Non-steroidal anti-inflammatory drugs (NSAIDs) like diclofenac are superior to naproxen in short term and superior to corticosteroid injections in long term.[12]

One of the most popular orthotic device is the elbow band which is worn just below the elbow. It is hypothesized that binding of the muscles limits their expansion and decreases the contribution to force production made by muscle fibers located proximal to the brace.[13] The forearm/ wrist brace relaxes the extensor carpi radialis brevis muscle and thereby allowing the tendon to recover.[14] A study comparing the two braces showed that forearm/ wrist brace use showed marginally better pain relief than elbow strap.[15]

The studies with forearm/ wrist splint included splints in 20-30 degrees of wrist extension.[14,15] We have used a universal tennis elbow splint which has an aluminum plate on dorsal aspect with 5 degrees of dorsal angulation. We hypothesized that reducing the degree of wrist extension will relax the extensor carpi radialis muscle. We used patient related tennis elbow examination questionnaire and grip strength to evaluate the outcomes in our patients.

Material & Methods:

This study was approved by the ethical board of our institution dated 10/01/2018 prior to the enrollment of the patients for the study. We studied 360 consecutive patients presenting to our institution from January 2018 to April 2019. We included any patient presenting with pain over lateral side of elbow, pain aggravating on resisted wrist dorsiflexion and resisted finger extension. Patients with pain duration more than 3 weeks, those who underwent treatment in form of any physiotherapy modality and or corticosteroid injection at any stage of the disease were excluded from the study. Also patients with previous fractures of elbow and forearm bones, any surgical intervention of elbow, wrist or forearm and cervical radiculopathy were excluded from the trial. Table.1 summarizes the inclusion and exclusion criteria. We were able to include 144 patients in our study. Patients were randomly allocated using the sealed envelopes.

Inclusion Criteria:

1. Pain over lateral side of elbow.
2. Aggravation of pain on resisted dorsiflexion of wrist.
3. Aggravation of pain of resisted extension of fingers.
4. Tenderness over lateral epicondyle or just below lateral epicondyle.

Exclusion Criteria:

1. Pain over lateral elbow longer than 3 weeks.
2. Surgical history over elbow, forearm or wrist.
3. Congenital deformity of affected upper arm.
4. Previous physiotherapy or corticosteroid treatment for lateral epicondylitis.
5. Cervical radiculopathy.
6. Autoimmune disorder that cause inflammatory responses in joints.

Study Design:

Patients were randomly assigned to two groups. Group A patients were given universal wrist extension block splint and group B patients were given elbow bands. They were advised to use the brace throughout the 6 weeks treatment period with removal only while having bath. Both group patients were given diclofenac sodium 50mg twice a day for five days along with rabeprazole 40mg. The measurements for evaluation scores were taken on day 0 (enrollment day) and day 42 (6 weeks). Both group patients were allowed to work or go about their daily activities with the braces on. The elbow band was worn just below the elbow. The universal tennis elbow splint is worn around the wrist as shown in the figure 1 and figure 2. It has an aluminum core which holds wrist in 5 degrees of extension. It blocks wrist extension completely and allows only few degrees of wrist flexion. Finger and elbow joint movements are not affected.

Figure 1: Universal tennis elbow splint

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Figure 2: Clinical side view of splint

Outcome Measures:

To measure the grip strength the CAMRY digital hand dynamometer was used in all patients. The patient was asked to use maximum strength to grip the hand dynamometer and was asked to rate the pain on the visual analogue scale (VAS) while gripping. The grip strength was noted as shown in the digital dynamometer and VAS was measured between scale of 0 which represents no pain at all and 10 which represents maximum imaginable pain. The patient rated tennis elbow evaluation (PRTEE) score was noted using the scale as shown in appendix A. We modified the last point below the usual activities heading to, pain during riding a moped/ driving a car/ sporting activity. The physiotherapists were appointed to help patient in answering in the PRTEE form, so no column is left unanswered.

The three dependent variables which were noted at the beginning and the end of the study were the grip strength, VAS score on measuring grip strength and PRTEE score. The other variables like age, sex and affected limb is the dominant or non-dominant was noted at the beginning of the study.(Appendix A)[16]

Observation & Results:

Inter-group comparison of median PRTEE Score:

Distribution of median baseline and 6 weeks PRTEE score of cases studied did not differ significantly between two study groups (P-value>0.05 for both). Distribution of median % change in PREQ score at 6 weeks among the cases studied did not differ significantly between two study groups (P-value>0.05). Improvement (average % change) in PREQ score at 6 weeks is relatively better in Group A [Splint] compared to Group B [Elbow brace], however the difference did not reach statistical significance (P-value>0.05).

Intra-group comparison of median PRTEE Score:

In both groups A [Splint] and B [Elbow brace], distribution of median 6 weeks PRTEE score improved significantly compared to median baseline PRTEE score (P-value<0.001 for both).

Inter-group comparison of median Pain Score (VAS):

Distribution of median baseline and 6 weeks pain score (VAS) among the cases studied did not differ significantly between two study groups (P-value>0.05 for both). Distribution of median percentage change in pain score (VAS) at 6 weeks among the cases studied did not differ significantly between two study groups (P-value>0.05). Improvement (average percentage change) in Pain score (VAS) at 6 weeks is relatively better in Group A [Splint] compared to Group B [Elbow brace], however the difference did not reach statistical significance (P-value>0.05).

Intra-group comparison of median Pain Score (VAS):

In both groups A [Splint] and B [Elbow brace], distribution of median 6 weeks Pain score (VAS) improved significantly compared to median baseline pain score (VAS) (P-value<0.001 for both).

Inter-group comparison of median grip strength:

Distribution of median baseline and 6 weeks grip strength among the cases studied did not differ significantly between two study groups (P-value>0.05 for both). Distribution of median percentage change in grip strength at 6 weeks among the cases studied did not differ significantly between two study groups (P-value>0.05). Improvement (average percentage change) in grip strength at 6 weeks is relatively better in Group A [Splint] compared to Group B [Elbow brace], however the difference did not reach statistical significance (P-value>0.05).

Intra-group comparison of median grip strength:

In both groups A [Splint] and B [Elbow brace], distribution of median 6 weeks grip strength improved significantly compared to median baseline grip strength (P-value<0.001 for both).

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Table 1: Inter-group distribution of average (median) of PRTEE score, Pain score (VAS) and Group strength of cases studied.

Scores		Group A [Splint] (n=72)		Group B [Elbow Brace] (n=72)		P - value
		Median	Min-Max	Median	Min-Max	
PRTEE Score	Baseline	94.5	75 - 100	93.0	71 – 100	0.541^{NS}
	6 weeks	11.0	1 – 76	10.0	0 – 67	0.222^{NS}
	% change	87.9%	--	76.4%	--	0.153^{NS}
P-value (Intra - group)	Baseline vs 6 weeks	0.001***		0.001***		
Pain Score (VAS)	Baseline	9	6 – 10	9	7 – 10	0.803^{NS}
	6 weeks	1	0 – 3	2	0 – 5	0.196^{NS}
	% change	84.7%	--	82.0%	--	0.177^{NS}
P-value (Intra - group)	Baseline vs 6 weeks	0.001***		0.001***		
Grip Strength	Baseline	21.5	10 – 43	21.0	11 – 34	0.104^{NS}
	6 weeks	55.0	42 – 69	54.0	39 – 68	0.333^{NS}
	% change	173.1%	--	169.7%	--	0.138^{NS}
P-value (Intra - group)	Baseline vs 6 weeks	0.001***		0.001***		

P-value (Inter-group) by Mann-Whitney U test, P-value (Intra-group) by Wilcoxon's signed rank test. P -value<0.05 is considered to be statistically significant. ***P-value<0.001,NS-Statistically non-significant.

Table 2: Distribution of demographic characteristics of cases studied

Parameters		Total number of cases (n=144)	
		n	%
Age group (years)	=30	13	9.02
	31 – 40	77	53.46
	41 – 50	32	22.22
	51 – 60	11	7.65
	>60	11	7.65
Sex	Male	87	60.42
	Female	57	39.58
Dominant hand	Yes	102	70.83
	No	42	29.17

Distribution of age:

Tennis elbow was commonly reported at the age group of 31-40 years of age. This age group comprised of 53.46% of total age group of patients.

Distribution of sex:

The most common sex group was male in the study groups with 60.42% of all study group

Distribution of dominant hand:

The most common involvement of hand was the dominant hand in the study groups with 70.83% of cases having the dominant hand involvement.

The splint group showed marginally better improvement in VAS, PRTEE and grip strengths but was not statistically significant. Both groups of patients showed statistically significant improvement in the VAS, PRTEE and grip strengths. This shows that no statistically significant improvement in patients from one group to other. The values improved in both groups.

Demographical result shows that tennis elbow is most common in males aged 31-40 year old and in the dominant hand.

Discussion:

The recent study by Streek et al[14] showed no difference in outcomes in patients treated by wrist splint or the forearm brace. They used a wrist splint with a 20-30 degree of dorsiflexion and mentioned that maybe by slightly modifying the angle or degree of the wrist dorsiflexion may change the outcome. We used a splint with aluminium core that will allow the wrist to stay in 5 to 10 degree of wrist dorsiflexion. The results show slightly better outcome in pain and function by using this brace. But this does not have statistically significant difference. A similar study was done by Garg et al, which showed results with slightly better outcome in wrist splint group than the elbow braces.[15] They used different outcome measures compared to our study. We used the patient rated tennis elbow evaluation scale as it not only measures pain at rest but also grades pain at regular activities. The PRTEE score has better reliability and sensitivity compared to other scoring systems available today.[16,17] We also used the hand grip score to actually measure the functional outcome of the study. The VAS score during grip strength measurement gave us a measure to see how pain and grip strengths vary with treatment.

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The results show that there is significant improvement in symptoms and function in both groups. The use of wrist splint or elbow brace reduces the activity of the affected arm and thereby improving the symptoms in both the groups. The wrist splint group had a complete wrist movement restrictions. The patient with elbow brace were allowed to use the hand for daily activities with the brace on, but most patients later reported that they avoided using the affected arm completely. This may have brought a bias in outcomes wherein both the groups stopped the activity of the affected arm completely. The use of anti-inflammatory medications was recommended by the ethical board as patients to be included were acute and severe presentation. We did not differ in duration or content of medications prescribed, so both groups received same medications and for same duration.

The demographics show that it occurs most commonly in dominant hand as per the increase in activity which increases the wear and tear and thereby degenerative tendinitis. Males were affected most commonly. We assume this to be related to work and activity related, as no other variable was studied to link the increase in tennis elbow in males. Most common age group was seen in 31-40 age which is clearly the age group of transition between young adults and middle age. This is the workforce group as well as the degeneration occurs rapidly in this group.

We observed certain limitations in our study, wherein we did not compare the outcome with the control group which were not given any treatment. We also feel 144 patients is a small study group. We did not include patients with previous treatment for the tennis elbow. We feel the need to study the effect of these modalities in previously treated and now recurred patients.

Conclusion:

The use of wrist splint significantly improved the symptoms of the tennis elbow. The outcome is comparable to use of tennis elbow brace. The outcome is not statistically significant if compared between the two groups. We found the final outcome of both the groups to be the same. The change in degree of wrist extension seems to make no statistical difference in outcome between using of elbow brace and the wrist splint.

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Appendix A[16]

PATIENT-RATED TENNIS ELBOW EVALUATION

Name: Date:

The questions below will help us understand the amount of difficulty you have had with your arm in the past week. You will be describing your average arm symptoms over the past week on a scale 0-10. Please provide an answer for all questions. If you did not perform an activity because of pain or because you were unable, then you should circle a "10". If you are unsure please estimate to the best of your ability. Only leave items blank if you never perform that activity. Please indicate this by drawing a line completely through the question.

1. PAIN in your affected arm											
Rate the average amount of pain in your arm over the past week by circling the number that best describes your pain on a scale from 0-10. A zero (0) means that you did not have any pain and a ten (10) means that you had the worst pain imaginable.											
When you are at rest	0	1	2	3	4	5	6	7	8	9	10
When doing a task with repeated arm movement	0	1	2	3	4	5	6	7	8	9	10
When carrying a plastic bag of groceries	0	1	2	3	4	5	6	7	8	9	10
When your pain was at its least	0	1	2	3	4	5	6	7	8	9	10
When your pain was at its worst	0	1	2	3	4	5	6	7	8	9	10
2. FUNCTIONAL DISABILITY											
A. SPECIFIC ACTIVITIES: Rate the amount of difficulty you experienced performing each of the tasks listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0 -10. A zero (0) means you did not experience any difficulty and a ten (10) means it was so difficult you were unable to do it at all											
Turn a doorknob or key	0	1	2	3	4	5	6	7	8	9	10
Carry a grocery bag or briefcase by the handle	0	1	2	3	4	5	6	7	8	9	10
Lift a full coffee cup or glass of milk to your mouth	0	1	2	3	4	5	6	7	8	9	10
Open a jar	0	1	2	3	4	5	6	7	8	9	10
Pull up pants	0	1	2	3	4	5	6	7	8	9	10
Wring out a washcloth or wet towel	0	1	2	3	4	5	6	7	8	9	10
B. USUAL ACTIVITIES: Rate the amount of difficulty you experienced performing your usual activities in each of the areas listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0 -10. By "usual activities", we mean the activities that you performed before you started having a problem with your arm. A zero (0) means you did not experience any difficulty and a ten (10) means it was so difficulty you were unable to do any of your usual activities.											
1. Personal activities (dressing, washing)	0	1	2	3	4	5	6	7	8	9	10
2. Household work (cleaning, maintenance)	0	1	2	3	4	5	6	7	8	9	10
3. Work (your job or everyday work)	0	1	2	3	4	5	6	7	8	9	10
4. Recreational/sporting activities/driving	0	1	2	3	4	5	6	7	8	9	10

Comments:

Scoring Instructions minimize non response by checking forms when patients complete them. Make sure that the patient left an item blank because they could not do it, that they understand that should have recorded this item as a "10". If patients are unsure because they have rarely performed an activity in the past week, then they should be encouraged to estimate their average difficulty. This will be more accurate than leaving it blank. If they never perform an activity they will not be able to estimate and should leave it blank. If items from a subscale are left blank, then you can substitute the average score from that subscribe.

Total score = Pain subscale + Function subscale

Best score = 0, Worst Score = 100

Pain and disability contribute equally to score

Reliability of subscales and total score are sufficiently high that both subscales and total are reportable.

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