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Review

The Role of Dry Needling in Complex Regional Pain Syndrome Management: A Mini Review

I Putu Eka Widyadharma*[1], Aurelia Vania[1], Bryan Gervais de Liyis[2], Ni Luh Putu Saswatasya Widha Putri[2], Jimmy Fransisco Abadinta Barus[3], Boya Nugraha[4,5]

[1]Department of Neurology, Faculty of Medicine, University of Udayana/Prof Ngoerah General Hospital, Bali, Indonesia
[2]Faculty of Medicine, University of Udayana, Bali, Indonesia
[3]Department of Neurology, Faculty of Medicine and Health Science, Atmajaya Catholic University of Indonesia/ St Carolus Hospital, Jakarta, Indonesia
[4]Department of Rehabiliation and Sport Medicine, Hannover Medical School, Hannover, Germany
[5]Hannover Rehabiliation services and Science Consulting, Hannover, Germany

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Abstract

Complex Regional Pain Syndrome (CRPS) presents as a multifaceted condition characterized by pain, autonomic dysregulation, and motor dysfunction. Within the realm of pain management, Dry Needling (DN) emerges as a promising therapeutic modality. This systematic review assesses the role of DN in the management of CRPS, with a focus on pivotal outcomes encompassing pain intensity, disability, and musculoskeletal factors. Our systematic review encompassed rigorous searches through PubMed, Scopus, Web of Science (WoS), Cochrane Library, ScienceDirect, and Google Scholar, spanning studies up to January 2023, without language constraints. Four studies meeting predetermined inclusion criteria were identified, collectively encompassing a cohort of 47 patients afflicted with unilateral upper limb CRPS Type I. Following DN, a palpable reduction in pain intensity was ubiquitously observed among all subjects. Furthermore, assessments employing the Disabilities of the Arm, Hand, and Shoulder (DASH) score indicated a substantial reduction in disability levels post-DN intervention. Impressively, musculoskeletal ultrasonography underscored an amelioration in muscle condition, concomitant with discernible enhancements in motor function disturbances post-DN. These compelling findings suggest that DN may substantively complement a multimodal CRPS management paradigm. DN has the capacity to target the fundamental issue of motor function impairment while concurrently promoting pain relief and reducing disability in the intricate context of CRPS.

Keywords: Complex regional pain syndromes; Dry needling; Pain management

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*Corresponding Author: I Putu Eka Widyadharma
Department of Neurology, Faculty of Medicine, University of Udayana/Prof Ngoerah General Hospital, Bali, Indonesia
Email: eka.widyadharma@unud.ac.id

Introduction

Complex Regional Pain Syndrome (CRPS) manifests as persistent regional pain that deviates from the anticipated temporal or intensity trajectory following trauma or lesions. This syndrome is characterized by sensory anomalies, sudomotor irregularities, vasomotor edema, motor deficits, and trophic abnormalities, primarily localized to distal extremities [1]. CRPS delineates two distinct categories: CRPS type I (CRPS-I) and CRPS type II (CRPS-II). CRPS-I, formerly termed reflex sympathetic dystrophy, is characterized by the absence of nerve lesions. Conversely, CRPS-II, historically referred to as causalgia, presents with discernible nerve lesions [1,2]. In a Korean epidemiological study, CRPS exhibited an annual incidence of 29.0 per 100,000 individuals, with advanced age (>70 years) and female gender identified as risk factors. CRPS-I appears to predominate over CRPS-II in prevalence [3]. Aggregate incidence rates based on two previous studies ranged from 5.46 to 26.2 per 100,000 individuals annually [4,5]. Upper extremities are more susceptible than lower extremities, with fractures serving as the principal antecedent event [2,5]. The trajectory of CRPS varies, encompassing a spectrum from self-limiting and mild manifestations to chronic and enduring symptoms. The progression of this condition can be profound, impinging upon the patient's quality of life and imposing substantial burdens upon both the patient and family.

A systematic investigation has revealed diverse CRPS outcomes: prospective studies indicate notable symptom reduction within the initial 6-13 months; while retrospective inquiries highlight that 22-90% of individuals continue to endure symptoms during extended follow-up. Furthermore, cross-sectional analyses underscore the existence of a patient cohort wherein enduring pain and sensory manifestations persist over the long term [6]. Presently, a multifaceted therapeutic approach is endorsed for CRPS management, encompassing physical and occupational therapy, pharmacological interventions, psychiatric strategies, and interventional procedures [7]. Chronic CRPS is a condition that is difficult to treat with conservative management alone. In fact, an additional study underscores that despite the application of conservative therapy and neurostimulation, approximately 20-45% of patients continue to report persistent pain [8]. The intricacies of CRPS management stem from the co-occurrence of multiple mechanisms. As such, it is prudent to adopt a therapeutic strategy tailored to the specific mechanisms at play in a given case, thereby optimizing treatment outcomes [7].

Prominent components implicated in the pathology and mechanisms underpinning CRPS encompass myofascial pain syndrome (MPS) and myofascial trigger points (MTrPs) [9]. The diagnostic and therapeutic considerations of myofascial pain have been prominently advocated within the context of CRPS management [10]. Within the scope of MPS therapies, dry needling (DN) stands out as a noteworthy intervention. DN entails the insertion of needles, akin to acupuncture needles, into target MTrPs, with the objective of mitigating pain and augmenting the range of motion [11]. DN was found to be effective in increasing the range of motion in one study, even though it is less effective in reducing pain [12]. Conversely, an alternate study has recommended DN for MPS management, citing its effectiveness in mitigating pain associated with this condition [11,13]. Management of CRPS targeting the MPS and MTrP components using DN has shown good outcomes in some case reports [14–16]. This exposition aims at a thorough assessment of DN's efficacy in the comprehensive management of CRPS; thus, contributing to the evolving discourse in this domain.

Methods

Search Strategy

This article constitutes a narrative review that undertook an assessment of the efficacy of dry needling (DN) within the domain of CRPS management. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and schema were meticulously adhered to throughout the process of literature search and study retrieval for this narrative review [17]. The entire process, from literature search to data extraction and bias assessment, involved three authors. Any discrepancies were resolved through consensus, with two additional authors participating in the decision-making process. All includes studies were rechecked for eligibility. The literature searching was carried out comprehensively using the electronic databases of PubMed, Scopus, Web of Science (WoS), Cochrane Library, ScienceDirect, and Google Scholar up to April 2024. The combination of keywords used based on the patient, intervention, and outcome (PICO) framework (Table 1) included: 1) “complex regional pain syndrome” OR “reflex sympathetic dystrophy” OR “causalgia”, 2) “dry needling” OR “intramuscular stimulation” OR “trigger point injection”, 3) “numeric rating scale” OR “visual analog* scale” OR “disabilities of the arm shoulder and hand” OR “range of motion” OR “musculoskeletal ultrasonography”. The authors did not apply any restrictions towards date of publication. This review specifically incorporated an array of study designs, including retrospective, prospective, case studies, and case series studies, all of which furnished outcome data for CRPS patients subjected to DN therapy. Exclusion criteria were invoked, encompassing non-human subjects, instances

Table 1. Eligibility criteria in PICOS model

	Inclusion criteria	Exclusion criteria
Population	CRPS patient	Not human
Intervention	DN	DN not as the primary therapy
Control (only for clinical trial)	Treatment consists of standard CRPS therapy only	
Outcomes	NRS/VAS, DASH score, result of musculoskeletal ultrasonography	Outcome was not specific as a result of DN
Study design	Clinical trial, cohort, case-control, case series, single case report	Review article, qualitative study, letter to editor

CRPS: Complex Regional Pain Syndrome, DASH: Disabilities of The Arm, Shoulder, and Hand, DN: dry needling, NRS: Numeric Rating Scale, VAS: Visual Analogue Scale

where DN was not the primary therapeutic approach, incompletely reported outcomes, absence of post-DN outcome elucidation, non-availability of full-text in English, and unpublished or unattainable full-text.

Data Analysis

Data extracted from each study included: patient data information, study design, clinical manifestations of CRPS, precipitating factors for CRPS, other treatments provided, information on DN interventions, and patient outcomes. The patient outcomes assessed included: 1) Numeric Rating Scale (NRS) / Visual Analogue Scale (VAS), 2) Disabilities of The Arm, Shoulder, and Hand Score (DASH score), and 3) musculoskeletal ultrasonography (MSKUSG) result.

Results

Study Selection

A comprehensive literature search conducted across

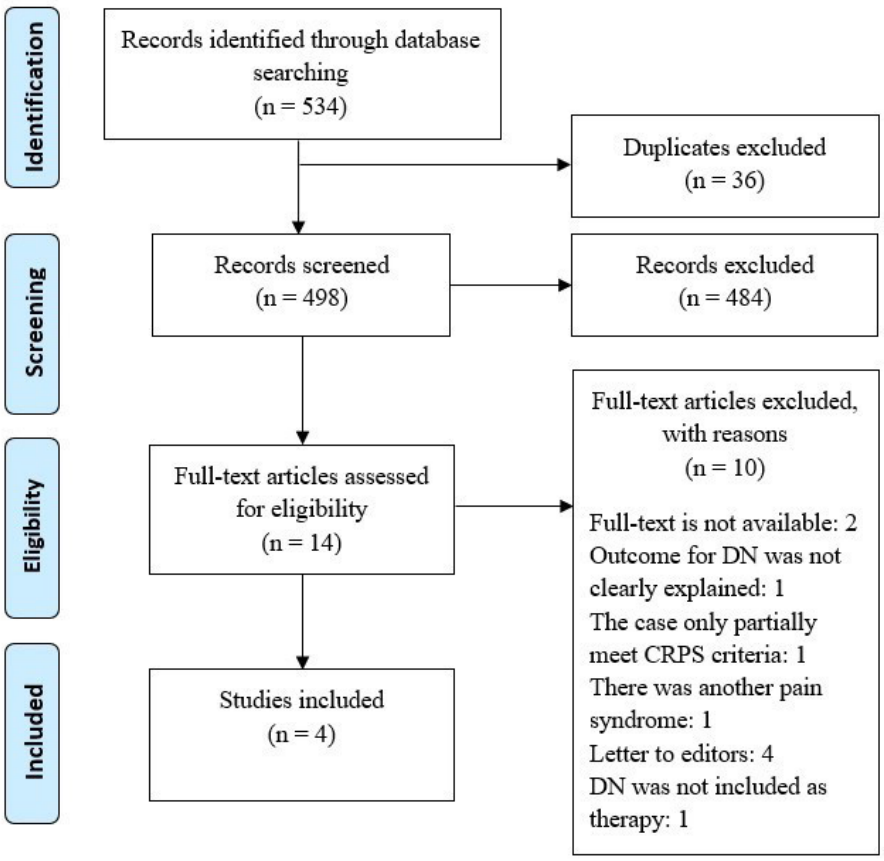

Figure 1. Literature search flowchart

Table 2. Study Characteristics

Author	Study design	Subjects	Trigger factors	Interventions	Outcomes
Vas et al. 2016[18]	Retrospective analysis	44 patients with CRPS-I in the upper limb who met the Budapest criteria, ranged in aged 24 to 80 years. CRPS duration: 3 - >9 months NRS: 2-9 (rest pain) NRS: 5-10 (movement pain) Skor DASH: 83-87	24 patients with trauma, fracture, surgery, and immobilization. 10 patients with trauma, fracture, and immobilization 4 patients with soft tissue trauma and immobilization 4 patients with spontaneous shoulder hand syndrome 1 patient with a history of cervical spine tuberculosis 1 patient with history of herpes zoster at C6-7	Oral medication Physiotherapy USGDN 3 times per week for 45-60 days.	No pain when resting or moving. There were no sensory and sudomotor symptoms. There were no asymmetrical temperature conditions. DASH score: 9-12. MSKUSG: return of normal myoarchitecture. There was an increase in muscle mass and reduce in muscle edema.
Geete D et al. 2019[16]	Case report	Male patient, 48 years old with: Pain in right extremity Sensoric + sudomotor abnormality Motoric abnormality VAS: 4/10 DASH: 115	Trauma + fracture + surgery + immobilization	Conservative and surgical therapy for fracture and dislocation in right extremity. Bupivacaine and kenacort injection Trytomer oral Myofascial release therapy USGDN 3 sessions per week Exercise program	VAS: 0/10 (9 months post treatment) DASH: 34 (9 months post treatment) Patient can work again after 9 months post treatment
Vas et al. 2016[19]	Case report	Female patient, 24 years old with: Pain in right extremity Sensoric + vasomotor + sudomotor abnormality Motoric abnormality NRS: 6/10 (at rest) painDETECT: 13 DASH: 70.8	Hand overused 3 years ago	Analgetic; physiotherapy; steroid injection and oral steroid; surgery. USGDN twice every weeks for 1 month then once every week for 45 days followed by every 2 weeks and every month.	painDETECT: 3 DASH: 6.3 Normal professional activities. MSKUSG: improvement of the abnormality. Outcomes were assessed after 6 months of USGDN intervention.
Pai RS et al. 2018[20]	Case report	Female patient, 39 years old with: Pain in right extremity Sensoric + vasomotor + sudomotor abnormality Motoric abnormality painDETECT: 10 DASH: 88.8 Patient with comorbid of chronic traumatic arthritis.	Fracture + surgery + immobilization	Oral medication SGB Physiotherapy CBT Intraarticular radio-ulnar and radio-humeral injection USGDN twice every week for 6 months followed by USGDN 2 sessions per month for 1 year.	Almost complete improvement after 3 months (DASH score: 33.52, painDETECT score: 2) and complete improvement after 1 year (DASH score: 10.3, painDETECT score: 1) in shoulder and hand movements

CBT: Cognitive Behavioral Therapy, CRPS: Complex Regional Pain Syndrome, DASH: Disabilities of The Arm, Hand, and Shoulder, MSKUSG: Musculoskeletal Ultrasonography, NRS: Numeric Rating Scale, SGB: Stellate Ganglion Block, USGDN: Ultrasound-Guided Dry Needling, VAS: Visual Analogue Scale

PubMed, Scopus, WoS, Cochrane Library, ScienceDirect, and Google Scholar initially yielded a total of 534 studies. Subsequent to the removal of duplicates, the remaining pool consisted of 498 studies. Through a meticulous screening process involving title and abstract evaluation, 484 studies were excluded as they did not align with the study objectives. Out of the residual 14 studies, a further 10 studies were excluded from the review. Specifically, this exclusion was attributed to unavailability of full-text in two instances, presence of four letter-to-editor articles, partial conformity to CRPS criteria in one case, presence of an alternative pain syndrome in another study, lack of outcomes post-DN in one study, and the absence of DN being categorized as myofascial trigger point therapy in yet another study. Ultimately, this review assimilated a modest total of 4 studies, which encompassed 3 case reports and 1 quasi-experimental investigation (Figure 1).

Patient Characteristics

The studies meeting the defined inclusion criteria encompassed a collective cohort of 47 individuals afflicted with CRPS localized exclusively in the unilateral upper limb, as elaborated in table 2. Notably, all cases were attributed to CRPS-I, with the observed literature search yielding no instances of CRPS afflicting the lower extremities and subsequently receiving DN intervention. The age spectrum of the reported patients spanned from 24 to 80 years, with the cohort comprised of 26 female and 21 male patients. Dominantly, limb fracture and surgical procedures accounted for the primary precipitating events leading to CRPS manifestation (constituting 55.3% of cases). Diagnostic assessment for the 47 CRPS patients was carried out in accordance with the Budapest criteria. In terms of the duration of CRPS experience prior to initiation of ultrasound-guided dry needling (USGDN) management, the range extended from 2 to 36 months. Apart from USGDN, the patients profiled in the examined studies underwent a diverse array of supplementary therapies, encompassing oral medications, steroid injections, stellate ganglion blocks (SGB), physiotherapy, physical therapy, and cognitive behavioral therapy (CBT) [16,18–20].

Ultrasound-Guided Dry Needling Management

The intervention of DN was meticulously conducted with the guidance of ultrasonography. Employing 32-gauge needles, the DN procedure targeted muscles situated within the neck, shoulder, and upper limb regions, tailored to the specific musculature implicated in the CRPS presentation of each patient. The DN sessions, initiated 2-3 times per week at the outset of therapy, persisted for variable durations ranging from 45 days to a span of one year [16,18–20]. DN was reported to require sedation in one patient to smooth the needle insertion in the first 2-3 sessions [19]. Complications arising subsequent to DN manifested in 2 studies, primarily in the form of pain and ecchymosis. Pain emerged upon needle penetration through the skin, particularly accentuated in patients exhibiting allodynia and hyperalgesia. Furthermore, a pain-resembling cramping sensation manifested at the needle insertion point into muscular tissue, akin to a muscle twitch as perceived by the operator. Ecchymosis under the skin was documented post-needle removal; however, it was reassuring to note that this complication spontaneously resolved within a span of 7-10 days [18,20].

Patient Outcomes

The outcome assessed in this study included 3 components, namely: pain scales, patient's disability, and the result of musculoskeletal ultrasonography. The pain component was assessed on a pain scale as measured by NRS or VAS. The disability component was assessed from the DASH score, which is a questionnaire designed to assess the ability of the upper limb to perform daily activities in patients with musculoskeletal abnormalities in the upper extremities [21]. Of the 47 patients, the NRS score was reported to be in the range of 2-9 for pain at rest and 4-10 for pain during movement before receiving USGDN intervention. USGDN improved pain complaints in which pain was completely gone in 3 studies. The DASH score of CRPS patients was found to be in the 70-115 score. This score showed a significant decrease to 6-34 after USGDN intervention [16,18–20]. Sensory symptoms, sudomotor disturbances, and vasomotor disturbances were reported to be reduced after SGB intervention, but motor impairment only improved after DN [20]. Improvement of sensorimotor complaints could be found after 1-3 DN sessions, thereby increasing patient cooperation for the next DN session [18,19]. Improvement of sensorimotor complaints after each DN session also supported physical therapy or physiotherapy so that it became more effective [18].

Musculoskeletal ultrasonography showed the appearance of muscle destruction, fibrosis which were marked by hyperechoic muscle features, decreased muscle mass, and muscle edema in CRPS patients before receiving DN intervention. MSKUSG image showed improvement in muscle condition after DN intervention along with improvement of motor disturbances. These improvements were indicated by finding a normal muscle image in the form of a hypoechoic picture of muscle covered with hyperechoic muscle fascia, decreased muscle edema, and increased muscle mass. These improvement in MSKUSG images could be found after 15-45 days of DN intervention [16,18–20]. Improvement of complaints of pain and motor problems as well as sudomotor and vasomotor disor-

ders helped patients with CRPS to return to their daily activities and work. Vas L et al study showed 88.6% of patients showed an improvement in their condition at 1 year of follow-up (21.4% were not reachable at follow-up) [18]. Other studies showed patients were able to return to work at 6 months and 9 months of follow-up [16,19].

Discussion

This mini review identified four studies consisting of three case reports and one quasi-experimental study. Our review showed that DN can be an effective treatment in providing better outcomes in CRPS patients. DN refers to the insertion of a fine needle into a MTrP without the administration of any substance [22]. DN emerged as notably superior to placebo interventions, sham DN, and alternative therapies in diminishing pain and elevating tenderness thresholds in patients grappling with musculoskeletal pain. This heightened effectiveness was demonstrated both in the immediate term and was sustained at the 3-month follow-up interval. Moreover, DN yielded superior functional outcomes compared to scenarios wherein no therapeutic intervention was administered or false DN was employed [23]. DN is thought to act on peripheral, spinal, and supraspinal mechanisms of pain relief. It improves homeostasis in the MTrP area, thereby reducing peripheral and central pain sensitization. DN can activate pain inhibition mechanisms originating in the brain or spinal cord [22]. In this cohort of 47 patients, DN was administered utilizing the ultrasound-guided technique. This approach affords precise localization of MTrPs, ensures the exactness of needle positioning within muscles, and minimizes the risks of nerve and vascular compromise. The application of ultrasonography further bestows valuable anatomical insights and facilitates the discernment of gross pathological alterations within the musculature [24]. The resolution captured on ultrasound findings is associated with the improvement of motor impairments.

Pain is often the most disturbing symptom in the majority of patients with CRPS. The intensity of pain may change over time and pain may be accompanied by hyperalgesia and/or allodynia. These are the typical symptoms of neuropathic pain [1,25]. Allodynia appears to involve thick afferent fibers (Aβ); while damage to the peripheral sensory neurons underlies hyperalgesia and spontaneous pain [26]. Motor symptoms such as weakness, stiffness, and range of motion disturbances were found to be the symptoms most likely to persist for the long term [6]. Roughly 15% of individuals afflicted by CRPS will attest to persistent pain and enduring physical debilitation even two years subsequent to the inception of the condition. During the initial phases of CRPS, pain primarily precipitates disability. However, as the condition advances into later stages, disability arises from the amalgamation of both motor impairment and pain [25]. Disability in CRPS patients can be assessed by the DASH questionnaire which has components of symptoms and functional status [21]. The goal of CRPS treatment is to control the pain and restore the functional abilities of CRPS patients. Therefore, the outcomes that were assessed in this review were divided into 3 categories, namely: pain scale, disability, and MSKUSG features. In this review, DN showed effectiveness in reducing pain and improving abnormal muscle conditions as evidenced by musculoskeletal ultrasound examination in CRPS patients. DN also improves disability as indicated by a decrease in the DASH score.

DN assumes a pivotal role in the management of CRPS by stimulating MTrPs, thereby inducing relaxation of these points and subsequent mitigation of co-contraction and muscle stiffness. An MTrP, designated as a hypersensitive, palpable muscle band, engenders pain upon compression and serves as the origin of the patient's symptomatic presentation, concurrently eliciting referred pain. This construct holds paramount significance within the pathophysiological framework of MPS [22]. Allen et al. found that 56% of 134 CRPS patients had myofascial components based on the findings of a trigger point on physical examination. Compression on this trigger point caused CRPS symptoms in the patient. They also found a longer duration of CRPS and CRPS in the upper extremities to be the risk factors for myofascial dysfunction [27]. Another study also found myofascial dysfunction in 61% of CRPS patients and motor neglect was more common in patients with myofascial dysfunction [28]. Prevalence of MTrP was 20–60% in several different muscles in 20 CRPS patients [29]. The sequence of events for myofascial dysfunction and CRPS remains unclear. Based on the study from Allen et al., wherein an escalating duration of symptoms correlates with an augmented probability of myofascial dysfunction, myofascial dysfunction is potentially a consequence of pain and subsequent immobilization within the afflicted limb [27]. Nonetheless, studies have not definitively dismissed the prospect that myofascial dysfunction could manifest as a primary syndrome in select patients. It becomes conceivable that MPS could potentially serve as a predisposing risk factor or an instigating trigger for the onset of CRPS [29]. A study evaluating ultrasound images in 18 upper limb CRPS-I patients found changes in MSKUSG images occurring after 2 weeks of CRPS-I onset. Furthermore, these changes exhibiting disparities from descriptions of muscle abnormalities attributed to immobilization. This supports the hypothesis that myofascial dysfunction might represent a primary event precipitated by the underlying disease process, rather than merely an ancillary occurrence resulting from immobilization [24].

DN treatment can lead to the relaxation of MTrPs and associated muscles. This relaxation culminates in the resolution of co-contraction, subsequently driving an amelioration of clinical symptoms and disability evident in CRPS. The subsequent attenuation of inflammation aligns with the reversal of muscle over-contraction, fostering a reduction in pain perception. This therapeutic effect of DN substantiates the hypothesis positing the involvement of the myofascial component in the CRPS pathology. The targeted approach of DN, particularly aimed at MTrPs, bears the potential to reinstate the pathological equilibrium characteristic of CRPS. Notably, this approach holds promise in reestablishing muscle coordination functionality and concomitantly curbing the manifestations of secondary dimensions within CRPS [14–16,18–20]. Our findings align with case reports and one quasi-experimental study, affirming the positive impact of DN on CRPS. Long-term results indicate improved outcomes, enabling normal activities within 6-12 months. Management of MTrPs involves non-invasive and invasive approaches. Invasive interventions include corticosteroid, lidocaine, botulinum toxin injections, and DN. Comparative data for DN and other methods are limited. Studies in related musculoskeletal disorders with myofascial pain component show varied results, with some indicating DN's equivalence and others suggesting less effectiveness compared to alternative injection methods.

Wet needling garnered higher patient satisfaction and lesser discomfort compared to DN, yet DN yielded favorable outcomes [30]. Across the board, pain scores and pressure thresholds improved significantly in all groups. Lidocaine and botulinum toxin injections outperformed DN in reducing VAS scores and enhancing quality of life [31]. Another study found that DN matched wet needling with lidocaine in effectiveness, despite slightly heightened discomfort [32]. Comparably, both and lidocaine injections exhibited equal efficacy for treating MTrPs in chronic neck pain, yielding no significant distinction [33]. In cases involving temporomandibular joint (TMJ) related MPS, both methods demonstrated efficacy in pain relief and functional restoration [34]. Immediate symptom improvement for MTrPs showed no substantial contrast between lidocaine injection and DN. The effectiveness of both hinges on eliciting a local twitch response during trigger point injection. This suggests that the therapeutic effect is predominantly attributed to the needle insertion itself, rather than the injected substance [35]. It is notable that wet needling does not exhibit therapeutic superiority over DN [36].

This review is comprised of 3 case reports and one quasi-experimental study, both lacking control groups and potentially biased. The absence of randomized controlled trials leads to very low-quality evidence. Further research is vital to confirm DN's efficacy for CRPS and its comparison with other trigger point injection methods in multimodal CRPS management. Despite limitations, positive outcomes were observed in 47 patients undergoing DN therapy. Consequently, DN could be considered within a multimodal CRPS management approach, primarily to enhance motor function, alongside pharmacological and interventional measures addressing pain symptoms and secondary manifestations of CRPS.

Conclusion

This study's findings indicated favorable outcomes in CRPS patients following DN, manifesting as diminished pain scores, alleviated CRPS-related disabilities, and the amelioration of muscle abnormalities evidenced by MSKUSG. DN's action in alleviating co-contraction between agonist and antagonist muscles underscores its role in mitigating symptoms and disability, particularly those attributed to motor aberrations within CRPS. Moreover, these findings corroborate the pivotal roles of MTrPs and MPS within the CRPS mechanism. Consequently, MTrPs and MPS emerge as primary therapeutic targets warranting consideration in the comprehensive treatment of CRPS patients.

Conflict of Interests

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