Psychometrics in temporomandibular disorders

An overview

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The purpose of this paper is to review the methods and results of psychometric testings in temporomandibular disorders (TMD) during the past decade. Assessments of psychologic and behavioral factors have been performed for various reasons. The results are often ambiguous and comparisons troublesome. No encompassing psychologic TMD profile has been identified, but small elevations in anxiety, depression, somatization, and stress are often reported; they may be cause or effect. Subcategorization of the patients into diagnostic subgroups suggests that psychologic differences exist but may be small; myogenic patients may have more psychologic difficulties than 'joint' patients. More distinct, robust psychologic subsets of patients, unrelated to the structural diagnosis, have been identified by means of clustering techniques. Irrespective of clinical signs, a certain proportion of the patients are psychologically distressed, whereas others easily adapt to the pain and dysfunction. No single variable has been identified that can predict outcome or compliance. Several psychometric instruments are described. □ *Literature review; pain; personality; psychology; temporomandibular joint syndrome*

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Quantitative assessments of psychologic and behavioral factors in temporomandibular disorders (TMD) have been performed for various reasons.

Investigators have considered personality, emotional, and behavioral factors to be of etiologic significance or important in predisposing for or maintaining TMD. Symptoms of TMD might also have psychologic consequences. 'Illness behavior', the various ways in which patients perceive, evaluate, and respond, or do not respond, to symptoms, has also been considered important in the understanding of TMD. Psychologic, social, and cultural influences are among the determinants for such behavior.

One way to evaluate psychologic, social, and behavioral aspects is to use psychometric instruments, 'paper and pencil' tests. Such inventories are standardized, and norms have been developed for many of them. They can provide more objective information than open-ended clinical interviews and enable quantification and useful comparisons between different groups. Psychometric tests, developed for various reasons, have therefore been used also in the context of TMD. These instruments are based on scientific methods, and The American Psychological Association has developed guidelines to ensure validity and reliability of psychologic tests (1). New tests have also been developed specifically for use with patients with TMD.

The reasons for using psychologic tests, instruments, or inventories in TMD have varied. Some have been used to clarify etiologic components by evaluating personality traits or states or behavior factors. Others have been used to differentiate between subgroups. Specific factors, like stress, anxiety, and depression, have also been evaluated to help develop treatment strategies. Other tests have been used to predict outcome of treatment or to predict compliance. Still others have been used to evaluate the behavior in response to illness. Psychometrics may thus be of interest in onset, maintenance, and treatment outcome of TMD.

The purpose of this paper is to describe the psychometric tests that have been used in the context of TMD during the past decade and to review the results of the testing procedures.

Psychometrics and clinical history

The diagnosis of facial pain conditions relies on the clinician's ability to collect and analyze various data, including psychologic factors. One important question is whether inventories are superior to conventional history-taking in identifying relevant psychologic factors.

A diagnostic tool like the Temporomandibular Joint (TMJ) Scale (see Appendix) measures, among other factors, the global state of emotional functioning and stress on separate scales. When comparing the test scores with clinician ratings, significant correlations have been found with psychologic factors ($r = 0.47$) and with stress ($r = 0.42$) for 274 TMD and non-TMD subjects (2).

Another comprehensive microcomputer-based psychometric instrument, IMPATH: TMJ (see Appendix), is also specifically intended to facilitate the assessment of several aspects of TMD, including behavioral and psychosocial factors (3). The experience with these tests is limited.

Gale & Dixon (4) correlated answers on several different questionnaires, distributed to 132 TMD patients, most of them with chronic conditions. Some tests evaluated anxiety specifically: Anxiety and Depression Scale/Anxiety (ADS/AN), Profiles of Mood States/Tension-Anxiety (POMS/T), and Taylor Manifest Anxiety Scale (TMAS). Some evaluated depression: Anxiety and Depression Scale/Global Depression (ADS/GD), the Depression Questionnaire/Depth of Depression (DQ/DD) and General Depression (DQ/GD), Automatic Thoughts Questionnaire (ATQ-30), Center for Epidemiologic Studies Depression Scale (CES-D), and Profiles of Mood States/Depression-Dejection (POMS/D) (see Appendix). Positive and statistically significant correlations were found between the tests for both anxiety ($r = 0.51$–0.69) and depression ($r = 0.37$–0.83). Two simple questions, 'how depressed are you' and 'do you consider yourself more tense than calm or more calm than tense', correlated well with the total battery and were therefore considered a good approximation for preliminary screening diagnosis.

Oakley et al. (5), after establishing that physicians seem to detect psychologic problems with low accuracy during ordinary history-taking in medical patients, estimated the sensitivity and specificity of dentists' ability to identify psychosocial factors of supposed importance in TMD patients. Three experienced dentists' impressions of certain psychologic traits—depression, anxiety, stress, and denial—were derived from an ordinary initial dental examination of 107 TMD patients without systematically exploring psychosocial problems. The information from the history were compared with the patients' answers from psychologic testing, using the Minnesota Multiphasic Personality Inventory (MMPI), Beck's Depression Inventory (BDI), the Social Readjustment Rating Scale (SRRS), and the Spielberger Stait-Trait Anxiety Inventory (STAI) (see Appendix). The results of the comparisons suggested that the routine chairside screening procedures overdiagnosed psychologic problems. Whereas most true-positive cases were identified by the dentists, the true-negative were not. The correlations between the dentists' ratings and the psychologic tests scores were low.

Tests to evaluate etiologic components

It has been assumed that TMD patients have distinct personality characteristics and emotional states that are related to their condition, and several attempts have been made to establish such a relationship.

Salter et al. (6) tested 104 subjects with facial pain of different origin by means of the General Health Questionnaire (GHQ), the Crown-Crisp Experimental Index (CCEI), and the Parental Bonding Instrument (PBI) (see Appendix). One group consisted of TMD patients without evidence of

joint lesions, another group of patients with facial pain associated with a physical lesion, and a final group of undiagnosed facial pain patients. None of the groups showed any significantly deviating psychologic profiles or any abnormal parental bonding attitudes, although the last group contained proportionately more psychologically ill patients.

Moss & Adams (7) also did not find significant differences in personality, anxiety, or depression between a group of TMD patients and two non-TMD control groups when assessed with MMPI, STAI, and BDI. The 10 subjects in each group were assessed in a non-pain state.

Keefe & Dolan (8) used several behavioral measures to evaluate and compare pain behavior and coping strategies in patients with low-back pain or TMD. The patients, 32 in each group, also answered the McGill Pain Questionnaire (MPQ) as a measure of pain and the Symptom Checklist 90-Revised (SCL-90R), to assess psychologic distress (see Appendix). The groups had similar pain ratings, although the low-back pain patients were much more functionally limited. Both groups also had similar and elevated scores, compared with normative data, on the somatization, obsessive–compulsive, depression, and anxiety subscales. The two groups differed greatly among themselves in pain behavior and coping strategies.

The question of whether the assumed psychologic status in TMD patients is also found in symptomatic subjects not seeking treatment was systematically investigated by Kleinknecht et al. (9). TMD symptoms were evaluated by questionnaires in 621 subjects from a community sample. Two distinct clusters of TMD symptoms were identified. One, called 'core TMD', included jaw muscle pain, joint pain/sounds, and bruxism. The other was called 'peripheral TMD' and included also headache, ringing ears, dizziness, and neck/shoulder pain. Three psychosocial scales were answered: the CES-D, the Repression-Sensitization Scale (R-S), and the Multidimensional Health Locus of Control (MHLC) (see Appendix). The number of reported symptoms was significantly related to scores on depression and repression-sensitization in both groups. When the covariation between the two clusters was controlled for, the correlations to psychosocial factors were low in the first cluster but high in the other. Psychosocial variables were all more strongly correlated to peripheral TMD. The authors concluded that any particular psychosocial profile may not be characteristic of TMD patients but of patients with large numbers of symptoms in general.

van der Laan et al. (10, 11) examined the occurrence of signs and symptoms of TMD in subjects not seeking treatment. Psychologic factors were evaluated in one group with natural dentition and one with complete dentures. The 261 subjects completed two scales on the Hopkins Symptoms Checklist (HSCL) (see Appendix), five scales on the Dutch short form of the MMPI, and a Dutch personality inventory. Both signs and symptoms correlated positively and significantly with several interrelated psychologic variables in both groups. It was concluded that somatization was of etiologic importance for signs and symptoms of TMD.

The question of whether psychologic factors may be the consequence rather than an antecedent for TMD was examined by Southwell et al. (12). They compared 32 TMD patients with age-matched controls, dental patients attending the same clinic, on the Eysenck Personality Questionnaire (EPQ), STAI, and Pennybaker Inventory of Limbic Languidness (PILL) (see Appendix). TMD patients scored significantly higher on introversion, neuroticism, and trait anxiety but not on state anxiety. The conclusion was that TMD patients do have personality characteristics that are vulnerable to life stress.

Schnurr et al. (13) tested 202 TMD patients psychometrically, about one-fifth diagnosed as having myogenic facial pain and the rest internal disorder. Seventy-nine controls with pain-related injuries not involving the TMJ and 71 healthy controls were also evaluated. The tests used were Basic Personality Inventory (BPI), MHLC, Illness Behavior Questionnaire (IBQ) Perceived Stress Scale (PPS), and Ways of Coping (see Appendix). TMD patients and pain

controls scored higher on hypochondriasis, anxiety, and depression scales than controls, but the differences were not considered clinically significant. No differences were found between TMD subgroups. The test procedures were repeated 5 months later, after conservative treatment, and the former increases were found to be decreased in patients who responded positively. No relations were found between pain variables and diverse facets of personality in the TMD group. This was the case in the non-TMJ pain group; as pain increased, so did anxiety, depression, hypochondriasis, and perceived stress.

The psychologic profiles of 98 female TMD patients were recently compared to controls by means of the CCEI (14). Patients scored higher in somatization, indicating that patients are more anxious about bodily concerns. Patients also scored lower than the controls in the hysteria scale.

Finally, Gerke et al. (15) evaluated various psychologic factors, as recorded by the Gerke–Goss inventory (see Appendix), in 312 patients with facial pain of different origins. TMD and dental pain patients showed more anxiety than atypical facial pain patients, and TMD patients showed more hypochondriasis than the other two groups.

Eight of 10 studies thus identified some psychologic discrepancies among TMD patients as compared with controls, but no common psychologic profile has been identified. Although TMD patients do not appear to be a psychologically homogeneous group, increased somatization, anxiety, and depression of mild severity are recurrent terms in the results from many studies, but the scores are still within the normal range in some studies.

Tests to differentiate between subgroups

The etiology of TMD differs, and there are diagnostically heterogeneous groups among the patients. A common way to differentiate patients is to classify them into homogeneous groups on the basis of similar signs and symptoms—muscle- or joint-related. Several authors have used psychometrics to explore the possibility that the subgroups differ also psychologically and not only on a structural basis.

Eversole et al. (16) carefully segregated TMD patients into those with myogenic facial pain and those with internal disorder. Patients with atypical facial pain constituted a third group, about 50 in each group. Patients with myogenic pain and those with atypical facial pain scored higher than patients with internal derangement with regard to hypochondriasis, depression, and hysteria on the MMPI. Although psychopathologic factors were more significant in these groups, the increases were still within the normal range. Patients diagnosed as having an internal disorder, who also were in pain, had some MMPI scores that were higher than the norm but lower than those of the myogenic and atypical facial pain patients. The patient groups thus differed in both structural and psychologic variables.

The nature and extent of psychologic differences among TMD patients with primary myalgia, primary TMJ problems, or a combination of these were also evaluated by McCreary et al. (17), using the MPQ, BDI, STAI, and MMPI. The primary myalgia group was found to have highest scores on pain and distress measures, followed by the combination group and the TMJ group in that order. When differences in pain levels were controlled for, measures of somatic 'overconcern' remained significantly higher in the myalgia group, whereas the differences in anxiety and depression were less clear. A discriminant function analysis of the psychologic variables to predict subgroups correctly identified 74% of the TMJ and 46% of the myalgia patients.

Analysis of psychologic factors along other dimensions than those based on diagnostic categories, defined by clinical symptoms and pathogenesis, have also been done and uncovered subsets of patients that were earlier masked.

To ascertain whether psychologically discrete profiles emerged when using the SCL-90R, Butterworth & Deardorff (18) tested 100 TMD patients, most diagnosed as having internal disorder. A multivariate clustering

statistical procedure was applied and could identify three homogeneous subgroups. One group of 30% was classified as 'psychologically normal'. The second group, 44%, was labeled 'moderately distressed', with elevated somatization, depression, and anxiety. A third group, 26%, was called 'severely distressed', demonstrating even higher elevations in somatization, depression, and anxiety and also in obsessive-compulsive, interpersonal sensitivity, hostility, phobia, and psychotism scales. Questionnaires assessing multiple aspects of pain variables like quality, location, interference with work, and coping were also answered. The first group was found to have significantly lower pain ratings and interferences with activities of daily functioning than the other two groups. The patients' self-ratings of ability to cope with the pain were also highest in the first group. This research did not address the question of etiologic significance of psychologic factors in TMD or their relation to structural abnormality. However, different psychologic subgroups with related differences in pain experience and self-reported coping ability were identified.

Rudy et al. (19) classified 100 TMD patients along psychosocial and behavioral dimensions. They used the West Haven–Yale Multidimensional Pain Inventory, WHYMPI (see Appendix) and identified, through cluster analysis, three unique groups. The groups were labeled 'adaptive copers' (32%; less pain, more activity), 'dysfunctional' (46%; great pain and impact on functioning), and 'interpersonal distressed' (22%; low support from families). Through sophisticated statistical methods the classification system was shown to have good reliability. The accuracy of the taxonomy was confirmed by successfully classifying a further 50 TMD patients. External validity was confirmed by other tests and clinical examinations. The important aspect of this work was that the classification was derived from psychosocial and behavioral factors, and the differences between the subgroups were not related to, for example, clinical or roentgenographic signs or to pain duration.

There is evidence that there are psychologic differences across diagnostic subgroups, myogenic, internal disorders, combinations, and atypical facial pain. By using partly the same diagnostic categories and test, independent investigators show similar results; myogenic patients appear to have more psychologic difficulties than 'joint' patients even when different pain levels are compensated for. There is also evidence that there exist distinct subgroups differentiated along other lines than those based on structural diagnosis.

Tests to evaluate stress

It has often been suggested that TMD might be a somatic reaction to internalized stress. Several investigators have therefore evaluated the impact of stress in TMD through psychometric inventories.

Using the SRRS, Stein et al. (20) tested 16 patients with various TMD signs and 8 unaffected controls, to evaluate stressful life events. It is assumed that emotional stress is related to life change events, desirable or undesirable. The patients were found to experience significantly more stressful life events than the controls, before or after manifestations of TMD. The scores were also significantly correlated with the number of TMD symptoms.

Speculand et al. (21) used the Paykel checklist (see Appendix) to compare stressful life events in 85 TMD patients in pain and 85 matched controls. Again, patients were found to experience more negative events than controls before the onset of TMD, and it was claimed that the events had a formative role in the disorder. The negative events concerned work, money, health problems, and loss of interpersonal relationships. Desirable events were reported with almost equal frequency by patients and controls.

To identify potential risk factors for TMD that relate to life stress, Marbach et al. (22) evaluated 151 symptomatic patients without evidence of organic changes and 139 matched healthy controls for several aspects including psychologic ones. A large number of tests were used: Spence–Helmreich's Masculinity and Femininity Scales, Miller Behavioral Style Scale, Zuckerman's Sen-

sational Seeking Scale, Marlowe–Crowne Need for Approval Scale, Rotter's Locus of Control Scale (LCS), Levenson's LCS, and Psychiatric Epidemiology Research Interview Life Event Scales (PERI) (see Appendix), among others. Patients tended to be more external in LCS and were more concerned with health matters but had also more physical illness. It was concluded that TMD patients were more psychologically distressed, but differences were only found in a few personality measures, however. TMD patients were characterized by physical illness and fewer sources of emotional support.

Beaton et al. (23) tested 172 consecutive TMD patients, half of the sample diagnosed as having a internal disorder and half having orofacial muscle pain, with the Symptoms of Stress (SOS) (see Appendix). The levels of symptomatic and psychologic distress were found to be higher in TMD patients, both men and women, than in 48 healthy controls. Both total stress scores and most subscales differed significantly.

Stockstill & Callahan (24) evaluated personality hardiness and other dimensions using a test by Kobasa, the SRRS, the Seriousness of Illness Survey, the TMAS, and the CES-D (see Appendix) in 47 TMD patients and matched controls. Patients were significantly less hardy, more psychophysiologically vulnerable. Most differences in other measures, such as in anxiety, depression, stressful life events, or prevalence of somatic illness, were in the expected direction although not significantly different.

All studies that have addressed the question specifically found some association between stress and symptoms of TMD.

Tests to predict treatment outcome and compliance

A screening device that could identify patients who require psychologic care rather than more aggressive treatment would naturally be valuable. Several attempts have been made to use psychologic tests to narrow down treatment options and predict outcome of treatment of TMD.

The IBQ was administered to 100 consecutive TMD patients (painful myogenic and/or arthrogenic symptoms except for arthrosis) and 100 controls to prospectively identify patients resistant to conservative treatment (25). The TMD patients had significantly increased levels of disease conviction and affective disturbances like anxiety or depression and were less likely to deny problems in their lives compared with controls. Half of the 13% of the patients who did not respond to treatment showed abnormal illness behavior. On the basis of this screening device, 75% of the TMJ patients could be excluded from further psychologic assessment at little risk of incorrect classification.

Lipton & Marbach (26) evaluated several sociologic, clinical, behavioral, and psychologic (Lagner 22-item index; see Appendix) aspects of 129 subjects with myogenic TMD or joint-related TMD before conservative treatment. Thirty-nine per cent of the patients did not respond to treatment. Discriminant analysis was used to identify variables related to successful treatment response, as judged by two clinicians. Clinical factors and psychologic distress were found irrelevant. However, nearly 80% of the treatment response was correctly predicted from variables concerning attitudes and sociocultural and emotional values in both diagnostic groups.

Funch & Gale (27) used the Health Locus of Control (HLC), DQ, and TMAS (see Appendix) to evaluate compliance in 78 chronic TMD patients. The tests could not identify factors that predicted completion of a behavioral treatment program aimed at reducing symptoms. Neither could clinical examinations or interviews. Social factors such as attitudes toward pain were the only significant predictors.

Salter et al. (28) evaluated 60 patients with TMD clinically and on the GHQ, CCEI and PBI before and after conservative or no treatment. Irrespective of whether they received treatment, 75% of the patients reported subjective improvement. The follow-up psychologic profiles were not significantly different from pre-treatment in either 'shape' or 'elevation'. Outcome—'much better', 'a little better', or 'the same'—

was not related to initial symptom severity but to scores on GHQ and CCEI tests in a curvilinear relation. Mild psychologic distress seemed to facilitate successful outcome, whereas minimal or, particularly, excessive distress was associated with poor results. The 'shape' of the psychologic profiles was not related to outcome, but 'elevation' was. A discriminant function analysis of the initial psychologic evaluation correctly classified 60% of the patients.

In a study by Gerke & Goss (29) 103 TMD patients were treated conservatively, after evaluation with STAI, Zung Depression Test, a modified SRRS (see Appendix), and clinical examination. No physical or psychologic variables could be associated with success or failure of treatment.

Gerke et al. (30) also used the three tests mentioned above and the IBQ and also evaluated several clinical variables in 43 TMD patients, to predict successful subjective response to simple conservative therapy. Again, any psychologic tests alone or different clinical variables alone classified the patients only slightly better than chance. However, grouping clinical and psychologic factors resulted in more than 80% successful prediction.

Tversky et al. (31) used the Hamilton Rating Scale (HRSD) (see Appendix) to classify 64 TMD patients as depressed or non-depressed subjects, confirmed by a psychiatrist, before treatment with splints or antidepressants or a combination. The depressed patients benefited most from the combined therapy.

One hundred and sixty-eight chronic TMD patients were evaluated with the BDI, STAI, and MMPI before treatment or evaluation by McCreary et al. (32). Outcome of treatment was assessed in various self-measures of pain and jaw function up to 2 years later. 'Overconcern' about somatic functioning and somatization were predictive of poor treatment response. The variance and some inconsistent relationships, however, caused the authors to caution about using psychosocial characteristics for individual prediction.

No single variable, structural or psychologic, that can predict outcome with certainty has been identified at present. Combining psychologic and clinical information seems to increase the ability to differentiate between patients. Sociologic variables also seem important for compliance and outcome.

Discussion

Direct comparisons of the results among studies that used psychometrics are troublesome, since they differ in design and choice of tests. Even though the same instruments have been used in several independent research reports, comparison are intricate. The BDI, CES-D, CCEI, IBQ, MMPI, SRRS, STAI, and TMAS have all been used in three or more studies (see Appendix and Refs. 32–82). The major difficulty is that the populations that the tests have been used on have been defined and subdivided in different ways. Other reasons are that different scales have been used in different studies, and the raw data are not always provided. When comparisons are possible, there are both similarities and differences in the results.

The results from studies concerning conventional history-taking and psychometrics differ, but one conclusion might be that dentists can identify psychologic problems during an interview, although not with the same precision as tests can. The studies do not endorse routine psychologic testing. Simple questions about depression and anxiety, two common psychologic conditions of supposed interest in TMD, might be included in an initial interview that serves as a preliminary screening. At least two psychosocial inventories, specifically intended for TMD purposes, are available (3, 76).

The issue of whether TMD patients have certain personality traits in common has been addressed frequently for more than 40 years. The results from the past decade are still contradictory and confusing. Small increases, particularly on somatic items on certain common tests, may reflect symptoms rather than psychopathology, according to several authors (13, 19). The possible deviating psychologic profile may be considered an adjustment disorder. It has also been

suggested that the elevated scores might be related to coexisting symptoms (9). The existence of certain predisposing psychologic factors in TMD remains a possibility, but the theory of an all-encompassing personality has definitely not been proved. A similar conclusion has recently been drawn in a review by Marbach (83). Prospective studies need to be done to establish whether deviating personality characteristics, if they exist, are a cause or effect of the disorder.

It has also been pointed out that psychologically distressed patients may accumulate at tertiary TMD clinics, where most research is done. Although the vast majority of TMD patients recover irrespective of treatment strategies, the etiology is often unclear, and the therapist may therefore appear awkward when unable to ameliorate the pain. The subsequent mutual disillusionment might have psychologic consequences.

The results from testing different subgroups further support the conclusion that there is no specific TMD personality. Different diagnostic categories appear to have different psychologic profiles (16, 17). The results have implications for different etiologic factors among the groups and may be compatible with a psychophysiologic theory for some patients with myogenic pain.

The differences in psychometric test results between structurally based diagnostic subgroups are small, however. Other combinations of psychologic features are stronger. Independent research with conceptual similarities, the use of multivariate hierarchical clustering techniques, have identified distinct, robust homogeneous psychologic and behavioral subsets of patients with certain characteristics in common (18, 19). These subgroups are unrelated to any structural diagnosis. About one-third of the TMD patients appear to be normal, whereas one-fourth seem to be 'severely distressed', irrespective of clinical signs. However, a similar proportion of the general population can also be described as psychiatrically impaired (25). The rest of the patients constitute a moderately dysfunctional group. This approach is new in the context of TMD, and it is possible that the results may have important implications in research and patient care. The results might help explain the clinically frustrating observation that apparent similar signs might have very disparate 'meanings' and consequences for the patients or that similar treatments might lead to different outcomes. Along this new dimension it might be understood that the degree of a subjective symptom is not necessarily in direct proportion to its medical basis and that the pain the patient describes actually might be a complex interplay between psychologic and organic factors.

Dual diagnoses, labeling both the organic and psychologic aspects of the pain, occur in other areas and facilitate the understanding of certain phenomena. A 'two-axis' diagnostic system has recently been suggested for TMD research and clinics (84). It is probable that these newly described psychologic dimensions will be considered more closely in future TMD research with regard to how they may be related to, for example, treatment outcome or compliance.

Several pain conditions, particularly chronic cases, have sometimes been considered a complex synthesis of organic and psychologic factors. Whether TMD patients resemble these other 'pain patients' with regard to psychologic factors is controversial. TMD patients have been found to differ in test scores when compared with patients with atypical facial pain (15, 16), as they do in age and sex distribution. The TMD patients as a group have also been found to be psychologically closer to a healthy control population than to a pain clinic population (25). The results from the division of TMD patients along psychometric lines, on the other hand, show that a subset of patients do have similarities to 'pain patients' (19). Again, the heterogeneous population of patients renders a generalization impossible.

Stress, although sometimes a blurred conception, seems to be related to TMD as it is to the occurrence of various other disorders or even accidents. Much of the data are correlational and do not indicate causality. A relationship between 'paper and pencil' tests of stress and TMD seems to exist, however (20, 21, 23). 'Life-stress' might be very personal and difficult to register. There seem

to be sizable individual variations in the degree to which stress is associated with TMD.

The outcome of treatment might depend on several different variables—not only on type of signs and symptoms but also on type of patient. Differences in illness behavior, social and sociocultural variables, and somatic overconcern have been found in non-responding compared with responding groups (25, 26, 32). Although formal testing might distinguish between successful and unsuccessful outcome groups, the variance is considerable, and the tests are not strong enough to predict outcome in individual cases and to identify potential non-responders with certainty. The relation between psychologic and other factors in treatment response may be very complex and not linear (28). Whether treatment outcome is related to the psychometrically derived subgroups that have been described is not known at this time.

The diagnostic skills and judgement of an experienced clinician cannot be replaced. Although tests might provide an additional source of information, the utility of formal psychometrics in routine dental practice is limited. Patients answering positively to psychologic and behavioral questions in an initial interview can be evaluated with lengthier inventories. Standardized assessment is accessible, but a cautious interpretation of test results is necessary since no definitive cutoff scores exist. As with many other diagnostic systems and medical tests, false-negative and false-positive results do occur with some regularity. The subject can also respond randomly, although this is evaluated in tests like the MMPI. The results can therefore not be used to make definitive statements about a patient's status but must be construed in a wider context, which might require expertise. Since many test questions have the potential of invading the subjects' privacy, the results must be handled with strict confidentiality.

A modern treatment strategy provides a multidimensional approach to pain, but the use of tests in the initial assessment of the individual TMD patient is not warranted at present (33, 34). One important area for psychometric tests might still be research.

Several approved tests exist. Over a hundred tests can be identified, and some 40 have been used in the context of TMD. The usefulness of the MMPI is verified in many investigations. When it is too extensive, it might be replaced by SCL-90R, another psychodiagnostic multidimensional instrument. Specific qualities such as depression can be quantified with the BDI or CES-D. Anxiety can be estimated with the STAI. All these tests have been used in various contexts and have acceptable reliability and validity (see Appendix). The IBQ is a common way to systematically evaluate 'illness behavior', and the MPQ assesses qualitative aspects of pain.

In summary, psychometrics might add information to the understanding of TMD. Although somatization, stress, anxiety, and depression sometimes seem related to TMD, any description of an all-embracing TMD personality seems to be a statistical impossibility. So far TMD patients as a whole do not seem to be a subset of 'pain patients'. Subgroups of patients, divided on the basis of structural diagnosis, seem to differ psychologically in a logical manner. Perhaps the categorization of patients along psychologic and behavioral dimensions will turn out to be fruitful. These factors are certainly involved in TMD.

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Appendix

ADS, The Anxiety and Depression Scale (used in Ref. 4)

68 items, yes/no. Subscales concerning anxiety/AN and depression/GD (35).

ATQ-30, The Automatic Thoughts Questionnaire (used in Ref. 4)

30 items concerning depression from 'not at all' (1) to 'all the time' (5). Correlates highly with Beck Depression Scale and MMPI (36).

BPI, Basic Personality Inventory (used in Ref. 13)

240 items, true-false; 12 scales: hypochondria's, depression, denial, interpersonal problems, alienation, persecutory ideas, anxiety, thinking disorder, impulse expression, social introversion, self-depreciation, and deviation. Similar to MMPI (37).

BDI, Beck's Depression Inventory (used in Refs. 5, 7, 17, 32)

A self-report instrument intended to measure quantitatively behavioral manifestations of depression in 21 items, rated 0–3 (38, 39).

CES-D, The Center for Epidemiological Studies Depression Scale (used in Refs. 4, 9, 24)

20 items concerning depression from 'rarely or none of the time' (0) to 'most or all of the time' (3) (40). Adequate test and retest consistency (41).

CCEI, Crown–Crisp Experimental Index (used in Refs. 6, 14, 28)

48 items; classifies subjects in 6 different psychologic profiles, free-floating and phobic anxiety, obsessive–compulsive, somatization, depressive, and hysteria (42).

DQ, The Depression Questionnaire (used in Refs. 4, 27)

57-item yes/no answers. Measures depth of depression/DD and general depression/GD (43).

EPQ, Eysenck Personality Questionnaire (used in Ref. 12)

90 items. Evaluates personality characteristics of neuroticism, extroversion, and psychotism and has a lie scale (44).

GHQ, The General Health Questionnaire (used in Refs. 6, 28)

28 items. An easily administered paper and pencil test for first-line screening of psychiatric illness (45).

Gerke–Goss Inventory (used in Ref. 15)

A battery of previously used clinical and psychologic tests available from the authors (15).

HLC, Health Locus of Control (used in Ref. 27)

11 items on a 6-point Likert-type scale measuring generalized expectancies regarding locus of control related to health (46).

HRSD, Hamilton Rating Scale for Depression (used in Ref. 31)

Observer rating scale developed to measure the severity of a major depression (47).

HSCL, Hopkins Symptom Checklist (used in Refs. 10, 11)

A self-report symptom inventory comprising 58 items scored on 5 underlying symptom dimensions: somatization, obsessive–compulsive, interpersonal sensitivity, anxiety, and depression (48).

IBQ, Illness Behavior Questionnaire (used in Refs. 13, 25, 30)

62-item questionnnaire, yes/no. Concerning attitudes to illness, own and others, and current psychosocial situation. Seven factors: general hypochondrias, disease conviction, psychologic versus somatic perception of illness, affective inhibition, affective disturbance, denial, and irritability are evaluated. Very sensitive, less specific (49).

IMPATH: TMJ (used in Ref. 3)

Initially developed to assess behavioral and psychosocial contributing factors in low-back pain. A microcomputer-based instru-

ment; the patient interacts with the computer for immediate analysis and database establishment. The software measure symptom severity, illness impact, and life functioning and quality of life. The test takes one to 2 h and can be compared with norms immediately (3).

Kobasa, hardiness questionnaire (used in Ref. 24)

A 36-item questionnaire, from several independent scales, about hardiness; commitment, control, and challenge. Evaluates functions to decrease the effects of stressful life events in producing illness. Factor-analyzed version of original six-scale questionnaire (50).

The Lagner 22-item index (used in Ref. 26)

A screening inventory, 22 items, evaluating psychophysiologic, depressive, and other symptoms (51).

Levenson's Health Locus of Control (used in Ref. 22)

Measures whether individuals perceive the forces that govern their lives as being internal or external (52).

Marlowe–Crowne Need for Approval Scale (used in Ref. 22)

Measures social desirability response (53).

MHLC, Multidimensional Health Locus of Control (used in Refs. 9, 13)

18-item Likert scale. Measures whether the extent to which a person believes his health is or is not determined by his own behavior (54)

MMPI, Minnesota Multiphasic Personality Inventory (used in Refs. 5, 7, 10, 11, 16, 17, 32)

A comprehensive personality inventory; 566-item true-false. Several different scales. Assesses validity; the subjects' approach to taking the test in L, F, and K scales. Several clinical scales like Hypochondrias (Hy), which measures concern for bodily functioning; depression (D); Hysteria (Hy), denial of emotional and interpersonal problems; psychasthenia (Pt), assessing worry, anxiety, and ruminations; frustration tolerance (Pd); suspicion and distrust (Pa); alienation and confusion (Sc); energy level and distractibility (Ma) (55, 56).

MPQ, McGill Pain Questionnaire (used in Refs. 8, 17)

Assesses qualitative aspects of pain. 78 verbal descriptors of pain are arranged in 20 groups, sensory, affective, evaluative, or miscellaneous. Arranged in order of intensity (57).

Miller Behavioral Style Scale (used in Ref. 22)

May evaluate denial (58).

Paykel's life event checklist (used in Ref. 21)

64-item checklist used as a basis for semi-structured interviews (59).

PBI, Parental Bonding Instrument (used in Refs. 6, 28)

Measures perception of early childhood experiences (60).

PPS, Perceived Stress Scale (used in Ref. 13)

14-item, 5-point Likert scale. Evaluates the extent to which situations in a person's life are perceived as stressful (61).

PERI, Psychiatric Epidemiology Research Interview Life Event Scales (used in Ref. 22)

Measurement of recent life events (62).

PILL, Pennybaker Inventory of Limbic Languidness (used in Ref. 12)

Scores somatic symptoms during preceding weeks (63).

POMS, The Profile of Mood States (used in Ref. 4)

Measures anxiety, depression on a total of 65 items from 'not at all' (0) to 'extremely' (4). Tension-anxiety subscale/T, and depression-dejection/D subscale (64).

Rotter's LCS, Locus of Control Scale (used in Ref. 22)

Measures whether individuals perceive the forces that govern their lives as being internal or external (65).

R-S, The Repression-Sensitization Scale (used in Ref. 9)

Evaluates emotional stress, physical symptoms (66).

SCL-90 R, Symptom checklist 90-R (used in Refs. 8, 18)

90 items on a 5-point scale. Assesses psychologic distress in nine symptom dimensions: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychotism. Three summary scales of overall psychologic distress, Global Sensitivity Index, Positive Symptom Distress, and Positive Symptom Total, are in-

cluded. Reliability and validity have been demonstrated (67–69).

Seriousness of Illness Survey (used in Ref. 24)

Assesses global somatic response to stress, based on 126 items scored in accordance with the respondent's concept of relative seriousness of illness (70).

SOS, The Symptoms of Stress (used in Ref. 23)

94 items, 0–4 points on 10 subscales. Assessing physical, behavioral, and psychologic symptoms of stress: peripheral, cardiopulmonary, neurologic, gastrointestinal, muscle tension, habit patterns, depression, anxiety, anger, and cognitive disorganization. From Cornell Medical Index (23).

Spence–Helmreich's Masculinity and Femininity Scales (used in Ref. 22)

Measures a personality variable, mastery orientation (71).

SRRS, Social Readjustment Rating Scale (used in Refs. 5, 20, 24, 29, 30)

43 'items', minor to significant life events that might have happened to the respondent, scored 11 to 100 points (72).

STAI, The Spielberger Stait-Trait Anxiety Inventory (used in Refs. 5, 7, 12, 17, 29, 30, 32)

2 subsets, each of 20 items, score current anxiety level (state) and the degree to which the individual is prone to experience anxiety (trait) (73, 74).

TMAS, Taylor Manifest Anxiety Scale (used in Refs. 4, 24, 27)

51 items, true-false. From items dealing with anxiety in MMPI (75).

The TMJ scale (used in Ref. 2)

97 items. Developed specifically to evaluate patients with TM disorders. Assesses 10 factors in 3 domains presumed to be relevant: physical, psychosocial (psychologic factors, stress, chronicity), and global (76–78).

Zuckerman's Sensation-Seeking Scale (used in Ref. 22)

Concerns use of alcohol and drugs (79).

The Zung Depression Test (used in Refs. 29, 30)

A self-rating scale; 20 items related to depressive symptoms, scored 1–4 from 'a little of the time' to 'most of the time'. Quantitative measure of symptoms of depression (80).

Ways of Coping (Revised) (used in Ref. 13)

66-item, 4-point Likert. 8 factors. Sample acts and thoughts dealing with stressful situations (81).

WHYMPI, West Haven-Yale Multidimensional Pain Inventory (used in Ref. 19)

13 scales assessing chronic pain patients. First section evaluates pain severity, how pain interferes, support from others, perceived life control, affective distress. Second section evaluates behavioral response: punishing responses, solicitous responses, and distracting responses. The last section evaluates general activity (82).