A REVIEW OF DRY NEEDLING

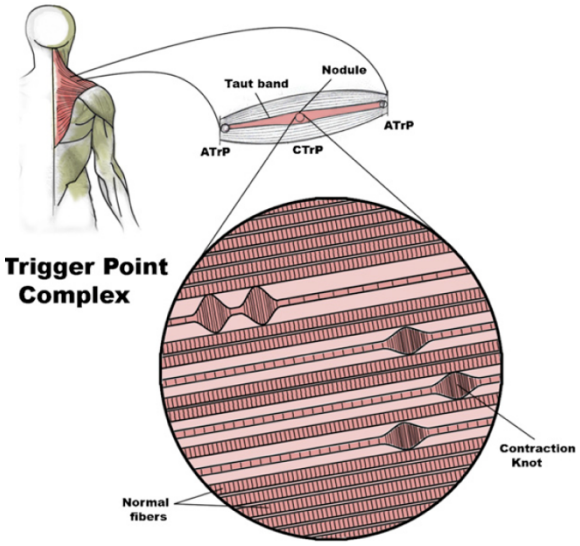
by Chris Adamson, SPT – Class of 2021

Introduction - What is Dry Needling?

Dry needling (DN) is a treatment technique that utilizes solid filiform needles to penetrate the skin and underlying tissues of the body. This treatment, which began in 1980 and came to the United States in 1984, is commonly employed by physical therapists all across the world.[1] Early adopters of the treatment technique include the United States, Canada, Chile, Ireland, Spain, South Africa and the United Kingdom.[1] Due to the relative novelty of the treatment technique, there exists a lack of uniformity in which DN is practiced. This variance in practice is exacerbated by the proprietary nature of educational programs, and the multitude of medical backgrounds of researchers and practitioners utilizing this modality. Therefore, the purpose of this literature review is to examine the roots of DN, the theoretical basis for treatment, common terminology and treatment techniques, and to provide conclusions that consider the current body of literature as a whole, as well as the efficacy of specific DN protocols.

What are Myofascial Trigger Points?

While this article will discuss multiple target tissues for treatment, the primary targeted tissue for DN treatment are myofascial trigger points (MTrPs). MTrPs are hyperirritable spots found in skeletal muscle that are associated with palpable nodules that are painful upon compression.[1] These nodules are typically found within a taut band of skeletal muscle tissue and can be subcategorized as either active or latent.[1] Active MTrPs exhibit the characteristic referred pain described by the patient, while latent MTrPs do not give rise to referred pain, but can still produce pain and dysfunction. Further, active MTrPs can become latent.[2] A study by Turo et al. found, following a 3 week course of dry needling, that 25 out of 48 subjects had their active MTrPs reduced to latent, while 13 subjects experienced complete resolution of their MTrP.[2] In addition to MTrPs, there are also sensitive areas of tissue known as tender points. Tender points are not characterized as having palpable nodules, eliciting referred pain, or existing in a taut band of skeletal muscle tissue.[1] The simplest way to explain the differences between these abnormalities is to view them in layers. A tender point is focal spot that is painful upon compression. A latent MTrP is painful upon compression and can be described as a palpable nodule that may exist in a taut band while an active MTrP has the previous characteristics, plus the addition of referred pain characteristic to the patients complaints.[1]



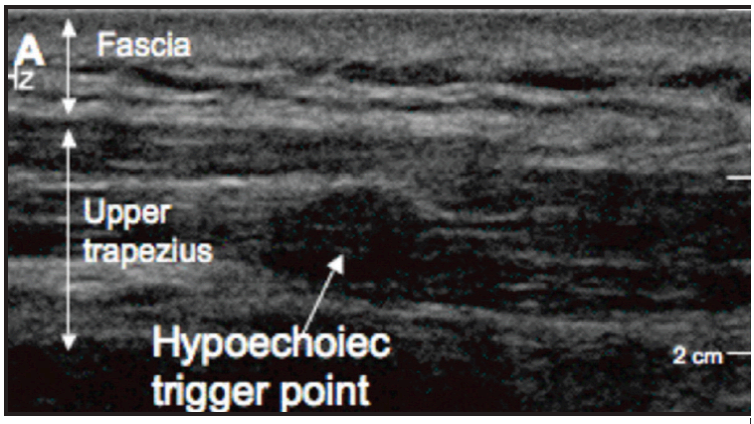
An illustration of the trigger point complex and numerous contraction knots within the central trigger point (CTrP)— (Image adapted from Shah et al., 2008)

Determination of MTrP Presence

The existence of MTrPs has long been scrutinized by clinicians in the medical field who, among other things, propose that a lack of interrater reliability identifying MTrPs disproves their existence. Early studies, for example Nice et al., 1992; Wolfe et al., 1992; Njoo and Van der Does, 1994[3] were unable to establish reliability of MTrP identification. However, these studies did not examine the primary physical features of MTrPs to support their identification.[3] By contrast, a study by Gerwin et al. examined the four physical features of an MTrP which include a tender point in a taut band of muscle, a local twitch response (LTR) to mechanical stimulation, a pain referral pattern characteristic of trigger points of specific areas in each muscle, and the reproduction of the patient's usual pain, finding substantial to outstanding agreement among 4 physicians in the physical identification of MTrPs.[3] Therefore, identification of MTrPs is most reliable when examiners seek out these specific features.

One of the hallmark studies identifying the presence of MTrPs was the study by Shah et al. 2005 in which micro dialysis needles were utilized to explore the chemical composition of focal areas believed to be MTrPs, as determined by physical palpation of the examiner.[4] This study identified elevated levels of pain-associated neuropeptides such as Substance P (SP), calcitonin gene-related peptide(CGRP) and inflammatory mediators such as interleukin-1 (IL-1) and tumor necrosis factor (TNF) in the vicinity of MTrPs.[4] Levels of these substances were significantly higher than surrounding tissues, indicating the presence of a focal, hypersensitive area consistent with the pain induced through physical compression of these locations.

More recent advances in diagnostic imaging have allowed for the visualization of MTrP such as the use of sonoelastography, an ultrasound modality that has identified MTrPs as elliptical shaped hypoechogenic (described as a solid mass relative to surrounding tissue) areas that correspond with trigger points found upon physical examination.[1] Similarly, Magnetic Resonance Elastography (MRE) has also been utilized to identify MTrPs by measuring the stiffness of soft tissues to examine asymmetries in muscle tone.[1]



A depiction of a MTrP found using sonoelastography.
(Image adapted from Unverzagt et al., 2015)

Though many clinicians still question the presence of MTrPs, the preponderance of evidence seems to lean toward the existence of MTrPs, rather than the alternative. While it appears that advances in medical imaging can now identify MTrPs[1], this provides little clinical value in the absence of diagnostic imaging. Therefore, in order to effectively utilize DN, the clinician must be able to reliably identify the presence of active or latent MTrPs with a physical exam. Recent literature, along with Gerwin et al. findings, suggests slight-to-very good interrater reliability identifying MTrPs.[5,6] Sanz et al. demonstrated slight to

moderate agreement among three experienced physical therapists who specialized in myofascial pain syndrome (MPS), in the identification of trigger points within the tibialis anterior, extensor digitorum longus, and the peroneus brevis muscles.[6] Also, Moral et al. demonstrated very good reliability among two physical therapists in identifying subjects with MPS and muscles found to have MTrPs.[5] A potential explanation for the greater interrater reliability seen in the Gerwin and Moral articles as compared to the Sanz et al. study is that the former studies discussed how the examiners met and trained together immediately prior to examining subjects. This allowed discussion and reconciliation of discrepancies in assessments, definitions, and grading of physical findings. While the Sanz et al. study described the experience of the examiners, it did not discuss whether the examiners practiced together prior to assessing subjects. Regardless of the level of agreement found in these studies, in general, there is a greater agreement of MTrP identification that occurs among practitioners who have more training and experience with examination of MPS.[5] Therefore, the probability that a reliable/valid physical examination for the presence and location of MTrPs increases as the body of literature continues to grow and clinicians become more knowledgeable and experienced in this area of study.

Dry Needling versus Acupuncture

The difference between DN and Acupuncture is often misunderstood by patients and untrained clinicians. Confusion is exacerbated by the fact that the needles used in both techniques are identical and are often referred to as "acupuncture needles." The major differentiation between DN and traditional Chinese Acupuncture (TCA) lies in the rationale and objective of the treatment. Traditional Chinese acupuncture is based upon the theory of "qi"(pronounced Chee), an idea that the body is influenced by an energy that flows throughout tissues and organs along pathways called "meridians."[1] It is the detection of an abnormal qi and a strategically placed acupuncture needle, that are believed to correct the flow of energy and resolve symptoms.[1] Conversely, dry needling refers to a scientific approach to the physical examination/location, and solicitation of a physiological response from the MTrP, as a result of needle insertion, which is intended to resolve pain and dysfunction. There are multiple theoretical models (described below) explaining how and why dry needling is practiced, however the most common mode of DN application is referred to as trigger point dry needling (TPDN), which involves physically identifying MTrPs and inserting the needle directly into the trigger point.

History

Despite the few similarities between DN and acupuncture, modern DN was not conceived as a modification of the traditional Chinese intervention. Instead, dry needling was developed through observation of a physician named Dr. Karel Lewit of Czechoslavkia.[1] During Dr. Lewit's practice as a neurologist, he reviewed literature comparing various types of Wet Needling (WN).[1,7] This included comparisons of injectable anesthetics and injected normal saline. In this research, Dr. Lewit found similar decreases in pain between anesthetic and normal saline groups.[1,7] Dr. Lewit had observed similar findings in his own practice and hypothesized that the immediate analgesic effect experienced by the patient was a result of puncture by needle, rather than the injected substance.[7] Continuing with this theory, in 1979 Dr. Lewit conducted a

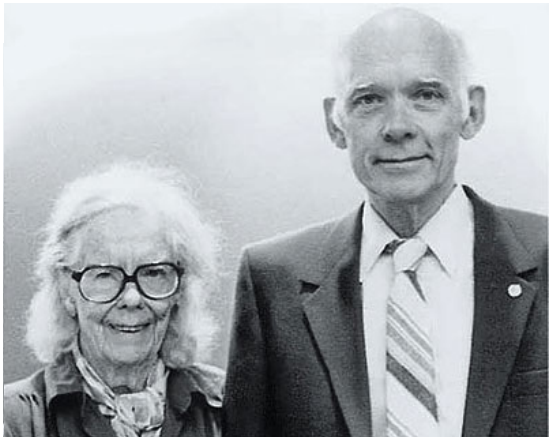
study where he performed dry needling on 241 subjects experiencing variety of myofascial pain disorders.[7] Of the 312 pain sites tested, immediate analgesia without hypesthesia (diminished sensation common with anesthetics) was found in 271 of 312 cases (86.8%).[7] Dr. Lewit described this phenomenon as the "needle effect" (NE) and proposed that the NE is good evidence the needle position was correct.[1,7] By utilizing WN, the patient would experience hypesthesia and would be unable to discern if the correct location had been treated.[7] Dr. Lewit's findings served as a catalyst for DN research and sparked the myriad of studies that followed.

Theoretical Models of MTrP Genesis

Radicular Model – The radicular, radiculopathy or "Gunn" model was presented by Canadian physician Chan Gunn who proposed that all sources of myofascial pain are a result of peripheral neuropathy or radiculopathy.[1,8] An example would be an atrophic muscle (due to neuropathy/disrupted nerve impulses), where the shortened tissue causes compression of local nociceptors.[8] By disrupting the efferent free flow of impulses, chemical agents develop leading to a hypersensitivity, and perpetuation of central sensitization.[1,8] In this model, MTrP's do not play a significant role because it is believed that treating the paraspinal muscles that correlate with the dysfunctional peripheral muscles will interrupt and resolve the free flow of impulses.[8]

Spinal Segmental Sensitization Model – This model is a hybrid of the radicular and trigger point model (see below) that recognizes the importance of both peripheral trigger points, as well as treatment of the correlating vertebral level of the paraspinal muscles.[1,8] The primary difference between this model and the radicular model is the use of an injection or WN as opposed to acupuncture needles.[1,8] Dr. Andrew Fischer, a physiatrist, developed this model based on his hypothesis that the cause of neuropathic pain was related to compression of spinal nerve roots created by narrowing of the foraminal space, or a sprain of the supraspinous ligament causing repeated pain stimuli entering the dorsal horn of the spinal cord with subsequent pain and dysfunction experienced along peripheral dermatomes and myotomes.[1,8] Treatment following this model involves DN and WN of paraspinal ligaments as well as tender or trigger points that may be causing the primary pain or compressing the spinal nerves, which can lead to pain and dysfunction.[1,8]

Trigger Point Model/Hypothesis – The term "Myofascial Trigger Point" was coined by Dr. Janet Travell in the 1950's.[9] Shortly thereafter, Dr. Travell and her colleague Dr. David G Simons developed the Trigger Point Manual that combined evidence and clinical expertise for the treatment of MPS.[1,8,10] Practicing TPDN includes identifying a MFTrP, often with a flat palpation technique, and inserting an acupuncture needle into the MFTrP.[8] One of the main objectives within the TPDN model is to elicit a local twitch response (LTR).[11] Many clinicians and researchers



Dr. Janet Travell (left) and Dr. David G. Simons (right), 1985.
https://www.dgs-academy.com/en/about-us/david-g-simons-md/

advocate that the elicitation and exhaustion of the local twitch response (LTR) is the most effective strategy for reducing symptoms associated with MPS.[6,8,11–13] The majority of the literature indicates improved outcomes when a LTR is elicited, however, there does not appear to be clinically important improvement in outcomes when multiple LTR's are produced, or continuing to DN until the LTR's are exhausted.[13]

Underlying Concepts of TPDN

Motor End Plate Hypothesis – The Motor End Plate Hypothesis (MEPH) is a proposed cause of MTrP's and is described as an abnormal disruption in the neuromuscular junction (motor end plate) that causes an increased release of acetylcholine (ACh).[14,15] The release of ACh is thought to activate individual sarcomeres causing spontaneous electrical activity (SEA).[14,15] Needle EMG studies have found SEA or "endplate noise" in the vicinity of active MTrP's, while areas void of MTrP's appear electrically silent.[4,11,14,15] Simons proposed that prolonged sarcomere shortening could trigger the energy crisis theory (ECT).[9]

Energy Crisis Theory – The Energy Crisis Theory (ECT) was proposed by Dr. Simons as a perpetual cycle where a prolonged shortening of sarcomeres compromises the local capillary circulation, therefore reducing the supply of oxygen needed to generate ATP and initiate the active process of muscle fiber relaxation (ATP needed to remove the myosin head from actin sites).[11,16] Proposed triggers for the ECT include increased metabolic demand secondary to direct trauma, recurrent microtrauma, eccentric contraction and the Cinderalla Hypothesis (CH).[15,17]

Cinderella Hypothesis – The Cinderalla Hypothesis (CH) elucidates an impairment in motor recruitment patterns when sub-maximal exertion occurs within skeletal muscle.[11] This hypothesis relies on the Henneman's "size principle", which proposes that smaller, type 1 muscle fibers are recruited first and are the last to yield during tetanic muscle contraction.[11,18] During low-level static contractions, larger type 2 muscle fibers are unrecruited, or are relatively insignificant in their contribution to the sustained contraction.[11,18] This causes the type 1 "Cinderella" fibers to become metabolically overloaded, leading to muscle damage and a disruption of calcium ion homeostasis.[11] An example of this theory would involve sitting at a desk typing for a prolonged length of time, utilizing postural stability muscles to maintain an upright seated position.[11] In this scenario, the smaller, Type 1 (slow-twitch) muscle fibers are recruited for prolonged low-level static muscle contraction, while the Type 2 (fast-twitch) fibers remain quiet.[11] In this scenario, newly identified MTrP's in the upper trapezius would support the theory of the Cinderalla Hypothesis.[11,19] This particular example was discovered in a study by Treaster et al., 2006.[19]

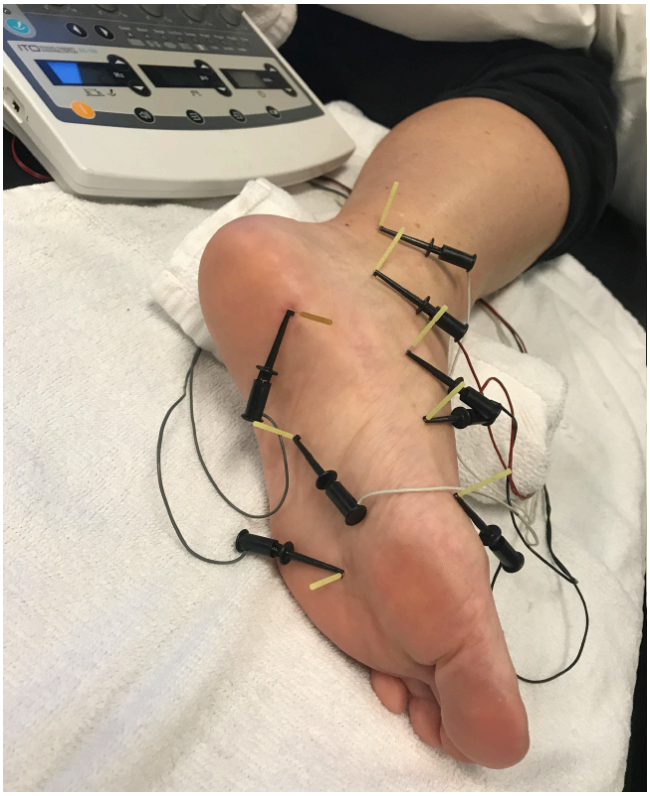
Types of DN

Superficial Dry Needling[20] **–** Type of DN where the needle is inserted to a depth of 5-10 mm overlying a MFTrP site.[20] The needle is left in situ until the patient no longer presents with a flexion withdrawal reflex (jump sign) and/or the utterance of an expletive (shout sign). Treatment can range from a few seconds to a couple minutes.

Deep Dry Needling[13,20,21] – This technique is what is typically referred to as Dry Needling. The technique involves locating a MFTrP within the muscle belly and inserting the monofilament needle into the center of the point. This type of DN can be combined with many of the techniques described below. DDN affects the skin, fascia, and muscle layers and often leads to post-treatment soreness.

Periosteal Pecking[22] **–** A form of DN where the needle is repeatedly tapped onto or near the periosteum of a bone. This type of DN is often used near the insertion of a tendon such as the medial tubercle of the calcaneus where it meets the plantar fascia. This type of DN is intended to stimulate microtrauma and local inflammation to assist in the repair of the tendinous attachment, particularly during the proliferative and remodeling phases of healing.

Electrical Dry Needling (EDN) – Also referred in the literature as Percutaneous Electrical Nerve Stimulation (PENS) or Intramuscular Electrical Stimulation (IMES or IES) and is an increasingly common technique used with TPDN. As the name implies, this technique includes the addition of electrotherapy to static, in situ dry needles. Typically, a TENS unit, electrical stimulation machine, or a point stimulator are connected to the needles via alligator clips or direct contact with the pointer probe and hand-held electrode. The rationale for combining electrical stimulation is to take advantage of local blood circulation and muscle relaxation properties associated with the modality.[1] There is very limited research to support the use of electrotherapy combined with DN, and even fewer articles to support specific parameters. However, the most commonly used parameters for muscle relaxation involve low frequencies of 2-4 Hz, to elicit repeated muscular contractions while using a high intensity (to patient tolerance).[1,23] Conversely, if the goal is to reduce neuropathic pain, higher frequencies of 80-100hz should be used to stimulate the release of gamma-aminobutyric acid, galanin, and dynorphin (opioid peptide) of the dorsal horn to inhibit pain impulses.[1]



An 8-point EDN protocol performed by Dr. James Dunning, PT (Image adapted from Dunning et al., 2018)

Common Ranges of EDN Parameters found in the Literature: [1,22–25]

Current: Asymmetric Biphasic **Frequency:** 2-10Hz **Pulse Width:** 100-250µs **Intensity:** <3mA

Needle Manipulation Techniques

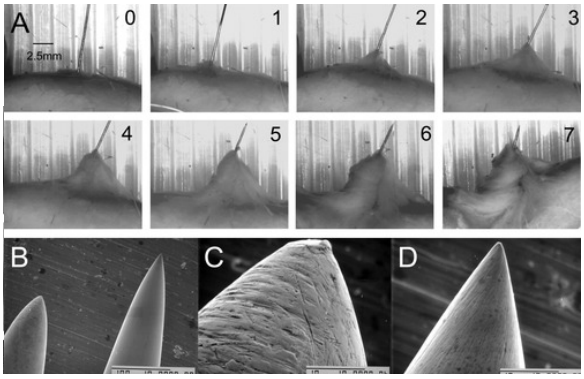
In Situ[1,20] **–** A static needling technique; The method is defined as inserting the needle and leaving in place for a period of time. Usually between 30s and a few minutes.

Systematic Placement – A predetermined placement of multiple needles, along the length of a muscle, taut band, or multiple muscles that traverse a similar path. E.g. Along the paraspinal muscles.

Pistoning[1] **–** A dynamic needling technique that refers to repetitive advances and retractions of the needle within the tissue. Some clinicians will utilize the pistoning motion while following a fan, cone, or the 4 cardinal directions (North, East, South, West) to increase the treatment area.

Peppering[26] **–** Another dynamic needling technique that utilizes the pistoning motion approximately 8-10 times while adjusting the angle of inclination continuously in a clockwise position. This technique effectively treats the MTrP while also needling the surrounding musculature.

Winding[1,27] **–** Synonymous with twirling or rotation, this technique is utilized once the needle has been penetrated to the desired depth. When in situ, the needle is rotated between a quarter turn up to several times in one direction to draw the fascia or soft tissues. In general, practitioners will rotate the needle counter-direction to "unwind" the tissues prior to removal of the needle. (pictured right)[29]



Demonstration of needle-rotation in rat subcutaneous connective tissue captured under microscope (Image adapted from Langevin et al., 2002)

Tenting[28] **–** This technique is an extension to "winding" which involves rotating the needle until the soft tissue is wound up tight around the needle. Ounce bound; the practitioner will gently pull up on the needle causing a local stretch of the collagen fibers wrapped around the needle.

Comments by the Author

Considering the evidence surrounding dry needling is still in its rudimentary stages and there is very little uniformity in the way that it is practiced. It is important to bring awareness to developing patterns in an attempt to solidify some of the core concepts, as well as shed light on areas for further research within this emerging modality. Therefore, the commentary below includes summative statements the author found clinically meaningful in his research on DN.

1. Local Twitch Responses are Important, **but the quantity of them may not be.** – Many articles have covered the importance of eliciting the LTR.[6,8,11–13] However, achieving more LTR's does not necessarily correlate with better outcomes. A study by Fernández-Carnero et al.[13] randomized 84 patients into 4 groups for the purpose of identifying a change in pain intensity or disability dependent on the number of LTR's that were provoked. The groups were broken

up as such, Group 1 – No LTR; Group 2 – 4 LTR's; Group 3 – 6 LTR's; and Group 4 – 6+ LTR's.[13] The authors found that all groups receiving DN experienced improvement in pain and disability at 1 week follow up.[13] However, the subjects in the 6 LTR and 6+ LTR's groups demonstrated clinically significant improvements in pain intensity when compared to the control group. There were not any significant between-group differences for pain intensity when 4 or more LTR's were achieved (group 2-4). Therefore, these results signify that obtaining at least 4 LTR's is important, however, obtaining greater than 4 LTR's does not appear to have additional benefit. In regard to disability, only groups 2 and 3 reached an average MCID of 5 on the neck disability index (NDI). This would signify that there is an ideal dosage between 4 and 6 LTR's in order to improve disability at 1-week follow-up. An area for future research would be comparisons of reactions in the 1-4 LTR range to determine if differences also exist in smaller dosages of LTR's.

2. DN increases Pressure Pain Threshold (PPT), reduces pain, and can improve disability.[23,27,30] – A systematic review by Gattie et al. found DN to be effective in reducing pain, increasing PPT, reducing tone and improving disability in the short term when compared to sham or placebo control groups.[30] In addition, the authors concluded that DN may be superior to no treatment, but that there was a small treatment effect when compared to other forms of physical therapy intervention (exercise, mobilizations, strength training, MFR, etc).[30] Therefore, the authors recommend DN be used as means to reduce short-term pain, and bridge the intervention toward active physical therapy interventions.[30]

3. Electrical Dry Needling (EDN) appears to provide increased benefits compared to standard dry needling in the short-term[23,25]**.** – Brennan et al. conducted a study comparing DN and EDN that found short-term pain relief in both groups occurred within the first 6 weeks of treatment and was maintained up to 12 weeks.[25] In the EDN group, the authors found a significant improvement in NDI scores at the 3-week mark, while the standard DN group did not see these improvements until week 6. There were no between group differences between 6 and 12 weeks. A study by Garcia De Miguel et al. found similar improvements in short-term pain relief as well as clinically meaningful improvement in NDI score within the EDN group as compared to the standard DN group at 1-week follow-up.[23] Therefore, EDN may be a superior treatment over standard DN when rapid improvement of disability is a main goal of therapy.

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