Pressure-Pain Threshold Variation in Temporomandibular Disorder Myalgia over the Course of the Menstrual Cycle

Hans Isselée, RPT
Doctoral Fellow
Faculty of Physical Education and Physiotherapy
Catholic University of Leuven
Leuven, Belgium

Division of Rehabilitation and Physiotherapy
General Hospital St Jan
Bruges, Belgium

Antoon De Laat, LDS, GHO
Professor
Stomatognathic Physiology
Cluster Oral Physiology
Department of Dentistry, Oral Pathology, and Maxillofacial Surgery
Catholic University of Leuven
Leuven, Belgium

Bernard De Mot, DDS, PhD
Professor
Head of the Training Centre for Dental Students
Division of Maxillo-Facial Surgery
Department of Dentistry
General Hospital St Jan
Bruges, Belgium

Department of Dentistry, Oral Pathology, and Maxillofacial Surgery
Catholic University of Leuven
Leuven, Belgium

Roeland Lysens, MD, PhD
Professor of Physical Medicine and Rehabilitation
Faculty of Physical Education and Physiotherapy
Catholic University of Leuven
Leuven, Belgium

Correspondence to:
Dr Antoon De Laat
Department of Oral and Maxillofacial Surgery
School of Dentistry
Catholic University of Leuven
UZ St Rafael
Kapucijnenvoer 7
B-3000 Leuven, Belgium
Fax: +3216332435
E-mail:
antoon.delaat@med.kuleuven.ac.be

Aims: *To evaluate the influence of the menstrual cycle on pressure-pain thresholds (PPTs) in patients with masticatory myalgia.* ***Methods:*** *Fluctuations in pain sensitivity during 2 consecutive menstrual cycles were assessed in 15 normally menstruating patients with a myogenous temporomandibular disorder (TMD). Muscle pain was measured by the use of pressure algometry and a visual analog scale (VAS). The McGill Pain Questionnaire was used to assess the sensory, affective, and evaluative dimensions of the pain.* ***Results:*** *Since 5 patients dropped out of the study due to pregnancy, unexpected menstrual cycle irregularities, or personal problems, statistical analysis was performed on 10 patients. Time had a significant influence on the pain condition. The PPTs of all muscle sites increased significantly and progressively over time by 16% to 42% in the follicular and luteal phases. PPTs remained low in the perimenstrual phase. The VAS pain rating did not correspond well with the PPTs, and the statistical analysis showed that the VAS ratings could not be used as predictors for the PPT measurements or detect the differences between cycle phases. The sensory, affective, and evaluative dimensions of the pain were significantly lower at the end of the trial.* ***Conclusion:*** *These data suggest a significant influence of the menstrual cycle on pain report and a nonspecific improvement of the chronic myogenous TMD.*

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Key words: pain threshold, menstrual cycle, masticatory muscle, myofascial pain

Pain of the masticatory muscles (masticatory myalgia) is one of the most common symptoms in temporomandibular disorder (TMD) patients.[1,2] The high predominance of females in their reproductive years in these patient groups[2–7] has led to more recent investigations to examine the possible influences of hormone levels on the level of reported pain. As is the case for masticatory myalgia, or trigeminal myofascial pain,[8] more women than men also appear affected by chronic pain syndromes such as migraine, rheumatoid arthritis, and chronic tension-type headache, as well as TMD.[9] The evidence for gender differences in clinical pain conditions has been reviewed by Berkley and Holdcroft[10] and Dao and LeResche.[11]

Data from patients with rheumatoid arthritis[12] and fibromyalgia[13] have suggested the importance of the hormonal state and time of the menstrual cycle in the pathophysiology of

these disorders. Migraine headaches were found to be related to the menstrual cycle.[14,15] The incidence of reported pain also differs before and after menopause.[16]

Using different types of experimental stimuli and techniques, studies in symptom-free subjects have provided growing evidence that pain perception in females fluctuates as a function of the ovarian cycle.[17,18] Also, several animal studies have reported fluctuations in pain sensitivity during the menstrual cycle[19,20] and thereby have provided a basis for understanding hormonal effects on mood, behavior, and cognition.[21] Recently, Bradshaw et al[22] found a modulating influence of circulating sex steroids on chronic peripheral inflammation in rats.

The possible effects of reproductive hormones on myofascial pain levels are less well understood.[11] Only a few studies have examined the association of facial pain levels with hormonal status. LeResche et al[23] reported that the use of oral contraceptives may increase the risk for TMD. A preliminary study of patients with myofascial pain[24] found that pain levels of users of oral contraceptives were more constant than those of nonusers.

Since the diagnosis of myofascial pain is based mainly on a report of pain on palpation,[25] pressure-pain thresholds (PPTs) are commonly used to quantify muscle tenderness. Over a period of several weeks, the reproducibility of PPTs appears to be poorer in patients compared to symptom-free subjects.[26,27]

The present prospective study was designed to evaluate whether myofascial pain report is influenced by the menstrual cycle. It was hypothesized that the levels of muscle pain could fluctuate with phases of the menstrual cycle, as has been reported in other studies in symptom-free subjects.[18,28] In addition, the natural course of reported pain over a longer period without treatment was investigated. It was speculated that a better knowledge of the hormonal influences on pain report in a clinical population could help to control longitudinal pain ratings for menstrual cycle–related differences, and even lead to implementation of these interactions in treatment strategies.

The specific purposes of this study were: *(1)* to measure and compare the PPTs during different phases of 2 consecutive menstrual cycles; *(2)* to evaluate and to compare the affective dimensions of pain during the different phases of the menstrual cycle and over time; and *(3)* to evaluate the influence of time on muscle pain as revealed by PPTs. Part of this study has been presented as an abstract.[29]

Materials and Methods

Population

The subjects for this study were recruited from 220 new patients consulting at the TMD clinic at the Department of Dentistry, St Jan General Hospital, Bruges, over an 18-month period. All patients had a history of complaints of masticatory muscle tenderness for at least 3 months to 15 years (mean 24 months). Previous treatment was not successful, and patients had not received treatment for the previous 2 months.

Myofascial pain was defined according to Axis I, category Ia and Ib, of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC-TMD).[30] Category Ia defines myofascial pain as pain of muscle origin, including a complaint of pain as well as pain associated with localized areas of tenderness to palpation in the muscles. There should be a report of pain or ache in the jaw, temples, face, preauricular area, or inside the ear at rest or during function. In addition to the general RDC-TMD, for the present study, pain needed to be reported in response to palpation of the masseter and temporalis particularly. Category Ib features limited movement and stiffness of the muscle during stretching in the presence of the myofascial pain.

The selection of the patients was performed in several steps, according to very strict inclusion and exclusion criteria, as noted below.

Inclusion Criteria. Patients were included if they met the following conditions: *(1)* women, in the age range from 18 to 40 years, who sought treatment; *(2)* pain fulfilling the diagnostic criteria (RDC-TMD) for myofascial pain; and *(3)* a regular menstrual cycle lasting between 26 and 33 days.

Exclusion Criteria. Patients were excluded if they presented the following signs or symptoms or with a history of the following diseases:

1. Signs or symptoms of disc displacement, arthrosis, or arthritis of the temporomandibular joint (TMJ) (according to categories II and III of the RDC)
2. History of traumatic injuries (eg, contusion, fracture)
3. Systemic diseases (eg, rheumatoid arthritis, fibromyalgia)
4. Neck complaints (eg, limited motion, pain)
5. Neurologic disorders (eg, trigeminal neuralgia)
6. Migraine or tension-type headache or hypertension
7. Less than 1 year postpartum

8. Use of drugs (eg, alcohol abuse) or medications (eg, antidepressant medication, oral contraceptives, exogenous hormone preparations)
9. Gynecologic disorders (eg, endometriosis)
10. Current or recent (within the last 2 months) therapy for the complaints

Because of the frequency of the measurements, only patients living near to the hospital were recruited. None of the patients who met the inclusion criteria refused to participate. The selected patients were informed about the aims and procedures of the study, which were approved by the local ethics committee, and gave informed consent. They agreed not to receive any active treatment during the course of the investigation. In addition, they were told that if the signs and symptoms or the pain became intolerable, the investigation would be stopped and treatment would start. After the trial was completed, the patients were invited for a reexamination at the TMD clinic and a treatment (splint therapy, physical therapy) was discussed.

Selection Procedure

Initial Visit at the TMD Clinic. All patients visiting the TMD clinic underwent a standardized clinical examination of the stomatognathic system by a trained examiner. The examination consisted of a thorough anamnesis and the measurement of active and assisted mouth opening, left and right laterotrusion, and protrusion. Clicking sounds (of the TMJ) during mandibular movement were examined manually and registered. The TMJs were palpated both laterally and posteriorly. The anterior, medial, and posterior temporalis; the tendon of the temporalis; the origin, body, and insertion of the masseter; the posterior and submandibular regions; and the area of the lateral pterygoid were palpated manually. Patients who did not meet the selection criteria were excluded at this stage of the study. A total of 18 patients were selected at this stage and included in the next step of the investigation.

Initial Visit at the Rehabilitation Center. The 18 patients were asked to visit the rehabilitation center for a standardized physical examination of the neck and shoulder girdle performed by a second investigator. This examination included active and assisted flexion-extension, lateral bending, and rotation movements. Segmental mobility testing of the cervical (C0-C1, C1-C2, C2-C3, C3-C4) and high thoracic (D1-D6) spine and of the shoulder girdle was performed. The muscles of the neck (sternocleidomastoid, trapezius, levator scapulae, splenius capitis, and semispinalis capitis) were examined as possible sources of referred pain. Only 1 patient exhibiting objective and subjective signs and symptoms of neck or shoulder pain was excluded at this stage of the study.

At the end of this examination, the 17 remaining patients were introduced to the pressure algometer and the recording procedures during an informal test session in order to fulfill the criteria of informed consent. The data from this session were not included in the statistical analysis. None of the patients refused further participation at this stage.

Gynecologic Interview and Planning of the Test Dates. After the test session, the patients were referred to a third independent investigator for an interview about possible gynecologic problems or complaints and their hormonal status. The subjects reported the exact dates of their recent 2 menses. One subject reported menstrual irregularities and 1 subject reported persistent anovulation. These subjects were excluded at this stage of the study. In the 15 remaining subjects, the dates of the previous menses were used to calculate each woman's cycle length. The subjects were asked to contact the investigator again at the first day of the forthcoming menstruation. During that contact the dates of the measurement sessions were planned according to the initially calculated cycle length: 2 sessions were scheduled in the follicular phase (days 10 to 12) and 2 sessions in the luteal phase (days 24 to 26). The subjects were then randomized to the first session. For 4 patients, the first measurements were taken during the follicular phase; for 5 patients, measurements began during the luteal phase; and for 1 patient, measurements began during the perimenstrual days; the PPT examiner was blinded to this information. Also, the exact dates of subsequent menses were reported, which allowed the independent investigator to plan the test dates of the second cycle. At the end of the experimental period, the exact dates of the menses were used to calculate retrospectively the phases during which the experimental sessions actually occurred.

Pain Assessment

Visual Analog Scale. During each measurement session, a mechanical VAS ruler (M-VAS) was used to measure the intensity of pain before the PPT measurement.[31] The plastic VAS ruler was 10 cm in length, and the scale was anchored by the verbal descriptors "no pain" and "extreme pain."

McGill Pain Questionnaire. In addition to scoring pain intensity, an indication of the nature of

pain was assessed by means of the McGill Pain Questionnaire (MPQ) (Dutch language version).[32,33] All patients completed the questionnaire at the beginning of the study and 9 patients at the end.

Mandibular Function Impairment Questionnaire. To evaluate the real impact of symptoms and signs on the mandibular function, the patients completed the Mandibular Function Impairment Questionnaire (MFIQ)[34] at the start of the study.

Graded Chronic Pain Scale. To determine the disability of the patient, patients filled out the Graded Chronic Pain Scale.[35]

Recording of PPTs. PPTs were measured with a Somedic Type II algometer (Solentuna, Sweden). The tip size was 1 cm^2 and the application rate 40 kPa/s. PPTs were taken at trigeminal sites (the bilateral temporal and masseteric muscles) and nontrigeminal sites (the left and right thumb eminence). At the start of each session, the subjects were familiarized with the measurement procedure and the equipment via a demonstration on the right forearm. The PPT was defined as the point at which a sensation of pressure changes into a sensation of pain. The latter was repeated at the beginning of each consecutive session to avoid confusion with pain tolerance.

After a 1-minute relaxation period, the PPTs of the muscle sites were measured in the following sequence, with intervals of a few seconds between sites: right temporalis, right masseter, left thumb, right masseter, right temporalis, left temporalis, left masseter, right thumb, left masseter, and left temporalis. After an interval of 5 minutes, the entire procedure was repeated. This process resulted in 4 measurements for each masticatory muscle point per session. The choice to start with the right or left side was made at random for each subject. This recording procedure proved to be reproducible.[25–27,36–38] Although in previous studies using the present experimental setup, no significant differences were found in PPTs recorded on a different time of the day,[27,36,37] the subjects were tested at the same time of the day during the entire study.

Follow-up Examination. At the end of the study, arrangements were made for the patients to revisit the TMD clinic to follow up with treatment of their symptoms. At least 1 year after the trial was completed, the patients were followed up by means of a telephone interview and a questionnaire or a visit at the TMD clinic.

Statistical Analysis

By means of a linear mixed model (SAS), differences regarding PPTs measured on the masseter, temporalis, and thumb muscles were analyzed with respect to *(1)* hormonal phases, *(2)* the 4 consecutive measurements of each muscle point per session, *(3)* painful and nonpainful side of the body, and *(4)* time. The eventual interactions of the VAS scores with the possible differences were also analyzed.

The fixed part of the model consists of time, hormonal phase, measurement, and painful or nonpainful side of the body. The measurements were also correlated over time for painful/nonpainful side by the use of patient and painful side as a random effect.

Because of the necessity for normality of the residual values, the raw PPT data were logarithmically transformed (= log(x)). The standard error (SE) was defined as the square of the variance of the estimate. *P* values followed by an asterisk (*P**) were corrected for multiple testing according to Tukey's method.

The scores on the MPQ obtained before and after the study were compared by means of a signed rank test.

Results

Population

Fifteen patients were evaluated during 2 complete menstrual cycles. During the study, 1 patient became pregnant. In 2 other patients, there was a discrepancy between the cycle length calculated before the study and the cycle length during the study (at least 4 days shorter than usual). Because these cycles might be associated with early ovulation, the data were excluded from statistical analysis. One subject was ruled out because the exact day of the last menses was not reported due to absence of the patient. Finally, 1 subject showed excessive irregularities in the schedule of the measurement sessions due to professional reasons. As a consequence, 10 patients were included in the statistical analysis.

According to the Graded Chronic Pain Scale,[35] 9 of the 10 patients could be classified as having a disorder with low pain-related disability but with high pain intensity (grade II of the classification system). One patient reported high disability with moderate limitation (grade III).

Table 1 Descriptors Chosen from the McGill Pain Questionnaire by 10 Patients at the Beginning of the Study and by 9 Patients at the End of the Study

Descriptors	Beginning of study (n = 10)	End of study (n = 9)
Sensory		
Pulsing-beating-cracking	1-0-1	1-0-0
Flickering-flashing-shooting	1-2-3	2-0-0
Pricking-boring-drilling	0-5-0	0-0-0
Sharp-cutting-lacerating	3-0-1	2-0-0
Pressing-pinching-gnawing	5-2-0	3-1-0
Tugging-splitting-wrenching	6-1-0	3-2-0
Hot-burning-scalding	0-0-0	0-0-0
Heat-glowing-scorching	0-0-0	0-0-0
Cool-cold-freezing	0-0-0	0-0-0
Tingling-itching-electric	0-0-2	0-0-0
Stiff-taut-cramping	3-5-1	2-1-0
Boring-nagging-stubborn	1-2-2	3-1-0
Affective		
Tiring-debilitating-exhausting	7-0-0	4-0-0
Miserable-depressing-sickening	1-2-0	0-0-0
Tense-close-suffocating	9-0-0	4-0-0
Fearful-frightful-terrifying	5-0-0	0-0-0
Punishing-cruel-killing	1-2-0	0-0-0
Evaluative		
Light-moderate-severe	2-6-1	8-1-0
Tolerable-annoying-terrible-unbearable	4-6-0-0	6-1-0-0
Uncomfortable-troublesome-terrifying-horrible	8-1-1-0	4-1-0-0

Table 2 Differences in Scores on the Pain Rating Index (PRI) of the McGill Pain Questionnaire at the Start and at the End of the Study, Expressed by the Median Drop in Scores

Scale	Median drop in score	Range	*P*
PRI-S	4	3–13	.0039*
PRI-A	2	1–6	.0078*
PRI-E	1.5	2–8	.0156*
PRI-T	8.5	6–24	.0039*

PRI-S = sensory part of the PRI; PRI-A = affective part of the PRI; PRI-E = evaluative part of the PRI; PRI-T = total score of the PRE.

*P = .05 was considered significant.

McGill Pain Questionnaire

Table 1 shows the description of sensory (S), affective (A), and evaluative (E) adjectives of the pain, as recorded at the beginning and at the end of the study. In the affective and evaluative subclasses, all subscales were used. In the affective subclass, a clear preference for the words *vermoeiend* (tiring) and *gespannen* (tense) was present. In the evaluative subclass, the adjectives *vervelend* (uncomfortable), *draaglijk* (tolerable), and *hinderlijk* (annoying) were preferred. Nine of the 12 subscales were used in the sensory subclass and the descriptors in this subclass varied substantially: *stekend* (boring), *trekkend* (tugging), *strak* (taut), and *drukkend* (pressing).

For the 3 MPQ dimensions, pain rating indices (PRI) were calculated: sensory (PRI-S), affective (PRI-A), and evaluative (PRI-E). These were the sum of the intensity order of ranking of the chosen adjectives (the adjective with the lowest pain intensity was ranked 1, and the adjective with the highest intensity was ranked 3 or 4). Summation of these 3 PRIs resulted in a PRI total score (PRI-T). On most subscales, the patients reported light to moderate pain at the start and at the end of the trial.

At the end of the study, the total score (P = .0039), the sensory part (P = .0039), the affective part (P = .0078), and the evaluative part (P = .0156) were significantly lower than at the start. The median score decreased by 8.5 (47%) for the total score, 4 (44.5%) for the sensory part, 2 (64.5%) for the affective part, and 1.5 (35%) for the evaluative part (Table 2).

PPT Measurements

In the whole patient group, 76 measurement sessions were held. Using the method of calculating back from the menses, the investigators were able to ascertain that 27 sessions were held during the mid- to late follicular phase (days 8 to12) and 25 sessions were held during the mid- to late luteal

phase (days 19 to 26). In 9 of the 10 subjects, 11 measurement sessions appeared to be taken during the perimenstrual days (days 27 to 1; day 1 = mense). Because these perimenstrual data were collected in nearly all of the patients, and because misestimation of these data was unlikely, they were included in the analysis as the perimenstrual phase.

The remaining 13 measurement sessions appeared to be taken on days 13 to 16. However, since the exact day of ovulation was unknown, and therefore misestimation was likely, the data were excluded from the analysis. This decision also prevented inclusion of periovulatory measurements in the follicular dataset.

Painful and Nonpainful Side. PPTs were not significantly different between the painful and the nonpainful side of the body for the masseter (P = .4007), temporalis (P = .1156), and thumb muscles (P = .4944).

Measurements Within a Session. The first PPT measurement of each session was significantly higher than the second and fourth measurements (P^* = .0104 and P^* < .0001, respectively) but not the third measurement (P^* = .8405). The second PPT measurement was significantly lower than the third measurement (P^* = .0329) but not significantly different from the fourth measurement (P^* = .9600). The third PPT measurement was significantly higher than the fourth measurement (P^*< .0001).

Time. At the beginning of the study, there was no significant difference in the masseter muscles between the PPTs measured during the various phases (follicular versus perimenstrual [P = .867], luteal versus perimenstrual [P = .9677]) (Fig 1). However, over time the PPTs measured during the 3 different phases appeared to evolve significantly differently (P = .0006). The PPTs in the follicular and luteal phases increased significantly (P = .0007 and P = .0005) during the study. In comparison to the start of the study, the PPT increased by 35%. In the perimenstrual phase, however, no significant differences were found over time (P = .6638). The differences between the perimenstrual and the follicular phases (P = .0194) and the perimenstrual and the luteal phases (P = .0248) were significant.

Similar to the masseter muscles, there were no significant differences in PPTs between the 3 phases for all measurements at the beginning of the study for the temporalis muscles (Figs 2a to 2d). However, the first and second PPT measurements (Figs 2a and 2b) increased significantly during the luteal phases (P = .0044 and P = .0590, respectively). The third and fourth PPT measurements increased significantly over time, both in the follicular (P = .0073 and P = .0011) and in the luteal phases (P = .0008 and P = .0001) (Figs 2c and 2d). Here, the increase was 38%.

In thumb muscles, the first PPT measurement also increased significantly over time (by 16%) during the follicular phases (P = .0208) (Fig 3a). The second PPT measurement decreased significantly (P = .0104) over time for the perimenstrual phase, whereas there was no time effect for the follicular and luteal phases (P = .0715 and P = .5803, respectively). In the thumb muscles, the PPTs during the perimenstrual phase were significantly lower (P = .0167) than at the onset of the study already (Fig 3b).

VAS Scores

As part of the MPQ and the questionnaire serving the RDC, a VAS is included (MPQ-VAS and RDC-VAS, respectively). At the start of the study, the mean MPQ-VAS score (± SD) of the present pain was 3.31 ± 0.61, mean minimum pain 1.74 ± 1.38 and mean maximum pain 6.3 ± 1.75. At the end of the study, the mean score of the present pain decreased by 33% to 2.23 ± 0.72. The mean RDC-VAS score of the present pain was 3 ± 0.81 at the beginning and 2.5 ± 0.79 at the end of the study. The VAS scores for present pain measured with a mechanical VAS ruler (M-VAS) during each consecutive session appeared not to predict the PPT on the masseter (P = .6126), temporalis (P = .7716), and thumb muscles (P = .3507), if all other variables (time, phase, number of measurements, and painful/nonpainful side) were available. The M-VAS score also did not account for the differences between the different hormonal phases.

Patient Follow-up

Four of the 10 patients found that their condition did not warrant any follow-up or treatment. Of the remaining 6 patients, 2 received splint therapy and 3 received physical therapy in combination with splint therapy. Of the prescribed 12 treatment sessions of physical therapy, the patients only used 3 to 5 visits.

One year after the end of the study, 8 patients reported complete remission of symptoms. The remaining 2 patients had slight periodic pain. One of these patients reported a very slow remission, while the other experienced fluctuating pain periods during which she used an occlusal splint.

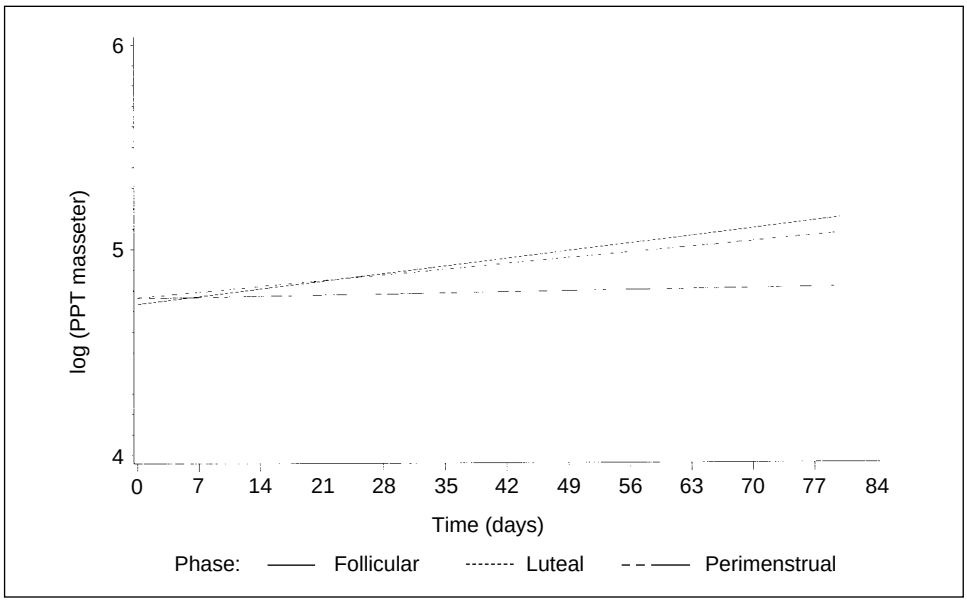


Fig 1 Average PPT measurement over time for the 3 different menstrual cycle phases in the first measurement at the masseter on the painful side. Log (PPT masseter) = logarithmic transformation of the raw data (= log(x)).

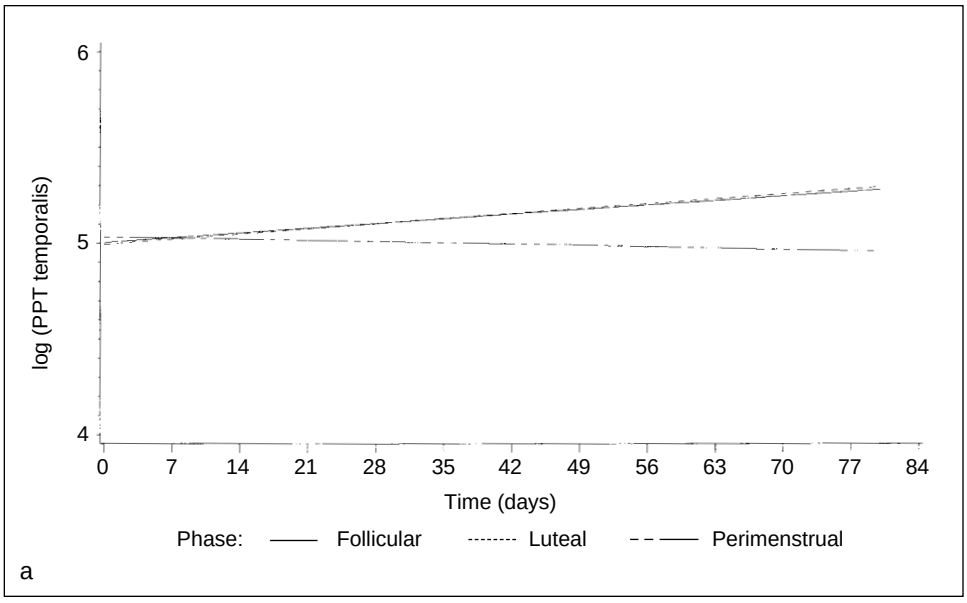
Discussion

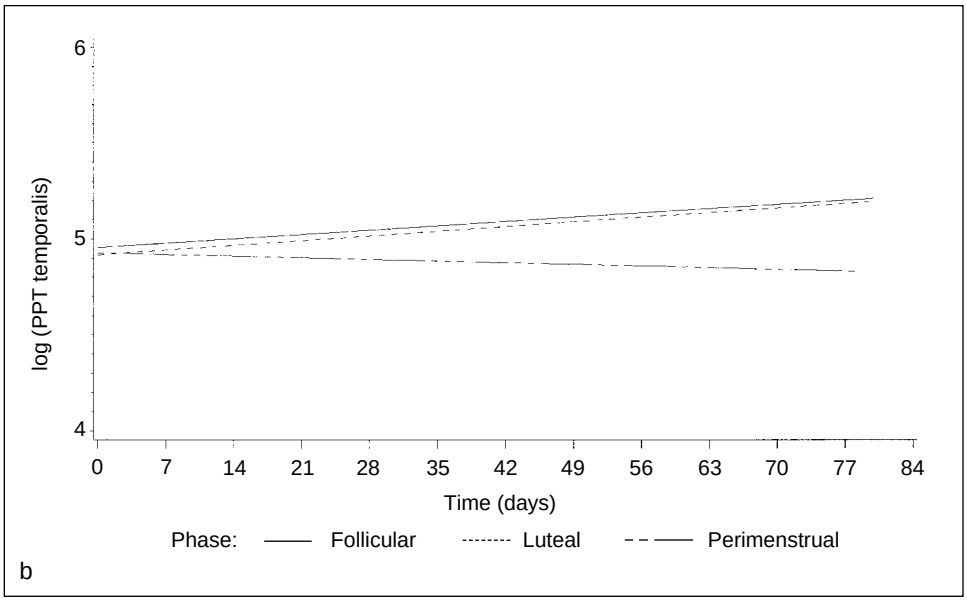
The present study was designed to evaluate the influence of the menstrual cycle on reported pain in chronic myogenous TMD patients, as evaluated by PPTs and VAS. In addition, the natural course of the untreated condition was followed up. The MPQ was used to evaluate the different dimensions of the pain and the quality of life. The main findings were that the PPT gradually increased over time and that significantly lower PPTs were measured during the perimenstrual phase.

PPTs Increased Over Time

The present data showed that time had a significant influence on the pain condition in these chronic myogenous TMD patients. The PPTs of all muscle sites increased significantly and progressively by 16% to 42% when measured during the follicular and luteal phases. Several factors could be responsible for this change.

First, entrance into a study lasting 2 months without treatment might have contributed to the patients' comfort, since they realized that they did not have a dangerous or malignant disorder. This might also explain why none of them refused to participate and why they were motivated and very disciplined in attending the appointments. It seems reasonable to assume that the observed improvement in the condition may be a result in part to the nonspecific effects of coping, expectation, being indirectly "under care," or increased comfort in the knowledge that treatment is not urgently needed. Feine and Lund[39] recently compared various forms of physical therapy and physical modalities (including placebo) of chronic musculoskeletal disorders, including TMD, and found that the amount of treatment and time that the patient spent with the therapist was a deciding factor in the patient's report of relief. Our patients spent a maximum of 30 minutes per measurement session in the hospital, receiving no treatment or counseling. Possibly the whole procedure in itself, which gave the patient the opportunity to relax in a professional environment, might have had a healing effect.[40,41] It is striking that after the trial was completed, only 5 of the 10 patients found it necessary to start the proposed treatment. In addition, 4 patients reported their condition as "acceptable" and did not return to the TMD clinic for the reevaluation. Another possible explanation might, of course, be that after 2 months of investigation, the patients were tired of the visits and would wait and see rather than rush into "another" tight treatment regimen. Feine and

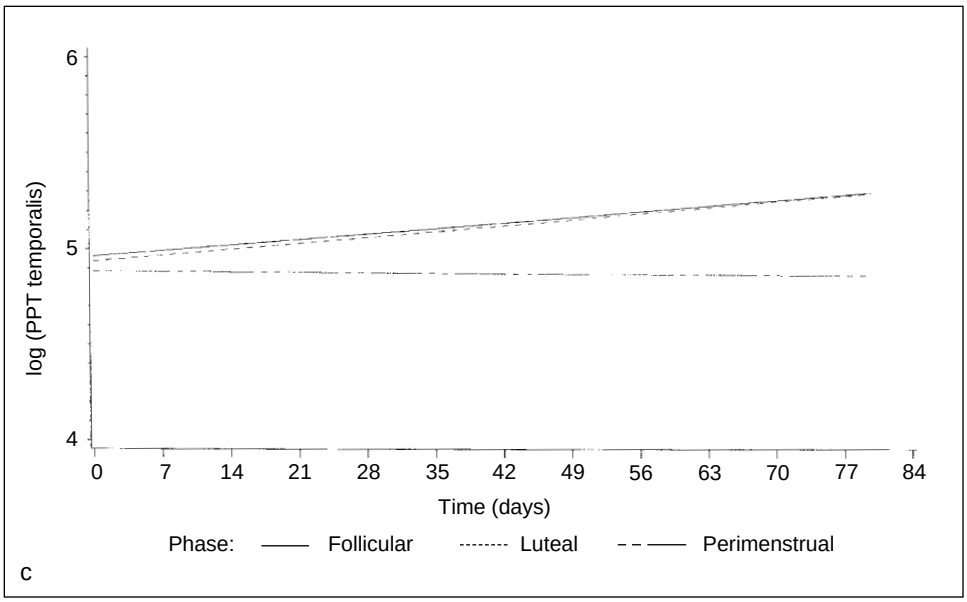


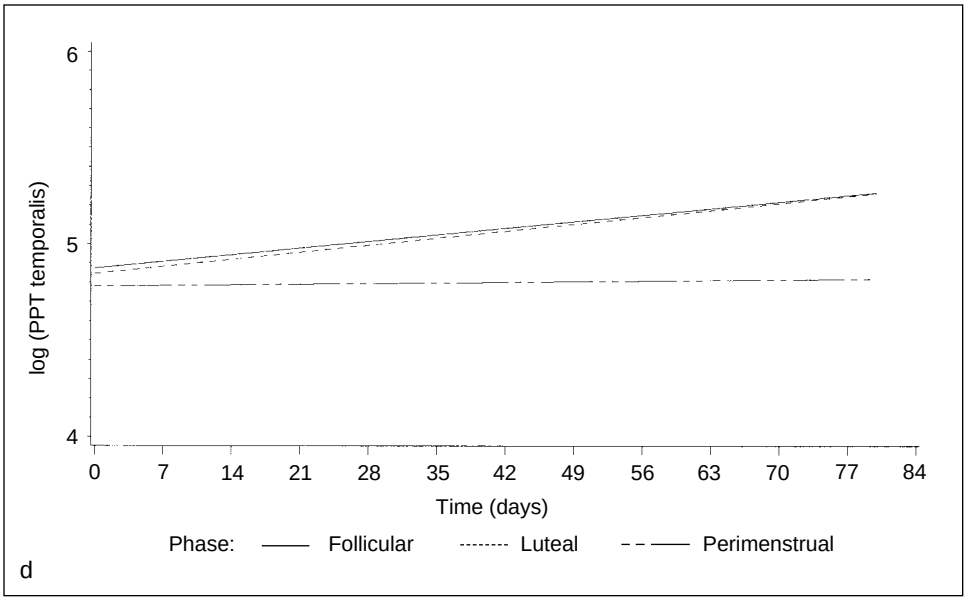


Figs 2a to 2d Average PPTs over time for the 3 different phases and the 4 measurements at the temporalis. The PPTs were adjusted for painful side. Log (PPT temporalis) = logarithmic transformation of the raw data (= log(x)).

Lund[39] reported that, with the exception of exercise therapy, the treatment of chronic muscle disorders was only efficacious as long as the treatment continued. In the present study, the results of the follow-up examination at the TMD clinic, at least 1 year after the trial was completed, confirmed a total remission of the symptoms in 8 and slight periodic pain in 2 patients. In this light, previous studies reporting a high rate of spontaneous remission and placebo effect[8,42,43] were confirmed. In another study, the spontaneous remission of symptoms was found to be the main reason for not returning to follow-up appointments.[44]

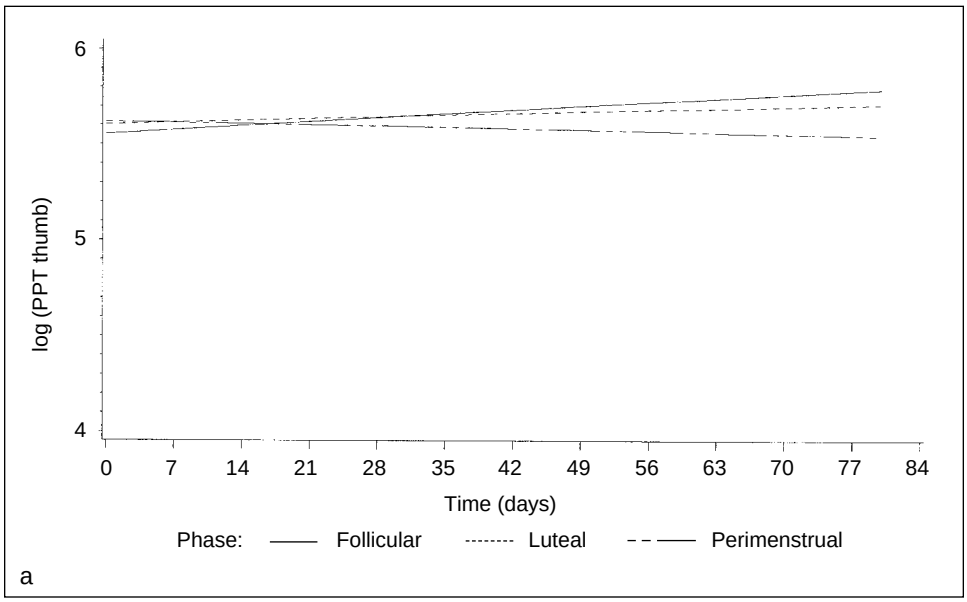
The possible influence of familiarization with the measurement procedure was unlikely. In a previous study,[28] no significant PPT changes over

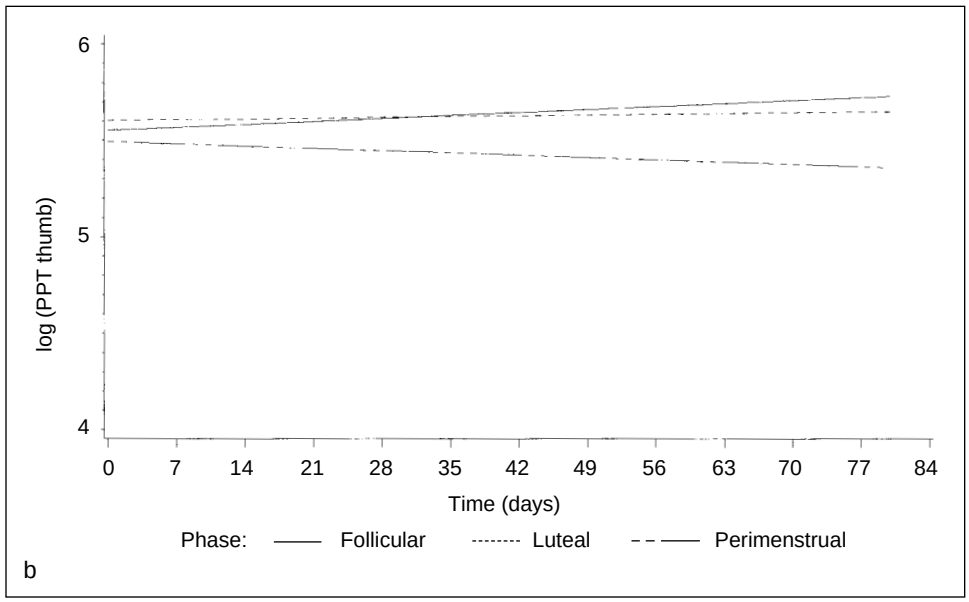




time were found in 3 control groups over a 10-month period. Previous observations on the reproducibility of PPTs over time yielded equivocal results in symptom-free subjects[27,38,45] and reported a rapidly declining reproducibility in myogenous TMD patients.[26,27] The present findings, ie, that time and hormonal states influence PPTs, might help to explain this confusion.

Another possible explanation for the gradual increase in PPTs can be found in the natural history of the condition. It is likely to assume that patients visit a clinic during times of severe pain. The improvement over time might therefore have occurred with or without participation in the study.





Figs 3a and 3b Average PPTs over time for the 3 different phases of the 2 measurements (measurements 1 and 3) of the thumb, adjusted for painful side. Log (PPT thumb) = logarithmic transformation of the raw data (= log(x)).

PPTs Remained Low During the Perimenstrual Phase

To our knowledge, no other studies have examined the influence of the menstrual cycle on PPTs in myogenous TMD patients. We hypothesized that the hormonal differences between the follicular and luteal phases could affect PPTs, as previously reported in asymptomatic populations.[18] The present data could not confirm this hypothesis.

We did not use a method to identify clearly the exact day of ovulation to avoid placing extra demands on the patients, who had already volunteered for an intensive study. As a consequence, some measurement sessions occurred outside of the follicular and luteal phases that were planned originally. To prevent misinterpretation of data in

the follicular phase, all measurements occurring on "doubtful" periovulatory days were excluded from the analysis. Retrospectively, the decision not to employ an ovulation kit or ultrasonic determination of the exact date of ovulation appeared to be the weakest point in the experimental design, since 13 of the 76 measurement sessions had to be excluded and 11 were determined to be perimenstrual. Future studies should certainly take this problem into account; this will also help avoid measurement of anovulatory cycles in women with regular menses. The risk of anovulatory cycles can be considered minor in subjects with a regular menstrual cycle.[46]

It is difficult to determine to what extent physical or psychologic factors influence PPT values, since it is known that both variables might be affected by the menstrual cycle.[47] If PPTs reflect underlying mechanisms of perceptual hyperresponsiveness attributable to cognition,[17,48–50] then the lower PPTs during perimenstrual days in particular suggest a higher psychophysiologic response of the whole person that is restricted to the perimenstrual days. Our results also imply that in the clinical setting, PPT measurement should take into account the perimenstrual phase.

It is striking that in the study of Giamberardino et al,[51] which involved delivering painful electrical stimuli to women with a clinical pain condition in the area stimulated, the lowest pain thresholds were also found during the perimenstrual phase. The similarity of PPT values between the 3 phases at the beginning of the study, however, might suggest an altered responsiveness of the whole person toward potentially painful stimuli during the initial visits and could reflect a continuously high state of arousal in these patients or central sensitization at the time they are seeking treatment.[52]

Due to the strict inclusion criteria and patient drop-out during the study, only 10 patients could be included in the analysis, which consequently only has limited power. In view, however, of the small PPT differences between luteal and follicular phases, a clinically relevant effect appears improbable, even if with considerably higher numbers, such an effect might be found statistically. In contrast, the 10% to 30% decrease in PPTs during the perimenstrual phase is clinically relevant.

VAS Scales Did Not Predict the PPT

The RDC-VAS and the MPQ-VAS had comparable mean scores for present pain at the start of the study, and the values were very similar to those reported earlier for myofascial pain, TMD, or other chronic pain conditions.[5,8,53] The scores for worst pain and mean pain during the last 6 months were much higher, which is in agreement with the findings that chronic pain patients overestimate their past pain.[54–56]

The M-VAS was used during each PPT measurement session and aimed to measure pain level fluctuations during the menstrual cycle. However, the subjective M-VAS pain rating of the patients did not correspond well with the somewhat more objective PPT measurement, and statistical analysis showed that the M-VAS ratings could not be used as predictors for the PPT measurements or detect the differences between the cycle phases. In fibromyalgia patients, a similar absence of correlation was reported between pain rated on a VAS and changing levels of neuropeptides during the hormonal cycle.[13] In symptom-free subjects, no cycle differences were found for any of the VAS measures.[17]

Quality of the Pain

The quality of the pain, as evaluated using the MPQ, showed a change in intensity, especially in the evaluative and affective dimensions of the pain and, to a lesser extent, in the sensory components of the pain. These observations may underline the importance of the experience of the pain in chronic myogenous TMD patients.[48] Recently, it was reported that anxious mood[57] and negative cognitions[58] were associated with chronic TMD and other types of chronic pain.

Side-to-Side Differences

In the present study, the PPTs of the painful and nonpainful side of the body were not significantly different. These findings are similar to those of the control groups and to the findings of Reid et al.[27] It has been reported that both peripheral and central neural mechanisms may be involved in the pathophysiology of chronic myogenous TMD.[59–63] Our observations may support the latter theory of central hyperexcitability.

In conclusion, the present data have shown that menstrual status influences pain report, especially during the perimenstrual days. Moreover, a gradual decrease in pain sensitivity, as expressed by the PPTs, was observed over time. In addition, an improvement in the affective and disability aspects of the pain was found. These results suggest a nonspecific improvement in chronic myogenous TMD over time and therefore support a conservative, nonaggressive management approach[64] toward these conditions.

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