ORIGINAL ARTICLE

Exploring Electrophysical Agent and Rehabilitation Exercise Utilisation Patterns in the Management of Lateral Epicondyle Tendinopathy: A Retrospective Analysis of a Malaysian Cohort

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ABSTRACT

Background & Objectives: Lateral epicondyle tendinopathy (LET), commonly known as tennis elbow, is a prevalent musculoskeletal condition. Rehabilitation involving electrophysical agents (EPAs) and exercises is frequently employed, but the utilisation patterns and gender-based differences in their application are not well understood. This study examines the utilisation of EPAs and rehabilitation exercises in managing LET among Malaysian patients, with consideration of gender-related differences in treatment utilisation patterns. **Method:** In this retrospective study, data were collected from 105 patients with LET treated at Hospital Canselor Tuanku Muhriz, Malaysia, between January 2018 and January 2023. Sociodemographic details, clinical profiles, and information regarding the utilization of EPAs and rehabilitation exercises were collected using a structured research form. Data were analysed using SPSS version 26. Descriptive statistics, independent t-tests, cross-tabulation, and correlation tests were performed. **Results**: LET was more prevalent in females (62.9%), particularly among Malay patients (54.3%), and most commonly affected the dominant arm (76.2%). Female office clerks, housewives, and health professionals were more affected than their male counterparts. There were no significant gender differences in symptom duration, but females underwent more rehabilitation sessions. Therapeutic ultrasound was the most used EPA (81.0%), followed by paraffin wax (72.4%). Strengthening and home exercise programs were prescribed to 97.1% of patients without significant gender-based differences in treatment preferences. **Conclusions**: The findings suggest a gap in adherence to evidence-based guidelines for LET management, with the frequent use of modalities like ultrasound and paraffin wax despite limited evidence. This highlights the need for individualized treatment plans that align with the best available evidence and consider patient-specific needs.

Keywords: electrophysical agents, lateral epicondylitis, musculoskeletal disorder, tennis elbow, rehabilitation exercises, gender-related differences

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INTRODUCTION

Lateral epicondyle tendinopathy (LET), commonly known as tennis elbow, is a prevalent enthesopathy disorder involving the origin of the extensor carpi radialis brevis muscle, located on the lateral aspect of the elbow (Chiarotto et al., 2023). This condition affects 1–3% of adults annually, with an incidence rate of 4-7 per 1,000 individuals (Johns & Shridhar, 2020). It primarily impacts individuals aged 30 to 60 years who engage in repetitive hand and wrist movements, such as athletes, labourers, and office workers (Chiarotto et al., 2023). Notably, the dominant arm is at a higher risk for developing this condition (Chiarotto et al., 2023; Degen et al., 2018). LET is characterized by upper extremity pain and tenderness, with symptoms that can be persistent and challenging to manage (Johns & Shridhar, 2020). Although the symptoms typically follow a self-limiting course, with most patients experiencing resolution within six to 24 months (Smidt et al., 2006), the underlying causes and mechanisms of LET are not well understood, and there is no universally accepted management approach proven to be more effective than the condition's natural course (Johns & Shridhar, 2020). However, this recovery period can be improved with appropriate treatment (Smidt et al., 2006).

Rehabilitation exercises are a well-established component of LET management (Lapner et al., 2022), including conventional physiotherapeutic exercises

such as strengthening, stretching, and deep transverse friction massage (Lapner et al., 2022; Lenoir et al., 2019). Rehabilitation exercises are a cornerstone in managing LET, but their effectiveness varies depending on the type and specific protocols used (Day et al., 2019; Lapner et al., 2022). Evidence suggests that both eccentric and concentric strengthening exercises targeting the extensor muscles of the forearm, particularly the extensor carpi radialis brevis, should be emphasized due to their role in reducing pain and improving function in LET patients (Chiarotto et al., 2023; Johns & Shridhar, 2020). However, despite these documented benefits, rehabilitation exercises alone may not suffice, highlighting the need for a multimodal approach to effectively address the condition's complex nature (Chiarotto et al., 2023; Johns & Shridhar, 2020).

Combining rehabilitation exercises with electrophysical modalities (EPAs) can enhance outcomes and improve patient compliance, especially for pain management (Lenoir et al., 2019; Luo et al., 2022). For instance, low-level laser therapy, when administered at the recommended dosage, provides short-term pain relief and less disability among LET patients, with or without an exercise regimen (Bjordal et al., 2008). It is believed that laser therapy exerts photobiomodulation effects, where light penetration into the tissue promotes tissue regeneration, reduces inflammation, and alleviates pain (Ahmad et al., 2022). Meanwhile, therapeutic ultrasound is widely utilized for LET treatment, offering thermal and mechanical effects that enhance soft tissue regeneration and integrity, reduce pain, and improve joint movement (Luo et al., 2022). On the other hand, other EPAs, such as TENS or extracorporeal shock wave therapy (ESWT), demonstrated limited evidence of effectiveness (Cheema et al., 2023). A recent systematic review and meta-analysis by Cheema et al. (2023) that analysed two LET trials found that ESWT provided no benefit compared with no active treatment for pain or function (Cheema et al., 2023). Similar findings were observed for TENS, indicating that the available evidence does not support the use of these passive modalities in the treatment of LET (Cheema et al., 2023).

With numerous EPAs available for managing LET, it is essential to identify the most effective strategies. However, uncertainty persists regarding the selection and application of these modalities, leading to varied treatment utilisation and inconsistent effectiveness (Lenoir et al., 2019; Luo et al., 2022); resulting in the underutilization of certain effective modalities, which may contribute to suboptimal pain management and slower patient recovery (Cheema et al., 2023). A clearer understanding of EPA efficacy and appropriate use is needed to ensure practitioners do not rely on less effective treatments, which could negatively impact patient outcomes. Additionally, investigating gender disparities in LET rehabilitation approaches could provide valuable insights into practice variations, highlighting gender-specific factors that may influence treatment outcomes and patient experiences. This study aims to describe the utilisation of rehabilitation exercises and EPAs in LET management, with a focus on identifying gender-related differences in treatment utilisation patterns. The findings are intended to inform current clinical practice and highlight potential areas for optimisation, rather than to evaluate treatment effectiveness.

METHODOLOGY

Study design

In this retrospective cross-sectional study, secondary data were collected from the medical records of patients diagnosed with LET who underwent treatment at the Physiotherapy Department of Hospital Canselor Tuanku Muhriz (HCTM) in Malaysia. The reporting of this study was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement to enhance transparency and methodological clarity. The study was conducted with ethical approval from the Research Ethics Committee of Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2023-206).

Study population

This study included Malaysian individuals aged 18 years and older who were diagnosed with LET and received rehabilitation at the Physiotherapy Department of HCTM. These diagnoses were made by attending physicians before patients were referred for physiotherapy treatment between January 2018 and January 2023. LET was diagnosed primarily on clinical grounds, with typical features including lateral elbow pain exacerbated by gripping or resisted wrist extension, localized tenderness over the lateral epicondyle, and exclusion of alternative elbow pathologies through clinical evaluation. Imaging investigations were not routinely required and were performed only when clinically indicated to rule out other conditions.

Procedures

The master record list, which included all cases documented at HCTM between January 2018 and January 2023, was obtained from the Physiotherapy Department. Access to the patients' files was granted following approval from the hospital's Ethics Committee, ensuring compliance with all relevant regulations and guidelines. The authors obtained permission through a formal application process that required submission of a detailed research proposal outlining the purpose and scope of the study. After a meticulous review of this database using predetermined criteria, 105 cases of LET were identified among the 221 cases related to elbow conditions receiving physiotherapy treatment at HCTM during the specified period; 94 cases not associated with LET, 9 files that were missing, and 13 cases that did not meet the inclusion criteria were excluded. To ensure the security and confidentiality of patient

information, all files were accessed in a secure hospital environment, and data were anonymized immediately upon extraction. All research team members signed confidentiality agreements to prevent unauthorized data disclosure.

The data extraction process was independently carried out by two authors to enhance the reliability and validity of the data collected. Each author independently extracted the data, ensuring consistent findings and minimizing the risk of bias or error. Any discrepancies in the data extracted by the two authors were resolved through discussion until a consensus was reached. The two authors involved in data extraction have a strong background in clinical research and physiotherapy. Sociodemographic information, clinical profiles, and data on the use of various EPAs, including hot packs, cryotherapy, TENS, and therapeutic ultrasound, were extracted. Data handling was systematically managed using a secure, encrypted database specifically designed for research purposes. This database was only accessible to authorized team members, ensuring controlled access. A standardized electronic data entry form was used to record all relevant information, reducing the risk of transcription errors and maintaining data integrity throughout the study.

Sociodemographic information included patient age, gender, ethnicity, age categories (young adults, adults, and older adults), and occupation categories according to the International Standard Classification of Occupations (ISCO) groups (Choi et al., 2020). Information on handedness, affected arm status, and any comorbidities or other illnesses was collected. Clinical profiles included symptom duration in months, the number of treatment sessions attended, a Visual Analog Scale (VAS) for pain intensity, and Jamar Dynamometer grip strength (measured in kilograms). For the utilization of electrophysical agents, all prescribed modalities, the number of modalities used per patient, and any combinations of EPAs utilized were recorded.

Data analysis

All statistical analyses were performed using SPSS version 26. Some variables had missing data. Baseline VAS data were available for 63.8% of participants, and grip strength data were available for 48.6%. Analyses were conducted using available data only (complete-case analysis), and no data imputation was performed. The sample size for each analysis is reported in the Results tables. Data distribution was assessed using the Shapiro-Wilk test and visual inspection of histograms. As several continuous variables, including symptom duration, number of treatment sessions, VAS scores, and grip strength, demonstrated non-normal distributions, these variables were summarised using median and interquartile range (IQR). Between-group comparisons for non-normally distributed continuous variables were conducted using the Mann-Whitney U test, while categorical variables were analysed using the chi-square test or Fisher's exact test where appropriate. Correlation analyses between continuous non-normally distributed variables were performed using Spearman's rank correlation coefficient. Statistical significance was set at $P < 0.05$.

RESULTS

The study reviewed 105 medical records of patients with LET. The patients had an average age of 51.8 ± 13.1 years, with over half (55.2%) aged 45 to 64 years. Interestingly, a higher percentage of female patients (62.9%) were affected by LET than their male counterparts, and the majority of patients were Malay (54.3%). Among these patients, 93.3% were right-handed, and approximately 76.2% of those affected experienced LET symptoms in their dominant arm. Occupation distribution among LET patients varied, with the highest representation found in the 'general & keyboard clerks' group (29.5%), while 'refuse workers' had the lowest representation (1.0%). Notably, there were significant gender-based differences in occupation, with female office clerks, housewives, and health professionals exhibiting a higher prevalence of LET compared to males ($X2 (11) = 28.64$, $p = 0.03$).

Clinical profiles of lateral epicondylitis

Regarding symptom duration, there was no significant difference between male and female patients with LET. The median duration of symptoms was 2 months (IQR = 2, 3 months) for both genders. However, females tended to undergo more treatment sessions than males, with a median of 3 sessions (IQR = 2, 3 sessions) ($P = 0.01$). Among LET patients, 63.8% had their Visual Analog Scale (VAS) pain scores recorded at baseline, with a median score of 5.0 (IQR = 4.0, 6.0). There was no significant difference in VAS scores between males and females. Grip strength at baseline was recorded for 48.6% of patients, and males had higher grip strength (median 15.0 kg [IQR 8.0, 21.0 kg]) than females ($P = 0.01$).

Additionally, the correlation results indicate a significant positive correlation ($r = 0.98$, $P < 0.05$) between grip strength and VAS pain score for females, while there is a weaker positive correlation ($r = 0.33$, $P > 0.05$) for male patients with LET.

Utilization of electrophysical agents and rehabilitation exercises

A wide array of treatment modalities was employed to manage LET, as detailed in Table 3. Among the EPAs, therapeutic ultrasound was the most frequently used treatment, administered to 85 (81.0%) patients, followed by paraffin wax treatment, administered to 76 (72.4%) patients (Figure 1). In contrast, transcutaneous electrical stimulation was used for 30.5% of patients, and hot packs were employed for 20.0%, while ice was the least utilized modality (3.8%). The majority of patients (68.6%) received treatment with two EPAs, with therapeutic ultrasound and paraffin wax being the

Table 1: Sociodemographic characteristics of the included lateral epicondyle tendinopathy cases (n = 105).

Variables	Overall (n = 105)	Sex		*P*-value
		Male (n = 39)	Female (n = 66)	
Age, years (mean ± SD)	51.8 ± 13.1	51.9 ± 14.6	51.9 ± 12.4	0.99
Age groups, years				
18 – 44 (young adults)	30 (28.6)	11 (28.2)	19 (28.8)	0.64
45 – 64 (adults)	58 (55.2)	20 (51.3)	38 (57.6)	
≥ 65 (older adults)	17 (16.2)	8 (20.5)	9 (13.6)	
Ethnicity				
Malay	57 (54.3)	24 (61.5)	33 (50.0)	0.22
Chinese	32 (30.5)	11 (28.2)	21 (31.8)	
Indian	13 (12.4)	2 (5.1)	11 (16.7)	
Others	3 (2.8)	2 (5.1)	1 (1.5)	
Hand dominance				
Right-handed	98 (93.3)	37 (94.9)	61 (92.4)	0.99
Left-handed	7 (6.7)	2 (5.1)	5 (7.6)	
Affected arm				
Dominant affected	80 (76.2)	30 (76.9)	50 (75.8)	0.99
Non-dominant affected	25 (23.8)	9 (23.1)	16 (24.2)	
Occupation (ISCO)				
General & keyboard clerks	31 (29.5)	14 (35.9)	17 (25.8)	0.03*
Retiree	22 (21.0)	11 (28.2)	11 (16.7)	
Housewife	19 (18.1)	0 (0.0)	19 (28.8)	
Health professionals	10 (9.5)	1 (2.6)	9 (13.6)	
Teaching professionals	6 (5.7)	2 (5.1)	4 (6.1)	
Sales workers	4 (3.8)	3 (7.7)	1 (1.5)	
Protective service workers	3 (2.9)	3 (7.7)	0 (0.0)	
Handicraft workers	3 (2.9)	1 (2.6)	2 (3.0)	
Machinery workers	2 (1.9)	1 (2.6)	1 (1.5)	
Personal service workers	2 (1.9)	2 (5.1)	0 (0.0)	
Agriculture workers	2 (1.9)	1 (2.6)	1 (1.5)	
Refuse workers	1 (1.0)	0 (0.0)	1 (1.5)	
Symptom duration, months: median (IQR)	2.0 (2.0, 3.0)	2.0 (1.0, 4.0)	3.0 (1.0, 5.0)	0.29
Number of treatment session: median (IQR)	3.0 (2.0, 3.0)	2.0 (1.0, 3.0)	3.0 (2.0, 3.0)	0.01*

Abbreviations: IQR, Interquartile Range; ISCO, International Standard Classification of Occupations; SD, Standard Deviation.
Note: All values presented as frequency (percentage) except for age, symptom duration, and number of treatment sessions. Statistical significance indicated by *, P < 0.05.

Table 2. Clinical profiles of the included lateral epicondyle tendinopathy cases (n = 105).

Variables	Overall (n = 105)	Sex		*P*-value
		Male (n = 39)	Female (n = 66)	
VAS pain; median (IQR)	5.0 (4.0, 6.0)	5.0 (4.0, 6.0)	5.0 (4.0, 6.0)	0.81
Grip strength, kg; median (IQR)	10.0 (6.0, 15.0)	15.0 (8.0, 21.0)	9.0 (4.3, 11.0)	0.01*
Correlation analysis; r-value	0.33	0.57	0.98	0.02*

Abbreviation: IQR, Interquartile range; VAS, visual analogue scale.
Note: Statistical significance indicated by *, *P* < 0.05.

most common combination (41.0%). Notably, the choice of the number of EPAs used did not differ between genders ($\chi 2$ (2) = 0.30, P = 0.86). In addition to EPAs, 97.1% of patients received home exercise programs after their first session with the therapists. Moreover, 95 (90.5%) patients were prescribed strengthening exercises after EPA treatment. In contrast, wrist extensor stretching and soft-tissue manipulation were prescribed to only 24 (22.9%) and 20 (19.0%) patients, respectively, compared with strengthening exercises. However, there were no significant gender differences in preferences for specific EPAs or exercises.

DISCUSSION

This study provides a descriptive overview of rehabilitation practice patterns for LET within a Malaysian tertiary healthcare setting. A higher distribution of LET was observed among females aged 45 to 64 years, with the dominant arm most frequently affected. These findings are consistent with existing epidemiological evidence identifying female sex, advancing age, and dominant arm use as important risk factors for LET (Sayampanathan et al., 2020). The observed sex distribution may reflect a combination of biological and biomechanical factors, including hormonal influences and sex-related differences in multifactorial nature of LET, arising from interactions among mechanical exposure, age- related tendon

Table 3. Utilization of electrophysical agents and rehabilitation exercise in the management of lateral epicondyle tendinopathy cases (n = 105).

Variables	Overall (n = 105)	Sex		*P*-value
		Male (n = 39)	Female (n = 66)	
Types of EPAs				
Therapeutic ultrasound	85 (81.0)	32 (82.1)	53 (80.3)	0.99
Paraffin wax	76 (72.4)	27 (69.1)	49 (77.8)	0.65
TENS	32 (30.5)	11 (28.2)	21 (53.8)	0.83
Hot pack	21 (20.0)	10 (25.6)	11 (16.7)	0.32
Cold therapy	4 (3.8)	2 (5.1)	2 (3.0)	0.63
Combination of EPAs				
3 EPAs	20 (19.0)	8 (20.5)	12 (18.2)	0.86
2 EPAs	72 (68.6)	27 (69.2)	45 (68.2)	
Only one	13 (12.4)	4 (10.3)	9 (13.6)	
Rehabilitation exercise				
Home exercise program	102 (97.1)	38 (97.4)	64 (97.0)	0.99
Wrist extensor strengthening	95 (90.5)	36 (92.3)	59 (89.3)	0.74
Wrist extensor stretching	24 (22.9)	7 (17.9)	17 (25.8)	0.47
Soft tissue manipulation	20 (19.0)	9 (23.1)	11 (16.7)	0.45

Abbreviations: EPAs, electrophysical agents; TENS, transcutaneous electrical neuromuscular stimulation.
Note: All values are presented as frequency (percentage). Statistical significance indicated by *, $P < 0.05$.

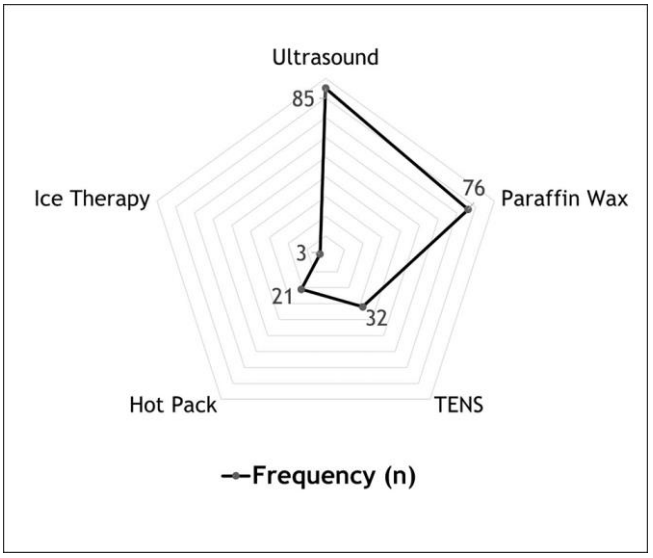

Figure 1. Frequency of electrophysical agent utilization during the first treatment session.
Note: TENS, Transcutaneous Electrical Nerve Stimulation.

changes, and individual susceptibility rather than a single causal factor.

Sex-based differences were also observed in grip strength, with female patients demonstrating lower baseline grip strength compared with male patients and local normative reference values (Jaafar et al., 2023). In contrast, grip strength values among male patients were generally higher than normative data reported for healthy males (Almashaqbeh et al., 2022). However, these comparisons were limited to baseline measurements, as follow-up grip strength data were unavailable. As such, no conclusions regarding treatment-related changes in grip strength or recovery trajectories can be drawn from the present findings. Furthermore, no meaningful association was observed between VAS pain scores and grip strength in this cohort. Although previous studies have reported inverse relationships between pain severity and muscle strength in occupational populations (Fifolato et al., 2021), such associations could not be substantiated within the constraints of the available retrospective data.

In terms of rehabilitation practice, the utilisation patterns observed in this study broadly reflect commonly applied approaches and are generally consistent with contemporary clinical practice guidelines for LET (Amako et al., 2022). More than half of the patients received a combination of two electrophysical agents (EPAs), with therapeutic ultrasound and paraffin wax being the most frequently utilised modalities. These findings highlight prevailing clinical practice patterns rather than treatment effectiveness. Existing evidence indicates that ultrasound therapy, when used in isolation, may not be more effective than a placebo for pain relief (Bisset & Vicenzino, 2015), although short-term symptom relief has been reported when ultrasound is combined with friction massage and exercise (Dingemanse et al., 2014). While sustained acoustic ultrasound has demonstrated benefits in selected contexts with prolonged daily application (Best et al., 2015), such protocols are often impractical in routine clinical settings. Similarly, paraffin wax therapy is theorised to provide superficial thermal effects that may support symptom modulation, yet robust clinical evidence supporting its effectiveness in LET remains limited (Dingemanse et al., 2014; Page, 2021). These findings underscore the importance of aligning EPA utilisation with available evidence while recognising real-world practice constraints.

Regarding rehabilitation exercises, home exercise programmes and strengthening exercises were the most frequently prescribed interventions. This aligns with previous studies highlighting the role of structured

strengthening programmes in LET management (Nilsson et al., 2007; Yoon et al., 2021). Eccentric strengthening exercises targeting the wrist extensors have been associated with improvements in pain and function in LET populations (Yoon et al., 2021). However, stretching exercises and soft tissue manipulation techniques were comparatively underutilised in this cohort, despite being recommended components of multimodal rehabilitation approaches (Lenoir et al., 2019; McQueen et al., 2021). These utilisation patterns may reflect therapist preferences, time constraints, or local practice norms rather than evidence-based prioritisation. Further investigation is warranted to better understand the factors influencing exercise prescription decisions in routine LET management. Overall, the findings of this study provide insight into current rehabilitation practice patterns for LET within a Malaysian tertiary care context. By characterising how EPAs and rehabilitation exercises are utilised in real-world clinical settings, the study highlights areas where clinical practice can be optimised by better aligning with contemporary evidence and guideline recommendations.

Strength and Limitation

A key strength of this study lies in its comprehensive examination of gender-related differences in the utilisation of electrophysical agents and rehabilitation exercises for LET. The inclusion of a broad range of treatment modalities provides a detailed overview of real-world rehabilitation practices. The sample size of 105 patients is relatively substantial for LET and enhances the robustness of the descriptive analyses. In addition, the use of routinely collected medical records from a tertiary healthcare setting offers valuable insight into actual clinical decision-making. The inclusion of relevant sociodemographic and clinical variables, such as occupation, symptom duration, and baseline pain scores, further strengthens the contextual understanding of the patient population.

Several limitations should also be acknowledged. The retrospective design may introduce selection bias and limit control over data completeness and measurement consistency. Missing data for certain clinical variables, including pain and grip strength, may have reduced the sample size available for specific analyses. Detailed information regarding the parameters, dosage, and progression of electrophysical agents and prescribed exercises was not consistently available, limiting a more granular interpretation of treatment utilisation. Furthermore, the single-centre setting may limit the generalisability of the findings to other healthcare contexts or regions in Malaysia. Future research using prospective, multi-centre designs is warranted to better characterise treatment utilisation and to evaluate clinical outcomes associated with different rehabilitation strategies for LET.

CONCLUSION

This study describes current rehabilitation practice patterns in the management of lateral elbow tendinopathy (LET). A higher distribution of cases was observed among females, particularly within specific occupational groups. Management was predominantly multimodal, with therapeutic ultrasound and paraffin wax commonly used as electro-physical agents, alongside strengthening exercises and home exercise programmes. Treatment selection appeared similar between genders, suggesting a relatively uniform clinical approach within the local clinical setting. Some commonly used modalities for symptom modulation, such as TENS and hot packs, as well as exercise components such as stretching, were less frequently utilised. These utilisation patterns are clinically relevant because they reflect real-world decision-making in a Malaysian tertiary healthcare context, where resource availability, workflow constraints, and prevailing clinical norms may influence treatment selection. These findings reflect variation in treatment utilisation and should be interpreted as descriptive of clinical practice rather than indicative of treatment effectiveness. Overall, the study provides insight into prevailing rehabilitation practices and offers a local evidence base that may support reflection, benchmarking, and potential optimisation of LET management within similar clinical settings.

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Competing interests

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Author contributions

Concept and design: NAMN, MAA; supervision: NAMN; resources and materials: TWS, NAMN, MAA; data collection and analysis: NAMN, MAA; literature search and writing of the manuscript: TWS, NAMN, MAA; critical review: NAMN, MAA. All authors approved the final version of the manuscript.

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