The triangle bruxism, pain, and psychosocial factors

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Chapter 8

GENERAL DISCUSSION

The issue of the relationship between pain and psychosocial factors is a complex subject, which is of interest for many practitioners dealing with several medical specialties. Especially pain practitioners in the fields of neurology, orthopedics, rheumatology, and dentistry, have experienced that the role of concurrent factors, such as depression, anxiety, and somatization, is important to determine the clinical manifestation of painful disorders and that these factors have a major influence on the treatment outcome as well [1]. The field of temporomandibular disorders (TMD) and orofacial pain is no exception, and early suggestions for a role of psychosocial factors in the etiology of pain in the jaw muscles date back to more than half a century ago [2]. Over the years, evidence has grown in support of a biopsychosocial model for temporomandibular disorders pain [3], to the point that dual-axis classification systems combining physical and psychosocial assessments for TMD patients were proposed [4]. Also, evidence has accumulated to assign a less important role for dental occlusion features in the pathogenesis of pain in the jaw muscles and temporomandibular joint [5]. Notwithstanding that, purported abnormalities of dental occlusion have been historically considered a major risk factor for TMD pain, and their correction a target for therapy. Despite the amount of evidence-based suggestions that occlusal factors are not a major risk factor for disease and that irreversible occlusal treatments cannot be recommended for TMD treatment or prevention [6], it seems that new paradigms of disease have yet to emerge in the TMD clinics. So, a search for new paradigms is a fundamental step for the near future of TMD research, and it is likely that they have to be searched within the biopsychosocial frame [7].

On the way toward an improvement of knowledge in this field, overload of jaw muscles and temporomandibular joints is viewed as a pathogenetic mechanism that may lead to the onset of pain, along with psychosocial factors. Bruxism, due to its potential for muscle and joint overload, has often been called into cause as a risk factor for TMD [8]. Thus, the focus of this thesis was to get deeper into the knowledge of the mutual interactions between bruxism, pain, and psychosocial factors, the assessment of which may provide strong contributions to the search for a comprehensive model of disease (i.e., TMD).

Systematic assessment of the literature

As a first step, two systematic reviews of the bruxism literature, one dealing with the relationship with TMD and the other with the role of psychosocial factors in the etiology of bruxism, were performed.

The systematic review of the literature on the bruxism-TMD relationship identified more than 40 papers on the issue published during the 1998-2008 decade (**Chapter 2**)[9], and a similar number of papers were retrieved for the bruxism-psychosocial factors review (**Chapter 4**)[10]. Despite this apparently overwhelming amount of studies, the quality of the examined investigations was less than optimal, and some common denominator shortcomings were detected. In particular, the major concern affecting the entire bruxism literature lies in the variety of criteria adopted to diagnose bruxism itself. In most studies, the diagnosis was based on self-report instruments (e.g., questionnaires, interviews) and there is lack of information on whether the authors were studying sleep or awake bruxism. Several studies have shown that a patient's self-report of bruxism is not reliable diagnostically, since it may be influenced by both the clinician's and the patient's conviction of a bruxing behavior being present [11,12]. At present, polysomnographic recording in adequately equipped sleep laboratories represents the standard of reference for the diagnosis of bruxism [13], but it has found less application than expected because of obvious logistic and economic problems. Portable EMG devices, which allow the recording of EMG activity of masticatory muscles during sleep in the habitual environment, reduce costs and limit patient discomfort, thus representing an acceptable instrument in the research setting [14]. Self-reported studies are more suitable to perform as large-sample investigations than PSG and EMG studies; so, the latter constitute only a minority of the bruxism literature.

Almost half of the papers included in the bruxism-TMD review based their findings on a diagnosis of bruxism in general and/or TMD in general, thus having a low level of specificity for the assessment of the relationship between the different types of bruxism motor activities, viz., clenching or grinding, and the different sources of TMD pain, viz., the masticatory muscles or the temporomandibular joints. In general, a trend for a positive (but unspecific) bruxism-TMD association was shown for the investigations using self-report or clinical diagnosis for bruxism. However, the problem of diagnostic bias is a

potential matter of concern for these kind of studies. Indeed, pain was preconceivedly indicated as a criterion for a bruxism diagnosis in the majority of papers, thus representing a bias for a positive finding of an association between pain and bruxism. In contrast, studies using more quantitative and specific methods to diagnose bruxism (i.e., polysomnography, electromyography) were not able to replicate such an association. Clearly, more research is needed to further elucidate this issue, since most of the available studies are cross-sectional or case-control investigations that are suitable to assess the role of bruxism as a potential risk factor for TMD but cannot give information on the temporal relationship, if existing, between the two disorders. So, importantly, longitudinal studies with several observation points over a long follow-up period are needed to draw conclusions on the actual cause-and-effect relationship between bruxism and TMD.

The attempts to provoke TMD symptoms via experimental sessions of prolonged jaw clenching/grinding, which is a potentially interesting field of research, failed to provide definitive conclusions due to problems of discriminating between pain and fatigue when assessing the effects of experimental clenching on the jaw muscles. In any case, it is likely that factors other than prolonged muscle contraction are needed to elicit chronic pain.

In view of the above limitations, the strongest available evidence regarding the bruxism-TMD issue came from studies showing that anterior tooth wear is not a major risk factor for TMD, but more specific studies, with the adoption of standardized systems for data collection, are needed to clarify the actual relationship between bruxism and TMD.

The same low level of specificity for the study of the different bruxism activities was found in the systematic literature review on the role of psychosocial factors in the etiology of bruxism. The term psychosocial factors was adopted here and below to group together all those psychological (e.g., stress, anxiety and mood disturbances, temperamental traits, and emotions) and social (e.g., workplace satisfaction, marital status, cultural and economic conditions, social behaviors, and expectations) factors that may have an effect on an individual's health, and constitute a common denominator influencing both bruxism and temporomandibular disorders. Despite this very specific definition adopted to frame the wide area of the psychological and psychiatric literature applied to bruxism, the literature

search and interpretation was complicated by the large number of psychometric instruments that were adopted in the different investigations.

As a common denominator with the bruxism-TMD literature, the majority of papers included in the second review were cross-sectional investigations dealing with a self-report ad/or clinical diagnosis of bruxism, thus presenting the same low level of specificity for the assessment of a causal relationship. Studies with such features showed some association of bruxism with anxiety, stress sensitivity, depression, and other personological characteristics. As in the case of the bruxism-TMD review, those findings coming from questionnaire-based studies were in contrast with EMG and sleep laboratory investigations, which were unable to replicate them.

Thus, it seems that the literature on bruxism, either focusing on its relationship with TMD or on the etiology of bruxism itself, is biased by the amount of data gathered with the adoption of a questionnaire-based self-report diagnosis of bruxism. Such an approach is often based on a single question on bruxism with a dichotomic answer possibility and, despite being suitable to collect large-sample data, it is not the most specific approach to depict the complexity of the bruxism continuum [15].

Controversial findings between studies relying on self-report and those relying on instrumentally-detected bruxism may be due to the fact that clinical and self-report studies are more suitable to detect awake bruxism (clenching type), while polysomnographic studies focused only on sleep bruxism (grinding type). Such hypothesis is in line with findings from the systematic reviews: wake clenching seems to be associated with psychosocial factors and a number of psychopathological symptoms and may be associated with self-reported TMD symptoms, while there is no evidence to relate sleep bruxism diagnosed by means of sleep laboratory investigations with psychosocial disorders and TMD symptoms.

As a specific conclusion on the etiological role of psychosocial factors, it must be pointed out that the role of episodic (related to any particular episode/event) stress as a potentially traumatic event that disrupts sleep and increases bruxism seems to be less important than believed in the past, and personality traits need to be further investigated to gain a deeper insight into the role of psychosocial factors.

As a general conclusion, it appears that the entire bruxism literature will benefit from efforts made to improve the specificity of diagnostic approaches for bruxism and for the discrimination between the various forms of the disorder, because this evolving field of research will surely benefit from a standardization and diffusion of diagnostic criteria.

The multicenter project

Within the above premises, a large-sample multicenter investigation was performed to further elucidate some aspects of the bruxism-TMD association **(Chapter 3)**[16], to provide data on the psychosocial assessment of TMD patients (**Chapter 6**)[17], and to relate psychosocial and physical diagnoses in TMD patients (**Chapter 7**)[18].

The starting point for conducting a multicenter project was the need for homogeneous diagnostic guidelines, and it was decided to adopt the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [4]. Despite several points of criticism which emerged from some recent papers [19,20] and which are contributing to a revision of the original 1992 version [21,22], the RDC/TMD remain the first choice when standardized data gathering and good possibilities for comparison between centers are needed. Thus, the adoption of the RDC/TMD was a compelling requisite to achieve diagnostic homogeneity in the four highly specialized clinics for TMD and orofacial pain diagnosis and treatment (two of which contributing with both axis I and II data [Padova, Tel Aviv], one with axis II data [Amsterdam], and one with non-patient population data [Helsinki]) that participated in the multicenter project which constitutes part of this thesis.

One of the most interesting results of the project was that axis II data seem to be more consistent across multicenter findings as compared to axis I diagnoses, which present a higher rate of cross-center variability. In the overall sample from which axis II data were available, accounting for up to more than 1100 TMD patients, the prevalence of high pain-related disability (GCPS grade III or IV) was 16.9%, that of severe depression was 21.4%, and that of severe somatization was 28.5%. Cross-center differences concerned lower depression and somatisation levels in the Dutch sample but, importantly, they were not relevant for the percentage of patients with high pain-related disability, which is likely to represent the most important predictor for symptoms severity and treatment outcome. A

much less consistent outcome emerged for axis I findings, with striking differences in the prevalence of the different diagnoses across the Italian and Israeli samples.

In particular, the prevalence of inflammatory-degenerative joint disorders was significantly higher in the Italians (79.4% vs. 19.6%), while most part of the Israeli sample was constituted by patients receiving a diagnosis of myofascial pain alone (36.8%). A possible explanation for such differences lies in the more widespread use of imaging techniques allowed by the Italian national healthcare system, which led to the prescription of magnetic resonance for a vast majority of TMD patients and, consequently, to a more profound assessment of joint disorders. Also, the peculiar location of the TMD Clinic at the University of Padova, which collects patients from several hospitals' maxillofacial surgery departments in Northern Italy, may contribute to a different ratio of joint-to-muscle TMD diagnoses and to a higher prevalence of multiple RDC/TMD diagnoses with respect to what was found in other TMD populations. Notwithstanding that, the literature on TMD prevalence contains many studies describing a high rate of cross-center variability [23]. So, it is likely that other factors contribute to the axis I diagnoses variability. Among these, one cannot exclude the existence of some small differences in the instruments, due to the translation procedures from the original English version or to the cultural adaptation procedures. Even more importantly, it must be noticed that some differences in the performance of the clinical tests may exist, since despite being involved in several previous RDC/TMD investigations, neither the examiners assessing patients in the Padova clinic nor those in the Tel Aviv clinic were formally trained by the RDC/TMD consortium. Finally, the possible existence of some ethnic or cultural factors underlying the different manifestation of TMD symptoms in the different patient populations has to be taken into account.

The multicenter data gathering that was part of this thesis was the largest so far in the TMD literature, and despite the above points of concern, several interesting findings did emerge.

As for the bruxism-TMD relationship assessment, RDC/TMD axis I physical diagnoses were cross-tabulated with self-reported awake and sleep bruxism diagnoses based on the RDC/TMD history questionnaire. In line with previous literature findings

described in the systematic review, in the overall sample composed by the Padova and Tel Aviv samples, a positive association between self-reported bruxism and TMD was observed, even if due to the univariate statistics no definitive information on the association between specific bruxism and TMD diagnoses can be provided. As above stated, some relevant differences emerged between the clinics' samples, i.e., for the prevalence of TMD diagnostic groups, for the percentage of positive responders to the awake/sleep bruxism questions, and for the association between the two variables. Myofascial pain alone was indeed the most common diagnosis in the latter sample, and it was the only diagnosis associated with self-reported bruxism both in the overall sample and in the Israeli sample. Also, the association was significant only in the 30-39 years age range, suggesting that other factors could be involved to determine a potential cause-and-effect relationship between bruxism and TMD, due to the fact that the two disorders were characterized by different age peaks but their association was significant only in the age range in which myofascial pain is more common. As a concluding remark, it should be noticed that the country-to-country differences in the healthcare systems, which may facilitate or discourage the adoption of imaging techniques for routine use, may have introduced another potential source of bias for the assessment of the bruxism-TMD association in favor of the clinically diagnosed myofascial pain with respect to TMJ disorders, in line with concerns that the original RDC/TMD were more prone to overdiagnose muscle disorders [24].

The other parts of the multicenter projects focused on axis II findings. As already stated throughout the manuscript, psychosocial disorders are the third vertex of the triangle with bruxism and pain, amongst others because of their recognized importance in temporomandibular disorders practice [25]. During the process of revising the RDC/TMD guidelines, there was consensus among researchers that the psychosocial assessment provided with the original version was a valid instrument to screen for non-physical symptoms and that only some minor changes were needed (e.g., the addition of an anxiety-evaluation instrument). Notwithstanding, axis II findings in TMD populations were described only in a few investigations. More importantly, (1) the consistency of the axis II instrument, viz., the relationship between findings achieved with the different assessment scales, has yet to be backed up with multicenter data, and (2) the relationship with axis I

physical diagnoses was assessed only in some selected populations and by the use of selected axis II items. The part of the thesis focusing on RDC/TMD axis II findings addressed such important aspects of the TMD literature.

Three-center (Padova, Tel Aviv, Amsterdam) data on the prevalence of RDC/TMD axis II diagnoses (e.g., depression, somatization, and graded chronic pain severity (GCPS) scores) in TMD patients were described. Levels of chronic pain-related disability were significantly correlated with depression and somatization scores, thus confirming the good internal consistency and construct validity of the measures included in the RDC/TMD axis II for psychosocial assessment [26]. High GCPS scores were significantly associated with pain lasting for more than six months, while some differences emerged between the three clinics as for the association of pain duration with depression and somatization scores.

The clinical significance of the data summarized in the above paragraph lies in their potential correlation with axis I physical diagnosis, which was assessed in another multicenter data analysis that also included a non-patient population recruited at the University of Helsinki. The overall sample, combining clinic and community cases, accounted for more than 1500 subjects receiving both axes I and II assessments. A significant correlation between GCPS scores and axis I findings was found in the overall sample, but not in the clinic sample. Such findings may suggest that a treatment seeking behavior, which may be identified as the fact of being part of a clinic population, is the key factor to determine the degree of pain-related impairment and that, once a treatment seeking behavior has established, the influence of the different physical axis I diagnoses on the degree of impairment is likely to be low. This represents an important field of research, since such a feature may help to further discriminate between patient and non-patient populations, as already suggested for other pain disorders [27]. All predictors for high disability were axis II findings (e.g., severe depression and somatization) or psychosocial aspects of the pain experience (e.g., pain duration, treatment seeking behavior), while none of the axis I diagnoses predicted the level of pain-related disability. Thus, physical findings did not determine the degree of psychosocial impairment. These data lend a strong support to the hypothesis that axis II findings, and more in general, all emotional aspects related

with the complex pain experience, are only weakly related with pain localization. An important aspect of these observations is that they fit well with the need to design studies that will be useful for the process of treatment-decision making. Hence, the clinical impact of these findings has to be assessed with future investigations aiming at a better identification of both the physical predictors and the psychosocial predictors of treatment outcome. More in general, the amount of data gathered with the multicenter project is worthy to be deepened also by the use of more sophisticated multivariate statistical approaches, which are fundamental to depict biological models and, more specifically, to explain the mutual interactions between the triangle's variables.

Experimental contribution

The role of psychosocial factors was also put into relation with bruxism in an investigation exploring the third side of the triangle, viz., the one connecting bruxism with the psyche **(Chapter 5)**[28]. One of the major shortcomings of the bruxism literature is likely related with the very definition of bruxism itself. Bruxism is not a disorder per se, but it should viewed as a continuum in which physiological motor activity of jaw muscles during sleep- and/or wake-time out passes a threshold, thereby increasing the likelihood of pathological consequences for the stomatognathic structures [29]. For this reason, all investigations attempting to dichotomize bruxism as present/absent are likely to miss important data on its frequency and severity that may be fundamental for an improvement of knowledge on such disorder. Among the strategies that could be adopted to avoid dichotomizing bruxism, measurement of muscle activity as an outcome parameter to quantify bruxism is a promising one. A four-channel EMG home-recording device was used to describe the correlation between sleep-time masticatory muscles activity (MMA) and psychological symptoms. Interesting findings did emerge, especially with regard to the relation between the duration of MMA events in the temporalis and masseter muscles during the early phases after sleep onset and trait anxiety scores. The association between MMA activity with the other investigated psychological symptoms (e.g., anxiety state, depression, anger) was not significant. Such results supported the view that personality features related with the individual management of anxiety, viz., trait, are likely to be more important than acute episodes of anxiety, viz., state, in the etiology of MMA. These

observations fit well with the literature observations that episodic stress, which in early studies was suggested to be the cause of bruxism [30], may not be a main risk factor. One individual's coping with stress, also referred to as stress sensitivity [31], is likely to be much more important than the severity of the stressful event itself to determine the individual response. This is in line with the widespread concept of resilience to stress described in the psychiatry and psychology literature [32]. In our investigation, the correlation between MMA duration and trait anxiety got progressively lost after the first two hours of sleep, thus suggesting that the early phases of a night's sleep were more likely to be disrupted by trait anxiety-related MMA events. This observation may be interpreted as a direct measure of the fact that trait anxiety might prevent some subjects from easily achieving REM and the deepest sleep stages, which are less subject to microarousals related with orofacial EMG events [33]. In turn, this is in line with the observation that EMG events mainly happen during the sleep stages 1 and 2 [34]. It may be hypothesized that the emerging correlation between MMA and trait anxiety in the first hours of sleep responds to a need to get the emotional tension out as early as possible while asleep, but more controlled research is needed to get deeper into this issue. In particular, it must be noted that univariate and multivariate regression analysis supported only in part the above findings from the above-discussed correlation analyses, since the psychosocial predictors of muscle work identified with the regression analysis were less significant than expected on the basis of their correlations with MMA duration. In any case, the final logit model including trait anxiety scores explained more than 40% of the amount of variance for muscle work exerted during the first two hours of sleep, which is a rare occurrence in multifactorial biological models. To our knowledge, the study described in chapter 5 is the first investigation relating anxiety to EMG-diagnosed sleep-time masticatory muscle activity. The outcome may be viewed as a point of convergence towards findings from studies with a clinical or self-report diagnosis of bruxism, which provided support to the bruxism-psychosocial disorders relationship.

Conclusions

Taken together, the researches presented in this thesis covered several aspects of the complex relationship between bruxism, pain, and psychosocial factors, allowing to add some interesting pieces of information to the available knowledge. The underlying concept

of the thesis was that the biopsychosocial model of disease that emerged in the TMD literature over the past few decades cannot exclude the assessment of some other potential risk factors. Among these, mechanical overload provoked by non-functional muscle activities, as those exerted with bruxism behavior, may be explored as a potential etiological factor. Findings from the investigations and reviews discussed in this thesis suggested that bruxism is a risk factor for TMD pain, but that more specific information is needed to hypothesize etiological diagnoses at the individual level. It is likely that the presence of psychological disorders is fundamental for the clinical manifestation of TMD symptoms, and that once pain is established it acts as a worsening factor for some psychosocial disorders (e.g., depression, somatization, pain-related disability). Interestingly, pain location, viz., muscle and/or temporomandibular joint, seems to be less important than believed in determining the association with the above disorders, thus suggesting that the pain-psychosocial disorders relation in TMD patients may be viewed as part of a systemic experience characterizing pain behavior. Future studies attempting to get deeper into the depiction of treatment seeking behavior are strongly recommended to shift from considerations made at the group level to a more accurate description of risk factors for disease at the individual level. Psychological disorders may also influence, at least to some extent, the features of bruxism activity, thus making the study of each single side of the "triangle" difficult. As a cautionary statement for future investigations, it might be suggested that studies on the bruxism-TMD association take into account for the potential influence that several psychosocial disorders have on both clinical conditions, in order to design researches as biologically plausible as possible.

In conclusion, there are enough elements to suggest that bruxism, pain, and psychosocial factors have mutual interactions to form a triangle-like diagram that is likely to play a major role in the TMD practice. Several aspects of the triangle are still to be elucidated, and the assessment of the relative importance of the three components as predictors of treatment outcome and prognostic factors is one of the most intriguing issues for future studies on orofacial pain.

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