Local Anesthetic Injections for the Short-Term Treatment of Head and Neck Myofascial Pain Syndrome: A Systematic Review with Meta-Analysis

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Submitted July 05, 2018;
accepted September 13, 2018.

Aims: To evaluate the effectiveness of local anesthetic trigger point injections in adults with myofascial pain syndrome (MPS) in the head, neck, and shoulder regions compared to dry needling, placebo, and other interventions. **Methods:** Randomized controlled trials using local anesthetic injections in adults diagnosed with MPS were included. The Cochrane Library, MEDLINE via PubMed, Web of Science, and EMBASE libraries were searched. The primary outcome was pain measured with a 0 to 10 visual analog scale (VAS). Secondary outcomes included pain threshold, range of cervical motion, depression scale, and pressure pain intensity (PPI) score. Risk of bias was analyzed based on Cochrane's handbook. **Results:** The initial search strategy yielded 324 unduplicated references up to April 1, 2018. A total of 15 RCTs were included, with 884 adult patients diagnosed with MPS. Meta-analysis showed a significant improvement in VAS pain scale of 1.585 units at 1 to 4 weeks in the local anesthetic group compared to the dry needling group (95% confidence interval –2.926 to –.245; $P = .020$). However, when only including double-blinded studies, the effect was not statistically significant ($P = .331$). There was also a significant improvement in pain of 0.767 units with local anesthetic at 2 to 8 weeks compared to placebo (95% confidence interval –1.324 to –0.210; $P = .007$). No statistically significant differences were found in other secondary outcomes between local anesthetic and all other interventions. **Conclusion:** Though local anesthetics provided a significant improvement in pain compared to dry needling, evidence was of low quality, and sensitivity analyses including only double-blinded studies provided no statistically significant difference. Additional studies are needed to confirm these results. *J Oral Facial Pain Headache 2019;33:183–198. doi: 10.11607/ofph.2277*

Keywords: *dry needling, local anesthetic, meta-analysis, myofascial pain, myofascial trigger points, systematic review, visual analog scale*

Myofascial pain syndrome (MPS) is a persistent musculoskeletal pain disorder with a prevalence ranging from 21% in orthopedic clinics to 30% in practices devoted to the treatment of temporomandibular disorders (TMD) and up to 95% in specialized pain management centers.[1–3] In 2016, the prevalence of MPS in the US general population was estimated to be 13.8%.[4] The exact cause of MPS is unknown.[5,6] Accidents, injuries, postural imbalance, psychologic stressors, surgeries, and over- or underuse of muscles are some contributing factors.[1] The complexity of this condition, as well as a lack of understanding of this disorder and training by health care professionals, can lead to failure in diagnosis, the use of unnecessary laboratory and imaging approaches, or even in some cases inappropriate interventions that might aggravate the condition.[7]

The head, neck, and shoulder regions are considered the most common regions for development of chronic myofascial pain, and female individuals are at higher risk than male individuals.[7,8] The main contributing factors are poor posture, TMJ disorders, and physical, social, behavioral, and emotional conditions.[9,10] MPS is characterized by deep aching pain arising from focally tender spots in a taut band of muscle called trigger points (TrPs).[1,11] Palpation of these TrPs causing a duplicating pain pattern is crucial in the diagnosis of the condition.[1,12] The treatment of MPS is complex and usually requires a multidisciplinary approach.[13]

Systemic and topical medications, muscle exercises, oral appliances, transcutaneous electrical nerve stimulation (TENS), biofeedback, and posture correction are some of the modalities for MPS treatment.[1,3,14] In addition, TrP injections have proven to be one of the most effective treatments,[15] decreasing pain and muscle spasms and increasing range of motion.[16] TrP injections include local anesthetic, saline, steroid, botulinum toxin, and dry needling techniques.[3,16] Fenz was the first to recommend using local anesthetic in the treatment of MPS in 1938.[17] Usually a clinician will utilize TrP injections after failure of noninvasive treatment modalities such as patient education, change in lifestyle, physical therapy, and medications.[5] The mechanism of action of local anesthetic TrP injections is either due to micro-irritation arising from the mechanical needling at the TrP site or due to the action of local anesthetics (pharmacologic effect).[2,5,15,17,18] In the micro-irritation view, pain suppression occurs due to neurologic inhibition secondary to an injection-induced micro-irritation/injury.[1] The injection triggers an inhibition via both a short-term (endogenous opioid) and longer-term (segmental inhibition) reaction. The key to the pain suppression is needling the center of the TrP and daily stretching of the taut band after the injection.[1] The mechanism of action of local anesthetics (pharmacologic effect) is the blocking of sodium ions from leaving the nerve cell, thereby preventing depolarization or propagation of an action potential.[2,9] In the literature, there are multiple studies[14–16,27] about the benefits and superiority of different TrP treatment modalities, but none have compared the use of local anesthetic TrP injections in the head, neck, and shoulder regions to dry needling, placebo, and other interventions. Therefore, the aim of this systematic review was to compare the effectiveness of local anesthetic TrP injections in the head, neck, and shoulder regions to dry needling, placebo, and other interventions in the treatment of MPS.

Materials and Methods

This systematic review adheres to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[19] The PICOS (population, intervention, comparison, outcome, setting) question was: In adult patients with MPS in the head, neck, or shoulder region, do TrP injections with local anesthesia compared to dry needling, placebo, and other interventions have an effect on posttreatment pain intensity, pain pressure threshold associated with applied pressure (algometer), range of motion, depression, and/or quality of life? The setting was hospital or university clinical care center or a community-based facility.

Inclusion and Exclusion Criteria

Studies were limited to publications in English of randomized controlled trials (RCT) on the efficacy of local anesthetic injections in adult patients with at least one active TrP defined as MPS based on Travell and Simons' criteria.[20,21] Patients had active taut bands with referred pain in the head, neck, and upper shoulder regions, including the following skeletal muscles: masseter, temporalis, lateral pterygoid, trapezius, occipital, sternocleidomastoid, rhomboideus supraspinatus muscles, infraspinatus muscles, suprascapular muscle, teres minor, splenius capitis, and semispinalis capitis muscles. Control groups included saline injection (placebo), dry needling/acupuncture, lidocaine plus hyaluronidase, or other comparison groups. The primary outcome measure was pain assessed with a visual analog scale (VAS). Secondary outcomes included pain threshold associated with applied pressure, measured using algometry (pressure pain threshold [PPT]),[2,5,15,18] range of motion in degrees, and depression scale.

Search Methods for Identification of Studies

Four electronic databases were searched using the following strategies.

- MEDLINE via PubMed (searched on 3/20/2017) limited to English language and Humans:
- ("Myofascial Pain Syndromes" [Mesh] OR myofascial pain syndrome* OR regional chronic myalgic disorder* OR trigger point* myalgia OR myofascial trigger point pain OR myofascial pain dysfunction OR masticatory muscle pain OR myogenous) AND (trigger point injection [MeSH Terms] OR trigger area injection OR taut band injection OR local anesthetic injection OR lidocaine injection OR bupivacaine injection OR procaine injection OR local anesthesia) AND (temporomandibular OR temporo-mandibular OR TMD OR TMJ OR masseter OR temporalis OR muscle* mastication OR jaw OR facial OR orofacial OR head OR neck OR trapezius OR sternocleidomastoid or sternomastoid or SCM or pericranial)
- Filters: Language: Limit to English
- Species: Limit to Humans
- The Web of Science and the Cochrane Library (searched on 3/20/2017) search strategy was:
- (Myofascial pain syndrome OR regional chronic myalgic disorder* OR trigger point myalgia OR myofascial trigger point pain OR myofascial pain dysfunction OR masticatory muscle pain OR myogenous) AND (trigger point injection OR trigger area injection OR taut band injection OR local anesthetic injection OR lidocaine injection OR bupivacaine injection OR

procaine injection OR local anesthesia) AND (temporomandibular OR temporo-mandibular OR masseter OR temporalis OR muscle mastication or muscles of mastication OR jaw OR facial OR orofacial OR head OR neck OR trapezius OR sternocleidomastoid OR sternomastoid OR pericranial)
- EMBASE Library (searched on 3/20/2017) search strategy:
- #1: 'myofascial pain' OR 'myofascial trigger point' OR (myogenous AND pain)
- #2: 'trigger point injection' OR 'local anesthetic agent' OR 'local anesthesia' OR 'lidocaine' OR 'lidocaine anesthesia and analgesia' OR 'bupivacaine' OR 'procaine'
- #3: 'temporomandibular joint disorder' OR 'temporomandibular joint' OR 'masticatory muscle' OR 'masseter muscle' OR 'temporalis muscle' OR 'jaw' OR 'face' OR 'orofacial pain' OR 'trapezius muscle' OR 'sternocleidomastoid muscle' OR 'pericranial'
- #4: #1 and #2 and #3

The search was performed again on April 1, 2018, in all four databases. No new relevant references were found.

Data Collection and Analysis

All the articles selected by the search strategies listed above were screened by three authors (E.N., J.D., B.K.). Duplicates were omitted. Titles and abstracts of all papers were reviewed according to the inclusion and exclusion criteria. If a consensus among the three reviewers was not met, the full article was then reviewed by all three. If disagreement still existed after reviewing the full article, final inclusion was decided by a fourth author (R.E.). The bibliography sections of all reviews, systematic reviews, and clinical guidelines from the original search, as well as all eligible RCTs, were scanned by the same three authors for any additional relevant references. Any new applicable study not in the initial search results was submitted to the same inclusion/exclusion criteria and then reviewed by the same three authors. If there was a disagreement, the full text was reviewed, with a fourth author (R.E.) making the final decision.

Data Extraction and Management

Three authors (E.N., J.D., B.K.) independently extracted data from the full-text articles of eligible studies. The data extracted included demographics of the participants, control group, intervention group, method of intervention, and the outcome of the results. Any disagreement regarding the data and information extracted between the three authors (E.N., J.D., B.K.) was resolved by a fourth review author (R.E.).

Assessment of Risk of Bias in Included Studies

The assessment of risk of bias for each included RCT was undertaken independently by two out of three reviewers (E.N., J.D., B.K.) and reviewed by the third author as part of the data extraction process and in accordance with the approach described in the Cochrane Handbook.[22]

Statistical Analyses

Only RCTs on local anesthetic injections for treatment of MPS were included. Due to the heterogeneity of the comparison groups, separate meta-analyses were conducted for local anesthetic outcomes compared to dry needling, placebo, or other interventions. Treatment effects were calculated to compare the results across studies. When authors reported medians and ranges, the results were converted to means and standard deviations (SD) using the following formulas: mean = median; SD = IQR/4; IQR = max range – min range. When authors reported the standard error of the mean (SEM), results were converted to standard deviations (SD = SEM * sqrt[N]), with N the sample size in that intervention group. For all outcomes (VAS pain, PPT, depression scale, and range of motion in mm), treatment effects were expressed as difference in means (DM) with 95% confidence interval (CI). Statistical heterogeneity was tested with Cochran Q test[23] and the I^2 statistic.[24] Estimates of effect were combined with a random-effects model if there was heterogeneity (Q test $P < .10$), or with the fixed-effects model otherwise. All statistical analyses were performed using Comprehensive Meta-Analysis version 3 software (Biostat). Subgroup analyses for each comparison group (dry needling, placebo, and other interventions) were performed. Sensitivity analyses including only double-blinded studies were also performed.

Quality of the Evidence

Quality of evidence assessment and summary of the findings were conducted using the software GRADE profiler (GRADEpro), following the Cochrane Collaboration and GRADE Working Group.[22]

Results

Results of the Search

The initial search strategy yielded 324 unduplicated references (including 9 references that were the result of cross-referencing the original titles). The records were assessed independently by three review authors, and based on the abstracts and titles, these were reduced to 34 relevant manuscripts. The main reasons for exclusion for those 290 references were that the intervention was not a local anesthetic

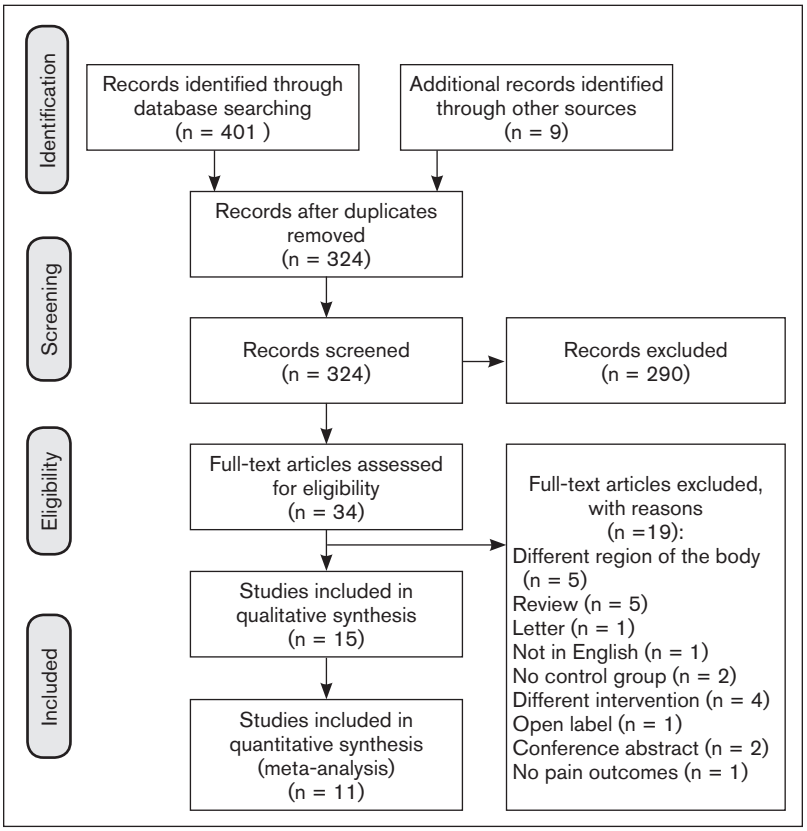


Fig 1 PRISMA flow diagram.[19]

injection (n = 90); the condition was not MPS (n = 92); there was no control group (n = 6); it was an editorial/opinion piece (n = 3); not an RCT (n = 7); case series/case report (n = 17); animal study (n = 3); not in English (n = 1); no pain outcome (n = 6); or a review or systematic review (n = 65).

Of the 34 references that underwent full-text analysis, 15 could be included. The main reasons for exclusion of those 19 references were no local anesthetic (n = 2) or patients received other interventions besides local anesthetic, such as a splint or exercises (n = 2); MPS in other regions of the body, including the lower back (n = 5); the study was a review of the literature (n = 2); not in English (n = 1); the study was a letter to the editor (n = 1); open label trial (n = 1); had no control group (n = 2); was a conference abstract lacking details for a review (n = 2); or no pain outcome was reported (n = 1). The PRISMA flowchart shows a summary of these results (Fig 1).

Included Studies

Therefore, a total of 15 RCTs were included in this review (Table 1).[2,3,5,9,14–18,25–30] Eight studies[2,5,17,18,26–29] were double-blinded, four[3,15,25,30] were single-blinded, and three[9,14,16] were not blinded. Local anesthetic injections were compared to other interventions in the treatment of MPS in the head, neck, and shoulder regions.

Population. The common inclusion criteria for all the studies was MPS diagnosed based on criteria described by Travell and Simons.[20,21] One study[29] included fibromyalgia patients with at least one TrP in one of the temporal muscles. Three studies[9,14,28] included participants with TrPs and headaches—in two studies[9,14] the authors stated that the bilateral TrPs were responsible for setting off the headache, while in the third study[28] subjects had bilateral myofascial TrPs and bilateral headache. MPS symptom duration ranged from 1 month[16] to 24 months.[18] Location of TrPs was confined to the head, neck, and shoulder regions (Table 2). The trapezius muscle was the most commonly injected[3,9,14,16,18,25,26,30]; other muscles included were masseter,[2,9,14] temporal,[9,14,29] occipital,[9,14] infraspinatus and/or levator scapulae,[3] pericranial,[28] and suprascapular.[27] Only one study[30] was set in a community-based clinic, while the rest were hospital- or university-based studies. The number of participants per study ranged from 20[27] to 127.[3] A total of 884 adult patients diagnosed with MPS were included in this systematic review. One study[2] included female participants only, while in the rest of the studies female predominance was clearly noted. The age of participants ranged from 18 to 75 years old.

Interventions. The intervention under study was 0.5% to 2% lidocaine in 13 studies[3,5,9,14–18,25,26,28–30] and 1% procaine in one study[2]; in one study,[17] 0.25% bupivacaine was compared to lidocaine. Number of TrP injections varied widely in the studies, from 1 TrP[3] to 32 TrPs injected.[15] Three studies[2,25,27] injected the most painful TrP without mention of how many, and two studies[5,28] injected all TrPs (Table 2). Dosage of local anesthetic also widely varied among the studies (Table 2).

Comparison Group. Considerable variety in the comparison groups was found among the included studies. Local anesthetic was compared to dry needling,[2,5,9,14–16,18,30] other drugs,[14,17,26,27] botulinum toxin A,[9,15] physiologic saline solution,[28,29] ultrasound-guided pulsed radiofrequency,[25] and physical therapy.[3]

The primary outcome in the majority of the studies was post-treatment pain measured with a

VAS,[2,3,5,15,16,18,28–30] a numeric rating scale (NRS),[25] or an ordinal self-rating visual NRS.[26] Other secondary outcomes reported by the authors included PPT,[2,5,15,18] pressure pain intensity (PPI) scale or pain score,[15,30] local twitch responses,[3,30] active cervical range of motion,[5,16,18,30] depression,[3,15,16,27,30] quality of life measured with the Short Form Health Survey (SF-36),[3,25] Disability Index,[15,26] and Nottingham Health Profile.[5,15,30]

The majority of the studies had some type of co-intervention: in six studies research subjects received a home-base exercise program,[5,15,16,18,26,30] while in another four studies patients were allowed to use rescue medication (ie, analgesics) (Table 3).[3,9,14,29]

Risk of Bias in Included Studies

Risk of bias was evaluated in 15 RCTs.[2,3,5,9,14–18,25–30] The results are presented in Table 4 and Fig 2.

Random Sequence Generation. Of the 15 studies, 7 studies[3,9,14,25,26,29,30] were considered at low risk for random sequence generation (techniques used to generate the randomization included block randomization, random envelope selection, and a random digit table). Eight of the studies[2,5,15–18,27,28] were assessed at unclear risk because although the authors indicated that the studies were randomized, there was no mention of how the randomization was done.

Allocation Concealment. Seven of the studies[3,5,16,17,26,28] were at low risk because the random sequence was placed in sealed envelopes prior to initiation of the study. Five of the studies stated they were double-blinded[2,18,25,27,29]; however, the authors did not indicate the method of allocation concealment, and therefore these studies were considered at unclear risk. Four of the studies[9,14,15,30] were categorized as high risk because there was no sequence allocation concealment described.

Blinding. Blinding of the participants, the researchers, the data assessors, and the data analyst was assessed. None of the studies effectively outlined how they blinded all four; therefore, zero studies were considered at low risk of bias. Eight studies[2,5,17,18,26–29] were considered at unclear risk of bias since the authors stated the study was double-blinded; however, they did not state the method of blinding for all four groups (participants, investigator, data assessors, analyst). Three[9,14,16] were at high risk of bias because the authors did not state that the study was blinded. Four[3,15,25,30] were single-blinded and also high risk because of lack of blinding method for the investigators delivering the injections and making the outcome assessments[3,15,30] or because the participants were not blinded.[25]

Incomplete Outcome Data. Eight studies[3,5,9,14,16,25,28,30] contained no missing data and were considered low risk of bias. Four of the papers[2,15,26,27] were deemed at unclear risk because even though dropouts were low, an intention to treat analysis was never done. Three studies[17,18,29] were at high risk. Two[17,29] of these were due to the high number of dropouts in the study (> 20%), and one was high risk because a group of patients with no local twitch response was excluded and not evaluated for pain after 2 weeks because they received additional treatments.[18]

Selective Reporting. Fifteen studies listed and reported the outcomes and received a rating of low risk of bias in relation to selective reporting.

Other Bias. Other forms of bias analyzed were funding sources, co-interventions, unbalanced groups at baseline, etc. Three[25,27,28] of the reviewed papers were considered low risk for these biases because the studies were appropriately funded by nonbiased, unquestionable funding sources; they had zero co-interventions; and all groups were balanced at baseline. Seven of the studies[2,5,15,16,18,26,30] were considered at unclear risk because they had co-interventions as part of the study, and one[15] had slightly unbalanced groups at baseline. The other five[3,9,14,17,29] research papers had a high risk of bias due to participants using supplemental medications (ibuprofen,[3,9,14] acetaminophen,[3] nimesulide[29]), massage,[17,29] or physiotherapy and stabilization plate.[17] The remaining three[25,27,28] had low risk of bias related to no co-intervention.

Overall Risk of Bias. None of the research papers were considered to have low overall risk for bias. Five studies[2,5,26–28] were assessed at unclear risk, and 10 studies[3,9,14–18,25,29,30] were considered at high risk for bias (Table 4; Fig 2).

Effects of Interventions

All the studies reported short-term results, between 1 and 8 weeks.

Local Anesthetic vs Dry Needling. Statistically significant heterogeneity was found (Q $P < .001$; $I^2 = 90\%$) among the six studies[2,5,15,16,18,30] reporting posttreatment short-term VAS pain at 1 to 4 weeks. Patients injected with local anesthetics reported a significantly lower intensity of pain compared to dry needling at 1 to 4 weeks (random-effects model: DM = −1.586; 95% CI = −2.926 to −0.245; $P = .020$) (Fig 3a). Although five studies out of six showed a favorable outcome for local anesthetic,[5,15,16,18,30] only three were statistically significant.[15,16,18]

Only one study reported VAS pain at 12 weeks posttreatment[16]; therefore, a meta-analysis for medium-term (3 months) pain could not be conducted.

Sensitivity Analyses. Similar results were found when excluding one study by Hong et al,[18] as that study included only patients with local twitch response (random-effects model: DM = −1.039; 95% CI = −2.018 to −0.061; $P = .037$).

Table 1 Summary of Eligible RCTs

Study	Diagnosis/total sample size/setting, country	Gender/age, Mean ± SD or range	Interventions and sample size per group
Ay et al[16]	MPS N = 80 University hospital, Turkey	28 M/52 F 19–58 y	Lidocaine + home exercise (n = 40) Dry needling + home exercise (n= 40)
Cho et al [25]	MPS N = 35 University hospital, South Korea	19 M/16 F 39–64 y	Lidocaine (n = 18) Ultrasound-guided pulsed radiofrequency (n = 17)
Choi et al[26]	MPS N = 61 University clinic, South Korea	18 M/43 F 25–75 y	Lidocaine (n = 31) Lidocaine + hyaluronidase (n = 30)
Eroğlu et al[5]	MPS N = 60 University clinic, Turkey	7 M/53 F 18–50 y	Lidocaine (n = 20) Dry needling (n = 20) Oral flurbiprofen (n = 20)
Ga et al[30]	MPS N = 39 Community-based clinics, South Korea	3 M/36 F 36–91 y	Lidocaine injection (n = 21) Acupuncture (n = 18)
Hong[18]	MPS N = 58 University clinic, California, USA	16 M/42F 27–56 y	Lidocaine injection (n = 26) Dry needling (n = 15)
Iwama and Akama[27]	MPS N = 20 Hospital, Japan	6 M/14 F 20–51 y	Split-design (n = 20): Lidocaine in one shoulder; water-diluted lidocaine in the other shoulder
Kamanli et al[15]	MPS N = 29 University clinic, Turkey	6 M/23 F 25–54 y	Lidocaine injection (n = 10, 32 TrP) Dry needling (n = 10, 33 TrP) Botulinum toxin injection (n = 9, 22 TrP)
Karadaş et al[28]	MPS N = 108 Hospital, Turkey	32 M/76 F 18–54 y	1 lidocaine injection (n = 27) 5 lidocaine injections (n = 27) 1 saline injection (n = 27) 5 saline injections (n = 27)
Lugo et al[3]	MPS N = 127 Hospital, Colombia	23 M/104 F 25–53 y	Lidocaine (n = 43) Physical therapy (n = 43) Combination lidocaine + physical therapy (n = 41)
McMillan et al[2]	MPS N = 30 Hospital, UK	30 F 23–53 y	Procaine (n = 10) Dry needling (n = 10) Simulated local anesthesia + simulated dry needling (n = 10)
Sabatke et al[29]	MPS N = 70 University clinic, Brazil	70 F 23–70 y	Lidocaine (n = 21) Placebo (n = 26) Control group (n = 23)
Tschopp and Gysin[17]	MPS N = 107 University hospital, Switzerland	27 M/80 F 31–66 y	Lignocaine (n = 33) Bupivacaine (n = 40) Saline group (n = 34)
Venâncio et al[14]	MPS N = 45 School of Dentistry, Brazil	5 M/40 F 18–65 y	Lidocaine (n = 15) Dry needling (n = 15) Lidocaine + corticoid (n = 15)
Venâncio et al[9]	MPS N = 45 School of Dentistry, Brazil	5 M/40 F 18–65 y	Lidocaine (n = 15) Dry needling (n = 15) Botulinum toxin A, 25 or 50 U (n = 15)

MPS = myofascial pain syndrome; TrP = trigger point; RCT = randomized controlled trial.

Excluding Single-Blinded and Studies Lacking Blinding. However, when only including double-blinded studies,[2,5,18] the effect of the local anesthetic was similar, with an improvement of 1.478 VAS units (95% CI = −4.458 to 1.502), but no statistical significance (P = .331) (Fig 3b).

Subgroup Analysis: High Risk of Bias vs Low/Unclear. When including only high risk of bias studies, the results were favorable for local injections (P = .007). However, when including only studies at unclear risk of bias, the results were not significant (P = .952), suggesting the presence of bias (Fig 3b).

Inclusion criteria	Study type/ risk of bias
Aged 19 and 58 y; Presence of at least one active TrP in the upper trapezius muscle defined as MPS[20]; Symptom duration for 1 mo	Not blinded RCT/ high risk
Aged 20 to 70 y; Complaint of myofascial pain in the trapezius muscle not confined to 1 dermatome or myotome during physical examination, and the presence of taut bands in the muscle with 1 or more identifiable TrPs along the muscle; Symptoms that persisted for at least 3 mo; Normal results on the neurologic examination, including deep tendon reflexes, manual muscle testing, and sensory exam; NRS pain ≥ 3	Single-blind RCT/ high risk
Aged 25 to 75 y; Diagnosis of MPS involving both trapezius muscles and posterior neck and/or upper back pain of myofascial origin; Pain ≥ 3 mo of moderate to severe intensity (score ≥ 30 points on a 0–100 scale)	Double-blind RCT/ unclear risk
Diagnosed with MPS originating from the neck and back muscles (diagnosis made in accordance with the clinical findings as defined by Travell and Simons)[21]	Double-blind RCT/ unclear risk
Age > 60 y; TrP (MPS) of one or both upper trapezius muscles; Complaining of chronic shoulder or neck pain or headache; Duration > 6 mo	Single-blind RCT/ high risk
Presence of at least one active TrP located in the upper trapezius muscle defined as MPS[21]; Onset of pain ranged from 1 to 24 mo before the study; Tender spots in one or more palpable taut bands; Typical pattern of referred pain distributed in the ipsilateral posterolateral cervical paraspinal area, mastoid process, or temporal area (TrP); Palpable or visible local twitch responses on snapping palpation at the most sensitive spot in the taut band; Restricted range of motion in lateral bending of the cervical spine to the opposite side	Double-blind RCT/ high risk
Adult volunteers with chronic myofascial pain to the same degree in both shoulders; All volunteers had TrPs in the bilateral suprascapular regions with moderate pain	Double-blind RCT/ unclear
Patients with at least one TrP located on cervical, back, or shoulder muscles; Disease of at least 6-mo duration and not receiving any treatment during the previous 8 wk; For comparison with the contralateral side of the body, special attention was paid to patients with myofascial pain on only one side	Single-blind RCT/ high risk
Age between 18 and 65 y; Diagnosed with frequent episodic-type tension headache according to the criteria published in 2004 by the International Headache Society (normal physical and neurologic examination results and had headache less than 15 d per mo during the previous 6 mo); Myofascial TrP located in the pericranial muscles defined by Travel and Simons manual[21]; Bilateral headache, and myofascial TrPs detected bilaterally	Double-blind RCT/ unclear risk
Older than 18 y; Multiple TrPs in one or more of the following muscles: the trapezius, the infraspinatus, and/or the levator scapulae (cervical portion), diagnosed by neck or shoulder pain, which may or may not be accompanied by the typical pattern of referred pain in the compromised muscle; Neck or shoulder pain over the prior 6 wk; Pain score of ≥ 40 mm on a 0–100-mm VAS	Single-blind RCT/ high risk
Women 20 to 50 y; Primary complaint of frequent pain (≥ 4 times per k) in the jaw muscles, of at least 12 wk duration; Tenderness to palpation at a minimum of three sites in the jaw muscles, including at least one in the masseter; Palpation of a tender area in the masseter that led to changes in patterns of referred pain	Double-blind RCT/ unclear risk
Patients with fibromyalgia; Pain in the region of the face and/or neck and headache; Had at least one TrP in one of the temporal muscles (right or left) regardless of whether palpation of these points caused headache	Double-blind RCT/ high risk
Subjects with pain in the lateral aspect of the face and TrP in the masticatory muscles	Double-blind RCT/ high risk
Moderate to severe headache present for at least 6 months; At least one uni- or bilateral TrP in the orofacial (masseter, temporalis) or cervical region (occiput, trapezius) responsible for setting off the headache	Not blinded RCT/ high risk
Headache diagnosis and classification were made in accordance with the criteria of the International Headache Society; Moderate to severe headache present for at least 6 mo; At least one uni- or bilateral TrP in the orofacial (masseter, temporalis) or cervical region (occiput, trapezius) sensitive to palpation responsible for setting off the headache	Not blinded RCT/ high risk

Low risk of bias studies are needed to corroborate the results in this review.

Subgroup Analysis: Home Treatment vs None. Studies including some home treatment (ie, home exercises/analgesics/spray and stretch technique/ warm moist compresses) showed a significantly favorable result for local injections (P = .010). However, the one study with no home treatment did not show a significant result (P = .801). This subgroup analysis suggests that the home treatment might be contributing to the outcome, though how much is unknown.

Table 2 Injection Details and TrP Locations

Reference	Location of TrPs	Local anesthetic injection details	Dry needling/ acupuncture group
Ay et al[16]	Upper trapezius muscle	2 mL of 1% lidocaine (n = 40)	Dry needling (n = 40)
Cho et al[25]	Trapezius muscle	10 mL of 0.6% lidocaine (n = 18)	N/A
Choi et al[26]	Both trapezius muscles	3.2 mL solution of a 1:1 mixture of 1% lidocaine and 0.9% normal saline (n = 33)	N/A
Eroğlu et al[5]	Trapezius muscle, rhomboideus, supraspinatus muscles	0.2 mL 2% lidocaine injections (n = 20)	Dry needling (n = 20)
Ga et al[30]	Upper trapezius muscle	0.2 mL of 0.5% lidocaine (n = 21)	Acupuncture (n = 18)
Hong[18]	Upper trapezius muscle	0.02 to 0.05 mL of 0.5% lidocaine with local twitch response (n = 26)	Dry needling (n = 15)
Iwama and Akama[27]	Suprascapular muscle	2 mL of 1% lidocaine (n = 20) 2 mL (0.5 mL 1% lidocaine and 1.5 mL water) (n = 20)	N/A
Kamanli et al[15]	Trapezius, levator scapula, teres minor, supraspinatus, infraspinatus muscles	1 mL 0.5% lidocaine injection (n = 10)	Dry needling (n = 10)
Karadaş et al[28]	Frontal, temporal, masseter, sterno-cleidomastoid, semispinaliscapitis, trapezius and splenius capitis muscles bilaterally	2 mL of 0.5% lidocaine (n = 27) 5 injections of 2 mL of 0.5% lidocaine (n = 27)	N/A
Lugo et al[3]	Trapezius infraspinatus, levator scapulae muscles	1 mL of 0.5 % lidocaine without epinephrine (n = 43)	N/A
McMillan et al[2]	Masseter muscle	0.5 mL of 1% procaine + simulated dry needling (n = 10)	Dry needling + simulated LA (n = 10)
Sabatke et al[29]	Temporal muscle	0.2 to 0.5 mL of 2% lidocaine without vasoconstrictor (n = 21)	N/A
Tschopp and Gysin[17]	Lateral pterygoid, sternocleidomastoid, other masticatory muscles	5 mL lignocaine 1% ampules (1 mL/TrP) (n = 33) 5 mL bupivacaine 0.25% ampules (1 mL/TrP) (n = 40)	N/A
Venâncio et al (2008)[14]	Orofacial (masseter, temporalis) or cervical region (occiput, trapezius)	0.2 mL of 0.25% lidocaine without vasoconstrictor (n = 15)	Dry needling (n = 15)
Venâncio et al (2009)[9]	Orofacial (masseter, temporalis) or cervical region (occiput, trapezius)	0.2 mL of 0.25% lidocaine without vasoconstrictor (n = 15)	Dry needling (n = 15)

TrP = trigger point; N/A = not applicable; LA = local anesthetic; BTX = botulinum toxin.

Table 3 Co-Interventions and Adverse Effects in Included Studies

Reference	Co-interventions	Adverse effects
Ay et al[16]	Home exercises	No side effects observed
Cho et al[25]	None	Not mentioned
Choi et al[26]	Home exercises	Not mentioned
Eroğlu et al[5]	Home exercises	Not mentioned
Ga et al[30]	Home exercises	Lidocaine group: 38.1% patients with soreness, 4.8% with subcutaneous hemorrhage, and 4.8% with dizziness Acupuncture group: 50% patients with soreness
Hong[18]	Spray and stretch technique	Lidocaine group: 42.3% soreness Dry needling group: 100% soreness
Iwama and Akama[27]	Not mentioned	Not mentioned
Kamanli et al[15]	Home exercises	Lidocaine group: Coldness and burning sensation at the treatment site in 30% (3 patients) Paresthesia in 30% (3) lidocaine group patients Discomfort at the time of injection was felt by 20% (2) Dry needling group: Discomfort at the time of injection was felt by 80% Botulinum toxin group: Fatigue in 55.6% (5), muscle Pain in 33.3% (3) Headache in 10% (1)
Karadaş et al[28]	Not stated	1 injection saline group: Pain at injection area (1), dizziness (1), cervical muscle spasm (1) 1 injection lidocaine group: Pain at injection site (1) 5 injections saline group: Pain at injection site (1), dizziness (1) 5 injections lidocaine group: pain at injection area 1, dizziness 1, cervical muscle spasm 1

Placebo/ saline group	Other intervention	No. of TrPs injected
N/A	N/A	At most 2 TrPs
N/A	Ultrasound-guided pulsed radiofrequency (n = 18)	Most painful point in trapezius
N/A	Same solution of lidocaine supplemented with hyaluronidase (H-LASE, 1500 IU;600 IU/mL) (n = 33)	2 of the most painful taut bands in each side of the right and left trapezius
N/A	7 d 200 mg/d oral flurbiprofen (n = 20)	All active TrPs
N/A	N/A	All TrPs found bilaterally
N/A	N/A	Until local tenderness was eliminated
N/A	N/A	The most painful TrP
N/A	Botulinum toxin A injection (n = 9)	Lidocaine (n = 32 TrPs) Dry needling (n = 33 TrPs) BTX group (n = 22 TrPs)
1 injection 2 mL of NaCl 0.9% (n = 27) 5 injections 2 mL of NaCl 0.9% (n = 27)	N/A	All TrPs
	Physical therapy (n = 43) Physical therapy + lidocaine (n = 41)	One TrP
Simulated LA + simulated dry needling (n = 10)		Most tender TrP
0.2 mL to 0.5 mL of 0.9% saline (n = 26) No treatment group (n = 23)		Not stated
5 mL saline 0.9% (real amount injected was 1 mL/TrP) (n = 34)	N/A	1–7 TrPs
N/A	0.2 mL of 0.25% lidocaine without vasoconstrictor + 0.2 mL decadron 4 mg/mL (n = 15)	1–3 TrPs
N/A	25–50 U botulinum toxin A (n = 15)	1–3 TrPs

Table 3 Co-Interventions and Adverse Effects in Included Studies cont.

Reference	Co-interventions	Adverse effects
Lugo et al[3]	Analgesics	Lidocaine group: Localized hematoma (2/43), Minimal bleeding (1/43) Physical therapy + lidocaine group: Localized hematoma (4/41)
McMillan et al[2]	None	Residual hyperalgesia in masseter muscle
Sabatke et al[29]	Nimesulide tablets 100 mg, 2×/d for 2 d (n = 8) Warm, moist compresses 3–4×/d for 10–15 min or soak the injection area in a warm bath	Not stated
Tschopp and Gysin[17]	Analgesics/stabilization plate/physiotherapy/ massage (unclear if this was stopped during treatment)	Lignocaine: Transitory facial palsy (2/33) Bupivacaine: Transitory facial palsy (3/40), Bilateral facial palsy (1/40)
Venâncio et al (2008)[14]	Rescue medication (ibuprofen 200 mg, 3–4×/d max) Self-care management, counseling, or home physical therapy	Not stated
Venâncio et al (2009)[9]	Ibuprofen 200 mg for rescue headache 3 or 4×/d	Not stated

Table 4 Summary of Risk of Bias for Eligible Studies

Study	Random sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective reporting	Other potential bias	Overall bias
Ay et al[16]	?	–	+	–	–	?	+
Cho et al[25]	–	?	+	–	–	–	+
Choi et al[26]	–	–	?	?	–	?	?
Eroğlu et al[5]	?	–	?	–	–	?	?
Ga et al[30]	–	+	+	–	–	?	+
Hong[18]	?	?	?	+	–	?	+
Iwama and Akama[27]	?	?	?	?	–	–	?
Kamanli et al[15]	?	+	+	?	–	?	+
Karadaş et al[28]	?	–	?	–	–	–	?
Lugo et al[3]	–	–	+	–	–	+	+
McMillan et al[2]	?	?	?	?	–	?	?
Sabatke et al[29]	–	?	?	+	?	+	+
Tschopp and Gysin[17]	?	–	?	+	–	+	+
Venâncio et al (2008)[14]	–	+	+	–	–	+	+
Venâncio et al (2009)[9]	–	+	+	–	–	+	+

– = low; + = high risk; ? = unclear.

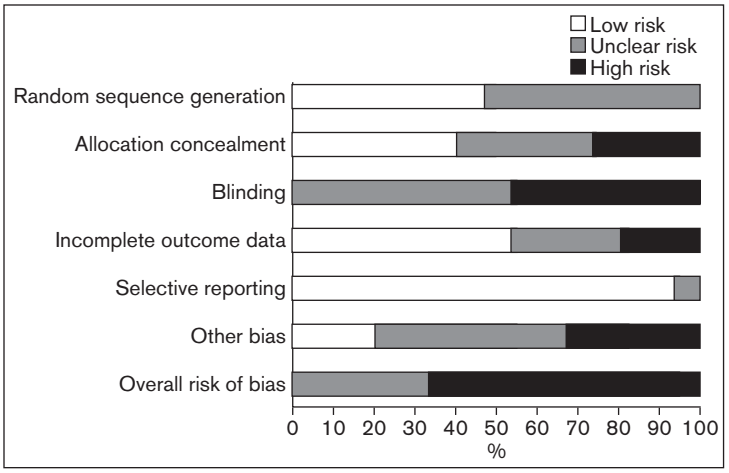


Fig 2 Summary of risk of bias of eligible RCTs.

Pain Pressure Threshold. By placing the plastic tip on the TrP and increasing the pressure by 1 kg/second, the pressure value at which the patient felt the first discomfort was recorded in kg.[31,32] No statistical heterogeneity was found (Q P = .546; I^2 = 0%), nor was a significant difference in PPT between local anesthetic and dry needling at 2 to 4 weeks (fixed-effects model: DM = 0.101; 95% CI = −0.130 to 0.332; P = .392) (Fig 4a). Similar results were found when excluding Hong et al.[18]

Sensitivity Analyses. No statistically significant difference was found between local anesthetic and dry needling/acupuncture for PPT when including only double-blinded studies (P = .720) (Fig 4b).

Range of Motion. Only two studies reported any of the following outcomes of range of motion: extension; flexion; left rotation; right rotation; left lateral flexion; and right lateral flexion at 14 days or 1 month. No statistically significant difference was found between local anesthetic and dry needling in range of motion outcomes. Hong[18] reported the cervical range of motion without details (such as if it was an extension, flexion, rotation, or lateral flexion) and could not be included in the meta-analysis.

Depression. Three studies reported depression outcomes[15,16,30] using three different scales (Beck Depression Inventory, short-form Korean version of Geriatric Depression Scales, and Hamilton depression score) with statistical heterogeneity (Q P = .045; I^2 = 68%) and no statistically significant difference (random-effects model: SDM = −0.239; 95% CI = −0.898 to 0.419; P = .476) found between local anesthetic and dry needling/acupuncture in depression outcomes. Due to the differences in scales, the SDM was reported instead of the DM.

Local Anesthetic vs Placebo. In two studies, researchers used saline injection as a placebo intervention.[28,29] In one study, researchers compared local anesthetic to simulated local anesthesia (a drop of isotonic saline was also introduced just below the skin using a 27-gauge needle over a nontender part of the muscle) and simulated dry needling (an acupuncture needle is placed just into the skin over a nontender part of the muscle, then removed immediately[2]).

VAS Pain. No significant heterogeneity was found (Q P = .471; I^2 = 0%). Local anesthetic improved VAS pain significantly compared to placebo at 2 to 8 weeks (fixed-effects model: DM = −0.767; 95% CI = −1.324 to −0.210; P = .007) (Fig 5). All three studies were double-blinded.

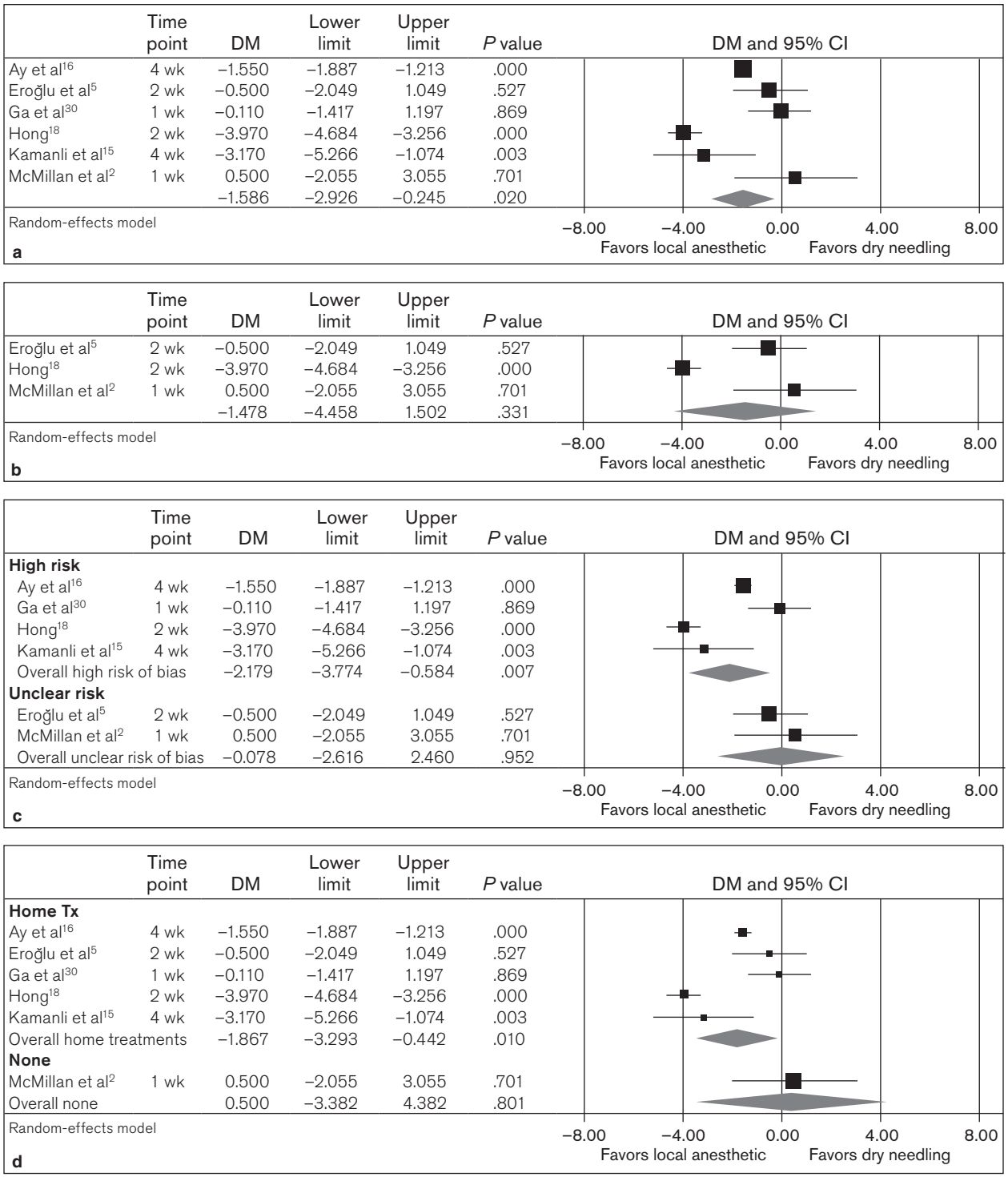
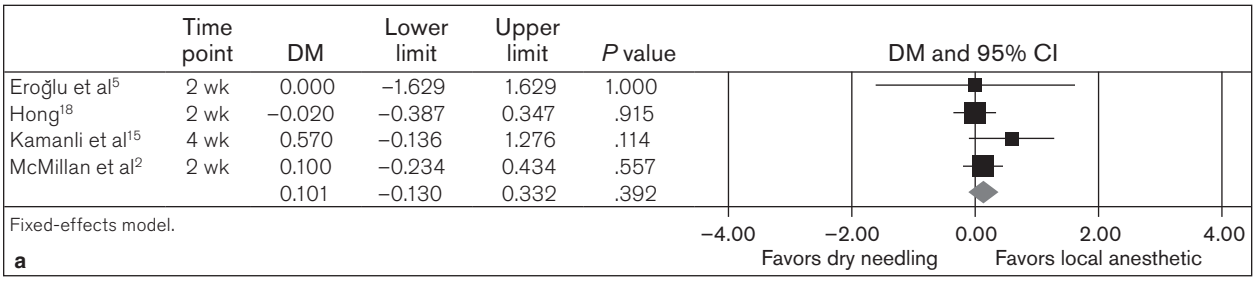


Fig 3 Subgroup analyses comparing local anesthetic intervention vs dry needling for pain on a 0 to 10 visual analog scale (VAS). **(a)** When including all studies measuring VAS pain, there was a significant improvement with local anesthetic (P = .020). **(b)** When including only double-blinded studies, the results were not statistically significant (P = .331). **(c)** When including only high risk of bias studies, the results were favorable for local anesthetic (P = .007) vs when including unclear risk of bias (P = .952). **(d)** Studies including some home treatment (ie, home exercises/analgesics/spray and stretch technique/warm moist compresses) showed a significant result (P = .010) in favor of local anesthetic, but not the study with no home treatment (P = .801). DM = difference in means.

Pressure Pain Threshold. Only one study reported PPT[2] comparing local anesthetic and placebo; no meta-analysis was possible.

Local Anesthetic vs Other Interventions. No statistically significant heterogeneity was found (Q P = .120; I^2 = 45.3%). There was no statistically



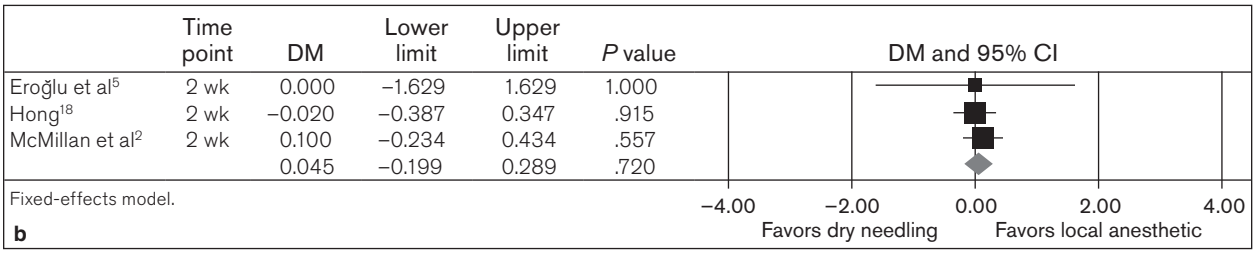
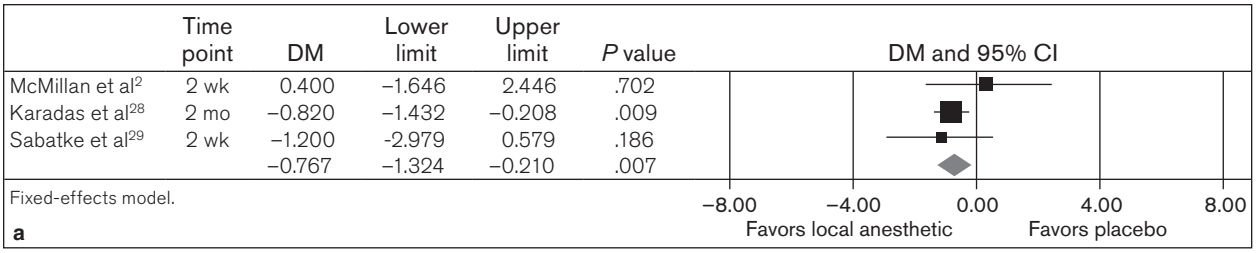


Fig 4 Subgroup analyses comparing local anesthetic vs dry needling for pressure pain threshold (PPT). No statistically significant difference was found between local anesthetic and dry needling/acupuncture when including **(a)** all eligible studies ($P = .392$) or **(b)** only double-blinded studies ($P = .720$). Subgroup analyses by risk of bias and home treatment showed similar results. DM = difference in means.



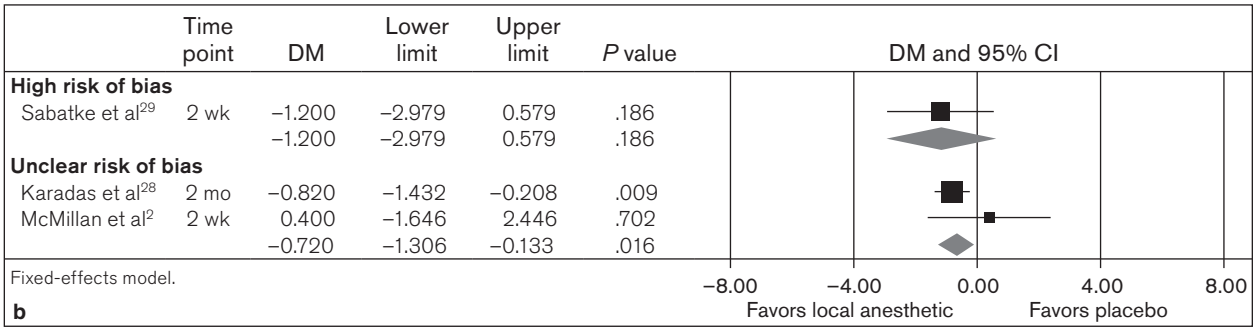


Fig 5 Meta-analysis comparing local anesthetic intervention vs placebo for pain on a 0 to 10 visual analog scale (VAS). **(a)** VAS pain improved significantly 2 to 8 weeks posttreatment with local anesthetic compared to placebo ($P = .007$). All three studies were double-blinded. **(b)** Similar results were found for high risk of bias studies and studies with unclear bias. DM = difference in means.

significant difference in VAS pain between local anesthetic group and other interventions at 2 to 4 weeks (fixed-effects model: DM = 0.351; 95% CI = −0.004 to 0.706; $P = .053$).

Pressure Pain Threshold. No statistically significant heterogeneity was found (Q $P = .581$; $I^2 = 0\%$). There was no statistically significant difference in PPT in kg between the local anesthetic group and other interventions (including placebo) at 2 to 4 weeks (fixed-effects model: DM = 0.283; 95% CI = −0.336 to 0.902; $P = .370$).

Depression. Two studies compared local anesthetic to other interventions (PT and botulinum toxin) with no heterogeneity (Q $P = 0.480$; $I^2 = 0\%$). No difference in depression scale compared to other interventions (PT and botulinum toxin) was observed at 4 weeks (SDM = −0.063; 95% CI = −0.450 to 0.324; $P = .750$).

Adverse Effects. No adverse effects were reported in eight studies after TrP local anesthetic injections.[5,9,14,16,25–27,29] Soreness and burning sensation were reported as postoperative side effects at

Table 5 Summary of the Evidence and Quality of the Findings (GRADE): Local Anesthetic Compared to Dry Needling, Placebo or Other Interventions for the Treatment of Head and Neck Myofascial Pain Syndrome

Outcomes	No. of participants (studies), follow-up	Quality of the evidence (GRADE)	Anticipated absolute effects: Risk difference with local anesthetic (95% CI)
Local anesthetic compared to dry needling			
VAS pain (0–10)	240 (6), 1–4 wk	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean VAS pain in the local anesthetic groups was 1.586 lower than the dry needling groups (2.926 to 0.245 lower; *P* = .020).
Pain pressure threshold (PPT) (kg)	80 (3), 2–4 wk	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean PPT in the local anesthetic groups was 0.101 higher than the dry needling groups (0.130 lower to 0.332 higher; *P* = .392).
Depression scale	139 (3), 1 mo	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean change in depression scale in the local anesthetic groups was 0.239 standard deviations lower than the dry needling groups (0.898 lower to 0.419 higher; *P* = .720).
Local anesthetic compared to placebo			
VAS pain (0–10)	121 (3 s), 2–8 wk	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean VAS pain in the local anesthetic groups was 0.767 lower than the placebo groups (1.324 to 0.210 lower; *P* = .007).
Local anesthetic compared to other interventions			
VAS pain (0–10)	240 (5), 1–4 wk	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean VAS pain in the local anesthetic groups was 0.351 higher than in the other intervention groups (0.004 lower to 0.706 higher; *P* = .053).
PPT (kg)	59 (2), 2–4 wk	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean PPT in the local anesthetic groups was 0.283 higher than in the other intervention groups (0.336 lower to 0.902 higher; *P* = .370).
Depression scale	103 (2), 1 mo	⨁⨁◯◯ LOW[a,b] due to risk of bias, imprecision	The mean depression scale in the local anesthetic groups was 0.063 standard deviations lower than in the other intervention groups (0.450 lower to 0.324 higher; *P* = .750).

CI = confidence interval.
GRADE Working Group grades of evidence: high quality = further research is very unlikely to change our confidence in the estimate of effect; moderate quality = further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; low quality = 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 = we are very uncertain about the estimate.
[a]All included studies assessed at unclear or high risk of bias.
[b]Small number of studies with small number of patients (< 400 total patients).

the site of injection in four studies.[15,18,28,30] Dizziness was reported in two studies.[28,30] Subcutaneous hemorrhage, hematoma, and minimal bleeding were reported in two studies.[3,30] Paresthesia at the site of injection was reported in two studies.[2,15] Cervical muscle spasm was reported in one study.[28] Transitory facial palsy was reported in one study[17] (Table 3).

Quality of the Evidence (GRADE). Only RCTs reporting similar outcomes were pooled into a meta-analysis. Due to unclear or high risk of bias, the small total sample size of participants in each meta-analysis (< 400), and the small number of studies pooled, the quality of the evidence was low (Table 5).

Discussion

Main Findings

Local Anesthetic vs Dry Needling. Overall, the quality of the evidence (GRADE) was low due to unclear/high risk of bias and small sample size, with a total number of subjects per meta-analysis below 400. When posttreatment pain in local anesthetic groups was compared to dry needling, an improvement of 1.586 units was found (95% CI = −2.926 to −0.245; *P* = .020) on a 0 to 10 VAS. When only including double-blinded studies, the effect of the local anesthetic was similar, with an improvement of 1.478 VAS

units (95% CI = −4.458 to 1.502), but this was not statistically significant (P = .331). This lack of statistical significance could be due to lack of statistical power, as the number of included studies went from six to three due to lack of blinding. Subgroup analyses including high risk of bias studies vs unclear/low risk of bias studies suggested bias might be in part responsible for the significant results and needs further research. A second subgroup analysis, grouped by whether home treatment was received or not, suggested the addition of home treatment might be substantial, though this is hard to say due to the small sample size (only one study stated that they did not provide any home treatment). Further studies are needed to elucidate if the effect of local anesthetic is real or due to high bias studies or home treatments provided to the patients.

Local Anesthetic vs Placebo. According to Kelly 2001,[33] the minimum clinically significant difference in a VAS is 1.2 units (95% CI = 0.9 to 1.5 units). The difference in VAS pain of 0.767 units comparing local anesthetic to placebo group may not be clinically significant.

No other statistically significant difference was found in PPT or depression scale. As for findings when comparing local anesthetic to other interventions, no significant differences were found. Quality of evidence for those findings was low.

Agreements and Disagreements with Other Studies or Reviews

There is prior evidence that TrPs respond to local anesthetic injections better than dry needling in terms of pain intensity measured on a VAS scale.[10,34–38] Some reviews disagree and conclude that the nature of the injected substance makes no difference to the outcome and there is no therapeutic benefit in local anesthetic over dry needling.[39–44] These results are inconclusive, as it was found that local anesthetic improved VAS pain significantly compared to dry needling at 1 to 4 weeks when including all studies, but these results were not significant when including only double-blinded studies. Bias and home treatment seemed to have an effect on the results based on the subgroup analyses; however, further studies are needed.

These results indicate that local anesthetic injection and dry needling had similar improvement in range of motion, which is in agreement with previous reviews.[10,35] In terms of PPT outcomes, the results have shown that both local injection and dry needling improved PPT with no statistically significant differences, which also agrees with previous studies.[37,42]

No statistically significant difference was found between local anesthetic vs other interventions in depression scale. Two articles found local anesthetic for TrPs helped to reduce depression,[35,45] but the difference was not statistically significant.

Overall Completeness and Applicability of Evidence

The electronic databases searched were the Cochrane Library, MEDLINE via PubMed, Web of Science, and EMBASE up to April 1, 2018. The reference sections of the included studies and reviews were hand searched to find any additional eligible studies. The results of this systematic review are applicable to 18- to 75-year-old patients with head, neck, and upper shoulder MPS. Since the reported treatment duration ranged from 1 to 8 weeks, this review cannot comment on the long-term efficacy of local anesthetic injection and dry needle.

Heterogeneity of the Review

Clinical heterogeneity was present in multiple areas in this review. The small number of studies precluded subgroup analyses by type, amount, and concentration of local anesthetic (lidocaine concentration ranged from 0.5% to 2%, and procaine was 1%). There was also heterogeneity among the muscles targeted from neck and shoulder muscles (ie, trapezius, rhomboid, supra-scapulae, levator scapulae) to muscles of mastication (ie, masseter, temporalis) to pericranial muscles. Heterogeneity was also obvious in the population selected: Two studies included only female patients,[2,29] one study included fibromyalgia patients,[29] and three studies included headache patients,[9,14,28] which could bias the results if female patients or fibromyalgia or headache patients had a different reaction to the intervention than their counterparts. Due to the different types of interventions in the comparison group, subgroup analyses were presented separately comparing local anesthetic to placebo, dry needling, and other interventions (ultrasound-guided pulsed radiofrequency, use of different medications [ie, botulinum toxin, oral flurbiprofen 200 mg, lidocaine + hyaluronidase, lidocaine + corticoid]). One study included only older patients over 60 years old,[30] which could bias the results if older patients respond differently to the intervention than younger patients. Studies were conducted mostly by physical therapists[3,5,15,16,18,25] and a few by dentists,[2,9,14] which could bias the results due to differences in treatment approaches (eg, dentists usually do not use dry needling, while physical therapists are more prone to using dry needling treatment). Most of the studies recommended some type of home exercise,[5,15,16,26,30] moist compresses,[29] or physical therapy[3,17] and/or allowed medications.[3,9,14,17,29] It is unclear if the patients followed the recommendations and how these co-interventions could bias the results. In terms

of statistical heterogeneity, however, only one meta-analysis (Fig 3a) suffered statistically significant heterogeneity (Q $P < .001$; $I^2 = 90\%$), and a random-effects model was used. Sensitivity analyses were conducted with only double-blinded studies to minimize risk of bias due to lack of blinding.

Implications for Research

This systematic review with meta-analyses provides low evidence for the use of local anesthesia in the management of MPS in the head, neck, and upper shoulder regions. Due to unclear or high risk of bias, the small total sample size of participants in each meta-analysis (< 400), and the small number of studies pooled, the quality of the evidence was low. There is a need for further well-designed, randomized, placebo-controlled, double-blinded studies for the use of TrP injections with local anesthesia in MPS patients in the head, neck, and upper shoulder regions. Future treatment studies should include detailed patient demographics of trial subjects, including age, gender, comorbidities, details of the areas affected and treated, and the rationale for determining injection sites. Dosages should also be included, and home treatment should be clearly monitored. Larger sample sizes could be applied to future research. Based on this systematic review, it can be concluded that the strength of the evidence is low, and it is hoped that this review will stimulate further research in this area.

Conclusions

Pain reduction was statistically significant in the local anesthetic groups compared to dry needling groups; however, the quality of the evidence was low due to unclear or high risk of bias and statistical heterogeneity. Analyses including only double-blinded RCTs provided no statistical difference between local anesthetic and dry needling, with no major adverse effects noted in this review. The findings support the common practice of utilizing TrP injections after failure of noninvasive treatment modalities such as patient education, change in lifestyle, physical therapy, and medications; however, additional studies with larger numbers of participants, clearly monitored home treatments, and minimal risk of bias are needed to confirm these results.

Acknowledgments

The authors of this review would like to thank Dr Gayle Macdonald for help with editing and formatting of the manuscript. The authors have no funding and no conflicts of interest.

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