Trigger Points in the Suboccipital Muscles and Forward Head Posture in Tension-Type Headache

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Objective.—To assess the presence of trigger points (TrPs) in the suboccipital muscles and forward head posture (FHP) in subjects with chronic tension-type headache (CTTH) and in healthy subjects, and to evaluate the relationship of TrPs and FHP with headache intensity, duration, and frequency.

Background.—Tension-type headache (TTH) is a prototypical headache in which myofascial TrPs in the cervical and pericranial musculature can play an important role.

Design.—A blinded, controlled pilot study.

Methods.—Twenty CTTH subjects and 20 matched controls without headache participated. TrPs were identified by eliciting referred pain with palpation, and increased referred pain with muscle contraction. Side-view pictures of each subject were taken in sitting and standing positions, in order to assess FHP by measuring the craniovertebral angle. Both measures were taken by a blinded assessor. A headache diary was kept for 4 weeks in order to assess headache intensity, frequency, and duration.

Results.—Sixty-five percent (13/20) CTTH subjects showed active TrPs and 35% (7/20) had latent TrPs in the suboccipital muscles. Six (30%) controls also had latent TrPs. Differences in the presence of suboccipital muscle TrPs between both the groups were significant for active TrPs ($P < .001$) but not for latent TrPs ($P > .5$). CTTH subjects with active TrPs reported a greater headache intensity and frequency than those with latent TrPs ($P < .05$). The degree of FHP was greater in CTTH subjects than in controls in both sitting and standing positions ($P < .01$). Within the CTTH group, there was a negative correlation between the craniovertebral angle and the frequency of headache ($r_s = -0.6$, $P < .01$, in sitting position; $r_s = -0.5$, $P < .05$, in standing position). CTTH subjects with active TrPs had a greater FHP than those with latent TrPs, though this difference was not significant.

Conclusions.—Suboccipital active TrPs and FHP were associated with CTTH. CTTH subjects with active TrPs reported a greater headache intensity and frequency than those with latent TrPs. The degree of FHP correlated positively with headache duration, headache frequency, and the presence of suboccipital active TrPs.

Key words: tension-type headache, myofascial pain, myofascial trigger points, suboccipital muscles, forward head posture

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Headache disorders are one of the most common problems seen in medical practice. Among many types of headache disorders, tension-type headache (TTH) is the most frequent in adults. Population-based studies suggest 1-year prevalence rates of 38.3% for episodic TTH and 2.2% for chronic TTH (CTTH). In spite of its scientific interest, the pathogenesis of TTH is not clearly understood. Some authors have claimed that pain from pericranial head, neck, and/or shoulder muscles is referred to the head, and is experienced as headache. In their comprehensive text, Simons et al described the referred pain patterns from different myofascial trigger points (TrPs) in head and neck muscles, which produced pain features that are usually found in patients suffering from TTH. A TrP is a hyper-irritable spot associated with a taut band of a skeletal muscle. It is painful on compression and on stretch, and usually gives rise to a typical referred pain pattern. Some characteristics of TTH, such as pressure or band-like tightness and increased tenderness on palpation of neck and shoulder muscles, resemble the descriptions of referred pain originating in TrPs.

Within the cervical musculature, suboccipital muscles can develop TrPs, accounting for a referred pain pattern that spreads to the side of the head over the occipital and temporal bones (Figure 1). This referred pain can spread to both sides, being perceived as bilateral headache. Simons et al stated that postural abnormalities in the cervical spine might be responsible for the activation of TrPs in these muscles. One frequently noted abnormal posture is an excessive forward head position, or forward head posture (FHP). Hyperextension of the neck or increased cervical lordosis is a common consequence of FHP. FHP is usually associated with shortening of the posterior cervical extensor muscles (suboccipital, semispinalis, splenii, and upper trapezius muscles) as well as shortening of the sternocleidomastoid muscle. Marcus et al found that subjects with TTH showed a greater number of posture abnormalities than control healthy subjects. FHP was included among the posture abnormalities; however, the difference in FHP between both study groups was not specified. These authors also found that TTH subjects showed a greater number of either active or latent TrPs than healthy subjects. In the same way, TrPs in the suboccipital muscles were assessed, but specific differences within these muscles were not reported.

Suboccipital muscle TrPs and FHP might be implicated in the genesis and/or maintenance of TTH. Furthermore, the management of these abnormalities could produce significant relief in patients suffering from TTH. We have not found any paper in the peer-reviewed literature analyzing the relationship between suboccipital TrPs and FHP in patients with TTH. This paper describes the presence of both FHP and suboccipital muscle TrPs in subjects with CTTH and in healthy control subjects. In addition, we assessed the relationship among FHP, suboccipital TrPs, and several clinical variables concerning the intensity and the temporal profile of headache.

**MATERIAL AND METHODS**

**Subjects.** Twenty subjects presenting with CTTH and 20 healthy age- and sex-matched subjects without headache during the previous year...
participated in this study from February to November of 2004. Subjects with CTTH were diagnosed according to the criteria of the International Headache Society (IHS) by an experienced neurologist.\textsuperscript{5} CTTH subjects had to have headache on at least 15 days per month. A headache diary was kept for 4 weeks in order to confirm the diagnosis.\textsuperscript{13} All subjects were examined on days in which headache intensity was less than 4 points on a 10-cm horizontal visual analog scale. The health status of all participants was clinically stable, without current symptoms of any other concomitant chronic disease.

This study was supervised by the Departments of Physical Therapy and Neurology of Rey Juan Carlos University and Fundación Hospital Alcorcón, and it was also approved by the local human research Committee. All subjects signed an informed consent prior to their inclusion.

**Myofascial Trigger Point Examination.**—TrPs were sought in the suboccipital muscles by assessor 2 (C.F.P.) who had more than 4 years experience in TrPs diagnosis, and who was also blinded to the subjects’ condition. Diagnostic criteria as described by Simons et al\textsuperscript{4} and by Gerwin et al\textsuperscript{14} were adapted for the suboccipital muscles and used to diagnose TrPs. Specifically, the diagnosis of TrPs in these muscles was made when there was tenderness in the suboccipital region and referred pain evoked by maintained pressure for 10 seconds (Figure 1). A TrP was considered active if the subject recognized the evoked referred pain as familiar, ie, similar to other sensations that he/she was used to perceive; conversely, a TrP was considered latent if the subject did not recognize the evoked referred pain as a familiar pain.\textsuperscript{4,14}

We also considered an increase in referred pain on muscle contraction as a relevant sign of TrP activity. To evaluate the effect of muscle contraction on referred pain intensity, subjects lay supine with the cervical spine in a neutral position. Assessor 2 palpat the suboccipital region for 10 seconds. If referred pain was evoked, subjects were asked to extend the neck which produced palpable contraction of the posterior cervical muscles, and, we presume, the suboccipital muscles, that are not palpable. Subjects were asked to keep the neck straight and only extend at the cervical–occipital junction, to focus the contraction on the rectus capitis posterior muscles and other extensor suboccipital muscles.

The TrP examination was performed in a blinded fashion. After TrP assessment, the subject was asked if the TrP was familiar or reproduced a familiar pain. Since control subjects could have had some head pain but not headache, the assessor remained blinded through the end of the examination.

**Forward Head Posture Assessment.**—A picture of the lateral view of each subject was taken to objectively assess FHP.\textsuperscript{15-17} The base of the camera was set at the height of the subject’s shoulder. The tragus of the ear was clearly marked and a plastic pointer was taped to the skin overlying the spinous process of the seventh cervical vertebra (C7). Once the picture was obtained, it was used to measure the cranovertebral angle:\textsuperscript{15-17} the angle between the horizontal line passing through C7 and a line extending from the tragus of the ear to C7 (Figure 2). A smaller cranovertebral angle indicated a greater FHP. A previous paper reported the reliability of this procedure as high (ICC = 0.88).\textsuperscript{15}

In each examination, FHP was assessed in two different positions: a relaxed sitting position and a relaxed standing position in a standard protocol. A picture of the lateral view of each subject was taken at both positions. These measurements were acquired by an assessor blinded to the subjects’ condition.

![Fig 2.—Measurement of the craniovertebral angle. The angle was assessed directly from a side-view picture using a protractor image and a straight edge.](image)
**Subject Assessment.**—All subjects had two appointments within a 4-week period. In the first visit, assessor 1 gave a headache diary to CTTH subjects. Each CTTH subject registered on this diary the daily headache intensity on a 10-cm horizontal visual analog scale (VAS; range: 0 = no pain and 10 = maximum pain), the headache duration (in hours per day), and the number of days with headache. This headache diary was kept for 4 weeks. Assessor 1 also informed control healthy subjects about physical therapy and headache, but did not give them a headache diary. Assessor 2, blinded to the subjects’ condition, took the two pictures of each subject in sitting and standing positions.

Four weeks later, assessor 2 repeated the same head posture assessment and examined the suboccipital muscles for the presence of TrPs. The following variables were assessed from the diary by the first assessor: (1) headache intensity, which was calculated from the mean of the VAS of the days with headache, (2) headache frequency (days per week), and (3) headache duration (hours per day).

**Statistical Analysis.**—Data were analyzed with the SPSS statistical package (12.0 Version). A normal distribution of quantitative data was assessed by means of the Kolmogorov–Smirnov test. Quantitative data without a normal distribution (ie, headache intensity, duration, and frequency) were analyzed with nonparametric tests, whereas quantitative data with a normal distribution (ie, craniovertebral angle in sitting and standing positions) were analyzed with parametric tests. The chi-square test was used to compare the two subject groups for the presence of latent and active TrPs. The unpaired t-test was used to compared the FHP between both study groups. The nonparametric two-tailed Wilcoxon signed rank test was used to analyze the differences in the clinical variables relating to headache (headache intensity, frequency, and/or duration) among CTTH subjects with respects to TrPs activity, ie, latent or active TrPs. The Spearman’s rho ($r_s$) test was used to analyze the association between the craniovertebral angle (FHP) in CTTH subjects and the clinical variables relating to headache (headache intensity, frequency, and/or duration). Finally, the unpaired t-test was used to analyze the differences in FHP among CTTH subjects with either latent or active TrPs. The statistical analysis was conducted at a 95% confidence level. A $P$ value less than .05 was considered statistically significant.

**RESULTS**

A total of 20 CTTH subjects, 9 men and 11 women, aged 18 to 70 years old; and 20 healthy volunteers, 12 men and 8 women, aged 20 to 68 years old, were studied. No significant differences were found for gender or age between both the study groups. CTTH subjects were examined on days in which headache intensity was less than 4 on the VAS (mean: 2.5 ± 0.5). Demographic data of each group are given in Table 1.

All CTTH subjects showed TrPs in the suboccipital muscles. Thirteen CTTH subjects (65%) had active TrPs whereas 7 (35%) had latent TrPs. Conversely, 6 (30%) control subjects had latent TrPs. Differences in the presence of suboccipital muscle TrPs between both groups were significant for active TrPs ($P < .001$) but not for latent TrPs ($P > .5$). Within the CTTH group,

### Table 1.—Demographic Data of Both Groups

<table>
<thead>
<tr>
<th></th>
<th>CTTH (n = 20)</th>
<th>Controls (n = 20)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male/female)</td>
<td>11/9</td>
<td>12/8</td>
<td>NS</td>
</tr>
<tr>
<td>Age (years)</td>
<td>38 ± 18</td>
<td>35 ± 10</td>
<td>NS</td>
</tr>
<tr>
<td>Length of history (years)</td>
<td>5.5 ± 7.5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Headache intensity (VAS)</td>
<td>5.5 ± 2.2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Headache frequency (days per week)</td>
<td>5.2 ± 1.3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Headache duration (hours per headache day)</td>
<td>9.5 ± 2.3</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Values are expressed in mean ± standard deviation. CTTH = chronic tension-type headache; NS = nonsignificant; VAS = visual analog scale (0 to 10); — = inconclusive results.
there was a significant association between the presence of active TrPs and both headache intensity and headache frequency outcomes \((P < .05)\). However, headache duration did not correlate to TrP activity, whether the TrP was active or latent (Table 2).

To verify the reliability of FHP measurements and to check if the head posture remained stable during the study, two separate sets of pictures were taken from each subject with a 4-week interval. No significant differences were found between the two measurements (paired Student’s \(t\)-test): seated \(P > .5\); CCI = 0.962, \(P < .001\); standing \(P > .6\); CCI = 0.98, \(P < .001\). Therefore, data for further analysis were derived from the average of the two values corresponding to each position.

The craniovertebral angle was smaller in CTTH subjects than in controls (Table 3). Within the CTTH group, a negative correlation was found between headache frequency and the craniovertebral angle in both the sitting \((r_s = -0.6; P < .01)\) and the standing position. Headache frequency increased as the craniovertebral angle in either position was smaller. Headache duration also showed a significant negative correlation with the craniovertebral angle in the sitting position \((r_s = -0.5; P < .05)\), but not in the standing position. Otherwise, CTTH subjects with active TrPs tended to have a greater FHP than CTTH subjects with latent TrPs \((46^\circ \pm 9.4^\circ\) versus \(49.6^\circ \pm 8.1^\circ\) in sitting position; \(48.2^\circ \pm 10.7^\circ\) versus \(52^\circ \pm 6.1^\circ\) in standing position), though the differences were not statistically significant.

### COMMENTS

This controlled study of CTTH subjects demonstrated that all subjects presenting with CTTH had suboccipital muscle TrPs, either latent or active. Furthermore, we demonstrated that FHP was more common in subjects with CTTH, and that the degree of FHP correlated positively with headache frequency and duration. Finally, we showed that headache intensity and frequency was greater in CTTH subjects who had active TrPs compared to those with only latent TrPs.

Active suboccipital TrPs were associated with referred pain that reproduced usual headache in 13/20 (65%) of the CTTH subjects, consistent with active TrPs. Conversely, 7/20 (35%) of CTTH subjects had latent TrPs. CTTH subjects with active TrPs reported a greater headache intensity and headache frequency than those with latent TrPs. Conversely, 6 (30%) control subjects had latent TrPs. Therefore, both groups had a similar number of latent TrPs \((P < .5)\). The difference between them was in the presence of active

### Table 2.—Headache Intensity, Frequency, and Duration Depending on the Type of Myofascial Trigger Point in the Suboccipital Muscles in the Tension-Type Headache Group

<table>
<thead>
<tr>
<th></th>
<th>Headache Intensity (VAS)</th>
<th>Headache Frequency (Days per Week)</th>
<th>Headache Duration (Hours per Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active TrPs ((n = 13))</td>
<td>6 (3.15 to 9)*</td>
<td>6 (4 to 7)*</td>
<td>8.7 (3 to 12)</td>
</tr>
<tr>
<td>Latent TrPs ((n = 7))</td>
<td>4.6 (2.2 to 7)</td>
<td>4.9 (4 to 6)</td>
<td>9.8 (4 to 13)</td>
</tr>
</tbody>
</table>

Values are expressed as median (minimum–maximum); VAS = visual analog scale (0 to 10).

TrPs = myofascial trigger points.

*Significant in comparison with the latent TrPs subgroup (two-tailed Mann-Whitney signed rank \(U\)-test, \(P < .05\)).

### Table 3.—Craniovertebral Angle and Myofascial Trigger Points in the Suboccipital Muscles in Both Groups

<table>
<thead>
<tr>
<th></th>
<th>CTTH ((n = 20))</th>
<th>Controls ((n = 20))</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHP sitting</td>
<td>44.9° (\pm 7.5^\circ)</td>
<td>51.9° (\pm 5.7^\circ)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>FHP standing</td>
<td>47.9° (\pm 7.9^\circ)</td>
<td>54.3° (\pm 6.5^\circ)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Active TrPs</td>
<td>13 (65%)</td>
<td>0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Latent TrPs</td>
<td>7 (35%)</td>
<td>6 (30%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

CTTH = chronic tension-type headache; FHP = forward head posture (values are expressed in mean \(\pm\) standard deviation); NS = nonsignificant; TrPs = suboccipital myofascial trigger points.
TrPs that were significantly greater in the CTTH group ($P < .001$). This is expected, as latent TrPs, have been commonly observed in healthy, normal subjects.$^{19}$

Our study supports the hypothesis that TrPs in the suboccipital muscles might play an important role in the genesis of TTH. In their clinical descriptions, Simons et al claimed that the referred pain evoked by these muscles spread to the head and was usually perceived as bilateral headache.$^4$ The suboccipital muscles that extend the neck at the occipital–atlas junction (rectus capitis posterior major and minor, and the oblique capitis superior) are not directly palpable. The implication that the suboccipital muscles were critically involved in the CTTH subjects was based on the characteristic referred pain pattern of these muscles (Figure 1), in contrast to the referred pain patterns characteristic of the other posterior cervical muscles such as the semispinalis and splenii.$^4$ Gerwin has suggested that the referred pain from TrPs and TrPs themselves are important in the patients’ perception of TTH.$^5$ Headache pain is most likely referred pain from TrPs in the posterior cervical, neck, and shoulder muscles, mediated through the spinal cord and the brainstem trigeminal nucleus caudalis, rather than direct tenderness of the pericranial muscles themselves.

Nociceptive inputs from TrPs in the suboccipital muscles can produce a continuous afferent bombardment into the trigeminal nerve nucleus caudalis. Convergence of the nociceptive afferents from the receptive fields of cervical roots C1–C3 which include the suboccipital muscles, and those of the trigeminal nerve, occurs in the nucleus caudalis.$^{20}$ Such repeated nociceptive activation of the nucleus caudalis can produce central sensitization, potentially reducing the headache threshold in CTTH.$^{21}$

CTTH subjects showed more pronounced FHP (smaller craniovertebral angle) than control subjects in both sitting and standing positions ($P < .01$). The mean craniovertebral angle in the nonheadache group ($51.9^\circ \pm 5.7^\circ$) was similar to that reported for healthy subjects by Watson and Trott ($49.1^\circ \pm 2.9^\circ$)$^{16}$ and by Treleaven et al ($50.7^\circ \pm 7.9^\circ$)$^{22}$ In addition, the CTTH group, with a greater FHP, reported greater headache duration and frequency than those CTTH subjects with lesser FHP. This suggests that the greater the suboccipital muscle contraction, as would be expected in greater FHP, the more the nociceptive input into the trigeminal nucleus caudalis, and the lower the headache or pain threshold, consistent with increased central sensitization.

CTTH subjects with active TrPs tended to have a smaller craniovertebral angle than those with latent TrPs, although the difference did not reach a significant level. Although shortening of craniovertebral muscles associated with FHP might be responsible for the activation of TrPs,$^2,4,9,10$ it is also possible that FHP might be a consequence of TTH, i.e., an antalgic posture to try to reduce pain. Nevertheless, this study strongly suggests that shortened, contracted suboccipital muscles associated with FHP contribute to the origin or the perpetuation of CTTH. This must be verified by future research.

This paper demonstrated that there is an association of FHP, suboccipital active TrPs, and CTTH. This finding is important because the referred pain pattern from these TrPs were consistent with the headache pattern of subjects with CTTH. Although suggested recently by Gerwin,$^2$ the referred pain pattern from headache TrPs has not been considered in previous controlled studies of headache subjects.

There are some limitations to our study. First, only subjects with CTTH were included. Hence, our results cannot be extrapolated to episodic TTH (ETTH) or to other headache disorders. It would be interesting to repeat the same procedure with subjects suffering from ETTH and other types of headache. The second limitation was the sample size. This is the first study in the literature analyzing the relationship among FHP, TrPs in the suboccipital muscles, and clinical features in TTH. It will be necessary to repeat the same procedure with a greater number of subjects. Further research is needed to clearly define the role of head posture and nociceptive inputs, and referred pain from suboccipital muscle TrPs and TrPs in the other posterior cervical muscles in the genesis and/or maintenance of TTH.

In conclusion, suboccipital active TrPs and FHP were associated to CTTH. CTTH subjects with active TrPs reported a greater headache intensity and frequency than those with latent TrPs. The degree of FHP correlated positively with headache duration, headache frequency, and the presence of suboccipital active TrPs.
Acknowledgments: We would like to thank Dr. David Simons for his kind encouragement and support.

REFERENCES