



Consistency of Dry-Needling Interventions Across High-Quality Randomized Trials: A Critical Systematic Exploration of Intervention Reporting and Fidelity

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ABSTRACT

Objective: The purpose of this study was to systematically explore the reporting of trigger-point dry needling (DN) in high-quality randomized clinical trials (RCTs) and to evaluate those trials' intervention fidelity.

Methods: A focused systematic review and meta-analysis was conducted. PubMed and Cochrane databases were searched for systematic reviews focusing on DN, published from January 2014 to January 2019. Randomized clinical trials with a low risk of bias were identified and their reported intervention data extracted. Dry-needling interventions were categorized according to common technique elements, and the Template for Intervention Description and Replication (TIDieR) was used to appraise their intervention fidelity.

Results: Fifteen systematic reviews were identified, and from these we extracted data from 26 RCTs. Twelve unique technique descriptors were identified, and 8 technique archetype categories were distinguishable, based on whether a local twitch response defined the start of the intervention, whether continuous needle insertion and withdrawal was used, and what criteria determined the cessation of needling. The median number of TIDieR items reported was 8.5 out of 12. Explicit procedure reporting was uncommon for intervention tailoring (38%) and rare for intervention mode (19%) and modifications (7%).

Conclusion: Across the RCTs included in this review, substantial heterogeneity in the choice and reporting of DN was evident. In particular, systematic underreporting of intervention tailoring, mode clarification, and procedure modification undermined intervention fidelity. The development and adoption of standardized intervention guidelines is recommended to enhance uniform and nuanced reporting of DN interventions. (*J Manipulative Physiol Ther* 2021;44:546-557)

Key Indexing Terms: *Myofascial Pain Syndromes; Trigger Points; Dry Needling; Research Design*

INTRODUCTION

Myofascial pain is a frequently reported cause for visits to primary care physicians and is thought to exact a significant burden of cost and disability on mainly older, chronically afflicted people.¹⁻⁴ Clinical manifestations of myofascial pain (sometimes referred to as myofascial pain syndrome) can be ameliorated by mechanical stimulation of areas of exquisite local tenderness called trigger points (TrPs).³ In this regard, repetitive insertion of minimally invasive filiform needles,

termed dry needling (DN), has been used by physical-medicine health care providers.⁵⁻⁹

Dry needling is supported by evidence from randomized clinical trials (RCTs), with findings from systematic reviews (SRs) indicating that across body regions, DN may offer effective short-term pain relief and improvements in range of motion and quality of life.^{6,7,10-13} Given the weight of evidence, it is surprising that DN is excluded from national and international clinical-practice guidelines either generally, for pain relief in locomotor system disorders,¹⁴ or specifically, in the management of common regional musculoskeletal disorders such as non-specific low back pain.¹⁵

The CONSolidated Standard of Reporting Trials (CONSORT) statement ensures consistent reporting of RCT data.¹⁶ However, this guideline has been criticized for being too generic to provide reasonable intervention fidelity, which can be operationally defined as the provision of reasonable assurances that the experimental intervention was delivered as originally intended and in a standardized and consistent manner.¹⁷⁻¹⁹ As a result, extensions of the CONSORT

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guidelines have been developed in instances where more nuanced intervention reporting is required.^{17,20} An extension of the CONSORT guidelines governing the reporting of acupuncture interventions, the STRICTA guidelines, became available in 2010.¹⁷ However, these guidelines have not been widely adopted in studies reporting DN.^{20,21} It would therefore appear that investigators either are unaware of these guidelines or do not consider them applicable for the reporting of DN RCTs.

Variations in the reporting of DN interventions have been noted in previous investigations.^{6,7,10} In the absence of reporting guidelines specific to DN interventions, it is possible that high-quality DN RCTs are being produced using generic, rather than nuanced, standards of reporting. This weakness in reporting standards may be contributing to poor intervention fidelity and consequently perceptions of poor RCT internal validity.

Therefore, the purpose of this investigation was to systematically evaluate the manner in which DN is being reported and determine whether internal validity might be under threat. To operationalize this aim we posed 2 questions: Are intervention elements reported uniformly for DN? And do inconsistencies, if they occur, tend to cluster around particular areas of intervention reporting?

METHODS

Design

This study was framed as a focused systematic review and meta-analysis and followed the Preferred Reporting Item for Systematic Reviews and Meta-Analyses (PRISMA) recommendations.^{22,23} No patient outcomes are reported, and therefore registration in the International Prospective Register of Systematic Reviews (PROSPERO)²⁴ was not undertaken.

Literature-Search Strategy and Data Sources

Our search strategy was conceptualized to identify a sample of studies representing DN reporting across available RCTs. To achieve this, we conducted electronic searches in PubMed and Cochrane databases during January 2019, identifying relevant SRs focused on TrP dry needling.²⁵ The use of PubMed was based on search capability, medical subject headings, and use of references beyond other databases,²⁶ whereas Cochrane was chosen specifically for its high standards in evidence-based health care and international recognition.²⁷

Given the context of inquiry, we combined search-term variations of “dry needling,” “myofascial pain,” and “trigger points” (see also Appendix 1). In addition, we delimited the search by excluding acupuncture and injection SRs through the use of the keywords “NOT acupuncture” and “NOT injections.” The electronic search procedure was

supplemented with a hand search of reference lists of the studies included.

Inclusion Criteria

Available SR literature served as a means of accessing RCTs with a low risk of bias. We included SRs featuring an intervention commensurable with DN of myofascial trigger points or TrPs, regardless of whether DN was used as the main intervention, that were published in English within the previous 5 years (January 2014-January 2019).

For RCT studies, those comparing dry needling to either sham dry needling or other treatments were included. We anticipated that multiple types of RCT quality-appraisal instruments would be used in the SRs. Therefore, the top 25th percentile of the respective quality score was set as the minimum level for inclusion.

Exclusion Criteria

Other needling interventions, like acupuncture and injection types, were excluded. In instances where uncertainty existed, we deferred to the inclusion criteria of the SR from which the primary RCT was sourced.

Study Selection

Two authors (K.K. and T.D.) independently screened first the SR and then the RCT titles, abstracts, and full text according to the criteria already described. Throughout this process, a third investigator (C.M.) functioned as the tie-breaker in instances where consensus could not be reached.

Data Extraction and Description of DN Interventions

From the SRs, two authors (C.M. and E.B.) extracted RCT data including author details, needle type, technique descriptor used, and technique elements reported. Moreover, technique elements reported were also extracted: the rationale for initiating the DN intervention, the mode of needle application, and the criteria for DN cessation. Data were entered into a standard spreadsheet and double-checked by a third author (K.C.), who also resolved instances where consensus could not be reached.

Evaluation of Intervention Reporting and Replicability

The Template for Intervention Description and Replication (TIDieR) was used to evaluate intervention reporting as a proxy measure of fidelity.²⁸ The TIDieR is a 12-item checklist developed to ensure that reporting contains the essential details for replication of the focus intervention. Two authors (K.K. and T.D.) evaluated the RTCs independently. In instances where variation in evaluations occurred, a third author (K.C.) acted as referee.

Table 1. Description of Dry-Needling Techniques and Categorization of Technique Element Types

Author	Needle Type	Descriptor	Technique Elements			Assigned Group
			LTR defines start	Continual insertion and withdrawal	Criteria for cessation	
Itoh et al ²⁹	SSS	S-P	Y	Y	Cc, T	1
Itoh et al ³⁰	SSS	S-P	Y	Y	Cc, T	1
Itoh et al ³¹	SSS	S-P	Y	Y	Cc, T	1
Cotchett et al ²⁰	Acu	RPWA	Y	Y	Cc, T	1
Eftekharsadat et al ³²	DN	RPWA	Y	Y	Cc, T	1
Rossi et al ³³	SSS	Pistoning	Y	Y	Cc, T	1
Ga et al ³⁴	Acu	FiFo	Y	Y	Cc	2
Fernandez-Camero et al ³⁵	Acu	FiFo	Y	Y	Cc	2
Calvo-Lobo et al ³⁶	HSS	FiFo	Y	Y	Cc	2
Calvo-Lobo et al ³⁷	HSS	FiFo	Y	Y	Cc	2
Irnich et al ³⁸	N/S	RPWA	Y	Y	Cc	2
Llamas-Ramos et al ³⁹	SSS	FiFo	Y	Y	T	3
Mejuto-Vazquez et al ⁴⁰	SS	FiFo	Y	Y	T	3
Tellez-Garcia et al ⁴¹	SSS	FiFo	Y	Y	T	3
Mendigutia-Gomez et al ⁴²	SSS	FiFo	Y	Y	T	3
Myburgh et al ⁴³	Acu	Deep & superficial	Y	Y	T	3
Mayoral et al ⁴⁴	N/S	FiFo	Y	Y	No.	4
Pecos-Martin et al ⁴⁵	MF	FiFo	Y	Y	No.	4
Hong ⁴⁶	Hypo	FiFo	N	Y	Cc, T	5
Edwards and Knowles ⁴	SS-Acu	Superficial	N	N	Cc, T	6
Tekin et al ⁴⁷	Acu	Twitch and withdraw	N	Y	Cc	7
Couto et al ⁴⁸	Acu	Deep	N	N	T	8
Diracoglu et al ⁴⁹	Acu	Guide tube	N	Y	N/S	N/A
Sterling et al ²¹	Acu	Peck and twirl	N	Y	N/S	N/A
Zheng et al ⁵⁰	N/S	US guided	N	N	N/S	N/A
Perez-Palomares et al ⁵¹	Acu	FiFo	Y	Y	N/S	N/A

Studies are listed in chronological order.

Acu, acupuncture; Cc, clinical criteria; DN, dry needling; FiFo, fast-in and fast-out; HSS, headless stainless steel; Hypo, hypodermic; LTR, local twitch response; MF, monofilament; N, no; N/A, not assigned; N/S, not specified; No., number; RPWA, repeated partial withdraw and advance; S-P, sparrow-pecking; SS, stainless steel; SSS, single-use stainless steel; T, time; US, ultrasound; Y, yes.

Synthesis and Analysis of Results

Due to the lack of standardized reporting criteria, a quantitative meta-analysis was not conducted. Instead, after data were presented descriptively, studies were grouped according to similarities in technique element reported (Table 1).^{4,20,29-51} After this grouping, an intervention flow typology was constructed to visualize variations in reporting as they occurred at key intervention decision junctures (Fig 1).

The overall outcome of TIDieR data reporting was presented descriptively as frequencies and median values. In addition, a dot plot was created to visualize items where systematic omissions were observed (Fig 2).

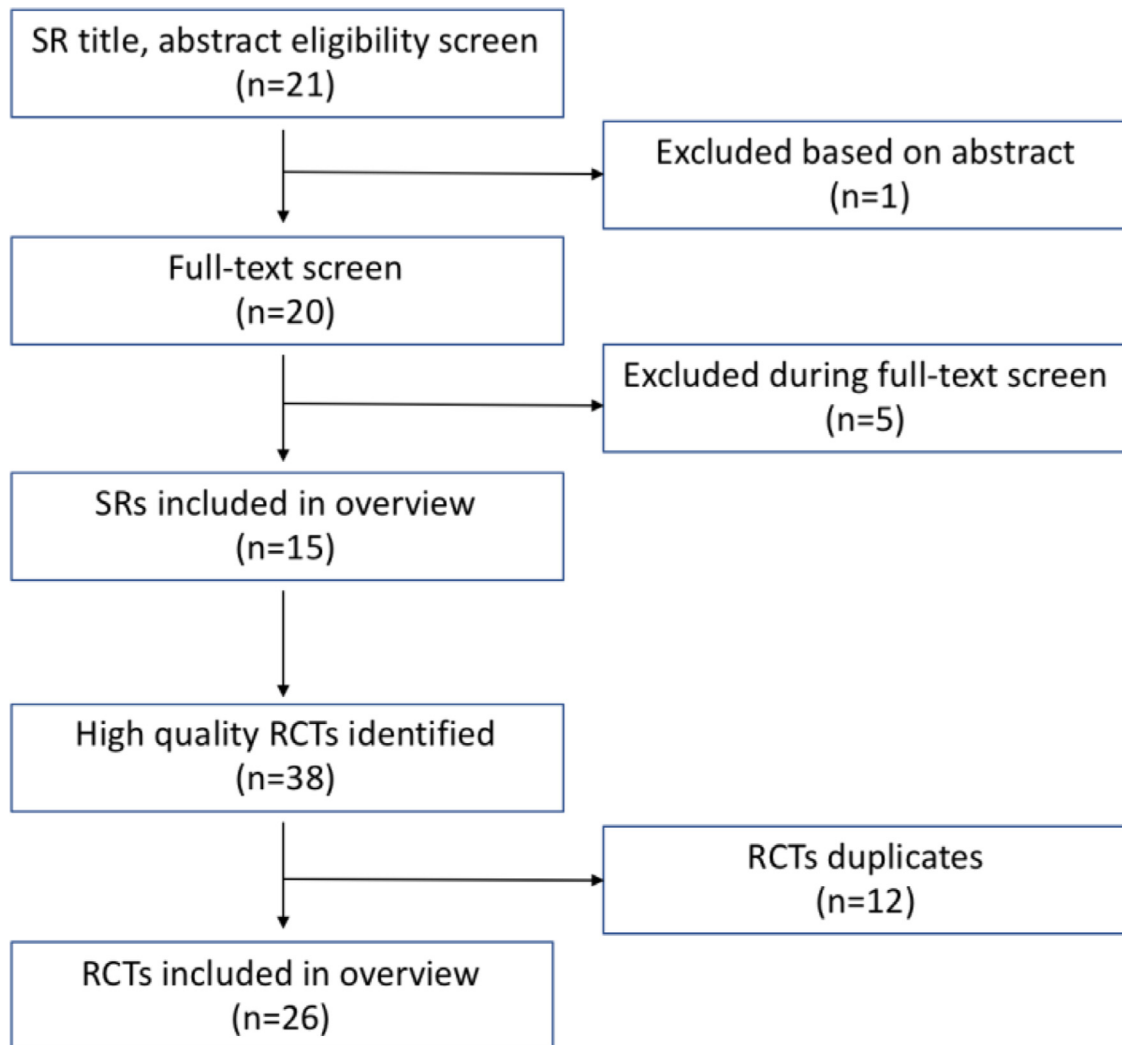
Ethics

As a systematic literature review, and in accordance with the stipulations of the Regional Committees on Health Research Ethics for Southern Denmark, this study was exempt from ethical review.

RESULTS

Screening Flow and Description of Studies

Studies were identified during January 2019, with the screening flow illustrated in Figure 3. The 15 SRs from which RCTs were drawn included RCTs published



SR= Systematic review, RCT= Randomised Clinical Trial.

Fig 1. Typology of dry-needling interventions used in randomized controlled trials, illustrating technique elements and decision junctures. The number of studies reporting a given element is indicated in parentheses. Four studies did not report one or more technique elements, and were excluded. LTR, local twitch response.

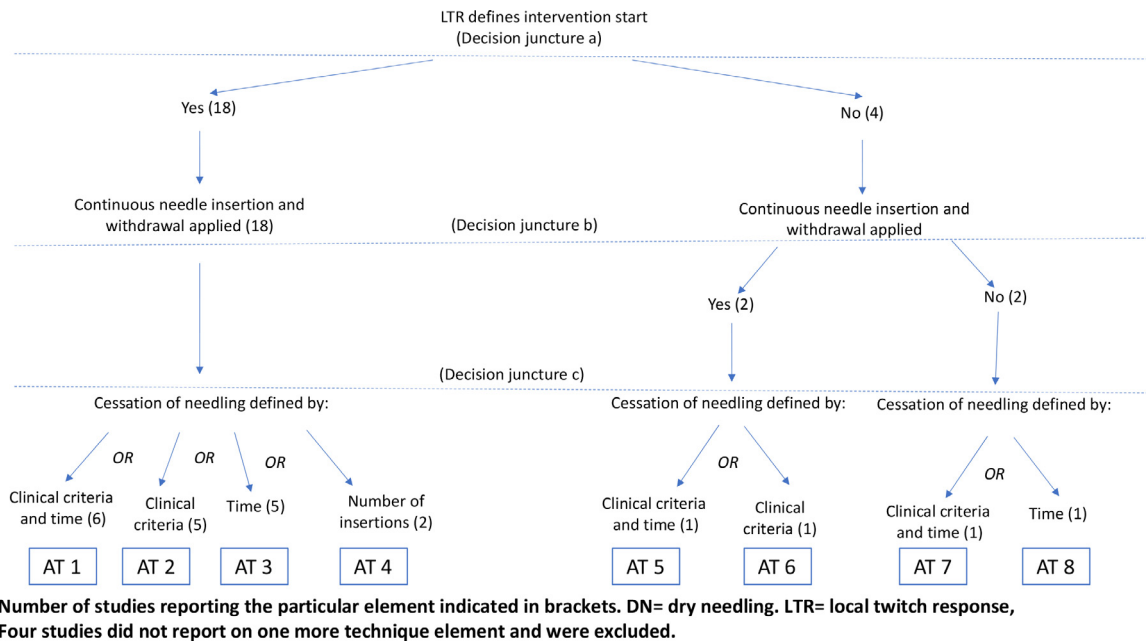


Fig 2. TIDieR (Template for Intervention Description and Replication) intervention reporting scores, by least-reported items. A circle indicates that the item was reported, a semicircle that it was not.

between 1994 and 2018, and these covered a range of conditions, anatomical structures, regions, and specific outcomes.^{6,10,12,13,52-62}

Twenty RCTs were included based on their high Physiotherapy Evidence Database scale evaluations,^{21,32-40,42,44-51,63} and 6 were based on the low risk of bias assessment through the Cochrane Risk of Bias Tool.^{20,29,30,31,41,43} The SRs and their RCTs are presented in Table 2.

Needle-Type Reporting

The most common descriptors for needle type were “stainless steel”,^{29-31,33,36,37,39,40-42} and “acupuncture”,^{20,21,34,35,43,47,48,49,51,63} each being reported in 38% of the RCTs (Table 1). The use of a dedicated “dry needling” needle was reported in 1 RCT, and 2 studies did not specify the type of needle used.

Categorization of DN Interventions

Twelve distinct technique descriptors were identified. The most common, the so-called fast-in and fast-out technique, was reported in 12 studies (46%; see Table 1).

Based on common DN intervention elements, 8 archetypes (Fig 1) emerged describing the initiation, conduct, and cessation of needling.

Evaluation of Intervention Reporting and Replicability

We found that TIDieR scores ranged between 6 and 11 out of a possible 12, with the median being 8.5. Eight studies (30%) scored 10 or higher^{20,21,36,37,41,43,51,63} (see Table 3).

As can be seen in Figure 2, systematic omissions in reporting occurred with respect to DN intervention tailoring, mode, and modification. For these items, details were omitted in 62%, 81%, and 93% of studies, respectively.

DISCUSSION

To our knowledge, this investigation is the first to critically interrogate the internal validity of intervention methods underpinning DN in RCTs.

Are Intervention Elements Reported Uniformly for DN?

An important evolutionary step in DN was the emergence of evidence that the active ingredient arises from mechanical hyperstimulation of soft tissue loci constituting the myofascial trigger points. In addition, it has become clear that repeated needle insertion and retraction are required to optimize this effect.^{46,48,64} In this regard, neither hypodermic (wet needles) nor traditional acupuncture needles function optimally, and as a result, purpose-built DN needles have begun to appear, with innovations such as polished steel shafts, silicone lubrication, and narrower tip angles.^{65,66} From the reported data, it seems unlikely that standardization exists around the use of needle type for DN interventions. Moreover, with the high prevalence of acupuncture-type needles, it appears that investigators have not focused on the use of needles that are best suited to repetitive insertion.⁵¹ Needle design represents an important salient issue, as equivalence in the content of interventions across studies cannot currently be assumed.¹⁸

We identified 12 unique technique descriptors. For example, the interventions conducted by Mendigutia-Gomez et al⁴²

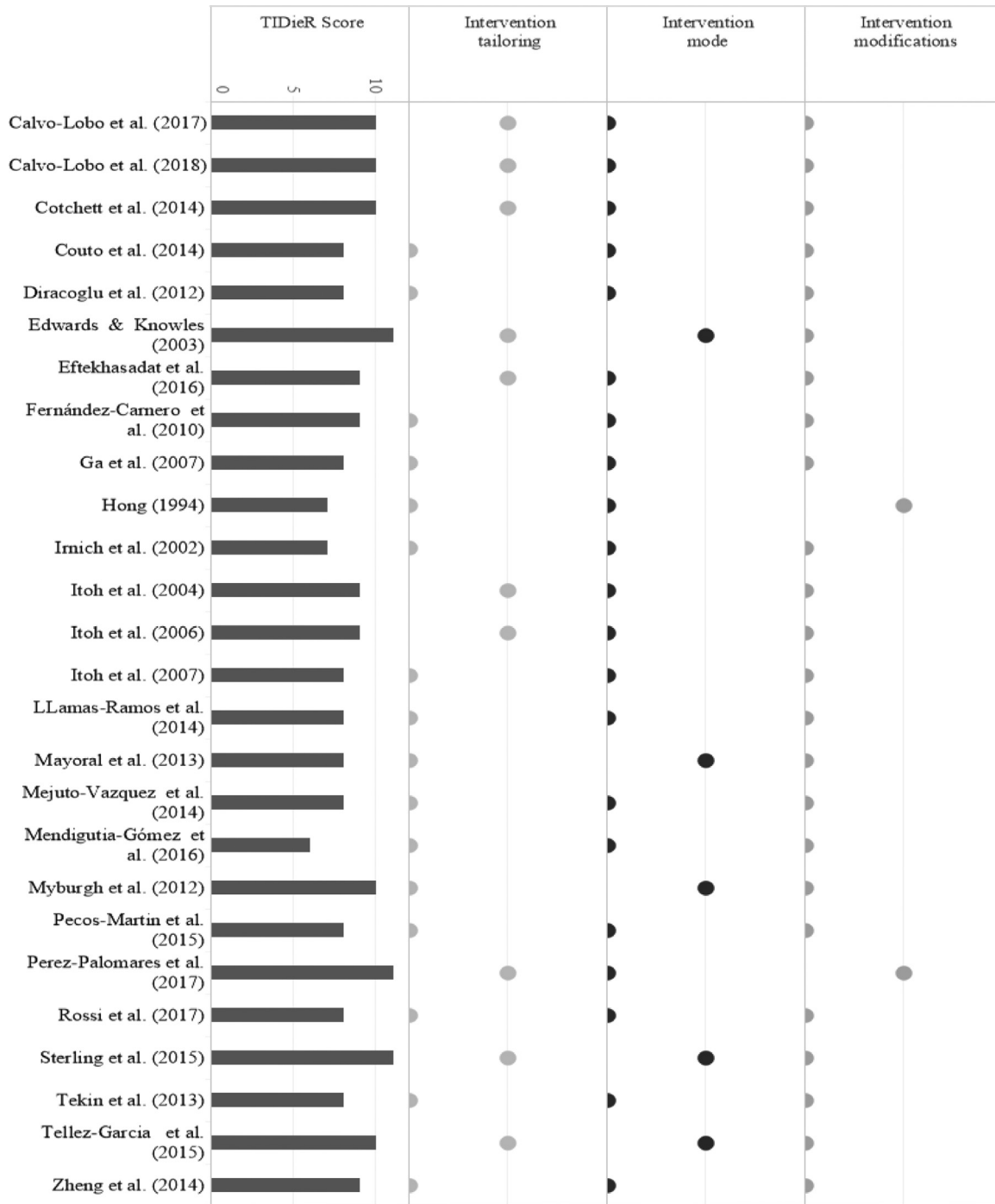


Fig 3. Screening and inclusion flow diagram. RCT, randomized clinical trial; SR, systematic review.

and Myburgh et al⁴³ were initially categorized as, respectively, “fast-in and fast-out” and “deep and superficial.” With their common approach to initiating the DN intervention, their use of a continuous needle movement, and their time-related criteria for intervention cessation, these 2 DN interventions could be more meaningfully reclassified under the same DN subtype. By collapsing the interventions in this manner, we were able to reduce the variation by a third. However, looking across the decision junctures

of the DN intervention flow typology (Fig 1), this still resulted in 8 intervention archetypes. The differences in the number of needle insertions, as well as the duration of the procedure, raise questions regarding the consistency with which intervention content is delivered, and are germane to process fidelity.¹⁸

These findings indicate that DN varies with respect to the reporting of physical materials used as well as the manner in which procedures are performed.

Table 2. Systematic Reviews and Randomized Clinical Trials Identified and Included

SR	RCTs Identified	No. of RCTs Included
Ong and Claydon ¹²	Hong ⁴⁶	1
Boyles et al ⁵³	Cotchett et al, ²⁰ Fernandez-Carnero et al, ³⁵ Llamas-Ramos et al, ³⁹ Zheng et al ⁵⁰	4
Cagnie et al ⁵⁵	Hong, ⁴⁶ Itoh et al, ³¹ Myburgh et al ⁴³	2
Liu et al ⁵⁷	Ga et al, ³⁴ Hong, ⁴⁶ Irnich et al, ³⁸ Itoh et al ³¹ Tekin et al ⁴⁷	3
Morihisa et al ¹⁰	Cotchett et al, ²⁰ Mayoral et al ⁴⁴	2
Gattie et al ⁵⁶	Pecos-Martin et al, ⁴⁵ Sterling et al ²¹	2
Espejo-Antunez et al ⁶	Couto et al, ⁴⁸ Diracoglu et al, ⁴⁹ Irnich et al, ³⁸ Mejuto-Vazquez et al, ⁴⁰ Pecos-Martin et al, ⁴⁵ Tekin et al ⁴⁷	2
Mata Diz et al ⁶⁰	Edwards and Knowles ⁶³	1
Salvioli et al ⁶¹	Cotchett et al ²⁰	0
Braithwaite et al ⁵⁴	Cotchett et al, ²⁰ Sterling et al ²¹	0
Hall et al ⁶²	Calvo-Lobo et al, ³⁶ Calvo-Lobo et al, ³⁷ Mendigutia-Gomez et al ⁴²	3
Liu et al ⁵⁸	Itoh et al, ²⁹ Itoh et al, ³⁰ Tellez-Garcia et al ⁴¹	3
Al-Boloushi et al ⁵²	Eftekharsadat et al ³²	1
Mansfield et al ⁵⁹	Calvo-Lobo et al, ³⁶ Perez-Palomares et al, ⁵¹ Rossi et al ³³	2
Vier et al ¹³	Fernandez-Carnero et al ³⁵	0
Total		26

Studies are listed in chronological order. Italicized RCTs were excluded as duplicates. RCT, randomized clinical trial; SR, systematic review.

Do Inconsistencies, If They Occur, Tend to Cluster Around Particular Areas of Intervention Reporting?

Dry needling is provided to 1 individual at a time, and one might therefore argue that the mode, as with surgery, is implicit. However, the TIDieR guidelines nevertheless require authors to report issues such as whether the session was performed in a private or open location, whether interaction between clinician and patient was allowed, and whether an assistant was present during the intervention.²⁸

In the DN context, tailoring commonly occurs when different needle sizes are used to accommodate anatomical variation, as well as differences in the duration of needling due to the persistence of clinical findings such as the local twitch response.² These procedural variations, occurring at the level of the individual research participant, require explicit reporting.

At times, modifications to DN procedures may be required to accommodate unforeseen issues encountered early on in a study. In these instances, adaptations to both the materials and personnel involved should be reported. If no such issues

occur, or if the intervention is carried out in accordance with a published protocol or published pilot study, this should be explicitly stated in the methodology reporting.⁶⁷

The studies by Cotchett et al²⁰ and Sterling et al²¹ were the only one included in the present study to report making use of the STRICTA guidelines. Both fared very well with respect to TIDieR reporting criteria, the former scoring 10 and the latter 11 out of a possible 12. Interestingly, though, the issues judged as absent from their reporting were mode and modification in the case of Cotchett et al and tailoring in the case of Sterling et al (see also Fig 2). We would argue that this finding points toward the value of the STRICTA guidelines in raising intervention fidelity, but that they are not fully transferable to the reporting of DN interventions.

Our findings indicate substantial inconsistencies in technique elements and reporting issues clustered around tailoring, mode, and modification of individual DN interventions. Therefore, notwithstanding general high standards of reporting, these issues threaten the intervention fidelity and consequently the internal validity of DN RCTs.

Table 3. TIDieR Checklist Evaluation of Intervention Reporting and Replicability for Included Studies

Study	TIDieR												Score (Out of 12)
	Name	Why	What (Materials)	What (Procedures)	Who	How (Mode)	Where	When and How Much	Tailoring	Modifications	How Well (Planned)	How Well Actual)	
Hong ⁴⁶	✓	✓	✓	✓	✓	—	—	✓	—	✓	—	—	7
Irnich et al ³⁸	✓	✓	—	✓	✓	—	✓	✓	—	—	—	✓	7
Edwards and Knowles ⁵³	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	11
Itoh et al ²⁹	✓	✓	✓	✓	✓	—	✓	✓	✓	—	—	✓	9
Itoh et al ³⁰	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Ga et al ³⁴	✓	✓	✓	✓	✓	—	✓	✓	—	—	✓	—	8
Itoh et al ³¹	✓	✓	✓	✓	✓	—	✓	✓	✓	—	—	✓	9
Fernandez-Carnero et al ³⁵	✓	✓	✓	✓	✓	—	✓	✓	—	—	✓	✓	9
Diracoglu et al ⁴⁹	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Myburgh et al ⁴³	✓	✓	✓	✓	✓	✓	✓	✓	—	—	✓	✓	10
Mayoral et al ⁴⁴	✓	✓	✓	✓	✓	✓	—	✓	—	—	—	✓	8
Tekin et al ⁴⁷	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Couto et al ⁴⁸	✓	✓	✓	✓	✓	—	—	✓	—	—	✓	✓	8
Cotchett et al ²⁰	✓	✓	✓	✓	✓	—	✓	✓	✓	—	✓	✓	10
Llamas-Ramos et al ³⁹	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Mejuto-Vazquez et al ⁴⁰	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Zheng et al ⁵⁰	✓	✓	✓	✓	✓	—	✓	✓	—	—	✓	✓	9
Pecos-Martin et al ⁴⁵	✓	✓	✓	✓	✓	—	✓	✓	—	—	—	✓	8
Sterling et al ²¹	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	11
Tellez-Garcia et al ⁴¹	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	—	✓	10
Eftekharsadat et al ³²	✓	✓	✓	✓	✓	—	✓	✓	✓	—	—	✓	9
Mendigutia-Gomez et al ⁴²	✓	✓	✓	✓	—	—	—	✓	—	—	—	✓	6
Calvo-Lobo et al ³⁶	✓	✓	✓	✓	✓	—	✓	✓	✓	—	✓	✓	10
Perez-Palomares et al ⁵¹	✓	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	11
Rossi et al ³³	✓	✓	✓	✓	✓	—	—	✓	—	—	✓	✓	8
Calvo-Lobo et al ³⁷	✓	✓	✓	✓	✓	—	✓	✓	✓	—	✓	✓	10

Recommendations for Future Investigations

Reporting guidelines that improve nuanced reporting quality, which in turn will increase confidence in the internal validity of RCT evidence, require further scrutiny.⁶⁸ Specifically, the adoption of STRICTA for DN interventions requires formal investigation, and if it is not found to be suitable in its current form,¹⁷ a standardized set of DN procedures needs to be agreed upon. We recommend a consensus process.⁶⁹ In the interim, we encourage the use of the STRICTA guidelines, as they appear to aid in demonstrating methodological rigor.

Based on our previous arguments to continue the development of DN as a unique intervention, we argue for the use of purpose-built DN needles as the benchmark practice. However, future investigations must be devised to test the assertions of superior patient comfort and fewer needle-related side effects.⁶⁶

Strengths

This investigation used a novel methodology for appraising consistency by combining substantive intervention categorization and fidelity evaluation. This approach made it possible to generally assess the likelihood of threats but also to specifically point out where DN reporting might be improved.

Limitations

Our search strategy was based on only 2 databases; therefore some studies may not have been included. Future studies in this context, following an exhaustive search strategy, may consider including EBSCO, the Physiotherapy Evidence Database, Scopus, and Web of Science.

We aimed to include RCTs that were judged to demonstrate high levels of reporting quality. Our findings are therefore not generalizable across all recent DN RCTs, even though fidelity issues are likely to exist in trials with lower standards of reporting. Moreover, due to this focus, it may be possible that more than 12 technique descriptors exist across the DN RCT literature.

Four of the authors (K.C., K.K., T.D., and C.M.) are certified in the use of DN. None of the authors were practicing acupuncturists, and future studies may consider expert opinion in other areas using acupuncture and dry needling in developing their methodology.

Three studies, all conducted by Itoh et al,²⁹⁻³¹ used the term “TrP acupuncture,” which created uncertainty regarding their inclusion and forced us to revert to our decision rule. In retrospect, excluding these studies would not have affected the overall findings.

CONCLUSION

Substantial heterogeneity in the choice and reporting of DN was evident across high-quality RCTs, and in particular we observed systematic underreporting of intervention tailoring, mode clarification, and procedure modification. These 2

factors undermine intervention fidelity and consequently represent a threat to internal validity. A greater degree of uniform and nuanced reporting is required to reduce methodological uncertainty. To address this issue, we recommend the implementation of a relevant, standardized extension of the standard nonpharmaceutical intervention reporting guideline.

FUNDING SOURCES AND CONFLICTS OF INTEREST

No funding sources or conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): C.M.

Design (planned the methods to generate the results): C.M., K.K., T.D.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): C.M., K.C.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): K.K., T.D.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): C.M., K.K., T.D.

Literature search (performed the literature search): K.K., T.D.

Writing (responsible for writing a substantive part of the manuscript): C.M.

Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): C.M., K.K., T.D., K.C., E.B.

Practical Applications

- We observed inconsistent reporting of the description of dry needling (DN), as well as systematic underreporting of mode, modification, and tailoring procedures in reported randomized clinical trials (RCTs).
- The current standards of reporting call into question the fidelity of DN intervention process and thus threaten the internal validity of high-quality RCTs.
- Clinicians and researchers may consider including in their reporting the criteria for initiating the DN intervention, the mode of needle application, and the criteria for DN cessation.
- These technique elements could form part of guidelines for reporting DN procedures in RCTs.

REFERENCES

1. Shah JP, Thaker N, Heimur J, Aredo JV, Sikdar S, Gerber L. Myofascial trigger points then and now: a historical and scientific perspective. *PM R*. 2015;7(7):746-761.

2. Çakıt BD, Genç H, Altuntaş V, Erdem HR. Disability and related factors in patients with chronic cervical myofascial pain. *Clin Rheumatol*. 2009;28(6):647-654.
3. Srbely JZ. New trends in the treatment and management of myofascial pain syndrome. *Curr Pain Headache Rep*. 2010;14(5):346-352.
4. Jafri MS. Mechanisms of myofascial pain. *Int Sch Res Notices*. 2014;2014: 523924.
5. Tough EA, White AR, Cummings TM, Richards SH, Campbell JL. Acupuncture and dry needling in the management of myofascial trigger point pain: a systematic review and meta-analysis of randomised controlled trials. *Eur J Pain*. 2009;13(1):3-10.
6. Espejo-Antunez L, Tejada JF, Albornoz-Cabello M, et al. Dry needling in the management of myofascial trigger points: a systematic review of randomized controlled trials. *Complement Ther Med*. 2017;33:46-57.
7. Hu HT, Gao H, Ma RJ, Zhao XF, Tian HF, Li L. Is dry needling effective for low back pain?: a systematic review and PRISMA-compliant meta-analysis. *Med (Baltimore)*. 2018;97(26):e11225.
8. Dunning J, Butts R, Mourad F, Young I, Flannagan S, Perreault T. Dry needling: a literature review with implications for clinical practice guidelines. *Phys Ther Rev*. 2014;19(4):252-265.
9. Ijaz N, Boon H. Evaluating the international standards gap for the use of acupuncture needles by physiotherapists and chiropractors: a policy analysis. *PLoS One*. 2019;14(12):e0226601.
10. Morihisa R, Eskew J, McNamara A, Young J. Dry needling in subjects with muscular trigger points in the lower quarter: a systematic review. *Int J Sports Phys Ther*. 2016;11(1):1-14.
11. Fleckenstein J, Zaps D, Ruger LJ, et al. Discrepancy between prevalence and perceived effectiveness of treatment methods in myofascial pain syndrome: results of a cross-sectional, nationwide survey. *BMC Musculoskelet Disord*. 2010;11:32.
12. Ong J, Claydon LS. The effect of dry needling for myofascial trigger points in the neck and shoulders: a systematic review and meta-analysis. *J Bodyw Mov Ther*. 2014;18(3):390-398.
13. Vier C, Almeida MB, Neves ML, Santos ARSD, Bracht MA. The effectiveness of dry needling for patients with orofacial pain associated with temporomandibular dysfunction: a systematic review and meta-analysis. *Braz J Phys Ther*. 2019;23(1):3-11.
14. Guo Y, Zhao H, Wang F, et al. Recommendations for acupuncture in clinical practice guidelines of the national guideline clearinghouse. *Chin J Integr Med*. 2017;23(11):864-870.
15. Oliveira CB, Maher CG, Pinto RZ, et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. journal article. *Eur Spine J*. 2018;27(11):2791-2803.
16. Groeneweg R, Rubinstein SM, Oostendorp RAB, Ostelo RWJG, van Tulder MW. Guideline for reporting interventions on spinal manipulative therapy: Consensus on Interventions Reporting Criteria List for Spinal Manipulative Therapy (CIRCLE SMT). *J Manipulative Physiol Ther*. 2017;40(2):61-70.
17. MacPherson H, Altman DG, Hammerschlag R, et al. Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): extending the CONSORT statement. *J Evid Based Med*. 2010;3(3):140-155.
18. Wickersham K, Colbert A, Caruthers D, Tamres L, Martino A, Erlen JA. Assessing fidelity to an intervention in a randomized controlled trial to improve medication adherence. *Nurs Res*. 2011;60(4):264-269.
19. Horner S, Rew L, Torres R. Enhancing intervention fidelity: a means of strengthening study impact. *J Spec Pediatr Nurs*. 2006;11(2):80-89.
20. Cotchett MP, Munteanu SE, Landorf KB. Effectiveness of trigger point dry needling for plantar heel pain: a randomized controlled trial. *Phys Ther*. 2014;94(8):1083-1094.
21. Sterling M, Vicenzino B, Souvlis T, Connelly LB. Dry-needling and exercise for chronic whiplash-associated disorders: a randomized single-blind placebo-controlled trial. *Pain*. 2015;156(4):635-643.
22. Jeffries LJ, Milanese SF, Grimmer-Somers KA. Epidemiology of adolescent spinal pain: a systematic overview of the research literature. *Spine (Phila Pa 1976)*. 2007;32(23):2630-2637.
23. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009;62(10):e1-e34.
24. PROSPERO: International Prospective Register of Systematic Reviews. Available at: <https://www.crd.york.ac.uk/prospero/>. Accessed November 3, 2018.
25. Paez A. Grey literature: an important resource in systematic reviews. *J Evid Based Med*. 2017;10(3):233-240.
26. Lu Z. PubMed and beyond: a survey of web tools for searching biomedical literature. *Database (Oxford)*. 2011;2011:baq036.
27. von Elm E, Ravauud P, Maclehorse H, et al. Translating Cochrane reviews to ensure that healthcare decision-making is informed by high-quality research evidence. *PLoS Med*. 2013;10(9):e1001516.
28. Hoffmann TC, Glasziou PP, Boutron I, et al. Die TIDieR Checkliste und Anleitung—ein Instrument für eine verbesserte Interventionsbeschreibung und Replikation [Better reporting of interventions: Template for Intervention Description and Replication (TIDieR) checklist and guide]. *Gesundheitswesen*. 2016;78(3):e174. [in German].
29. Itoh K, Katsumi Y, Kitakoji H. Trigger point acupuncture treatment of chronic low back pain in elderly patients—a blinded RCT. *Acupunct Med*. 2004;22(4):170-177.
30. Itoh K, Katsumi Y, Hirota S, Kitakoji H. Effects of trigger point acupuncture on chronic low back pain in elderly patients—a sham-controlled randomised trial. *Acupunct Med*. 2006;24(1):5-12.
31. Itoh K, Katsumi Y, Hirota S, Kitakoji H. Randomised trial of trigger point acupuncture compared with other acupuncture for treatment of chronic neck pain. *Complement Ther Med*. 2007;15(3):172-179.
32. Eftekharsadat B, Babaei-Ghazani A, Zeinolabedinzadeh V. Dry needling in patients with chronic heel pain due to plantar fasciitis: a single-blinded randomized clinical trial. *Med J Islam Repub Iran*. 2016;30:401.
33. Rossi A, Blaustein S, Brown J, et al. Spinal and peripheral dry needling versus peripheral dry needling alone among individuals with a history of lateral ankle sprain: a randomized controlled trial. *Int J Sports Phys Ther*. 2017;12(7):1034-1047.
34. Ga H, Choi JH, Park CH, Yoon HJ. Dry needling of trigger points with and without paraspinal needling in myofascial pain syndromes in elderly patients. *J Altern Complement Med*. 2007;13(6):617-624.
35. Fernandez-Camero J, La Touche R, Ortega-Santiago R, et al. Short-term effects of dry needling of active myofascial trigger points in the masseter muscle in patients with temporomandibular disorders. *J Orofac Pain*. 2010;24(1):106-112.
36. Calvo-Lobo C, Pacheco-da-Costa S, Hita-Herranz E. Efficacy of deep dry needling on latent myofascial trigger points in

- older adults with nonspecific shoulder pain: a randomized, controlled clinical trial pilot study. *J Geriatr Phys Ther.* 2017;40(2):63-73.
37. Calvo-Lobo C, Pacheco-da-Costa S, Martinez-Martinez J, Rodriguez-Sanz D, Cuesta-Alvaro P, Lopez-Lopez D. Dry needling on the infraspinatus latent and active myofascial trigger points in older adults with nonspecific shoulder pain: a randomized clinical trial. *J Geriatr Phys Ther.* 2018;41(1):1-13.
 38. Irnich D, Behrens N, Gleditsch JM, et al. Immediate effects of dry needling and acupuncture at distant points in chronic neck pain: results of a randomized, double-blind, sham-controlled crossover trial. *Pain.* 2002;99(1-2):83-89.
 39. Llamas-Ramos R, Pecos-Martin D, Gallego-Izquierdo T, et al. Comparison of the short-term outcomes between trigger point dry needling and trigger point manual therapy for the management of chronic mechanical neck pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2014;44(11):852-861.
 40. Mejuto-Vazquez MJ, Salom-Moreno J, Ortega-Santiago R, Truyols-Dominguez S, Fernandez-de-Las-Penas C. Short-term changes in neck pain, widespread pressure pain sensitivity, and cervical range of motion after the application of trigger point dry needling in patients with acute mechanical neck pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2014;44(4):252-260.
 41. Tellez-Garcia M, de-la-Llave-Rincon AI, Salom-Moreno J, Palacios-Cena M, Ortega-Santiago R, Fernandez-de-Las-Penas C. Neuroscience education in addition to trigger point dry needling for the management of patients with mechanical chronic low back pain: a preliminary clinical trial. *J Bodyw Mov Ther.* 2015;19(3):464-472.
 42. Mendigutia-Gomez A, Martin-Hernandez C, Salom-Moreno J, Fernandez-de-Las-Penas C. Effect of dry needling on spasticity, shoulder range of motion, and pressure pain sensitivity in patients with stroke: a crossover study. *J Manipulative Physiol Ther.* 2016;39(5):348-358.
 43. Myburgh C, Hartvigsen J, Aagaard P, Holsgaard-Larsen A. Skeletal muscle contractility, self-reported pain and tissue sensitivity in females with neck/shoulder pain and upper trapezius myofascial trigger points—a randomized intervention study. *Chiropr Man Therap.* 2012;20(1):36.
 44. Mayoral O, Salvat I, Martin MT, et al. Efficacy of myofascial trigger point dry needling in the prevention of pain after total knee arthroplasty: a randomized, double-blinded, placebo-controlled trial. *Evid Based Complement Alternat Med.* 2013;2013: 694941.
 45. Pecos-Martin D, Montanez-Aguilera FJ, Gallego-Izquierdo T, et al. Effectiveness of dry needling on the lower trapezius in patients with mechanical neck pain: a randomized controlled trial. *Arch Phys Med Rehabil.* 2015;96(5):775-781.
 46. Hong CZ. Lidocaine injection versus dry needling to myofascial trigger point. *Am J Phys Med Rehabil.* 1994;73(4):256-263.
 47. Tekin L, Akarsu S, Durmus O, Cakar E, Dincer U, Kiralp MZ. The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial. *Clin Rheumatol.* 2013;32(3):309-315.
 48. Couto C, de Souza IC, Torres IL, Fregni F, Caumo W. Paraspinal stimulation combined with trigger point needling and needle rotation for the treatment of myofascial pain: a randomized sham-controlled clinical trial. *Clin J Pain.* 2014;30(3):214-223.
 49. Diracoglu D, Vural M, Karan A, Aksoy C. Effectiveness of dry needling for the treatment of temporomandibular myofascial pain: a double-blind, randomized, placebo controlled study. *J Back Musculoskelet Rehabil.* 2012;25(4):285-290.
 50. Zheng Y, Shi D, Wu X, et al. Ultrasound-guided miniscalpel-needle release versus dry needling for chronic neck pain: a randomized controlled trial. *Evid Based Complement Alternat Med.* 2014;2014: 235817.
 51. Perez-Palomares S, Oliván-Blázquez B, Perez-Palomares A, et al. Contribution of dry needling to individualized physical therapy treatment of shoulder pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2017;47(1):11-20.
 52. Al-Boloushi Z, Lopez-Royo MP, Arian M, Gomez-Trullen EM, Herrero P. Minimally invasive non-surgical management of plantar fasciitis: a systematic review. *J Body Mov Ther.* 2019;23(1):122-137.
 53. Boyles R, Fowler R, Ramsey D, Burrows E. Effectiveness of trigger point dry needling for multiple body regions: a systematic review. *J Man Manip Ther.* 2015;23(5):276-293.
 54. Braithwaite FA, Walters JL, Li LSK, Moseley GL, Williams MT, McEvoy MP. Effectiveness and adequacy of blinding in the moderation of pain outcomes: systematic review and meta-analyses of dry needling trials. *PeerJ.* 2018;6:e5318.
 55. Cagnie B, Castelein B, Pollie F, Steelant L, Verhoeven H, Cools A. Evidence for the use of ischemic compression and dry needling in the management of trigger points of the upper trapezius in patients with neck pain: a systematic review. *Am J Phys Med Rehabil.* 2015;94(7):573-583.
 56. Gattie E, Cleland JA, Snodgrass S. The effectiveness of trigger point dry needling for musculoskeletal conditions by physical therapists: a systematic review and meta-analysis. *J Orthop Sports Phys Ther.* 2017;47(3):133-149.
 57. Liu L, Huang QM, Liu QG, et al. Effectiveness of dry needling for myofascial trigger points associated with neck and shoulder pain: a systematic review and meta-analysis. *Arch Phys Med Rehabil.* May 2015;96(5):944-955.
 58. Liu L, Huang QM, Liu QG, et al. Evidence for dry needling in the management of myofascial trigger points associated with low back pain: a systematic review and meta-analysis. *Arch Phys Med Rehabil.* 2018;99(1):144-152. e2.
 59. Mansfield CJ, Vanetten L, Willy R, di Stasi S, Magnussen R, Briggs M. The effects of needling therapies on muscle force production: a systematic review and meta-analysis. *J Orthop Sports Phys Ther.* 2019;49(3):154-170.
 60. Mata Diz JB, de Souza JR, Leopoldino AA, Oliveira VC. Exercise, especially combined stretching and strengthening exercise, reduces myofascial pain: a systematic review. *J Physiother.* 2017;63(1):17-22.
 61. Salvioli S, Guidi M, Marcotulli G. The effectiveness of conservative, non-pharmacological treatment, of plantar heel pain: a systematic review with meta-analysis. *Foot (Edinb).* 2017;33:57-67.
 62. Hall ML, Mackie AC, Ribeiro DC. Effects of dry needling trigger point therapy in the shoulder region on patients with upper extremity pain and dysfunction: a systematic review with meta-analysis. *Physiotherapy.* 2018;104(2):167-177.
 63. Edwards J, Knowles N. Superficial dry needling and active stretching in the treatment of myofascial pain—a randomised controlled trial. *Acupunct Med.* 2003;21(3):80-86.
 64. Lewit K. The needle effect in the relief of myofascial pain. *Pain.* 1979;6(1):83-90.
 65. Anandkumar S, Manivasagam M. Effect of fascia dry needling on non-specific thoracic pain—a proposed dry needling grading system. *Physiother Theory Pract.* 2017;33(5):420-428.
 66. Corfixen K, Myburgh C. *Dry Needling 101: A Clinician's Handbook.* Copenhagen, Denmark: Physical Health Media; 2012.

67. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: Template for Intervention Description and Replication (TIDieR) checklist and guide. *BMJ*. 2014;348:g1687.
68. Rubinstein SM, van Eekelen R, Oosterhuis T, de Boer MR, Ostelo RWJG, van Tulder MW. The risk of bias and sample size of trials of spinal manipulative therapy for low back and neck pain: analysis and recommendations. *J Manipulative Physiol Ther*. 2014;37(8):523-541.
69. de Villiers MR, de Villiers PJ, Kent AP. The Delphi technique in health sciences education research. *Med Teach*. 2005;27(7):639-643.