THE EFFECT OF STRETCHING AND STRENGTHENING EXERCISE IN THE MANAGEMENT OF LATERAL EPICONDYLITIS

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Abstract

Background: Lateral Epicondylitis (LE) is a common overuse injury of Elbow that generates pain over the lateral aspect of elbow. LE is one of the most common causes of elbow and forearm pain encountered in clinical practice commonly associated with resistant wrist or finger extension and gripping activities. The management of LE is enlightened by various form physical modalities and therapeutic exercise like stretching and strengthening exercise. The purpose of this prospective study was to investigate the effects of stretching and strengthening exercises on pain and grip strength of LE. **Materials and methods :** Eighty patients were enrolled, non-randomized, and divided into 2 groups an experimental Group-A of 40 (44.5 ± 1.5 years) whose receive therapeutic exercise in the form of stretching and strengthening of common extensor forearm muscle and a control Group-B of 40 (41.4 ±2.5 years). Study duration was about one year. Both Group received UST over the lateral aspect of elbow with the 3MHz frequency and 0.5 watt/cm^2 intensity for 5 min three sessions per week for six weeks. They were evaluated at every weeks of treatment for six weeks. Comparison between Group-A and Group-B was done with Wilcoxon Rank sum test and unpaired t-test. **Results:** By the end of the trial period, statistical data analysis in between the two groups showed a significant improvement in pain scores of VAS and the maximal isometric grip strength at sixth week. **Conclusion:** This study depicts that therapeutic exercise is more effective in reducing pain and improvement of grip strength. So, stretching and strengthening exercise should be considered as a main therapeutic armamentarium in the management of LE.

Key words: Lateral epicondylitis; Stretching and Strengthening exercise; VAS; Isometric grip strength.

Introduction

Lateral Epicondylitis (LE) is a condition involving the wrist extensors at the lateral epicondyle, which was first described by Runge in 1873 as 'schreiberkrampfe' translates as 'writer cramp'. condition was described as secondary to an improper backswing[1-2]. Insidious onset of pain may radiate distally towards the forearm. Pain is exacerbated with resisted wrist extension or repetitive wrist movements, especially with full elbow extension[3]. Symptoms usually have an exacerbation and remission episode of 6 months, but it can persist up to 2 years.Patients also may complain of weakness in grip strength with attempts to grasp or carry objects. Typically they have transient symptom relief with activity modification or relative rest[4]. It produces disability and significant workdays lost.The common term 'tennis elbow' is misleading, as only 5% of cases are associated with racquet sports[5]. However, approximately 50% of tennis player will suffer from this condition at one point in their carrier, with a high predilection for novice players. LE may develop as a result of a single trauma to the lateral elbow[6]. This condition typically presents in the dominant elbow of 45 to 54 years of patient, with equal gender involvement. The prevalence of LE is estimated to be 1.3% to 2.8% in the general population and up to 15% in the high-risk occupation[7]. High-risk occupations include people performing combination of repetitive and forceful movements of the arms[8]. The Extensor Carpi Radialis Brevis (ECRB) is the most common muscle involve with this, and was described by Cyriax in 1936[9]. Predisposing factors

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may include repetitive microtrauma and poor vascularization of the ECRB[10]. Maximal point tenderness located at or within 2 to 5 cm anterior and distal to it. Provocation maneuvers as reveled by Cozen's test, is considered positive if pain occurs at the lateral epicondyle of a fully extended elbow with resisted wrist extension[11]. Although the signs and symptoms of LE are clear and its diagnosis is easy bit, no ideal treatment yet available. Most of the clinicians advocate a conservative approach the main stay of treatment[12]. Exercise program is most common option for conservative treatment[13]. A wide array of physiotherapy have been recommended for the management of LE[14]. Exercise program consisting of eccentric and static stretching has shown good clinical results in LE[15]. Optimal time for holding this stretching position vary, ranging from as little as 30s to as much as 60s[16]. Static stretching is defined as passively stretching a given muscle-tendon unit by slowly placing it in a maximal position of stretch and sustaining it there for an extended period of time[17]. Two types of exercise program: home and supervised exercise program carried out in a clinical setting. A home exercise program is commonly advocated for patients with LE and the patient visits the therapist once or twice per week for further instructions; whereas in the supervised exercise program carried out in the clinic, the patient visit the clinic every day to follow the exercise program under supervision of the therapist[18]. This maximal stretching position is determined by the moderate discomfort and/or pain that the patient experiences[19]. Strengthening Exercises essentially three forms such as: i) Isometric ii) Concentric iii) Eccentric. Most physiatrist agree that eccentric contractions appear to have the most beneficial effects for the treatment of LE[3]. Flexibility has been defined as the range of motion possible about a single joint or through a series of articulations[20]. Static stretching exercises are individualized by patient feedback as to the discomfort and/or pain experienced during the procedure. The best stretching position result for the ECRB tendon is achieved with the elbow in extension,forearm in pronation and wrist in flexion and with ulnar deviation.

Materials and methods

A prospective study was carried out in the Department of Physical Medicine and Rehabilitation, Bangabandhu Shiekh Mujib Medical University (BSMMU) Dhaka over a period from 1st July 2016 to 30th June 2017. A total of 80 patients of lateral epicondylitis enrolled in our study according to inclusion and exclusion criteria irrespective of sex. The diagnosis of LE was confirmed by history and clinical examination. The selected patients were non-randomly divided into two groups on the basis of the admission. Among the selected 80 patients, the even numbered (2, 4, 6 and so on) were included in Group A (Experimental group) and odd numbered in Group B (Controlled group). The inclusion criteria were patients aged >20 years and <80 year of age , pain lasting for more than three month in the lateral elbow region, tenderness over the lateral elbow region, pain over the lateral elbow region during resisted active extension of the wrist, patients with pain Score and tenderness Index of 3 were only included as study population and patient with infection, malignancy and systemic illness (Diabetes Mellitus) polyarthritis, patient with cervical radiculopathy, concomitant tenderness present in other bony prominence in case of enthesitis were excluded from the study. Data were collected from the selected patients using a semi structured questionnairestarting from demographic characteristics, clinical history, a detailed clinical examination, preoperative findings and postoperative outcome including complications. Outcome measures were by VAS, Isometric maximal grip strength. Data were processed and analyzed with the help of SPSS (Statistical Package for Social Sciences) for Windows, version 11.5. Descriptive statistics were used to analyzed the data. The categorical data were compared between groups using Wilcoxon Rank sum test and unpaired t-test, Level of significance was set at 0.05 and $p< 0.05$ was considered significant. The summarized findings of data analyses were presented in the form of tables and figures with due statistical interpretation.

Clinical Intervention

Study participants were requested to continue their normal activities and avoid otherforms of treatment during study period. The Subjects other than the designated protocol were not permitted to administer any other forms of electrotherapy or other techniques (Steroids, acupuncture) during the intervention period of thetrial. Group-A (Experimental group): In this group 40 patients were given Stretching and Strengthening exercises and

conventional therapy i.e Ultrasound Therapy (UST) deep transverse friction massage, use counter force brace, and advice regarding activities of daily living. Group-B (Controlled): In this group 40 patients received conventional therapy as mention above and advice regarding activities of daily living. The treatment for each group was continued for six weeks when other treatment modalities were prohibited. Patient's assessment was done on VAS score, Tenderness index, and isometric grip strength testing every week for six weeks.

Stretching and Strengthening Exercise

Stretching exercise: Stretching exercise was given as follows. Each type of exercise hold 15 to 30 second and repeat 5 times, twice daily.

i) *Wrist extensor stretch:* Extend your arm in front of you with your palm up, than palm down.Bend your wrist, pointing your hand toward the floor.With your other hand, gently bend your wrist further until you feel a mild to moderate stretch in your forearm. Hold for at least 15 to 30 seconds.

ii) Reverse prayer stretch: Start with the backs of your hands together in front of you at your waistline.Slowly bring your wrists up toward your face by bending your elbows until you feel a mild to moderate stretch in your forearms, keep the backs of your hands together and your hands close to your body.Hold for 15 to 30 seconds.

iii) *Thumb stretch:* Place your forearm on a table with your thumb pointing upward and your hand hanging over the edge of the table. Lower your thumb toward the base of your little finger and close your hand into a fist. Slowly lower your hand so your little finger moves towards the floor (As if you are shaking hands) Hold for 15 to 30 seconds.

Strengthening Exercises are Given by Following Method

A. Finger extension: Place a rubber band around all five finger tips. Spread fingers 25 times, repeat 3 times. If resistance is not enough, add a second rubber band or use a rubber band of greater thickness which will provide more resistance

B. Ball squeeze: Place rubber ball or tennis ball in palm of hand, squeeze 25 times, repeat 3 times. If pain is reproduced squeeze a folded sponge or piece of foam.

C. Wrist Extension: Place 1 lb. weight in hand with palm facing downward (Pronated) supports forearm at the edge of a table or on your knee so that only your hand can move. Raise wrist/hand up slowly (concentric contraction), and lower slowly (eccentric contraction).

D. Wrist Flexion: Place 1 lb. weight in hand with palm facing upward (supinated); support forearm at the edge of a table or on your knee so that only your hand can move. Bend wrist up slowly (Concentric) and thenlower slowly (Eccentric) (Similar to exercise above).

Assessment of Outcome

All the patients to be assessed baseline Score then weekly for six weeks and the results will be recorded in the data sheet. The data sheet will be coded without the name of the patient. The following factors will be considered comparing the treatment.

- *Maximal grip strength:* Grip strength is a reliable, objective measure of isometric strength of hand.[21] Maximum isometric grip strength was measured in kilograms using Jamar hydraulic hand dynamometer. Measurement was taken with subject in sitting, elbow flexed at 90 degree with forearm in neutral position and wrist in extension and ulnar deviation. Three measurements were made and maximum value of repetitions was recorded. Reliability and validity of Jamar dynamometer is already established.[21]
- *Patients assessment of pain score:* Visual Analogue Scale (VAS): The VAS has been widely used and is considered to be a robust, sensitive and reproducible method of expressing pain severity. The extreme limits of this scale are defined in terms of pain severity, with no pain entered at the lower end and agonizing at the upper end. Following treatment patients are required to put a mark on the line between the two extremes indicating their degree of pain relief in this 1-10 scale.

Results

We treated 80 patient, among them 40 were in Group A, other 40 in Group B. 45% of patients in Group-A were young adult ranges from 20-40 years , Whereas in Group-B, 45% were 41-60 years old, The mean ages of Group A and Group B were recorded as 44.5 ± 1.5 and 41.4 ± 2.5 years respectively. Most of the patients in either group (70% in Group-A and 75% in Group-B) were male.The outcome measurement of pain score

measured by VAS , functional impairment measured by isometric grip strength with hand dynamometer taken on 1st day as base line assessment then weekly for six weeks. The age and sex distribution of the study population are illustrated in table I. Most of the patients have gradual onset of pain found in this study (62.5% in Group A and 60% in Group B). There was no significant difference between the groups in terms of onset of pain (p =0.485). Though the data was not normally distributed, Wilcoxon matched-pairs signed test was applied for comparison of pretreatment and post treatment pain scores as on VAS within Group A and Group B and Wilcoxon ranked sum (Mann-Whitney) test was applied for comparison of post treatment VAS score between Group A and Group B. By analyzing pain scores with VAS as outcome measurement, obtained results revealed post treatment improvement in both group. In comparison of post treatment VAS score between groups, experimental group found remarkable improvement (Table II, III and Figure-1). By analyzing data of isometric grip strength as outcome measures for both the groups, following results were obtained. Improvements of Post treatment isometric grip strength were noticeable in experimental Group-A (Table IV, V).

Table I : Age and sex distribution of patients between groups (n=80)

Age	Group A (n1 = 40)	Group B (n2 =40)	p-Value
20 – 40	18(45.0)	14(35.0)	
41 – 60	14(35.0)	18(45.0)	0.607
61 – 80	8(20.0)	8(20.0)	
Sex			
Male	28(70)	30(75)	0.412
Female	12(30)	10(25)	

Table II: Comparison of pretreatment and post treatment pain scores as on VAS within Group A and Group B

Group	Pretreatment		Post treatment		W value	p value
	Mean	SD	Mean	SD		
Group A	6.50	1.59	2.40	1.15	115	<0.0001
Group B	6.25	1.30	4.50	1.28	115	<0.0005

Table III: Comparison of post treatment VAS score between Group A and Group B

Group	Mean	SD	W value	p value
Group A	2.400	4.667	146.50	0.0003
Group B	4.500	1.355	315.50	

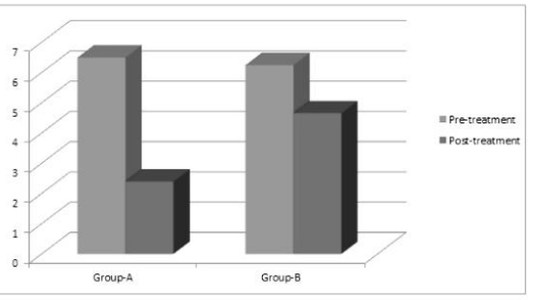

Fig 1 : Comparison of mean VAS Score in both groups

Table IV : Comparison of pretreatment and post treatment maximal isometric grip strength within Group A and Group B

Group	Pretreatmentisometric grip strength (In kg.)		Post treatment isometric grip strength (In kg.)		t value	p value
	Mean	SD	Mean	SD		
Group A	18.540	5.272	28.540	9.751	9.232 with 14 d.f.	<0.0001
Group B	17.133	5.371	20.911	5.708	5.469 with 14 d.f.	<0.0005

Table V: Comparison of post treatment isometric grip strength between Group A and Group B

Group	Mean	SD	t value	p value
Group A	28.540	9.751	2.751 with 28 d.f.	0.0131
Group B	20.911	5.708		

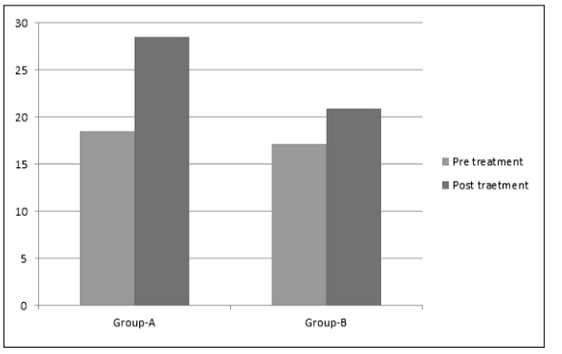

Fig 2 : Comparison of isometric grip strength in both groups

Discussion

The outcome of this study showed that reduction of pain, improvement in functional status and improvement of isometric grip strength was evident in both groups. The results showed that stretching and strengthening exercise when given along with conventional therapy resulted in significantly better in terms of subjective and objective outcomes then conventional therapy alone in patients with

chronic LE. It was suggested that tissue experiencing lower strain, predisposes to some specific regions of the tendon to structural weakening[22]. It causes difficultyin performing patient'sactivitiesof daily living. Pain and tenderness is the main characteristic of tennis elbow that elicit on direct palpation over the lateral epicondyle of elbow and with gripping activities. VAS is the most commonly used scale to observe the subjective pain therefore it was taken as an outcome measure[23]. According to Pienemakithere is a strong association between pain on palpation at the lateral epicondyle, pain provocation by manual tests and maximum grip strength[24]. According to Stratford et al the maximum grip strength demonstrated as outcome measurement tool in response to an intervention[25]. The therapeutic modality given in the form of ultrasound. Pain was relieved after applying ultrasound by directly influencing the transmission of painful impulses by eliciting changes within the nerve fibers and elevating pain threshold. Whereas indirect pain reduction occurs as a result of increased blood flow and increased capillary permeability to the affected area. In this experimental group, stretching and strengthening exercises given. As it was hypothesized according to Pienemaki et al (1996), stretching and strengthening of common origin of wrist extensors muscleimprove wrist movements of the subjects[26]. Pain at rest and during activity reduced significantly more in experimental group than controlled group. It's revealed that exercises in the form of stretching and strengtheningof common extensor of wrist may have an effect on pain perception of patients. Patient's occupationalcharacteristics affect the working ability, Different types of activities produce different pattern of strains in the upper limb, and therefore it's important to observe the change in ability to work and grip strength of the study population. In the experimental group,functional outcome and grip strength improved significantly, hence improvement occurs in the ability to do their schedule work thanthe control group.The rationale of stressing exercises origin of ECRB through progressive eccentric and concentric resistance exercises results in the production of a dense collagenous scar in the area of attachment; thus, pain is eliminated. This idea is supported by the work of Curwin and Stanish,who wrote that the tension created through eccentric contractions allows the formation of new fibrous tissue at the musculotendinous unit, making it more resistant to damage[27]. Literatures suggest that strengthening and stretching exercise both are main components of exercise program, because tendons must have sufficient flexibility before strengthening.The exercise treatment used in this study started with soft tissue-stretching and strengthening exercises. As a whole we exercised muscles, tendons and ligaments and also the osteotendinous insertion region in experimental group, we advised to patient show to perform activities of daily living.The results were in support to the study carried out by Pienimaki et al (1996) to explore effectiveness of progressive stretching strengthening exercise to compare this treatment with the results of local pulsed ultrasound in chronic lateral epicondylitis[26]. Martinez et al studied the comparative effectiveness of a home exercise program including stretching alone versus stretching supplemented with eccentric or concentric strengthening among ninety four subjects for six week. He concluded that significant improvement occur in all three group in with pain-free grip strength, Patient-rated Forearm Evaluation Questionnaire and visual analog pain scale[27,28]. The findings were consistent with the findings of the experimental study.

Limitation

Limitation of our study were:

i) The sample size was small so the results cannot be generalized to overall population

ii) Long term follow up was not taken to provide results about endurance

iii) Supervised exercise program was not given among the patients.

Conclusion

Stretching and Strengthening exercises program along with conventional physical therapy intervention and modification of daily activities is more effective in terms of relieving pain, improving functional capability and improving pain free maximal isometric grip strength than conventional physical therapy alone in patients having lateral epicondylitis. Therefore the study concluded that stretching and strengthening exercise helps early recovery from the condition with most of the cases experiencing improvement of pain (Both in terms intensity and frequency) and tenderness.

Recommendation
Further studies with increased number of patients and long term follow up are needed, supervised exercise program will be more authentic for the better outcome.Multi centered & long duration studies are required.

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Contribution of authors
MNK: Conception, acquisition of data drafting and final approval.
SMA: Interpretation of data, critical revision and final approval.
MAE: Design, interpretation of data and final approval.
FN: Data analysis, manuscript drafting and final approval.

Disclosure
All the authors declared no competing interest.

References
1. Runge F. ZurGenese und Behandlung des Schreibekrampfes, Berliner KlinWochenschr. 1873;10:245-248.

2. Morris H, Rider's sprain. Lancet Prevalence, incidence and remission rates of some common rheumatic disease and syndromes.Marc C. Hochberg, Alan J. Silman, Josef S. Smolen.Elseiver Health Science. 2010; 2 :557.

3. Kraushaar B, Nirschl R. Current concepts review–tendinosis of the elbow (Tennis elbow). Clinical features and findings of histological, immune histo-chemical and electron microscopy studies.J Bone Joint Surg. 1999; 81:259–285.

4. Calfee R et al. Management of lateral epicondylitis current concepts. J Am AcodOrthopSurg. 2008:16;19-29.

5. PaoloniJa et al. Randomized, double-blind, placebo-controlled clinical trial of a new topical glyceyltrinitrate patch for chronic lateral epicondylosis. Br. J Sports Med. 2009, 299-302.

6. LaBan MM et al. Occult Periarthrosis of the Shoulder.A possible progenitor of Tennis Elbow.Am J phys Med Rehabil. 2005: 84(11) 895-898.

7. Shiri et al. Prevalence and determinants of lateral and medial epicondylitis a population study. Am J Epidemol. 2006;164 (11):1065-1074.

8. Nikhil N. Verma M. Tennis Elbow Causes and Risk Factors [Internet]. Sports-health. 2018 [Cited 31 December 2018]. Available from: https://www.sports-health.com/sports-injuries/elbow-injuries/tennis-elbow-causes-and-risk-factors.

9. Cyriax JH. The pathology and treatment of tennis elbow. J Bone joint Surg Am. 1936;4:921-940.

10. Schneeberger AG. Arterial vascularization of the proximal extensor carptradialisbrevistendon. ClinOrthopRelat Res. 2007;71:475-479.

11. Malanga, GA and Nadler S. Musculoskeletal Physical Examination. an Evidence based Approach. Philadelphia, PA: Elsevier Mosby. 2006.

12. Vicenzine B, Wright A. Lateral epicondylalgia. I. Epidemiology, pathophysiology, aetiology and natural history. PhysTher Rev. 1996;1:23-34.

13. Noteboom T, Cruver S, Keller A. et al. Tennis elbow: a review. J Orthop Sports physTher 1994;19:357-66.

14. Trudel D, Duley J, Zastrow I, Kerr EW, Davidson R, MacDermid JC. Rehabilitation for patients with lateral epicondylitis: A systematic review. J Hand Ther. 2004;17:243-266.

15. Manias P, Stasinopoulos D.A. controlled clinical pilot trial to study the effectiveness of ice as a supplement to the exercise programme for the management of lateral elbow tendinopathy. Br. J Spors Med. 2006;40:81-85.

16. Webright WG, Randolph BJ, Perrin DH. Comparison of nonballistic active knee extension in neural slump position and static stretching techniques on hamstring flexibility. J Orthop Sports PhysTher. 1997;26:7–13.

17. Selvier T, Wilson J. Methods utilized in treating lateral epicondylitisPhysTher Rev 2000;5: 117-124.

18. Stanish W, Curwin S, Mandell S. Tendinitis: its etiology and treatment. Oxford: Oxford University Press. 2000.

19. Stasinopoulos D, Stasinpoulos I. Comparison of effects of Cyriaxphyositherapy, a supervised exercise programme add polarized polychromatic non-coherent light (Bioptron light) for the treatment of lateral epicondylitis. ClinRehabil. 2006;20;12-23.

20. Alter M. Sport stretch, 2nd ed. Champaign, IL: Human Kinetics, 1996.Publication. 1997.

21. Mathiowetz V, Weber K, Volland G, Kashman N. Reliability and validity of grip and pinch strength evaluations. The Journal of hand surgery. 1984;9(2):222-226.

22. Oatis, C. Kinesiology. 2nd ed. Philadelphia, etc.: Lippincott Williams & Wilkins. 2010;307.

23. Woo SL, Buckwalter JA. Injury and repair of the musculoskeletal soft tissues. Savannah, Georgia, June 18–20, 1987. Journal of Orthopaedic Research. 1988;6(6):907-931.

24. Pienimäki T, Tarvainen T, Siira P, Malmivaara A, Vanharanta H. Associations between pain, grip strength and manual tests in the treatment evaluation of chronic tennis elbow. The Clinical journal of pain. 2002;18(3):164-170.

25. Stratford P, Lavy D, Gowland C. Evaluative properties of measures used to assess patients with lateral epicondylitis at the elbow. Physiotherapy Canada. 1993;45:160-164.

26. Tunomo T Pienmaki, VAnharanta H. Progressive strengthening and stretching Exercises and Ultrasound for Chronic Lateral Epicondylitis. Physiotherapy. 1996;82(9):522-530.

27. William D Stanish, Sandra Curwin and Scott Mandell. (Pp 140) Tendinitis: its etiology and treatment. British journal of sports medicine. 2001;35(2):139. Oxford University Press, 2000. ISBN 0 19 263582 2.

28. Martinez-Silvestrini JA, Newcomer KL, Gay RE, Schaefer MP, Kortebein P, Arendt KW. Chronic lateral epicondylitis: Comparative effectiveness of a home exercise program including stretching alone versus stretching supplemented with eccentric or concentric strengthening. Journal of Hand Therapy. 2005;18(4):411-420.