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ABSTRACTS OF SELECTED PRESENTATIONS

Editorial note

The Abstracts give early recognition to some recent scientific studies. They are reproduced on the understanding that the material has not been previously published. Individual authors should be contacted for details of their experimental method and analytical approach to their results before any conclusions are judged and quoted.

Validation of diagnostic criteria for sleep bruxism

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Several diagnostic criteria for bruxism can be taken from the literature; however, most of them have never been validated. This study examined whether predictor variables taken from physical examinations and questionnaires were related to the actual bruxism levels.

Fifty dental students agreed to participate in this study and eight examination variables and seven questionnaire variables were collected from them. The subjects measured their nocturnal EMG activity from the right masseter muscle for six consecutive nights in their home by means of a portable EMG device. Off-line analysis was performed on data from second to sixth nights. By using a custom made software, all EMG activity elevations above a minimum threshold of 50% of each subject’s individually established maximum voluntary contraction (MVC) level were quantified with regard to the duration and number of elevations and then three outcome variables, which were event number per hour (number/h), event duration per hour (duration h⁻¹), and duration per event (duration/event), were calculated. A multiple stepwise regression (MSR) analysis was conducted to assess the 15 predictor variables and the three outcome variables.

These MSR analyses revealed that the joint sound score remained in the regression equation as a predictor (n = 50, P < 0.05) of the likelihood that a subject would exhibit longer bruxism events (duration h⁻¹ and number h⁻¹). It must be noted that the self-awareness and tooth attrition status were found not to be strong predictors and even for the above variable where significant association was found, the likelihood ratio between the variable and predicted outcomes was not robust.

Automated analysis for portable EMG recording of nocturnal masseter activity in bruxers

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Facial pain of patients with craniofacial disorders might be caused by muscle overload. In a former study (Gallo et al., 1999) we collected data on masseter EMG of healthy subjects during sleep by means of portable recorders (integration time of 500 ms). The automated analysis of the tracings yielded the normal range of activity in the natural environment. For this study, we focused on the analysis of the distribution of masseter activity in bruxers by means of the same automated system used for asymptomatic subjects.

For this purpose, data from single masseter channels of polysomnographic recordings of 10 bruxers and 10 controls were reformatted as if they had been recorded by means of the portable devices. The signals were analysed for number, amplitude and duration of contraction episodes (signal portions above a threshold which could contain subthreshold portions shorter than the standby time of 5 s). The signal amplitude was expressed in percentage of the amplitude at maximum voluntary contraction (%MVC).

In the bruxers, 166.8 ± 48.5 contraction episodes per night, i.e. 20.4 ± 5.7 h⁻¹, with a net duration of 84 ± 24 s and an integral of the amplitude over time of 1916 ± 740 %MVCs were found (controls: 96.5 ± 39, 12.9 ± 3.5, 47 ± 1.2 s and
99 ± 280 %MVCs, respectively). For these parameters there was a statistically significant difference between the two groups (t-test, P < 0·01). The distribution of all contraction episodes of all bruxers according to net duration and mean amplitude was shifted towards shorter episodes with a massive presence of episodes between 60 and 70% MVC, much higher than in controls.

Reference

Is self-reported jaw pain on mouth opening associated with a reduced bruxism time index?
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Sleep-related bruxism (SB) is a frequently encountered problem in the dental office, for which evidence-based causal therapy possibilities are not yet available. We are currently performing a large-scale double-blind placebo-controlled randomized clinical trial to evaluate several management strategies for SB. So far, we have measured 35 participants, all of them clinically diagnosed bruxers (11 men; 24 women; mean age = 39·2 ± 11·4 years). A first (baseline) night in the sleep laboratory confirmed their clinical diagnosis, i.e. all had more than four bruxism episodes per hour of sleep (> 4 EpiH). The baseline recordings were preliminarily analysed to establish a cut-off criterion for a polysomnographical SB diagnosis that, in addition to the previously established criterion (i.e. > 4 EpiH), also respects the time spent bruxing. We therefore calculated an index that expresses this aspect as a percentage of the total sleep time: the bruxism time index (BTI). The BTI was highly correlated with the number of EpiH (Pearson’s correlation coefficient = 0·92; P = 0·000). Linear regression analysis revealed that a BTI of > 0·4% corresponds with the > 4 EpiH criterion (F-value for the significance of the overall model = 146·2; P = 0·000). Future analyses may yield an additional intensity (power) cut-off criterion as well. As the relationship between SB and jaw pain is still unclear, we also determined, in 28 of the 35 participants, the influence of self-reported (VAS) jaw pain during mouth opening before and after the first night on the BTI. BTIs in bruxers whose evening and/or morning VASs ≥ 10 mm (n = 10) tended to be lower than those in bruxers whose VASs were less than 10 mm (n = 18) (1·4 ± 1·0 and 2·7 ± 2·5%, respectively; Two sample t-test; T = 1·98; P = 0·059).

This finding confirms previous suggestions in the literature that jaw pain might be associated with a reduced bruxism activity. This can be understood as a protective mechanism that prevents (further) overloading of the masticatory system. (Supported by the IOT.)

The clinical assessment of TMJ sounds by means of auscultation, palpation or both
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Anterior disc displacements are an important diagnostic subgroup (Group II) of TM disorders according to the Research Diagnostic Criteria (RDC; Dworkin & LeResche, 1992). Although the RDC yields clear-cut criteria for the diagnosis of a disc displacement, the interobserver reliability for the clinical recognition of joint sounds is highly variable. This high variance may be caused by the fact that the clinical assessment of joint sounds is difficult. In many previous studies, auscultation with a stethoscope was used. This technique is often claimed to be the most reliable one. However, it is unclear whether in these studies, auscultation was performed without simultaneous palpation of the contralateral joint. Therefore, the aim of the present study was to test the interobserver reliability of the clinical assessment of TMJ sounds by means of auscultation, palpation or both. A total of 220 undergraduate students (100 men; 120 women; mean age 21·9 ± 3·6 years) was examined independently by two calibrated dentists for the presence, probable presence or absence of sounds caused by anterior disc displacement, hypermobility, or another cause. The 79 students underwent auscultation only (i.e. without contralateral manual palpation); 87 students underwent bilateral palpation: the remainder (54 students) was subjected to both auscultation and palpation. The results show that the combination technique yields the highest reliability (Cohen’s k = 0·53). For other techniques, k-values of 0·46 (auscultation) and 0·48 (palpation) were found.

It was concluded that the combination of auscultation and palpation yields the highest interobserver reliability for the recognition of TMJ sounds, although the differences with other techniques were small. (Supported by the IOT)

Reference
Short-term effects of physiotherapy versus counselling for the treatment of myofascial pain of the jaw muscles

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The aim of the present study was to compare the efficacy of physiotherapy and counselling for the treatment of myofascial pain of the jaw muscles. Sixty-three consecutive myogenous TMD patients, diagnosed according to the RDC-TMD criteria, were assigned to two treatment groups with a balanced-block randomization. The first group received only counselling with general information about self-care of jaw musculature. The second group received the same general information supplemented by self-massage, application of moist heating pads and stretching exercises of the masticatory muscles.

Treatment success was decided on treatment contrast (TC), based on relative changes of sufficiently large anamnestic and clinical scores (van der Glas and van Grootel, 2000). Additional measurements included pressure pain threshold (PPT) of the masseter, anterior temporalis and Achilles' tendon, pain during gum chewing and spontaneous muscle pain scores rated on visual analogue scales (VAS). Data were collected at baseline and 3 months after start of treatment. Mann-Whitney's test and Fisher’s exact test were used for statistical analysis. Sixteen patients dropped out from the study: eight from the counselling and eight from the physiotherapy group. The success rate was 13 of 23 (57%) patients for counselling and 18 of 24 (75%) for the physiotherapy group (P > 0.05). There was no significant difference between groups in all the other variables.

Over a short-term period, physiotherapy, as used in this protocol, does not appear superior to counselling for the treatment of TMD myofascial pain.

Aim: In a randomized controlled trial investigate the short-term effect of treatment with stabilization appliance compared with a control appliance in patients with temporomandibular disorders (TMD) of mainly myogenous pain.

Material and methods: Out of 926 referrals to the Department of Stomatognathic Physiology in Malmö for treatment of TMD during 2 years, 338 patients were clinically screened for possible participation in the study. Patients with mainly myogenous pain were selected from the original group of 926 patients. Sixty TMD patients with mainly myogenous pain were allocated at random into two equally sized groups: (T) treatment group given a stabilization appliance; (C) control group given a control appliance. The study was performed as a randomized controlled trial and comprised four visits. At the last visit, after 10 weeks of treatment with occlusal appliance, the treatment outcome was evaluated.

Results: There was a significant reduction of changes in overall severity of pain, reported pain during mandibular movements and reduction of changes in severity of headache in the treatment group compared with the control group. There was also a significant decreased number of tender masticatory muscles in the treatment group compared with the control group.

Conclusion: The results of this short-term evaluation suggest that the stabilization appliance is effective in the alleviation of symptoms and signs in TMD patients of mainly myogenous pain. The stabilization appliance can therefore be recommended for TMD patients of mainly myogenous pain.

Recurrent headache in patients with temporomandibular disorders of mainly arthrogenous origin. A short- and long-term evaluation of the treatment effect of occlusal appliance therapy. A randomized controlled trial

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Introduction: In patient material recurrent headache has been presented in about 40–70%.

Aim: The aim of this study was to evaluate recurrent headache before and after treatment with a stabilization or control appliance. The effect of treatment should be evaluated both in a short and long time perspective.

Materials and methods: Sixty patients with TMD of mainly arthrogenous origin were selected from patients referred for treatment of TMD. The patients were randomly assigned to a treatment group (T), stabilization appliance, and a control group (C), control appliance. The study was performed as a randomized controlled trial evaluating the
treatment effect after 10 weeks, 6 and 12 months. Patients who reported a negative treatment outcome and/or any discomfort associated with the appliances either had their appliances adjusted or received a stabilization appliance creating a new mixed group (M).

Results: In the T and C groups, 77 and 83% respectively, reported headache at least once a week before treatment. At the 10 week follow-up a statistically significant difference was found regarding less frequent headache within the T-group but not within the C-group. Frequent headache was also found statistically significantly less often in the T-group compared with the C-group. At the 6 and 12 month follow-ups the frequency of headache seemed to have diminished within groups.

Conclusion: Treatment with a stabilization appliance seems to have a positive effect on recurrent headache in a short- and long-term perspective in patients with TMD of mainly arthrogenous origin.

Psychological distress in chronic craniomandibular and cervical spinal pain patients

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In chronic craniomandibular disorders, a relationship with psychological distress has often been investigated, with contradictory results. Recent studies on chronic pain patients have shown that the level of psychological distress is related to the number of painful body areas. Therefore, the aim of this study was to analyse differences in psychological distress between craniomandibular pain patients with or without cervical spinal pain, taking the number of painful body areas below the cervical spine also into account. Based on an oral history and, independently performed, dynamic/static tests, the presence or absence of a painful CMD or CSD was recognized. To assess the level of psychological distress, the Dutch version of the Symptom Checklist 90 (SCL-90) was used. The number of painful body areas was indicated on the body drawing of the McGill Pain Questionnaire (MPQ-DLV).

From the initial 250 participants, 103 persons could unequivocally be classified as having or not having a painful CMD and/or CSD and fully completed both questionnaires. Patients with both craniomandibular and cervical spinal pain showed higher levels of psychological distress than patients with only local craniomandibular pain and persons without pain (ANOVA and t-tests, \( P = 0.026-0.000 \)). Further, persons with more painful body areas below the cervical spine showed higher SCL-90 scores (ANOVA and t-tests, \( P = 0.045-0.000 \)). In conclusion, chronic craniomandibular pain patients with a coexistent cervical spinal pain show more psychological distress than patients with only local craniomandibular pain and asymptomatic persons. (Supported by the IOT)

The McGill pain questionnaire in patients with myogenic facial pain and TMJ disorders

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The assessment of pathologies characterized by pain situated at the temporomandibular joint (TMJ) or cheek, consequent on disorders of the TMJ itself and/or of the craniofacial or masticatory muscles is still controversial. As verbal pain assessment techniques are of help in discriminating between different pain sensations, our purpose was to assess the discriminative capacity of the McGill Pain Questionnaire (MPQ) in patients with TMJ disorders or with myogenous facial pain (MP).

The MPQ was administered to 57 TMJ and 28 MP patients. Weighted MPQ item scores, subscale Pain Rating Indexes (PRI), total PRI and the number of words chosen were calculated. Mean scores were tested for significant differences (Student’s t) and the frequency with which each descriptor was chosen by the patients of both groups was also analysed. Furthermore, the data were processed through two systems based on a counter-propagation neural network: the Self Organising Map (SOM) system, and a cluster-like analysis.

In the MP group 16 of 20 mean MPQ item scores and all mean PRI were significantly higher than those of the TMJ group. The SOM analysis was able to distribute the two groups in the two different halves of the map; only two of 28 MP cases (7%) and 12 of 57 TMJ cases (21%) were misplaced. The cluster-like analysis based on the 20 MPQ item scores was able to correctly recognize 94·73% TMJ patients and 89·28% MP patients.

In conclusion, the MPQ showed a consistent discriminative capacity between TMJ and MP patients.

Quid test and clinical findings in a TMD treatment-seeking population

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The aim of the present study was to investigate the response pattern to ‘QUID test’ (Italian analogue of the
Statistical analysis was performed using $t$ and chi-squared tests. Significance level was set to 0.05. The percentages of the six groups were: TMD 53.71%, eTMD 9.17%, H 4.80%, N 1.31%, AFP 6.11%, NOFP 24.89%. Significant differences were found in:

- pain intensity between H and TMD ($P = 0.034$), and between AFP and eTMD ($P = 0.027$);
- hypermobility and cervical problems between NOFP and TMD ($P = 0.021$ and 0.0001, respectively);
- presence of psychobehavioural factors (axis II) between eTMD and AFP ($P = 0.05$);
- type and distribution of words chosen; particularly five descriptors showed a significantly different pattern of distribution;
- affective component of pain experience (PRIRcA): highest for the AFP group.

Eccentric anterior wear facets in the diagnosis of temporomandibular disorders

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The present study aimed at testing whether eccentric anterior bruxing facets are associated with clinical signs from the temporomandibular joints and with palpatory tenderness of the muscles of mastication. Wear facets in the canine and incisor areas were assessed by inspecting dental stone casts made at baseline and at the end of a 4-year clinical trial involving 129 adolescents and young adults. The subjects who showed distinct increase in wear were divided into three groups: (i) wear pattern indicating an anterior thrust of the working side mandible, (ii) wear pattern indicating a posterior thrust of the working side mandible and (iii) other wear patterns. The assessment of wear patterns was made without knowledge of clinical signs of temporomandibular disorders (TMD). The eventual change in muscular or joint signs of TMD from baseline to the final examination was then obtained from the records, and the association with wear pattern was calculated.

There was no significant evidence of an association between eccentric anterior wear and signs of TMD. The direction of the mandibular thrust generated by bruxing was also unassociated with the presence of TMJ and muscular signs. In conclusion, the predictive value of eccentric anterior wear facets in young subjects is too low to be helpful in the diagnosis of TMD.

Differences in chewing strategies used by edentate people

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Aim: To examine, in detail, the different masticatory measures that contribute to individual chewing strategies of edentate people.

Measures: Variables relating to displacement and force were derived using a new three dimensional implant force transducer, a mucosal pressure transducer and measurements of mandibular movements.

Materials: Five edentate subjects with conventional upper dentures and lower dentures stabilized on two dental implants. The subjects chewed unilaterally on their preferred chewing side. Seven foods were chewed – almond, fruit pastille, chewing gum and four different meats.

Analysis: The data were analysed by separating each sequence into cycles and ‘phases’ of cycles for which variables were derived.

Results: As expected, the results showed greater differences between subjects than between foods. From the five subjects, four basic strategies were identified in response to the different foods: one subject primarily modulated force, one subject modulated the number of cycles, two subjects modulated force and the number of cycles and one subject showed little modulation at all. As part of these strategies many striking differences between subjects were observed, e.g. one subject showed little modulation of her ‘default’ chewing pattern for different foods, yet one subject modulated the number of force and manipulation cycles, the force strategy (forces increasing through sequences) and swallow thresholds.

Conclusion: People appear to develop different strategies to compensate for chewing difficulty by modulating speed, the number of cycles and/or penetration forces.
Life quality and psychosomatic conditions of patients wearing complete dentures
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Along with denture related factors (for instance poor-fitting denture bases inadequate vertical and horizontal jaw relationships) personality conditions such as depression or psychosomatic disorders pre-existing during treatment of an edentulous patient may affect the treatment outcome and the possibility of successful adaptation of the full dentures. Muller-Fahlbusch termed this a 'psychogenic full dentures disability'. This is not an uncommon problem, up to 15% individuals from a not selected aged population may present psychosomatic disorders (Hinterhuber & Fleischhacker, 1997).

The aim of this study was to explore the suitability of special questionnaires, to identify these difficulties to treat and in the follow ups time intensive patients before treatment.

Twenty-five patients wearing complete dentures for many years and classified as 'average' were recruited for this study. A group of 220 patients with psychosomatic diseases of the University of Münster and a healthy German population served as control groups using the same questionnaires.

First the personality profile was explored (general health condition and specific dental problems). Further questionnaires were used to determine the psychosomatic condition of the patient: the Hospital Anxiety and Depression Scale-Deutsche Version (HADS-D), the Münster and Gießener Beschwerdebogen, the SF-36 Health Surveys and at least a questionnaire for the common dental case history.

Life quality of the investigated edentulous patients was not restricted by full denture wearing. This patient group showed surprisingly, with regard to vitality, significant higher scores \( P = 0.015 \) than the healthy control group with the own dentition. This indicates that life quality must not be restricted by wearing full dentures. Comparing this patient group with psychosomatic patients, we found highly significant differences \( P < 0.000 \) when using the Münster and the Gießener questionnaire. Comparing the edentulous patients with the healthy group no differences were found. Concerning anxiety and depression there were no differences between edentulous patients and the control group. Furthermore, the 'Münster Beschwerdebogen' and 'Hospital Anxiety and Depression Scale – Deutsche Version' proved to be a good screening instrument for use in practice to identify patients with psychosomatic disorders before dental treatment.

Biofeedback experiments with a submaximal jaw closing force
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Temporomandibular disorders are often accompanied with pain in the elevator muscles such as Mm. Masseterici and Mm. Temporales. In most experiments measurement of the closing force of these muscles was conducted with maximum bite force using EMG-devices.

The experiments presented here were conducted using visual or audible biofeedback using force transducers. Visual feedback was presented on a computer screen using geometrical graphics. Audible feedback used two different signals, the frequency of these audio signals was modulated. The force was chosen between 5 and 30 N, which is near the forces actually used for chewing, but far less than maximum clenching force. The persons chosen for the experiments were divided into two groups: A group of younger persons did not wear any removable dentures, a group of older persons was wearing a total prosthesis of the upper and lower jaw. The results were processed statistically and graphically.

The goal for the persons conducting the experiments was to select a closing force as near as possible to the given force which was shown using the biofeedback. The actual force used by the person was also shown.

There were no statistically significant differences in the results using 5, 10 or 30 N as given force. Results showed that older edentulous patients can modulate the chewing force not as exactly as younger persons. Especially when using low closing forces (5 N) the edentulous persons showed less exactness in reaching the given closing force.

The results of the experiments may be used to develop a test to determine the capability of older patients to perform exact closing (and chewing) movements.

In vivo horizontal forces on implants depending on the type of occlusion
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Minimizing horizontal forces on implants is one of the important aims of an occlusal design. Therefore, several proposals have been made in literature, e.g. flat cuspal slopes or narrow occlusal surfaces. Our aim was to test how these occlusal designs would influence horizontal forces.
Ten healthy subjects with unilateral partially edentulous arches were provided with fixed partial dentures (FPD) on two ITI-implants. The opposing jaw was fully dentate. After an adaptation of 6 month measurement setups with a measuring FPD were put into the mouth. The sensoring device, which consisted of two abutments equipped with strain gauges, evaluated the forces in three dimensions. For each person three FPDs were made with a different design of the occlusal surface. The first FPD exhibited cusps with steep slopes (S), the second showed flat cusps (F) and the third had a narrow occlusal surface (N). The peak forces of the chewing cycles of each patient were evaluated. While chewing wine gum the average values of the forces in three dimensions. (s.d. 85.7 N) and 273-9 N (s.d. 63-7 N). With the first FPD (S) mean horizontal forces of 47-9 N (s.d. 34-8 N) were found whereas with the flat surface an average force of 47-4 N (s.d. 37-1 N) was measured. The narrow occlusal surface was associated with an average reduction of the forces of about 50-9% to a mean value of 24-4 N (s.d. 10-6 N) (P < 0.005). The inclination of occlusal slopes did neither affect vertical nor horizontal forces significantly. However, narrowing of the occlusal surface in theoro-vestibular direction by 30% showed a significant reduction of the lateral forces exerted on the implants by more than 50%. A reduced oro-vestibular width of the occlusal surface is recommended especially for diameter-reduced implants, in case of an unfavourable relationship between implant and crown length or for implants that are strongly inclined to the occlusal plane.

Influence of muscle contraction and jaw movement speed on the estimation of chewing force from elevator muscle EMG

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Recent studies have shown that an additional muscle activity (AMA) in chewing was responsible for excessive masticatory forces that had been estimated from isometric bite force–activity relations. Our aim was to test the thesis that this AMA could be identical to the speed-dependent ‘anticipatory activity’ that was found in symmetrical jaw closing (Abbink et al., 1999). In this case, forces estimated from EMG should be realistic for slow mastication, but should strongly increase with faster chewing movements.

In 56 dentate volunteers the activities of bilateral masseter and anterior temporal muscles were measured during (a) right-sided chewing, (b) right-sided isometric clenching on a bite fork with alternating loads. These biting tasks were carried out with slow, habitual and fast movement speeds (30, 64, 102 cycles min⁻¹). Masticatory forces were estimated for each speed by putting activities found in task (a) into bite force/activity relations obtained from task (b).

In slow and habitual mastication, activities of the working side masseter were equal and exceeded the corresponding clenching activities by factors of 2-8 and 2-4, respectively (P < 0.001). Consequently, forces estimated from slow (680 N) and habitual (695 N) chewing did not differ significantly and were unrealistically high. These estimated forces and hence the corresponding AMAs did not depend on the speed movement in the same way as the anticipatory activity described in Abbink et al. (1999). In contrast, forces estimated from fast chewing (811 N) were significantly higher (P < 0.001) and corresponding AMAs qualitatively behaved like anticipatory activities. In conclusion, the AMA in chewing could be explained by anticipatory muscle activity for high movement speeds. In slow and habitual chewing however, the AMA may contain amounts of activity with a different origin.

Reference

Maximal bite force and EMG during bilateral and unilateral clenching

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The observed maximal bite force is known to depend on the measuring method employed. Bite position, bite rise and unilateral or bilateral biting influence the observed bite force. The maximal bite force obtained when clenching unilaterally is smaller than the bite force summed for the two sides of a bilateral measurement (Bakke et al., 1989). We determined bite force and muscle activity of the masseter and temporal muscles during maximal voluntary clenching in a group of 81 dentate subjects. The bite force was measured between the first molars both bilaterally and unilaterally. The summed bite force obtained from the bilateral measurement was 569 ± 170 N. The bite force obtained for unilateral clenching was significantly lower: 430 ± 142 N. No significant differences in bite force between the right and left side for both the bilateral and unilateral measurements were observed. The muscle
activity of the masseter and temporal muscles obtained from bilateral clenching did not differ significantly (masseter: 248 ± 149 µV and temporalis: 232 ± 105 µV). Also no significant differences were observed in muscle activity between the right and left side during bilateral clenching. We observed a significantly lower muscle activity in both masseter and temporalis for unilateral clenching as compared with bilateral clenching. The results of unilateral clenching showed no differences in muscle activity between the ipsi- and contralateral side for the masseter muscle (186 ± 127 µV). However, the muscle activity at the ipsilateral side of the temporal muscle (197 ± 127 µV) was significantly higher than at the contralateral side (150 ± 81 µV). We may conclude that bilateral clenching yields bite forces that are over 30% larger than those obtained during unilateral clenching. The muscle activity during unilateral clenching is symmetrical in the masseter muscles, but asymmetrical in the temporal muscles.

Reference


Twitch forces in human masseter during experimental muscle pain

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Motor control strategies in relation to pain are not completely understood. Decreased firing rates of single motor units (SMU), but with a constant bite force have recently been demonstrated in the presence of masseter pain suggesting the existence of compensatory mechanisms (Sohn et al., 2000). The aim of this study was to describe twitch force characteristics of masseter SMU using spike triggered averaging (STA) before and during experimental muscle pain. Ten healthy subjects (20–29 years) participated. Fine wire electrodes were inserted into the masseter to record SMU activity. Subjects performed an isometric contraction on a force transducer (Kistler, Switzerland) with their incisor teeth to keep the SMU steady firing. A template-matching procedure was used to identify SMU and the corresponding force was determined with STA. One-min test series were recorded before 1, 4, 7, 10, 15 and 20 min after injection of 0.2 mL 100 µg mL⁻¹ capsaicin into the masseter. Pain was continuously scored on 10-cm visual analogue scales (VAS). The amplitude of twitch force and contraction time was measured. Injection of capsaicin into the masseter caused a deep, painful sensation with a VAS peak of 5.5 ± 0.6 cm. Twitch amplitudes were significantly influenced by pain (ANOVA: P < 0.001) with higher amplitudes during pain-1-min (56.1 ± 10.7 mN) and pain-4-min (53.5 ± 11.9 mN) compared with before pain (33.9 ± 11.6 mN; P < 0.05). The contraction time (51.6 ± 4.4 ms) was not significantly changed during pain (ANOVA: P > 0.029). The present study suggests that increased twitch force during painful muscle contraction could compensate for decreased firing rates of SMU.

Reference


Focal dystonia of the lateral pterygoid muscles treated with botulinum toxin

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Oromandibular dystonia (OD) is a movement disorder characterized by involuntary activity of the craniofacial muscles. The present study deals with dystonic activity in the lateral pterygoid muscles (LP) of two women causing mandibular overbite, tiredness in the face and chewing and speech difficulties in one (HN, 61 years). In the other (BS, 37 years) OD was characterized by irregular lateral and protrusive jaw movements with and without tooth contact and frequent bilateral headache.

By intra-oral approach and without attempt to distinguish between the two heads the activity of LP was assessed by quantitative electromyography (EMG). Concentric needle electrodes were used for diagnosis and follow-up, monopolar cannula electrodes for the EMG-guided injection of botulinum toxin (Botox®, Allergan Inc., USA). In addition, activity in the temporal, masseter and digastric muscles was recorded with bipolar surface electrodes and mandibular movements were assessed graphically. Compared with reference values of postural activity, OD in both patients was associated with a marked increase in LP. Botox injections resulted in transient reduction of spontaneous and maximal activity, but it took two to three treatments with intervals of 3–4 months to obtain distinct subjective and clinical improvement. However, in HN followed for 18 months after breakthrough of treatment, the effect of the two latest injections lasted 8–9 months or three to four times longer than typical.

Using quantitative EMG to locate the abnormal activity and to guide injections, treatment of LP dystonia with botulinum toxin is effective and safe.

Interactions between swallowing centre, chewing centre and supramedullary region during elicitation of swallows by superior laryngeal nerve (SLN) stimulation
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Swallowing centre (swl-c) which controls motor behaviour of swallowing receives inputs from other regions including respiratory center, chewing center (chw-c) and supramedullary region. However, interactions between them are unclear. The objective of this study was to elucidate such interactions using freely behaving six domestic male rabbits. Swallows were elicited by superior laryngeal nerve (SLN) stimulation. The electromyographic activities (EMGs) of masticatory and swallowing muscles were measured. Although there was a significant decrease in the number of swallows by superior laryngeal nerve (SLN) stimulation, the latency of thyrohyoid EMG onset and cycle durations between with and without SLN stimulation at rest and during chewing were not significantly different. Decerebration was performed to investigate the influence of supramedullary region. Although there was a significant increase in the number of swallows with and without SLN stimulation at rest and during chewing, the absolute increase in the number of swallows was same. After decerebration, the number of swallows was decreased significantly. There were no significant differences in the latency of thyrohyoid EMG onset and cycle durations between with and without SLN stimulation.

It is concluded that (i) swallows induced by SLN stimulation may be identical to those induced by food bolus, (ii) generation of swallows by swl-c might be controlled by chw-c, (iii) swl-c might affect the rhythm generator in chw-c and (iv) supramedullary region might send a tonic excitatory input to swl-c and maintains its excitability.

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Handy measurement for tongue motion and coordination with laryngeal elevation at swallowing
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In managing elderly people's quality of life, dysphagia is a critical problem because of its presumable relation to pneumonia. In the oral stage of swallowing, the tongue involves profoundly and its proper performance is necessary for bolus forming and transferring to the pharynx. In this regard, informative videofluorography, however, requires special facilities and inevitable exposure to radiation. For the present study, we prototyped a device for a safe and handy objective estimation of tongue motion and its coordination with laryngeal elevation at swallowing.

Ten healthy subjects were asked five times to swallow 5 mL of water. The tongue pressure was recorded by means of two strain gauge pressure transducers aligned in 20 mm distance on a brass strap placed along the palatal midline. Laryngeal vibration was recorded with piezoelectric acceleration transducer. Time difference between each pressure onset of the anteriorly/posteriorly located transducers and impulsive output of laryngeal vibration were measured.

Pressure onset of the anteriorly located transducer preceded posterior one for 294 ± 164 ms. Considering the distance of transducers, tongue squeezed at 93 ± 60 mm s⁻¹ speed. Laryngeal vibration occurred 671 ± 175 ms after the anterior pressure onset. There was a large variation in these parameters between subjects. The total recording time for each subject was <10 min. Although the information is limited, the developed device could handily describe some aspects of tongue motion and its coordination with laryngeal elevation.

Tongue and hyoid movements in feeding and speech
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Feeding and speech depend on integrated movements of the jaws, tongue surface and tongue base–hyoid complex. Phylogenetically and ontogenetically, the movements of feeding antedate those required for speech. The hypothesis that speech movements would fall within the range used in feeding was tested.

Lateral projection videofluorographic records were made for 10 subjects eating 8 g samples of three foods and reading a standard diagnostic speech text (Grandfather Passage). Radiopaque markers were glued to the upper and lower canines and tongue. Marker positions (Cartesian coordinates) for each video frame were plotted relative to the upper occlusal plane (X axis) and to a perpendicular dropped from that plane at the upper canine (Y axis). A plot of all coordinates per record gives the spatial domain (in the sagittal plane) within which a given marker moved.

Tongue marker domains showed an extraordinary range of movement in feeding with extensive palatal contact. In speech, there was little palatal contact, and markers moved within a smaller sagittal domain. Although speech
domains fell within the range for feeding, their centroids were highly statistically different, \( P < 0.001 \) (Hald test for differences in bivariate populations). In contrast, the hyoid domain for speech was anterior to that used in feeding and had almost no overlap with it \( (P < 0.0001) \). Our hypothesis is confirmed for the tongue surface markers but not for the hyoid. We conclude that patterns of hyoid movement in speech are a specific adaptation for speech.

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The effect of local anaesthesia of the mandible on external-load compensation during jaw closing

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In the past, chewing experiments with simulated food resistance have shown that jaw muscle responses to overcome the resisting load are mainly of sensory origin and only partly pre-programmed, even if loading can be anticipated (Ottenhoff et al., 1992). It is unknown to what extent the several types of sensors involved in adjusting jaw-muscle activity contribute to this response. Such sensors are, for example, periodontal receptors, sensitive to pressure on the teeth, and jaw muscle spindles, sensitive to changes in muscle length and therefore to changes in jaw position.

We studied the activity of the masseter and temporal muscles during rhythmic open–close movements of the jaw. An electromagnetic device generated a load that simulated food resistance during jaw closing. Halfway the experiment, local anaesthesia was applied to the front part of the mandible with the aim to reduce possible feedback from periodontal receptors in this region to the jaw muscles.

Anaesthesia did not affect the activity of the masseter muscles and their responses to the simulated food resistance. In the temporal muscles the reflex response (latency <120 ms) to the loading also did not change. However, with anaesthesia less temporal muscle activity was observed towards the end of jaw closing and during clenching.

The results indicate that periodontal receptors in the mandible contribute little to the strong reflex responses of the jaw muscles to loading. Near the end of jaw closing and during clenching, when forces on the teeth are larger, output of periodontal receptors in the mandible may facilitate the activity of the temporal muscles. This facilitation may have been reduced by anaesthesia.

Reference


Correlation between salivary flow rates and masticatory performance

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The aim of the present investigation was to study the effect of saliva flow on chewing efficiency by means of measurements of salivary flow rates as well as of parameters of masticatory performance. For this reason, 26 patients (13 xerostomic and 13 controls) with similar individual characteristics (14 females aged 41 ± 12.2 years; 12 males aged 38 ± 10.9 years) without CMD were encouraged to chew different foods (jelly bears, peanuts and rusk). Resting and stimulated flow rates of whole saliva (WHL) were ascertained after the method of Dawes (1987); resting and stimulated flow rates of palatal saliva (PAL) were determined with the help of the method of Niedermeier and Huber (1989); time of mastication (TM) as well as the number (NC) and duration (DC) of chewing cycles and time for swallowing (TS) were assessed using video recording. The mean resting WHL was 0.12 ± 0.05 mL min⁻¹; the mean stimulated WHL was 0.24 ± 0.09 mL min⁻¹; the mean resting PAL was 6.29 ± 7.88 μL cm⁻² min⁻¹ and the mean stimulated PAL was 8.96 ± 8.34 μL cm⁻² min⁻¹. Statistical analysis (Pearson method) revealed a strong correlation between resting or stimulated PAL and TM \((R = 0.808\) or 0.834 for rubber bears; \(R = 0.877\) or 0.900 for peanuts; \(R = 0.840\) or 0.882 for rusk), DC \((R = 0.763\) or 0.785 for rubber bears; \(R = 0.836\) or 0.867 for peanuts; \(R = 0.749\) or 0.779 for rusk) and TS \((R = 0.877\) or 0.902 for rubber bears; \(R = 0.860\) or 0.918 for peanuts; \(R = 0.822\) or 0.864 for rusk). Only for rusk, resting and stimulated PAL correlated fairly with NC \((R = 0.697\) and 0.736). No sufficient correlation was found between resting or stimulated WHL and parameters of mastication. The results clearly demonstrate that mucous saliva flow rates significantly bias measurements of masticatory performance.

A reliability study of clinical occlusal tooth wear measurements

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Tooth wear represents a clinical problem that is becoming increasingly important in ageing populations. Attrition caused by bruxism is its most visible sign. To determine the optimal moment to start the restoration of the worn dentition, one should first be able to measure the amount of tooth wear reliably in the clinical setting. So far, most studies of tooth wear severity have been performed on dental study casts. However, such an indirect approach is less applicable to the everyday dental practice, the more so because by grading of casts, the identification of dentine exposure is hard or even impossible to achieve. In this study, occlusal tooth wear was assessed clinically in 45 volunteers (17 men; 28 women; mean age 33.7 ± 10.7 years), TMD patients and symptom-free persons alike, on four occasions: two calibrated examiners graded the occlusal wear at two different points in time, using a 5-point scale (0 = no wear; 1 = visible wear within the enamel; 2 = visible wear with dentine exposure and loss of clinical crown height <1/3; 3 = loss of crown height between 1/3 and 2/3; 4 = loss of crown height >2/3). The overall values of the intra-rater and interrater reliability, expressed as Cohen’s $\kappa$, were substantial ($\kappa = 0.60$–0.678) and did not differ significantly from one another (repeated measures ANOVA: $F_{3,19} = 1.428$, $P = 0.266$). The clinical variable ‘quadrant’ (e.g. right maxillary dental arch) did not influence the values of $\kappa$ whereas the interrater reliability during the first session was better for the element types ‘incisors’ and ‘cuspids’ than for the element type ‘premolars’ (one-way ANOVA: $F_{3,23} = 4.577$, $P = 0.012$; post hoc Bonferroni tests: $P = 0.030$ and 0.036). Qualitative assessment of the clinical variable ‘severity of wear’ indicated that the more advanced the tooth wear is, the more reliably it can be graded. The presence of restorations did not influence the reliability. It was concluded that occlusal tooth wear can be assessed reliably in the clinical setting, especially in the anterior parts of a dentition that demonstrates considerable wear. (Supported by the IOT)

Task-related electromyographic spectral changes in the human jaw muscles

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The masticatory muscles differ in their fibre type composition. It can therefore be expected that their electromyographic (EMG) power spectra will differ during the performance of different bite force tasks. In the present study surface EMG activity was picked up from the masseter, and anterior and posterior temporalis muscles of nine adult subjects. Direction and magnitude of bite force were recorded using a three-component force transducer. Bite forces were exerted in five different directions: vertical, forward, backward, to the right and to the left of the subject. Non-vertical forces were kept at an angle of 15° from the vertical. Force levels of 25, 50, 100 and 200 N were exerted in each of the investigated directions. Data collected were analysed by means of a regression model for repeated measurements.

It appeared that the mean power frequency (MPF) values of the posterior temporalis were significantly lower ($P < 0.01$) than those of the masseter and anterior temporalis. The MPF values of the masseter muscles decreased with an increase of bite force magnitude ($P < 0.001$) whereas the MPF values of the anterior and posterior temporalis did not change significantly ($P > 0.05$). The MPF values were significantly influenced by the direction of bite force ($P < 0.01$). The observed changes of MPF are possibly related to the recruitment of different fibre types and support the concept that the masticatory muscles behave heterogeneously.

Palatal plate of different designs for the suppression of masseter muscle activity during sleep

A challenge to the concept of placebo splint

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Several designs of palatal appliance have been reported for the treatment of craniofacial disorders. However, the effect of these appliances has not yet been fully clarified. This study aimed to reveal the effect of palatal appliances of different design on mandibular muscle activity during sleep.

Four volunteers (three women and one man, mean age 36.0 years) were used in this study. For each subject, four different types of palatal appliances were used. The palatal appliances were (1) horse shoe type (1 mm thick), (2) thin appliance which covered the whole palate (1 mm thick), (3) thick appliance which filled the palatal concavity and (4) appliance with half the thickness of the third appliance.

These appliances were worn for 1 week in a randomized sequence with 1-week interval between each appliance. Right masseter muscle EMG was recorded three nights per week at home. The EMG signal longer than 0.25 s was classified as a burst and a signal shorter than 0.25 s was classified as a brief burst of fragmentary myoclonus (FM).
Patients’ assessment of efficiency of physiotherapeutic treatment modalities in temporomandibular disorders (TMD)

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Especially in the last 10 years the aetiological significance of occlusion for TMD was relativated and the search for other alternative therapeutic strategies was intensified. For the treatment of myogenous and arthrogenous problems in TMD different kinds of physiotherapy are reported. Our intention of the present pilot study was focused on patients’ perception of efficiency of different physiotherapeutic modalities and in relation to splint therapy.

A total of 187 patients of the TMD clinic in Düsseldorf were retrospectively asked to fill out a questionnaire with topics on physiotherapeutic home training programme (HTP), on professional physiotherapy (PP), on splint therapy (ST) and overall assessment of treatment effort (OATE). Eighty-one questionnaires could be analysed and evaluated in relation to three diagnostic TMD subgroups (myogenous, arthrogenous and mixed).

The HTP was positively assessed in 74%, PP in 70% and ST only in 38%. Fifty-one per cent of patients could realize HTP regularly per day, 86% of patients could realise PP regularly per week. The majority of patients felt improvement after some weeks/months of HTP resp. PP. No significant relation could be detected between TMD subgroups and patients’ assessment to HTP, PP, ST and OATE.

Based on patients’ assessment the results indicate that physiotherapeutic treatment modalities are highly efficient, whereas a differentiation between mentioned TMD subgroups does not seem to exist. A minority of patients (c. 20–25% of clinical cases) does not respond to dental-occlusal and physiotherapeutic therapy very well. Therefore, a multidisciplinary psychosocial-based treatment approach might be useful in these cases.
failed to reach 58 subjects at the second survey. Of the remaining 614 subjects, 367 (166 males and 201 females with a mean age of 53.1 ± 14.2 years) returned the questionnaire, for a return rate of 59.8%. Information about three TMD symptoms [temporomandibular joint (TMJ) pain, limitation of mouth opening, TMJ noise] was obtained from the questionnaire, and fluctuation of these symptoms was assessed by comparing three pairs of answers between the first and second surveys. Information about 18 hypothesized risk factors for TMD (age, sex, trauma, bruxism, malocclusion, oral habit, etc.) were also obtained from the questionnaire at the first survey. To evaluate how strongly each risk factor was associated with precipitation and perpetuation of TMD symptoms, odds ratio of each risk factor for precipitating or perpetuating TMD symptoms was calculated by means of logistic regression analysis.

Statistically significant risk factors for precipitating TMD symptoms were lip biting for TMJ pain (3.65) and trauma for limitation of mouth opening (3.20), and statistically significant risk factors for perpetuating TMD symptoms were female for TMJ pain (4.50) and TMJ noise (3.85) (odds ratio in parenthesis). The possible aetiological significance of these factors in TMD should be validated by future research.

Reference

Association between oral habits and signs/symptoms of temporomandibular disorders in Flemish adolescent girls
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The influence of oral habits on the development of signs and symptoms of temporomandibular disorders (TMD) and pain is unclear. The prevalence and nature of such oral habits may also vary geographically. The aim of the present study was to assess the prevalence of parafunctions in Flemish adolescent girls and to study the interrelationship with TMD. A group of 261 school girls (15–16 years of age) participated. A questionnaire used in a similar study (Gavish et al., 2000) was translated and inquired for oral habits (chewing of gum, nails or foreign objects, eating of seeds, crushing of ice or food, continuous leaning on the arm, daytime or night-time grinding or clenching, jaw play, unilateral chewing) and TMD symptoms (joint noises, catching or locking, joint or muscle pain, tension or fatigue in the muscles). A brief clinical examination was performed by a single examiner: active and passive maximal mouth opening, presence of joint sounds, palpation tenderness of the lateral poles of the joints and of the masseter and anterior temporalis muscles, extent of abrasion of the canines, tongue or cheek imprints. Statistical evaluation used Spearman correlation, chi-squared analysis and multiple regression analysis. The intra-examiner reproducibility was moderate to high (κ 0.6–0.8 – Spearman Correlation 0.99 for maximal mouth opening). The frequency of reported oral habits was high: leaning on the arm (98%), gum chewing (89%, mean duration 3 h day⁻¹), lip- (62.1%) and cheek-biting (41%), ice-crushing (30%). There was a significant (P < 0.0001) but weak (0.30) positive correlation between the number of oral habits and the number of symptoms. Internal derangements were significantly (P < 0.0001) but weakly (0.25) correlated with jaw play and other oral habits. There was no relation between tooth clenching and myogenous pain (χ^2, P = 0.31, but only 27% power). Multiple regression analysis showed that the number of symptoms increased by 52% if the subject reported ‘jaw play’, by 24% if chewing gum more than 2 h day⁻¹, by 28% while cheek biting and by 25% if chewing unilaterally.

Deformation/displacement of posterior digastric and sternocleidomastoid muscles during posterior digastric muscle palpation using magnetic resonance imaging and image processing procedure
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Objective: As the process of palpation is basically subjective, the scientific evidence for masticatory muscle palpation, especially from an anatomical point of view, is scarce. Our previous study concerning the quantification of masseter muscle deformation during palpation using magnetic resonance imaging and image analysis procedure showed that masseter muscles are deformed and their fascia must be stretched during palpation (Ishikawa et al., Int J Prosthodont, in press). The aim of this study was to further evaluate the deformation/displacement of posterior digastric and sternocleidomastoid muscles during posterior digastric muscle palpation using almost the same procedure as in the previous study.
Subjects and methods: Subjects were 10 male volunteers with an average age of 26.8 years. MR images were taken using a 1.5 T scanner (MAGNEX 150 SHIMAZU Co. Ltd, Kyoto, Japan). Images were obtained on the axial plane with a spin-echo, T1-weighted technique using a head coil. At first, non-compressed condition (control) was taken, then the continuously compressed condition of the bilateral posterior digastric muscle region using round plastic balls was taken. By superimposing a compressed image on a non-compressed image, deformation/displacement was subjectively evaluated and measured using free image analysing software (NIH-image).

Results and conclusion: Deformation of the bilateral posterior digastric muscle was difficult to identify, however, the average amount of displacement in medial direction was 9.0 ± 5.3 mm. Although we tried to compress posterior digastric muscles, sternocleidomastoid muscles were additionally deformed and displaced. The amount of medial displacement was 9.3 ± 4.7 mm. The values contained in our results exhibited fairly substantial variance. These findings suggest that masticatory muscle palpation is subjective and inconsistent.

Permeability of the petrotympanic fissure

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The communicating canal through the petrotympanic fissure of the glenoid fossa is about 2 mm long in the new-born, but may measure up to 15 mm in the adult. It connects the middle ear with the fossa. Little is known about its permeability.

After defreezing, 20 temporomandibular joints were extracted from 10 freeze preserved cadavers (seven females and three males, mean age >65 years at death), with a circular cutter from lateral following a transversal axis. The cylindrical tissue sample contained the external auditory meatus, parts of the petrous bone with the middle and inner ear, the styloïd process and the complete temporomandibular joint with condyle, disc and part of the attached lateral pterygoid muscle.

The soft tissue except the disc was removed manually and thereafter India ink was percolated into the middle ear directly by introducing a needle through the tympanic membrane, without pressure. The perfusion was stopped once the India ink started to flow out from the tube auditiva. In the following the samples were cooled again and the tympanic chamber was opened from above to gain a free view on the ossicles. Thereafter, the petrotympanic canal was carefully opened under magnification (magnifier, operating microscope) and checked for percolated India ink.

It resulted that in three of the 20 joints, the ink had percolated from the middle ear to the glenoid fossa through the petrotympanic fissure.

The question arises whether infectious diseases of the middle ear could possibly reach the retrodiscal pad and therefore the temporomandibular joint, although such a situation has never been described up to nowadays.

The relationship between sleep apnoea, bruxism, and the time it took the patient to seek for treatment in TMD patients

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It has been suggested that the length of time from the onset of symptoms to the time the patients seek treatment and sleep disorders has a large effect on the treatment of TMD, especially in conservative treatment. In this experiment the relationship between the time it took patients to seek treatment and bruxism and sleep disorders was clarified.

Twenty female TMD patients (13 arthrogenous, 7 myogenous) in their twenties were selected. The length of time it took for the patients to seek for treatment was determined from the questionnaire. Using a wireless telemeter system, the EEG, FOG, ECG, masseter EMG, mental EMG, and respirogram of subjects were recorded throughout night and the frequency of bruxism and sleep apnoea was calculated. Bruxism was defined as those burst groups associated with muscular activities that lasted more than 5 s or had more than two bursts within 5 s. The relationship among the length of time needed to seek for treatment, frequency of bruxism and sleep apnoea was investigated.

Both the frequency of bruxism and sleep apnoea increased when the length of time it took for the patient to seek treatment was long (bruxism: \( r = 0.655 \), \( P < 0.01 \)). The frequency of sleep apnoea increased as the frequency of bruxism increased \( (r = 0.495, P < 0.05) \).

From these results it was suggested that there was a direct correlation among the three factors, the length of time it took to seek for treatment, frequency of bruxism and frequency of sleep apnoea. and when taking natural history it was imperative to pay more attention.

Psychological factors and adaptation to artificial interferences in healthy subjects with and without TMD history

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It has often been suggested that psychological factors play a role in temporomandibular disorders (TMD). However, reports on psychopathology and personality characteristics in TMD patients and controls have been equivocal. We have reported in a double-blind RCT (LeBell et al., 2000) that subjects with a previous TMD history react differently in terms of TMD signs and symptoms to artificial interferences than subjects with no earlier TMD history. In the present study, we compared the psychological characteristics of these subjects and analysed the role of psychological factors in the adaptation process.

The study sample of 47 women consisted of two groups: 26 women (mean age 24) without and 21 women (mean age 31) with TMD history. The subjects with TMD history had been treated earlier and they felt healthy when the intervention started. The groups were divided into true interference and placebo interference subgroups. Before the intervention, the subjects were interviewed. They also filled in questionnaires dealing with psychological and somatic symptoms, daily stress, coping strategies, personality characteristics, health hardiness and illness beliefs. During the 2-week follow-up period, the subjects rated the intensity of 10 symptoms on the visual analogue scale (VAS) and their impact on vocational and leisure time functioning. In addition, daily stress, life changes, somatic and psychological symptoms and coping with pain were explored.

In general, the groups were similar in their psychological characteristics. There were, however, some differences in coping strategies. At the end of the intervention, the subjects with TMD history and exposed to true interferences reported more frequently than the other subjects muscle tension and neurological symptoms, thus indicating greater sensitivity to artificial interferences. This difference cannot be attributed to the observed base-line personality characteristics as the groups did not differ in them. However, differences in coping strategies may play a role in the impaired adaptation.

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Reference

Artificial interferences in TMD patients and healthy subjects.

The effect of change of oral sensory input accordance with the experimental occlusal interference on electroencephalogram

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The aim of this study is to clarify the effect of the change of oral sensory input on brain function and to confirm whether it can be detected electroencephalographically.

Eight healthy dentate dental students were selected as subjects, and asked to wear the experimental occlusal interference on the right second molar for 1 week. Simultaneous recordings were made with electromyograms (EMG) and electroencephalogram (EEG) before and after maximum clenching. Evaluation by visual analogue scale (VAS) questionnaires was also done. Twelve-session experiments were carried out over a period of 12 days. Daily changes of EMG activity of masticatory muscle, six comfort parameters (VAS), and EEG caused by premature contact were analysed statistically applying repeated measured ANOVA and Tukey–Kramer analysis.

The discomfort which was described by VAS did not disappear during the interference period. Just after applying the interference, EMG activity during clenching was decreased significantly (P < 0.01) compared with control. Significant change in EEGs between before and after clenching were observed, that is, the percentage power fraction of β wave (% β) tends to increase. On the contrary, % α in EEGs after clenching decreased significantly (P < 0.01) compared with before clenching during the interference period, as verified by VAS evaluation.

In conclusion, it is suggested that the decrease of % α in EEGs after clenching may be caused by prematurr contact influence on the masticatory system, reflected in the presence of discomfort during occlusion, and somatosensory information from the occlusal sensation might be recognized in the higher centre of the brain, and the possibility of detecting change might be indicated electroencephalographically.

Alteration in mandibular posture by vibration of posterior fibres of the temporalis muscle

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Introduction: Vibration causes reflex muscle shortening because of excitation of muscle spindle primary afferents. Although this is subordinate to voluntary control, responses have been demonstrated in jaw elevator and (unexpectedly) in jaw depressor muscles. Forward posturing of the mandible is a common habit. The only part of
the perioral musculoskeletal system that actively retrudes the mandible is the posterior part of the temporalis muscle. This study set out to investigate the effect of vibration of this area on the horizontal position of the mandible during a jaw registration procedure.

Method: In a randomized cross-over study, the posterior fibres of both left and right temporales of 17 subjects were vibrated synchronously at 180 Hz. Interocclusal wax jaw registrations were recorded for each subject with and without vibration applied. Position of the mandible was assessed by mounting pairs of casts using these registrations and measuring their position relative to intercuspal position.

Results: In 17 subjects, the effects of vibration on mandibular posture were: no change in one; protrusion in two; and retraction in 14. A sign test returned a value of P < 0.01.

Discussion: Reasons for the protrusion seen in two subjects are discussed. These may be anatomical or methodological. However, vibration of the posterior part of the temporalis muscle retruded the mandible in a significant majority of cases.

Possible gender-related differences in a jaw reflex evoked by stimulation of the human lip
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It has been reported that the latency of the jaw jerk reflex in symptom-free human female subjects is significantly shorter than in male subjects (Kossioni et al., 1994). In the present study, we have begun to investigate whether there are any gender-related differences in other jaw reflexes. The EMG recordings were made from an active masseter muscle in 16 young adult age-matched subjects (eight male, eight female; aged 20–43 years). Inhibitory reflexes were evoked in the muscle by applying stimuli through bipolar electrodes clipped over the lower lip with the cathode placed intraorally on the oral mucosa. While the stimuli were being applied, the subjects maintained the EMG level at around 10% of maximum with the aid of visual feedback. The presence or absence of reflex responses was determined as previously described (Louca et al., 1996). Wilcoxon Rank Sum tests were used to compare the properties of the short- (~10–15 ms) and long- (~40–50 ms) latency inhibitory reflexes evoked by the stimuli in the two groups. There was no significant difference between the male and female groups in the threshold or latency of either reflex. However, the duration of the long-latency inhibition was significantly shorter in females than in males (median values: 290 versus 440 ms, P = 0.015). These preliminary findings suggest that, at least in young human subjects, there is a gender-related difference in the strength but not in the presence of long-latency inhibitory jaw reflexes.

References


Computer simulation of the occlusal anatomy of the first mandibular molar after varying the determinants of mandibular movement in the CICERO CAD/CAM system
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Static and dynamic occlusal interferences often occur in restorations. The CICERO CAD/CAM technique was used to control the occlusal dimensions of all-ceramic restorations by setting the variables which determine the mandibular contact movements. The anatomy of the occlusal form of the (pre)molar teeth is influenced by the setting of the sagittal and transversal determinants of mandibular contact movements.

In this study the variation in occlusal morphology of a high- and low-limit setting of six variables was compared with an averaged setting. The settings (high, low and averaged, respectively) of the mandibular movement: the sagittal condylar (60°, 0°, 30°) and the incisal guide angle (60°, 0°, 30°) as well as the long centric articulation (1.2 mm, 0 mm, 0.6 mm) influence mainly the anteroposterior direction, whereas the settings of Bennett movement (laterotrusion: 30°, 0°, 15°), Bennett side shift (laterotranslation: 1, 0, 0.5 mm) and the wide centric (lateral intercuspal contact area: 0.6, 0, 0.3 mm) will mainly influence the transversal direction of the mandibular movement.

The influence of the variation of settings on ‘dynamic’ crown morphology as compared with the static crown morphology was studied by comparison of mesio-distal and bucco-lingual sections at the same occlusal position of the first lower molar design. Furthermore, the amount of material needed for the correction of the ‘static’ crown to avoid interferences in dynamic conditions was calculated.

It appeared that most correction was needed for the ipsilateral settings: Bennett side shift (1.0 mm), Bennett movement (30°) and the Sag. Condylar guidance (0°) as well as the Incisal angle (0°), which could be studied in the
Mustard oil (MO) has been used to induce inflammation and nociceptor activation in various tissues. It has been proposed to selectively activate small afferent fibres but more detailed knowledge on the functional characteristics and activation mechanisms of the responding neurones seems to be limited. In the present study we recorded intra-dental nerve responses to hydrodynamic dentinal stimulation and MO. Also, the effect of local application of morphine on the induced nerve responses was studied.

The experiments were performed on six beagle dogs (three females and three males, 1–2 years old, 9.5–12.5 kg). They were anaesthetized with sodium pentobarbitone (35 mg kg\(^{-1}\)). The inferior alveolar nerve of the left side was exposed for nerve dissection and recording. The intradental nerve fibres were identified by monopolar electrical stimulation of the canine tooth crown. Dentine was exposed at the tip of the test tooth and the responses of the nerve fibres to drilling, probing and air blasts were tested. The test cavity was then drilled deep close to the pulp until 1-5 m NaCl induced nerve firing. After that MO was applied in the cavity. In six other canine teeth nerve activity was recorded from cavities drilled in dentine in the midcrown and the cervical area. The same stimuli were applied in the stimulation cavity as in the single fibre recordings.

Seven single intra-dental nerve fibres responding to drilling, probing and air blasts were recorded. Mustard oil induced long lasting firing of action potentials in all seven afferents with a latency of 5–10 min. In the dentine recordings nerve responses to MO were completely abolished by pre-treatment of the stimulation cavity with morphine (20 mg mL\(^{-1}\)) for 15 min but the responses to hydrodynamic stimulation and 2.5 m NaCl were unaffected. Further, in four teeth naloxone (7.5 mg mL\(^{-1}\)) was applied in the cavity for 10 min and after that the responses to MO recovered.

The present results indicate that the same intra-dental nerve fibres are activated by hydrodynamic stimulation and MO. However, the mechanism of activation induced by MO seems to be different from other stimuli and sensitive to opioids.

### Acute inflammatory response to dentine-bonding

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The phlogogenic potential of dentine-bonding-agents is still disputed. It was the aim of this study to demonstrate acute pulpal inflammation in teeth that were treated with a glutaraldehyde and HEMA containing primer.

Twenty-two Wistar rats underwent microsurgical preparation of a lower incisor in accordance with the vital microscopy usage oriented biocompatibility test. Sixteen animals were divided into two test groups. Their teeth were treated with the primer for 20 s \((n = 8)\) and 10 min \((n = 8)\). Six animals comprised the control group \((n = 6)\).

During a 120-min follow up the pulpal blood circulation was investigated for haemodynamic changes. The animals were killed and pulpal specimens were stained immunohistochemically.

CD43 positive cells were labelled by incubation with W3/13 monoclonal antibodies. CD43 is a highly expressed surface antigen on polymorph neutrophil granulocytes (PMN). By this means, the amount and distribution of infiltrating PMN in the affected pulp could be demonstrated.

Vital microscopic observation of the pulpal blood circulation showed irreversible stasis and thrombosis after primer application. The intensity of the haemodynamic changes was dependent on application duration.

The semiquantitative determined influx of PMN was highest in pulps of teeth that had been primed for 10 min. Control teeth never showed irreversible circulatory changes nor highly elevated PMN influx.

From these results it can be concluded that the tested primer has a phlogogenic potential in pulp-close cavities.

The combined method of in vivo blood circulation observation and immunofluorescence microscopic demonstration of target cells serves as a good indicator for acute inflammatory responses.

### Maximum bite force after the replacement of complete dentures

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In complete denture wearers the maximum bite force (MBF) is known to be considerably lower than in dentate people. Low MBF might therefore be an indication of poor denture fit but there is limited evidence on this. Therefore, the aim of the present study was to investigate whether MBF can be improved by the replacement of complete dentures for elderly people.

Nine edentulous volunteers, average age 74.2 ± 5.5 years and average denture experience 19.4 ± 19.5 years (1–50 years), had replacement dentures made. Functional impressions were taken after border moulding using zinc oxide eugenol paste. After a rehearsal session, MBF was recorded with the old dentures, and with the new dentures immediately at insertion, at 3, 8 days, 2–3 weeks, 1, 2, 3 and 6–10 months post-insertion (p.i.). The MBF was recorded with the central bearing point method using a full-bridge strain gauge with a confirmed linearity from 1 to 1000 N and an accuracy of ±1 N. Data were analysed off-line using the mean of two peak readings per patient per session.

The results indicate that MBF tended to be impaired when replacement dentures were first fitted (n.s.). However, this trend reversed during the first month p.i. for patients with a moderate lower ridge resorption of Atwood (1963) grade 3 or 4 (n = 5). Patients with more severe lower ridge resorption (Atwood grade 5 or 6; n = 4) showed a significantly lower MBF over the entire observation period (P = 0.05) and took longer to regain bite strength. Only patients with moderate bone resorption exceeded their pre-insertion level of MBF within the observation period of 6–10 months p.i. In contrast to one report of immediate improvement of MBF at insertion of a new or relined denture (Leyka et al., 2000), the present study suggests that, at least for elderly patients with severe bone resorption, delayed improvement of MBF should be expected.

References

Functional impression and bite registration: a single session procedure for the construction of complete dentures
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The closed-mouth technique for the construction of complete dentures provides in the first session both impressions and a rough idea of the jaw relation in habitual intercuspation. The aim of this study was to apply this methodological advantage to the open-mouth technique and to assess whether the arbitrary moulding of tooth position-analogue plastic rims on functional impression trays facilitates a subsequent preliminary bite registration. Therefore, 104 complete dentures, manufactured by students during their final exams, were surveyed at 22 different test points using the Gutowski-Meyding gauge. Furthermore, the position of the front teeth, the lip support and the vertical dimension were assessed clinically.

The results were as follows
Upper complete denture
vertical distance: middle of ridge – incisal edge of central incisor: 13 ± 3 mm (5–21)
vertical distance: middle of ridge – tip of cusp of first molar: 9 ± 2 mm (2–16)
sagittal distance: middle of ridge – incisal edge of central incisor 7 ± 2 mm (3–14)
Lower complete denture
vertical distance: middle of ridge – incisal edge of central incisor: 12 ± 3 mm (7–19)
vertical distance: middle of ridge – tip of cusp of first molar: 13 ± 3 mm (5–20)
sagittal distance: middle of ridge – incisal edge of central incisor: 3 ± 2 mm (0–6)
Complete dentures in maximum intercuspation
vertical distance upper to lower ridge region central incisor 20 ± 4 mm (12–33)
vertical distance upper to lower ridge region first molar 21 ± 4 mm (9–34)

Because of the interindividual variance the arbitrary moulding of the tooth position-analogue plastic rims seems not ideal. However, a functional and aesthetically pleasing existing denture should be surveyed to pre-shape functional impression trays. Such individualized trays proved clinically a valuable tool for functional impressions and an immediate preliminary bite registration.