Effectiveness of Dry Needling on the Lower Trapezius in Patients With Mechanical Neck Pain: A Randomized Controlled Trial

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Abstract

Objective: To evaluate the effect of dry needling into a myofascial trigger point (MTrP) in the lower trapezius muscle of patients with mechanical idiopathic neck pain.

Design: A single-center, randomized, double-blinded controlled study.

Setting: Patients were recruited from the student population of a local hospital by advertisement in the university clinic from January 2010 to December 2011.

Participants: Patients (N=72) with unilateral neck pain, neck pain for ≥3 months, and active trigger points in the lower trapezius muscle were randomly assigned to 1 of 2 treatment groups. All the patients completed the study.

Interventions: Dry needling in an MTrP in the lower trapezius muscle, or dry needling in the lower trapezius muscle but not at an MTrP.

Main Outcome Measures: The visual analog scale (VAS), Neck Pain Questionnaire (NPQ), and pressure-pain threshold (PPT) were assessed before the intervention and 1 week and 1 month postintervention.

Results: Treatment with dry needling of the lower trapezius muscle close to the MTrP showed decreases in pain and PPT as well as an improvement in the degree of disability (P<.001) compared with the baseline and control group measurements (P<.001). The dry-needling technique performed in the MTrP showed more significant therapeutic effects (P<.001).

Conclusions: The application of dry needling into an active MTrP of the lower trapezius muscle induces significant changes in the VAS, NPQ, and PPT levels compared with the application of dry needling in other locations of the same muscle in patients with mechanical neck pain.

Physiotherapists use trigger point dry needling (TrP-DN) as an invasive treatment where a solid filament needle is inserted into a myofascial trigger point (MTrP)—a hyperirritable nodule or spot of exquisite tenderness to palpation that refers pain at a distance and can cause distant motor and autonomic effects—to reduce pain symptoms. MTrPs are classified as active, symptom-producing or latent and are not spontaneously symptomatic.

Investigators have found TrP-DN to be an effective technique to release pain in temporomandibular disorders, for preventing pain after total knee arthroplasty, and for treating supraspinatus lesions. Additionally, recent studies reported that TrP-DN increased the cervical range of motion as well as decreased pain immediately after treatment and at a 4-week follow-up point in patients with upper-quarter myofascial pain syndromes, particularly neck pain.

Moreover, imbalances of the scapulothoracic muscles have been found in patients with neck pain and cervicogenic headache,
where trigger points in the lower trapezius muscle produced muscle dysfunction and local and referred pain.\textsuperscript{13-15} Although many studies\textsuperscript{16-19} reported that patients with neck pain had trigger points in the cervical and shoulder muscles, such as the upper trapezius muscle, few authors have studied trigger points as the main cause of neck pain.

Despite the already beneficial effects of TrP-DN, we might be able to maximize these effects by performing TrP-DN on the active trigger point instead of other sites of the same muscle.\textsuperscript{20} However, to our knowledge, no studies have analyzed the site-specific effects of TrP-DN therapy.

We aimed to analyze the effects of TrP-DN on active trigger points in the lower trapezius muscle in patients with neck pain compared with TrP-DN in another site of the same muscle. Additionally, we evaluated the role of the lower trapezius muscle in the pain and disability of patients with neck pain. We hypothesized that TrP-DN is more effective on the active trigger points than other points in the same muscle.

**Methods**

The present research refers to a single-center, randomized, double-blinded control study. The study was guided by the Consolidated Standards of Reporting Trials (CONSORT) statement and included the CONSORT checklist.

**Participants**

Seventy-two participants (14 men, 58 women) aged 18 to 42 years (mean age ± SD, 23.4±5.9) with mechanical idiopathic neck pain participated in the study. Participants were randomly recruited from the student population by advertisement in the university clinic from January 2010 to December of 2011.

Criteria for inclusion in this study were (1) unilateral neck pain, (2) neck pain for ≥3 months, and (3) active trigger points in the lower trapezius (performed by a physiotherapist with 12 y of experience in trigger point diagnosis). The diagnosis of active MTrPs in the lower trapezius muscle was based on the major criteria proposed by Simons et al\textsuperscript{1,7}: (1) presence of a palpable taut band in the skeletal muscle; (2) presence of an exquisitely tender spot in the taut band; (3) recognition of the elicited pain as the patient’s pain; and (4) a painful limit induced by the full-stretch range of motion. When 3 of the 4 criteria were met, a positive MTrP was diagnosed.

Participants were excluded from this study if they had (1) a history of neck trauma; (2) cervical radiculopathy; (3) previously had surgery in the neck or shoulder area; (4) a history of diagnosed primary headache; (5) trigger point therapy or TrP-DN in the neck within the previous 6 months; (6) evidence of cognitive dysfunction; or (7) needle phobia. This study was performed in Principe de Asturias Hospital in Alcalá de Henares (Madrid). All subjects signed an informed consent before data collection. The study was approved by the Ethical Committee of Principe de Asturias Hospital in Alcalá de Henares.

**Interventions**

The patients were randomly assigned to the treatment group (n = 36) (TrP-DN: on the trigger point of the lower trapezius) or the control group (n = 36) (non-TrP-DN: 1.5 cm medially from the trigger point of the lower trapezius). An external clinical assistant randomly assigned the intervention to each participant using the Epidat software version 4.0\textsuperscript{21,22} computerized randomization program to generate the intervention allocation. Hence, for each intervention, both the subjects and investigators were blinded: the dry-needling procedure was performed by the same physiotherapist expert in this treatment, and the evaluation process was performed by another physiotherapist who was blinded to the patients’ group assignments. Additionally, subjects were blinded to the group to which they belonged because the treatment out of the TrP-DN (non-TrP-DN) was performed very close to the trigger point.

In the treatment group, participants were placed on their side for treatment (this position reduces the risk of producing a pneumothorax) while the physiotherapist firmly held the lower trapezius muscle in a pincer grasp to precisely locate the trigger point for TrP-DN. Then a monofilament needle was directed upward across the muscle mass as it was held by the fingers to avoid any possibility of penetrating the lung and causing a pneumothorax.\textsuperscript{23} The needle was moved up and down within the muscle, using a “fast-in and fast-out” technique.\textsuperscript{24} Needle insertions were repeated 8 to 10 times. The procedure of TrP-DN was similar to that used by Hong\textsuperscript{23,24} (fig 1).

The control group received the same protocol in the lower trapezius muscle, but the needle tip was inserted in other points close to, but outside of, the trigger point location (non-TrP-DN) (1.5 cm medially from the trigger point) (see fig 1).

We used the same dry stainless steel needles\textsuperscript{25} (0.25×25 mm) for both interventions. The area was always first disinfected with a skin antiseptic. On needle removal, pressure was immediately applied to the skin using a cotton bud to prevent excessive bleeding.\textsuperscript{26}

The treatment group (TrP-DN) and the control group (non-TrP-DN) were treated by a physiotherapist who had 12 years of clinical experience in the management of trigger points using this technique. The TrP-DN was applied to the ipsilateral side of the neck pain, which was 63.9% on the right side and 36.1% on the left side.

All the participants were contacted to schedule follow-up appointments at Principe de Asturias Hospital.

**Outcome measures**

**Subjective pain intensity**

Pain intensity was assessed using a visual analog scale (VAS). The VAS for pain measures the amount of pain experienced by a subject, with a continuous range from 0 for no pain and 10 for maximum pain. It has been validated as a reliable, generalizable, and an internally consistent measure of clinical and experimental pain.\textsuperscript{26}

The subjects were asked to indicate the pain levels that they experienced before treatment and 1 week and 1 month after treatment.

**Disability measures**

The Neck Pain Questionnaire (NPQ)\textsuperscript{27} was used to assess self-perceived levels of disability as a result of neck pain. The NPQ
includes 9 parameters for monitoring symptoms over time and understanding how the neck pain affects the ability to manage everyday life: neck pain intensity, sleeping, numbness in the arm at night, carrying objects, duration, when reading/watching television, when working, during social activities, and when driving. The last item is optional. The answers for each question are on a scale from 0 to 4. The sum of all responses is calculated and converted into a score percentage. The percentage score provides information about the patient’s level of functionality (0% for the least disabled, 100% for the most severely disabled). In addition, the NPQ presents an item (question 10) that evaluates the patient’s assessment of change in pain after follow-up. The NPQ has been shown to have validity, reliability, and internal consistency, and it is an instrument with sensitivity to changes in both short-term and long-term periods. The minimal clinically important difference for the NPQ has been determined to be a 25% score reduction from the baseline.

Disability was assessed before and 1 month after treatment.

Pressure-pain threshold

The trigger point of the lower trapezius muscle was identified while participants were lying on their side for treatment, by using a pincer grasp of the hyperirritable spots in the taut bands of the same muscle. To locate the trigger point, the point was marked with indelible ink, and the distance between this mark and the medial border of the scapula was measured with a caliper. This mark established the site for all testing. Because of the criteria proposed by Simons, the location for the follow-up measures was stable.

A pressure algometer, which has been proven to be both reliable and valid, was used to assess the pressure-pain threshold (PPT). The algometer was applied to the marked site with the rubber rod perpendicular to the surface of the skin. Pressure was increased at a rate of approximately 1 kg/cm² every second until the subject reported “pain,” and then compression was stopped. Three repetitive measurements at an interval of 30 seconds were performed at each site. The average value of the 3 measures was then used for data analysis.

The PPT was assessed before, immediately posttreatment, and 1 week and 1 month posttreatment.

Statistical analysis

The sample size calculation was based on results reported by a previous pilot study with 40 subjects: 20 experimental and 20 control subjects. In this study, the main dependent variable was pain (assessed by the VAS), and after 1 month of treatment, the mean VAS scores were 3.90±1.63 in the control group and 2.74±2.05 in the experimental group.

We used this result to determine the size effect (Cohen’s difference between 2 means). The size effect was .63. Furthermore, we assumed an alpha level of .05 and a desired power (B) of 80% with a ratio of the sample sizes of the 2 groups being 1 (N2/N1) and with a 1-tailed hypothesis test. These assumptions generated a sample size of at least 32 participants per group. G*Power 3.1.3

Fig 1  (A) Position of patient during dry needling. (B) Dry needling on the lower trapezius, near but outside the trigger point (1.5 cm away from the trigger point). (C) Dry needling on the lower trapezius on the trigger point.

Fig 2  Consolidated Standards of Reporting Trials flow diagram of subject recruitment throughout the course of the study.
for Windows\textsuperscript{33,34} and David Walker’s effect size calculator\textsuperscript{34} were used. The final sample was 72 subjects.

To assess the influence of the different types of interventions (TrP-DN on the trigger point vs TrP-DN 1.5 cm from the trigger point) and the time of measurement on the results of the questionnaires and the PPT, a mixed model with linear procedures was conducted because we designed a repeated-measures study with unequal intervals between measurements. Our analysis included within-subject variables (the time of measurement with 4 levels: before, immediately after, 1 wk and 1 mo after the intervention) and treatment.

We performed a post hoc paired \( t \) test with a Bonferroni adjustment for alpha inflation to explore the effects of the interaction between the time of the measurements and the type of the intervention. We investigated the relationship between the type of the intervention and the subjective rating of improvement on a 5-point scale using a contingency table and a chi-square test, which was calculated by the exact method. The intensity of the association was assessed using a contingency coefficient. SPSS for Windows (version 18.0\textsuperscript{e}) was used for all statistical analyses. Significance was accepted at an alpha level of .05.

### Results

One hundred thirty-four subjects were screened for eligibility. Sixty-two were excluded: 35 were excluded because they did not meet the inclusion criteria, and 27 refused to participate because of personal issues unrelated to the intervention (such as a lack of time) (fig 2). Finally, 72 subjects were treated, and 36 were assigned to the experimental group and 36 to the control group. No significant difference was found between the 2 groups in terms of the demographic and clinical characteristics at baseline (table 1).

### Table 1 Sex, age, and preintervention pain intensity measurements

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (y)</th>
<th>M</th>
<th>W</th>
<th>Neck Pain Duration (mo)</th>
<th>Northwick</th>
<th>VAS (cm)</th>
<th>PPT (kg/cm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>36</td>
<td>23±5</td>
<td>6</td>
<td>30</td>
<td>5.7±2.6</td>
<td>19.7±7.9</td>
<td>5.3±1.5</td>
<td>2.8±0.5</td>
</tr>
<tr>
<td>Placebo</td>
<td>36</td>
<td>23±6</td>
<td>8</td>
<td>28</td>
<td>7.0±2.8</td>
<td>22.1±11.4</td>
<td>5.6±1.6</td>
<td>2.8±0.6</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>23±5</td>
<td>14</td>
<td>58</td>
<td>6.4±2.7</td>
<td>20.9±9.8</td>
<td>5.4±1.6</td>
<td>2.8±0.6</td>
</tr>
</tbody>
</table>

NOTE. Values are mean ± SD or as otherwise indicated. Pain intensity measured using the Northwick questionnaire (Northwick). Abbreviations: M, men; W, women.

The mixed-model linear analysis revealed a significant group-by-time interaction (\( F = 75.913, P < .001 \)) for subjective pain intensity, with patients treated by TrP-DN showing a 40.9% and 60.9% reduction between the baseline measurements and the 1 week and 1 month posttreatment measurements (\( P < .001 \)). The between-group differences showed that the treatment group had a greater reduction in the subjective intensity of neck pain than the control group 1 week and 1 month posttreatment (2.4 and 2.7 points less pain in the treatment group 1 wk and 1 mo later, respectively; \( P < .001 \)) (table 2).

The mixed-model linear analysis revealed a significant group-by-time interaction (\( F = 17.881, P < .001 \)) for NPQ, in which patients treated with TrP-DN experienced a reduction of 50.5% in neck pain and a lower level of disability from neck pain compared with baseline measurements (\( P < .001 \)), and achieved 5.6 times more reduction in neck pain than those in the control group by the 1-month follow-up time point (\( P < .001 \)) (table 3).

On the tenth question on the NPQ, the contingency table analysis showed a significant correlation between being in the treatment or control group and the change in the patient’s condition. This association was measured by the chi-square test (\( P < .001 \)). In the treatment group, 14 subjects were “much better,” 20 subjects were “slightly better,” and 2 subjects were “the same as before” at the 1-month follow-up. In the control group, 1 subject was “slightly better,” 19 subjects were “the same as before,” 8 subjects were “slightly worse,” and 8 subjects were “much worse” at the 1-month follow-up (fig 3).

The mixed-model linear analysis revealed a significant group-by-time interaction (\( F = 116.273, P < .001 \)) for the PPT in which patients treated with TrP-DN showed a significant increase of 54.9%, 53.8%, and 57.4% compared with baseline measurements immediately after treatment and 1 week and 1 month later, respectively (\( P < .001 \)). However, patients in the control group also

### Table 2 Subjective pain intensity outcome data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-treatment</th>
<th>1wk Post-treatment</th>
<th>1mo Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control*</td>
<td>5.6±1.6</td>
<td>5.3±1.6</td>
<td>5.1±1.5</td>
</tr>
<tr>
<td>Treatment*</td>
<td>5.3±1.5</td>
<td>2.6±1.8</td>
<td>2.1±1.6</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>differences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>0.3 (−0.0 to 0.6)</td>
<td>0.5 (0.1−0.9)</td>
<td></td>
</tr>
<tr>
<td>Treatment group</td>
<td>2.7 (2.0−3.3)</td>
<td>3.2 (2.6−3.8)\textsuperscript{1}</td>
<td></td>
</tr>
<tr>
<td>Between-group</td>
<td>2.4 (1.6−3.2)</td>
<td>2.7 (2.0−3.4)\textsuperscript{1}</td>
<td></td>
</tr>
</tbody>
</table>

NOTE. Values are mean ± SD or mean (95% confidence interval).
* 0–10 scale.
\textsuperscript{1} Statistically significant (\( P < .001 \)).

### Table 3 NPQ outcome data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-treatment</th>
<th>1mo Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control*</td>
<td>22.1±11.4</td>
<td>20.4±8.1</td>
</tr>
<tr>
<td>Treatment*</td>
<td>19.7±7.9</td>
<td>9.9±7.4</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>change score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>1.7 (−0.1 to 3.6)</td>
<td>9.7 (7.3−12.2)</td>
</tr>
<tr>
<td>Treatment group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-group</td>
<td>8.0 (5.0−11.0)</td>
<td></td>
</tr>
</tbody>
</table>

NOTE. Values are mean ± SD or mean (95% confidence interval).
* 0–36 questionnaire.
\textsuperscript{1} Statistically significant (\( P < .001 \)).

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showed a significant reduction of 22.6% and 9.2% immediately after the treatment and 1 week later, respectively, compared with their baseline measurements by the PPT (P<.001), and the between-group differences showed that the treatment group had higher values of PPT compared with the control group throughout the follow-up period (1.2 times higher immediately after TrP-DN, 1.4 times higher 1 wk after treatment, and 1.4 times higher 1 mo after treatment; P<.001) (table 4).

**Discussion**

In the present study, we found that in patients with mechanical idiopathic neck pain, TrP-DN produced greater effects on the VAS and PPT assessments, as well as the degree of disability, when the technique was performed on the site of the trigger point compared with 1.5 cm medially from the trigger point. A recent study that used dry needling on the active trigger points in the trapezius, which is associated with cervical pain, increased the size and blood flow to the site of the active trigger point, and decreased the VAS scores and increased the PPT scores of the subjects.

Although many studies reported decreased pain and increased motion in patients with neck pain after TrP-DN, to our knowledge this is the first study reporting the importance of site-specific TrP-DN in the treatment of muscle trigger points in patients with myofascial cervical pain. Srbely et al reported similar results in the supraspinatus muscle. However, these differences were unclear in studies by Tsai and Fernández-Carnero and colleagues when they used a sham TrP-DN intervention above the trigger point into the subcutaneous layer but not reaching the muscle layer. Additionally, other studies have shown a significant improvement after treatment in the active trigger points but not in the sham-needling group in short-term follow-up assessments.

Although the pathophysiology of trigger points remains unclear, muscle overload associated with repetitive and prolonged activities and low-level muscle contractions may produce changes in the fiber structure, localized tissue stiffness, and the blood flow properties of the biochemical milieu. Additionally, many authors have reported more acidic biochemical environments in active trigger points as well as elevated levels of inflammatory mediators, neuropeptides, and proinflammatory cytokines, which are typically associated with persistent pain and tenderness. The mechanical effect of the needle may improve the fiber structure, the localized tissue stiffness, and the local circulation of the biochemical milieu associated with the trigger point. The change of local blood flow and the induction of local twitch responses through TrP-DN at the trigger points may improve ischemia, hypoxia, and the presence of algesic substances such as substance P and the calcitonin gene-related peptide. This corresponds with the decrease in pain and local tenderness after the TrP-DN of a trigger point, which persisted at least 1 month after therapy in our study.

Additionally, in this study, we reported that TrP-DN treatment of the lower trapezius improved the perceived level of disability caused by neck pain, and thus the lower trapezius was shown to be associated with neck pain as Simons first reported. In agreement, Arendt-Nielsen and Graven-Nielsen suggested that trigger points in the lower trapezius muscle may induce motor alterations (such as restricted range of motion, weak regions, and reduced coordination) and sensory alterations (such as pain and tenderness). This is the first study investigating the effect of treating

**Table 4** PPT outcome data

<table>
<thead>
<tr>
<th>Variable (kPa)</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
<th>1wk Post-treatment</th>
<th>1mo Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (kPa)</td>
<td>2.8±0.6</td>
<td>3.5±0.7</td>
<td>3.1±0.6</td>
<td>3.0±0.6</td>
</tr>
<tr>
<td>Treatment (kPa)</td>
<td>2.8±0.5</td>
<td>4.3±0.6</td>
<td>4.3±0.6</td>
<td>4.4±0.5</td>
</tr>
<tr>
<td><strong>Within-group differences</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>−0.6 (−0.8 to −0.5)</td>
<td>−0.3 (−0.4 to −0.3)</td>
<td>−0.4 (−0.3 to −0.6)</td>
<td></td>
</tr>
<tr>
<td>Treatment group</td>
<td>−1.5 (−1.6 to −1.4)</td>
<td>−1.5 (−1.03 to −1.4)</td>
<td>−1.6 (−1.7 to −1.4)</td>
<td></td>
</tr>
<tr>
<td>Between-group difference</td>
<td>−0.9 (−1.1 to −0.6)</td>
<td>−1.2 (−1.41 to −1.1)</td>
<td>−1.4 (−1.6 to −1.2)</td>
<td></td>
</tr>
</tbody>
</table>

*Within-group differences are given as change from preintervention measure.

Statistically significant (P<.001).
the lower trapezius for cervical myofascial pain. Many authors reported altered function of the axioscapular muscles in mechanical neck pain and greater upper trapezius activity and a weak lower trapezius on the side of pain in patients with cervical pain.\textsuperscript{16-19,35-47}

Because we reported increased effects (changes in the PPT value and pain sensitivity in patients with mechanical idiopathic neck pain) after the TrP-DN treatment of trigger points in the lower trapezius muscle, this increase could affect the spinal and supraspinal mechanisms as well as both peripheral and central mechanisms.\textsuperscript{36,46} The high-pressure stimulation of nociceptors during TrP-DN in patients with muscle pain enhanced activity in the somatosensory and limbic regions associated with pain.\textsuperscript{49} This activity was more enhanced when a trigger point was stimulated in the trapezius in patients with myofascial pain syndrome than in the equivalent control area within the same muscle.\textsuperscript{49} TrP-DN in the trigger points of the lower trapezius area may produce antinociception of pain in patients with mechanical idiopathic neck pain, possibly through coupled ascending and descending pain control pathways.\textsuperscript{50} In addition, the diffuse noxious inhibitory control system may be involved.\textsuperscript{50,51} TrP-DN may be a clinically painful heterotopic conditioning stimulus that could induce processes involved in the cortical modulation of pain as well as the descending modulation of spinal nociceptive activity.\textsuperscript{51,52}

**Study limitations**

The present study has some limitations. We assessed and treated 1 muscle in the cervical region, although other muscles may be implicated in cervical pain; we do not know whether these hypoalgesic effects are widespread, involving trigger points in other cervical muscles; and we assessed the distance from the trigger point of the lower trapezius to the scapula’s medial border with a caliper for which the interrater and test-retest reliabilities were not assessed. Additionally, our study contained midterm effects; thus, future studies should investigate the long-term effects of TrP-DN. Moreover, the results of this study should be interpreted with caution, taking into account that the subject population was young, which could reduce extrapolation to all populations.

**Conclusions**

The application of TrP-DN on an active trigger point in the lower trapezius muscle shows higher improvements in pain, the PPT, and the NPQ levels compared with TrP-DN out of trigger points in patients with mechanical idiopathic neck pain. For clinical applications, health professionals should ensure accurate trigger point localization to enhance the effects of the dry-needling technique.

**Suppliers**

a. Epidat software version 4.0; Creative Common.
b. Stainless steel needles (AGU-A1041P); Agupunt.
c. Wagner Pain Test Model FPK; Wagner Instruments.
e. SPSS for Windows, version 18; SPSS Inc.

**Keywords**

Neck pain; Rehabilitation; Trigger points

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Dry needling on the lower trapezius


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