Effect of Systemic Versus Topical Nonsteroidal Anti-inflammatory Drugs on Postexercise Jaw-Muscle Soreness: A Placebo-Controlled Study

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Certain types of jaw-muscle pain may be managed with pharmacologic treatment. This study evaluated the effect of topical and systemic nonsteroidal anti-inflammatory drugs on acute postexercise jaw-muscle soreness. Ten men without temporomandibular disorders performed six 5-minute bouts of submaximal eccentric jaw exercise. The outcome variables were pressure pain thresholds and pain tolerance thresholds at the masseter muscles, and maximum voluntary occlusal force. Surface electromyography from the masseter muscles was used to assess the development of muscle fatigue during the exercise period. Three treatment modalities were tested in a placebo-controlled, double-blind approach: (A) placebo gel and placebo tablets; (B) nonsteroidal anti-inflammatory drug gel (2 g, 5% ibuprofen) and placebo tablets; and (C) placebo gel and nonsteroidal anti-inflammatory drug tablets (400 mg ibuprofen). The subjects used their medication 3 times a day for 3 days in the postexercise period. In the exercise period, the mean power frequency of the electromyography signal, pressure pain threshold, pain tolerance threshold, and maximum voluntary occlusal force decreased significantly (analysis of variance, P < .01). In the postexercise period, the effect of treatment on pressure pain thresholds was significant (F[2,9] = 4.41, P = .02). On day 3, treatment with topical nonsteroidal anti-inflammatory drugs was associated with significantly higher pressure pain thresholds as compared to treatment with systemic nonsteroidal anti-inflammatory drugs (P < .05) and placebo (P < .05). Treatment effects on pain tolerance thresholds and on maximum voluntary occlusal force were nonsignificant. The results demonstrated that repeated eccentric jaw exercise caused muscle fatigue and low levels of postexercise pain and soreness. Topical nonsteroidal anti-inflammatory drugs seem to have some advantages over systemic nonsteroidal anti-inflammatory drugs for management of exercise-induced jaw-muscle pain.
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The neurochemical and biomechanical mechanisms responsible for postexercise muscle soreness (PEMS) are unclear.[1-3] Postexercise muscle soreness in limb muscles has been associated with microstructural ruptures of the sarcomere architecture[4,5] and damage to the surface membrane, as indicated by the release of creatine kinase.[6,7] Inflammation is also likely to be involved, since massive histologic alterations, such as necrosis of
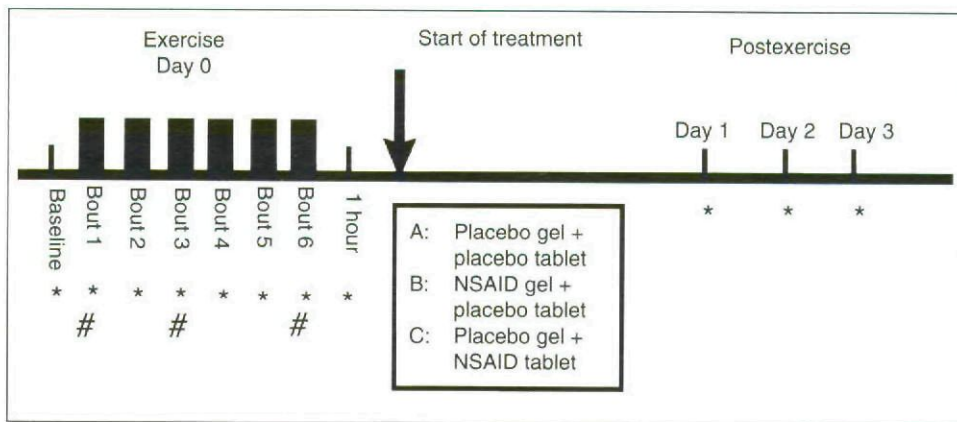
Fig 1 Overview of study design (*denotes PPT, PTT, MVOF measurements; #denotes EMG recordings).

muscle fibers and cellular infiltration, are observed.[4,8,9] Damage to muscle tissue may lead to repair processes accompanied by local swelling and sensitization of nociceptors through the release of histamine, bradykinin, and prostaglandin (PG). This sequence of events could explain the development of muscle soreness and pain.[10,11] Acetylsalicylic acid is known to inhibit the synthesis of PGs, perhaps also reducing bradykinin-induced activation of nociceptive muscle afferents (type IV).[10,12] The blockage of this response by a cyclo-oxygenase inhibitor in animals in whom the connection to the central nervous system had been cut[10] suggests that the site of action is local.

Because some studies have shown PG synthesis-inhibiting drugs to have little or no effect,[13-16] the clinical importance of PGs for the development of PEMS has been questioned. Other studies have demonstrated that nonsteroidal anti-inflammatory drugs (NSAIDs) and steroidal treatments do have an effect on PEMS.[17-22] Furthermore, Smith et al[23] demonstrated a significant covariance between the serum content of prostaglandin E_2 (PGE_2) and subjective ratings of PEMS, giving support to the idea that inflammatory processes are involved in PEMS. The active substances in topical NSAID appear to be concentrated in the muscle fascia, muscle tissue, and joint capsule, as well as the synovial fluid,[24] and it has been shown to relieve various musculoskeletal pain conditions as well.[21,25-27] Topical application of NSAID offers a therapeutic advantage over systemic administration since serum concentration is lower, and consequently the risk for adverse gastrointestinal events is smaller.

The present randomized, placebo-controlled, double-blind study compared the effect of systemic versus topical NSAID on experimental postexercise soreness in jaw muscles. The electromyographic (EMG) activity of the masseter muscles was recorded to obtain an electrophysiologic index of muscle fatigue during the eccentric jaw exercises. Pressure pain threshold (PPT) and pain tolerance threshold (PTT) at the masseter muscles were chosen as outcome variables for muscle soreness, and maximum voluntary occlusal force (MVOF) was used to evaluate the effect on jaw motor function.

Materials and Methods

Subjects

Ten men participated in the study (mean age 25.8 ± 0.5 years [SE]). All were in good health and had no history or complaints of temporomandibular disorders (TMD).[28] None of the subjects showed more than mild occlusal wear or hypertrophy of the masseter muscles upon voluntary contraction.[29] Manual palpation of the masticatory muscles was performed in accordance with published guidelines to verify the absence of painful muscle disorders.[28] Informed consent was obtained prior to study inclusion. The study was accepted by the Local Ethics Committee and the National Board of Health.

Study Design

Three treatment modalities (A, B, C) were tested during three sessions separated by 2-week intervals (Fig 1). Each treatment was preceded by an exercise period (day 0). Baseline measurements of PPT, PTT, and MVOF were obtained, followed by six 5-
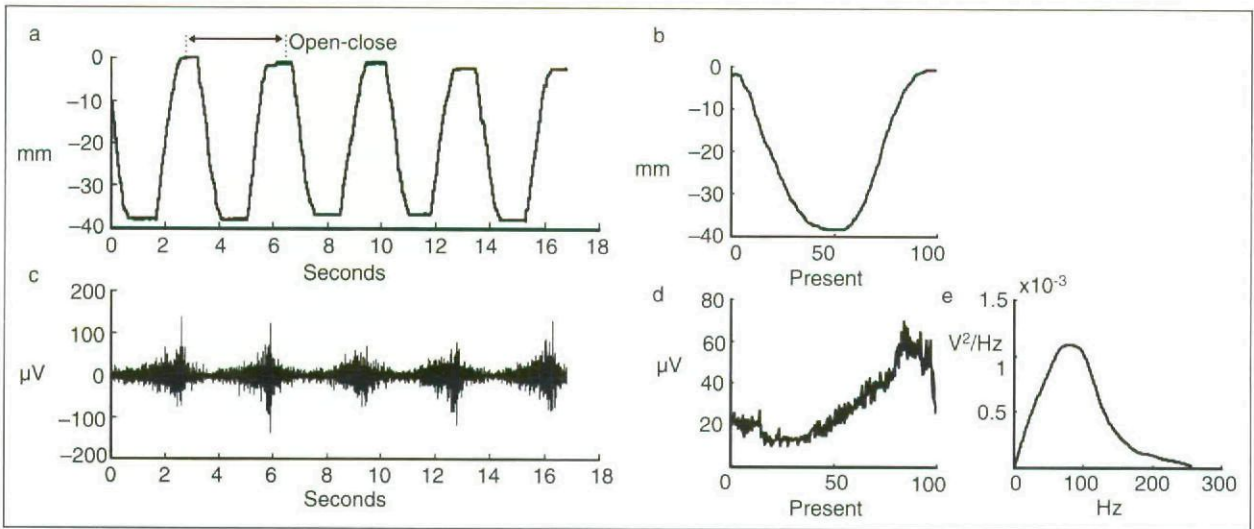
Figs 2a to 2e   Analysis of jaw movements *(a, b)* and EMG signals *(c, d, e)* from the masseter muscles. Detection of multiple open-close cycles was done on movement signal *(a)*. The open-close cycles were normalized (100%) and averaged to produce mean open-close cycles *(b)*. The EMG signal *(c)* was cut and arranged into open-close cycles, which also were normalized, rectified, and averaged to produce a mean EMG profile *(d)*. Note EMG activity during opening. The maximum peak amplitude and the mean power frequency *(e)* were calculated.

minute bouts of eccentric jaw exercise. Pressure pain thresholds, PTTs, and MVOFs were measured at the end of each bout and 1 hour afterward. The first of the three treatment modalities was then assigned to the subject in a randomized, balanced fashion (Table 1). The subjects used their medication for the next 3 postexercise days (days 1 to 3), and PPT, PTT, and MVOF were measured. Two weeks later a new exercise day was scheduled, and the subjects received the next treatment modality. All measurements were performed by the same investigator, who was blinded to the content of the different treatment modalities until the study was completed.

Eccentric Jaw Exercise

Jaw Movements.   Subjects were placed in a cephalostat to support their forehead. Eight constant-torque spring coils (Tensator, Milton Keynes, UK), 250 g each, were attached to the frame of the cephalostat below the mandible (as detailed in an earlier report by the present authors[22]). The mandible was connected via the lower canines to the spring coils. During each exercise bout, which lasted for 5 minutes, subjects were asked to slowly open their mouth as wide as possible and then to close it in a rhythm dictated by a metronome (1/3 Hz). To counteract the downward pull of the spring coils, subjects were required to contract their jaw-closing muscles during jaw opening, which corresponds to eccentric work for the jaw-closing muscles (see Figs 2c and 2d). The vertical movement of the mandible

Table 1   Allocation of Treatment Modalities

Subject	Session 1	2	3
1	A	B	C
2	B	C	A
3	C	A	B
4	A	B	C
5	B	C	A
6	C	A	B
7	A	B	C
8	B	C	A
9	C	A	B
10	A	B	C

was monitored by a simple mechanical system with a constant-torque spring coil (Tensator) coupled to a variable resistor and connected to the lower incisors. The change in resistance was proportional to the displacement of the lower jaw. The movement signal was digitized.

Electromyography.   Bipolar disposable surface electrodes (Blue Sensor Type N-10-A, Medicotest, Ølstykke, Denmark) were placed symmetrically on the central part of the masseter muscles at an interelectrode distance of 10 mm. A saline-soaked ground electrode was wrapped around the neck. The EMG signals were amplified differentially 5,000 to 20,000 times (Disa 15CO1, Denmark), fil-

tered (20 to 200 Hz), sampled (512 Hz), and stored. Five-minute EMG activity was recorded during the first, third, and sixth bouts at all three sessions (Fig 1).

Analysis of Jaw Movements and EMG. The movement signal was filtered through a low-pass finite-impulse filter (filter order = 20, cutoff frequency = 10 Hz), and the differentiated vertical position, which is the vertical velocity, was used to determine onset/offset during the open-close movement. Jaw closing was defined as the zero-crossing velocity at which the velocity changed from positive (jaw closing) to negative (jaw opening). An onset was detected when the velocity in a 20-sample window reached below a defined threshold of 10 mm/sec and changed from positive to negative. The detected onsets were used to cut and arrange the 5-minute EMG signal into normalized (100%) open-close cycles (Figs 2a to 2e). A similar technique has previously been applied to analyze EMG activity during gait[30] and mastication.[31] The mean power frequency (MPF) of the EMG signals was calculated, and the normalized open-close cycles were averaged to produce a mean profile of the rectified EMG signal, which was used for calculation of maximum peak amplitude[30] (Figs 2a to 2e).

Outcome Variables

Pressure Algometry. An electronic pressure algometer (Somedic AB, Farsta, Sweden) with a probe diameter of 6 mm and a constant application rate of 30 kPa/sec was used.[22] The probe was held perpendicular to the central part of the masseter muscle, midway between the upper and lower border and 1 cm posterior to the anterior border. Subjects were instructed to keep their teeth slightly apart to avoid contraction of the jaw-closing muscles during pressure stimulation. The PPT was defined as the pressure (kPa) the subjects first perceived as painful. Subjects pushed a thumb switch when the threshold was reached, which froze the pressure on the digital display. The PPT was determined in triplicate and the mean was then calculated. The interval between successive pressure stimuli was about 1 minute. The PTT was defined as the maximum pressure subjects were willing to accept, and it was only determined once. The pressure stimulation was stopped if the pressure exceeded 1000 kPa.

Maximum Voluntary Occlusal Force. A U-shaped occlusal force transducer (Aalborg University, Aalborg, Denmark), 7 mm high and 1.1 × 1.1 cm in area, was covered with plastic tubes to protect the teeth.[22] The MVOF between the

molars on both sides was measured, and then subjects were instructed to clench their teeth as hard as they could for 3 to 4 seconds. Verbal encouragement was given to exert the maximum effort. The peak value represented the MVOF and was stored on a display. This was repeated 3 times, and the mean was calculated. Fifteen to 30 seconds elapsed between repeated measurements. Small occlusal indices were fabricated to guide the placement of the occlusal force transducer in the same position.

Scores for pain intensity and soreness from the MVOF procedure were recorded on a 100-mm visual analogue scale (VAS). The left extreme was "no pain" or "no soreness" and the right extreme was "worst imaginable pain" or "worst imaginable soreness."

Treatment Modalities

The following three treatment modalities were studied: *(A)* placebo gel and placebo tablets; *(B)* topical treatment with an NSAID gel (2 g, 5% ibuprofen, Dolorgiet, Sankt Augustin, Germany) and placebo tablets; and *(C)* systemic treatment with placebo gel and NSAID tablets (400 mg ibuprofen, Nycomed-DAK, Roskilde, Denmark). Tablets and gels were coded in accordance with the requirements of a double-blind study. The placebo and NSAID gels were similar in viscosity, scent, and appearance, as were the NSAID and placebo tablets. Treatment was initiated after the last recording on day 0 and continued 3 times a day (morning, noon, evening) for the next 3 days (Fig 1). Subjects were shown how to rub the gel carefully into the skin for at least 5 minutes and to concentrate application and rubbing over the masseter muscle. Subjects were instructed to use their medication 2 hours before appointments on days 1, 2, and 3.

Statistical Analysis

Pressure pain threshold, PTT, and MVOF from the left and right side showed no significant differences and were averaged. Parametric statistics (mean + SE) and two-way analyses of variance (2-ANOVA) with repeated measures were used. The first 2-ANOVA focused on the exercise day: time was one factor (8 levels) and session the other (3 levels, 1 treatment modality per session). The second 2-ANOVA was applied to the postexercise period: treatment modality was one factor (3 levels) and time the other (3 levels). Levels of significance were adjusted for multiple comparisons with the use of Student-Newman-Keul's (SNK)

multiple comparisons test. Significance was accepted at $P < .05$.

Results

Pressure Pain Thresholds

Pressure pain thresholds at baseline were 180 ± 18 kPa. In the exercise period (day 0) PPTs were significantly affected by time ($F[7,9]) = 18.15$, $P < .001$), but there was no difference between the three sessions ($F [2,9] = 3.175$, $P = .066$). Pressure pain thresholds were significantly lower 1 hour after the last exercise bout as compared to baseline measurements (SNK: $P < .05$) (Fig 3).

In the postexercise period, PPTs were significantly affected by time ($F[2,9] = 6.87$, $P = .006$) and treatment ($F[2,9] = 4.41$, $P = .028$), and there was a significant interaction between factors ($F[4,9] = 5.19$, $P = .002$). On day 3, treatment with topical NSAID caused significantly higher PPTs than did systemic NSAID (SNK: $P < .05$) or the placebo (SNK: $P < .05$) (Fig 3).

Pain Tolerance Thresholds

Pain tolerance thresholds at baseline were 349 ± 40 kPa. Pressure tolerance thresholds were significantly affected during the exercise period ($F[7,9] = 9.19$, $P < .001$), but there were no significant differences between the three sessions ($F[2,9] = 1.375$, $P = .278$). Pain tolerance thresholds were significantly lower 1 hour after the last exercise bout as compared to baseline measurements (SNK: $P < .05$) (Fig 3).

In the postexercise period as well, PTTs demonstrated a significant effect of time ($F[2,9] = 7.381$, $P = .005$) but not of treatment ($F[2,9] = 1.905$, $P = .177$) (Fig 3).

Maximum Voluntary Occlusal Force

Maximum voluntary occlusal force at baseline was 610 ± 25 N. On the exercise day, there was a significant time effect ($F[7,9] = 4.997$, $P < .001$), but no significant difference between the three sessions ($F[2,9] = 0.860$, $P = .439$). Maximum voluntary occlusal force was significantly lower 1 hour after the last exercise bout as compared to measurements after bouts 1, 2, 3, 4, and 5 (SNK: $P < .05$) (Fig 3).

In the postexercise period, neither time nor treatment had a significant effect on MVOF ($F[2,9] = 0.115$, $P = .892$; $F[2,9] = 1.406$, $P = .271$).

On the 100-mm VAS scale, low scores of pain and soreness were registered for the clenching pro-
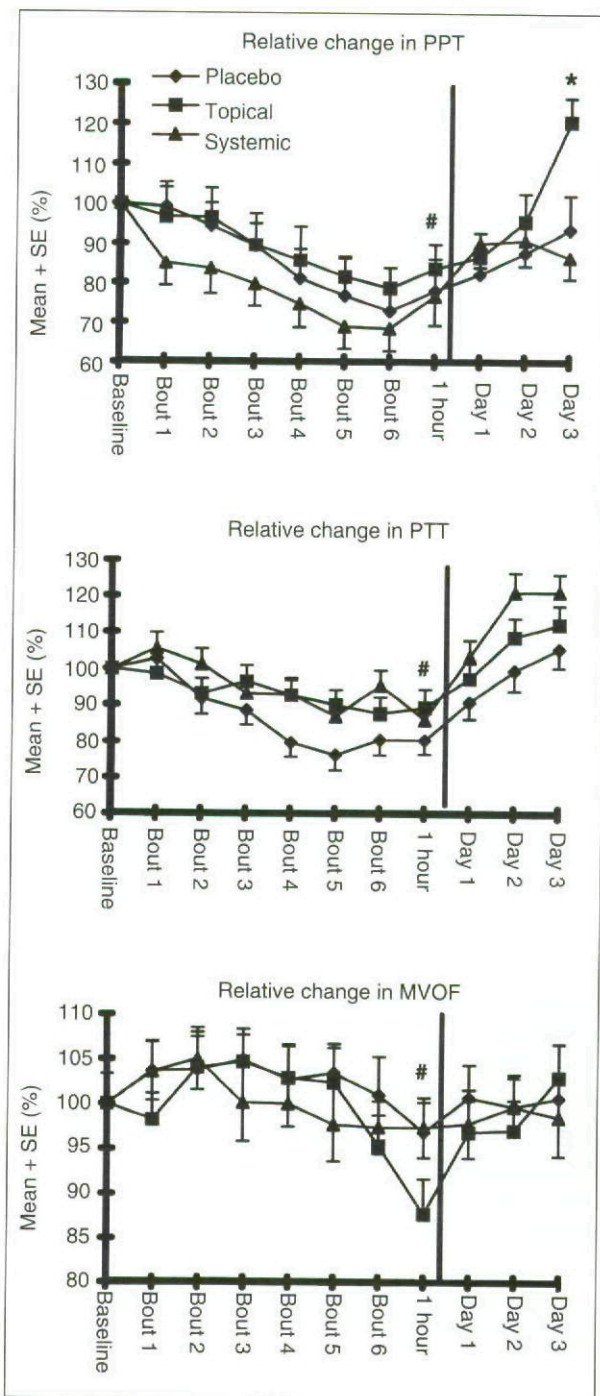

Fig 3 Outcome variables from the study. Relative changes (%) in pressure pain threshold (PPT), pain tolerance threshold (PTT), and maximum voluntary occlusal force (MVOF) during the exercise period (day 0) and during the postexercise period (days 1 to 3). Subjects (n = 10) used their medication (placebo and systemic and topical NSAIDs) after the last measurement on day 0 (vertical bars) and for the next 3 days (#indicates significant time effect during exercise period [2-ANOVA: $P < .001$]; *indicates significant difference between treatments [SNK, $P < .05$]).
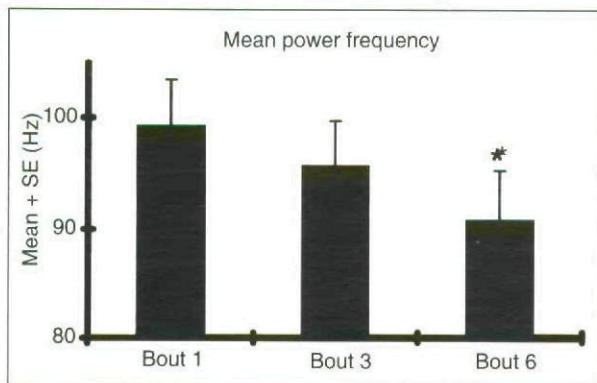
Fig 4 Mean power frequency of the EMG signals during the first, third, and sixth bouts of eccentric jaw muscle exercise. *Indicates a significant difference between bout 1 and bout 6 (SNK, $P < .05$).

cedures on all 3 postexercise days (10.2 ± 4.6 and 9.1 ± 2.8). There was no significant time effect ($F[2,9] = 0.204$, $P = .817$; $F[2,9] = 0.758$, $P = .483$) or treatment effect ($F[2,9] = 0.574$, $P = .573$; $F[2,9] = 1.375$, $P = .278$).

Electromyography

The EMG activity of the masseter muscles provided an electrophysiologic index of muscle fatigue during the eccentric jaw exercises. Prolonged EMG activity of the masseter muscles during the jaw-opening phases was observed in all subjects (see Fig 2c). On the exercise day, the MPF was significantly dependent on time ($F[2,9] = 7.53$, $P < .008$). The MPF was significantly lower during the sixth as compared to the first bout (SNK: $P < .05$) (Fig 4). The maximum peak amplitude showed no significant time effect ($F[2,9] = 1.309$, $P = .287$).

Discussion

The present study has shown that topical NSAID has a significant effect on PPTs at the masseter muscles 3 days after eccentric exercise of the jaw muscles. The effect of topical NSAID was greater than that of systemic NSAID.

Postexercise Muscle Soreness and Inflammation

Several studies have shown that inflammatory cells such as monocytes, macrophages, and neutrophils appear in the muscle after extensive eccentric exercise, and that cytokines, Ca^{++}, and notably PGE_2 are released.[3,8,9,11,23] Whether an inflammatory com-

ponent alone is sufficient to cause PEMS or whether a biomechanical component from tissue swelling is required is not known, but it seems likely that both mechanisms are involved.[11] It has been suggested that tissue swelling and disruption to the extracellular matrix may be more important to the production of pain and inflammation than the mechanical damage to the muscle fibers.[9] Christensen[32] argued that swelling was important for the development of postexercise jaw muscle pain when he found that intramuscular pressure was increased 3 to 4 hours after experimental bruxism. Pain and soreness are exacerbated during muscle contractions in PEMS, which suggests that swelling and increased intramuscular pressure could provide an adequate mechanical stimulus to activate PGE_2-sensitized receptors.[11,33]

Postexercise Muscle Soreness and Nonsteroidal Anti-inflammatory Drug Application

The aforementioned findings of inflammatory reactions and PGE_2 release are consistent with clinical studies that have shown an effect of aspirin and NSAID on PEMS.[17–22] Thus, formation of inflammatory mediators may be inhibited at the cyclo-oxygenase cycle. This finding concurs with animal studies of bradykinin-induced neuronal responses in type IV muscle afferents, which can be inhibited by acetylsalicylic acid.[10,12] The available data therefore seem to suggest an effect of NSAID on PEMS, although perhaps this effect differs depending on the amount and extent of muscle tissue damage.

There are differences in the absorbability, pharmacokinetics, and bioavailability between gel preparation of ibuprofen for percutaneous application and oral tablet preparation of ibuprofen. One study compared systemic ibuprofen (400 mg) with topical ibuprofen (10 g, 5% gel) in 18 healthy women and found that the gel required a longer time to reach peak plasma levels, which were only one-sixth of those reached after systemic administration.[34] Geise[35] reported that 55.4% of topically applied ibuprofen was distributed in the skin and 44.6% within the first 6 mm of the muscle. It was concluded that ibuprofen in muscles reaches clinically relevant concentrations after topical administration.[35] A recent review of the clinical effect of NSAID on chronic TMD concluded that there was no evidence to support the use of NSAID but that short trials of NSAID treatment could be considered in patients with an overt inflammatory component.[36] Thus, use of topical NSAID in certain types of acute jaw muscle pain might be considered.

Postexercise Soreness in Limb Versus Jaw Muscles

One study suggested that jaw pain and soreness in some patients with bruxism may resemble PEMS in limb muscles.[37,38] Although this study did not investigate clinical bruxism, some differences between PEMS in limb and jaw muscles have not been explained. First, as in previous experimental studies on isometric and isotonic jaw muscle contractions, the present eccentric exercise paradigm produced a small effect on the days following the day of the exercise.[39,40] The PPTs in the masseter muscles were reduced about 15 to 20% in association with placebo treatment and indicated low levels of muscle pain and soreness. The VAS scores for pain and soreness after the MVOF procedures were also low (about 10/100). Compared to the severe postexercise pain and soreness in limb muscles,[41] these features are less pronounced. Second, the onset and duration of pain and soreness in the masticatory muscles seem to be both faster and shorter than in the limb muscles. Dao et al[37] reported that pain in patients with bruxism was at its worst in the morning and vanished during the day, whereas several studies on PEMS in limb muscles have shown that it takes 2 to 3 days to develop the peak pain and soreness and that the symptoms usually last for 5 to 6 days.[41–44] Third, it is well established that eccentric exercise of limb muscles can cause the development of PEMS,[33] but the effect is less clear when a pair of jaw muscles actually performs eccentric work. A complex synergistic action of other jaw muscles may compensate for the load, and jaw muscle action may not be eccentric in the entire range of motion.[39,45] It has recently been proposed that PEMS is not a question of eccentric versus concentric exercise, but of force per muscle fiber.[46] Finally, other investigators have shown a training effect of PEMS in limb muscles,[47,48] which has not been identified in jaw muscles. The biologic background for these apparent differences between jaw muscles and limb muscles needs to be studied in order to optimize treatment.[49]

Postexercise Muscle Soreness, Muscle Fatigue, and Occlusal Force

In the present study we included EMG recordings of the masseter muscles to indicate the development of muscle fatigue. The shift to lower MPFs during the exercise bouts was in accordance with other studies on muscle fatigue.[45,50] Information about muscle fatigue in the jaw muscles is based primarily on concentric contractions,[51–53] but the masseter muscles

were significantly fatigued by eccentric contractions, as indicated by the decrease in MPF. However, fatigue did not seem to cause a dramatic development of postexercise muscle soreness. The relationship between fatigue and jaw muscle pain needs to be studied in more detail.

The maximum voluntary contraction (MVC) in patients with chronic low back pain (CLBP), fibromyalgia, and TMD is reported to be either unchanged[54] or significantly lower than in control subjects.[55–58] Reductions of MVC in the presence of pain have also been reported in experimental studies with dynamic contraction[4,43,59] or with intramuscular infusion of hypertonic saline.[60] A model was recently proposed to explain the interaction between pain and muscle function, and it was stated that pain causes a reduced ability to contract muscles forcefully.[61] In the present study, the MVOF was not significantly changed in the postexercise period, which probably was a result of the low levels of pain and soreness.

Conclusion

The present study has shown that repeated eccentric jaw-muscle contractions may lead to a gradual shift in the mean power frequency of the EMG signals. The lower frequency suggested that fatigue developed during induction of PEMS. Pressure pain threshold at the masseter muscle was the only outcome measure that was affected by treatments. Administration of topical NSAID as compared to systemic NSAID was associated with significantly higher PPT, indicating a minor advantage.

Acknowledgments

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Resumen

Comparación del Efecto de las Drogas Antiinflamatorias No Esteroides Sistémicas y Tópicas Sobre la Sensación de Dolor de los Músculos Mandibulares Después del Ejercicio: Un Estudio Controlado con Placebos

Ciertos tipos de dolor muscular mandibular puede ser manejados con agentes farmacológicos. Este estudio evaluó el efecto de las drogas antiinflamatorias no esteroides (AINE) tópicas y sistémicas, sobre la sensación de dolor de los músculos mandibulares después del ejercicio. Diez hombres sin desórdenes temporomandibulares realizaron seis tandas de ejercicio mandibular excéntrico submáximo por períodos de 5 minutos. Las variables que se tuvieron en cuenta en los resultados fueron los umbrales del dolor a la presión y los umbrales del la tolerancia al dolor en los músculos masetero, y la fuerza oclusal voluntaria máxima. Se utilizó la electromiografía de superficie de los músculos maseteros, para evaluar el desarrollo de la fatiga muscular durante el período de ejercicio. Se examinaron tres tipos de tratamiento utilizando una modalidad controlada con placebos, y al doble ciego: (A) gel de placebo y tabletas de placebo; (B) gel de drogas AINE (2 g, 5% ibuprofén) y tabletas de placebo; y (C) gel de placebo y tabletas de drogas AINE (400 mg ibuprofén). Las personas utilizaron sus medicaciones 3 veces al día por 3 días en el período después ejercicio. Durante el período de ejercicio, el poder de frecuencia media de la señal de la electromiografía, el umbral del dolor a la presión, el umbral de tolerancia al dolor, y la fuerza oclusal voluntaria máxima disminuyeron significativamente (análisis de varianza, $P < 0.01$). En el período después del ejercicio, el efecto del tratamiento sobre los umbrales del dolor a la presión fue significativo (F $[2,9] = 4.41$, $P = 0.02$). En el tercer día, el tratamiento con drogas AINE tópicas produjo umbrales del dolor a la presión significativamente más altos en comparación con el tratamiento con drogas AINE sistémicas ($P < 0.05$) y placebo ($P < 0.05$). Los efectos del tratamiento sobre los umbrales de tolerancia al dolor y sobre la fuerza oclusal voluntaria máxima no fueron significativos. Los resultados demostraron que el ejercicio mandibular excéntrico repetido causó fatiga muscular y niveles bajos de dolor y sensibilidad después del ejercicio. Las drogas AINE tópicas parecen tener ciertas ventajas sobre las drogas AINE sistémicas para el manejo del dolor muscular mandibular inducido por el ejercicio.

Zusammenfassung

Die Wirkung von systemischen gegenüber von lokalen nichtsteroidalen entzündungshemmenden Medikamenten auf die Nachbelastungs-Kaumuskelempfindlichkeit: eine Placebo-kontrollierte Studie

Gewisse Typen von Schmerzen der Kaumuskulatur können pharmakologisch behandelt werden. Diese Studie ermittelt die Wirkung von lokalen und systemischen nichtsteroidalen entzündungshemmenden Medikamenten auf die akute Nachbelastungs-Kaumuskelempfindlichkeit. Zehn Männer ohne temporomandibuläre Erkrankungen leisteten sechs 5-Minuteneinheiten von submaximaler exzentrischer Kauarbeit. Die Ergebnisvariablen waren die Druckschmerzschwelle und die Schmerztoleranzschwelle beim M. masseter, sowie die maximale willkürliche okklusale Kraft. Die Oberflächenmyographie der Mm. masseteri wurden gebraucht, um die Entwicklung der Muskelermüdung während der Arbeitsperiode zu beurteilen. Drei Behandlungsmodalitäten wurden in einem Placebo-kontrollierten, doppelblinden Versuch getestet: (A) Placebo-Gel und Placebo-Tabletten; (B) nichtsteroidaler entzündungshemmender Gel (2g, 5% Ibuprofen) und Placebo-Tabletten; sowie (C) Placebo-Gel und nichtsteroidale-entzündungshemmende Tabletten (400 mg Ibuprofen). Die Personen nahmen ihre Medikation dreimal täglich für 3 Tage in der Nachbealstungsperiode. In der Arbeitsperiode sanken die durchschnittliche Leistungsfrequenz des elektromyographischen Signals, die Druckschmerzschwelle, die Schmerztoleranz schwelle und die maximale willkürliche okklusale Kraft signifikant (Varianzanalyse, $P < .01$). In der Nachbelastungsphase war die Wirkung der Behandlung auf die Druckschmerzschwelle signifikant ($F[2,9] = 4.41$, $P = .02$). Am dritten Tag war die Behandlung mit lokalen nichtsteroidalen entzündungshemmenden Medikamenten verbunden mit einer signifikant höheren Druckschmerzschwelle verglichen mit der Therapie mit systemischen nichtsteroidalen Entzündungshemmern ($P < .05$) und Placebo ($P < .05$). Der Therapieeffekt auf die Schmerztoleranzschwelle und die maximale willkürliche okklusale Kraft war nicht signifikant. Die Ergebnisse zeigten, dass wiederholte exzentrische Kauarbeit Muskelermüdung, sowie tiefere Pegel des Nachbelastungsschmerzes und der Nachbelastungsempfindlichkeit verursacht. Lokale nichtsteroidale Entzündungshemmer schienen gegenüber den systemischen nichtsteroidalen entzündungshemmenden Medikamenten in Bezug auf die Behandlung von arbeitsinduzierten Schmerzen der Kaumuskulatur gewisse Vorteile zu haben.