



Original Article

Comparative Study to Observe the Effect of TENS and UST in Lateral Epicondylitis

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Abstract

Background: Lateral Epicondylitis (LE), also known as "Tennis Elbow," affects the upper extremities. Many management methods were tested in clinical studies. No single strategy works. Therapeutic ultrasonography can cure lateral epicondylitis noninvasively and cheaply. Several studies found a placebo effect. TENS for lateral epicondylitis is popular due to its low cost, ease, non-invasiveness, and limited contraindications.

Objective: The study compares UST and TENS for lateral epicondylitis.

Methods: After protocol approval, the DMCH Physical Medicine and Rehabilitation department conducted this six-month randomized clinical experiment. Lateral epicondylitis outpatients were invited. 30 TENS patients and 30 UST patients had lateral epicondylitis. Lottery randomization (1:1) separated them into two groups for data analysis: Group A: transcutaneous electrical nerve stimulation, NSAIDs, omeprazole, therapeutic exercise; Group B: ultrasonography therapy. All patients got conservative treatment and therapeutic exercise for 6 weeks. Final follow-up was 6 weeks following initial appointment. Participants provided written consent. SPSS 21 analyzed data.

Results: The study population's mean age was 38.78 ± 6.09 SD (years) [31-50 years], with 54.1% male and 44.3% female. The mean age of UST and TENS groups was 39.53 ± 6.16 and 38.03 ± 6.01 SD (years), respectively, and age distribution was similar ($P > .05$). 93% of patients involved the right hand, 7% the left. Baseline grip strength and VAS scores were 33.63 ± 7.1 and 33.80 ± 8.38 in UST and TENS groups, respectively. Before intervention, the group distribution was homogenous ($p > 0.05$). After 6 weeks, both groups showed significant improvement in VAS score and grip strength (UST- 2.50 ± 1.43 vs TENS 3.40 ± 0.97 and UST- 40.63 ± 7.66 vs TENS 38.50 ± 9.06 ; $p < .001$). Over six weeks, UST group had greater VAS and grip strength changes than TENS group ($p < 0.001$).

Conclusion: Lateral epicondylitis treatment is better with UST than TENS. However, a bigger randomized controlled trial is advised due to the study's small sample size.

Keywords: TENS, UST, Lateral Epicondylitis

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Introduction

Lateral epicondylitis, also known as tennis elbow, is a pathology characterized by pain over the lateral aspect of the elbow.¹ It occurs most often between the third and sixth decades of life and usually affects the dominant arm.² This painful condition of the elbow occurring in 1–3% of the population. Reported overall age and sex-adjusted incidence of lateral epicondylitis is 3.4 per 1000, with a higher incidence among male and female

patients 40 to 49 years old and 50 to 59 years old, respectively.³ It commonly been attributed to the inflammation and is thought to result from overuse of the extensor carpi radialis brevis (ECRB) muscle by repetitive microtrauma resulting in a primary tendinosis of the extensor carpi radialis brevis, with or without involvement of the extensor digitorum communis (EDC).⁴ In tennis, the predominant activity of the wrist

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extensors in all strokes might be one explanation for predisposition to the condition.⁵ However, this can happen in general population due to overuse of the tendon due to any reason mostly associated with work-related activities. Data suggest that, about fourteen percentage of diagnosed lateral epicondylitis patients were associated with work-related activities that involve repetitive and forceful wrist and hand functions.⁶ The most common symptom is pain which is aggravated by gripping, heavy lifting, or simple tasks of daily living. This symptoms including pain and loss of function compels the patients to withdraw themselves from daily activities.⁷ It has been estimated that up to 30% of patients reporting time off work amounting to an average 4–5 absent work days.⁸ The Pain does not usually persist for longer than 12 months, and over 80% of patients would be expected to be better (complete or partial recovery) by within a year.⁹

Although the disease is known since long time but there is no general agreement on the precise aetiology and pathophysiology of lateral epicondylitis. For that reason, no definitive guidelines are available for the treatment of this significantly painful and incapacitating condition.¹⁰ More than 40 treatment methods have been recommended for lateral epicondylitis over the decades.¹¹ Among them non-steroid anti-inflammatory drugs along with splinting, exercises, massage, manual therapy, physiotherapy were commonly practiced by the physicians.¹² Besides these, local injection therapy, and even sometimes surgery is indicated in refractory cases. Nevertheless, still no single treatment is clearly effective in the majority of patients.¹³ For that reason, use of instrumental electro physical modalities, ranging from ultrasound, extracorporeal shock wave therapy (ESWT), transcutaneous electrical nerve stimulation (TENS) to laser therapy were trialed for several times and have been practiced for the treatment of lateral epicondylitis in recent years.¹⁴ Ultrasonography, is thought to be helpful for lateral epicondylitis particularly due to its thermal and mechanical effects on the target tissue leading to increased metabolism, circulation, extensibility of connective tissue, and tissue regeneration. However, several randomized, double-blind, placebo-controlled trial found these tools is not much effective for a large treatment effect than placebo.¹⁵ Whereas, Schleicher *et al.*, concluded that during the acute phase ultrasound is helpful.¹⁶ Transcutaneous electrical nerve stimulation (TENS) is an inexpensive, safe, non-pharmacological form of analgesia. It can be used in various clinical settings.¹⁷ Studies suggest that it have beneficial effects in treatment of lateral epicondylitis. Moreover, as it is simple to apply, it promotes self-management. Shin *et al.*, showed a decrease in mean pain intensity after 5 days, but the brief treatment period and small sample (n = 12 per group) restrict robust inferences.¹⁸ Weng *et al.*, showed a positive outcome for TENS and a reduction in pain.¹⁹

Objectives

To find out the comparative effectiveness of TENS over UST in lateral epicondylitis.

Methods

After protocol approval, the DMCH Physical Medicine and Rehabilitation department conducted this six-month randomized clinical experiment. Lateral epicondylitis outpatients were invited. 30 TENS patients and 30 UST patients had lateral epicondylitis. Lottery randomization (1:1) separated them into two groups for data analysis: Group A: transcutaneous electrical nerve stimulation, NSAIDs, omeprazole, therapeutic exercise; Group B: ultrasonography therapy. All patients got conservative treatment and therapeutic exercise for 6 weeks. Final follow-up was 6 weeks following initial appointment. Participants provided written consent.

Inclusion Criteria

Age: 30 to 50 years

Sex: Both sex

Pain lasting for more than 3 weeks over lateral epicondyle of dominant hand

Tenderness over lateral elbow region of dominant hand

Pain with any two of the following three tests:

Exclusion Criteria

Bilateral lateral epicondylitis.

Any nodule ulcer or ganglion on lateral epicondyle.

Any surgery around elbow.

Trauma over elbow.

Systemic metabolic disease- DM, thyroid disease.

Chronic inflammatory diseases-Rheumatoid arthritis,

Seronegative spondyloarthopathy.

Cervical spondylosis.

Carpal tunnel syndrome.

Intralesional injection over the site with corticosteroid or local anesthetic in last 6 months.

Any peripheral nerve injury.

Data Processing and Analysis

Statistical analysis was performed using the statistical program Statistical Package for Social Science (SPSS) version 21.0. Continuous variables (age, etc) were expressed as mean $\pm$ SD and comparison of both group was measures by student-t test. Nominal variables (gender etc.) were expressed as number and percentage. For comparisons between means of same groups in different time was calculated by paired t-test and comparison in between group was measured by independent-t test. In all cases statistical significance was considered < 0.05 .

Results

Out of 60 LE patients, majority were from age group 30 to 35 years. The mean age of patients was 38.78 ± 6.09 . Minimum age of the patients was 30 and maximum age of the patients was 50.

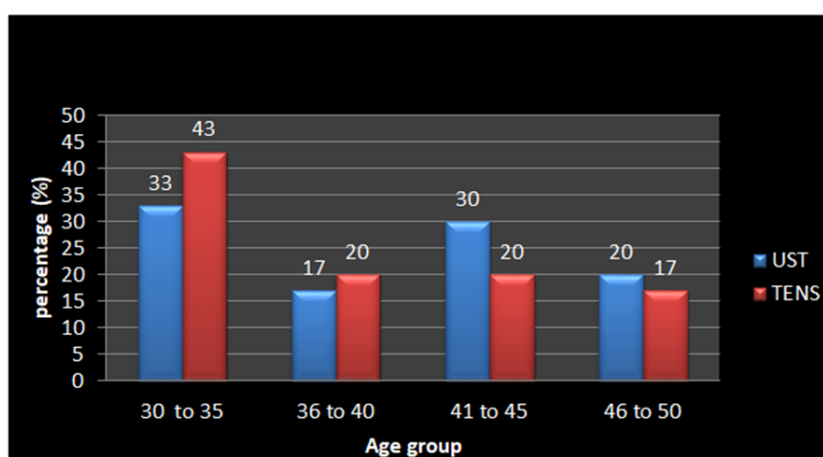


Figure 1: Age distribution of the patients

Overall, 54.1% patients were male and 44.3% patients were female. Of 30 patients in UST group, 60% were male and 40% were female. Similarly, in TENS group, 50% was female and 50% were male patients.

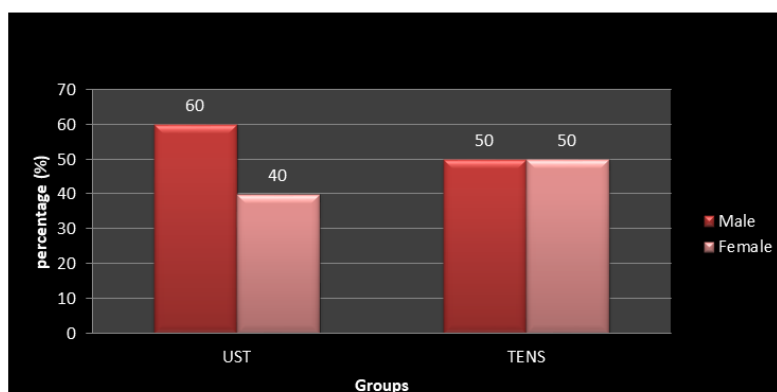


Figure 2: Sex distribution of the patients

Of 60 patients, majority 97% patients had tenderness, 17% patients had swelling and 7% patients had elevated joint temperature as the symptoms of lateral epicondylitis. Only 2% patients had crepitus in joint movement. Total of 33% patients had pain for last two to six months. Long term pain like pain duration for more than one year was common for 28% patients. 22% patients had pain for less than one month and 17% patients had pain for last seven months to one year.

Table 1: Clinical presentation and duration of pain among patients (n=60)

Clinical presentation	Frequency	Percentage (%)
Tenderness	58	96.7
Swelling	10	16.7
Elevated joint temperature	04	6.7
Crepitus in joint movement	01	1.7
Positive Cosen's test	60	100%
Positive Mill's test	60	100%
Duration of pain		
Less than one month	13	21.7
Two to six months	20	33.3
Seven months to one year	10	16.7
More than one year	17	28.3

The baseline VAS score was 7.47 ± 1.28 in UST group and 7.07 ± 1.63 in TENS group. The difference was not statistically significant ($p > 0.05$). Base line grip strength was 33.63 ± 7.21 in UST and 33.80 ± 8.38 in TENS group. The distribution was homogenous ($p > 0.05$).

Table 2: Comparison of baseline data between two groups for Grip strength and VAS (n=60)

Variables	Groups	Baseline (mean $\pm$ SD)	P-value
VAS	UST	7.47 ± 1.28	0.24
	TENS	7.07 ± 1.63	
Grip Strength	UST	33.63 ± 7.21	0.93
	TENS	33.80 ± 8.38	

P-value is determined by independent samples T-test

For UST, the VAS and grip strength both had significant ($p < 0.05$) changes from (7.47 ± 1.30) to (2.50 ± 1.43) and (33.63 ± 7.21) to (40.63 ± 7.66) respectively. Also, for TENS, the VAS and grip strength both has significant ($p < 0.05$) changes from (7.07 ± 1.63) to (3.40 ± 0.97) and from (33.80 ± 8.38) to (38.50 ± 9.06).

Table 3: Comparison of baseline data and week 6 data for Grip strength and VAS for both groups, (n=60)

Variables	Groups	Baseline (mean $\pm$ SD)	Week 6 (mean $\pm$ SD)	P-value
VAS	UST	7.47 ± 1.30	2.50 ± 1.43	<0.001
	TENS	7.07 ± 1.63	3.40 ± 0.97	
Grip Strength	UST	33.63 ± 7.21	40.63 ± 7.66	<0.001
	TENS	33.80 ± 8.38	38.50 ± 9.06	

P-value is determined by paired-t test

The changes in VAS and grip strength over six weeks was significantly higher in UST group than TENS group ($p < 0.001$).

Table 4: Comparison of changes in VAS and Grip strength between two groups

Variables	UST (mean $\pm$ SD)	TENS (mean $\pm$ SD)	P-value
VAS	4.97 ± 1.67	3.67 ± 1.71	<0.001
Grip strength	-7.00 ± 1.74	-4.70 ± 2.63	

P-value is determined by independent samples t-test

Patients' satisfaction after treatment was assessed using CGI score. The lower the score in CGI the higher the satisfaction. Mean CGI score was significantly higher in UST group than TENS group (1.8 ± 0.96 vs. 2.4 ± 1.04 , $p < 0.05$).

Table 5: Comparison of two groups using CGI values (n=60)

Variable	UST N (%)	TENS N (%)	p-value
CGI score (mean $\pm$ SD)	1.8 ± 0.96	2.4 ± 1.04	0.013

P value determined by Student's

Discussion

Total 60 patients of lateral epicondylitis were taken for this study. Thirty patients were selected for UST group and another 30 for TENS group by randomization.²⁰ Patients aged between 30 to 50 years were included in this study. Mean age of all patients was 38.78 ± 6.09 years. Majority patient belonged to younger age group 30 to 35 years. Thirty three percent patients of UST group and 43% patients of TENS group were aged between 30 to 35 years. This finding is concordant with that of Varghese

*et al.*²¹ They studied patients between 20 to 60 years and found that majority (60%) patients belonged to the younger age group 20–40 years. This is consistent as Vaquero-Picado *et al.*, noted that lateral epicondylitis mainly affects middle-aged patients.²² Coonrad *et al.*, noted that tennis elbow is four time more common in the fourth decade of life.²³

Majority patients were male in this study. Among UST group 60% patients were male and among TENS group 50% patients were male. Overall, 54.1% patients were male and 44.3% patients were female. Varghese *et al.*,

similarly found 53.3% male patients and 46.7% female patients in their study entitled “Socio-demographics and clinical profile of patients with lateral epicondylitis”.²¹ Also, Ahmed *et al.*, in his thesis regarding risk factors of tennis elbow attending in a tertiary care hospital in Dhaka found that 53.3% patients were male and 46.7% patients were female in his study.²⁴ Majority patients came from urban area (60%) and 40% patients came from rural area. This is concordant with the findings of Ahmed *et al.*²⁴ He reported 51.7% patients coming from urban area and 48.3% patients coming from rural area. In this study majority patients (40%) completed SSC or attended classes below SSC and 28.3% patients were illiterate overall. This higher than the proportion of illiterate patients (6.7%) found in the study by Ahmed *et al.*²⁴ In his study he found 30% patients completing SSC. It was observed that lateral epicondylitis are more common in hard workers. Shiri *et al.*, found that of occupational risk factors, forceful activities, high force combined with high repetition or awkward posture and awkward postures are associated with epicondylitis.²⁵ Vaquero-Picado *et al.*, noted that any activity involving excessive and repetitive use of extensor muscles of elbow (for example tennis, playing an instrument, typing, manual work) may cause the tendinosis.²² This explains why hard manual workers were proportionately high in this study.

Majority patients had monthly income below 10000 taka in both groups. As majority patients were hard manual workers and as manual workers are more likely to be paid low wages this explain the economic distribution of the study. The most common presentation was tenderness over lateral epicondyle (96.7%) followed in decreasing order by swelling (16.7%), elevated joint temperature (6.7%) and crepitus in joint movement (1.7%). Mill's test and Cosen's test were positive in hundred percent cases. This is comparable with the findings of Varghese *et al.*,²¹ They found tenderness in 95% patients, swelling in 13.3% patients and elevated joint temperature in 8.3% patients. They also found positive Mill's test and Cosen's test in 100% patients. Duration of pain was more than one year in 28.3% patients and less than one year in 71.7% patients. This is comparable with the findings of Varghese *et al.*, who reported 61.7% patients having illness for more than one year 38.3% patients having illness for less than one year.²¹ Lateral epicondylitis commonly affects dominant hand. Nirschl *et al.*, noted that 75% cases of lateral epicondylitis occur in dominant arm.²⁶ In the present study 93% patients had involvement of right hand 7% had involvement of left hand. In this study patients' pain was assessed using VAS score and strength of the affected arm was assessed by grip strength. Baseline VAS score was 7.47 ± 1.28 in UST group and 7.07 ± 1.63 in TENS group with the difference being statistically non-significant ($p > 0.05$). Base line grip strength was 33.63 ± 7.1 in UST and 33.80 ± 8.38 in TENS group. The distribution was statistically similar ($p > 0.05$). Shamsi *et al.*, found a baseline VAS score of

7.63 ± 1.34 in UST group and 6.57 ± 1.41 in TENS group in a similar study entitled “Comparative Study of Ultrasound and Tens in the Management of Tennis Elbow”.²⁷

In both UST group and TENS group reduction in VAS score from baseline to after two weeks of treatment was statistically significant. In UST group VAS score reduced from 7.47 ± 1.30 to 2.50 ± 1.43 ($p < 0.001$). In TENS group VAS score improved from 7.07 ± 1.63 to 3.40 ± 0.97 . Shamsi *et al.*, treated their patients for 5 weeks and reported a similar reduction in VAS score after treatment in both groups.²⁷ In their study VAS score improved from 7.63 ± 1.24 to 0.43 ± 0.46 in UST group ($p < 0.001$) and from 6.57 ± 1.41 to 2.81 ± 1.15 in TENS group ($p < 0.001$). Grips strength improved from 33.63 ± 7.21 to 40.63 ± 7.66 in UST group and 33.80 ± 8.38 to 38.50 ± 9.06 in TENS group. In both groups the improvement was statistically significant ($p < 0.001$). Oken *et al.*, compared the effect of ultrasound therapy with laser therapy and brace therapy in lateral epicondylitis patients.²⁸ In contrast to present study, they did not find any improvement in grip strength over 2 weeks of UST treatment for lateral epicondylitis. Palekar compared conventional TENS with phonophoresis for lateral epicondylitis 56 and found grip strength improved from 30.27 ± 7.69 to 37.77 ± 6.37 in TENS group. Oken *et al.*, found laser therapy superior and Palekar found phonophoresis therapy superior.²⁸ Other therapies than UST and TENS was beyond the scope of this study, but a comparison to UST group and TENS group of their studied shows the UST treatment had better improvement of lateral epicondylitis associated grip strength reduction in the present study. UST mediated changes in VAS score and Grip strength were statistically higher than that of TENS mediated changes ($p < 0.001$). Also, patient satisfaction as measures by CGI six-point scale in the study was found to be significantly higher in UST group in this study. Shamsi *et al.*, came to a similar conclusion in their comparison of UST and TENS group.²⁷ They also noted that changes made by UST was superior to TEN treatments in lateral epicondylitis. Various modalities of treatment are being tested for Tennis Elbow with variable reports on their effect.²⁹⁻³⁴ Among them UST and TENS are two common modalities applied. In the present study UST was found to be superior in reduction of pain and gain of strength in Tennis Elbow patients.

Conclusion

Overall improvement is noticed following UST and TENS therapy. But significantly higher changes is noticed in patients who received UST therapy than TENS therapy as evidenced by improvement of both VAS score and Grip strength score. As a result, it can be concluded that UST is relatively safe and effective technique as a treatment option of lateral epicondylitis. However, further larger studies are needed to finalize the comment.

References

1. Cohen M, da Rocha Motta Filho G. Lateral epicondylitis of the elbow. *Revista Brasileira de Ortopedia (English Edition)*. 2012 Jul 1;47(4):414-20.
2. Reza Nourbakhsh M, Fearon FJ. An alternative approach to treating lateral epicondylitis. A randomized, placebo-controlled, double-blinded study. *Clinical Rehabilitation*. 2008 Jul;22(7):601-9.
3. Degen RM, Conti MS, Camp CL, Altchek DW, Dines JS, Werner BC. Epidemiology and disease burden of lateral epicondylitis in the USA: analysis of 85, 318 patients. *HSS Journal*. 2018 Feb;14(1):9-14.
4. Bauer JA, Murray RD. Electromyographic patterns of individuals suffering from lateral tennis elbow. *Journal of Electromyography and Kinesiology*. 1999 Aug 1;9(4):245-52.
5. De Smedt T, de Jong A, Van Leemput W, Lieven D, Van Glabbeek F. Lateral epicondylitis in tennis: update on aetiology, biomechanics and treatment. *British journal of sports medicine*. 2007 Nov 1;41(11):816-9.
6. van Rijn RM, Huisstede BM, Koes BW, Burdorf A. Associations between work-related factors and specific disorders at the elbow: a systematic literature review. *Rheumatology*. 2009 May 1;48(5):528-36.
7. Dingemanse R, Randsdorp M, Koes BW, Huisstede BM. Evidence for the effectiveness of electrophysical modalities for treatment of medial and lateral epicondylitis: a systematic review. *British journal of sports medicine*. 2014 Jun 1;48(12):957-65.
8. Lewis M, Chesterton LS, Sim J, Mallen CD, Hay EM, van der Windt DA. An economic evaluation of TENS in addition to usual primary care management for the treatment of tennis elbow: results from the TATE randomized controlled trial. *PloS one*. 2015 Aug 28;10(8):e0135460.
9. Dundar U, Turkmen U, Toktas H, Ulasli AM, Solak O. Effectiveness of high-intensity laser therapy and splinting in lateral epicondylitis; a prospective, randomized, controlled study. *Lasers in medical science*. 2015 Apr;30(3):1097-107.
10. Smidt N, Lewis M, Windt DA, Hay EM, Bouter LM, Croft P. Lateral epicondylitis in general practice: course and prognostic indicators of outcome. *The Journal of rheumatology*. 2006 Oct 1;33(10):2053-9.
11. Johnson GW, Cadwallader K, Scheffel SB, Epperly TD. Treatment of lateral epicondylitis. *American family physician*. 2007 Sep 15;76(6):843-8.
12. Olaussen M, Holmedal Ø, Lindbæk M, Brage S. Physiotherapy alone or in combination with corticosteroid injection for acute lateral epicondylitis in general practice: a protocol for a randomised, placebo-controlled study. *BMC Musculoskeletal Disorders*. 2009 Dec 4;10(1):152.
13. Peterson M, Elmfeldt D, Svärdsudd K. Treatment practice in chronic epicondylitis: a survey among general practitioners and physiotherapists in Uppsala County, Sweden. *Scandinavian journal of primary health care*. 2005 Jan 1;23(4):239-41.
14. Falconer J, Hayes KW, Chang RW. Therapeutic ultrasound in the treatment of musculoskeletal conditions. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*. 1990 Jun;3(2):85-91.
15. D'vaz AP, Ostor AJ, Speed CA, Jenner JR, Bradley M, Prevost AT, Hazleman BL. Pulsed low-intensity ultrasound therapy for chronic lateral epicondylitis: a randomized controlled trial. *Rheumatology*. 2006 May 1;45(5):566-570.
16. Schleicher I, Szalay G, Kordelle J. Die Therapie der Epicondylitis—eine aktuelle Übersicht. *Sportverletzung· Sportschaden*. 2010 Dec;24(04):218-24.
17. Ediz L, Alpayci M. Electrotherapeutic interventions for tennis elbow or lateral epicondylitis: a brief review of the literature. *Physics international*. 2012 Jul 1;3(2):44.
18. Shin JY, Seo KM, Kim DK, Kim BK, Kang SH. The effect of prolotherapy on lateral epicondylitis of elbow. *Annals of Rehabilitation Medicine*. 2002 Dec 1;26(6):764-8.
19. Weng CS, Shu SH, Chen CC, Tsai YS, Hu WC, Chang YH. The evaluation of two modulated frequency modes of acupuncture-like tens on the treatment of tennis elbow pain. *Biomedical Engineering: Applications, Basis and Communications*. 2005 Oct 25;17(05):236-42.
20. Hossain S. Effectiveness of myofascial release (biceps brachii, pectoralis major, latissimus dorsi) to reduce pain among patients with tennis

- elbow (Doctoral dissertation, Bangladesh Health Professions Institute, Faculty of Medicine, the University of Dhaka, Bangladesh)).
21. Varghese DV, Rai HR, Varghese J, Renjith V. Socio-demographics and clinical profile of patients with lateral epicondylitis. *Indian Journal of Public Health Research & Development*. 2017;8(3):153-7.
 22. Vaquero-Picado A, Barco R, Antuña SA. Lateral epicondylitis of the elbow. *EFORT open reviews*. 2016 Nov 22;1(11):391-7.
 23. Coonrad RW, Hooper WR. Tennis elbow: its course, natural history, conservative and surgical management. *JBJS*. 1973 Sep 1;55(6):1177-82.
 24. Ahmed S. Risk factors of tennis elbow patients attended at two selected organizations in Dhaka (Doctoral dissertation, Department of Physiotherapy, Bangladesh Health Professions Institute, CRP).
 25. Shiri R, Viikari-Juntura E. Lateral and medial epicondylitis: role of occupational factors. *Best practice & research Clinical rheumatology*. 2011 Feb 1;25(1):43-57.
 26. Nirschl RP, Pettrone FA. Lateral and medial epicondylitis. *Master techniques in Orthopedic Surgery. The Elbow*. New York, Raven Press: 129. 1994;148.
 27. Shamsi S, Khan S, Alyazedi FM, Al Thoriri N, Hassan A, Ghamiddi A. Comparative Study of Ultrasound and Tens in the Management of Tennis Elbow. *International Journal of Medical and Health Research*. 2015.
 28. Oken O, Kahraman Y, Ayhan F, Canpolat S, Yorgancioglu ZR, Öken ÖF. The short-term efficacy of laser, brace, and ultrasound treatment in lateral epicondylitis: a prospective, randomized, controlled trial. *Journal of Hand Therapy*. 2008 Jan 1;21(1):63-8.
 29. Clunie GP, Ralston SH. Rheumatology and bone disease. *Davidson's Principles and Practice of Medicine*. 23rd edition. UK: Elsevier Ltd. 2018:1022.
 30. Chen WS, Annaswamy TM, Yang W, Wang TG, Kwon DR, Chou LW. Physical agent modalities. In *Braddom's physical medicine and rehabilitation 2021 Jan 1* (pp. 338-363). Elsevier.
 31. Bisset L, Paungmali A, Vicenzino B, Beller E. A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. *British journal of sports medicine*. 2005 Jul 1;39(7):411-22.
 32. Halle JS, Franklin RJ, Karalfa BL. Comparison of four treatment approaches for lateral epicondylitis of the elbow. *Journal of Orthopaedic & Sports Physical Therapy*. 1986 Aug;8(2):62-69.
 33. Lee S, Ko Y, Lee W. Changes in pain, dysfunction, and grip strength of patients with acute lateral epicondylitis caused by frequency of physical therapy: a randomized controlled trial. *Journal of physical therapy science*. 2014;26(7):1037-1040.
 34. Chesterton LS, van der Windt DA, Sim J, Lewis M, Mallen CD, Mason EE, Warlow C, Vohora K, Hay EM. Transcutaneous electrical nerve stimulation for the management of tennis elbow: a pragmatic randomized controlled trial: the TATE trial (ISRCTN 87141084). *BMC Musculoskeletal Disorders*. 2009 Dec 11;10(1):156.

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