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Pericranial muscle tenderness is associated with widespread pain sensitivity, psychiatric comorbidity, and dysfunctional psychological responses to pain in healthy young adult females

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Introduction

The most common clinical finding in chronic tension-type headache (CTTH) is increased tenderness of pericranial myofascial tissues to palpation, hypothesized to reflect sensitization of pain transmission circuits at the trigeminal nucleus and possibly higher order deficits in pain central processing/modulation.¹⁻³ CTTH sufferers also exhibit elevated scores on measures of daily life stress and psychological symptoms, and are more likely to be diagnosed with a mood or anxiety disorder than healthy controls.⁴⁻⁶ However, little is known about the occurrence or correlates of pericranial muscle tenderness (PMT) in the general population or the relationship of PMT to

psychological variables. This study examined the relationship of PMT to pain sensitivity and psychological variables in young adult females. Multiple measures of cephalic and extracephalic pain sensitivity and multiple psychological measures were assessed in young women who exhibited high and low levels of PMT.

Method

Psychological measures

The Beck Depression Inventory⁷ (BDI) and the Beck Anxiety Inventory⁸ (BAI) assessed symptoms of depression and anxiety, respectively. The McGill Pain Questionnaire-Short Form⁷ (MPQ-SF) assessed pain quality while the Pain Catastrophizing Scale⁷ (PCS) assessed pain coping. The Undergraduate Stress Questionnaire⁹ (USQ) assessed subjective stress. Finally, the Primary Care Evaluation of Mental Disorders⁷ (Prime-MD) was used to obtain DSM-IV diagnoses of mood and anxiety disorders.

Pericranial muscle tenderness

PMT was assessed by manual palpation modified to include the use of a fingertip palpometer.^{10,11} Five pericranial muscles (temporalis, masseter, suboccipital, posterior cervical, middle trapezius) were palpated bilaterally with a fingertip pressure of 500 g/cm². The participant was asked to report tenderness for each palpation site on a scale of 0 (no pain) to 10 (worst pain imaginable). The sum of the ratings (total tenderness score: TTS) for the 10 sites was used as the PMT score for each assessment giving the TTS a range of 0-100.

Pressure pain thresholds (PPT)

PPT were measured at two bilateral points—the anterior temporalis and the middle digit—using a handheld meter.^{11,12} Pressure was applied at a constant rate of about 0.5 kg/s and participants were asked to indicate when the pressure became painful. The maximum force applied was recorded and the average of three readings taken 10 seconds apart was used as the PPT score.

Manual tender point survey (MTPS)

A standardized tender point protocol whereby nine bilateral survey points (occiput, trapezius, supraspinatus, gluteal, low cervical, second rib, lateral epicondyle, greater trochanter, and the knee) are located for palpation.¹³ Pressure was applied gradually by 1 kg/s over a period of 4 seconds by use of a dolorimeter. Participants rated each palpation on an 11-point scale, from 0 (no pain) to 10 (worst pain ever experienced). Scores at each site (two muscles—occiput and trapezius—also included in the PMT assessment were excluded from the MTPS score) were summed to create a total tenderness score.

Forearm tourniquet ischaemia

This task assessed the participant's report of pain intensity during, and coping following, a painful stressor. Participants conducted 2 min of forearm exercise using the non-dominant arm, then briefly raised the arm for exsanguinations. A pressure cuff was applied to the bicep, inflated to 220 mmHg, and the arm was placed in a rested position. Participants were asked to rate the intensity of their arm pain using an 11-point scale where 1 = sensory threshold, 5 = pain threshold, and 10 = maximum tolerable. Numerical ratings were requested at six intervals during the procedure.

Experimental procedure

The experiment was conducted in two sessions. During the first session, female college students completed self-report measures and clinical interview and underwent PMT and PPT assessments. Participants who exhibited low or high levels of PMT (low = PMT total score = 0; high = PMT total score ≥ 15 with tenderness (PMT score ≥ 3) in three or more muscles) were scheduled a second experimental session. During the second session, PMT and PPT were repeated, and the MTPS and forearm ischaemia task were completed.

Results

Participant characteristics

Two hundred and ninety participants completed session 1, 59 participants completed session 2 (high PMT = 24; low PMT = 36). Participants predominantly self-identified as Caucasian with a mean age of 19.05 (SD = 1.6).

Physiological assessments

Table 18.1 presents the means and standard deviations for the physiological assessments. Comparison of PMT scores in sessions 1 and 2 indicated the PMT assessment was highly reliable ($Rho = 0.95$, $P < 0.001$). Participants in the high PMT group exhibited significantly higher PMT scores in session 2 than the low PMT group ($U = 0.50$, $P < 0.001$).

PPT scores were highly stable from session 1 to session 2 (finger PPT $Rho = 0.81$; temporalis PPT $Rho = 0.70$; both $P < 0.001$). In both sessions 1 and 2, high PMT participants exhibited significantly lower finger PPT (session 1: $U = 189$, $P < 0.001$; session 2: $U = 189$, $P < 0.001$) and temporalis PPT (session 1: $U = 179$, $P = 0.001$; session 2: $U = 224$, $P = 0.002$) scores compared with the low PMT group. High PMT participants also exhibited significantly higher MTPS scores than low PMT participants ($U = 23$, $P < 0.001$). To clarify further this pattern of widespread tenderness, Figure 18.1 presents median scores from the MTPS reported by tender points assessed for both high and low PMT groups. As shown, the high PMT group demonstrated increased tenderness in comparison with the low PMT group on each of the nine tender points assessed.

Table 18.1 Mean and standard deviations of pericranial muscle tenderness (PMT) total tenderness score, pressure pain thresholds, and manual tender point survey scores by group and session

	High PMT (n = 24)	Low PMT (n = 36)
Total tenderness score (0-100)		
Session 1	30.00 (14.67)	0
Session 2	27.25 (15.13)**	0.08 (.37)
Pressure pain thresholds (kg): Session 1		
Finger	8.24 (2.69)**	12.28 (4.45)
Temporalis	4.42 (1.15)**	6.21 (2.27)
Pressure pain thresholds (kg): Session 2		
Finger	8.41 (3.74)**	12.59 (4.77)
Temporalis	4.65 (1.27)**	6.25 (2.07)
Manual Tender Point Survey (0-140)	68.92 (20.37)**	9.91 (13.57)

**Indicates significantly different from low PMT Group, $P < 0.002$.

Psychological measures

Table 18.2 presents mean and standard deviations for the self-report measures collected during session 1. The high PMT group demonstrated significant differences when compared with the low PMT group on nearly every psychological measure taken during session 1 ($P \leq 0.005$). Individuals in the high PMT group were also significantly more likely to receive a Prime-MD diagnosis of a mood or anxiety disorder than individuals in the low PMT group ($\chi^2 (2, n = 60) = 20.39$, $P < 0.001$).

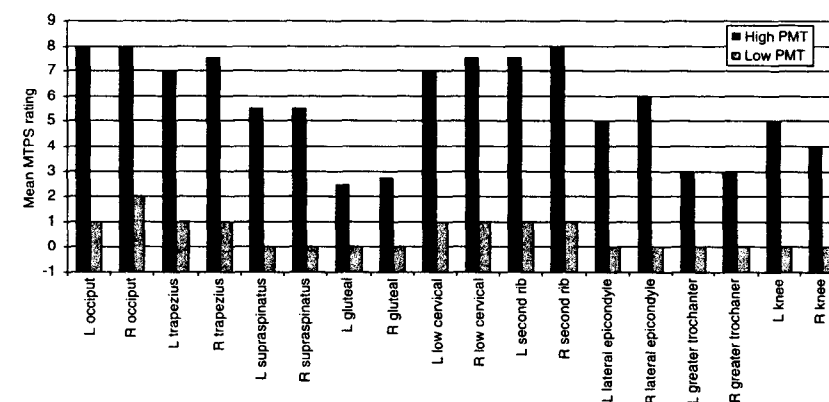


Fig. 18.1 Median MTPS scores by group and tender point assessed.

Table 18.2 Mean and standard deviations of session 1 psychological measures by group

	High PMT (n = 24)	Low PMT (n = 36)
Beck Depression Inventory	12.04 (11.35)**	5.67 (5.58)
Beck Anxiety Inventory	11.00 (7.76)**	4.14 (4.18)
McGill Pain Questionnaire-SF	7.08 (5.57)**	1.61 (1.78)
Pain Catastrophizing Scale	13.71 (8.86)**	7.44 (8.50)
Undergraduate Stress Questionnaire	71.92 (29.39)**	47.61 (24.88)

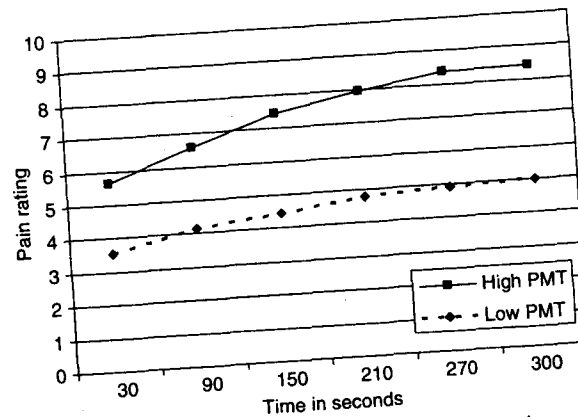
*Indicates significantly different from low PMT Group, $P \leq 0.005$.
 **Indicates significantly different from low PMT Group, $P < 0.001$.

Ischaemic arm task

Figure 18.2 presents mean pain ratings recorded during the task. A two Group (high PMT and low PMT) by six Time mixed model ANOVA revealed a significant main effect for Time ($F [1.73, 100.20] = 34.84, P < 0.001$) and a significant main effect for Group ($F [1, 58] = 32.96, P < 0.001$). Post-tests revealed that pain ratings progressively and regularly increased through the first five assessment periods ($P < 0.001$). Additionally, the high PMT group reported significantly higher pain ratings than the low PMT group at all six assessments ($P < 0.001$).

Conclusions

PMT does not reflect a local deficit in processing of nociceptive information pain from trigeminal nerves but, even in healthy young females, appears to be associated

**Fig. 18.2** Pain ratings during ischaemic arm task over time by group.

with a central dysregulation of pain and affect. High levels of PMT were associated with pain sensitivity across multiple pain measures and at both cephalic and extra-cephalic sites, as well as deregulated affect, increased subjective stress, and poor pain coping. Previous research has focused on the role of PMT in CTTH. However, PMT appears to index the type of central dysregulation of pain and affect likely to underlie multiple myofascial (not just facial) pain disorders. This suggests that the presence or absence of PMT in CTTH is likely to identify important subtypes of CTTH that will differ in pathophysiology. Understanding the relationships between the pervasive pain sensitivity indexed by PMT and the correlated dysregulation of affect, perceived stress, and deficits in coping are likely to be important in understanding the pathophysiology of not only CTTH, but other pain disorders as well. These young adults may be at high risk for developing pain and headache disorders.

References

- Lipchik GL, Holroyd KA, O'Donnell FO, *et al.* (2000) Exteroceptive suppression periods and pericranial muscle tenderness in chronic tension-type headache: Effects of psychopathology, chronicity, and disability. *Cephalalgia* 20, 638-46.
- Lipchik GL, Holroyd KH, Talbot F, Greer M (1997) Pericranial muscle tenderness and exteroceptive suppression of temporalis muscle activity: a blind study of chronic tension-type headache. *Headache* 37, 368-76.
- Bendtsen L, Jensen R, Olesen J (1996) Qualitatively altered nociception in chronic myofascial pain. *Pain* 65, 259-64.
- Holm JE, Holroyd K, Hursey KG, Penzien D (1986) The role of stress in recurrent tension headaches. *Headache* 26, 160-7.
- Wang S, Liu H, Fuh J, Liu C, Wang P (1999) Comorbidity of headaches and depression in the elderly. *Pain* 82, 239-43.
- Holroyd KA, Stensland M, Lipchik G L, Hill KR, O'Donnell FS, Cordingley G (2000) Psychosocial correlates and impact of chronic tension-type headaches. *Headache* 40, 3-16.
- Turk DC, Melzack R (eds) (2001) *Handbook of Pain Assessment*, 2nd edn. The Guilford Press, New York.
- Beck AT, Epstein N, Brown G, Steer RA (1988) An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol* 56, 893-97.
- Crandall CS, Priesler JJ, Aussprung J (1992) Measuring life event stress in the lives of college students: Undergraduate Stress Questionnaire (USQ). *J Behav Med* 15, 627-62.
- Langemark M, Olesen J (1987) Pericranial tenderness in tension headache. *Cephalalgia* 7, 249-55.
- Janke EA, Holroyd KA, Romenak K (2004) Depression increases onset of tension-type headache following laboratory stress. *Pain* 111, 230-8.
- Langemark M, Jensen K, Jensen TS, Olesen J (1989) Pressure pain thresholds and thermal nociceptive thresholds in chronic tension-type headache. *Pain* 38, 203-10.
- Okifuji A, Turk DC, Sinclair JD, Starz TW, Marcus DA (1997) A standardized manual tender point survey. *J Rheumatol* 24, 377-83.