**Article Full Title**

The forgotten radial nerve: A conceptual framework for treatment of lateral elbow pain

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**Paper Abstract**

Background: Lateral elbow pain is a prevalent musculoskeletal overuse disorder that has serious consequences for musculoskeletal health, occupational performance, and overall healthcare burden. Available treatment options (traditional therapy and steroid injections) have been studied rigorously, yet supporting evidence is weak. The majority of treatment options available are targeted at the local pathology of the common extensor tendon as the apparent source of pain, and do not adequately address the cause, the source of overuse, and mechanism of injury. Purpose: The purpose of this paper is to describe a novel approach, a regional interdependence model, to reduce symptoms of upper extremity musculoskeletal overuse in populations at risk by addressing a broader systematic approach versus a localized symptom driven approach for the assessment and treatment of lateral elbow pain. Methods: The proposed framework - Think in nerve length and layers (TINLL)- accounts for nerve tension and muscle balance in the entire extremity. In this paper we describe the application of the TINLL model for assessment and treatment of SRSN irritation in individuals with lateral elbow pain and propose a method for treatment and for further studies. The proposed treatment approach combines mobilization with movement, elastic taping, and isometric exercises to address impairment at each level: joint alignment, neural tension, and the superficial sensory nervous system. Results: Our findings of reduced pain with a relatively small number of therapy sessions in a small retrospective cohort of patients using the TINLL framework for assessment and treatment supports further formal study of this approach in a larger cohort with longer follow-up to determine effectiveness compared to current treatments. Conclusion: Future studies will test and compare the efficacy of the TINLL framework and model of treatment on the short- and long-term outcomes in individuals with chronic lateral elbow pain compared to traditional therapy.

**NIH Risk of Bias Tool**

1. **Was the research question or objective in this paper clearly stated?**

Yes

1. **Was the study population clearly specified and defined?**

Yes

1. **Was the participation rate of eligible persons at least 50%?**

Cannot Determine, Not Reported, Not Applicable

1. **Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?**

Cannot Determine, Not Reported, Not Applicable

1. **Was a sample size justification, power description, or variance and effect estimates provided?**

Cannot Determine, Not Reported, Not Applicable

1. **For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?**

Yes

1. **Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?**

Yes

1. **For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?**

Yes

1. **Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?**

Cannot Determine, Not Reported, Not Applicable

1. **Was the exposure(s) assessed more than once over time?**

No

1. **Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?**

No

1. **Were the outcome assessors blinded to the exposure status of participants?**

Cannot Determine, Not Reported, Not Applicable

1. **Was loss to follow-up after baseline 20% or less?**

Cannot Determine, Not Reported, Not Applicable

1. **Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?**

Cannot Determine, Not Reported, Not Applicable

**Key Finding #1**

Clinical management of lateral elbow pain that included mobilization with movement (MWM) techniques, stretches, strengthening, and elastic taping resulted in reduced pain in a small retrospective cohort of patients.

**Key Finding #2**

Clinical management of lateral elbow pain that solely addresses the local pathology is not adequate. Addressing nerve tension and muscle balance throughout the entire extremity, rather than just the elbow, will result in superior outcomes.

**Key Finding #3**

Think in nerve length and layers (TINLL) is a clinical framework that can be applied to treatment of lateral elbow pain to ensure various components of the kinetic chain have been addressed.

**Key Finding #4**

MWM approaches are effective at correcting joint alignment and should be coupled with elastic taping to maintain proper movement and alignment of the mobilized joint.

**Please provide your summary of the paper**

The TINLL framework proposed by Taylor and Wolff addresses the fact that the radial nerve is frequently forgotten as a contributor to pain experienced by those who have been diagnosed with lateral epicondylitis. This framework aids therapists in taking a broader approach, to not forget about the interdependence of the kinetic chain. As part of this framework, the authors recommend the use of proximal radio-ulnar joint mobilizations in supine at various degrees of supination to increase range of motion limitations often reported with this patient population. Following joint mobilizations, mobilizations with movement (MWM) techniques were implemented at both the elbow and the shoulder to further increase range of motion limitations and decrease pain levels. In addition to the other recommended components of the TINLL framework, the aforementioned interventions resulted in complete absence of symptoms following 4 visits to hand therapy. Limitations of this study include the relatively small cohort (23 patients) and the nature of the study (retrospective cohort study). These limitations were noted by authors, who called for further assessment of the TINLL framework with a larger cohort and longer follow-up duration. Further limitations of this study include neglecting to address potential confounding variables, poorly defined independent and dependent variables, and lack of specifics provided regarding timeframe of treatment, statistics used to analyze results, and the inclusion and exclusion criteria utilized for selection of participants used.

**Please provide your clinical interpretation of this paper. Include how this study may impact clinical practice and how the results can be implemented.**

Management and treatment of lateral elbow pain should include various intervention strategies, including manual therapy (i.e., mobilizations with and without movement), strengthening (specifically isometric strengthening to aid in joint "setting"), stretching, and other modalities (i.e., elastic taping). Additionally, it is essential to address the involvement of both proximal (glenohumeral joint) and distal joints (distal radioulnar joint, radiocarpal joint) in order to provide treatment that goes beyond addressing only the local pathology.