ERIC GATTIE, PT, DPT[1] • **JOSHUA A. CLELAND,** PT, PhD[2] • **SUZANNE SNODGRASS,** PT, PhD[3]

The Effectiveness of Trigger Point Dry Needling for Musculoskeletal Conditions by Physical Therapists: A Systematic Review and Meta-analysis

STUDY DESIGN: Systematic review and meta-analysis.

BACKGROUND: An increasing number of physical therapists in the United States and throughout the world are using dry needling to treat musculoskeletal pain.

OBJECTIVE: To examine the short- and long-term effectiveness of dry needling delivered by a physical therapist for any musculoskeletal pain condition.

METHODS: Electronic databases were searched. Eligible randomized controlled trials included those with human subjects who had musculoskeletal conditions that were treated with dry needling performed by a physical therapist, compared with a control or other intervention. The overall quality of the evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation.

RESULTS: The initial search returned 218 articles. After screening, 13 were included. Physiotherapy Evidence Database quality scale scores ranged from 4 to 9 (out of a maximum score of 10), with a median score of 7. Eight meta-analyses were performed. In the immediate to 12-week follow-up period, studies provided evidence that dry needling may decrease pain and increase pressure pain threshold when compared to control/sham or other treatment. At 6 to 12 months, dry needling was favored for decreasing pain, but the treatment effect was not statistically significant. Dry needling, when compared to control/sham treatment, provides a statistically significant effect on functional outcomes, but not when compared to other treatments.

CONCLUSION: Very low–quality to moderate-quality evidence suggests that dry needling performed by physical therapists is more effective than no treatment, sham dry needling, and other treatments for reducing pain and improving pressure pain threshold in patients presenting with musculoskeletal pain in the immediate to 12-week follow-up period. Low-quality evidence suggests superior outcomes with dry needling for functional outcomes when compared to no treatment or sham needling. However, no difference in functional outcomes exists when compared to other physical therapy treatments. Evidence of long-term benefit of dry needling is currently lacking.

LEVEL OF EVIDENCE: Therapy, level 1a.
J Orthop Sports Phys Ther 2017;47(3):133-149. Epub 3 Feb 2017. doi:10.2519/jospt.2017.7096

KEY WORDS: *dry needling, intramuscular stimulation, randomized controlled trial*

Dry needling is a technique in which a fine needle is used to penetrate the skin, subcutaneous tissues, and muscle, with the intent to mechanically disrupt tissue without the use of an anesthetic.[42] Dry needling is often used to treat myofascial trigger points (MTrPs), which are described as localized hypersensitive spots in a palpable taut band of muscle. These hyperirritable spots can be classified as active MTrPs when they produce spontaneous pain and, when palpated, reproduce a patient's familiar pain. Latent MTrPs do not produce spontaneous pain and are only painful upon palpation.[1] Myofascial trigger points are commonly found in patients with musculoskeletal pain.[25]

The physiological mechanism underpinning the effects of dry needling remains to be elucidated. However, it has been suggested that dry needling may produce both local and central nervous responses to restore homeostasis at the site of the MTrPs, resulting in a reduction of both peripheral and central sensitization to pain.[13,17,18] Tsai et al[41] demonstrated that needling of distal trigger points causes a reduced sensitivity of proximal trigger points. Centrally, dry needling may activate descending control mechanisms in the brain or spinal cord.[18,19] Dry needling has been shown to immediately increase pressure pain threshold (PPT) and range of motion, decrease muscle tone, and decrease pain in patients with musculoskeletal conditions.[17,24,28,32]

[1]Concord Hospital Rehabilitation Services, Concord, NH. [2]Department of Physical Therapy, Franklin Pierce University, Manchester, NH. [3]University of Newcastle, Callaghan, Australia. No grant support was provided. The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article. Address correspondence to Dr Eric Gattie, 264 Pleasant Street, Concord, NH 03301. E-mail: ericgattie@gmail.com

Six[4,5,11,20,23,30] of the 8[31,40] systematic reviews since 2013 concluded that dry needling is more effective in the short term for decreasing pain when compared to sham or placebo treatment. There is currently weak evidence (only 2[4,5] of the 8 systematic reviews) for dry needling's effect on functional outcomes or quality of life. The evidence to support dry needling in the long term for decreasing pain or improving functional outcomes is currently lacking, as no previous reviews included evidence of long-term effects.

An increasing number of physical therapists in the United States and throughout the world are using dry needling to treat musculoskeletal pain.[9,10] As dry needling becomes more commonly used by physical therapists, it is important to continually appraise the existing evidence to support or refute its effectiveness.

Previous reviews have commonly focused on a specific anatomical region rather than the entire body,[20,23,30,31] and have not examined the effectiveness of dry needling applied by a single health professional. To improve its generalizability to physical therapy practice, the available evidence on dry needling, as applied by physical therapists, must be examined. Therefore, the purpose of this systematic review and meta-analysis was to determine the short-term and long-term effectiveness of dry needling delivered by a physical therapist for any musculoskeletal pain condition.

METHODS

This systematic review and meta-analysis was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[29]

Search Strategy

Eligible studies in this systematic review included human subjects with musculoskeletal conditions who had been treated by a physical therapist with dry needling, compared with a control, sham, or other intervention. Only randomized controlled trials were included. Studies were excluded if patients were less than 18 years of age and if the full text was not published in English.

The electronic databases MEDLINE, AMED, CINAHL, and Embase were searched independently by the primary investigator in consultation with a biomedical librarian. The terms "dry needling" or "intramuscular stimulation," paired with "random," "group," "trial," "randomized controlled trial," or "controlled clinical trial," were used to search the electronic databases. Results were limited to human studies. An example of the search strategy is included in the **APPENDIX** (available at www.jospt.org). Bibliographic reference lists from identified articles were hand searched for any other potential study not identified during the database searches. Search results are displayed in **FIGURE 1**.

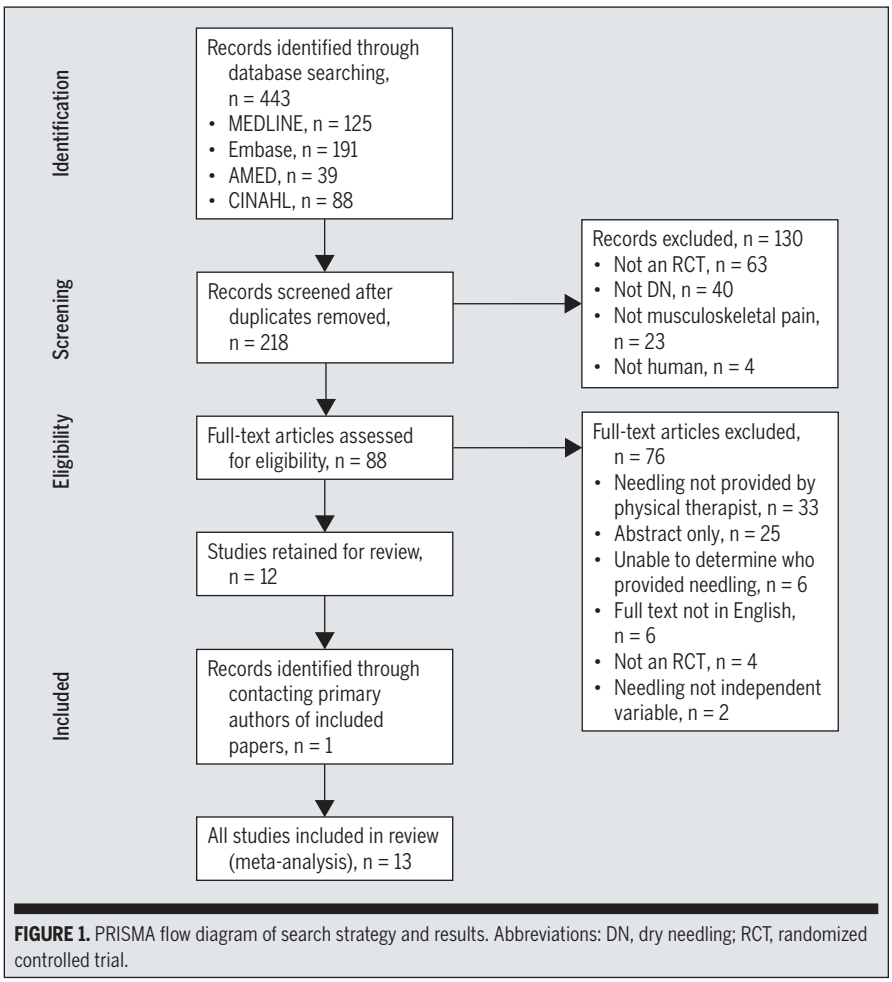


FIGURE 1. PRISMA flow diagram of search strategy and results. Abbreviations: DN, dry needling; RCT, randomized controlled trial.

Study Selection

After the duplicate articles retrieved from the different databases were removed, 2 independent reviewers (E.G. and Kelly Lavallee) screened titles and abstracts to determine which studies met the inclusion and exclusion criteria. Studies that appeared to meet the inclusion criteria or whose eligibility could not be determined from the title/abstract screening were retrieved for full-text review by 2 independent reviewers (E.G. and Sebastian Sabadis). Disagreements between reviewers were resolved by consulting a third reviewer (J.C.) who was blind to other reviewers' decisions on whether

TABLE 1 STUDY CHARACTERISTICS

Study	n	Age, y	Diagnosis (Duration)	Intervention Group (n)	Outcome Measure	Time to Outcome	Pain*	PPT*	Functional Outcome*	PEDro Score
Arias-Buría et al[2]	20	58 ± 15 57 ± 11	Postsurgical shoulder pain (5.8 ± 5.2 mo and 5.4 ± 8.5 mo)	1. PT+ DN (10) 2. PT (10)	Pain, ADLs, ROM, and strength (the Constant-Murley score)	1 wk	Not statistically significant		PT and DN	7
Campa-Moran et al[6]	36	53.9 ± 12.7 45.8 ± 15.4 48.7 ± 10.2	Chronic myofascial neck pain (10.0 ± 2.9 mo, 11.8 ± 4.4 mo, 14.0 ± 3.6 mo)	1. DN (12) 2. OMT (12) 3. ICT (12)	Pain (VAS), PPT, FNXL (NDI), PCS, ROM (cervical spine)	Immediate, 2 d, 2 wk	Not statistically significant	OMT	DN and OMT greater than ICT	6
Casanueva et al[7]	120	56.26 ± 12.03 50.82 ± 9.36	Fibromyalgia (11.88 ± 9.86 y, 10.08 ± 7.74 y)	1. DN (60) 2. Control (60)	Pain (VAS), PPT, FNXL (SF-36)	6 wk, 12 wk	DN at 6 and 12 wk	DN at 6 and 12 wk	DN at 6 and 12 wk	4
Santos et al[36]	22	38.5 ± 5.1 24.5 ± 2.7 25.8 ± 3.0	Myofascial pain (>6 wk)	1. DN (7) 2. ICT (8) 3. Control (7)	Pain (VAS), FNXL (WHOQOL-BREF)	Immediate, 3 wk, 6 wk	ICT		Not statistically significant	5
Edwards and Knowles[12]	40	57 ± 12 55 ± 17 57 ± 19	Myofascial pain (16 ± 23 mo, 10 ± 12 mo, 16 ± 19 mo)	1. DN (14) 2. Stretching (13) 3. Control (13)	Pain (short form of the McGill Pain Questionnaire), PPT	3 wk, 6 wk	DN at 6 wk over control, but not at 3 wk	DN at 6 wk, but not at 3 wk		7
Llamas-Ramos et al[24]	94	31 ± 3 31 ± 2	Chronic mechanical neck pain (7.4 ± 2.6 mo, 7.1 ± 2.9 mo)	1. DN (47) 2. ICT (47)	Pain (NPRS), PPT, FNXL (Northwick Park NPQ), ROM (cervical spine)	Immediate, 1 wk, 2 wk	Not statistically significant	DN at all follow-up periods	Not statistically significant	8
Mayoral et al[27]	40	71.65 ± 6.06 72.90 ± 7.85	TKA (treated immediately prior to TKA)	1. DN (20) 2. Sham DN (20)	Pain (VAS), FNXL (WOMAC), ROM (knee), postoperative demand for analgesics, peak isometric strength (knee)	1 mo, 3 mo, 6 mo	DN at 1 mo		Not statistically significant	7
Mejuto-Vázquez et al[28]	17	24 ± 7 25 ± 4	Acute mechanical neck pain (3.4 ± 0.7 d, 3.1 ± 0.8 d)	1. DN (9) 2. Control (8)	Pain (NPRS), PPT, ROM (cervical spine)	Immediate, 1 wk	DN	DN		8
Pecos-Martín et al[32]	72	23 ± 5 23 ± 6	Chronic neck pain (5.7 ± 2.6 mo, 7.0 ± 2.8 mo)	1. DN (36) 2. Sham DN (36)	Pain (VAS), PPT, FNXL (NPQ)	Immediate, 1 wk, 4 wk	DN	DN	DN	9
Pérez-Palomares et al[33]	122	45.85 ± 14.4	Chronic low back pain	1. DN (58) 2. PENS (64)	Pain (VAS), PPT, disability (ODI)	3 wk	Not statistically significant	Not statistically significant	Not statistically significant	6
Salom-Moreno et al[35]	27	33.4 ± 2.8 33.0 ± 2.4	Chronic lateral ankle sprains (8.9 ± 1.3 mo, 9.2 ± 1.8 mo)	1. DN and EX (14) 2. EX (13)	Pain during sport (NPRS), FNXL (FAAM)	12 wk	DN		DN	7
Sterling et al[38]	80	41.5 ± 1.1 41.7 ± 12.3	WAD >3 mo (20.6 ± 18.0 mo, 15.9 ± 12.8 mo)	1. DN and EX (40) 2. Sham DN and EX (40)	Pain (VAS), PPT, FNXL (NDI)	6 wk, 12 wk, 6 mo, 12 mo	Not statistically significant	DN at 12 wk	DN at 6 and 12 mo	9
Ziaeifar et al[43]	33	26.50 ± 8.57 30.06 ± 9.87	Trigger points in the UT muscle	1. DN (17) 2. ICT (16)	Pain (VAS), PPT, FNXL (DASH)	1 wk	DN	Not statistically significant	Not statistically significant	4

Abbreviations: ADLs, activities of daily living; DASH, Disabilities of the Arm, Shoulder and Hand questionnaire; DN, dry needling; EX, exercise; FAAM, Foot and Ankle Ability Measure; FXNL, functional outcome; ICT, ischemic compression technique; NDI, Neck Disability Index; NPQ, Neck Pain Questionnaire; NPRS, numeric pain-rating scale; ODI, Oswestry Disability Index; OMT, orthopaedic manual therapy (mobilization); PCS, Pain Catastrophizing Scale; PEDro, Physiotherapy Evidence Database; PENS, percutaneous electrical nerve stimulation therapy; PPT, pressure pain threshold; PT, physical therapy; ROM, range of motion; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; TKA, total knee arthroplasty; UT, upper trapezius; VAS, visual analog scale; WAD, whiplash-associated disorder; WHOQOL-BREF, short form of the World Health Organization Quality of Life Questionnaire; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

**Green, in favor of DN; yellow, not statistically significant; red, in favor of control/sham or other intervention.*

TABLE 2 PEDro Scale Scores for Individual Items*

	Item†											
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total Score**
Arias-Buría et al[2]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	7
Campa-Moran et al[6]	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	6
Casanueva et al[7]	Yes	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4
Edwards and Knowles[12]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Llamas-Ramos et al[24]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Mayoral et al[27]	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	7
Mejuto-Vázquez et al[28]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Pecos-Martín et al[32]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Pérez-Palomares et al[33]	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	6
Salom-Moreno et al[35]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Santos et al[36]	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	Yes	5
Sterling et al[38]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Ziaeifar et al[43]	Yes	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4
Total, n (%)	13 (100)	13 (100)	8 (62)	12 (92)	3 (23)	0 (0)	9 (69)	9 (69)	7 (54)	13 (100)	13 (100)	

Abbreviation: PEDro, Physiotherapy Evidence Database.
**Criterion 1 is not added to the total score, which is out of 10. Median, 7; interquartile range, 2; range, 4 to 9.*
†1, eligibility criteria specified; 2, random allocation; 3, concealed allocation; 4, baseline comparability; 5, blinding of subjects; 6, blinding of therapists; 7, blinding of assessors; 8, more than 85% follow-up; 9, intention-to-treat analysis; 10, reporting of between-group statistical comparisons; 11, reporting of point measures and measures of variability.

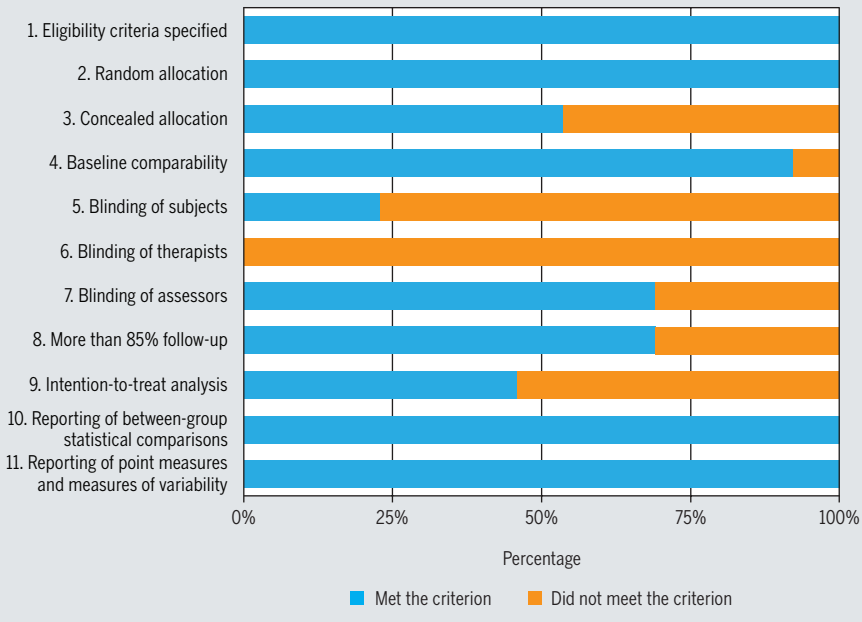


FIGURE 2. Risk-of-bias of the included studies, presented as the percentage that met the PEDro scale criteria. Abbreviation: PEDro, Physiotherapy Evidence Database.

the study should be included. Once study selection was complete, primary authors of included studies were e-mailed and asked if they were aware of any other studies that would satisfy eligibility requirements.

Data Extraction and Quality Assessment

Data extraction was performed by the primary investigator (E.G.), and the data were compiled into a standardized data-extraction form. Data included sample size, diagnosis, inclusion/exclusion criteria, duration of symptoms, type of needling intervention (location, technique, and duration), main outcomes, time to outcome, and harm reported.

Included studies were analyzed by 2 independent reviewers (E.G. and Sebastian Sabadis), using the PEDro (Physiotherapy Evidence Database) quality scale. The PEDro scale is based on 11 criteria, of which 10 contribute to the score, representing methodological quality and risk of bias. The first item is not included in the score, as it relates to external validity of the study. The PEDro scale has been shown to have fair to good interrater reliability, with an intraclass correlation coefficient of 0.55 (95% confidence interval [CI]: 0.41, 0.72)[26] and higher scores indicating higher methodological quality. Disagreements between the review-

TABLE 3 Summary of Findings for Dry Needling Compared to Control/Sham

	Immediate to 12-wk Follow-up			6 to 12 mo	
	Pain	**PPT**	**Functional Outcome**	**Pain**	**Functional Outcome**
Quality assessment					
Studies, n	6	5	5	2	2
Study design	Randomized trials	Randomized trials	Randomized trials	Randomized trials	Randomized trials
Risk of bias	Serious*	Serious*	Serious*	Not serious	Not serious
Inconsistency	Serious†	Serious†	Serious†	Not serious	Not serious
Indirectness	Not serious	Not serious	Not serious	Not serious	Not serious
Imprecision	Not serious	Not serious	Not serious	Serious‡	Serious‡
Other considerations	None	Publication bias strongly suspected§	None	None	Publication bias strongly suspected§
Patients, n					
Dry needling	336	334	268	91	91
Control/sham	325	327	261	85	85
Absolute effect‖	−0.7 (−1.06, −0.34)	0.8 (0.32, 1.27)	−0.44 (−0.85, −0.04)	−0.26 (−0.58, 0.06)	−0.32 (−0.62, −0.02)
Quality	Low	Very low	Low	Moderate	Low

Abbreviation: PPT, pressure pain threshold.
**Greater than 25% of participants from studies with a high risk of bias.*
†Statistically significant heterogeneity.
‡Small sample size (less than 400).
§Asymmetrical funnel plot.
‖Values in parentheses are standardized mean difference (95% confidence interval).

TABLE 4 Summary of Findings for Dry Needling Compared to Other Treatment in the Immediate to 12-Week Follow-up

	Pain	**PPT**	**Functional Outcome**
Quality assessment			
Studies, n	6	4	6
Study design	Randomized trials	Randomized trials	Randomized trials
Risk of bias	Not serious	Not serious	Not serious
Inconsistency	Serious*	Serious*	Serious*
Indirectness	Not serious	Not serious	Not serious
Imprecision	Not serious	Serious†	Serious‡
Other considerations	None	Publication bias strongly suspected§	Publication bias strongly suspected§
Patients, n			
Dry needling	256	232	138
Other treatments	253	230	138
Absolute effect‖	−0.43 (−0.77, −0.10)	0.61 (0.08, 1.14)	−0.01 (−0.49, 0.47)
Quality	Moderate	Very low	Very low

Abbreviation: PPT, pressure pain threshold.
**Statistically significant heterogeneity.*
†Wide confidence intervals.
‡Small sample size (less than 400).
§Asymmetrical funnel plot.
‖Values are standardized mean difference (95% confidence interval).

ers were resolved by consulting another reviewer (Jodi Young) who was blind to previous assessment scores.

Quantitative Data Synthesis and Analysis

Interrater agreement between the reviewers who screened the studies for inclusion was performed using kappa statistics.[21]

Meta-analyses of study outcomes were performed wherever possible using

RevMan (The Nordic Cochrane Centre, Copenhagen, Denmark). For analysis of continuous data, standardized mean differences (SMDs) with 95% CIs were used, as this method has been reported to be more generalizable[39] and allows for assessment of studies utilizing different scales to assess the same outcome. The random-effects model was used to account for variability between studies and its effect on the intervention. The I^2 statistic was used to measure the heterogeneity between trials.[15] An I^2 value of 25% represents a small, 50% a moderate, and 75% a large degree of heterogeneity.[16] Effect size was interpreted using Cohen's criteria for pooled estimates.[8] Cohen described 0.2 as small, 0.5 as moderate, and 0.8 as large effect sizes.[8]

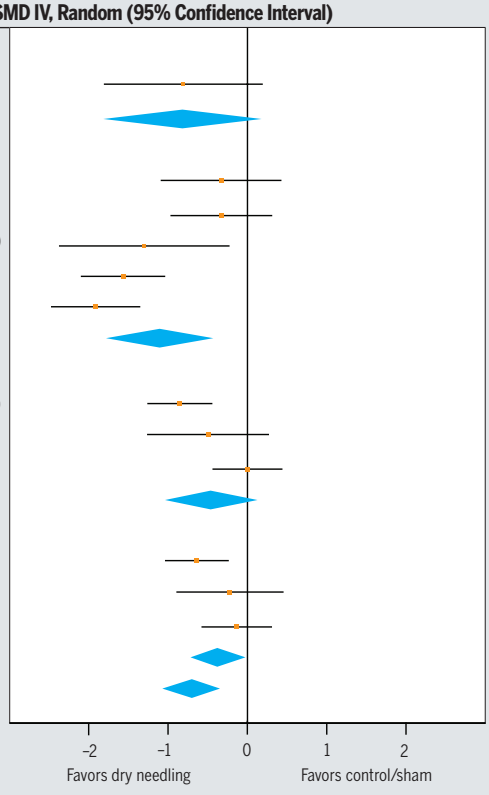
To assess for risk of publication bias, funnel plots were constructed.[22] A symmetrical funnel plot indicates a lower risk of publication bias, whereas an asymmetrical funnel plot indicates a high risk of publication bias.

A 2-point change in pain on a visual analog scale (VAS) ranging from 0 to 10 was considered a clinically meaningful change in pain for between-group comparisons, as this criterion was also used in a previous systematic review of dry needling,[20] enabling comparisons with the previous literature. As we were unable to find evidence describing the minimal clinically important difference for PPT, between-group comparisons were not performed for PPT.

Two reviewers (E.G. and J.C.), using the Grading of Recommendations Assessment, Development and Evalua-

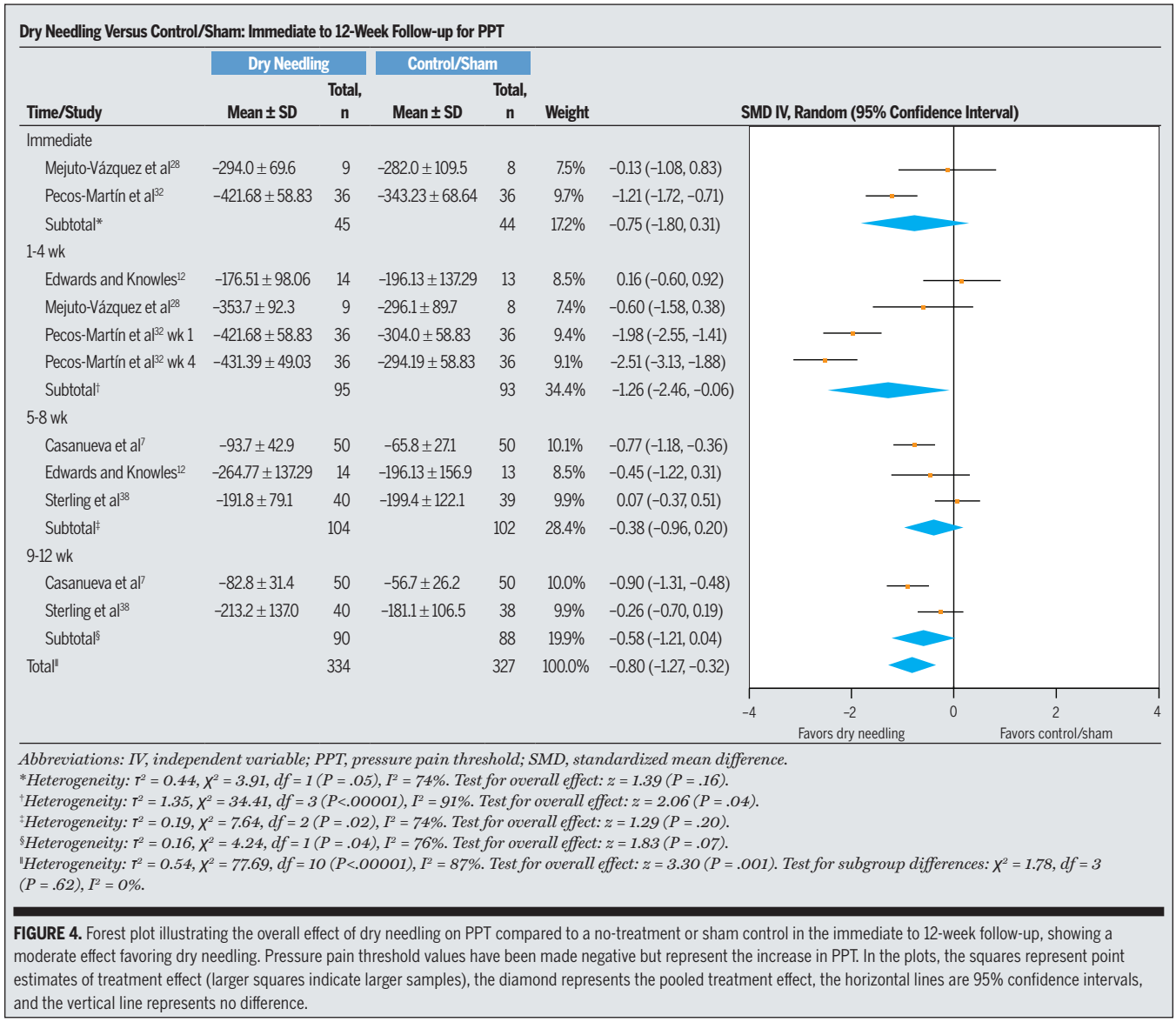
Dry Needling Versus Control/Sham: Immediate to 12-Week Follow-up for Pain

	Dry Needling		Control/Sham			
Time/Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Immediate						
Mejuto-Vázquez et al[28]	3.8 ± 1.9	9	5.5 ± 2.1	8	6.0%	−0.81 (−1.81, 0.19)
Subtotal*		9		8	6.0%	−0.81 (−1.81, 0.19)
1-4 wk						
Edwards and Knowles[12]	13.0 ± 10.2	14	16.5 ± 10.2	13	7.5%	−0.33 (−1.09, 0.43)
Mayoral et al[27]	23.8 ± 24.86	20	32.3 ± 25.72	18	8.3%	−0.33 (−0.97, 0.31)
Mejuto-Vázquez et al[28]	2.0 ± 1.7	9	4.6 ± 2.1	8	5.6%	−1.30 (−2.38, −0.23)
Pecos-Martín et al[32] wk 1	2.6 ± 1.8	36	5.3 ± 1.6	36	9.1%	−1.57 (−2.10, −1.04)
Pecos-Martín et al[32] wk 4	2.1 ± 1.6	36	5.1 ± 1.5	36	8.9%	−1.91 (−2.48, −1.35)
Subtotal†		115		111	39.3%	−1.10 (−1.78, −0.42)
5-8 wk						
Casanueva et al[7]	6.5 ± 2.1	50	8.0 ± 1.3	50	9.9%	−0.85 (−1.26, −0.44)
Edwards and Knowles[12]	9.1 ± 11.6	14	14.9 ± 11.0	13	7.4%	−0.50 (−1.27, 0.27)
Sterling et al[38]	3.2± 2.0	40	3.2 ± 2.3	39	9.7%	0.00 (−0.44, 0.44)
Subtotal‡		104		102	27.0%	−0.45 (−1.03, 0.14)
9-12 wk						
Casanueva et al[7]	6.9 ± 2.3	50	8.1 ± 1.3	50	9.9%	−0.64 (−1.04, −0.24)
Mayoral et al[27]	20.61 ± 21.49	18	25.31 ± 20.03	16	8.1%	−0.22 (−0.90, 0.46)
Sterling et al[38]	3.2 ± 2.1	40	3.5 ± 2.3	38	9.7%	−0.14 (−0.58, 0.31)
Subtotal§		108		104	27.7%	−0.36 (−0.71, −0.02)
Total‖		336		325	100.0%	−0.70 (−1.06, −0.34)



Abbreviations: IV, independent variable; SMD, standardized mean difference.
**Heterogeneity: not applicable. Test for overall effect: z = 1.58 (P = .001).*
†Heterogeneity: τ^2 = 0.47, χ^2 = 20.12, df = 4 (P<.001), I^2 = 80%. Test for overall effect: z = 3.18 (P = .11).
‡Heterogeneity: τ^2 = 0.19, χ^2 = 7.70, df = 2 (P = .02), I^2 = 74%. Test for overall effect: z = 1.51 (P = .13).
§Heterogeneity: τ^2 = 0.03, χ^2 = 2.95, df = 2 (P = .23), I^2 = 32%. Test for overall effect: z = 2.09 (P = .04).
‖Heterogeneity: τ^2 = 0.29, χ^2 = 50.06, df = 11 (P<.001), I^2 = 78%. Test for overall effect: z = 3.84 (P<.001). Test for subgroup differences: χ^2 = 4.00, df = 3 (P = .26), I^2 = 25%.

FIGURE 3. Forest plot illustrating the overall effect of dry needling on pain compared to a no-treatment or sham control in the immediate to 12-week follow-up, showing a moderate effect favoring dry needling. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.



Abbreviations: IV, independent variable; PPT, pressure pain threshold; SMD, standardized mean difference.
**Heterogeneity: $\tau^2 = 0.44$, $\chi^2 = 3.91$, $df = 1$ ($P = .05$), $I^2 = 74\%$. Test for overall effect: $z = 1.39$ ($P = .16$).*
†Heterogeneity: $\tau^2 = 1.35$, $\chi^2 = 34.41$, $df = 3$ ($P<.00001$), $I^2 = 91\%$. Test for overall effect: $z = 2.06$ ($P = .04$).
‡Heterogeneity: $\tau^2 = 0.19$, $\chi^2 = 7.64$, $df = 2$ ($P = .02$), $I^2 = 74\%$. Test for overall effect: $z = 1.29$ ($P = .20$).
§Heterogeneity: $\tau^2 = 0.16$, $\chi^2 = 4.24$, $df = 1$ ($P = .04$), $I^2 = 76\%$. Test for overall effect: $z = 1.83$ ($P = .07$).
‖Heterogeneity: $\tau^2 = 0.54$, $\chi^2 = 77.69$, $df = 10$ ($P<.00001$), $I^2 = 87\%$. Test for overall effect: $z = 3.30$ ($P = .001$). Test for subgroup differences: $\chi^2 = 1.78$, $df = 3$ ($P = .62$), $I^2 = 0\%$.

FIGURE 4. Forest plot illustrating the overall effect of dry needling on PPT compared to a no-treatment or sham control in the immediate to 12-week follow-up, showing a moderate effect favoring dry needling. Pressure pain threshold values have been made negative but represent the increase in PPT. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

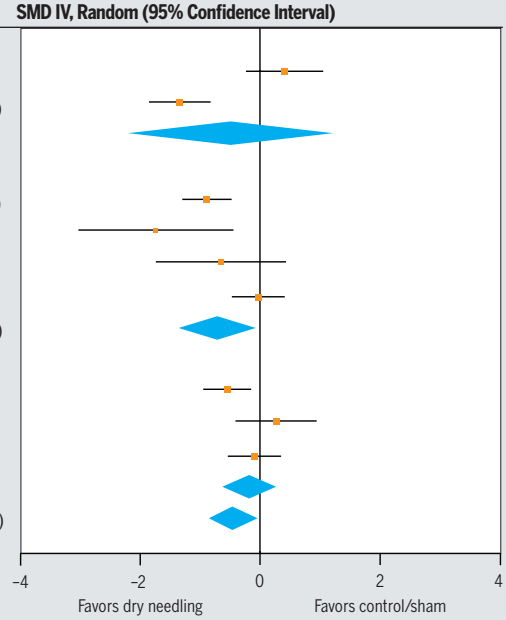
tion (GRADE) approach,[3] performed an analysis of the studies included in each meta-analysis independently. After appraising the evidence, each meta-analysis was classified as 1 of the following levels of evidence to support its findings[14]:

- High-quality evidence: further research is very unlikely to change our confidence in the estimate of effect
- Moderate-quality evidence: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
- Low-quality evidence: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
- Very low–quality evidence: any estimate of effect is very uncertain

Randomized controlled trials began with a high-quality evidence classification but were downgraded based on 5 domains: (1) study design and risk of bias (downgraded if greater than 25% of the participants were from studies with a high risk of bias, which we defined as PEDro scale scores of less than 6); (2) inconsistency of results (downgraded if significant heterogeneity was present on visual inspection or the I^2 value was greater than 50%); (3) indirectness (generalizability of the findings downgraded if greater than 50% of the participants were outside the target group); (4) imprecision (downgraded if fewer than 400 participants were included in the comparison for continuous data); and (5) other (publication bias).[37] We reduced the quality of evidence by 1 level for each domain not met in the comparison to determine the

Dry Needling Versus Control/Sham: Immediate to 12-Week Follow-up for Functional Outcomes

Time/Study	Dry Needling Mean ± SD	Dry Needling Total, n	Control/Sham Mean ± SD	Control/Sham Total, n	Weight	SMD IV, Random (95% Confidence Interval)
1-4 wk						
Mayoral et al[27]	16.94 ± 10.68	20	12.92 ± 8.29	18	11.1%	0.41 (−0.24, 1.05)
Pecos-Martín et al[32] wk 4	9.9 ± 7.4	36	20.4 ± 8.1	36	12.3%	−1.34 (−1.85, −0.83)
Subtotal*		56		54	23.4%	−0.48 (−2.19, 1.24)
5-8 wk						
Casanueva et al[7] 6 wk	−33.6 ± 20.2	50	−17.1 ± 16.6	50	13.3%	−0.89 (−1.30, −0.47)
Santos et al[36] global	−12.1 ± 6.5	7	3.0 ± 9.5	7	6.0%	−1.74 (−3.03, −0.44)
Santos et al[36] physical	−2.0 ± 5.6	7	1.7 ± 5.0	7	7.3%	−0.65 (−1.74, 0.43)
Sterling et al[38] 6 wk	32.2 ± 16.8	40	32.7 ± 16.8	39	13.0%	−0.03 (−0.47, 0.41)
Subtotal†		104		103	39.5%	−0.69 (−1.34, −0.04)
9-12 wk						
Casanueva et al[7] 12 wk	−28.0 ± 23.42	50	−17.1 ± 16.6	50	13.4%	−0.53 (−0.93, −0.13)
Mayoral et al[27] 12 wk	13.82 ± 11.48	18	10.64 ± 10.42	16	10.7%	0.28 (−0.39, 0.96)
Sterling et al[38] 12 wk	30.8 ± 17.1	40	32.1 ± 16.0	38	13.0%	−0.08 (−0.52, 0.37)
Subtotal‡		108		104	37.1%	−0.17 (−0.61, 0.28)
Total§		268		261	100.0%	−0.44 (−0.85, −0.04)



Abbreviations: IV, independent variable; SMD, standardized mean difference.
**Heterogeneity: $\tau^2 = 1.44$, $\chi^2 = 17.28$, $df = 1$ ($P<.0001$), $I^2 = 94\%$. Test for overall effect: $z = 0.55$ ($P = .59$).*
†Heterogeneity: $\tau^2 = 0.28$, $\chi^2 = 11.17$, $df = 3$ ($P = .01$), $I^2 = 73\%$. Test for overall effect: $z = 2.09$ ($P = .04$).
‡Heterogeneity: $\tau^2 = 0.09$, $\chi^2 = 4.86$, $df = 2$ ($P = .09$), $I^2 = 59\%$. Test for overall effect: $z = 0.74$ ($P = .46$).
§Heterogeneity: $\tau^2 = 0.28$, $\chi^2 = 37.40$, $df = 8$ ($P<.00001$), $I^2 = 79\%$. Test for overall effect: $z = 2.14$ ($P = .03$). Test for subgroup differences: $\chi^2 = 1.73$, $df = 2$ ($P = .42$), $I^2 = 0\%$.

FIGURE 5. Forest plot illustrating the overall effect of dry needling on functional outcomes in the immediate to 12-week follow-up compared to no treatment or sham control, showing a small effect favoring dry needling. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

overall quality rating of the evidence for each meta-analysis performed.

RESULTS

Study Selection

The database search returned a total of 218 articles after duplicates were removed. Following title and abstract screening, 88 manuscripts were selected for full-text review. **FIGURE 1** illustrates the flow of papers through the review. After the full review process, 12 studies were selected for inclusion.[2,7,12,24,27,28,32,33,35,36,38,43] After contact with primary authors of included studies, 1 further study was identified for inclusion,[6] resulting in a total of 13 studies. The absolute degree of rater agreement for the first and second stages of the study selection was 86% and 93%, respectively. The chance-corrected degree of agreement was good for screening by title and abstract ($\kappa = 0.717$; 95% CI: 0.629, 0.806) and good for screening by full text ($\kappa = 0.759$; 95% CI: 0.575, 0.943). For the title and abstract screening, the third reviewer resolved 38 disagreements, most commonly over whether the study met the inclusion criteria for dry needling (31%). For the full-text screening, the third reviewer was needed to resolve 3 disagreements, all regarding the type of health practitioner who provided the needling.

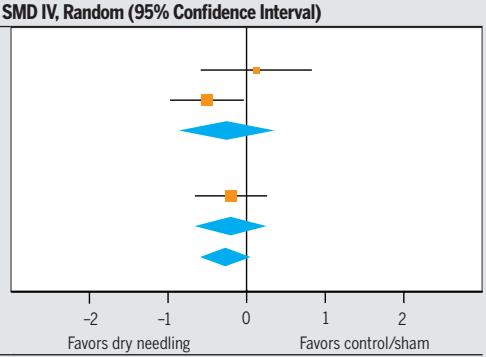
Study Characteristics

This systematic review focused on musculoskeletal pain and included 13 studies: 6 on neck pain (5 on mechanical neck pain[6,24,28,32,43] and 1 on chronic whiplash-associated disorder[38]), 1 on postoperative shoulder pain,[2] 1 on chronic lower back pain,[33] 1 on total knee arthroplasty,[27] 1 on chronic ankle instability,[35] 2 on myofascial pain,[12,36] and 1 on fibromyalgia.[7] Inclusion and exclusion criteria varied greatly across the studies. The characteristics of the 13 studies are included in **TABLE 1**.

The 13 trials in this systematic review included a total of 723 participants. The majority (85%) of the included studies examined the effects of dry needling in participants with chronic musculoskeletal conditions. Two trials (15%) examined dry needling either coinciding with

Dry Needling Versus Control/Sham: 6- to 12-Month Follow-up for Pain

Time/Study	Dry Needling Mean ± SD	Dry Needling Total, n	Control/Sham Mean ± SD	Control/Sham Total, n	Weight	SMD IV, Random (95% Confidence Interval)
6 mo						
Mayoral et al[27]	23.51 ± 22.5	17	20.86 ± 18.58	14	18.9%	0.12 (−0.58, 0.83)
Sterling et al[38]	3.5 ± 2.4	37	4.7 ± 2.3	35	39.8%	−0.50 (−0.97, −0.03)
Subtotal*		54		49	58.7%	−0.25 (−0.85, 0.36)
12 mo						
Sterling et al[38]	2.8 ± 2.4	37	3.3 ± 2.6	36	41.3%	−0.20 (−0.66, 0.26)
Subtotal†		37		36	41.3%	−0.20 (−0.66, 0.26)
Total‡		91		85	100.0%	−0.26 (−0.58, 0.06)

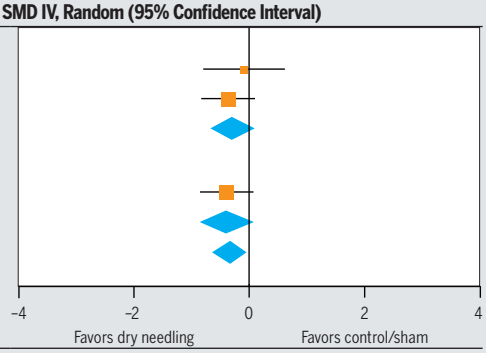


Abbreviation: IV, independent variable; SMD, standardized mean difference.
**Heterogeneity: $\tau^2 = 0.10$, $\chi^2 = 2.10$, $df = 1$ ($P = .15$), $I^2 = 52\%$. Test for overall effect: $z = 0.80$ ($P = .42$).*
†Heterogeneity: not applicable. Test for overall effect: $z = 0.84$ ($P = .40$).
‡Heterogeneity: $\tau^2 = 0.01$, $\chi^2 = 2.24$, $df = 2$ ($P = .33$), $I^2 = 11\%$. Test for overall effect: $z = 1.59$ ($P = .11$). Test for subgroup differences: $\chi^2 = 0.02$, $df = 1$ ($P = .90$), $I^2 = 0\%$.

FIGURE 6. Forest plot illustrating the overall effect of dry needling on pain compared to a no-treatment or sham control in the 6- to 12-month follow-up period, showing a small effect favoring dry needling. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

Dry Needling Versus Control/Sham: 6- to 12-Month Follow-up for Functional Outcomes

Time/Study	Dry Needling Mean ± SD	Dry Needling Total, n	Control/Sham Mean ± SD	Control/Sham Total, n	Weight	SMD IV, Random (95% Confidence Interval)
6 mo						
Mayoral et al[27]	9.7 ± 7.36	17	10.53 ± 11.52	14	17.7%	−0.09 (−0.79, 0.62)
Sterling et al[38]	29.7 ± 17.0	37	36.27 ± 18.9	35	40.9%	−0.36 (−0.83, 0.10)
Subtotal*		54		49	58.6%	−0.28 (−0.67, 0.11)
12 mo						
Sterling et al[38]	27.3 ± 16.5	37	34.1 ± 18.4	36	41.4%	−0.39 (−0.85, 0.08)
Subtotal†		37		36	41.4%	−0.39 (−0.85, 0.08)
Total‡		91		85	100.0%	−0.32 (−0.62, −0.02)



Abbreviations: IV, independent variable; SMD, standardized mean difference.
**Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 0.41$, $df = 1$ ($P = .52$), $I^2 = 0\%$. Test for overall effect: $z = 1.40$ ($P = .16$).*
†Heterogeneity: not applicable. Test for overall effect: $z = 1.63$ ($P = .10$).
‡Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 0.53$, $df = 2$ ($P = .77$), $I^2 = 0\%$. Test for overall effect: $z = 2.12$ ($P = .03$). Test for subgroup differences: $\chi^2 = 0.12$, $df = 1$ ($P = .73$), $I^2 = 0\%$.

FIGURE 7. Forest plot illustrating the overall effect of dry needling on functional outcomes in the 6- to 12-month follow-up compared to no treatment or sham control, showing a small effect favoring dry needling. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

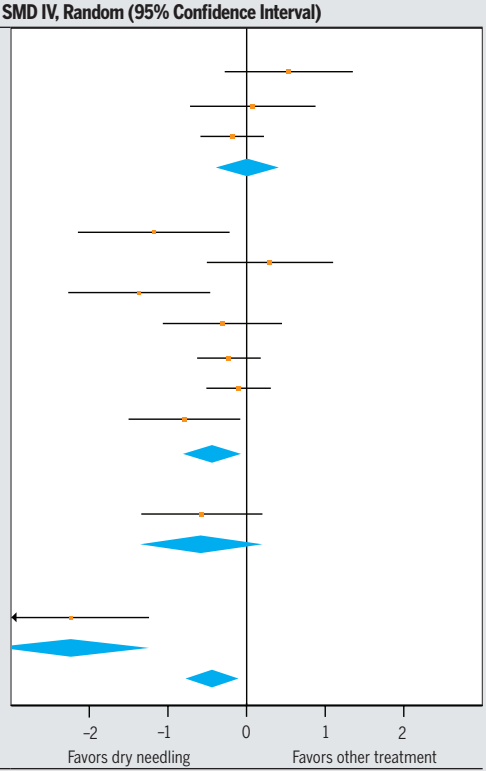
surgical intervention or after surgical intervention.

Two of the studies utilized control groups that did not receive dry needling, 3 used control groups that received sham dry needling, 6 compared dry needling to other treatments, and 2 used a variety of comparison groups (**TABLE 1**). All dry needling and comparison treatments were performed by physical therapists. Follow-up periods ranged widely from immediate to 12 months.

The risk of bias within studies was assessed with PEDro scale scores (**TABLE 2**). The absolute percent of rater agreement for PEDro scale scoring was 94%, and the chance-corrected degree of agreement was very good (κ = 0.863;

Dry Needling Versus Other Treatment: Immediate to 12-Week Follow-up for Pain

Time/Study	Dry Needling Mean ± SD	Dry Needling Total, n	Other Treatment Mean ± SD	Other Treatment Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Immediate						
Campa-Moran et al[6] OMT	39.7 ± 17.8	12	29.8 ± 17.8	12	7.5%	0.54 (−0.28, 1.35)
Campa-Moran et al[6] STT	39.7 ± 17.8	12	38.2 ± 19.2	12	7.6%	0.08 (−0.72, 0.88)
Llamas-Ramos et al[24]	1.9 ± 1.4	47	2.2 ± 1.8	47	11.3%	−0.18 (−0.59, 0.22)
Subtotal*		71		71	26.4%	0.02 (−0.38, 0.41)
1-4 wk						
Arias-Buría et al[2]	−10.28 ± 2.7	10	−7.0 ± 2.6	10	6.4%	−1.19 (−2.15, −0.22)
Campa-Moran et al[6] OMT	13.3 ± 14.8	12	9.4 ± 10.1	12	7.6%	0.30 (−0.51, 1.10)
Campa-Moran et al[6] STT	13.3 ± 14.8	12	34.3 ± 14.8	12	6.8%	−1.37 (−2.28, −0.46)
Edwards and Knowles[12]	13.0 ± 10.2	14	17.1 ± 15.2	13	8.0%	−0.31 (−1.07, 0.45)
Llamas-Ramos et al[24] wk 1	1.3 ± 1.1	47	1.6 ± 1.5	47	11.3%	−0.23 (−0.63, 0.18)
Llamas-Ramos et al[24] wk 2	0.9 ± 0.8	45	1.0 ± 1.1	46	11.2%	−0.10 (−0.51, 0.31)
Ziaeifar et al[43]	1.34 ± 1.93	17	3.05 ± 2.3	16	8.4%	−0.79 (−1.51, −0.08)
Subtotal†		157		156	59.6%	−0.44 (−0.81, −0.07)
5-8 wk						
Edwards and Knowles[12]	9.1 ± 11.6	14	15.2 ± 8.8	13	7.9%	−0.57 (−1.34, 0.20)
Subtotal‡		14		13	7.9%	−0.57 (−1.34, 0.20)
9-12 wk						
Salom-Moreno et al[35]	1.4 ± 1.0	14	3.5 ± 0.8	13	6.2%	−2.24 (−3.23, −1.25)
Subtotal§		14		13	6.2%	−2.24 (−3.23, −1.25)
Total‖		256		253	100.0%	−0.43 (−0.77, −0.10)



Abbreviations: IV, independent variable; OMT, orthopaedic manual therapy (mobilization); SMD, standardized mean difference; STT, soft tissue techniques.
**Heterogeneity: $\tau^2 = 0.03$, $\chi^2 = 2.48$, $df = 2$ ($P = .29$), $I^2 = 19\%$. Test for overall effect: $z = 0.09$ ($P = .93$).*
†Heterogeneity: $\tau^2 = 0.13$, $\chi^2 = 13.46$, $df = 6$ ($P = .04$), $I^2 = 55\%$. Test for overall effect: $z = 2.32$ ($P = .02$).
‡Heterogeneity: not applicable. Test for overall effect: $z = 1.45$ ($P = .15$).
§Heterogeneity: not applicable. Test for overall effect: $z = 4.42$ ($P < .0001$).
‖Heterogeneity: $\tau^2 = 0.22$, $\chi^2 = 33.82$, $df = 11$ ($P < .001$), $I^2 = 67\%$. Test for overall effect: $z = 2.52$ ($P = .01$). Test for subgroup differences: $\chi^2 = 17.64$, $df = 3$ ($P < .001$), $I^2 = 83\%$.

FIGURE 8. Forest plot illustrating the overall effect of dry needling on pain compared to other treatment in the immediate to 12-week follow-up, showing a small effect favoring dry needling. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

95% CI: 0.771, 0.955). The PEDro scale scores for included studies ranged from 4 to 9 (out of a maximum score of 10), with a median score of 7 and an interquartile range of 2 (6-8). None of the trials were able to blind the treating therapist, and only 3 (23%) of the trials were able to blind subjects through the use of sham dry needling. Only 8 (62%) studies included concealed allocation. All studies specified eligibility criteria, randomized patients, provided results of between-group statistical comparisons for at least 1 key outcome, and provided both point measures and measures of variability for at least 1 key outcome. Most studies (n = 12, 92%) scored well on having similar groups at baseline. Nine (69%) of the studies collected measures of at least 1 key outcome from more than 85% of the subjects initially allocated to groups. The risk of bias across studies is displayed in **FIGURE 2**.

TABLES 3 and **4** provide the summary of findings and quality of evidence for all comparisons and outcomes included in this review.

Dry Needling Versus Control/Sham: Immediate to 12-Week Effects

Seven studies[7,12,27,28,32,36,38] examined the immediate to 12-week effects of dry needling, and 6[7,12,27,28,32,38] were able to be grouped for meta-analyses to determine the effect on pain (**FIGURE 3**). There is low-quality evidence suggesting a moderate effect[8] (SMD, −0.7; 95% CI: −1.06, −0.34) favoring dry needling over control/sham. Heterogeneity was high (I^2 = 78%). All 7 studies favored dry needling over control/sham at all assessment points for reducing pain, except for Ster-

ling et al[38] at 6 weeks. The 2 studies with the largest treatment effect were Pecos-Martín et al[32] at 1 and 4 weeks and Mejuto-Vázquez et al[28] at 1 week, with a raw treatment effect size of 2.7, 3.0, and 2.6 on a VAS, respectively, which are considered clinically meaningful changes in pain. The raw treatment effect sizes for the remaining studies[7,12,27,38] on pain (1.7, 0.35, 0.85, 1.5, 0.58, 0, 1.2, 0.47, 0.3) are of questionable clinical meaningfulness (**FIGURE 3**).

Five studies[7,12,28,32,38] examined the immediate to 12-week effects of dry needling on PPT and were able to be meta-analyzed (**FIGURE 4**). There is very low–quality evidence suggesting a moderate effect (SMD, 0.8; 95% CI: 0.32, 1.27) favoring dry needling over control/sham. Heterogeneity was high (I^2 = 87%). On 9 of 11 occasions that PPT was assessed in the 12 weeks after intervention, dry needling increased PPT to a greater degree than control/sham.

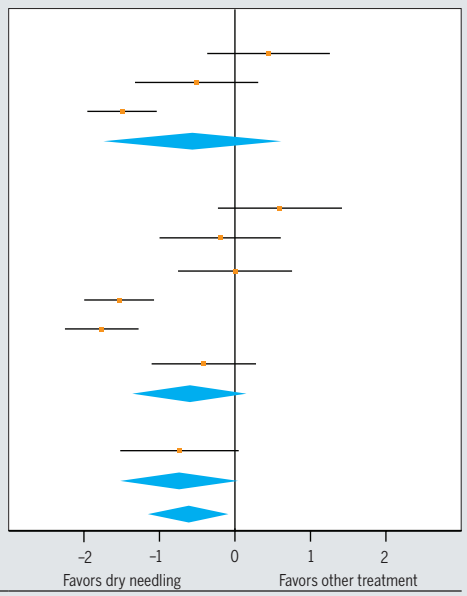
Five studies[7,27,32,36,38] assessed functional outcomes versus control/sham during the immediate to 12-week follow-up (**FIGURE 5**). There is low-quality evidence suggesting a small effect[8] (SMD, −0.44; 95% CI: −0.85, −0.04) favoring dry needling over control/sham. Heterogeneity was high (I^2 = 79%). Three out of the 5 studies (60%) found that dry needling improved functional outcome scores more than control or sham treatment.

Dry Needling Versus Control/Sham: 6- to 12-Month Effects

Two studies[27,38] examined the long-term effect of dry needling and were meta-analyzed to determine effect on pain (**FIGURE 6**). There is moderate-quality evidence suggesting a small effect[8] (SMD, −0.26; 95% CI: −0.58, 0.06) favoring dry needling over control/sham in the long term. The 95% CI crosses the line of no difference, and heterogeneity was low (I^2 = 11%). Two time points analyzed by Sterling et al[38] were in favor of dry needling, whereas that of Mayoral et al[27] was in favor of control/sham. The raw VAS scores in the Sterling et al[38] trial indicate a reduction in pain in favor of dry needling at 6 months of 1.2 points, and at 12

Dry Needling Versus Other Treatment: Immediate to 12-Week Follow-up for PPT

	Dry Needling		Other Treatment			
Time/Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Immediate						
Campa-Moran et al[6] OMT	−231.04 ± 174.55	12	−312.83 ± 181.42	12	9.4%	0.44 (−0.37, 1.26)
Campa-Moran et al[6] STT	−231.04 ± 174.55	12	−155.53 ± 102.97	12	9.4%	−0.51 (−1.32, 0.31)
Llamas-Ramos et al[24]	−326.2 ± 39.5	47	−267.0 ± 39.0	47	11.1%	−1.50 (−1.96, −1.04)
Subtotal*		71		71	29.9%	−0.56 (−1.74, 0.63)
1-4 wk						
Campa-Moran et al[6] OMT	−234.37 ± 178.48	12	−321.65 ± 91.2	12	9.4%	0.59 (−0.23, 1.42)
Campa-Moran et al[6] STT	−234.37 ± 178.48	12	−206.92 ± 65.7	12	9.5%	−0.20 (−1.00, 0.61)
Edwards and Knowles[12]	−176.51 ± 98.06	14	−176.51 ± 107.87	13	9.7%	0.00 (−0.75, 0.75)
Llamas-Ramos et al[24] wk 1	−326.8 ± 49.4	47	−257.6 ± 39.5	47	11.1%	−1.53 (−2.00, −1.07)
Llamas-Ramos et al[24] wk 2	−326.2 ± 39.0	45	−247.3 ± 49.0	46	11.0%	−1.76 (−2.25, −1.28)
Ziaeifar et al[43]	−1611.23 ± 456.98	17	−1421.96 ± 435.42	16	10.0%	−0.41 (−1.10, −0.28)
Subtotal†		147		146	60.6%	−0.60 (−1.35, 0.16)
5-8 wk						
Edwards and Knowles[12]	−264.77 ± 137.29	14	−176.51 ± 88.26	13	9.6%	−0.74 (−1.52, 0.05)
Subtotal‡		14		13	9.6%	−0.74 (−1.52, 0.05)
Total§		232		230	100.0%	−0.61 (−1.14, −0.08)



Abbreviations: IV, independent variable; OMT, orthopaedic manual therapy (mobilization); PPT, pressure pain threshold; SMD, standardized mean difference; STT, soft tissue techniques.

**Heterogeneity: τ^2 = 0.96, χ^2 = 17.85, df = 2 (P<.001), I^2 = 89%. Test for overall effect: z = 0.92 (P = .36).*

†Heterogeneity: τ^2 = 0.78, χ^2 = 42.25, df = 5 (P<.001), I^2 = 88%. Test for overall effect: z = 1.54 (P = .12).

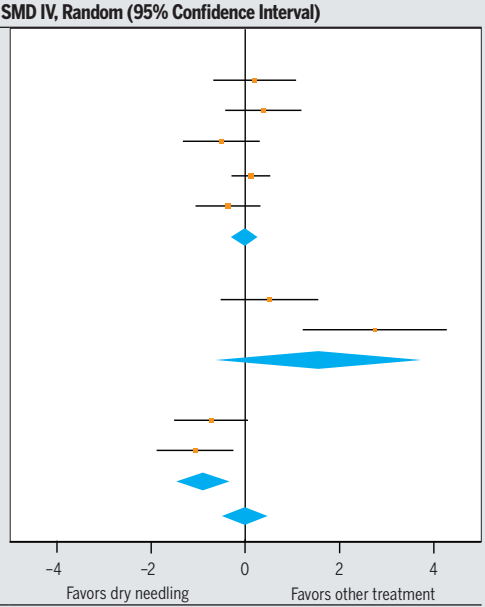
‡Heterogeneity: not applicable. Test for overall effect: z = 1.84 (P = .07).

§Heterogeneity: τ^2 = 0.61, χ^2 = 60.34, df = 9 (P<.001), I^2 = 85%. Test for overall effect: z = 2.25 (P = .02). Test for subgroup differences: χ^2 = 0.09, df = 2 (P = .96), I^2 = 0%.

FIGURE 9. Forest plot illustrating the overall effect of dry needling on PPT compared to other treatment in the immediate to 12-week follow-up, showing a moderate effect favoring dry needling. Pressure pain threshold values in the figure are negative but represent the increase in PPT. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

Dry Needling Versus Other Treatment: Immediate to 12-Week Follow-up for Functional Outcomes

Time/Study	Dry Needling Mean ± SD	Dry Needling Total, n	Other Treatment Mean ± SD	Other Treatment Total, n	Weight	SMD IV, Random (95% Confidence Interval)
1-4 wk						
Arias-Buría et al[2]	−8.0 ± 1.6	10	−8.3 ± 1.3	10	10.8%	0.20 (−0.68, 1.08)
Campa-Moran et al[6] OMT	12.2 ± 5.7	12	10.0 ± 5.5	12	11.4%	0.38 (−0.43, 1.19)
Campa-Moran et al[6] STT	12.2 ± 5.7	12	15.2 ± 5.7	12	11.4%	−0.51 (−1.33, 0.30)
Llamas-Ramos et al[24] wk 2	5.4 ± 3.1	45	5.0 ± 3.7	46	15.0%	0.12 (−0.30, 0.53)
Ziaeifar et al[43]	12.81 ± 10.15	17	16.93 ± 11.59	16	12.5%	−0.37 (−1.06, 0.32)
Subtotal*		96		96	61.2%	0.00 (−0.29, 0.28)
5-8 wk						
Santos et al[36] global	−12.1 ± 6.5	7	−19.7 ± 18.1	8	9.5%	0.51 (−0.53, 1.55)
Santos et al[36] physical	−2.0 ± 5.6	7	−19.8 ± 6.5	8	6.3%	2.75 (1.22, 4.28)
Subtotal†		14		16	15.7%	1.55 (−0.63, 3.74)
9-12 wk						
Salom-Moreno et al[35] ADL	−95.4 ± 5.5	14	−90.6 ± 7.2	13	11.7%	−0.73 (−1.51, 0.05)
Salom-Moreno et al[35] sports	−91.7 ± 9.0	14	−81.0 ± 10.4	13	11.4%	−1.07 (−1.89, −0.25)
Subtotal‡		28		26	23.1%	−0.89 (−1.46, −0.33)
Total§		138		138	100.0%	−0.01 (−0.49, 0.47)



Abbreviations: ADL, activities of daily living; IV, independent variable; OMT, orthopaedic manual therapy (mobilization); SMD, standardized mean difference; STT, soft tissue techniques.
**Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 3.96$, $df = 4$ ($P = .41$), $I^2 = 0\%$. Test for overall effect: $z = 0.01$ ($P = .99$).*
†Heterogeneity: $\tau^2 = 2.05$, $\chi^2 = 5.62$, $df = 1$ ($P = .02$), $I^2 = 82\%$. Test for overall effect: $z = 1.39$ ($P = .16$).
‡Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 0.35$, $df = 1$ ($P = .56$), $I^2 = 0\%$. Test for overall effect: $z = 3.10$ ($P = .002$).
§Heterogeneity: $\tau^2 = 0.36$, $\chi^2 = 26.92$, $df = 8$ ($P<.001$), $I^2 = 70\%$. Test for overall effect: $z = 0.04$ ($P = .97$). Test for subgroup differences: $\chi^2 = 10.02$, $df = 2$ ($P = .007$), $I^2 = 80\%$.

FIGURE 10. Forest plot illustrating the overall effect of dry needling on functional outcomes compared to other treatment, showing no treatment effect of dry needling versus other treatment. In the plots, the squares represent point estimates of treatment effect (larger squares indicate larger samples), the diamond represents the pooled treatment effect, the horizontal lines are 95% confidence intervals, and the vertical line represents no difference.

months of 0.5 points. The raw VAS score at 6 months in the Mayoral et al[27] trial was 0.26 in favor of the control (**FIGURE 6**).

Two studies[27,38] assessed long-term effectiveness of dry needling on functional outcomes versus control/sham (**FIGURE 7**). There is low-quality evidence suggesting a small effect (SMD, −0.32; 95% CI: −0.62, −0.02) favoring dry needling over sham/control. Heterogeneity was low (I^2 = 0%).

Dry Needling Versus Other Treatment: Immediate to 12-Week Effects

Eight studies[2,6,12,24,33,35,36,43] examined the immediate to 12-week effects of dry needling, and 6 were able to be included in meta-analyses to determine the effect on pain (**FIGURE 8**). There is moderate-quality evidence suggesting a small effect[8] (SMD, −0.43; 95% CI: −0.77, −0.10) favoring dry needling over other treatment. Heterogeneity was moderate (I^2 = 67%). On 9 of 12 occasions when pain was assessed, results favored dry needling compared to other treatment (**FIGURE 8**). Only Salom-Moreno et al[35] found a raw effect size on pain of greater than 2 points (2.1) at 12 weeks, in favor of dry needling. All other raw effect sizes on pain are of questionable clinical meaningfulness when compared to other treatments (**FIGURE 8**).

Four studies[6,12,24,43] examined the immediate to 12-week effects of dry needling on PPT compared to other treatments and were meta-analyzed (**FIGURE 9**). There is very low–quality evidence suggesting a moderate effect (SMD, 0.61; 95% CI: 0.08, 1.14) favoring dry needling over other treatment. Heterogeneity was high (I^2 = 85%). On 7 of 10 occasions of measurement, PPT results were in favor of dry needling compared to other treatment.

Six studies[2,6,24,35,36,43] assessed functional outcomes versus other treatment over various periods ranging from 1 week to 12 weeks (**FIGURE 10**). There is very low–quality evidence suggesting no treatment effect (SMD, −0.01; 95% CI: −0.49, 0.47) of dry needling over other treatments. Heterogeneity was moderate (I^2 = 70%). Only 1[35] of the 6 studies (17%) that compared dry needling to other treatment reported that dry needling led to greater improvement in functional outcome.

Publication Bias

Funnel plots were constructed to determine the risk of publication bias in the 8 meta-analyses performed (**FIGURE 11**). The funnel plots for the effects of dry needling versus control/sham on pain for immediate to 12-week follow-up (**FIGURE 11A**), on functional outcomes for immediate to 12-week follow-up (**FIGURE 11C**), on pain for 6- to 12-month follow-up (**FIGURE 11D**), and for the effects of dry needling versus other treatment on pain for immediate to 12-week follow-up (**FIGURE 11F**) are symmetrical, suggesting a lower likelihood of publication bias. However, the asymmetrical funnel plots for PPT (**FIGURES 11B** and **11G**), the effects of dry needling versus control/sham on functional outcomes for 6- to 12-month follow-up (**FIGURE 11E**), and the effects of dry needling versus other treatment on functional outcomes for immediate to 12-week follow-up (**FIGURE 11H**) suggest a possible risk of publication bias.

DISCUSSION

The results of the current systematic review and meta-analyses suggest that there is very low–quality to moderate-quality evidence that dry needling performed by physical therapists is more effective than a no-treatment control or sham dry needling for reducing pain (low-quality evidence; effect size [SMD], −0.7; 95% CI: −1.06, −0.34) and improving PPT

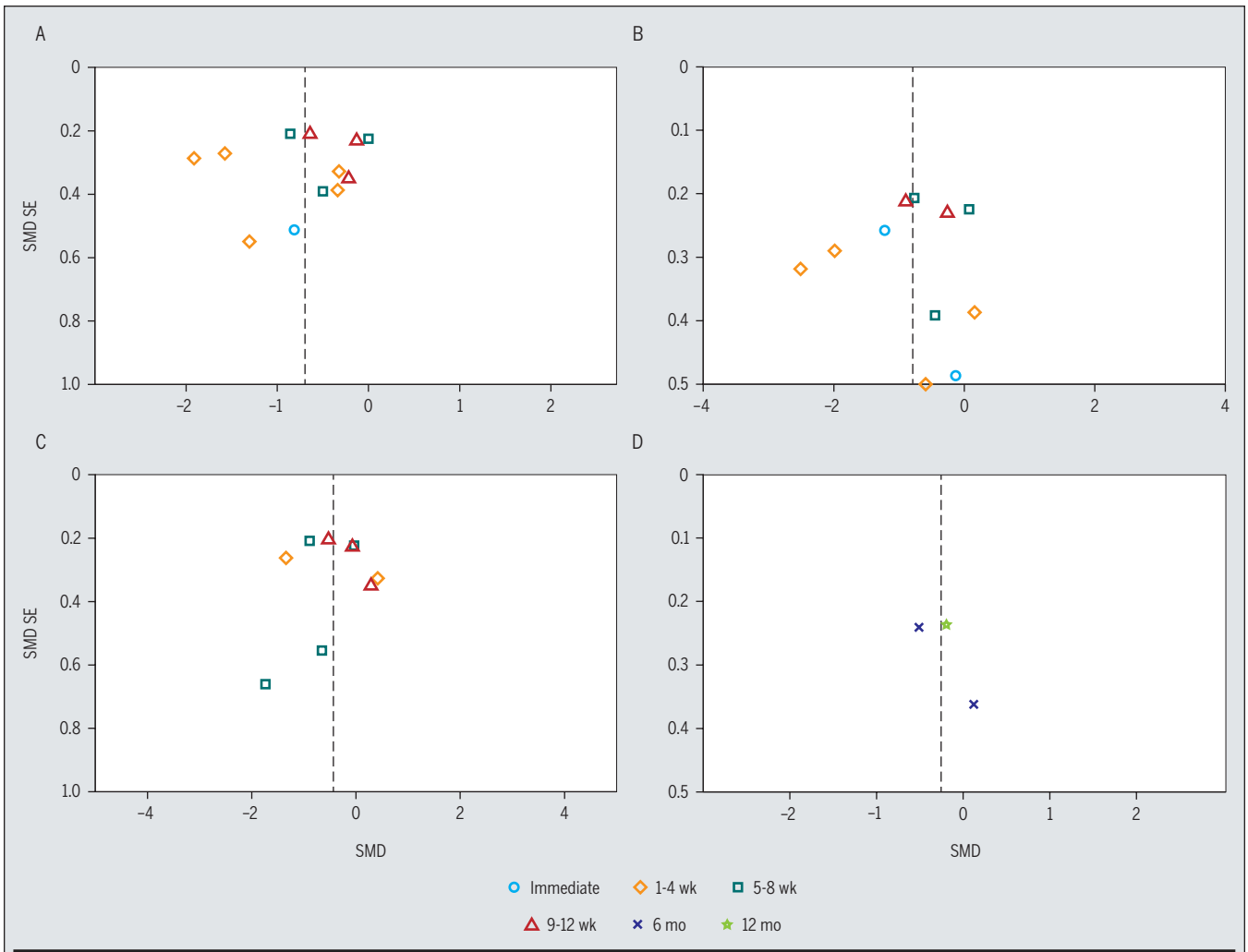


FIGURE 11. Funnel plots for meta-analyses showing (A) dry needling's effect on pain compared to sham or control in the immediate to 12-week follow-up period, (B) dry needling's effect on pressure pain threshold compared to sham or control in the immediate to 12-week follow-up period, (C) dry needling's effect on functional outcomes compared to control/sham in the immediate to 12-week follow-up period, (D) dry needling's effect on pain compared to control/sham in the 6- to 12-month follow-up period, (E) dry needling's effect on functional outcomes compared to control/sham in the 6- to 12-month follow-up period, (F) dry needling's effect on pain compared to other treatment in the immediate to 12-week follow-up period, (G) dry needling's effect on pressure pain threshold compared to other treatment in the immediate to 12-week follow-up period, (H) dry needling's effect on functional outcome compared to other treatment in the immediate to 12-week follow-up period. The shapes indicate at which follow-up time period the outcomes were assessed. Abbreviations: SE, standard error; SMD, standardized mean difference. (*Continues on page 146.*)

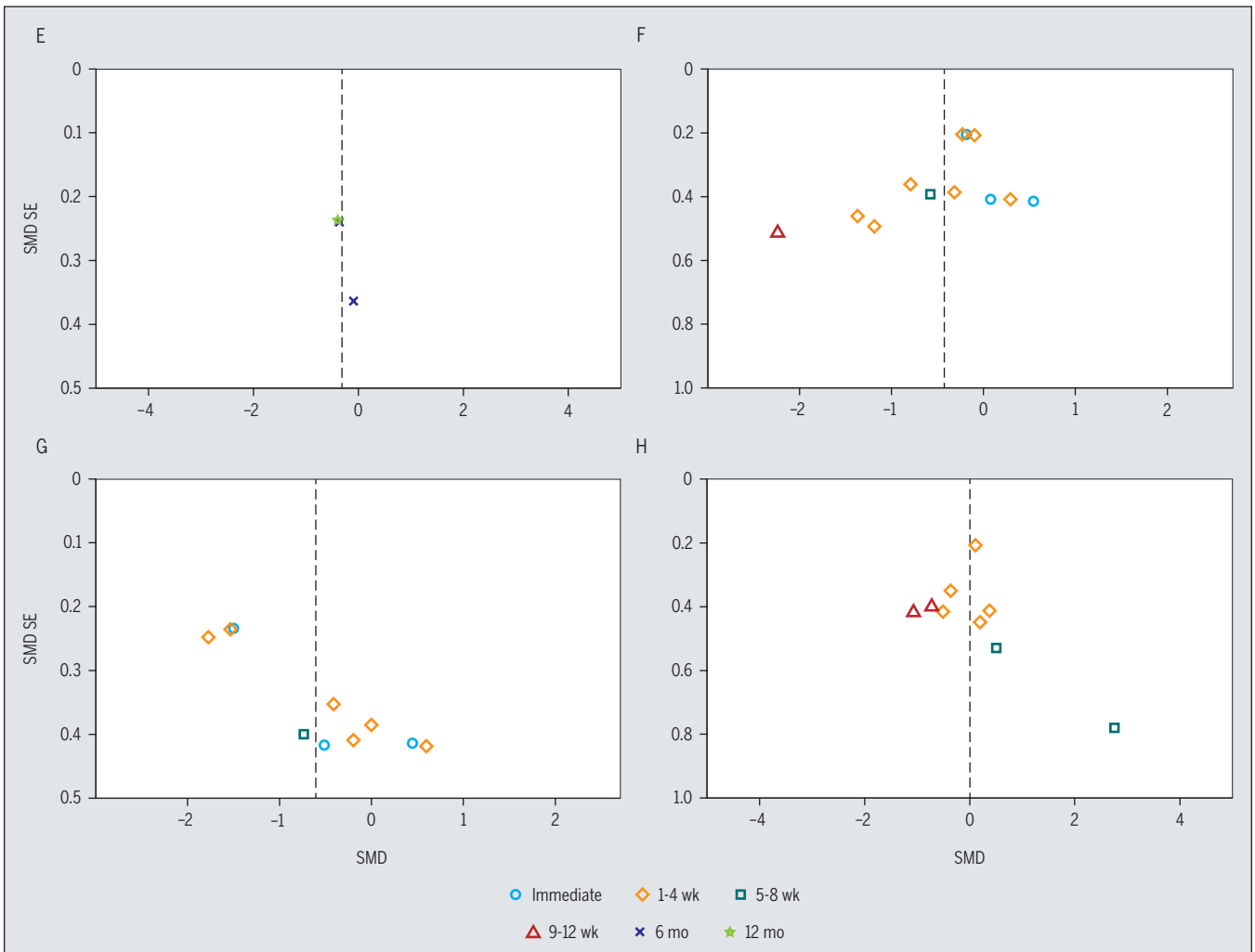


FIGURE 11 (CONTINUED). Funnel plots for meta-analyses showing (A) dry needling's effect on pain compared to sham or control in the immediate to 12-week follow-up period, (B) dry needling's effect on pressure pain threshold compared to sham or control in the immediate to 12-week follow-up period, (C) dry needling's effect on functional outcomes compared to control/sham in the immediate to 12-week follow-up period, (D) dry needling's effect on pain compared to control/sham in the 6- to 12-month follow-up period, (E) dry needling's effect on functional outcomes compared to control/sham in the 6- to 12-month follow-up period, (F) dry needling's effect on pain compared to other treatment in the immediate to 12-week follow-up period, (G) dry needling's effect on pressure pain threshold compared to other treatment in the immediate to 12-week follow-up period, (H) dry needling's effect on functional outcome compared to other treatment in the immediate to 12-week follow-up period. The shapes indicate at which follow-up time period the outcomes were assessed. Abbreviations: SE, standard error; SMD, standardized mean difference.

(very low–quality evidence; effect size [SMD], 0.8; 95% CI: 0.32, 1.27) during the immediate to 12-week follow-up period. During this same immediate to 12-week follow-up period, there was also a small but significant effect for improving functional outcomes (low-quality evidence; effect size [SMD], −0.44; 95% CI: −0.85, −0.04); however, due to the varied outcome tools and musculoskeletal conditions examined, it is not clear whether this treatment effect was clinically meaningful. At all follow-up occasions during the immediate to 12-week period, dry needling showed moderate to large treatment effects on both pain and PPT. On average, within the immediate to 12-week period, the raw treatment effect on pain was 1.27 points better on the VAS in the dry needling group than in the control/sham group. Although this value does not exceed the clinically meaningful change in pain of 2.0,[20] the overall raw effect on pain, combined with the moderate treatment effect observed in the meta-analyses, suggests that dry needling may be more effective when compared to a no-treatment control or sham needling based on low- to moderate-quality evidence.[34] At 6 to 12 months, dry needling appears to be favored when compared to the no-treatment control or sham needling, but the 95% CI crosses the line of no difference, suggesting that this difference between treatments is not significant. Yet, at 6 to 12 months, there

was a small but significant treatment effect in favor of dry needling compared to a no-treatment control or sham needling on functional outcomes. Only 2 studies[27,38] with 6- to 12-month follow-up periods met our inclusion criteria. The lack of studies examining the long-term outcomes of dry needling performed by physical therapists on musculoskeletal pain warrants caution when interpreting these findings. Results of meta-analyses within this review support a statistically significant treatment effect of dry needling for improving pain, PPT, and functional outcomes when compared to no-treatment control or sham treatment during the immediate to 12-week follow-up period. At the 6- to 12-month follow-up periods, the treatment effect is no longer statistically significant for pain and is small and of questionable meaning for functional outcomes.

When dry needling performed by physical therapists is compared to other treatments, primarily soft tissue manual therapy techniques, there is moderate-quality evidence to suggest that it is more effective at reducing pain (effect size [SMD], −0.43; 95% CI: −0.77, −0.10) and very low–quality evidence to suggest that it increases PPT (effect size [SMD], 0.61; 95% CI: 0.08, 1.14) during the immediate to 12-week period. The treatment effect is largest at 4 and 12 weeks in regard to pain and appears to have a moderate treatment effect on PPT when immediate to 12-week results are meta-analyzed. Although the raw effect sizes for pain and PPT compared to other treatments are of questionable clinical meaningfulness, the CI does not cross the no-difference line, suggesting a true treatment effect favoring dry needling. Compared to other treatments, dry needling does not have a significant treatment effect on functional outcomes (very low–quality evidence; effect size [SMD], −0.01; 95% CI: −0.49, 0.47). Yet, it does not appear that there is any significant effect in favor of other interventions that were utilized in the studies included in this review.

To our knowledge, this review is the first to investigate dry needling performed by a single health profession (physical therapy). This improves the generalizability of our findings to physical therapists, and provides evidence that dry needling may be an effective treatment technique when used by physical therapists trained in its use in an appropriate patient for the management of musculoskeletal pain.

The findings of this review are in agreement with those of previous reviews,[4,5,11,20,23,30] in that dry needling may be superior to no treatment or sham needling in reducing pain in the immediate to 12-week follow-up period. Results from this review differ from those of previous reviews[20,23,40] showing an overall treatment effect of dry needling compared to standard care/other treatment; the present review found that dry needling performed by physical therapists provided a small treatment effect compared to other interventions performed by physical therapists for reducing pain and increasing PPT. It is possible that differences between dry needling and other physical therapy interventions were found in the current review because previous reviews[4,5,20,23,31] commonly have compared dry needling to other types of needling (eg, wet needling, which is not performed by physical therapists). In the current review, dry needling was compared to (1) exercise/soft tissue mobilization/joint mobilization for postsurgical shoulder pain,[2] (2) proprioception/strengthening for ankle pain,[35] (3) ischemic compression techniques in 4 studies on neck pain,[6,24,36,43] (4) orthopaedic manual therapy consisting of joint mobilization of the cervical and thoracic spine for neck pain,[6] (5) active stretching for neck pain,[12] and (6) percutaneous electrical nerve stimulation for chronic lower back pain.[33]

Dry needling is a passive modality, and this review suggests that it may be most effective in reducing pain and increasing PPT and functional outcomes in the immediate to 12-week treatment period. When dry needling is utilized in appropriate patients, it may aid in decreasing musculoskeletal pain, allowing for additional, more active physical therapy interventions to maximize functional outcomes and reduce patient disability.

Limitations

This systematic review has some limitations. The included studies were limited to those investigating dry needling performed by physical therapists, which might have excluded articles reporting the effects of dry needling on musculoskeletal pain performed by other practitioners. This was intentional, as the study examined evidence specific to physical therapists performing dry needling. Another limitation is the high heterogeneity in 5 of the 8 meta-analyses performed. This may be explained by the inclusion of studies investigating any type of musculoskeletal pain, where participant samples differed, comparison groups varied, and follow-up times for outcomes were different. The heterogeneity was one of the reasons we elected to use the random-effects model, allowing for improved internal validity of the results. We included all types of musculoskeletal conditions because this is typical of physical therapy clinical practice, where therapists treat a variety of clinical conditions. Also, only studies published in English were included in this review.

Though we only included randomized controlled trials, the actual overall quality of the evidence was considered to be very low to moderate using the GRADE approach. This quality of evidence suggests that further research is likely to have an important effect and is likely to change the estimate; therefore, the findings should be interpreted accordingly. Also, our results are limited to the studies included in the review. The present findings cannot be generalized to different patient populations treated by different practitioners with varied training in dry needling.

CONCLUSION

Based on the GRADE approach,[3] very low– to moderate-quality evidence from studies in a variety of musculoskeletal conditions strongly suggests that dry needling performed by physical therapists is more effective than no treatment or sham dry needling for reducing pain, improving PPT, and improving functional outcomes in the immediate to 12-week follow-up period.

Although findings of this review provide very low– to moderate-quality evidence for the effectiveness of dry needling for reducing pain and improving PPT when compared to other physical therapy interventions during the immediate to 12-week follow-up period, the small effect sizes and the varied study populations and comparison interventions utilized do not support a strong recommendation of dry needling over other physical therapy interventions. For functional outcomes, there was no effect of dry needling compared to other treatments. Further high-quality studies with long-term outcomes are needed to determine the long-term effectiveness of dry needling compared to other commonly utilized physical therapy interventions on musculoskeletal pain, as few of the included studies reported long-term outcomes.

KEY POINTS

FINDINGS: Very low– to moderate-quality evidence suggests that dry needling performed by physical therapists is more effective than no treatment, sham dry needling, or other treatments for reducing pain and improving PPT in patients presenting with musculoskeletal pain in the immediate to 12-week follow-up period. Very low– to low-quality evidence suggests superior outcomes with dry needling for functional outcomes when compared to no treatment or sham needling, but no difference in functional outcomes when compared to other physical therapy treatments. Evidence of the long-term benefit of dry needling is currently lacking.

IMPLICATIONS: Dry needling appears to be at least as effective as other treatments included in this review, and more effective than sham or no treatment for reducing pain and increasing PPT during the immediate to 12-week treatment period in patients with musculoskeletal pain.

CAUTION: The overall quality and limited number of studies reporting on dry needling performed by physical therapists at this time, combined with the high heterogeneity found in the results of the meta-analyses, indicate that readers should use caution when interpreting these results.

ACKNOWLEDGMENTS: *The authors would like to thank Debbie Booth for her advice with search design and Kelly Lavallee, Sebastian Sabadis, PT, and Jodi Young, PT, for their contributions during the study selection and quality assessment.*

REFERENCES

1. Alvarez DJ, Rockwell PG. Trigger points: diagnosis and management. *Am Fam Physician*. 2002;65:653-660.
2. Arias-Buría JL, Valero-Alcaide R, Cleland JA, et al. Inclusion of trigger point dry needling in a multimodal physical therapy program for postoperative shoulder pain: a randomized clinical trial. *J Manipulative Physiol Ther*. 2015;38:179-187. https://doi.org/10.1016/j.jmpt.2014.11.007
3. Balshem H, Helfand M, Schünemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol*. 2011;64:401-406. https://doi.org/10.1016/j.jclinepi.2010.07.015
4. 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;23:276-293. https://doi.org/10.1179/2042618615Y.0000000014
5. Cagnie B, Castelein B, Pollie F, Steelant L, Verhoeyen 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;94:573-583. https://doi.org/10.1097/PHM.0000000000000266
6. Campa-Moran I, Rey-Gudin E, Fernández-Carnero J, et al. Comparison of dry needling versus orthopedic manual therapy in patients with myofascial chronic neck pain: a single-blind, randomized pilot study. *Pain Res Treat*. 2015;2015:327307. https://doi.org/10.1155/2015/327307
7. Casanueva B, Rivas P, Rodero B, Quintial C, Llorca J, González-Gay MA. Short-term improvement following dry needle stimulation of tender points in fibromyalgia. *Rheumatol Int*. 2014;34:861-866. https://doi.org/10.1007/s00296-013-2759-3
8. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
9. Dommerholt J, Bron C, Franssen J. Myofascial trigger points: an evidence-informed review. *J Man Manip Ther*. 2006;14:203-221. https://doi.org/10.1179/106698106790819991
10. Dommerholt J, Grieve R, Layton M, Hooks T. An evidence-informed review of the current myofascial pain literature – January 2015. *J Bodyw Mov Ther*. 2015;19:126-137. https://doi.org/10.1016/j.jbmt.2014.11.006
11. 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;19:252-265. https://doi.org/10.1179/108331913X13844245102034
12. Edwards J, Knowles N. Superficial dry needling and active stretching in the treatment of myofascial pain – a randomised controlled trial. *Acupunct Med*. 2003;21:80-86.
13. Furlan AD, van Tulder M, Cherkin D, et al. Acupuncture and dry-needling for low back pain: an updated systematic review within the framework of the Cochrane Collaboration. *Spine (Phila Pa 1976)*. 2005;30:944-963.
14. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336:924-926. https://doi.org/10.1136/bmj.39489.470347.AD
15. Higgins JP, Green S. *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*. Oxford, UK: The Cochrane Collaboration; 2011.
16. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327:557-560. https://doi.org/10.1136/bmj.327.7414.557
17. Hsieh YL, Kao MJ, Kuan TS, Chen SM, Chen JT, Hong CZ. Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. *Am J Phys Med Rehabil*. 2007;86:397-403. https://doi.org/10.1097/PHM.0b013e31804a554d
18. Huguenin L, Brukner PD, McCrory P, Smith P, Wajswelner H, Bennell K. Effect of dry needling of gluteal muscles on straight leg raise: a randomised, placebo controlled, double blind trial. *Br J Sports Med*. 2005;39:84-90. https://doi.org/10.1136/bjsm.2003.009431
19. 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;99:83-89. https://doi.org/10.1016/S0304-3959(02)00062-3
20. Kietrys DM, Palombaro KM, Azzaretto E, et al. Effectiveness of dry needling for upper-quarter myofascial pain: a systematic review and meta-analysis. *J Orthop Sports Phys Ther*. 2013;43:620-634. https://doi.org/10.2519/jospt.2013.4668
21. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159-174.
22. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ*. 2009;339:b2700. https://doi.org/10.1136/bmj.b2700
23. 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*. 2015;96:944-955. https://doi.org/10.1016/j.apmr.2014.12.015
24. Llamas-Ramos R, Pecos-Martín 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;44:852-861. https://doi.org/10.2519/jospt.2014.5229
25. Lucas N, Macaskill P, Irwig L, Moran R, Bogduk N. Reliability of physical examination for diagnosis of myofascial trigger points: a systematic review of the literature. *Clin J Pain*. 2009;25:80-89. https://doi.org/10.1097/AJP.0b013e31817e13b6
26. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. *Phys Ther*. 2003;83:713-721.
27. Mayoral O, Salvat I, Martín 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. https://doi.org/10.1155/2013/694941
28. Mejuto-Vázquez MJ, Salom-Moreno J, Ortega-Santiago R, Truyols-Domínguez S, Fernández-de-las-Peñas 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;44:252-260. https://doi.org/10.2519/jospt.2014.5108
29. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6:e1000097. https://doi.org/10.1371/journal.pmed.1000097
30. 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;11:1-14.
31. 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;18:390-398. https://doi.org/10.1016/j.jbmt.2013.11.009
32. Pecos-Martín D, Montañez-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;96:775-781. https://doi.org/10.1016/j.apmr.2014.12.016
33. Pérez-Palomares S, Oliván-Blázquez B, Magallón-Botaya R, et al. Percutaneous electrical nerve stimulation versus dry needling: effectiveness in the treatment of chronic low back pain. *J Musculoskelet Pain*. 2010;18:23-30. https://doi.org/10.3109/10582450903496047
34. Sackett DL, Straus SE, Richardson WS. *Evidence-Based Medicine: How to Practice and Teach EBM*. 2nd ed. Edinburgh, UK: Churchill Livingstone; 2000.
35. Salom-Moreno J, Ayuso-Casado B, Tamaral-Costa B, Sánchez-Milá Z, Fernández de-las-Peñas C, Alburquerque-Sendín F. Trigger point dry needling and proprioceptive exercises for the management of chronic ankle instability: a randomized clinical trial. *Evid Based Complement Alternat Med*. 2015;2015:790209. https://doi.org/10.1155/2015/790209
36. Santos RB, Carneiro MI, Oliveira DM, Maciel AB, Monte-Silva KK, Araújo MG. Impact of dry needling and ischemic pressure in the myofascial syndrome: controlled clinical trial. *Fisioter Mov*. 2014;27:515-522. https://doi.org/10.1590/0103-5150.027.004.AO03
37. Saragiotto BT, Maher CG, Yamato TP, et al. Motor control exercise for nonspecific low back pain: a Cochrane Review. *Spine (Phila Pa 1976)*. 2016;41:1284-1295. https://doi.org/10.1097/BRS.0000000000001645
38. 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;156:635-643. https://doi.org/10.1097/01.j.pain.0000460359.40116.c1
39. Takeshima N, Sozu T, Tajika A, Ogawa Y, Hayasaka Y, Furukawa TA. Which is more generalizable, powerful and interpretable in meta-analyses, mean difference or standardized mean difference? *BMC Med Res Methodol*. 2014;14:30. https://doi.org/10.1186/1471-2288-14-30
40. Tough EA, White AR. Effectiveness of acupuncture/dry needling for myofascial trigger point pain. *Phys Ther Rev*. 2011;16:147-154. https://doi.org/10.1179/1743288X11Y.0000000007
41. Tsai CT, Hsieh LF, Kuan TS, Kao MJ, Chou LW, Hong CZ. Remote effects of dry needling on the irritability of the myofascial trigger point in the upper trapezius muscle. *Am J Phys Med Rehabil*. 2010;89:133-140. https://doi.org/10.1097/PHM.0b013e3181a5b1bc
42. Venâncio RA, Alencar FG, Zamperini C. Different substances and dry-needling injections in patients with myofascial pain and headaches. *Cranio*. 2008;26:96-103. https://doi.org/10.1179/crn.2008.014
43. Ziaeifar M, Arab AM, Karimi N, Nourbakhsh MR. The effect of dry needling on pain, pressure pain threshold and disability in patients with a myofascial trigger point in the upper trapezius muscle. *J Bodyw Mov Ther*. 2014;18:298-305. https://doi.org/10.1016/j.jbmt.2013.11.004

APPENDIX

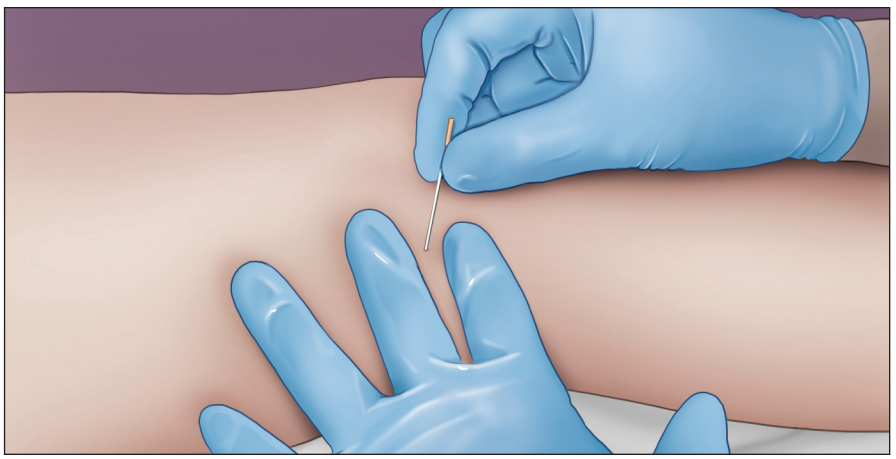
SEARCH STRATEGY FOR MEDLINE

1	Dry needl*.mp
2	intramuscular adj3 stimulation
3	or 1-2
4	random*.tw.
5	group*.tw.
6	trial.tw
7	randomized controlled trial.pt
8	controlled clinical trial.pt
9	or 4-8
10	3 and 9
11	Limit to humans

Trigger Point Dry Needling

J Orthop Sports Phys Ther 2017;47(3):150. doi:10.2519/jospt.2017.0502

Increasingly, physical therapists in the United States and throughout the world are using dry needling to treat musculoskeletal pain, even though this treatment has been a controversial addition to practice. To better generalize to physical therapy practice the findings about dry needling thus far, the authors of a study published in the March 2017 issue of *JOSPT*[1] identified the need for a systematic review examining the effectiveness of dry needling performed by physical therapists on people with musculoskeletal pain. Their review offers a meta-analysis of data from several included studies and assesses the evidence for risks of bias.



EVIDENCE SHOWS SHORT-TERM EFFECTIVENESS. The available evidence suggests that dry needling helps reduce pain, increases pressure pain threshold, and improves function in the immediate to 12-week treatment period for patients with musculoskeletal pain.

BOTTOM LINE FOR PRACTICE

The results of this systematic review indicate that dry needling may be an effective intervention for appropriate patients with musculoskeletal pain. At the same time, the very low to moderate quality of the evidence limits the strength of conclusions that can be drawn, and optimal treatment techniques and dosing are not known. Dry needling appears to be more effective than sham, control, or other assessed treatments for improving pressure pain threshold, and more effective than sham or control for reducing pain in the short term. However, dry needling is neither more successful than other assessed treatments beyond 12 weeks nor more helpful for improving functional outcomes.

WHAT WE KNEW

Previous reviews support the effectiveness of dry needling on reducing pain when compared to sham or placebo treatments, but are not specific to dry needling performed by physical therapists.

WHAT WE ASKED

"Is dry needling delivered by a physical therapist an effective treatment for reducing pain, improving pressure pain threshold, and improving functional outcomes for patients with musculoskeletal pain?"

WHAT WE FOUND

The authors scrutinized 13 randomized controlled studies that examined the effectiveness of dry needling on musculoskeletal pain. They found that, to date, most of the evidence is of very low to moderate quality. There are also risks of bias in the available research. Further, very little evidence exists regarding the longer-term benefits of dry needling, or that guides optimal treatment techniques and dosing.

WHAT WE KNOW NOW

At present, only a small number of trials have examined dry needling in physical therapy, and these are of very low to moderate quality. When considering data from physical therapist practice and compared with sham or no treatment, dry needling appears to be effective for reducing pain, increasing pressure pain threshold, and improving function during the immediate to 12-week treatment period in patients with musculoskeletal pain, but not during the longer term. Further, dry needling seems no more helpful than other treatments included in this review for improving function—treatments such as exercise/soft tissue mobilization/joint mobilization, proprioception/strengthening, ischemic compression techniques, orthopaedic manual therapy, active stretching, and percutaneous electrical nerve stimulation. More rigorous research is needed to confirm the efficacy of dry needling overall, and to investigate its longer-term effectiveness.

REFERENCE

1. 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;47:133-149. https://doi.org/10.2519/jospt.2017.7096

This *JOSPT* Perspectives for Practice was based on an article by Gattie et al[1] and was produced by a team of *JOSPT*'s Special Features Editorial Board and staff, led by co-editors Kathryn Sibley, PhD, and Linda Li, PT, PhD, and by Editor-in-Chief J. Haxby Abbott, DPT, PhD, FNZCP, using material contributed by the authors of the original research report.[1]