Dry Needling in Physical Therapy Practice: Adverse Events Part 1: Types and Frequency of Adverse Events

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ABSTRACT

Dry needling (DN) is an increasingly-used modality employed by physical therapists for the treatment of musculoskeletal pain and dysfunction. Continuing educational programs in DN targeted to licensed physical therapists have proliferated in the past decade and research into the efficacy of this intervention is accelerating. When using any new treatment technique, the potential risks involved must be weighed against the potential therapeutic benefits. Knowledge of the adverse events (AE) associated with DN is essential in the risk management of physical therapy practice and can help minimize their occurrence. Part 1 of this clinical commentary will review the types and frequencies of mild AE associated with DN. Part 2 will consider the more significant and serious AE that may occur during DN. A discussion of the concerns of treating pregnant patients with this modality will also be included.

Key Words: acupuncture, pneumothorax, trigger point

INTRODUCTION

Dry needling (DN) has become an increasingly-used modality in the treatment of musculoskeletal pain and dysfunction by physical therapists in the United States. In 2012, the American Physical Therapy Association updated the professional scope of practice to include DN as a skilled intervention useful in alleviating physical impairment and functional limitations.[1] Post-graduate training programs and research into the use and effectiveness of DN in clinical practice continue to grow. These educational programs are often of a short duration as they build upon the knowledge and skills already obtained in the entry-level formal training of physical therapists.[2] Internationally, DN courses developed for physical therapists are also short in duration (initial introductory courses in Canada and Israel are often 32 hours in length) and it has been shown that the technique is easy for physical therapists to learn safely.[3]

In some states, the addition of DN into the physical therapy scope of practice has involved protracted legal attacks from the acupuncture community, which, for the most part, opposes this development. Acupuncturists claim that physical therapists are actually practicing acupuncture by performing DN interventions and are unqualified to do so. They argue that the brevity of DN courses threatens public safety.[4,5] Despite this rhetoric, there is no evidence thus far of serious adverse events (AE) associated with DN by physical therapists.[6]

Both acupuncture and DN are generally considered to be low-risk interventions but serious complications have occasionally been reported in the literature. Since DN is an invasive intervention, practitioners must be cognizant of the risks involved.

WHAT ARE ADVERSE EVENTS?

An adverse event is "an unexpected and undesired incident directly associated with the care or services provided to the patient; an incident that occurs during the process of providing health care and results in patient injury or death; or an adverse outcome for a patient, including an injury or complication."[7] Unfortunately, any treatment that can have a therapeutic effect can also have an adverse effect.[8] Given that medical errors are the third leading cause of death in the United States, a culture of safety is imperative in medicine. Traditionally, orthopaedic physical therapy is considered to be safe, in part because the training of physical therapists embraces traditions of wide error margins to help minimize risk.[9] Safety is a vital consideration for physical therapists who embrace intervention modalities that have the potential for serious risks (ie, high velocity cervical manipulation or DN).

FREQUENCY OF ADVERSE EVENTS ASSOCIATED WITH NEEDLING MODALITIES: A LITERATURE REVIEW

Any invasive technique that involves a needle insertion involves risks. Broadly speaking, DN is an intervention modality that uses thin, solid filament needles to create a therapeutic effect when the skin is punctured. Unlike treatment interventions involving injections to create a clinical effect ("wet needling"), no substance is introduced into the body when performing DN treatments. Dry needling is an umbrella term that encompasses many types of approaches (Table 1).

Currently there are no national or international systems for tracking data on AE associated with DN or acupuncture. The usual method of tracking AE is to conduct prospective surveys sent to either practitioners or patients designed specifically for this purpose. Self-reporting by practitioners regarding AE is limited in both accuracy and reliability as recall and selection bias in reporting can occur. Adverse effects may appear after a treatment session and a practitioner may not even be aware of their development. Patients will often underreport an AE as a result of a treatment if there is no change or decline in functional status.[10] Frequency of AE is therefore difficult to determine and may be underreported in prospective surveys.

Publishing *case reports* can also be helpful to learn about types and treatments of AE but they do not give reliable data on frequency. Most case reports are published by practitioners who treat the patients with AE such as pneumothorax or a broken or a forgotten needle in the tissue following a DN intervention.[11,12]

Adverse events may be classified according to severity: mild or minor, significant and serious.[13] Generally speaking, mild AE are of a short duration, reversible, and cause minimal inconvenience to the patient. Significant AE will require some medical intervention and/or will interfere with a patient's activities. Adverse effects are considered serious if they require a hospitalization or prolong an existing hospitalization, cause a persistent or significant disability, or are life-threatening or even result in death.[14] The timeframes for AE severity has not yet been clearly defined but mild AE will usually last a few hours while significant and serious AE can persist for days or weeks. The lack of standardization of AE has contributed to an absence of

Table 1. Common Dry Needling Styles

DRY NEEDLING STYLE	DEFINITION/SOURCE
Trigger Point Dry Needling	Myofascial trigger point model[14]
Intramuscular Manual Therapy	American term associated with the myofascial trigger point model[1]
Intramuscular Stimulation	Chan Gunn's "radiculopathy model," a neurosegmental model[39]
Superficial Dry Needling	Baldry model[40]
Spinal Segmental Sensitization Model	Dr. Andrew Fisher: combines features of trigger point model and Gunn's radiculopathy model[41]
Classical or Traditional Acupuncture	Acupuncture is an ancient form of Chinese medicine involving the insertion of solid filiform needles into the skin at specific points on the body to achieve a therapeutic effect[42]
Western Medical Acupuncture	A therapeutic modality that is an adaptation of Chinese acupuncture using current knowledge of anatomy, physiology, pathology and the principles of evidence-based medicine[43]

Adapted from the Health Quality Council of Alberta. The Safe Practice of Dry Needling in Alberta. October 2014.

clarity on this subject. The ability to grade AE associated with DN (both in frequency and severity) would be helpful in developing an informed consent for patients undergoing these interventions.[15]

A summary of published research from the past two decades of AE related to acupuncture and DN by various practitioners is found in Table 2. Most research has focused on AE related to acupuncture rather than DN. Although both use the same tools (mono-filament needles of varying lengths and gauges), there are differences in the techniques. Dry needling often involves a deeper needle insertion and needle manipulation to obtain a reaction called a *local twitch response*. Needle retention may not occur. Acupuncture involves needling to the depth of the acupuncture point and needle manipulation to get "de qi".[16,17] "De qi" is defined as a tingling, heaviness, numbness, or other feeling that occurs after an acupuncture needle has been properly placed in the body. Needle retention is common and may last 15 to 20 minutes or longer. Because of the differences in needle techniques, it is uncertain whether data based primarily on acupuncture interventions applies to DN interventions.[18]

Reviews of the research in Table 2 show that design limitations and format variations limit the comparison of results. Some research analyzed practitioner-reported data while others relied on patient's responses to questionnaires. Methodology variables and lack of reliability and validity in the research limit their usefulness in determining the frequency of AE. When performed by adequately trained practitioners, both acupuncture and DN appear very safe but there have been documented fatalities and serious AE like pneumothorax and infections as a result of interventions.[19,20] A review of these studies has shown some changes in the frequency and types of AE over the decades. Advances in education standards and the advent of single-use disposable needles have reduced the frequency of infections, for example.

Only the Brady study[18] has specifically focused on AE occurring as a result of DN performed by physical therapists. This prospective study recruited 51 volunteers from a group of 183 Irish physiotherapists who had received the *64-hour David G. Simons Academy* trigger point DN training. The participants completed two questionnaires surveying the number of trigger point DN interventions they performed and any AE that occurred as a result. Of the 39 physiotherapists who completed the survey, 19.18% reported mild AE associated with the 7,629 treatments. Bleeding and bruising were the most common AE but all were deemed to be mild and not significant. Compared with research that looked at AE related to acupuncture, this rate was higher but other research looked at AE from a patient's perspective.[21] It is noted that patients often underreport an AE as a result of an intervention if there is no change or decline in their functional status.[10] A major limitation of the Brady paper is that the data were self-reported and practitioners volunteered to participate, which may result in an inaccurate reporting of AE. The study has also been criticized for not reaching a target level of interventions that would be required to identify a serious AE.[22]

The New Zealand Physiotherapy professional organization has implemented a voluntary system to report AE in physical therapy interventions, including DN and acupuncture.[23] The system is unique in that it also allows for anonymous reporting of AE by physiotherapists and differentiates treatments of trigger point DN and other styles of needling that involve sustained needle retention (like acupuncture and auriculotherapy). The McDowell study reviewed 176 voluntary self-reported AE associated with interventions performed by New Zealand physiotherapist-acupuncturists from 1998 to 2013. Eighty-one percent of the AE reported were considered to be minor. Dry needling treatments accounted for 14.8% of the AE reported compared with >71% for treatment methods that involved sustained needle retention. Dry needling treatments were associated with a 3% higher ratio of major-to-minor AE compared with sustained needling styles but some AE like vasovagal reactions (VVR), were higher with sustained needling treatments. The underreporting of AE is probable and the needling style could not always be determined from the reporting, a factor which could have skewed the data and conclusions.

To summarize: AE from both DN and acupuncture interventions are usually mild and transient in nature (Table 3). The most common mild AE include bruising and bleeding, pain (during and after intervention), and syncope/vasovagal response.[24,25] Significant or severe AE are rare, although individual case studies have described injuries associated with DN. Serious AE are commonly associated with practitioner negligence and poor adherence to practice standards.[26] These more serious AE will be reviewed in Part 2 of this clinical commentary. Precautions related to treating pregnant women will also be examined.

MILD ADVERSE EVENTS

Bleeding and Bruising

Mild bleeding and bruising are the most

Table 2. Research of Adverse Events in Acupuncture and Dry Needling (2001-2018)

Author of Study	Study location and type	Practitioner type	Source of results
White et al 2001[44]	UK/Prospective study	Physicians, physical therapists	Practitioner
MacPherson et al[13]	UK/Prospective study	Acupuncturists	Practitioner
Ernst E et al 2001[45]	Europe and Far East/Prospective study review	Medical physicians, acupuncturists	Practitioner or patient
Witt et al 2001[21]	Germany/Prospective study	Medical physicians	Patients
Lao L et al 2003[38]	UK/Review of Case reports 1965-1999	All included (physician, chiropractors, acupuncturists, osteopaths)	Published case reports
Melchart et al 2004[46]	Germany/Prospective study	Medical physicians	Practitioner
White et al 2006[14]	UK/Prospective study	Medical physicians/physical therapists/ acupuncturists	Practitioners
Ernst E et al 2011[47]	International/Systematic review of clinical research and case reports between 2000-2009	Acupuncturists	Published systematic reviews and case research
Xu et al 2013[48]	International/Review of Case Reports 2000-2011	Acupuncturists/physical therapists/ physicians/ Unspecified	Published case reports
Brady et al 2014[18]	Ireland	Physical therapists	Practitioners
McDowell JM et al 2014[23]	New Zealand/Cross-sectional descriptive study	Physical therapists	Practitioners

Table 3. Types of Dry Needling/Acupuncture Adverse Events by Severity and Frequency

Severity	Mild/Minor	Significant	Serious
Frequency	Common: (1-10%)	Uncommon: (0.1% - 1%)	Rare: (0.01-.1%)
	• Bleeding • Bruising • Pain - during/after • Dizziness • Temporary symptoms aggravation • Nausea • Sweating • Fatigue	• Prolonged pain • Excessive bleeding or bruising • Nerve injury • Headache • Vomiting • Forgotten needles • Seizures • Extreme fatigue • Severe emotional reactions	• Pneumothorax/Haemothorax • Other organ puncture • Infection • Broken needle • Cardiac Tamponade
Data derived from MacPherson et al,[13] White A,[14] Witt et al,[21] Brady et al.[18]			

common AE associated with DN and are difficult to prevent.[27] Bleeding can occur outwardly or inwardly as a result of needling, and small hematomas can develop in the muscles or skin. Mild pressure over the needle site with a cotton ball is usually sufficient to minimize bleeding.

Screening patients for bleeding disorders (such as thrombocytopenia) and the use of anticoagulants and certain medications and supplements are recommended prior to DN interventions.[28] McCulloch et al conducted a systematic review of the literature to evaluate the safety of patients taking anticoagulant medications.[29] The study asked the question, "Does acupuncture in anticoagulated patients present a higher-than-expected risk of bleeding?" The bleeding complication rate was 1.4% (56 incidents in 3,974 intervention sessions) with the vast majority being either an asymptomatic bruise or a minor drop of blood, as is common in many needling procedures. None of the bleeding was considered significant and all incidents were stopped with digital pressure. The authors concluded that acupuncture has a high degree of safety with patients taking anticoagulant medications. Since similar needles are used with DN, this conclusion may apply to this type of treatment as well. The complications of bleeding and bruising would increase if larger gauge needles like syringes were used to perform DN treatments.

Some practitioners advocate the use of anti-bruising topical products to help minimize bruising. *Arnica Montana* is a perennial herb thought to be an anti-ecchymosis as a result of a vasodilation effect and possible up-regulation of macrophage activities. In fact, the majority of randomized controlled trials show that homeopathic *Arnica Montana* is no better than a placebo in treating bruising, swelling, and pain.[30]

More serious bleeding occurs if arteries or veins are punctured during DN. Arterial bleeding is rare but will spread quickly and pulsate. Blood vessels can be avoided with an understanding of underlying vascular anatomy and palpation of the area prior to needling. If a blood vessel is punctured, a sharp, painful sensation may be felt (especially with arteries). Bleeding into a fascial compartment is dangerous as increased pressure can cause tissue damage.

Case studies describing serious AE associated with bleeding illustrate the importance of anatomical knowledge. Peuker and Gronemeyer described 4 cases of blood vessel lesions (including the development of an anterior compartment syndrome) as a result of acupuncture.[31] Recently, Berrigan et al reported on the development of an epidural hematoma as a result of DN.[32] An otherwise healthy 62-year-old woman with a body mass index (BMI) of 19.2 was treated for myofascial neck pain with DN of the infraspinatus, rhomboids, trapezius and upper cervical multifidus muscles. On the 4th treatment session, she felt a "warm sensation" throughout her body after a needle insertion. Later that day, she began experiencing increased pain and neck stiffness. Three days post-intervention her daughter found her in her home with an altered mental status. She was transferred to an emergency room where an evaluation revealed a complex epidural hematoma, which necessitated admission into an intensive care unit. A gradual resolution of neuropathic pain symptoms occurred in the 2 months after hospital discharge. This case illustrates the importance of specific anatomy and needle trajectory knowledge and understanding of the relationship of needle depth and BMI.

Pain During or After Intervention

Increased pain during treatments is more commonly associated with DN than acupuncture. Brady et al[18] found the frequency of pain *during* DN interventions to be 3.01% while the frequency of pain *after* the DN intervention was slightly lower (2.19%). The pain may be the result of neuromuscular injury or hemorrhagic and inflammatory changes caused by the needling. The area of pain is often in the area that was needled or in the trigger point referral pain pattern. The number of needle insertions and the pain perceived during the needling had a positive correlation to the pain experienced post-treatment. The number of local twitch responses elicited during treatment did not affect post-needling soreness.[33]

Post-intervention pain is often described as a dull aching or a constant pressure and usually will persist for less than 72 hours. Travell and Simons recommended the avoidance of strenuous activities for 2-3 days after trigger point injection (which involved a larger gauge needle) to avoid soreness but no research supports this advice.[34] It is also likely that the duration of post-treatment pain may have been longer and more severe because larger gauge syringe needles were used instead of the solid filiform needles more commonly employed today. Patients with a low baseline of myofascial pain may show a reduced tolerance to post-treatment soreness compared with those who present with higher myofascial trigger point pain levels pre-treatment. Communication with patients about the possibility of some short-term post-treatment pain is recommended and the pain may even be reframed as a positive therapeutic sign.[35] Additional therapies may help decrease post-needling soreness and include low load exercises, hot packs, transcutaneous nerve stimulation and Kinesio Tape application but few guidelines regarding their efficacy are available.

Vasovagal Response

A VVR is an autonomic nervous response that occurs as an indirect result of needling or other stimuli. The autonomic nervous system responds through sensory impulses along autonomic afferent fibers. This stimulation can cause bradycardia, hypotension, and syncope as a result of a transient withdrawal of sympathetic tone and an increase in vagal tone. The signs and symptoms are variable and may include dizziness, nausea, sweating, and paleness. The patient may also report feeling lightheaded, blurred or tunneling of vision, or yawning. Symptoms can progress to eventual unconsciousness.

Vasovagal responses are a relatively rare AE associated with acupuncture and DN, occurring in .02 - 7% of all interventions.[36] Christensen et al reviewed clinic data from an 18-month period of patients receiving acupuncture interventions, primarily performed by interns at the University of Minnesota Masonic Children's Hospital in conjunction with the Northwestern Health Sciences University. A retrospective chart review of 281 interventions showed 5 cases of documented VVR that resulted in intervention termination or alteration. Of these 5 cases, 3 had received acupuncture for the first time. Common features of patients who had a VVR included those with increased stress levels, irregular sleep, and disruption of regular lifestyle patterns.

Patients and practitioners can find the occurrence of a VVR to produce anxiety despite the quick recovery that generally occurs. Practitioners must be well versed in the prevention and treatment of VVR. Awareness of patients who have a fear of needles or phobias concerning blood or injury is essential prior to DN. Vasovagal responses are more common among patients who are nervous, fatigued, having DN for the first time, hungry, or dehydrated.[37] Recommendations to eat and drink 1-2 hours prior to interventions are helpful. Patients should be treated in a comfortable position in a supine or prone position or a zero-gravity chair. Vigorous needle manipulation in a seated position may cause a marked vasodilation and lead to hypotension.[38] Minimizing the number of needles and avoiding aggressive needling dependent on patient response is important, especially in the initial treatments.

The treatment environment should be comfortable and quiet. Symptom recognition is important, and communication (both verbal and non-verbal) with patients during DN is essential. If a person is showing signs of a VVR, removal of the needles and elevation of the feet with the patient being supine is helpful. Monitoring of airway, blood pressure, and pulse is required. Patients who have this type of reaction should notify health care professionals prior to future blood draws or DN sessions.

CONCLUSION

Dry needling is a treatment modality that is commonly used by physical therapists in clinical practice. As an invasive technique, the potential for AE exists and is not without some risk to the patient. Most of the AE related to DN are of a mild and transient nature and include bruising and bleeding, pain, and the possibility of a VVR. Part 2 of this series will discuss some of the rare severe complications that can occur with DN treatments in the next edition of *OP.*

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