The ‘dry-needle technique’: intramuscular stimulation in tension-type headache

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The ‘dry-needle technique’, an intramuscular stimulation technique carried out by using a fine solid, 1-inch long, 30-gauge needle, was investigated in the treatment of tension-type headache (TTH) in a randomized, placebo-controlled trial. Fifteen patients with TTH received intramuscular needle insertions into six designated trigger points, while 15 controls received subcutaneous insertions. Headache indices, muscle tenderness and neck ROMs were evaluated before and after treatment. Mean headache indices improved significantly after treatment, both in the treatment group and in the placebo group, but the difference between the two groups was insignificant. In the treatment group the tenderness score and the neck ROM limitation score were significantly improved after treatment, while there was no significant improvement in the placebo group. We conclude that more and larger controlled, comparative trials are needed to show whether the dry-needle technique is an effective non-pharmacological alternative for the treatment of TTH.

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Introduction

Tension-type headache (TTH) is a bilateral, pressure-like headache of mild-to-moderate intensity which can last from 30 min to 7 days and has only one accompanying symptom, such as nausea, vomiting, photophobia and phonophobia. Physical and neurological examination is normal. In episodic TTH there are less than and in chronic TTH there are more than 15 attacks per month. These two types of TTH are again divided into two subgroups in which there is presence of pericranial muscle tenderness or not (1).

The ‘dry-needle technique’ is an intramuscular stimulation technique carried out by using a fine solid 30-gauge needle which is 1 inch long (2). It has been used in several chronic pain disorders including headache (2–4). The only study using the dry-needle technique for the treatment of various headache syndromes is an uncontrolled non-blinded study (4). We report the first placebo-controlled, randomized study investigating the efficacy of the dry needle technique in subjects with TTH.

Patients and method

This is a placebo-controlled, randomized, double-blind study including 30 patients, all women. Patients were recruited from our headache outpatient clinic. All patients included in the study had TTH; 20 (66.7%) had chronic TTH, eight (26.7%) had episodic TTH and two (6.7%) had episodic TTH in combination with migraine without aura. The headaches were diagnosed according to the diagnostic criteria of the International Headache Society (1) published in 1988, and diagnosis was based upon the history given, excluding possible organic causes for headache by history, neurological and physical examination and necessary laboratory examinations. Patients without pericranial muscle involvement were not included. Patients were asked to keep a headache diary, from which the pre-treatment baseline values were calculated, and were followed-up 15 days before and during the study. All patients had only used analgesics for headache treatment in the past and were not allowed to use any analgesic drugs during the study. There were no patients using excessive
analgesics and there was no difference in analgesic consumption between the two treatment groups.

Pain intensity, trigger-point tenderness and neck range of motion (ROM) were assessed in all patients before and after treatment. A headache index (HI) was calculated for each patient, from the statements in the headache diary, by multiplying the headache intensity and the days with headache. Muscle tenderness was assessed by palpating the neck muscles at their insertion at the linea nucha superior using a 4 degrees rating scale described below. Neck ROM was assessed as degree of restriction during lateral flexion to the right, lateral flexion to the left, anterior flexion, posterior flexion, rotation to the right, rotation to the left, flexion-rotation to the right and flexion-rotation to the left. The following rating scales were used for assessment:

- **Pain intensity**: 0 = no pain; 1 = mild pain; 2 = medium pain; 3 = intense pain; 4 = severe pain.
- **Trigger-point (muscle) tenderness**: 0 = no report of pain and no visible reactions; 1 = report of tenderness but no visible reaction; 2 = report of painful tenderness and visible reaction by face and mimics; 3 = report of severe pain and marked visible reaction or avoidance.
- **ROM**: 0 = no restriction; 1 = minimal restriction (35–45°); 2 = medium restriction (20–35°); 3 = marked restriction (less than 20°).

Patients were allocated by chance into either the active treatment group or the placebo group. In the active treatment group intramuscular stimulation was carried out by 30-gauge, 1-inch needles to six pre-designated trigger points: two behind the mastoid reaching the left and right m. splenius capitis; two at both sides of C-5 reaching the left and right m. splenius capitis and m. splenius cervicis; and two into the mid-trapezius muscle reaching the left and right m. trapezius. All patients received needle insertions to the six pre-designated trigger points previously described by Gunn (2).

The needles were left inserted in the muscle for 30 min. While the active group received intramuscular needle insertions, needles were inserted only subcutaneously in the placebo group.

The patients in both groups were treated at weeks 1, 2, 3 and 4 by using this technique. Post-treatment evaluation was carried out at week 4. Evaluation and needle insertion were carried out by two separate neurologists, the one doing the evaluation being blind to the treatment given.

The data were analysed by using the Students’ *t*-test, paired *t*-test, Mann–Whitney *U*-test, Wilcoxon test, covariance analysis and the chi-square test.

**Results**

Thirty patients, all women, were entered into the study. The mean age was 27.9 ± 10 for the placebo group and 28.4 ± 11.6 for the treatment group. In the placebo group 10 (67%) patients had chronic TTH and five (33%) had episodic TTH, while in the treatment group there were 10 (67%) patients with chronic TTH, three (20%) with episodic TTH and two (13%) with episodic TTH in combination with migraine without aura. There was no significant difference between the two groups for all demographic data. The mean years of headache were 52.2 months in the placebo group and 37.6 in the treatment group.

The mean headache frequency was 25.2/month in the placebo group and 29.6/month in the treatment group, calculated from the headache diaries kept for 15 days.

The mean pre-treatment headache index was 37.4 ± 13.4 in the placebo group and 30.4 ± 16.4 in the treatment group. There was no significant difference (*P* > 0.05) between the two groups. The mean post-treatment HI was 15.7 ± 7.0 in the placebo group and 10.8 ± 5.9 in the treatment group. The headache indices in both groups significantly improved after treatment (*P* < 0.05) but the difference in improvement between both groups was non-significant (Fig. 1). The improvement in the headache indices resulted from reduction in both intensity and frequency of the headache.

The mean tenderness scores before treatment were 1.67 ± 0.49 in the placebo group and 1.67 ± 0.49 in the treatment group. After treatment the scores were 1.47 ± 0.64 in the placebo group and 0.60 ± 0.63 in the treatment group. When pre- and post-treatment scores were compared the difference in the placebo group was

![Figure 1 Pre- and post-treatment mean headache indices in both treatment groups](image_url)
non-significant, while there was significant improvement ($P<0.001$) in the treatment group (Fig. 2). The difference in improvement between both groups was significant ($P<0.001$).

Mean pre-treatment neck movement limitation scores for the right and left sides were $1.03\pm0.85$ and $0.87\pm0.74$, respectively, for the placebo group and $0.87\pm0.94$ and $0.80\pm1.08$, respectively, for the treatment group. There was no significant difference for the pre-treatment right and left mean ROM scores between both treatment groups. After 4 weeks of treatment the mean scores were $1.07\pm0.70$ and $0.80\pm0.68$, respectively, in the placebo group and $0.47\pm0.83$ and $0.33\pm0.49$, respectively, in the treatment group. After treatment both right and left ROM significantly improved in the dry-needle group ($P<0.05$), while post-treatment changes were not significant in the placebo group. When improvement in ROM was compared in the two groups the difference was non-significant (Fig. 3).

**Discussion**

The exact pathogenetic mechanisms of TTH are still under investigation. Pericranial muscle tenderness, which can be found in a lot of headache sufferers (5–7), is the most apparent abnormality in patients with TTH (5) and has been shown to be highly correlated to the intensity of tension headache in TTH (7). Involvement of the neck muscles is also a common feature of TTH and leads to limitation of neck movements (8).

Several drugs such as muscle relaxants, analgesics and antidepressants, as well as non-pharmacological treatments such as behavioral therapy, psychotherapy, hypnosis, bio-feedback and acupuncture, have been used in the treatment of TTH (9–15). The dry-needle technique has been used in several chronic pain disorders (2, 3), including chronic headache (4), but controlled studies showing the efficacy of this technique in TTH are lacking.

It has been reported that insertion of a needle with or without injection into a trigger point may produce immediate as well as prolonged analgesia (16, 17) One of the body’s responses to inflammation is the generation of injury potentials. The insertion of a needle into a muscle generates bursts of electrical discharges with amplitudes as high as 2 mV. These discharges can cause a shortened muscle to visibly fasciculate and relax instantly or within minutes. The effect of the stimulation can persist for days. Pain relief and muscle relaxation in
one region can spread to the entire segment, suggesting a reflex mechanism involving spinal modulatory systems. Sympathetic hyperactivity also responds to reflex stimulation, and the relaxation of smooth muscle can spread to the entire segment releasing vasospasm and lymphoconstriction (2). Needle injury physically dissipates fibrous tissue, causes local bleeding and may deliver numerous growth factors to the injured area, including the platelet-derived growth factor (PDGF) which attracts cells, induces DNA synthesis and stimulates collagen and protein formation. PDGF is a principal mitogen responsible for cell proliferation. Body cells are normally exposed only to a filtrate of plasma (interstitial fluid) and would not see the platelet factor except in the presence of injury, haemorrhage, and blood coagulation. This is a unique benefit not provided by other forms of local treatment (2).

In our study insertion of a needle into selected muscular trigger points caused a significant decline of 65% in the mean headache scores. Despite this improvement in our primary efficacy parameter, the headache scores, we failed to demonstrate any difference compared with placebo because of a very high placebo response (58%). However, there was significant improvement compared with placebo in muscle tenderness, one of our two secondary efficacy parameters. Although our other efficacy parameter, neck ROM limitation, improved significantly in the treatment group, while there was no significant improvement in the placebo group, the difference between both groups remained non-significant. Muscle tenderness and ROM limitation are prominent features of TTH that contribute to the sensation of pain (7, 8), so the reduction in headache scores in the treatment group may have been influenced by the improvement in both muscle tenderness and ROM limitation.

In TTH accompanied by muscle involvement, traditional Chinese acupuncture has been used for a long time but there is still debate about its effectiveness (10, 18–21). Although acupuncture has been shown to reduce the headache in TTH in some studies (10, 18, 19), it has been reported to be ineffective in reducing muscle tenderness and ROM limitation (10). Most of the studies on acupuncture for TTH have not mentioned the effects of treatment on muscle tenderness and ROM limitation, which are prominent features of TTH (18, 19). The dry-needle technique is different from classic acupuncture (2). The differences are listed in Table 1. Hansen and Hansen reported a decline of 31% in the headache score of their chronic TTH patients treated with acupuncture (18) while Carlsson et al. only achieved a 14% reduction (10), both of which are far below our headache reduction of 65%. Although we were unable to demonstrate effectiveness compared with placebo, the results of our study may suggest that the dry-needle technique seems to be more effective than acupuncture in reducing headache severity as well as muscle tenderness and ROM limitation, but comparative studies are needed to confirm this finding.

Galer and Kitahara assessed the efficacy of intra-muscular stimulation in the treatment of chronic headache in a retrospective study (4). Their study group of 19 patients consisted of various chronic headache syndromes, also including five patients with chronic TTH. They reported that four of their five TTH patients had an improvement in headache intensity and frequency after at least three intramuscular stimulations. Unfortunately their study was non-blinded, lacked a control and their numbers were too small to make a healthy comparison.

We conclude that the dry-needle technique in chronic TTH is effective in improving headache and symptoms such as muscle tenderness and ROM limitation that accompany and contribute to the pain in TTH, but we were unable to demonstrate a significantly different effect compared with placebo in relieving the headache itself. We hope that our study will inspire others to plan further studies using this technique. More and larger placebo-controlled, comparative trials are needed to show whether this technique is effective in the treatment of TTH in order to conclude that it

<table>
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<th>Table 1 Differences between classic acupuncture and the dry-needle technique (2)</th>
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<tr>
<td><strong>Acupuncture</strong></td>
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<td>No relation to medical diagnosis</td>
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<td>Medical examination can be applied</td>
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<td>The insertion points for the needle are related</td>
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<td>to Chinese philosophy. They are not scientific</td>
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<td>Knowledge of anatomy is not needed</td>
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<td>Short-term objective changes are not expected</td>
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could be an alternative, non-pharmacological treatment choice in patients with TTH.

References