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Review Article

Role of Intramuscular Corticosteroids in Trigger Point Injections: A Narrative Review

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Abstract

Background: Myofascial trigger points are common in patients with musculoskeletal pain. While local anesthetic injections are frequently used for treatment, the benefit or detriment of the addition of corticosteroids to the mixture remains unknown.

Objective: In this narrative review, we assessed pain-related and adverse outcomes after trigger-point injections with and without corticosteroids as a component of the injectate.

Methods: We conducted a literature search using PubMed for trials reported in English, selecting studies that directly compared the efficacy of local anesthetic alone to that of local anesthetic with the addition of a corticosteroids to quantify the efficacy and outcome measures.

Results: Four prospective trials met our selection criteria. Three of the four papers demonstrated no benefit from the addition of corticosteroids. One paper reported improved outcomes with the addition of steroids, but it was limited by its overall study design. Adverse outcomes were reported in three of the studies, but they were not specific to any particular group.

Limitations: Notable limitations of this narrative review were the relative paucity of comparative studies and the small number of participants enrolled in each trial.

Conclusion: Given the scarcity of literature, there is inconclusive evidence to support the addition of corticosteroids to the injectate when performing intramuscular trigger-point injections. Due to the numerous and potentially adverse side effects of steroid administration, injection with local anesthetic alone should be utilized as the initial treatment for refractory myofascial pain.

Keywords: Corticosteroids; Injection; Intramuscular; Local anesthetics; Myofascial pain; Myofascial pain syndrome, Narrative review

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Introduction

Intramuscular injections are a common procedure performed by physicians for the treatment of Trigger Points (TrPs) related to Myofascial Pain Syndrome (MPS). Consisting of well-localized hypersensitive nodules, TrPs are associated with acute or chronic pain of muscular origin. They are further identified by taut bands of skeletal muscle fibers that generate pain within the surrounding tissue (referred muscle pattern). TrPs can develop in any location containing skeletal muscle, but they most commonly involve the head, neck, shoulders, back, buttock or thigh regions [1].

A main barrier in the historical understanding of TrPs has been the lack of objective evidence to validate the TrP as a pain generator [2]. While no laboratory test or imaging study is accepted as the gold standard for diagnosis, techniques such as elastography, Electromyography (EMG), and muscle biopsy have all been investigated [1,3-5]. In current practice, TrPs are commonly identified and localized by physicians during physical examinations. Active TrPs are tender areas that produce pain spontaneously at rest and can be exacerbated by palpation. Latent TrPs do not cause pain spontaneously and require manipulation by the examiner to elicit symptoms. Both types of TrPs are capable of inhibiting range of motion and causing muscle weakness or even autonomic or proprioceptive dysfunction [1].

TrPs have been characterized as potential pain generators since the early 1900s. However, the underlying pathophysiological origin remains unknown [1,2,6]. Much attention has been focused on the "integrated hypothesis", a theory that attributes TrP formation to motor endplate dysfunction and localized tissue ischemia [1]. In this model, elevated levels of acetylcholine are released as the by-product of abnormal endplate activity. The ensuing calcium release leads to sustained contraction of skeletal muscle fibers that compress local blood vessels, causing ischemia and ultimately, hypoxia to the site of injury. Regional tissue hypoxia results in an ATP-inefficient anaerobic metabolism requiring a larger net expenditure to relieve muscle contraction. As a result, act in and myosin filaments remain interconnected, maintaining shortened sarcomeres; this leads to contracted knots of muscle and the formation of a TrP [1,2,6-8]. Due to prolonged muscle contraction, biochemical markers involved in pain and inflammation are released by the injured muscle and sensed by nociceptors. Studies have found an increased concentration of

serotonin, calcitonin gene-related peptide, bradykinin, interleukin, and substance P in the area surrounding active TrPs, suggesting their involvement in the inflammatory process [6,8,9].

Both conservative and invasive approaches have been taken for the treatment of myofascial TrPs. Frequently used noninvasive options include manual therapies and modalities such as heat, massage and ultrasound. Oral medications, including anti-inflammatory drugs, analgesics, and muscle relaxants, have also been used, but they are often associated with adverse effects [1,2,6]. The goal of invasive procedures such as dry needling or intramuscular injections is to provide mechanical disruption within a TrP and relax the muscle fibers. Dry needling alone has been shown to be effective, and injections containing saline, local anesthetics, corticosteroids and botulinum toxin have also been investigated in prior studies [2,10-14].

Although corticosteroids are commonly included as part of the injectate for various interventional pain procedures, the evidence supporting their synergistic efficacy is controversial. Multiple studies have suggested that epidural injections including steroids have minimal, if any, benefit when compared to using local anesthetic only [15-17]. Yet, for peripheral nerve block procedures, there is evidence that the addition of dexamethasone can prolong the duration of a block [18,19]. Corticosteroids are not without adverse side-effects, including hyperglycemia, weight gain, hypertension, bone demineralization, or mood changes [20-22]. Even a single injection of methylprednisolone has been shown to cause adrenal suppression in select patients [23].

The goal of this narrative review was to evaluate the efficacy of the addition of corticosteroids to intramuscular injectates for TrP treatment. Accordingly, we examined peer-reviewed, published literature to identify studies that directly compared TrPs in humans treated with and without corticosteroids for myofascial pain.

Materials and Methods

A literature search was conducted using PubMed for trials published from 1966 to October 1, 2015 to identify studies that quantified any additive benefit of corticosteroids to TrP injections.

Selection criteria

We selected pivotal studies that directly compared the efficacy of local anesthetic alone with that of local anesthetic with the addition of corticosteroids to determine any differences in pain relief or adverse effects. The search was limited to prospective human studies in the English language. Articles were excluded if they failed to include pain as a primary outcome. Pediatric populations, review articles, case reports, or case series with sample sizes of ≤10 patients were also excluded.

Risk of bias

Two authors independently graded each study using the Cochrane Risk of Bias Tool to assess the risk of bias in the selected prospective studies. Support for the judgments made for each manuscript is presented in table 1. Any discrepancy between these authors' assessments was evaluated by a third author.

Results

Four prospective studies met the inclusion criteria for this narrative review (Table 2). Bourne conducted a prospective, randomized, single blind trial comparing TrP injections containing both steroids and lidocaine with those containing lidocaine alone; the study included 57 patients with chronic back pain for whom conservative management had failed (details regarding failed treatments and duration of symptoms prior to the injection were not included) [13]. The patients received TrP injections, then follow-up evaluations 2 weeks after the last injection. Nineteen patients were injected with 1ml of triamcinolone 10mg/ml and 1ml of lidocaine 2%; 15 patients were injected with 0.25ml of methylprednisolone 40mg/ml, 0.75ml of water, and 1ml of lidocaine 2%; and 23 patients received injections of 2ml lidocaine 1%. Outcomes were recorded as either excellent, good, or a failure, depending on the decrement of sustained pain at follow-up. In the groups treated with a combination of lidocaine and corticosteroids (triamcinolone or methylprednisolone), 80% of the patients had an excellent outcome; in the lidocaine-only group, 80% of patients did not experience any benefit, and their treatments were deemed failures. The average total number of injections each patient received was higher in the groups with steroids as part of the injectate (among cases with excellent outcomes, steroid-group participants received a total of 3.1 TrP injections and lidocaine-group participants received 1.3; among those with failed outcomes, steroid-group participants received 4.6 TrP injections and lidocaine-group participants received 2.3). However, it was unclear whether the "total number of injections" referred to the treatment of multiple TrPs in different locations or a single TrP during subsequent office visits. TrPs with steroids as part of the injectate resulted in significantly better ($p < 0.001$) outcomes than TrPs with lidocaine alone and were therefore recommended by the author for the treatment of chronic back pain. Adverse effects included transient reports of facial flushing, glycosuria, and menstrual irregularities.

Garvey et al., conducted a prospective, randomized, double blind study investigating the effectiveness of TrP injections to treat lower back pain [24]. The study included 63 patients diagnosed with non-radiating low back strain with a single point of maximal tenderness for which 4 weeks of conventional medical treatments, including non-steroidal anti-inflammatory drugs, were ineffective. The patients attended follow-up examinations 2 weeks after undergoing TrP injection. Thirteen patients received TrP injections with 1.5ml of lidocaine 1%; 14 patients received TrP injections with 0.75ml of lidocaine 1% and 0.75ml of triamcinolone 20mg/ml; 20 patients underwent a single dry-needle stick; and 16 patients were given an ethyl chloride spray followed by 20 seconds of acupressure to the tender site. Outcomes were measured using patient responses on an 11-point pain scale and recorded binarily as either improved or not improved during the follow-up visit. Pain improvement was reported by 40% of the patients injected with lidocaine alone, by 45% of those injected with lidocaine and steroids, by 61% of those treated with a dry-needle stick, and by 66% of those given ethyl chloride spray and acupressure. Comparison of the group of individuals who received a TrP injection with medication and the group of individuals who did not receive an injected medication yielded a p-value of 0.093. Furthermore, no significant differences were found among the interventions. The authors concluded that there was no added benefit with the use of corticosteroids as part of the injectate. Increased pain

was noted as the main adverse reaction for three of the participants; one of these patients was part of the lidocaine-and-steroid injection arm, and two had received a dry-needle stick. A fourth patient, who had also received a dry-needle stick, presented to the emergency room the same evening following intervention with complaints of fever, chills, and gastrointestinal upset.

Author	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective outcome reporting	Other sources of bias
Bourne	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	High risk
	"In accordance with a randomized code…" Code was not defined.		"The patients and the assessor were unaware of the substance used."	All expected outcomes reported.	All expected outcomes reported.	No control over the total number of injections a patient could receive.
	Low risk		Low risk			Low risk
	"Assigned to one of four groups by a computer-generated four-tier entry list."		"Neither the patient nor the treating physician knew the contents of the injection."	High risk		
				"Our attrition rate was an unexpectedly high 20%."	Low risk	
Garvey et al.,		Unclear risk	High risk		All expected outcomes reported.	
			The study did not mention blinding of the patients or any physicians involved.			
	Low risk					
	"The patients were divided into three groups by random draw."			Low risk		
				All expected outcomes reported.		
			Low risk			High risk
			"All medical personal involved in the care of the patients as well as the patients were blinded to the treatment."		Low risk	No control over the total number of injections a patient could receive.
Venancio et al.,	Low risk				All expected outcomes reported.	
	"The block randomization method was used for the randomization of patients."	Unclear risk				
				Low risk		
				All expected outcomes reported.		Low risk
Misirlioglu et al.,					Low risk	
					All expected outcomes reported.	
		Low risk				
		"The randomization was performed by the second physiatrist who was not involved in patients' assessment and injection procedures."				

Table 1: Risk for bias in prospective studies.

Author	Year	Study Design	Methods	Outcome Measures	Results
Bourne	1984	Prospective, randomized, blinded	N = 57	Subjective patient response	In the groups treated with steroids, 80% had excellent results. In the group treated with only lidocaine, 80% were failures.
			A: 2% Lidocaine 1ml + Triamcinolone 1ml (10mg/ml) (n=19)		

			B: 2% Lidocaine 1ml + Methylprednisolone 0.25ml (40mg/ml) + Water 0.75ml (n=15)		Injections of steroids + lidocaine were more successful than lidocaine alone.
			C: 1% Lidocaine 2ml (n=23)		
			Subjects received varying number of injections. Follow-up done 2 weeks after last injection.		
Garvey et al.,	1989	Prospective, randomized, blinded	N = 63		Improvements in pain were seen in 40% of Group A, 45% of Group B, 61% of Group C, and 66% of Group D.
			A: 1% Lidocaine 1.5ml (n=13)		
			B: 1% Lidocaine 0.75ml + Triamcinolone 0.75ml (20mg/ml) (n=14)	Subjective patient response, pain scale	No significant differences were found among the groups.
			C: Single dry-needle stick (n=20)		
			D: Ethyl chloride spray 10s followed by acupressure 20s with needle guard (n=16)		
			Follow-up done 2 weeks post-injection		
Venancio et al.,	2008	Prospective, randomized			Significant improvement in the modified SSI at 1, 4, and 12 weeks in all three groups.
			N = 45		
			A: Dry needling (n=15)	Modified Symptom Severity Index (SSI), pain diary, pain questionnaire	Steroid + lidocaine group had less post-injection discomfort and less need to take oral rescue medication.
			B: 0.25% Lidocaine (n=15)		
			C: 0.25% Lidocaine + Dexamethasone 0.2ml (4mg/ml) (n=15)		
			Subjects received 1-3 injections during a single evaluation. Follow-up done at 1, 4, and 12 weeks after the injections.		
Misirlioglu et al.,	2015	Prospective, randomized, blinded			Significant improvement in NRS and LAS scores at 1 week, 1 month, and 3 months in both groups.
			N = 47	Pain measured by Numeric Rating Scale (NRS) and Likert Analogue Scale (LAS)	
			A: 2% Lidocaine 5ml (n = 22)		No significant differences were found between the groups.
			B: 2% Lidocaine 4ml + Betamethasone 1ml (n = 25)		
			Injections were performed under ultrasound guidance. Follow-up done at 1 week, 1 month, and 3 months after injection.		

Table 2: Trigger point injections: comparative studies.

Venancio et al., performed a prospective, randomized trial investigating the potential benefit of TrP injections containing lidocaine and steroids when compared to injections containing lidocaine alone to treat patients with both myofascial pain and headaches [25]. Forty-five patients with moderate-to-severe headaches and at least one TrP in the orofacial or cervical region that elicited a headache upon palpation were examined at the initial encounter, then 10 minutes, 1 week, 4 weeks and 12 weeks following injection. Group 1 was treated with dry needling; group two received a TrP injection with lidocaine 0.25%; and group 3 received a TrP injection containing lidocaine 0.25% and 0.2ml of dexamethasone 4mg/ml. Each patient received a total of one to three injections during the initial encounter, based on the number of TrPs that elicited a headache. Outcome measures included the modified Symptom Severity Index (SSI), a pain diary, a pain questionnaire, and physical examination. Results showed a significant decrease in the modified SSI from baseline at all follow-up examinations for each group ($p < 0.001$). A comparison of the length of time required to relieve local sensitivity and headache following injection showed no significant differences among the groups ($p = 0.9774$). Less post-injection discomfort was reported by participants who had received TrP injections with lidocaine and steroids than by those who had received injections with lidocaine alone or dry

needling (total discomfort lasted 1.2 days for the lidocaine-plus-steroid group, 1.73 days for the lidocaine-only group, and 2.53 days for the dry-needling group). The authors of the study concluded that TrP injections containing lidocaine alone and those containing lidocaine and steroids were both as effective as dry needling in this patient subset. Adverse effects were not reported.

Misirlioglu et al., conducted a prospective, randomized, double blind trial investigating the differences between TrP injections containing lidocaine and steroids and those containing lidocaine alone for the treatment of piriformis syndrome [26]. Forty-seven patients with tenderness and/or presence of a TrP over the piriformis muscle received TrP injections under ultrasound guidance. The injection was given intramuscularly at the point of maximum tenderness, and patients were subsequently evaluated 1 week, 1 month and 3 months after the procedure. Twenty-two patients received an injection of 5ml lidocaine 2%, while 25 patients received an injection containing 4 ml of lidocaine 2% and 1 ml of betamethasone. Outcomes were measured using the Numeric Rating Scale (NRS), Likert Analogue Scale (LAS), and patient responses to clinical maneuvers performed during the physical examination. The results showed that patients who received either type of TrP injection had statistically significant improvements in pain as measured by the NRS and LAS during each of the three evaluations ($p < 0.05$). A direct comparison of the two groups revealed no statistically significant difference ($p > 0.05$). The authors concluded that the addition of corticosteroids did not have an added benefit for the treatment of piriformis syndrome. Sciatic nerve block, which resolved within a few hours, was the main complication observed in 12 of the patients following injection; six of these patients had received lidocaine injections alone, while the other six had received injections of lidocaine and steroids.

Discussion

The term MPS is often ambiguous. Many define MPS as a syndrome characterized by myofascial TrPs, while others describe it as a generalized pain disorder of unspecific muscular origin. Often confused with MPS, fibromyalgia is a separate disease process with its unique features; it is a chronic pain condition involving multiple tender points in various regions throughout the body. Although fibromyalgia is often associated with diffuse pain, tender points can also occur in the same locations as TrPs. Patients can have both fibromyalgia and MPS concomitantly, which may add further confusion to the diagnosis [1]. In a study that compared patients diagnosed with both fibromyalgia and MPS to patients with only MPS, TrP injections were found to be less effective in patients with a dual-diagnosis [27].

Although TrP injections are widely used for interventional pain management, the pathophysiology of TrPs remains a complex and evolving topic. Data from two recent studies by Shah et al., support the proposed "integrated hypothesis". Their findings suggest evidence of inflammation and an increased concentration of specific inflammatory mediators, cytokines and neuropeptides near an active TrP [6,8,9]. Recognition of these sensitizing markers by nociceptors offers an explanation of how pain is generated. Still, it also raises questions regarding the inability of steroids to render a benefit when added to the injectate. Pain caused by TrPs is likely multifactorial and only partly attributed to inflammation, as suggested by the finding that mechanical disruption, rather than injectate material, is the critical factor in TrP injections [1,24,28].

Attempts to find an alternative method to diagnose TrPs have focused on techniques such as EMG, ultrasound elastography, and Magnetic Resonance Elastography (MRE). In one study employing EMG, the authors found sustained spontaneous electrical activity localized to a small region within a TrP. This activity was absent in surrounding tissue when the needle was positioned as little as 1mm away from the primary focus [3]. Use of this modality in clinical practice may prove challenging given heterogeneous practitioner skillsets and the precision needed to identify the exact target for needle placement. Two other studies investigated the application of elastography in ultrasound and magnetic resonance imaging. Both reported promising results suggesting that taut bands are detectable and quantifiable with MRE [4]. Ultrasound can be used to identify TrPs as focal, hypoechoic regions [5]. A recent trial examined the use of ultrasound vibration elastography as a method to quantify tissue changes in patients with TrPs treated with dry needling. This technique identifies TrPs based on vibrational patterns and color deficit on Doppler imaging when compared to normal surrounding muscle. The results showed concordant findings from physical examination and vibration elastography in patients who had received dry needling, suggesting that the use of elastography may make treatment processes more objective [29].

Dry needling itself has proven effective for the inactivation of a TrP. The actions of this procedure are thought to induce mechanical disruption of the TrPs and relax the muscle tissue [1,10]. The ability to elicit a local twitch response during needle stimulation has been crucial in obtaining immediate therapeutic relief. However, a comparative study between dry needling and injections containing anesthetic showed that dry needling was associated with longer and more severe post-injection soreness [7,28]. Therefore, the addition of anesthetic is recommended to minimize secondary discomfort.

Of the four studies included in our review, three revealed no significant differences between patients who received an injection of lidocaine and those who received a combination of lidocaine and corticosteroids. The exception was the trial conducted by Bourne, which, at the 2-week follow-up examination, revealed better outcomes associated with the addition of steroids [13]. However, the study's experimental design did not control for the total number of injections each patient received throughout the study. Consequently, the positive outcomes in the steroid-plus-lidocaine arm may be related to these patients undergoing a greater number of total injections than those in the lidocaine-alone treatment arm.

In Venancio's paper, both study groups showed significant pain improvements, but only patients treated with lidocaine and steroids reported less post-injection discomfort and ingestion of pain medication [25]. One explanation for these findings may be the anti-inflammatory effect of corticosteroids. However, similar to the Bourne study, the varied number of injections given to each subject may have confounded the results. The role of injectable corticosteroids in relieving inflammation is better described for intra-articular conditions than for soft-tissue diseases [30]. Despite the lack of studies investigating the effects of corticosteroids on TrPs, steroids are commonly used to suppress inflammation and tenderness at various sites throughout the body. They function by limiting the expression of cytokines, inhibiting the formation of inflammatory mediators, and decreasing cellular and fluid movement in the vascular space [31].

The addition of corticosteroids to the injectate is not without risk and may incite damage to muscle, skin, or other structures near a TrP [1]. Steroid injections into soft tissue have been associated with skin atrophy and depigmentation, and injection of steroids into a tendinous area should be avoided to minimize the risk of injury or tears [1,32]. In a study examining tendon pathology after direct steroid injection, histological findings revealed compromised cell growth, reduced mechanical integrity of the tendon, and increased collagen necrosis [33]. Although local anesthetics are known to have myotoxic properties, the effects of an injection containing both steroids and anesthetic may compound the adverse effects [1,34]. A study performed on rats found injections of triamcinolone and bupivacaine to have greater myotoxicity than injections with bupivacaine alone. The combination group had more extensive muscular lesions and delayed regeneration of damaged tissue than the group of rats treated with bupivacaine monotherapy [34]. Other well-known side-effects of prolonged or high-dose corticosteroids administration include weight gain, osteoporosis, and suppression of the pituitary-adrenal axis [22]. Importantly, case reports describe the onset of life-threatening conditions after a single dose of intra-articular or intra-muscular corticosteroids, including adrenal suppression, avascular necrosis, and fatal septicemia [23,35,36].

The main limitations of this review were the small number of studies and the limited sample size of each trial. We found only four papers that compared steroid TrP injections with a suitable control. The number of participants in these trials ranged from 45 to 63. Studies with larger samples are preferred to improve the validity of the outcomes. Another limitation was the differing compositions of the injectate solutions. Different steroids, concentrations of anesthetics, volumes, and injections sites were used in each trial, the impact of which is unclear. Variability in the total number of injections was a confounder in multiple studies that met our search criteria [13,25]. Furthermore, each paper relied upon subjective patient responses to measure the outcome.

Conclusion

Due to the paucity of well-designed studies, it remains difficult to draw definitive conclusions regarding the additive benefit of corticosteroids for TrP injections. Due to the rare but potentially severe side-effects of corticosteroids, practitioners should consider injection of a local anesthetic alone for the initial treatment of myofascial TrPs. Furthermore, the frequent dosing of corticosteroids of unclear benefit may greatly increase the cumulative exogenous corticosteroid burden on our patients, and limit their candidacy for other interventional pain management injections.

Future research is needed to elucidate the mechanism of pain propagation in TrPs and to determine the utility of corticosteroid injections in their treatment. Larger, well-designed, prospective randomized controlled trials are necessary to determine the role of corticosteroids in trigger point injections..

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