Original Paper

Pilot Study of the Clinical Equivalence of Laser Needle to Metal Acupuncture Needle in Treating Musculoskeletal Pain

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Abstract

Background: Acupuncture has been in clinical use for over 3000 years, and its methodology has evolved as new technological advances occurred over time.
Objective: To determine if relief of regional musculoskeletal pain using metal and laser needles at acupoints have clinical equivalence
Design: A prospective crossover cohort study of subjects previously treated for musculoskeletal pain with metal needles using laser stimulation of those same acupoints
Setting: Outpatient clinic
Subjects: 30 adults with chronic joint (knee or shoulder) and/or spine musculoskeletal pain previously successfully treated with acupuncture using metal needles
Intervention: Focused laser (Laserneedle) stimulation of the same acupoints previously treated with metal needles alternating with treatments using metal needles for 2 cycles (metal → laser → metal →laser)
Main Outcome Measures: VAS pain rating one to three weeks after treatment, patient preference (metal needle versus laser), laser complications
Results: For subjects with knee and shoulder arthritis, metal needle VAS was 5.9 while Laserneedle VAS was 3.1 (mean difference 2.8, $P<0.001$ single tail). For subjects with spine pain, the metal needle VAS was 3.7 while Laserneedle VAS was 2.95 (mean difference 0.75, $P<0.074$). 9/10 subjects with joint arthritis reported more efficacy with Laserneedle and the other found it equally efficacious. 10/20 spine pain subjects reported more pain relief efficacy with Laserneedle, and another 6 found the interventions equally efficacious. No complications from the laser treatment were noted.
Conclusions: This prospective, crossover cohort study of subjects with chronic musculoskeletal pain demonstrates that metal and laser acupuncture needles have clinical equivalence in reducing pain, and that patients (especially those with shoulder and knee arthritis) report preference for laser needle treatments.

Key words, pain, musculoskeletal pain, acupuncture, laser, crossover cohort study

Introduction

The *Yi Jing* (1) delineated many of the philosophic underpinnings that subsequently were incorporated into Traditional Chinese Medicine (TCM) diagnostic and treatment principles that were later described in the *Nei Jing* circa 200 BC. Thus, the founding text of acupuncture principles reflects over a thousand years of clinical acumen in diagnosing and treating human illness. As technology subsequently has evolved, so has the practice of acupuncture. Needle technology has improved as metallurgy has advanced, and electrical stimulation of needles (in lieu of or in conjunction with moxibustion) is commonly incorporated in acupuncture treatments worldwide. Continuing research into the mechanisms of acupuncture exploit contemporary advances in anatomic (2,3), physiologic (4), and clinical (5-7) technologies and scientific knowledge to advance the practice of acupuncture and allow an understanding from modern terminology of the beneficial effects of acupuncture treatments.

Though only about 30% of the acupuncture literature relates to its beneficial effects in treating pain conditions (1), it is perhaps the most widely known use of acupuncture in the West. Though some acupuncture theorists (8) continue to attempt to claim that *ahshi* tender points associated with the Muscle channels that are used to treat musculoskeletal pain are anatomically and physiologically distinct from the classical acupoints that exist on the Primary channels, this view is not supported by reference texts (9) which clearly state that the Muscle channels were never intended to be considered separate anatomic/physiologic structures by the founders of TCM theory, but rather the Muscle channels were a way to describe the musculotendinous structure of the body within the framework of channel theory. As such, classical acupoints can be used to treat pain in the Muscle channels, per the Shanghai College of Traditional Medicine text. All but 2 classical acupoints have pain indications (9,10). Contemporary musculoskeletal pain research provides physiologic evidence that this is true, as classical acupoints anatomically proximate to the common trigger points described in the Trigger Point Manual (11,12) have musculoskeletal pain indications (9,10) that are similar to those described for their proximate trigger points (6) in at least 94% of comparisons (and likely up to 97%).

Though low power ("cold") laser has been used to treat musculoskeletal pain in myofascial pain (13) and acupuncture (14) research studies for decades, until recently, technology has not allowed sufficient focusing of the laser beam to allow penetration of the laser light energy to the muscular layer of the body, where the Principal meridians are theorized to course (1,9). Laserneedle technology (15) has been recently introduced in Europe and the United States which provides a much more focused laser beam that can allow light energy to penetrate over 4 cm through the skin, and thus provide focused light energy to the body's muscular layer where classical acupoints (and trigger points) exist.

The purpose of the present pilot study is to determine whether Laserneedle stimulation of classical acupoints to treat musculoskeletal pain conditions has comparable clinical efficacy to use of metal acupuncture needles.

Methods

Thirty adult patients from the author's outpatient clinic practice were recruited into this minimal risk pilot study over a period of 2 months comparing metal needle to

Laserneedle for treating their chronic musculoskeletal pain conditions. Ten patients were male and 20 female. Their average age was 69.5 years (range 42-95, sd= 16.4 years). Ten patients had severe shoulder or knee osteoarthritis (Figure 1), and the other 20 had spine pain with related degenerative joint and disc disease and related myofascial pain. All subjects had been receiving metal acupuncture needle treatment for musculoskeletal pain refractory to standard medications (non-steroidal anti-inflammatory agents and/or muscle relaxants), physical therapy interventions (including modalities and TENS), and no (or non-sustained) improvement with trigger point injections or intra-articular corticosteroid injections. Verbal consent to participate was obtained from all patients for Laserneedle treatment, which has no significant reported adverse events related to its use to date (15).

Subjects were treated with the Laserneedle at the same local musculoskeletal pain points (Tables 1-4) that had been previously treated with metal needles. For spine pain patients, six points along the inner or outer Bladder channels in the paraspinal muscles that were maximally tender were chosen to treat with the metal/laser needles. BL-10 and BL-11 were included in the neck treatments, and BL-23 and BL-25 in the lumbar treatments. The next treatment was at the same points with the metal needles, and then the cycle was repeated on subsequent visits (metal → laser → metal → laser) for a total of two Laserneedle treatments separated by a minimum of 10 days (maximum 30 days depending on duration of clinical response). Thus the design is that of a prospective cohort crossover study. The study duration was 6 months total.

The author, who has over 20 years experience treating myofascial pain conditions, and over 10 years experience utilizing acupuncture for treating pain and visceral disorders) applied all treatments and recorded all data. Neutral statements about whether the laser would work better than needle for treating pain were used prior to treatments "some people prefer Laserneedle treatments, and others prefer metal needle". VAS pain scale was recorded prior to each treatment. Seirin J 0.14 mm, 40mm sterile disposable needles were used for the metal needle treatments and inserted 1-3 cm as appropriate for a given point until *deqi* response was obtained. No needle stimulation was performed, and treatments lasted 20 minutes. Laserneedle treatments were with 80 mW infrared laser at 50% power for 20 minutes at the same points used to treat with metal needles. Patient preference for laser versus needle stimulation was inquired after the 4 treatment cycle ended. Those subjects experiencing increased pain relief from the Laserneedle system were continued on that treatment, and duration of time between appointments was gradually increased to determine the maximum duration of efficacy of the pain relief with a Laserneedle treatment.

Statistics

Statistics were performed with VassarStats software. $P<0.05$ was considered statistically significant for analysis of means using single tail t-test.

Results

For patients with shoulder and knee arthritis pain, the Laserneedle treatment had increased efficacy and was preferred by subjects in 9/10 comparisons, while in the other subject the treatments were equally efficacious. The mean VAS rating after treatment

with metal needles was 5.9, while the VAS rating of 3.1 after Laserneedle treatment was significantly improved (mean difference= 2.8 +/- 0.94, $p<0.001$).

For patients with spine pain (Table 6), the Laserneedle treatment had increased efficacy and was preferred by subjects in 10/20 comparisons, had comparable efficacy but was preferred in 6/20 comparisons, and less efficacy in 4/20 patients (average 2 VAS points worse). Overall the mean VAS improvement with Laserneedle treatment compared to metal needle was 0.75. This improvement using the Laserneedle system approached but did not reach statistical significance (mean difference= 0.75+/-0.92, $p=0.053$).

Duration of effect with Laserneedle ranged from 5 days in setting of severe shoulder osteoarthritis, to 35 days in a patient with lumbar myofascial pain in the setting of degenerative joint and disc disease (mean duration= 17.8+/-7.52 days, CI=3.34 days).

No complications from the Laserneedle system were noted. The only complication from metal needles was painless, local bruising in 2 subjects which resolved spontaneously.

Discussion

Technology has advanced in the last decade that allows medical laser energy to be sufficiently focused to allow penetration through skin in humans over 4 cm (15). This allows precise stimulation of trigger points and classical acupuncture points which occur in the muscular/myofascial layer of the body (1,9).

Though separated by disparate cultures 2000 years apart, differing languages, and different levels of scientific knowledge leading to different but internally consistent conceptualizations of human health and disease, myofascial pain syndrome data has remarkably similar findings to those of the acupuncture tradition. This may be because ultimately the targets of the needles in both disciplines are the neurovascular bundles which course through the myofascial layer of the body (Figure 2). The Mayan culture also independently developed similar conceptualizations of using needling of specific body sites to treat pain and visceral disorders (16). This suggests that all these bodies of knowledge must be expressing varying interpretations of the same underlying human physiology of health and illness. Thus it should not be surprising that over 93% of the common trigger points described by Travell and Simons (11,12) are proximate to and have similar clinical indications to classical acupoints (5,6). Further, the myofascial referred-pain patterns of trigger points follow the meridians of their proximate classical acupoints in 91% of comparisons (7) and can be used to provide physiologic evidence of the Principal meridians (17). The similarity of the anatomic locations of shoulder girdle muscles (which can have trigger points anywhere in a muscle) and classical acupoints used in this pilot study is demonstrated in Figure 3.

The present study chose acupoints based on a neuroanatomic basis. The shoulder joint, for example, is innervated by fibers from the suprascapular nerve, axillary nerve, and branches from the lateral pectoral nerve (18). The points chosen stimulate those nerve branches, and/or the joint itself (Jubi). Though ST-38 is traditionally frequently used to treat shoulder problems, it was not included in the present treatment regimen which emphasized local classical acupoints that treat the problem and can be related to trigger points in the same muscle regions.

Though this pilot study did not randomize subjects or enroll subjects who were acupuncture naïve, the design does help eliminate placebo effect by having enrolled

subjects who already had favorable responses to metal needle treatments by the same practitioner, and by alternating metal and laser needle treatments twice to allow the patients more than one opportunity to decide which treatment worked better for them. Since subjects were followed beyond the duration of the study, the subsequent Laserneedle treatments for patients with positive clinical responses allowed any placebo-type effect to extinguish with subsequent treatments. No patients who reported improved pain relief with the Laserneedle system has experienced subsequent loss of efficacy, and in particular virtually every subject with severe joint arthritis has continued to report experienced clinically significant pain relief with the Laserneedle (compared to metal needles) that lasts up to three weeks even in the presence of complete joint space loss such as demonstrated in Figure 1.

The marked favorable clinical response to the Laserneedle intervention (nearly 3 VAS points better, $p<0.001$) in patients with marked shoulder and knee arthritis was not expected, and these results need to be confirmed in a formal, randomized, placebo controlled prospective study. The Laserneedle machine used in this study also has the capability of performing placebo infrared acupuncture using a switch that powers off the laser beam but otherwise the machine appears to run normally, and will allow both the patient and operator to be blinded as to whether the laser is active during the treatment.

Patients with spine pain also reported overall that the Laserneedle system was preferred for treatment of their pain, with half of the 20 patients experiencing enhanced relief with the Laserneedle compared to metal needles, and six others experiencing comparable relief.

As reported from prior European experience (14), no adverse effects from the Laserneedle treatment were noted. The potential of Laserneedle technology to allow safe treatment of painful joint arthroplasties or patients on anticoagulants, as well as to allow painless treatment of pediatric patients, is substantial.

Conclusions

The present pilot study of laser versus metal needle treatments for chronic musculoskeletal pain due to shoulder, spine, or knee degenerative changes suggests that Laserneedle stimulation is at least equivalent (and likely superior) to use of traditional metal needles. The absence of pain and lack of piercing of the skin with the Laserneedle technology offer an even greater safety profile than traditional metal needles. The benefits of Laserneedle treatments were particularly strong in treating major joint arthritis pain. Formal prospective, double blinded, placebo controlled studies should be pursued to confirm these findings; and the strength of the findings in the present study should provide impetus for further studies.

Disclosures

The author has no competing financial interests.

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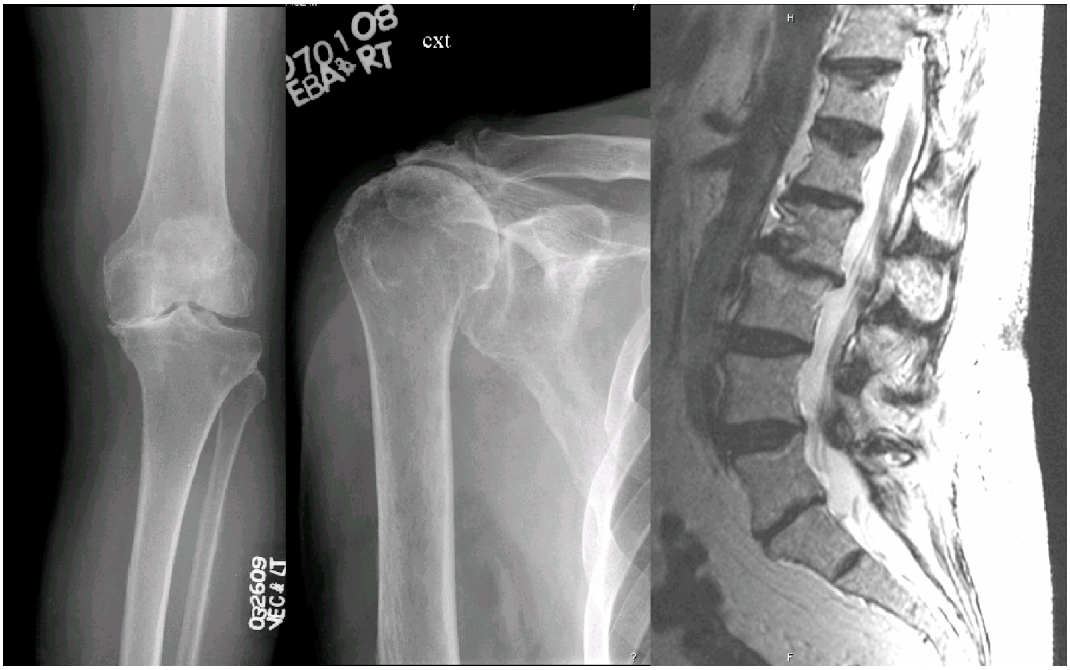

Figure 1. Examples of Typical Shoulder, Knee, and Spine Radiographs in the Subjects Treated

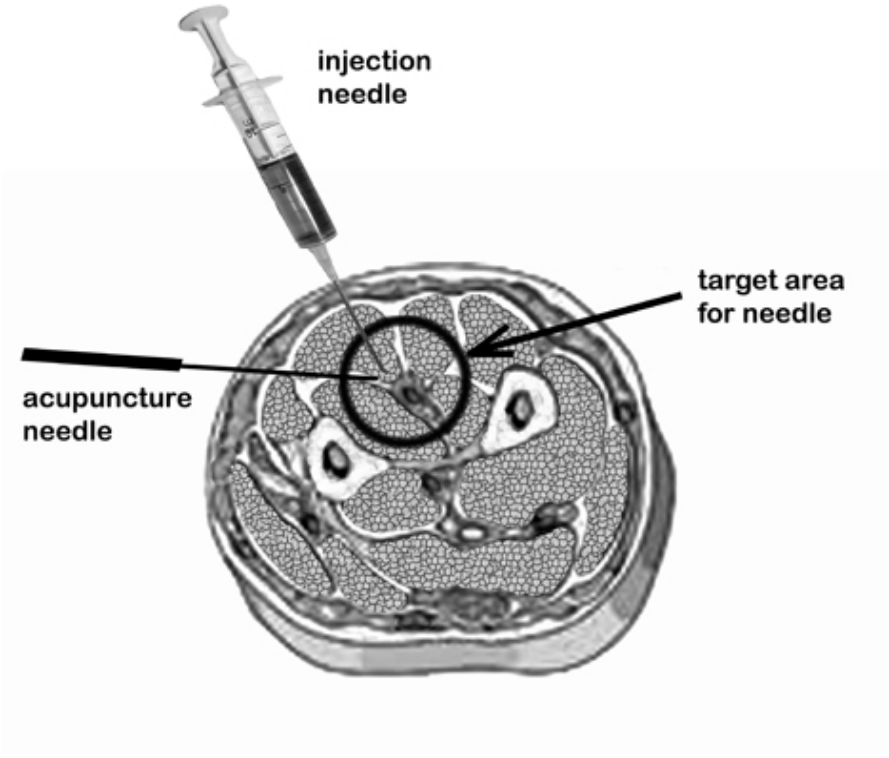

Figure 2. Trajectories of Trigger Point and Acupuncture Needles

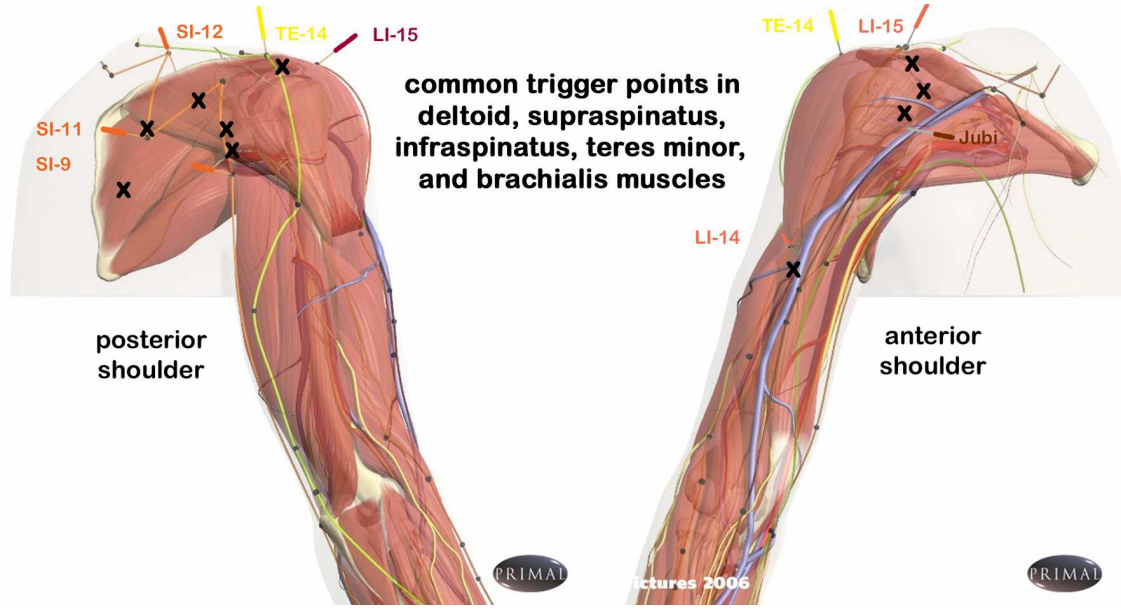

Figure 3. Relationship of Study Shoulder Acupoints to Shoulder Girdle Musculature

Muscle Trigger Point	Corresponding Acupoint	Nerve Affected
anterior deltoid	Jubi	axillary, branch of lateral pectoral
anterior deltoid	LI-15	supraclavicular
lateral deltoid	LI-14	axillary
posterior deltoid, supraspinatus tendon	TE-14	supraclavicular
posterior deltoid, teres major	SI-9	axillary
supraspinatus	SI-12	suprascapular
infraspinatus	SI-11	suprascapular

Table 1. Trigger Points and Anatomically Corresponding Acupoints Used to Treat Shoulder Pain

Acupoint	Actions	Acupuncture Pain Indications
Jubi	"raise arm"	
LI-14	Meeting point of Large Intestine with Small Intestine & Bladder channels	shoulder pain, arm pain
LI-15	Meeting point of Large Intestine with Small Intestine & Triple Energizer channels	shoulder pain, arm pain
TE-14	Meeting point of Triple Energizer channel with Yang linking vessel	shoulder pain, shoulder joint soft tissue diseases
SI-9	"true shoulder", activates the Small Intestine channel, alleviates pain, benefits the shoulder	shoulder or scapular pain, shoulder disorders
SI-12	Meeting point of Small Intestine channel with Large Intestine, Triple Energizer, and Gallbladder channels	benefits the shoulder and scapula
SI-11	"celestial gathering", activates the channel, moves qi, relieves pain	shoulder or scapular pain

Table 2. Acupoints for Shoulder Pain and Their Actions and Traditional Indications

Muscle Trigger Point	Corresponding Acupoint	Nerve Affected
vastus medialis	SP-10	femoral nerve
medial gastrocnemius	KI-10	saphenous nerve
vastus lateralis	ST-34	lateral femoral cutaneous nerve
lateral gastrocnemius	BL-39	common peroneal nerve
peroneus longus	GB-34	common peroneal nerve
n/a	infrapatellar point	branch of peroneal nerve

Table 3. Trigger Points and Anatomically Corresponding Acupoints Used to Treat Knee Pain

Acupoint	Actions	Acupuncture Pain Indications
SP-10	“sea of blood”, dispels stasis	medial thigh pain
KI-10	He sea point on Kidney channel, activates channel, alleviates pain	knee disorders, medial thigh pain
ST-34	Xi cleft point on Stomach channel, activates the channel, alleviates pain	knee disorders
BL-39	Lower He sea point on Triple Energizer channel, activates channel, relieves pain	leg muscle cramp or paralysis
GB-34	Hui point for tendons and muscles, He sea point on Gallbladder channel, activates channel, relieves pain, benefits the joints	leg pain, knee disorders

Table 4. Acupoints for Knee Pain and Their Actions and Traditional Indications