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Narrative Review

From Evidence to Clinical Practice: A Proposed Clinical Framework for Dry Needling in Tension-Type Headache

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ABSTRACT

Background: Dry needling (DN) is frequently used within physiotherapy management of tension-type headache (TTH). Although previous studies suggest potential benefits for headache-related outcomes, considerable heterogeneity persists regarding patient selection, target muscle selection, treatment dosage, and clinical decision-making processes.

Objective: To propose a clinically oriented framework for the application of DN in patients with TTH informed by the available scientific literature and contemporary physiotherapy practice patterns.

Methods: A narrative review and conceptual synthesis were conducted using evidence from studies addressing DN, myofascial pain mechanisms, headache pathophysiology, and physiotherapy management of TTH. Findings from recent investigations examining physiotherapy practice patterns and DN interventions were also considered to support framework development.

Results: Available evidence suggests that DN may represent a useful component of multimodal physiotherapy management for selected patients with TTH. However, substantial variability remains across intervention protocols, target muscle selection, dosage parameters, and clinical implementation strategies. Based on the narrative synthesis of the literature and clinical practice evidence, a six-domain clinical framework is proposed, including patient selection, clinical examination, target muscle selection, intervention parameters, multimodal integration, and reassessment strategies.

Conclusions: The proposed framework is intended as a conceptual tool to support clinical reasoning and promote greater consistency in DN application for TTH. It should not be interpreted as a validated clinical protocol. Future research should evaluate its feasibility, reliability, and clinical utility in prospective studies while further clarifying optimal treatment parameters and patient subgroups most likely to benefit from DN interventions.

Keywords: tension-type headache; physical therapy modalities; rehabilitation; trigger points; myofascial pain syndromes; treatment outcome; clinical decision-making.

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1. Introduction

Tension-type headache (TTH) is considered the most prevalent primary headache disorder worldwide and represents a substantial source of disability and socioeconomic burden. Recent Global Burden of Disease data continue to identify headache disorders among the leading causes of years lived with disability globally, particularly in individuals under 50 years of age[1,2]. According to the International Classification of Headache Disorders (ICHD-3), TTH is characterized by bilateral, pressing or tightening headache pain of mild-to-moderate intensity, typically without significant aggravation during routine physical activity[3]. Epidemiological evidence further suggests that the global burden of TTH remains considerable, reinforcing its importance as a public health concern[4].

Although the pathophysiology of TTH is multifactorial and not fully understood, increasing evidence supports the contribution of musculoskeletal dysfunctions and altered nociceptive processing in at least a subgroup of patients[5–7]. Pericranial tenderness, cervical musculoskeletal impairments, myofascial trigger points (MTrPs), and increased pressure pain sensitivity have frequently been reported in individuals with TTH[5–10]. Active MTrPs located in cervical and craniofacial muscles may reproduce familiar headache symptoms and potentially contribute to both peripheral nociceptive input and central sensitisation mechanisms[8–10].

Within this context, dry needling (DN) has gained increasing attention as a physiotherapy intervention for headache management. DN is commonly defined as an invasive technique involving the insertion of a solid filiform needle into muscular or connective tissue structures, frequently targeting MTrPs with the aim of modulating pain and neuromuscular dysfunction[11–13]. Proposed mechanisms include the reduction of peripheral nociceptive input, mechanical effects on dysfunctional motor endplates, modulation of local biochemical environments, and activation of endogenous pain inhibitory pathways[13,14]. When performed by appropriately trained clinicians, DN is generally considered a safe intervention, although minor adverse events such as post-needling soreness, bleeding, or bruising may occur, while serious complications remain uncommon[15,16].

Previous studies suggest that DN may contribute to improvements in headache intensity, headache frequency, pressure pain sensitivity, and disability in patients with TTH and related musculoskeletal pain conditions[17–22]. Commonly targeted muscles include the upper trapezius, suboccipital muscles, sternocleidomastoid, temporalis, and masseter muscles, all of which have been associated with referred pain patterns capable of reproducing headache symptoms[8,24,25]. Nevertheless, substantial variability persists across studies regarding intervention procedures, dosage, muscle selection, needle manipulation techniques, treatment frequency, and outcome assessment[17,18].

Recent evidence from a scoping review examining DN interventions in TTH identified considerable heterogeneity in treatment protocols and intervention parameters across published studies[26]. Similarly, findings from recent investigations exploring physiotherapy practice patterns have demonstrated variability in clinical reasoning approaches, dosage selection, and multimodal treatment integration within routine clinical practice[27].

This variability may hinder the translation of research findings into everyday physiotherapy management and contribute to inconsistencies in clinical decision-making. Furthermore, relatively few publications have attempted to integrate current evidence, clinical reasoning principles, and contemporary practice patterns into a structured framework specifically focused on DN for TTH. Consequently, the aim of this article is to propose a clinically oriented framework for the application of DN in patients with TTH, informed by the available scientific literature and contemporary physiotherapy practice patterns.

2. Methods

This article follows a narrative review and conceptual synthesis methodology aimed at integrating current scientific literature with contemporary physiotherapy practice patterns related to the management of TTH. The objective was not to estimate treatment effectiveness or systematically map all available evidence, but rather to develop a clinically oriented framework capable of supporting clinical reasoning and decision-making in the application of DN. Given the conceptual and practice-oriented nature of this work, a narrative review methodology was considered more appropriate than a systematic or scoping review approach.

2.1 Literature Search Strategy and Data Sources

A narrative literature search was conducted using the electronic databases PubMed, Scopus, Web of Science, and PEDro. The search was performed between January and March 2025. Additional studies were identified through manual screening of reference lists from relevant articles, reviews, and clinical guidelines.

Representative search terms included “tension-type headache”, “dry needling”, “trigger points”, “myofascial pain”, “physiotherapy”, “manual therapy”, and related combinations using Boolean operators (AND/OR).

Studies published in English or Spanish were considered eligible. No strict publication date restrictions were applied; however, preference was given to recent studies and evidence sources considered methodologically robust and clinically relevant.

2.2 Eligibility and Selection of Literature

Studies were considered relevant if they addressed one or more of the following domains:[(1)] dry needling interventions in TTH or related headache disorders;[(2)] myofascial pain mechanisms relevant to headache presentation;[(3)] physiotherapy management strategies for TTH; and[(4)] clinical reasoning processes applicable to invasive physiotherapy interventions.

Priority was given to systematic reviews, randomised controlled trials, observational studies, clinical guidelines, and influential theoretical publications that contributed to understanding the clinical application of DN in headache management.

Publications focusing exclusively on pharmacological interventions, non-headache populations without conceptual relevance to the framework, or topics unrelated to physiotherapy decision-making were not prioritised for inclusion.

2.3 Literature Synthesis and Framework Development

The selected literature was reviewed and synthesised narratively. Evidence was organised according to domains considered relevant to clinical reasoning in DN application: patient selection, clinical examination, target muscle selection, intervention parameters, multimodal integration, and reassessment strategies.

Rather than providing an exhaustive summary of all available evidence, the synthesis aimed to identify recurring clinical themes, areas of convergence, knowledge gaps, and practical considerations relevant to framework development. These thematic domains formed the basis of the proposed six-step clinical framework.

2.4 Integration of Clinical Practice Evidence

Publications originating from the authors' research group were included as complementary sources of practice-based evidence but were not used as the sole basis for any framework component. Whenever possible, these findings were interpreted in conjunction with independent evidence sources.

2.5 Conceptual Synthesis

A qualitative and interpretative synthesis process was undertaken to integrate findings from the literature into a coherent clinical reasoning structure. The resulting framework reflects the authors' interpretation of the available evidence and contemporary physiotherapy practice rather than a formally validated clinical protocol or consensus guideline.

2.6 Methodological Considerations

Given the narrative and conceptual nature of this article, no formal risk of bias assessment or methodological quality scoring was performed.

Nevertheless, greater emphasis was placed on evidence derived from systematic reviews, randomised controlled trials, clinical guidelines, and well-conducted observational studies.

This manuscript was prepared in accordance with the Scale for the Assessment of Narrative Review Articles (SANRA) guidelines.

3. Results and Conceptual Development of the Framework

The literature reviewed and the clinical practice evidence analysed were synthesised to identify recurring themes relevant to the application of DN in TTH. These themes informed the development of the proposed framework. Importantly, the framework should be interpreted as a conceptual and evidence-informed model derived from narrative synthesis and expert interpretation rather than as a clinically validated decision-making tool. The six domains included in the framework reflect areas consistently discussed across the literature and contemporary physiotherapy practice patterns, while some operational components represent the authors' interpretative integration of the available evidence.

3.1. Current Evidence on Dry Needling in Tension-Type Headache

Growing interest in invasive physiotherapy interventions has contributed to an expanding body of literature investigating the use of DN in patients with TTH. Current evidence generally supports the potential effectiveness of DN for improving headache-related symptoms, particularly when integrated within multimodal physiotherapy management strategies[17–23,26,29].

Previous studies have reported reductions in headache intensity, headache frequency, pressure pain sensitivity, and disability following DN interventions in patients with both episodic and chronic TTH[17,19–22]. These clinical effects may be associated with multiple neurophysiological mechanisms, including modulation of MTrP activity, reduction of peripheral nociceptive input, normalization of dysfunctional motor endplates, alterations in spinal and supraspinal nociceptive processing, and improvements in local muscular function[6,8,11,13,14].

Contemporary evidence additionally supports the concept that TTH should not be interpreted exclusively as a peripheral musculoskeletal disorder, but rather as a multidimensional condition involving variable interactions between musculoskeletal dysfunctions, altered nociceptive processing, psychosocial contributors, stress-related factors, sleep disturbances, and behavioral components[5–8,28]. Within this context, DN may represent one potentially relevant intervention targeting the musculoskeletal and nociceptive dimensions of the disorder as part of a broader individualized physiotherapy management strategy[28,29].

Despite these promising findings, the available literature demonstrates substantial methodological and clinical heterogeneity. Considerable variability exists regarding treatment dosage, number and frequency of sessions, needle insertion techniques, local twitch response elicitation, needle retention time, targeted musculature, and outcome assessment procedures[17,18,26]. Such heterogeneity complicates direct comparisons between studies and limits the establishment of standardized clinical recommendations for DN application in TTH.

One of the most consistent findings across the literature is the frequent targeting of cervical and craniofacial musculature associated with MTrPs and referred pain patterns capable of reproducing familiar headache symptoms[8,10,24,25]. Commonly treated muscles include the upper trapezius, suboccipital muscles, sternocleidomastoid, temporalis, and masseter muscles[19–22,26]. These muscles are frequently associated with pericranial tenderness, altered pressure pain sensitivity, cervical dysfunction, and headache-related referred pain patterns in patients with TTH[5–10,24].

Among these structures, the upper trapezius and suboccipital muscles appear to be the most frequently targeted in clinical studies, likely due to their anatomical and functional relationship with cervical musculoskeletal dysfunction and symptom reproduction[19–22,26]. Similarly, the sternocleidomastoid muscle has received considerable attention because of its characteristic referred pain distribution toward frontal, temporal, and periocular regions[25]. In some patients, temporomandibular musculature such as the temporalis and masseter muscles may also contribute to headache presentation, particularly in the presence of temporomandibular dysfunction, parafunctional behaviors, or craniofacial sensitization[24,25].

Current evidence additionally suggests that DN may demonstrate greater clinical applicability when incorporated as part of a broader multimodal physiotherapy approach rather than as

an isolated intervention[17,18,23,29]. Contemporary physiotherapy management of TTH increasingly emphasizes the integration of education, therapeutic exercise, manual therapy, stress-related management strategies, and self-management interventions alongside invasive techniques[6,7,28,29].

Nevertheless, several important limitations remain within the current evidence base. Many studies involve relatively small sample sizes, short-term follow-up periods, heterogeneous intervention protocols, and inconsistent reporting of clinical reasoning processes guiding muscle selection and treatment progression[17,18,26]. Furthermore, variability persists regarding patient stratification, identification of clinically relevant phenotypes, and dosage individualization strategies in both research and clinical practice settings[26–29].

3.2. Clinical Practice Patterns Among Physiotherapists

Recent evidence investigating physiotherapy management patterns in patients with TTH suggests that DN has become a frequently used intervention within contemporary clinical practice[27]. However, substantial variability persists regarding treatment application, clinical reasoning processes, dosage strategies, and integration with other therapeutic approaches[26,27].

Current practice patterns indicate that physiotherapists rarely apply DN as an isolated intervention. Instead, invasive techniques are commonly integrated within multimodal physiotherapy management strategies including therapeutic exercise, manual therapy, postural interventions, patient education, ergonomic advice, and self-management approaches[17,18,23,27,29]. This tendency appears consistent with contemporary multidimensional models of TTH, in which musculoskeletal dysfunctions, psychosocial factors, stress-related contributors, sleep disturbances, and lifestyle-related behaviors may simultaneously influence symptom persistence and clinical presentation[5–8,28].

Considerable variability additionally exists in muscle target selection among clinicians. Although the upper trapezius, suboccipital muscles, sternocleidomastoid, and temporalis muscles are among the most frequently treated structures, clinicians commonly adapt muscle selection according to individual symptom distribution, palpation findings, headache reproduction during physical examination, cervical dysfunction, symptom irritability, and perceived contributing factors[8–10,24–27]. While such variability may reflect attempts to individualize treatment strategies, it simultaneously highlights the absence of standardized clinical frameworks capable of guiding DN application in patients with TTH[26–28].

Differences in treatment dosage and intervention parameters have also been observed across clinical practice settings[26,27]. Variability exists regarding the number of muscles treated per session, session frequency, needle manipulation techniques, needle retention time, and the use of local twitch response elicitation[13,17,18,26]. Some clinicians appear to prioritize more aggressive trigger point deactivation approaches, whereas others adopt symptom-guided and tolerance-based strategies, particularly in patients presenting with widespread sensitivity, chronic pain presentations, or elevated symptom irritability[5–8,28].

Clinical reasoning processes further appear to be strongly influenced by practitioner experience, postgraduate training, and personal interpretation of available evidence[11,17,18,27]. In many cases, treatment decisions are guided not only by research evidence, but also by previous clinical

experience, patient expectations, perceived muscular involvement, psychosocial contributors, and individual responses to treatment progression[27,28]. Consequently, discrepancies frequently emerge between standardized research protocols and real-world physiotherapy practice[26,27].

Importantly, recent practice pattern findings also suggest increasing recognition of the need to integrate DN within broader biopsychosocial management models[27,28]. Physiotherapists frequently report combining invasive techniques with pain education, exercise prescription, stress management strategies, manual therapy interventions, and behavioral self-management approaches[17,23,27,29]. Such findings support the perspective that DN may represent one component within a comprehensive physiotherapy management strategy rather than a stand-alone therapeutic solution.

Taken together, these findings reinforce the need for evidence-informed clinical frameworks capable of supporting more structured and consistent decision-making while preserving individualized patient-centered care. Bridging the gap between research evidence and contemporary clinical practice may contribute to improved treatment standardization, more transparent intervention reporting, and future development of individualized invasive physiotherapy approaches for patients with TTH[26–29].

3.3. Development of a Proposed Clinical Framework for DN in TTH

The proposed framework emerged from the narrative integration of the literature reviewed together with clinical practice evidence and the authors' expert interpretation of areas where decision-making variability was consistently identified. The framework was not developed through a formal consensus process (e.g., Delphi methodology), nor has it undergone prospective validation. Consequently, it should be viewed as a conceptual tool intended to support clinical reasoning rather than as a prescriptive algorithm or evidence-based guideline.

Based on current scientific evidence, contemporary physiotherapy practice patterns, and emerging multidimensional models of TTH, a proposed clinical framework for the application of DN is presented. The framework aims to facilitate evidence-informed clinical reasoning, support more structured decision-making processes, and enhance consistency in the application of invasive physiotherapy interventions while preserving individualized patient-centered care[26–29].

The proposed model was developed as a pragmatic attempt to bridge the existing gap between heterogeneous research protocols and real-world clinical practice. Rather than establishing rigid treatment algorithms, the framework is intended to provide a flexible structure capable of supporting individualized clinical decision-making according to patient presentation, symptom irritability, musculoskeletal findings, psychosocial contributors, and treatment response.

The framework consists of six interrelated clinical domains: 1. patient selection, 2. clinical examination and phenotyping, 3. muscle target selection, 4. needling parameters and dosage, 5. multimodal integration, and 6. reassessment and clinical progression strategies. Although presented sequentially, these domains should be interpreted as dynamic and mutually interactive components within the overall clinical reasoning process. A concise summary of the six domains, their principal assessment components, and associated clinical decision-making considerations is presented in Table 1.

3.3.1. Patient Selection

Appropriate patient selection represents a fundamental component in the clinical application of DN for TTH. Current evidence suggests that patients presenting with episodic or chronic TTH accompanied by identifiable MTrPs, pericranial tenderness, cervical musculoskeletal dysfunction, or reproducible familiar headache symptoms during palpation may represent suitable candidates for invasive physiotherapy interventions[5–10,17–22,26].

Particular attention should be directed toward the identification of musculoskeletal impairments potentially contributing to symptom presentation. Common findings may include increased sensitivity within cervical and craniofacial musculature, restricted cervical mobility, impaired neuromuscular control, sustained postural dysfunctions, and the presence of active MTrPs capable of reproducing recognizable headache symptoms[5–10,24,25]. From a clinical reasoning perspective, these findings may help identify patients presenting with a more pronounced musculoskeletal phenotype potentially responsive to DN interventions[28].

In addition to physical findings, clinicians should consider psychosocial and behavioral factors that may influence treatment response and symptom persistence. Variables such as fear-related beliefs, pain catastrophizing, anxiety, stress-related burden, sleep disturbances, and patient expectations may influence both pain modulation and tolerance to invasive procedures[6,7,28]. Consequently, incorporating a biopsychosocial perspective during patient selection may facilitate more individualized and clinically appropriate decision-making processes.

Careful screening for contraindications and precautions remains essential prior to DN application[11,15,16]. Absolute contraindications may include patient refusal, local infection, active skin lesions, or inadequate clinician training. Relative precautions may include anticoagulant therapy, pregnancy-related considerations, severe needle-related anxiety, immunosuppression, or heightened pain sensitivity[15,16]. Furthermore, clinicians should remain vigilant for red flags suggestive of secondary headache disorders, including sudden-onset headache, progressive neurological symptoms, unexplained systemic signs, or substantial changes in headache presentation requiring medical referral[3].

Importantly, DN should not be considered universally appropriate for all patients with TTH. In some individuals, particularly those presenting with widespread hypersensitivity, dominant central sensitization-related features, elevated psychosocial distress, or poor tolerance to invasive procedures, alternative or initially less provocative treatment strategies may be preferable[6–8,28]. Consequently, clinical reasoning should prioritize individualized assessment and patient phenotyping rather than protocol-driven intervention selection.

The identification of patients most likely to benefit from DN continues to represent an important area for future research. Nevertheless, current evidence and contemporary clinical practice patterns suggest that patients presenting with clear musculoskeletal involvement and reproducible myofascial symptom patterns may represent the most appropriate candidates for invasive physiotherapy interventions within TTH management[26–29].

3.3.2. Clinical Examination

A comprehensive clinical examination is essential to guide clinical reasoning and optimize DN application in patients with TTH. Given the multidimensional nature of TTH, assessment should extend beyond pain localization alone and incorporate musculoskeletal, functional, sensory, behavioral, and psychosocial factors potentially contributing to symptom persistence and recurrent headache episodes[5–8,28].

The clinical examination should begin with a detailed patient history including headache frequency, duration, intensity, symptom distribution, aggravating and relieving factors, medication use, sleep quality, stress-related burden, occupational demands, physical activity levels, and previous treatment responses[3,28]. Identifying factors associated with headache exacerbation may help clinicians recognize potential perpetuating mechanisms and facilitate individualized treatment planning.

Physical examination should prioritize the assessment of cervical and craniofacial musculoskeletal impairments commonly associated with TTH[5–10]. Palpation of pericranial musculature may help identify active MTrPs, local tenderness, increased tissue sensitivity, and recognizable referred pain patterns[8–10,24,25]. Particular attention should be directed toward muscles frequently implicated in TTH presentations, including the upper trapezius, suboccipital muscles, sternocleidomastoid, temporalis, and masseter muscles[19–22,24–26].

Reproduction of the patient's familiar headache symptoms during manual palpation may represent a clinically relevant finding when selecting potential muscle targets for DN intervention[8,10,24]. Although symptom reproduction alone should not be considered diagnostic, it may assist clinicians in identifying muscular structures potentially contributing to the clinical presentation and support musculoskeletal phenotyping within the broader clinical reasoning process[28].

Assessment of cervical range of motion, joint mobility, postural control, cervical endurance, and neuromuscular function may additionally provide relevant information regarding cervical involvement[5–7,29]. Restrictions in upper cervical mobility, impaired cervical motor control, and sustained postural loading strategies are frequently observed in patients with TTH and may contribute to persistent mechanical stress and muscular sensitization[6,7].

Where available, clinicians may also consider the assessment of pressure pain sensitivity using pressure algometry or other quantitative sensory testing procedures[5,9]. Increased local and widespread mechanical sensitivity has been consistently reported in patients with TTH and may provide additional information regarding symptom irritability, nociceptive sensitization, and potential central sensitization-related mechanisms[5–9,28].

Importantly, the clinical examination should not focus exclusively on identifying structures to needle. Instead, assessment findings should contribute to a broader understanding of the patient's symptom presentation and guide multimodal management strategies[28,29]. DN-related decisions should therefore emerge from an integrated clinical reasoning process rather than from isolated trigger point identification alone.

Given the heterogeneity of TTH presentations, no single examination procedure can fully explain symptom presentation in all patients[6–8,28]. Consequently, clinicians should integrate

examination findings with patient history, symptom behavior, irritability levels, psychosocial contributors, and individual patient factors when determining the potential role of DN within overall physiotherapy management.

3.3.3. Muscle Target Selection Strategy

Appropriate muscle target selection represents one of the most clinically relevant and variable aspects of DN application in patients with TTH. Current evidence and clinical practice patterns suggest that muscle selection is commonly guided by the presence of MTrPs, symptom reproduction during palpation, regional pain distribution, and the identification of cervical or craniofacial musculoskeletal dysfunctions[8–10,19–22,26,27].

Rather than relying on standardized protocols targeting identical muscles across all patients, an individualized and symptom-based approach may provide greater clinical relevance. Given the heterogeneous presentation of TTH, clinicians should consider the dominant clinical phenotype, pain distribution, mechanical aggravating factors, irritability level, and associated musculoskeletal impairments when selecting treatment targets[6–8,28].

The upper trapezius muscle is among the most frequently treated structures in patients with TTH. Increased muscular tension, sustained postural loading, and active trigger points within this muscle may contribute to cervical discomfort and referred pain toward temporal and occipital regions[19–22,26]. DN of the upper trapezius may therefore be considered in patients presenting with a cervical-dominant phenotype characterized by postural overload, scapular tension, or regional tenderness.

Suboccipital musculature also represents a common treatment target due to its anatomical and neurophysiological relationship with upper cervical dysfunction and headache symptom reproduction. Increased sensitivity and trigger point activity within the suboccipital muscles may contribute to occipital pain, cervical stiffness, and headache referral patterns[8–10]. Patients presenting with upper cervical restriction and symptom exacerbation during sustained cervical postures may particularly benefit from addressing this region.

The sternocleidomastoid muscle has frequently been associated with referred pain patterns extending toward frontal, temporal, orbital, and facial regions[25]. Trigger points within this muscle may reproduce headache symptoms commonly reported in TTH, particularly in patients presenting with cervicogenic features or asymmetric pain distribution. However, due to anatomical complexity and proximity to neurovascular structures, DN of this muscle requires appropriate technical expertise and clinical training[11,15].

In patients presenting with temporomandibular dysfunction, jaw clenching behaviors, or craniofacial sensitization, the temporalis and masseter muscles may additionally represent clinically relevant targets[24,25]. Increased activity within masticatory musculature may contribute to headache persistence through sustained peripheral nociceptive input and referred pain mechanisms.

Importantly, muscle target selection should remain dynamic throughout the treatment process. Initial decisions may require modification according to patient response, symptom irritability, tolerance to intervention, and evolving clinical findings. In some cases, prioritizing fewer but

highly relevant muscular targets during early stages may improve treatment tolerance, particularly in patients with chronic pain presentations or widespread sensitivity.

Clinicians should additionally recognize that the presence of MTrPs alone does not necessarily justify DN intervention. Treatment decisions should emerge from an integrated clinical reasoning process incorporating patient goals, symptom behavior, functional limitations, and overall physiotherapy management objectives[28,29].

3.3.4. Needling Parameters and Intervention Dosage

Considerable variability currently exists regarding DN procedures and intervention dosage in patients with TTH. Differences in session frequency, number of treated muscles, needle manipulation techniques, retention time, and treatment duration continue to limit standardization across both research and clinical practice[17,18,26,27]. Consequently, rigid protocol-based approaches may not adequately reflect the individualized nature of invasive physiotherapy management in TTH.

Current evidence suggests that DN interventions are commonly applied one to two times per week over short- to medium-term treatment periods[17,19–22]. However, optimal treatment frequency remains unclear, and clinical decisions should be primarily guided by symptom irritability, patient tolerance, clinical response, and the presence of central sensitization features[5–8,28]. In highly irritable patients, lower treatment frequency and more conservative dosing strategies may help minimize post-treatment soreness and improve overall tolerance.

The number of muscles treated during each session should also be individualized according to symptom presentation and tissue sensitivity. While some patients may tolerate treatment of multiple muscular regions within a single session, others may respond more favorably to a more targeted approach focusing initially on one or two clinically relevant structures[26,27]. Excessive treatment volume in sensitive patients may increase post-intervention discomfort and temporarily exacerbate symptoms.

Needle manipulation techniques may additionally vary according to clinician preference, treatment goals, and patient tolerance. Some clinicians prioritize the elicitation of local twitch responses (LTRs) in an attempt to achieve trigger point modulation, whereas others adopt less aggressive techniques focused on mechanical stimulation and symptom tolerance. Although universal consensus has not been reached regarding the necessity of eliciting LTRs in every patient, available evidence suggests that their elicitation is frequently associated with favorable clinical outcomes and may represent an important component of DN treatment in some individuals. Nevertheless, positive clinical effects have also been reported in the absence of LTRs, indicating that they should not be considered an absolute prerequisite for treatment success. Therefore, clinicians may aim to elicit LTRs when clinically appropriate while adapting the intervention according to patient presentation, treatment tolerance, and overall clinical response[13,17,18].

Similarly, variability persists regarding needle retention time and manipulation intensity. In clinical practice, interventions may range from rapid in-and-out techniques to more sustained needle retention approaches. Given the absence of standardized evidence supporting specific

procedural parameters, clinicians should prioritize safety, patient comfort, and clinical response when determining intervention dosage[15,16].

Particular caution may be warranted in patients presenting with widespread hyperalgesia, chronic pain sensitization, high fear of movement, or elevated anxiety levels[5–8,28]. In such cases, gradual exposure to invasive techniques and conservative dosing strategies may improve acceptance and reduce adverse responses.

Although mild post-needling soreness is commonly reported following DN interventions, clinicians should appropriately inform patients regarding expected short-term responses and monitor potential adverse effects throughout the treatment process[15,16]. Clear communication regarding treatment goals and expected sensations may additionally improve therapeutic alliance and treatment adherence.

Importantly, DN dosage should not be considered static throughout treatment progression. Intervention parameters may require modification according to symptom evolution, functional improvement, treatment tolerance, and overall rehabilitation response. Regular reassessment therefore remains essential to guide ongoing clinical decision-making and optimize treatment application[26,27].

Given current limitations in standardization, future research should prioritize the identification of optimal dosing parameters and clinically meaningful progression strategies in patients with TTH. Until more robust evidence becomes available, individualized and symptom-guided dosing approaches appear most consistent with contemporary clinical practice[26–29].

3.3.5. Integration Within a Multimodal Physiotherapy Approach

Current evidence and contemporary clinical practice patterns suggest that DN should not be considered a stand-alone intervention in the management of TTH[6–8,17,18,27–29]. Instead, invasive physiotherapy techniques appear to demonstrate greater clinical relevance when integrated within a broader multimodal rehabilitation approach addressing the multiple factors potentially contributing to headache persistence.

TTH is widely recognized as a multifactorial condition involving interactions between musculoskeletal dysfunction, altered pain processing, psychosocial influences, lifestyle-related factors, and behavioral contributors[5–8,28]. Consequently, relying exclusively on passive or symptom-focused interventions may inadequately address the complexity of the clinical presentation. Integrating DN with active and educational strategies may therefore facilitate more comprehensive and patient-centered management.

Therapeutic exercise frequently represents a central component of multimodal physiotherapy management in TTH[6,7,29]. Exercise interventions targeting cervical motor control, postural endurance, scapular stabilization, and general physical activity may help improve muscular function, reduce mechanical overload, and enhance long-term self-management capacity. DN may potentially facilitate exercise participation by temporarily reducing pain sensitivity and muscular irritability, thereby improving tolerance to active rehabilitation[17,18,23].

Manual therapy techniques are also commonly combined with DN interventions in clinical practice[29]. Joint mobilization, soft tissue techniques, and cervical-thoracic manual therapy

approaches may complement invasive procedures by addressing mobility restrictions, tissue stiffness, and movement-related dysfunctions. However, the relative contribution of each intervention component remains difficult to determine due to the multimodal nature of most treatment programs[29].

Patient education should additionally be considered a fundamental aspect of physiotherapy management in TTH[28,29]. Education regarding pain mechanisms, headache triggers, stress management, sleep hygiene, ergonomic strategies, and self-management approaches may help address maladaptive beliefs and improve patient engagement in the rehabilitation process. Importantly, clinicians should avoid presenting DN as a "corrective" or curative intervention targeting isolated tissue dysfunction, as such explanations may reinforce unhelpful biomedical interpretations of pain.

Psychosocial and lifestyle-related factors should also be considered during treatment planning[28]. Stress, anxiety, poor sleep quality, occupational demands, and reduced physical activity levels may contribute significantly to symptom persistence and recurrence in patients with TTH. Consequently, integrating behavioral strategies and promoting active coping mechanisms may enhance long-term treatment outcomes beyond short-term symptom reduction alone.

The role of DN within multimodal management may therefore be conceptualized as a facilitating intervention aimed at modulating pain sensitivity and improving short-term symptom tolerance to support progression toward active rehabilitation strategies[17,18,23]. From this perspective, invasive physiotherapy represents one component within a broader clinical reasoning framework rather than the primary focus of treatment.

Overall, integrating DN within individualized multimodal physiotherapy programs appears most consistent with both current evidence and real-world clinical practice patterns in the management of TTH[26–29]. Further research is nevertheless required to clarify the optimal combination, timing, and sequencing of interventions capable of maximizing clinical outcomes in this population.

3.3.6. Reassessment and Clinical Progression

Ongoing reassessment represents a critical component of clinical reasoning in the application of DN for TTH[26,27]. Given the variability in patient presentation, symptom irritability, and response to treatment, regular evaluation is essential to determine clinical effectiveness, guide progression, and avoid unnecessary continuation of invasive interventions.

Reassessment should include both subjective and objective outcome measures. From a subjective perspective, clinicians should monitor changes in headache frequency, intensity, duration, and perceived disability[6–8]. Patient-reported outcomes such as global perceived effect, headache diaries, and pain-related questionnaires may provide valuable information regarding clinical progression over time.

From an objective standpoint, reassessment may include evaluation of cervical range of motion, muscular tenderness, pressure pain sensitivity, and the presence or absence of active myofascial trigger points[5–10,24,25]. Changes in palpation sensitivity and reduction in symptom reproduction during manual examination may also provide clinically relevant indicators of

treatment response, although these findings should always be interpreted within a broader clinical context[28].

An important aspect of reassessment involves determining whether DN is contributing meaningfully to overall patient improvement. In some patients, early symptom reduction may be observed following intervention; however, sustained improvement is more likely when DN is integrated within a progressive rehabilitation program[17,18,23]. If no clinically meaningful changes are observed after an appropriate trial period, clinicians should reconsider the role of invasive techniques within the treatment plan[26,27].

Clinical progression should be guided by patient response rather than predetermined protocols. In patients demonstrating positive responses, progression may involve reducing treatment frequency, decreasing the number of treated muscles, or transitioning toward a greater emphasis on active rehabilitation strategies such as exercise therapy and self-management[29]. Conversely, in patients with limited response, clinicians should reassess clinical hypotheses, modify muscle selection strategies, or consider alternative therapeutic approaches[28].

Importantly, escalation of invasive treatment intensity is not always appropriate in cases of suboptimal response. Increasing dosage or expanding the number of treated muscles without clear clinical justification may contribute to increased symptom irritability and reduced tolerance[5–8]. Instead, reassessment of underlying contributing factors, including psychosocial influences, central sensitization features, and lifestyle variables, may be more clinically appropriate[28].

Communication with the patient during reassessment is also essential. Discussing expected recovery trajectories, reinforcing realistic expectations, and involving patients in shared decision-making may enhance adherence and improve overall treatment engagement[28,29]. This is particularly relevant in chronic TTH presentations, where fluctuating symptoms and gradual improvement patterns are common.

Overall, structured and continuous reassessment allows clinicians to ensure that DN remains an appropriate and effective component of care. It also supports a dynamic and responsive clinical reasoning process, facilitating timely modification of interventions and promoting more efficient, evidence-informed physiotherapy management in patients with TTH[26–29].

Based on reassessment findings, clinicians may consider three broad decision pathways:

Proceed: clinically meaningful improvement in headache symptoms, function, or patient-reported outcomes with acceptable treatment tolerance.

Modify: partial response, emerging adverse effects, excessive post-treatment irritability, or identification of additional contributing factors requiring adaptation of dosage, target selection, or multimodal interventions.

Discontinue or Refer: absence of clinically meaningful improvement after an appropriate treatment trial, poor tolerance to the intervention, emergence of contraindications, or identification of red flags requiring medical assessment.

3.3.7. Safety Considerations

Safety represents a fundamental component of clinical reasoning when considering DN for patients with TTH, particularly when targeting cervical and craniofacial musculature. The decision to perform DN should always be preceded by a thorough assessment of indications, contraindications, patient preferences, and potential risks associated with the intervention[11,15,16].

Prior to treatment, clinicians should obtain informed consent after providing a clear explanation of the proposed procedure, expected benefits, potential adverse effects, alternative treatment options, and the limits of current evidence. Shared decision-making is especially important when invasive procedures are considered, allowing patients to make informed choices regarding their care.

Careful screening for contraindications and precautions is essential. Particular attention should be paid to patients receiving anticoagulant or antiplatelet therapy, those presenting with bleeding disorders, immunosuppression, active infection, local skin lesions, severe needle-related anxiety, or other conditions that may increase procedural risk. Clinical judgement should guide whether DN is appropriate or whether treatment modifications are required[15,16].

The anatomical complexity of cervical and craniofacial regions warrants particular caution. Muscles such as the sternocleidomastoid and deep cervical musculature are located in close proximity to important neurovascular and visceral structures. Consequently, clinicians should possess detailed anatomical knowledge and apply region-specific safety considerations when selecting treatment targets. DN in anatomically sensitive areas should only be performed by appropriately trained professionals operating within their scope of practice and according to relevant professional and regulatory standards[11,15].

Strict hygiene and infection-control procedures should be followed at all times. These include appropriate hand hygiene, skin preparation when indicated, the use of sterile single-use needles, and safe disposal of sharps in accordance with local regulations and professional guidelines. Adherence to these procedures contributes to minimizing infection risk and maintaining patient safety.

Although DN is generally considered a safe intervention when performed by qualified clinicians, minor adverse events such as post-needling soreness, transient pain, bruising, minor bleeding, or fatigue may occur[15,16]. Clinicians should inform patients about these expected responses and provide appropriate post-treatment guidance. Vasovagal reactions, including dizziness, nausea, sweating, or transient loss of consciousness, may occasionally occur, particularly in anxious individuals or during initial treatment sessions. Appropriate monitoring and management procedures should therefore be available whenever DN is performed.

Documentation of adverse events and patient responses should form part of routine clinical practice. Recording treatment details, immediate responses, adverse reactions, and follow-up outcomes facilitates clinical monitoring, supports quality assurance, and contributes to transparent reporting.

Finally, clinicians should remain alert to findings that may warrant medical referral. Red flags such as sudden-onset headache, progressive neurological symptoms, unexplained systemic signs, significant changes in headache characteristics, or suspicion of secondary headache dis-

orders require further medical evaluation. In such cases, DN should not replace appropriate diagnostic investigation or interdisciplinary management.

3.4. Clinical Summary of the Proposed Framework

The proposed clinical framework integrates current evidence, contemporary physiotherapy practice patterns, and the authors' conceptual synthesis into a structured yet flexible model for clinical reasoning in the application of DN for TTH. The six domains and their associated decision-making components are summarised in Table 1.

The clinical process begins with appropriate patient selection, where clinicians identify individuals with episodic or chronic TTH presenting with clear musculoskeletal involvement, myofascial trigger points, and reproducible headache symptoms. Careful screening for contraindications and red flags remains essential, alongside consideration of psychosocial and behavioral factors that may influence treatment response[3,15,16,28].

Following patient selection, a structured clinical examination is performed to identify relevant musculoskeletal dysfunctions. This includes assessment of cervical and craniofacial musculature, identification of trigger points, evaluation of cervical mobility and motor control, and interpretation of symptom reproduction during palpation[5–10,24,25]. These findings contribute to a broader understanding of the patient's headache presentation and guide subsequent clinical reasoning.

Based on examination findings, clinicians then determine individualized muscle target selection. Rather than applying uniform treatment approaches, muscle selection is guided by dominant clinical features, pain distribution patterns, and functional impairments. Commonly involved structures include the upper trapezius, suboccipital muscles, sternocleidomastoid, temporalis, and masseter muscles, although selection should always be tailored to the individual patient presentation[19–22,24–27].

Once treatment targets are identified, DN is applied using symptom-guided parameters. Intervention dosage, including frequency, number of muscles treated, and needle manipulation techniques, should be adjusted according to patient tolerance, symptom irritability, and clinical response. Conservative approaches may be preferable in highly sensitive or chronic presentations, while more progressive strategies may be considered in patients demonstrating good tolerance[17,18,26].

DN should be systematically integrated within a multimodal physiotherapy approach, including therapeutic exercise, manual therapy, and patient education. This integration is essential to address the multifactorial nature of TTH and to support long-term outcomes beyond short-term symptom modulation[6–8,28,29].

Finally, continuous reassessment guides clinical progression and treatment modification. Changes in headache characteristics, functional capacity, and musculoskeletal findings inform decisions regarding continuation, adjustment, or reduction of DN interventions[26,27]. Importantly, clinical progression should prioritize functional improvement and patient-centered outcomes rather than protocol-based escalation.

Overall, this framework should be interpreted as a conceptual and evidence-informed aid to clinical reasoning. It is not intended to function as a validated clinical guideline or treatment algorithm. Future studies should evaluate its feasibility, acceptability, reliability, and clinical utility in prospective clinical settings.

Table 1 summarises the key domains, assessment elements, and clinical considerations associated with the framework, whereas Figure 1 illustrates the overall workflow and dynamic interaction between its components.

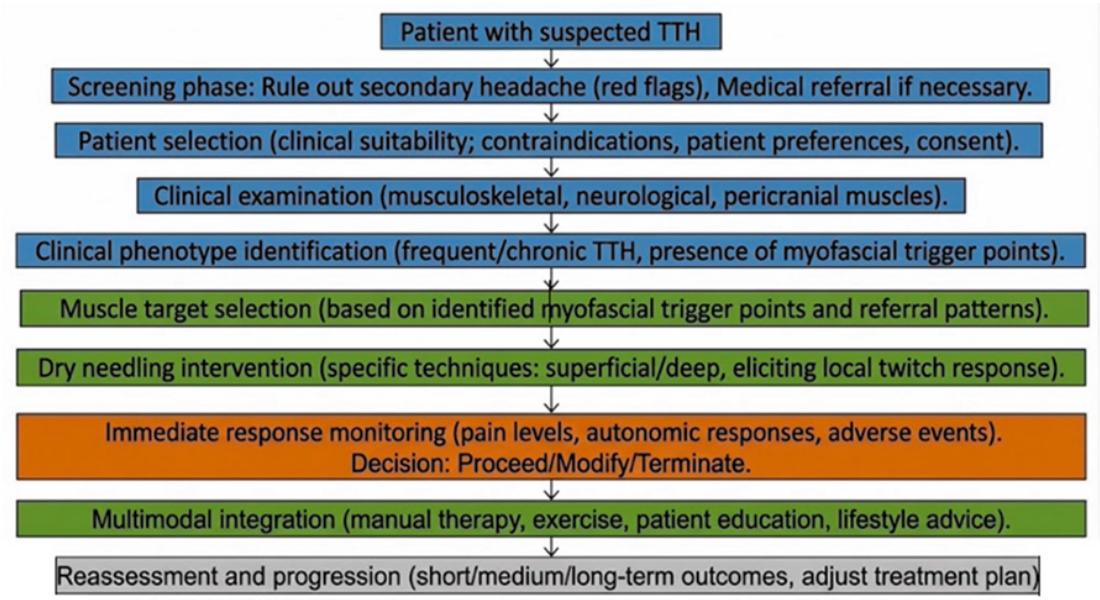

Figure 1. Clinical decision-making framework for the application of dry needling in TTH.

Table 1. Summary of the Proposed Clinical Framework

Domain	Key assessment elements	Clinical considerations	Possible actions
Patient selection	TTH diagnosis, MTrPs, musculoskeletal impairments, psychosocial factors	Screen contraindications and red flags	Proceed, modify approach, refer
Clinical examination	Cervical mobility, palpation, symptom reproduction, sensitization indicators	Identify contributing factors	Determine phenotype
Muscle target selection	Referred pain patterns, symptom reproduction	Individualised selection	Prioritise relevant muscles
Needling dosage	Irritability, tolerance, symptom severity	Conservative vs progressive dosage	Adjust frequency and intensity
Multimodal integration	Exercise, education, manual therapy	DN should not be isolated	Combine interventions
Reassessment	Headache frequency, intensity, disability, function	Monitor response	Continue, modify or discontinue

4. Discussion

This article proposes a clinically oriented framework for the application of DN in patients with TTH, integrating current scientific evidence with contemporary physiotherapy practice patterns. The primary aim of this framework is to bridge the persistent gap between research findings and real-world clinical decision-making, where considerable variability continues to exist in treatment application, muscle selection, and intervention dosage. Importantly, the proposed

model is conceptual in nature and should be interpreted as a clinical reasoning aid rather than a protocol derived from controlled validation studies.

Current evidence suggests that DN may contribute to improvements in headache-related outcomes, including pain intensity, frequency, and pressure pain sensitivity[17,20–22]. These effects are likely mediated by a combination of peripheral and central mechanisms, including modulation of MTrPs, reduction of nociceptive input, and alterations in pain processing pathways[8,10,13,14]. However, heterogeneity in study designs, intervention protocols, and outcome measures limits the development of clear clinical implementation guidelines[17,18,26]. In addition, most available trials are short-term and do not allow firm conclusions regarding long-term effectiveness or subgroup-specific responses.

In parallel, evidence describing physiotherapy practice patterns highlights substantial variability in how DN is applied in clinical settings, with differences in muscle selection, dosing strategies, and clinical reasoning approaches[26,27]. This suggests that current practice is largely driven by individual experience and local training rather than structured clinical frameworks. This variability further supports the need for structured but adaptable clinical reasoning models capable of guiding decision-making without restricting individual clinical judgement.

The proposed framework addresses this gap by providing a stepwise clinical reasoning model from screening to reassessment. Importantly, it does not aim to standardize treatment rigidly, but rather to support individualized, evidence-informed decision-making grounded in clinical presentation and patient response. This is particularly relevant in TTH, a condition characterized by heterogeneous and multifactorial presentations[6–8].

A key strength of this framework is its integration of scientific evidence with real-world clinical practice patterns, enhancing its ecological validity and potential applicability in routine care. Nevertheless, it should be acknowledged that part of the evidence base informing the framework includes studies from the authors' research group, which may introduce interpretative bias. Efforts were made to balance this by integrating independent literature across clinical trials, systematic reviews, and observational studies. To our knowledge, this represents one of the first attempts to structurally integrate DN decision-making within a comprehensive clinical reasoning model for TTH. However, this novelty claim should be interpreted cautiously given the existence of previous conceptual and clinical frameworks in related musculoskeletal pain conditions.

Furthermore, embedding DN within a multimodal rehabilitation approach aligns with current understanding of TTH as a biopsychosocial condition requiring integrated management strategies[6,7,28,29].

From a clinical perspective, the framework may assist physiotherapists in structuring decision-making processes related to patient selection, muscle targeting, dosage, and progression criteria. It may also contribute to improved consistency in clinical reasoning and reporting of DN interventions, which remains a current limitation in the literature and a barrier to evidence synthesis[26,27].

However, several limitations must be acknowledged. First, the proposed framework is primarily conceptual and has not yet been prospectively validated in clinical or experimental settings.

Its clinical utility therefore relies on theoretical integration of existing evidence and practice patterns rather than direct empirical testing. Second, although informed by current literature and clinical practice data, it does not eliminate the inherent variability and complexity of TTH presentations[5–8]. Finally, the absence of standardized dosing parameters for DN in TTH limits the ability to provide definitive recommendations within the framework[17,18,26]. Additionally, the narrative synthesis approach may introduce selection bias, as no formal systematic review methodology or protocol registration was undertaken.

Future research should focus on validating clinical decision-making models such as the one proposed in this article. In particular, pragmatic clinical trials and implementation studies are needed to evaluate whether structured frameworks improve treatment outcomes, clinical consistency, and patient satisfaction. Additionally, further research should aim to identify patient subgroups most likely to benefit from DN, as well as optimal integration strategies within multimodal physiotherapy programs[23,27].

5. Conclusions

This article presents a clinically oriented framework for the application of dry needling (DN) in patients with tension-type headache (TTH), developed by integrating current scientific evidence with contemporary physiotherapy clinical practice patterns. The proposed model is intended to support structured yet flexible clinical reasoning across the different stages of patient management, from initial assessment to treatment progression and reassessment. It should be interpreted as a conceptual and hypothesis-generating framework rather than a validated clinical guideline.

Although existing evidence suggests that DN may contribute to short-term improvements in pain-related outcomes in TTH, significant heterogeneity in study designs, intervention parameters, and reporting standards continues to limit the development of clear clinical guidelines. In parallel, real-world clinical practice demonstrates considerable variability in muscle selection, treatment dosage, and decision-making strategies, highlighting a persistent gap between research and clinical application.

The framework proposed in this article aims to address this gap by providing a stepwise approach that emphasizes patient selection, comprehensive clinical examination, individualized muscle targeting, symptom-guided intervention dosage, integration within multimodal physiotherapy care, and continuous reassessment. Rather than standardizing treatment in a rigid manner, it promotes clinical reasoning that is adaptable to individual patient presentation and evolving clinical response.

The proposed framework may assist clinicians in improving consistency, transparency, and reasoning in clinical decision-making, while also supporting future research aimed at optimizing invasive physiotherapy interventions in this population. Further studies are required to validate structured clinical models and to better define the role of DN within evidence-based management pathways for TTH. Future validation should include prospective clinical studies and implementation research assessing feasibility, effectiveness, and safety in real-world settings.

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