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Comparison Between LASER Therapy and Radial Shock Wave Therapy on Pain, Grip Strength, and Upper Limb Function in Subjects with Chronic Lateral Epicondylitis: A Randomized Clinical Trial

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ABSTRACT

Background: Lateral epicondylitis, with a 1-3% prevalence in the general population, is caused by overuse in sports and occupations, leading to microtears in the muscle, poor healing, and decreased function. This study aimed to compare the effectiveness of Laser therapy and RSWT in treating chronic lateral epicondylitis.

Methods: In this single-blinded study, 48 subjects (50 elbows) with 22 males and 26 females aged between 30 and 50 years with Chronic Lateral Epicondylitis were randomly divided into two groups. Group A (n=25,25 elbows) with a mean age of 42.96±5.4 years received Laser therapy, and Group B (n= 23, 25 elbows) with a mean age of 43.00±5.3 years received RSWT. Both groups received the Standardized Exercise Program, the Home Exercise Program, and the Ergonomic Care for 10 sessions. Subjects were assessed at Baseline and after completion of the 10th session.

Results: There was no significant difference ($p>0.05$) between the groups at baseline. Both groups showed statistically significant improvement ($p<0.05$) after 10 treatment sessions. Compared with Group A, Group B showed a significant improvement ($p<0.05$) in Pain, whereas there was no significant difference ($p>0.05$) in Grip Strength and Upper Limb Function between Group A and Group B.

Conclusion: Both LASER Therapy and RSWT effectively reduced pain and improved grip strength and upper limb function in patients with Chronic Lateral Epicondylitis, with RSWT showing a significant reduction in pain.

Keywords: Chronic Lateral Epicondylitis, LASER Therapy, Radial Shock Wave Therapy, Grip strength, Pain.

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INTRODUCTION

Lateral Epicondylitis (LE) is a musculoskeletal disorder that affects the wrist extensor muscles, leading to fibrosis and microtears. Overuse or repetitive trauma causes elbow pain, loss of function, and a significant impact on social and professional life [1-2].

According to Tosti et al., the term 'lawn tennis arm' was described by Morris in 1883; later on, the use of "tennis elbow" came, but less than 10% of patients with lateral elbow pain are tennis players, 50% develop symptoms, especially in novices and backhand stroke users [3]. Therefore, it can be considered a work- and sports-related disorder [2].

According to Kohia M et al. (2008), it occurs in approximately 1%-3% of the general population aged 35-55 years, with the dominant side involved in most cases. Lateral Epicondylitis is more common in women. The prevalence of Lateral Epicondylitis in the general population is 1.0-1.3% in men and 1.1-4% in women [4].

Lateral Epicondylitis diagnosis involves tenderness over the lateral epicondyle, limited elbow and wrist extension, pain, wrist extensor muscle atrophy, decreased grip strength, and muscle strength testing, with special tests like Mills', Cozens', and Maudsley's tests confirmed [5-7].

Lateral Epicondylitis treatment can be conservative or operative, aiming to control pain, preserve movement, improve grip strength, and restore function. Common treatments include NSAIDs, corticosteroid injections, physiotherapeutic approaches such as stretching, eccentric strengthening, friction massage, ergonomic care, and bracing, with surgical intervention for persistent pain and disability [13-15].

Low Level LASER Therapy (LLLT) is a common electro-physical modality beneficial for joint disorders and tendinopathy.[16] It increases fibroblast activity, collagen laying, and anti-inflammatory effects, while reducing pain by inhibiting a-delta and C fiber activities and platelet aggregation.[17-18] ESWT is a non-invasive treatment for tendinopathy, promoting pain relief, vascularization, protein biosynthesis, cell proliferation, neuro-chondroprotection, and tissue regeneration, ultimately improving functional outcomes [19]. Although previous systematic reviews suggested that little or no evidence exists for the use of ESWT in patients with lateral elbow tendinopathy, recently published meta-analyses reported superior outcomes of ESWT compared with sham or other passive treatments for pain reduction and Grip Strength [20].

Very few studies have compared LASER Therapy and RSWT for reducing pain, grip strength, and upper limb function in chronic Lateral Epicondylitis patients in the Indian population. Thus, this study aims to compare the effectiveness of the two modalities in chronic Lateral Epicondylitis.

METHODOLOGY

In this Randomized Clinical Trial, 48 prospective participants were included using a simple random sampling method via chit picking. Participants from both genders with an age group between 30-50 years having chronic Lateral Epicondylitis of more than 3months with a VAS score between 3-7 [9] and a positive response on at least two of the three provocative tests (Mills' test, Cozen's test, and Maudsley's test) [5-7]. Musculoskeletal disorders such as osteoarthritis, Rheumatoid Arthritis, fractures, deformities, and myositis ossificans. Nerve entrapment syndromes include pronator teres syndrome, carpal tunnel syndrome, and radial tunnel syndrome. Recent steroid injections or medication use may contribute to these conditions. Conditions such as cervical radiculopathy, stroke (reflex sympathetic dystrophy), Parkinson's disease, etc., and diminished skin sensation in a specific area are excluded.

PROCEDURE

Approval from the Institutional Ethical Committee (IEC) was obtained before the commencement of the study. 128 subjects with LE were assessed and screened according to the inclusion and exclusion criteria. All subjects were informed about the study in detail in the most understandable language. Written Informed consent in their preferred language was obtained from the subjects who agreed to participate (n=48). Then the demographic data was collected. The subjects were randomly divided into two groups using simple random sampling and a chit-picking method. Pain Intensity was assessed using the Visual Analogue Scale (VAS), Pain-Free Grip Strength using the Jamar Hand-Held Dynamometer, and Upper Limb Function using the Patient-Rated Tennis Elbow Evaluation (PRTEE) Questionnaire, all taken at baseline and at the end of two weeks of intervention and in Group A (n=25, 25 elbows) received Low Level LASER Therapy (LLLT), Standardized Exercise Program and Home Exercise Program with Ergonomic care for 10 sessions (5 sessions per week for 2 weeks). In Group B (n=23, 25 elbows) received Radial Shock Wave Therapy for 4 sessions (2 sessions per week for 2 weeks (on 1st day, 4th day, 7th day, and 10th day)), Standardized Exercise Program, and Home Exercise Program with Ergonomic care for 10 sessions (5 sessions per week for 2 weeks). Subjects continued their prescribed rescue medications throughout the study in both groups.

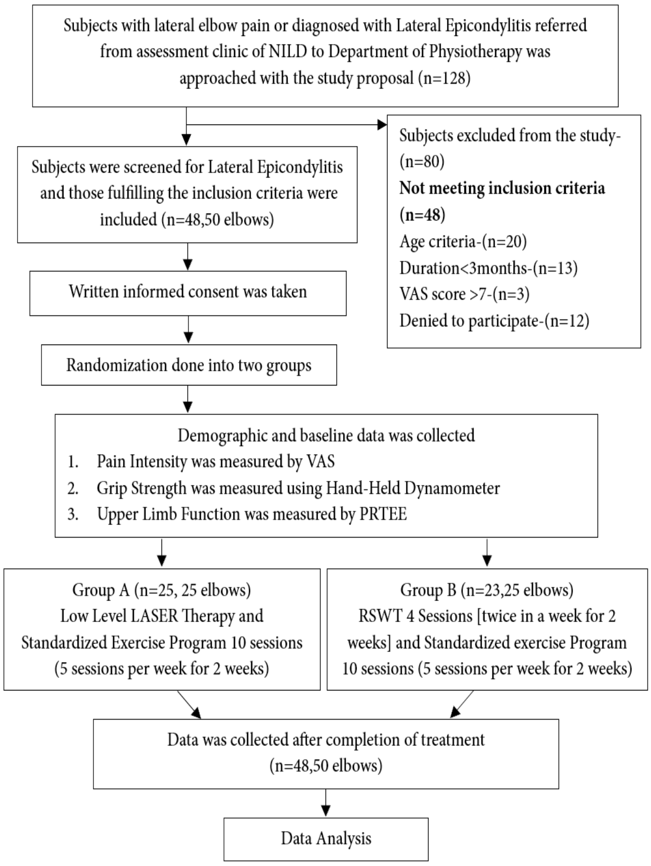


Figure 1: CONSORT Flow Diagram

INTERVENTION

Group A n=25, 25 elbows were given Low Level LASER Therapy.

Position of the subject: Patients were comfortably seated with their arms resting on a treatment table, wearing wavelength-specific goggles to prevent accidental exposure of the LASER beam to the eye. (Figure 2)

Figure 2: LASER Therapy

Position of the examiner: The examiner applied the LASER by holding the probe perpendicular to the skin on the affected side.

Procedure: The procedure was performed in the area of intense pain, at the anterior aspect of the Lateral Epicondyle and 9 points around it, using the LASER probe in a grid method and applying it to each point.

Dosage: 806 nm wavelength pulse current LASER, power skin intensity 40mW, 50% duty cycle, the spot size 0.5cm2, duration of treatment on each point is 30 sec with energy density 2.4 joules/ Cm2. Frequency was 50 Hz, 10 sessions in 2 weeks (5 sessions/week). Group B (n=23, 25 elbows) received Radial Shock Wave Therapy.

Position of the subject: The patient was positioned with their affected elbow, supinated for tangential application of shock waves to the common extensor origin. (Figure 3)

Figure 3: Radial Shock Wave Therapy

Procedure: Ultrasound gel was applied to the anterior aspect of the lateral epicondyle, focusing on the most intense pain. Dosage-1500 shocks, 1.5 bar, 16 Hz, < 0.1mJ/mm2 was applied 2 times in a week for 2 consecutive weeks (1^{st}, 4^{th}, 7^{th}, 10^{th} day).

Standardized Exercise Program: All subjects in both groups underwent a standardized program consisting of static stretching, wrist extensor strengthening, grip strengthening, the same home exercise program, and ergonomic care.

Stretching Exercises: Stretching of Wrist Extensors. Dosage - 30 sec hold with 3 repetitions with 10 sec rest in between (5 sessions per week for 2 weeks).

Strengthening exercises: Dosage Exercise was repeated for 30 repetitions per day for 2 weeks.

Eccentric wrist extension exercises: The subject was seated, with the elbow extended and the forearm pronated. Maximum wrist extension was instructed to slowly lower the wrist into flexion, again using the contralateral hand to return it to maximum extension, with free weights based on the subject's 10 RM.

Dosage: Exercise was repeated for 3 sets of 10 repetitions, with a 1-minute rest interval between sets, for 2 weeks.

Grip strengthening exercise: Dosage- Each exercise was repeated for 10 repetitions of 3 sets and 10-second rest between each set per day for 2 weeks.

Outcome Measures

The Visual Analogue Scale (VAS) was used to assess pain intensity on a 10 cm horizontal line. Measurement was taken from 0 to the point marked by the subject using a ruler. The reading was taken at baseline and at the end of the treatment [9-10]. (Figure 4)

Figure 4: Visual Analogue Scale

Pain-free Grip strength by Hand-Held Dynamometer: A Jamar Hand-Held dynamometer was used to measure grip strength in kilograms. Subjects were instructed to grip tightly within a pain-free range, and their grip strength was recorded. Two further readings were taken with 30 seconds rest, and the best score was used for data analysis [8,11]. (Figure 5)

Figure 5: Measurement of Pain-Free Grip Strength by Hand-Held Dynamometer

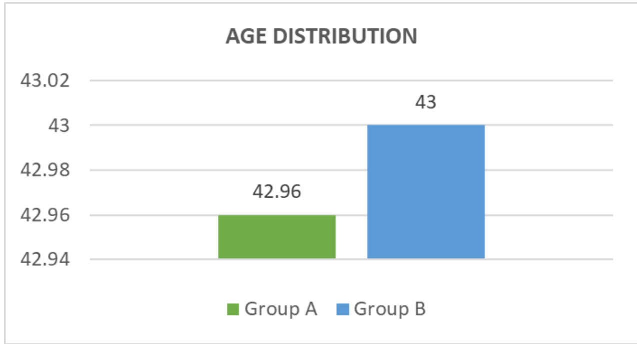
Upper Limb Function by Patient Rated Tennis Elbow Evaluation Questionnaire PRTEE is a 15-item self-reported questionnaire used to measure perceived pain and disability in Lateral Epicondylitis. It consists of pain, usual activities, and specific activities subscales. The score ranges from 0 to 150, with higher scores indicating greater disability. Subjects were asked to describe their average arm symptoms over two weeks, with a score of 0-10 indicating severe difficulty. Subjects were requested to answer all the questions. If the subject could not perform an activity because of pain, the subject was asked to circle "10" [12-13].

RESULTS

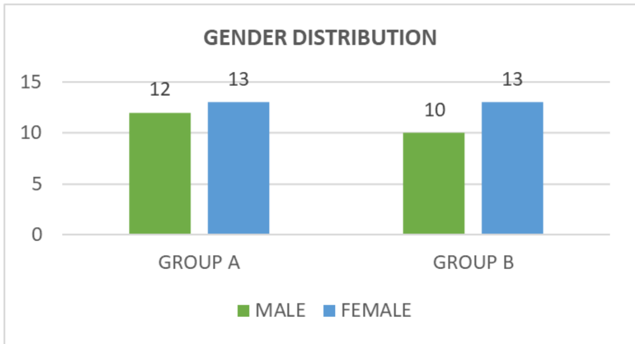
Analysis of demographic details revealed no statistically significant difference (p>0.05) between Group A & Group B at baseline for age (p=0.94) and gender (p=0.77). This showed that both groups were homogeneous at baseline with respect to age and gender.

Table 1: Demographic details (Level of significance was set with p≤0.05)

	Group-A (n=25)	Group-B (n=23)	P-Value
AGE (YEARS) (Mean ± SD)	42.96 ± 5.4	43.00 ± 5.3	0.94
MALE	12	10	0.77
FEMALE	13	13	



Graph 1: Age-wise Distribution of Subjects



Graph 2: Gender wise distribution of Subjects

Analysis of outcome parameters at baseline revealed that there was a statistically nonsignificant difference (p>0.05) between Group A & Group B for VAS 0 (p=0.39), for Grip Strength 0 (p=0.94), and for PRTEE 0 (p=0.26). This showed that both groups were homogeneous at baseline. (Table -02)

Table 2: Outcome Parameters at the Baseline (*Level of Significance was set at p≤0.05)

Outcomes	Group-A (n=25)	Group-B (n=23)	t-Value	p-Value
VAS 0	5.94 ± 0.8	5.72 ± 0.9	0.86	0.39
Grip Strength 0	12.48 ± 5.3	12.60 ± 6.5	-0.07	0.94
PRTEE 0	45.72 ± 14.4	40.70 ± 16.9	1.12	0.26

Within-group analysis

Group A: Group A showed significant (p<0.05) reduction in VAS from 5.94 ± 0.8 cm to 2.5 ± 1.1cm, significant improvement (p<0.05) in Grip Strength from 12.48 ± 5.3 kg to 20.08 ± 6.0 kg and significant reduction (p<0.05) in PRTEE score from 45.72 ± 14.4 to 16.98 ± 8.0 after 10 sessions of treatment. (Table-03)

Table 3: Within-group analysis of Group A (n=25) (*Level of Significance was set at p≤0.05)

Outcomes	Pre Treatment (Day 0)	Post Treatment (Day 10)	t-Value	p-Value
VAS (cm)	5.94 ± 0.8	2.5 ± 1.1	15.92	0.00*
Grip Strength (kg)	12.48 ± 5.3	20.08 ± 6.0	-9.92	0.00*
PRTEE	45.72 ± 14.4	16.98 ± 8.0	11.72	0.00*

Group B: Group B showed a significant reduction ($p<0.05$) in VAS from 5.72 ± 0.9cm to 1.7 ± 1.3cm, significant improvement ($p<0.05$) in Grip Strength from 12.60 ± 6.5kg to 18.48 ± 6.7kg, and significant reduction in PRTEE score from 40.70 ± 16.9 to 16.98 ± 8.0. (Table-04).

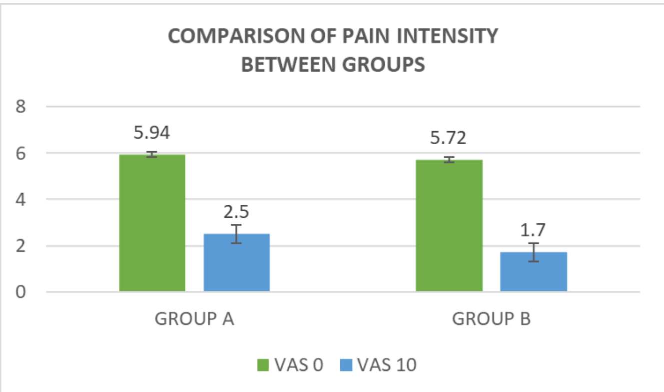
Table 4: Within-group analysis of Group B (n=23) (*Level of Significance was set at p≤0.05)

Outcome	Pre Treatment (Day 0)	Post Treatment (Day 10)	t-Value	p-Value
VAS (cm)	5.72±0.9	1.7±1.3	15.55	0.00*
Grip Strength (Kg)	12.60±6.5	18.48±6.7	-7.09	0.00*
PRTEE	40.70±16.9	15.14±10.7	13.19	0.00*

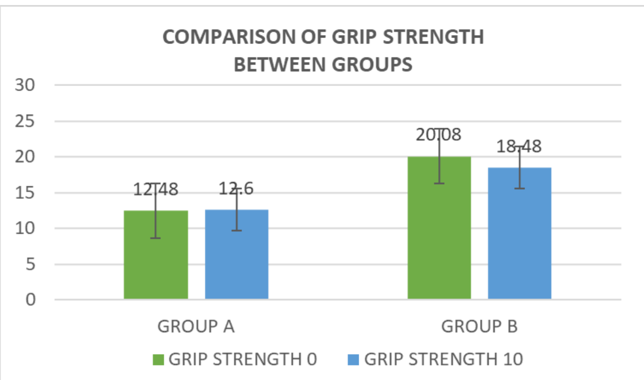
Comparison Between Group A and Group B: There was a statistically significant difference ($p<0.05$) in VAS found between Group A and Group B after 10 sessions of intervention (Table-05). However, no statistically significant difference ($p>0.05$) was found between Group A and Group B for Grip Strength and PRTEE, respectively, after 10 sessions of intervention.

Table 5: Comparison between Group-A & Group-B (*Level of Significance was set at p≤0.05)

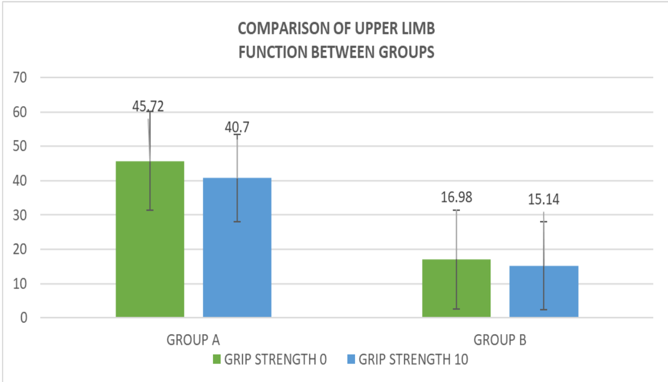
Outcome		Group-A (n=25)	Group-B (n=23)	t-Value	p-Value
VAS (cm)	VAS 0	5.94 ± 0.8	5.72 ± 0.9	0.86	0.39
	VAS 10	2.5 ± 1.1	1.7 ± 1.3	2.31	0.02*
Grip Strength (kg)	GS 0	12.48 ± 5.3	12.60 ± 6.5	- 0.07	0.94
	GS 10	20.08 ± 6.0	18.48 ± 6.7	0.87	0.38
PRTEE	PRTEE 0	45.72 ± 14.4	40.70 ± 16.9	1.12	5.02
	PRTEE 10	16.98 ± 8.0	15.14 ± 10.7	0.68	1.84



Graph 3: Comparison of Pain Intensity



Graph 4: Comparison of Grip Strength between Groups



Graph 5: Comparison of Upper Limb Function between Groups

DISCUSSION

The study compared the efficacy of Low-Level Laser Therapy (LLLT) and Radial Shock Wave Therapy (RSWT) for the treatment of chronic lateral epicondylitis (LE). After 10 sessions, both groups showed significant improvement in pain and function. Group B (RSWT) demonstrated a significant reduction in pain intensity ($p>0.05$), while changes in grip strength and PRTEE scores were not significantly different between groups.

Chronic pain, as defined by the International Association for the Study of Pain (IASP), exceeds the normal healing time of tissues and often lasts for more than 3 months [21]. LLLT employs both thermal and non- thermal mechanisms, offering photo-bio stimulation by affecting chromophore cells, increasing ATP production, and modulating calcium levels. This accelerates healing, reduces inflammation, and alleviates pain. Studies suggest that LLLT also prevents oxidative stress, reduces fibrosis, and enhances tendon recovery by normalizing metabolic rates, improving oxygenation, and lowering skin resistance, thereby reducing pain [22].

Lateral Epicondylitis, often misclassified as tendinitis, is now recognized as tendinosis because it lacks inflammatory cells. Pain in Lateral Epicondylitis is linked to neurotransmitter sensitization, such as increased glutamate, and chemical irritation from compounds like lactate.[23]

Several studies validate LLLT's effectiveness. Ozcan Ayser et al. (2023) found that it modulates neurotransmitters, enhances ATP production, and prevents fibrosis [24]. Delia B. Robert et al. (2013) in their research attribute LLLT's pain-relieving effects to reduced pro-inflammatory mediators (e.g., TNF-α, IL-6) and increased fibroblast proliferation, thereby improving collagen fibril size and biomechanical strength [17]. Moskvin et al. (2017) further confirm its therapeutic benefits, including anti-inflammatory and immunomodulatory effects [25]. These findings support the current study's conclusion that LLLT effectively reduces pain in chronic LE.

RSWT was similarly effective, showing a significant reduction in pain intensity. RSWT promotes soft-tissue healing by stimulating neovascularization and inhibiting pain receptors via the gate-control mechanism [26]. Shock waves generate cavitation bubbles, causing localized shear stress and micro-injuries that trigger biological responses [27]. Chen et al. (2004) study demonstrated that shock waves promote membrane hyperpolarization and activate local factors, such as VEGF-A and TGF-β1, aiding tissue repair [28]. Gaowen et al. (2020) observed enhanced fibroblast activity, angiogenesis, and reduced calcitonin-related peptide expression, leading to pain relief [21]. Studies by Turgay and Devrimsel found that RSWT was more effective than LLLT in reducing pain and improving function, as its micro-injuries stimulate neovascularization and tissue repair [29-30].

Both interventions improved Pain- Free Grip Strength (PFGS) after 10 sessions. Reduced pain intensity allowed for maximum grip effort. Chronic Lateral Epicondylitis is associated with muscle fiber abnormalities in the extensor carpi radialis brevis (ECRB) muscle, structural weakening at the enthesis, and reduced grip strength due to pain-related inhibition or fear of movement [31]. Onken et al. (2008) suggest that chronic pain can decrease motivation and alter limb physiology, leading to reduced muscle contractions and strength. Improved PFGS in this study reflects decreased pain-related inhibition, aligning with other studies demonstrating the effectiveness of these treatments in enhancing grip strength [32].

The PRTEE scale was used to evaluate pain and upper limb function. Both groups showed significant improvement, with pain reduction as the primary factor enhancing grip strength and daily function. Decreased PRTEE scores after intervention suggest these therapies improve work-related tasks and overall quality of life [21].

Additionally, the supervised exercise program, including wrist extensor stretching, eccentric strengthening, and grip exercises, enhanced recovery in both groups. Strengthening exercises stimulate mechanoreceptors in tenocytes, promoting collagen production and tendon repair [33-35]. Stasinopoulos et al. (2006) highlighted stretching's role in increasing tensile strength and reducing extensor origin tension [36]. Fyfe et al. (1992) emphasized eccentric exercises in tendon healing, as they stimulate cellular repair and collagen synthesis [37]. Glazebook et al. (1994) further demonstrated that combined stretching and strengthening exercises enhance tendon strength and functional activities [38].

These findings suggest that LLLT, RSWT, and a structured exercise program effectively reduce pain, improve grip strength, and enhance upper-limb function in patients with chronic Lateral Epicondylitis [39].

CONCLUSION

Both LLLT and RSWT effectively reduced pain, improved grip strength, and enhanced upper-limb function in patients with chronic Lateral Epicondylitis. RSWT demonstrated a more significant reduction in VAS scores than LLLT, though no significant differences were observed in grip strength and upper limb function between groups. Both treatments can serve as adjuncts to exercise programs to accelerate recovery from Lateral Epicondylitis.

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Conflicts of Interest: The authors declare no conflict of interest.

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