Published in final edited form as:
J Orofac Pain. 2010 ; 24(1): 79–88.

Research Diagnostic Criteria for Temporomandibular Disorders: Future Directions

Gary C. Anderson, DDS, MS[Associate Professor],
University of Minnesota School of Dentistry, Department of Diagnostic and Biological Sciences, MHST Rm 9-470, 515 Delaware Street SE, Minneapolis, MN 55455, Telephone: 612-624-3908, Fax: 612-626-2654

Yoly M. Gonzalez, DDS, MS[Assistant Professor],
University at Buffalo School of Dental Medicine, Department of Oral Diagnostic Sciences, 3435 Main Street, 355 Squire Hall, Buffalo, NY 14214

Richard Ohrbach, DDS, PhD[Associate Professor],
University at Buffalo School of Dental Medicine, Department of Oral Diagnostic Sciences, 3435 Main Street, 355 Squire Hall, Buffalo, NY 14214

Edmond L. Truelove, DDS, MSD[Professor],
University of Washington School of Dentistry, Department of Oral Medicine, Box 356370, Seattle, WA 98195

Earl Sommers, DDS, MSD[Clinical Associate Professor],
University of Washington School of Dentistry, Department of Oral Medicine, B317B Health Science Building, Seattle, WA 98195

John O. Look, DDS, PhD, MPH[Senior Research Associate], and
University of Minnesota School of Dentistry, MHST Rm 6-320, 515 Delware Street SE, Minneapolis, MN 55455

Eric L. Schiffman, DDS, MS[Associate Professor]
University of Minnesota School of Dentistry, MHST Rm 6-320, 515 Delaware Street SE, Minneapolis, MN 55455

Gary C. Anderson: ander018@umn.edu

Abstract

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) Validation Project provided the first comprehensive assessment of reliability and validity of the original Axis I and II. In addition, Axis I of the RDC/TMD was revised with estimates of reliability and validity. These findings are reported in previous papers. Further revisions for Axis I and II are presented for consideration by the TMD research and clinical communities. Potential Axis I revisions include addressing concerns with orofacial pain differential diagnosis and changes in nomenclature in an attempt to provide improved consistency with other musculoskeletal diagnostic systems. In addition, expansion of the RDC/TMD to include the less common TMD conditions and disorders would make it more comprehensive and clinically useful. The original standards for diagnostic sensitivity (≤0.70) and specificity (≤0.95) should be reconsidered to reflect changes in the field since the RDC/TMD was published in 1992. Pertaining to Axis II, current recommendations for all chronic pain conditions include standardized instruments and expansion of the domains assessed. In addition there is need for improved clinical efficiency of Axis II instruments and exploring methods to better integrate Axis I and II in clinical settings. To that end, this paper recommends an international symposium to provide future direction.

Keywords

temporomandibular disorders; diagnostic criteria; nomenclature; clinical utility; research

Introduction

Since the American Dental Association's president's conference on temporomandibular disorders (TMDs) in 1983, every major forum on this topic has highlighted the need for a reliable and valid diagnostic classification system to identify TMD cases, including specific subtypes.[1–3] In particular, the National Institutes of Health Technology Assessment Conference Statement on the Management of Temporomandibular Disorders released in 1996 articulated the need for epidemiological and experimental studies to determine the etiologic mechanisms of and risk factors for TMDs.[4] Results from such studies would provide the basis for an etiology-based diagnostic classification system necessary to best facilitate clinical research leading to improved management and treatments for these disorders.

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) presented by Dworkin and LeResche in 1992 provided an important first step towards an etiology-based system.[5,6] This symptom-based system provides well-defined operational definitions to distinguish TMD cases from controls, as well as to diagnose specific TMD subtypes. The RDC/TMD has been used in many epidemiologic and clinical studies of TMDs.

The RDC/TMD Validation Project reported on here has provided the first comprehensive and rigorous assessment of the RDC/TMD's reliability and validity, has considered additional clinical measures, and has presented recommendations for a revised RDC/TMD, including diagnostic algorithms. We have also provided preliminary estimates of the revision's reliability and validity (see the first through fifth papers in this series).[7–11] It is hoped these revised algorithms will better support studies of the natural histories, etiologies, and mechanisms of specific TMDs, as well as clinical trials of specific management strategies, as these are all steps necessary to the evolution of an etiology-based TMD diagnostic system. In the interim we believe that this revised diagnostic classification will also benefit patient care.

The findings from this project have also led us to consider further revision of both Axis I (clinical TMD conditions) and Axis II (pain-related disability and psychological status) assessments. However, we feel that such changes are beyond the scope of the project and require broader input from the TMD clinical, academic, and research communities. To this end, our team is recommending an international symposium be held to consider, deliberate, and reach consensus on additional revisions to the RDC/TMD. This paper outlines issues specific to each axis, as well as broader concerns for future clinical research on TMDs, as the basis for planning such a symposium.

Axis I

Issues related to Axis I include concerns with orofacial pain differential diagnosis, temporomandibular disorder nomenclature, the range and scope of conditions and disorders included in the Axis I taxonomy, and the appropriate standards for acceptable diagnostic sensitivity and specificity in future investigations.

Differentiating TMD from Other Pain Conditions

Distinguishing TMD pain from that of other pain conditions, which may have associated referred pain, hyperalgesia, allodynia and central sensitization presenting in the masticatory region is difficult using the RDC/TMD. In part the revised RDC/TMD shares this limitation with the original, as it was derived and tested using a sample designed to assess the ability of the test to distinguish subjects with varied TMDs from normal subjects. The scope of the study required that we assess the more common TMD disorders described in the original RDC/TMD and therefore our sample was heavily weighted toward these conditions. This is the first research question posed by the STARD statement.[15] The second phase recommended by STARD is to answer the question, "Are patients with specific test results more likely to have the target disorder than similar patients with other test results?" The final answer to the second phase STARD question will require testing in a broader sample with TMD and the less common regional pain conditions. This will also require validated criteria for these other pain conditions.

"For the present our recommendation is that the revised RDC/TMD be used in clinical and research settings after other orofacial pain conditions, including odontogenic sources, have been ruled out. This is consistent with other classification systems such as the ICHD-2 for headaches that arrives at a primary headache diagnosis only after history and physical examination do not suggest any other disorder.[34] The inclusion and exclusion criteria for this project, designed to rule out co-morbid conditions, will be useful to this task.[7] It was previously reported from that the inclusion of items assessing pain with jaw function or movement did not add substantially to the diagnostic accuracy of the revised RDC/TMD in this sample and were not added to the proposed revision (see the 5th paper in the series).[11] However, it is very possible that questions regarding the effect of jaw function and movement on pain may be useful in distinguishing TMD from other orofacial pain conditions. It has also been recognized that a "Comprehensive Pain Description" may be useful.[12] Past efforts using the McGill Pain Questionnaire, also administered as part of the RDC/TMD Validation Project, have suggested some value in distinguishing some orofacial pain conditions such as trigeminal neuralgia.[13,14] This data will be analyzed in the future."

Nomenclature

General agreement within the health care professions regarding diagnostic nomenclature is important to facilitate communication among clinicians and clinical scientists. It is our belief that the field of TMD would benefit from broader clinical use of the RDC/TMD. It has been suggested that dropping the word "research" from the title may encourage broader use by clinicians, i.e., the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD).

In addition, diagnostic nomenclature has important implications for how patients perceive their problems. As nomenclature changes were deemed beyond the scope of this project, the revised RDC/TMD Axis I uses that of the original RDC/TMD Axis I: Clinical TMD Conditions.[11] However, we recognize that the practicing communities of dentistry and medicine have used other terms for these musculoskeletal conditions. We present here other options for consideration.

Group I: Muscle Disorders—Since 1996, the guidelines of the American Academy of Orofacial Pain have included a category of "myalgia," reserved for nonspecific pain of masticatory muscles not meeting specific criteria for "myofascial pain" and other jaw muscle disorders.[16,17] Although trigger points have been described as a criterion for "myofascial pain" by the AAOP and others, reliability in their identification has been limited to κ=0.15–0.50 and even the definition of the phenomenon has not been agreed upon.[18,19] It would seem reasonable to consider using "myofascial pain" to designate the

presence of muscle pain with clinically demonstrated referral (with or without palpable trigger points) and use the term "myalgia" to designate muscle pain without referral. We did collect data on referral patterns elicited with palpation. However, although it has been used in other publications, "myalgia" has not seen broad usage in either dentistry or medicine.[20]

Group II: Disc Displacement—In the RDC/TMD Validation Project studies, imaging revealed that approximately 30% of the normal participants in the study sample had disc displacements with reduction, despite no evident clinical signs or symptoms of the condition. This finding is consistent with other reports in the TMD literature.[21–24] However, 11% of all disc displacements were categorized as disc displacement with reduction with transient limited opening (intermittent closed locking), and 10% were disc displacement without reduction with limited opening. These are stages of disc displacement with obvious impact on masticatory function. In summary, these findings characterize disc displacements with widely varied clinical presentations, from clinically insignificant to important.

An "identifier" or a diagnostic term for those disc displacements that appear to be clinically significant based on functional and mechanical impact would have clinical utility. A term used in the orthopedic, radiologic, and TMD literature is "internal derangement," defined as "an intra-articular mechanical disturbance which interferes with a joint's smooth action."[25] This term has also been used in the practice guidelines of the American Association of Oral and Maxillofacial Surgeons.[26] We suggest that the term "internal derangement" be used in reference to stages of this disorder when disc position has apparent functional and mechanical consequences, including significant deviation with opening, locking, or limited opening. Those disc displacements "with intermittent or transient (closed) locking "[27] and those "without reduction with limited opening" could be designated "internal derangements." In contrast, the term "disc displacement" could designate the benign states when these conditions cannot be detected clinically or have no clinical consequence. Disc displacement "without reduction without limited opening" would also be considered "disc displacement" without clinical consequence. This designation is particularly appropriate in light of the "normal" clinical presentation of this stage of disc displacement.

Group III: Arthralgia, Arthritis, Arthrosis—This diagnostic grouping includes the term "arthralgia" for clinical temporomandibular joint (TMJ) pain. The American Academy of Orofacial Pain has instead used "capsulitis" and "synovitis" for TMJ pain.[16,17] The rheumatologic literature uses the term "arthritis" for clinically evident joint pain with inflammation or swelling.[28] At this time, "capsulitis" and "synovitis" cannot be distinguished with any clinical test. Use of the terminology "arthritis" for TMJ inflammation with coincident joint pain would provide a parallel with medicine. However, our findings suggest that clinical signs of inflammation other than joint pain to palpation and loss of function, e.g., heat, erythema and swelling, are rarely seen in the temporomandibular joint.

The medical literature in the United States commonly uses the term "osteoarthritis," but not "osteoarthrosis."[28,29] Within the context of the RDC/TMD, the 2 terms are used to distinguish degenerative changes with and without pain, respectively. An alternative to "osteoarthrosis/osteoarthritis" is "degenerative joint disease," another commonly used term in both the dental and medical literatures.[26,30,31] As this term does not imply the presence or absence of joint pain, it could be used with a concurrent diagnosis of "arthralgia" when pain is present. This would be parallel to the current RDC/TMD convention in the case of joint pain with Group II: Disc Displacement, which must include a concurrent arthralgia (IIIa) diagnosis when joint pain is present.

Range and Scope of Conditions Included in the Axis I Taxonomy

An inherent tension exists between research diagnostic systems whose primary goal is to be reliable and valid at the expense of being relatively restrictive in scope versus clinical diagnostic systems whose primary goal is to be inclusive at the expense of increased reliance on clinical judgment. This tension also exists between the RDC/TMD and other clinical diagnostic evaluations and taxonomies for TMDs.[32,33] The original RDC/TMD did not provide diagnostic criteria for many of the less common masticatory muscle or TMJ disorders; the goal of the RDC/TMD was to provide solid assessment and diagnostic methods for the most common TMDs to serve as a foundation for subsequent expansion. Because the less common TMDs occur at a strikingly lower prevalence compared to the common ones, it was similarly beyond the scope of this project to assess all of the less common TMDs. However, we had an adequate number of participants to assess 7 additional TMDs, including myofascial pain with referral, temporalis tendonitis, disc displacement with reduction with transient limited opening (intermittent locking), TMJ subluxation/luxation, and 3 categories of tension-type headache with pericranial muscle tenderness. The tension-type headaches were classified using the International Headache Society criteria with the addition of temporalis muscle tenderness.[34] This approach would allow systematic investigation of headaches which may be jaw-related. Data to support these 7 TMD diagnoses will be reported in the future.

These additional disorders would expand the RDC/TMD Axis I to 12 clinical TMD conditions, as well as 3 types of tension-type headache. “Myofascial pain with referral” could be designated I.c. and “temporalis tendonitis” designated I.d. in Group I: Muscle Disorders. “Disc displacement with reduction with transient limited opening” could be classified an “internal derangement” and included in Group II: Disc Displacements. “Subluxation/luxation,” meaning wide-open joint dislocation, could constitute a new diagnostic grouping, Group IV: Temporomandibular Joint Hypermobility. Tension-type headache with pericranial muscle tenderness could provide the basis for an additional grouping, Group V: Tension-type Headache with Temporalis Muscle Tenderness (see Table 1).

Standards for Diagnostic Sensitivity and Specificity in Future Investigations

The original RDC/TMD published in 1992 defined an acceptable threshold for diagnostic validity as a sensitivity level of at least 0.70 and specificity greater than 0.95.[35] The rationale for the high specificity and relatively low sensitivity was that the common TMDs are not associated with mortality and “… can potentially have a high cost of treatment if carried into reconstructive, orthognathic or orthodontic interventions.” Such interventions were treatments in common use at that time. In addition, the effect of the low prevalence of TMDs on sensitivity and specificity was considered in setting the threshold. In general, the standard was an attempt to avoid false-positive diagnoses, i.e., overdiagnosis.[35] These diagnostic concerns also led to the strict inclusion criteria of the original RDC/TMD. As such, each diagnosis was a construct defined by strict operationalization. This strict operationalization was essential to that seminal stage of criteria development, and it paralleled the methodology used to establish taxonomic order for the diagnosis of complex, subjective mental-health disorders.

The advantage of strict inclusion criteria is high specificity, that is, few noncases being diagnosed as cases. The disadvantage is that borderline cases are more likely to be misclassified as normal. A sensitivity level of 0.70 is associated with a false-negative diagnosis rate of 30%, which can be problematic. Despite the low mortality of TMDs, morbidity can be high, with some individuals developing chronic, persistent conditions. “Missed” cases may have consequences over time.

In the years since the RDC/TMD was first presented, low-cost reversible treatments have come to typify the vast majority of clinical care in the field. Numerous studies have demonstrated that patient education, self-care, medications, jaw exercises, and splints can suffice for most TMD patients.[36,37] These treatments have much lower risk clinically and are more economical than many of those used in the past. These 2 factors, current use of more conservative care and the shortcomings of reduced standards for sensitivity, suggest a possible need for increased sensitivity of the RDC/TMD at the expense of some loss in specificity.

Several cut-off points in the criteria measures with their corresponding sensitivity and specificity could be considered for different applications and settings. This is described in the recent STARD statement regarding the reporting of studies of diagnostic accuracy.[15] For example a randomized trial dependent on a homogenous test group could use a cut-off point with lower sensitivity and higher specificity in contrast to the clinical applications described above. However, the morbidity and expense of ensuing treatments should also be considered when false positives and unnecessary treatment is burdensome or harmful to the patient. In conclusion, validation of a diagnostic instrument is an ongoing process and is dependent on the purpose for which it is used.[38]

Axis II

Issues related to Axis II concern the number and character of the constructs that constitute Axis II, improvement in efficiency of screening instruments to make them more acceptable for routine clinical use, interpretation of elevated scores from the nonspecific physical symptoms scale in pain patients, and integration of Axis I and Axis II information as a regular standard of care for the diagnosis, prognosis, and treatment of TMDs. Future efforts to refine Axis II measurement should be based on other ongoing work regarding the diagnosis and management of all chronic pain conditions.[39–41]

Number and Character of Axis II Constructs

The assessment of psychosocial dysfunction with the depression scale in Axis II appears to be a critically important aspect of Axis II; simultaneous with assessing distress, the potential for self-harm is also assessed. The low specificity, however, of the depression screener indicates that further work is needed to improve screener efficiency. Additionally, inclusion of other scales for other purposes into the formal Axis II structure needs to be considered.

A significant problem associated with observational and experimental studies in the field of TMDs has been the lack of standardized outcome measures, which has prevented meaningful comparisons among most TMD clinical trials. This methodological problem has also been an issue for trials examining other chronic pain conditions. This issue was addressed recently with the publication of the Initiative on Methods, Measurement and Pain Assessment in Clinical Trials (IMMPACT).[39,40] IMMPACT developed consensus recommendations for the use of specific outcome measures for core assessment in clinical trials for all chronic pain conditions. These core domains are *(1)* pain assessment; *(2)* physical functioning; *(3)* emotional functioning; *(4)* participant ratings of global improvement and satisfaction with treatment; *(5)* adverse events; and *(6)* participant disposition.[40] These recommendations lead to constructs that should be considered for inclusion in future revisions of RDC/TMD Axis II; measures suitable to address baseline status for a clinical trial (per IMMPACT recommendations) might also be equally suitable for the clinician to use for routine assessment regarding overall patient functioning. The challenge would be to design Axis II such that more comprehensive measurement does not occur at the expense of retaining an efficient screener for psychosocial dysfunction.

Some of the IMMPACT recommendations were already met by the original core constructs of the RDC/TMD Axis II.[5] We have demonstrated adequate reliability and validity of these Axis II constructs in a TMD setting.[10] The original purpose of Axis II was to act as a concise and efficient screener for identifying individuals at risk for behavioral and psychosocial factors that would impact disease progression and treatment response. Nevertheless, we suggest that the additions to Axis II as recommended by IMMPACT would improve assessment of baseline status, progression, and treatment response. Furthermore, adoption of the IMMPACT recommendations for the Axis II assessment would allow for standardization of outcome measures and comparison of TMD treatment outcomes with those of other chronic pain conditions.

The IMMPACT also recommended the use of "disease-specific" outcome measures.[40] For TMDs, this could include assessment of self-reported mandibular function. Axis II assessment may also benefit from the incorporation of additional tests for assessing constructs not included in the IMMPACT recommendations. Among these are the assessment of anxiety, stress, sleep disturbance, and quality of life, all of which have received recent attention in the chronic pain literature.[40] In summary, these changes would define a broader role for Axis II in the assessment of pain and biobehavioral status.

Based on the preceding, we suggest that additional domains for Axis II would be useful to address specific questions in a particular research setting. Table 2 summarizes our suggested changes and provides the core and additional domains, including the change in title for Axis II from "Pain-Related Disability and Psychological Status" to "Pain and Biobehavioral Status," which is consistent with the IMMPACT recommendations.

Improvements in Efficiency of Axis II Instruments to Make Them More Acceptable for Routine Clinical Use

A need for improved efficiency of the Axis II instruments is necessary to enhance their utilization by the practicing and research communities. If Axis II cannot be readily and easily applied, it will not be used. Improved efficiency will also allow for the possibility of enhancing the scope of Axis II as both a screening tool and a monitoring tool.

One aspect of the current NIH Roadmap is the multi-site Patient-Reported Outcomes Measurement Information System (PROMIS), in which one goal is to improve validity simultaneously with reducing length of typical self-report.[41] This should also be a goal for future Axis II development. The replacement of the original function checklist of Axis II with an instrument developed using the same tools as PROMIS is consistent with this goal.[42] For the present, to facilitate increased utilization in clinical settings, we also suggest that the use of at least 3 clinical screening instruments as well as characteristic pain intensity by all clinicians and researchers would allow better characterization of our patients and research cohorts (see Table 2, 2.1 General Screeners (2.1.1–2.1.3) and 2.2.1 Pain Intensity). More importantly, the use of a common nomenclature and assessment beyond clinical diagnoses would improve our ability to better serve and care for those with TMDs and chronic pain conditions.

Interpretation of Elevated Scores for the Nonspecific Physical Symptoms Scale in Pain Patients

The relatively low prevalence of somatoform disorders in their pure presentation, along with the marginal validity for the nonspecific physical symptoms scale (termed "somatization" in the SCL90) in the identification of modified somatoform disorders might lead one to regard a physical symptom checklist as largely irrelevant for assessing individuals with chronic TMD pain.[10] However, the following clinically useful interpretations are possible from the

RDC/TMD nonspecific physical symptoms scale: the presence of widespread pain is a strong predictor of additional pain disorders[43]; central nervous system dysregulation in chronic pain takes the form of increased somatosensory reactivity to any stimuli[44]; and preoccupation with illness and the sick role is a strong factor that retards therapeutic progress.[45] Further investigations regarding the kind of symptom reporting that the nonspecific physical symptoms scale provides are needed before the scale can be more reliably interpreted.

Integration of Axis I and Axis II Information as a Regular Standard of Care

Despite some clinical treatment studies that have focused on the role of psychosocial status in treatment outcome[46–49], the application of the RDC/TMD Axis II in day-to-day clinical decision-making in the practicing community has not been realized. Although the Axis II concepts are helpful in determining prognosis[50], the contribution of Axis I diagnostic status and its interaction with Axis II and their effects on chronicity and long-term disability has yet to be determined. Further studies need to more carefully examine, in particular, physical pathology over time associated with the TMJ and how that pathology interacts with behavior to produce disability or adaptation by the individual patient.

Supplemental Domains of Assessment

The RDC/TMD Validation Project included the collection of additional data beyond that needed for the RDC/TMD. These data represent domains that have previously been presented in the literature as potential markers of TMDs, outcomes of TMD conditions, or possible contributing factors to TMDs. These domains include pressure pain threshold algometry, orthopedic tests, and occlusal characteristics (Table 3).[60–64] Full analyses of data for these domains will be reported in future publications.

Conclusion

We recommend an international symposium be held to consider the issues enumerated here, develop consensus where possible, and further define the future of research in the clinical investigation of temporomandibular disorders. It is important that the process consider the classification systems of clinically-based professional organizations in order to foster the development of a diagnostic system useful to both the research and clinical communities.

The refinement and evolution of the RDC/TMD should support ongoing investigations of TMD etiology and natural history, as well genetic effects on these conditions.[44,65] Such work would facilitate experimental design and use of technology in future attempts to elucidate whether different temporomandibular disorders have different etiologies. These potential applications for the RDC/TMD warrant input from the broader community.

Finally, such a symposium should address the long-standing concerns with the designated collective term for these conditions, “temporomandibular disorders (TMDs).” This nomenclature has been a problem since the introduction of the term “TMD” and continues to the present.[1,4,66,67] In fact, the National Institute of Dental and Craniofacial Research presently uses the term “temporomandibular muscle and joint disorders (TMJD)” on its web page regarding diseases and conditions.[68] This nomenclature issue is important and worthy of broad consensus.

Acknowledgments

Acknowledgement of Validation Project Study Group

The RDC/TMD Validation Study Group is comprised of: University of Minnesota: Eric Schiffman (Study PI), Mansur Ahmad, Gary Anderson, Quentin Anderson, Mary Haugan, Amanda Jackson, Pat Lenton, John Look, Wei Pan, Feng Tai; University at Buffalo: Richard Ohrbach (Site PI), Leslie Garfinkel, Yoly Gonzalez, Patricia Jahn, Krishnan Kartha, Sharon Michalovic, Theresa Speers; and University of Washington: Edmond Truelove (Site PI), Lars Hollender, Kimberly Huggins, Lloyd Mancl, Julie Sage, Kathy Scott, Jeff Sherman, Earl Sommers. Research supported by NIH/NIDCR U01-DE013331.

References

1. Laskin, D.; Greenfield, W.; Gale, E.; Rugh, J.; Neff, P.; Alling, C., et al., editors. The President's Conference on the Examination, Diagnosis and Management of Temporomandibular Disorders. Chicago: American Dental Association; 1983.
2. Sessle, BJ.; Bryant, PS.; Dionne, RA., editors. Temporomandibular Disorders and Related Pain Conditions. Seattle: IASP Press; 1995.
3. Fricton, JR.; Dubner, R., editors. Advances in Pain Research and Therapy: Orofacial Pain and Temporomandibular Disorders. New York: Raven Press; 1995.
4. Management of temporomandibular disorders. National Institutes of Health Technology Assessment Conference Statement. J Am Dent Assoc. 1996; 127:1595–1606. [PubMed: 8952234]
5. Dworkin, SF.; LeResche, L., editors. J Craniomandib Disord Facial Oral Pain. Vol. 6. 1992. Research Diagnostic Criteria for Temporomandibular Disorders: review, criteria, examinations and specifications, critique; p. 301-355.
6. DeRouen, T. Statistical and methodological issues in temporomandibular disorder research. In: Sessle, BJ.; Bryant, PS.; Dionne, RA., editors. Temporomandibular Disorders and Related Pain Conditions. Seattle: IASP Press; 1995. p. 459-465.
7. Schiffman EL, Truelove EL, Ohrbach R, Anderson GC, John MT, List T, et al. Assessment of the validity of the Research Diagnostic Criteria for Temporomandibular Disorders: overview and methodology. J Orofac Pain. Submitted.
8. Look JO, John MT, Feng T, Huggins KH, Lenton PA, Truelove EL, et al. Research Diagnostic Criteria for Temporomandibular Disorders: reliability of Axis I diagnoses and selected clinical measures. J Orofac Pain. Submitted.
9. Truelove E, Pan W, Look JO, Mancl L, Ohrbach R, Velly A, et al. Research Diagnostic Criteria for Temporomandibular Disorders: validity of Axis I diagnoses. J Orofac Pain. Submitted.
10. Ohrbach R, Turner JA, Sherman JJ, Dworkin SF. Psychometric properties of the RDC/TMD measures. J Orofac Pain. Submitted.
11. Schiffman EL, Ohrbach R, Truelove E, Tai F, Anderson GC, Pan W, et al. Research Diagnostic Criteria for Temporomandibular Disorders: development of revised Axis I diagnostic algorithms and preliminary estimates of validity. J Orofac Pain. Submitted.
12. Goulet, JP.; Palla, S. The path to diagnosis. In: Sessle, BJ.; Lavigne, GJ.; Lund, JP.; Dubner, R., editors. Orofacial Pain: From Basic Science to Clinical Management. Chicago: Quintessence; 2008. p. 135-143.
13. Türp JC, Kowalski CJ, Stohler CS. Pain descriptors characteristic of persistent facial pain. J Orofac Pain. 1997; 11:285–90. [PubMed: 9656903]
14. Türp JC, Kowalski CJ, Stohler CS. Generic pain intensity scores are affected by painful comorbidity. J Orofac Pain. 2000; 14:47–51. [PubMed: 11203737]
15. Bossuyt PM, Reitsma JB, Bruns DE, Gatsonsi CA, Glasziou PP, Irwig LM, et al. The STARD statement for reporting studies of diagnostic accuracy: explanation and elaboration. Ann Intern Med. 2003; 138:W1–W12. [PubMed: 12513067]
16. The American Academy of Orofacial Pain. Orofacial Pain. In: Okeson, JP., editor. Guidelines for Assessment, Diagnosis, and Management. Chicago: Quintessence; 1996.
17. The American Academy of Orofacial Pain. Orofacial Pain. In: De Leeuw, R., editor. Guidelines for Assessment, Diagnosis, and Management. Chicago: Quintessence; 2008.
18. Myburgh C, Larsen AH, Hartvigsen J. A systematic, critical review of manual palpation for identifying myofascial trigger points: evidence and clinical significance. Arch Phys Med Rehabil. 2008; 89:1169–1176. [PubMed: 18503816]

19. Tough EA, White AR, Richards S, Campbell J. Variability of criteria used to diagnose myofascial trigger point pain syndrome- evidence from a review of the literature. Clin J Pain. 2007; 23:278–286. [PubMed: 17314589]
20. Gonzalez, YM.; Mohl, ND. Masticatory muscle pain and dysfunction. In: Laskin, DM.; Greene, CS.; Hylander, WL., editors. TMDs: An Evidence-Based Approach to Diagnosis and Treatment. Chicago: Quintessence; 2006. p. 255-269.
21. Kircos LT, Ortendahl DA, Mark AS, Arakawa M. Magnetic resonance imaging of the TMJ disc in asymptomatic volunteers. J Oral Maxillofac Surg. 1987; 45:852–854. [PubMed: 3477621]
22. Katzberg RW, Westesson PL, Tallents RH, Drake CM. Anatomic disorders of the temporomandibular joint disc in asymptomatic subjects. J Oral Maxillofac Surg. 1996; 54:147–153. [PubMed: 8604061]
23. Tasaki MM, Westesson PL, Isberg AM, Ren Y-F, Tallents RH. Classification and prevalence of temporomandibular joint disk displacement in patients and symptom-free volunteers. Am J Orthod Dentofac Orthop. 1996; 109:249–262.
24. Larheim TA, Westesson PL, Sano T. Temporomandibular joint disk displacement: comparison in asymptomatic volunteers and patients. Radiology. 2001; 218:428–432. [PubMed: 11161157]
25. Adams, JC.; Hamblen, DL. Outline of Orthopedics. 11. Edinburgh: Churchill Livingstone; 1990.
26. American Association of Oral and Maxillofacial Surgeons. Parameters and Pathways: Clinical Practice Guidelines for Oral and Maxillofacial Surgery (AAOMS ParPath 01). 2001.
27. Stegenga B, de Bont LGM, Boering G. Classification of temporomandibular joint osteoarthrosis and internal derangement. Part II: specific diagnostic criteria. Cranio. 1992; 10:107–117. [PubMed: 1423667]
28. Arthritis Foundation. Primer on Rheumatic Diseases. 12. Atlanta: Arthritis Foundation; 2001.
29. Altman RD. Criteria for classification of clinical osteoarthritis. J Rheumatol Suppl. 1991; 18:10–12. [PubMed: 2027107]
30. Haskin CL, Milam SB, Cameron IL. Pathogenesis of degenerative joint disease in the human temporomandibular joint. Crit Rev Oral Biol Med. 1995; 6:248–277. [PubMed: 8785264]
31. Brosseau L, Yonge KA, Robinson V, Marchand S, Judd M, Wells G, et al. Thermotherapy for treatment of osteoarthritis. Cochrane Database Syst Rev. 2003; (4):CD004522. [PubMed: 14584019]
32. Clark GT, Delcanho RE, Goulet JP. The utility and validity of current diagnostic procedures for defining temporomandibular disorder patients. Adv Dent Res. 1993; 7:97–112. [PubMed: 8260017]
33. The American Academy of Orofacial Pain. Orofacial Pain. In: De Leeuw, R., editor. Guidelines for Assessment, Diagnosis, and Management. Chicago: Quintessence; 2008. p. 142
34. Headache Classification Subcommittee of the International Headache Society. Cephalalgia. 2. Vol. 24 . 2004. The International Classification of Headache Disorders; p. 9-160.
35. Widmer, CG. Review of the literature: reliability and validation of examination methods. In: Dworkin, SF.; LeResche, L., editors. Research Diagnostic Criteria for Temporomandibular Disorders: review, criteria, examinations and specifications, critique J Craniomandib Disord: Facial Oral Pain. Vol. 6. 1992. p. 318-326.
36. Al-Ani MZ, Davies SJ, Gray RJM, Sloan P, Glenny AM. Stabilisation splint therapy for temporomandibular pain dysfunction syndrome. Cochrane Database Syst Rev. 2004; (1):CD002778. [PubMed: 14973990]
37. Truelove E, Huggins KH, Mancl L, Dworkin SF. The efficacy of traditional, low-cost and nonsplint therapies for temporomandibular disorder: a randomized clinical trial. J Am Dent Assoc. 2006; 137:1099–1107. [PubMed: 16873325]
38. Portney, LG.; Watkins, MP. Foundations of Clinical Research: Applications to Practice. 2. Upper Saddle River, NJ: Prentice Hall Health; 2000. p. 107-108.
39. Turk DC, Dworkin RH, Allen RR, Bellamy N, Brandenburg N, Carr DB, et al. Core outcome domains for chronic pain clinical trials: IMMPACT recommendations. Pain. 2003; 106:337–345. [PubMed: 14659516]

40. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain. 2005; 113:9–19. [PubMed: 15621359]
41. Rose M, Bjorner JB, Becker J, Fries JF, Ware JE. Evaluation of a preliminary physical function item bank supported the expected advantages of the Patient-Reported Outcomes Measurement Information System (PROMIS). J Clin Epi. 2008; 61:17–33.
42. Ohrbach R, Larsson P, List T. The jaw functional limitation scale: development, reliability and validity of 8-item and 20-item versions. J Orofac Pain. 2008 In press.
43. Macfarlane GJ. Looking back: developments in our understanding of the occurrence, aetiology and prognosis of chronic pain 1954–2004. Rheumatology. 2005; 44(Suppl 4):iv23–iv26. [PubMed: 16306478]
44. Diatchenko L, Nackley AG, Slade GD, Fillinigim RB, Maixner W. Topical review: idiopathic pain disorders pathways of vulnerability. Pain. 2006; 123:226–230. [PubMed: 16777329]
45. Dworkin SF. Illness behavior and dysfunction: review of concepts and application to chronic pain. Can J Physiol Pharmacol. 1991; 69:662–671. [PubMed: 1863918]
46. Dworkin SF, Turner JA, Mancl L, Wilson L, Massoth D, Huggins KH, et al. A randomized clinical trial of a tailored comprehensive care treatment program for temporomandibular disorders. J Orofac Pain. 2002; 16:259–276. [PubMed: 12455427]
47. Dworkin SF, Huggins KH, Wilson L, Mancl L, Turner J, Massoth D, et al. A randomized clinical trial using research diagnostic criteria for temporomandibular disorders-axis II to target clinic cases for a tailored self-care TMD treatment program. J Orofac Pain. 2002; 16:48–63. [PubMed: 11889659]
48. Gatchel RJ, Stowell AW, Wildenstein L, Riggs R, Ellis E. Efficacy of an early intervention for patients with acute temporomandibular disorder-related pain: a one-year outcome study. J Amer Dent Assoc. 2006; 137:339–347. [PubMed: 16570467]
49. Rudy TE, Turk DC, Kubinski JA, Zaki HS. Differential treatment responses of TMD patients as a function of psychological characteristics. Pain. 1995; 61:103–112. [PubMed: 7644232]
50. Garofalo JP, Gatchel RJ, Wesley AL, Ellis EI. Predicting chronicity in acute temporomandibular joint disorders using the Research Diagnostic Criteria. J Amer Dent Assoc. 2007; 129:438–447. [PubMed: 9573694]
51. Melzack R. The short-form McGill pain questionnaire. Pain. 1987; 30:191–197. [PubMed: 3670870]
52. Ohrbach R, Granger CV, List T, Dworkin SF. Pain-related functional limitation of the jaw: preliminary development and validation of the Jaw Functional Limitation Scale. Comm Dent Oral Epidem. 2008; 36:228–236.
53. John MT, Hujoel P, Miglioretti DL, Leresche L, Koepsell TD. Dimensions of oral-health related quality of life. J Dent Res. 2004; 83:956–960. [PubMed: 15557405]
54. Ware, JE.; Snow, KK.; Kosinski, M.; Gandek, B. SF-36 Health Survey: Manual and Interpretation Guide. Boston: The Health Institute, New England Medical Center; 1993.
55. Ware, JE.; Kosinski, M.; Keller, SD. SF-36 Physical and Mental Health Survey Summary Scales: A User's Manual. Boston: The Health Institute, New England Medical Center; 1994.
56. Ware J, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary test of reliability and validity. Med Care. 1996; 34:220–233. [PubMed: 8628042]
57. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28:193–213. [PubMed: 2748771]
58. McNair, DM.; Lorr, M.; Droppleman, LF. Profiles of Mood States. San Diego: Educational and Industrial Testing Services; 1971.
59. Guy, W. DHEW Publication No. ADM 76–338. Washington, DC: US Government Printing Office; 1976. ECDEU Assessment Manual for Psychopharmacology.
60. Ohrbach R, Gale N. Pressure pain thresholds, clinical assessment, and differential diagnosis: reliability and validity in patients with myogenic pain. Pain. 1989; 39:157–169. [PubMed: 2594394]

61. Visscher CM, Lobbezoo F, Naeije M. A reliability study of dynamic and static pain tests in temporomandibular disorder patients. J Orofac Pain. 2007; 21:39–45. [PubMed: 17312640]

62. Lobbezoo-Scholte AM, Steenks MH, Faber JAJ, Bosman F. Diagnostic value of orthopedic tests in patients with temporomandibular disorders. J Dent Res. 1993; 72:1443–1453. [PubMed: 8408888]

63. Lobbezzo-Scholte AM, de Wijer A, Steenks MH. Interexaminer reliability of six orthopaedic tests in diagnostic subgroups of craniomandibular disorders. J Oral Rehabil. 1994; 21:273–285. [PubMed: 8057195]

64. McNamara JA, Seligman DA, Okeson JP. The role of functional occlusal relationships in temporomandibular disorders: a review. J Orofac Pain. 1995; 9:73–90. [PubMed: 7581209]

65. Stohler CS. Craniofacial pain and motor function: pathogenesis, clinical correlates and implications. Crit Rev Oral Biol Med. 1999; 10:504–518. [PubMed: 10634586]

66. Sessle, BJ.; Bryant, PS.; Dionne, RA. Preface. In: Sessle, BJ.; Bryant, PS.; Dionne, RA., editors. Temporomandibular Disorders and Related Pain Conditions. Seattle: IASP Press; 1995. p. xiii-xiv.

67. Laskin DM. Editorial: Temporomandibular disorders: a term past its time? J Amer Dent Assoc. 2008; 139:124–128. [PubMed: 18245672]

68. National Institute of Dental and Craniofacial Research [homepage on the Internet]. Diseases and Conditions. Bethesda: NIDCR; [cited 2008 Feb 20]Available from http://www.nidcr.nih.gov/HealthInformation/DiseasesAndConditions/default.htm

Table 1
Proposed Outline for an Expanded Axis I: Clinical TMD Conditions

Modifications to the original Axis I, including additional diagnostic subgroups and terminology changes, are italicized. **A** designates diagnoses validated by the RDC/TMD Validation Project; **B** designates conditions with analysis in progress, using the RDC/TMD Validation Project data set.

Group I: Muscle Disorders

I.a. Myofascial Pain **A**

I.b. Myofascial Pain with Limited Opening **A**

I.c. Myofascial Pain with Referral **B**

I.d.Temporalis Tendonitis **B**

Group II: Disc Displacements

II.a. Disc Displacement with Reduction **A with imaging**

II.b. Disc Displacement without Reduction without Limited Opening **A with imaging**

II.c. Disc Internal Derangement with Reduction with Transient Limited Opening **B with imaging**

II.d. Disc Internal Derangement without Reduction with Limited Opening **A with imaging**

Group III: Arthralgia/Arthritis/Arthrosis

III.a. Arthralgia **A**/*Arthritis*

III.b. Osteoarthritis **A with imaging**/*Degenerative Joint Disease*

III.c. Osteoarthrosis **A with imaging**/*Degenerative Joint Disease*

Group IV: Temporomandibular Joint Hypermobility

IV.a. Subluxation/Luxation **B**

Group V: Tension-type Headache with Temporalis Muscle Tenderness

- *V.a. Infrequent Episodic Tension-type Headache Involving the Temporalis Muscle* **B**
- *V.b. Frequent Episodic Tension-type Headache Involving the Temporalis Muscle* **B**
- *V.c. Chronic Tension-type Headache Involving the Temporalis Muscle* **B**

Table 2
Proposed Outline for an Expanded Axis II: Pain and Biobehavioral Status

The Axis II instruments are designed to screen for biobehavioral status and pain. They are not diagnostic instruments. Constructs and/or instruments proposed as additions or modifications to the original RDC/TMD are italicized. **A** designates instruments validated for TMD by the RDC/TMD Validation Project; **B** designates measurements with data analysis for TMD in progress; **C** designates instruments validated in other settings; **D** designates proposed instruments fulfilling the recommendations of IMMPACT.

2.1 General Screeners

- 2.1.1 Emotion: Depression (Symptom Checklist 90-Revised [SCL-90-R] derived)[5] **A**
- 2.1.2 Physical Functioning: Pain-related Disability (Graded Chronic Pain Scale [GCPS])[5] **A**
- 2.1.3 *Comorbid Symptoms: Nonspecific physical symptoms (SCL-90-R derived)* **B**
- 2.1.4 *Oral Behaviors Checklist* **B, D**

2.2 Pain

- 2.2.1 Pain Intensity: Characteristic Pain Intensity (from GCPS)[5] **A**
- 2.2.2 *Pain Affect: from Short Form McGill Pain Questionnaire-Revised (SF-MPQ-R)*[51] **B**
- 2.2.3 *Temporal Patterning of Pain: instrument to be developed* **B, D**

2.3 Physical Functioning

- 2.3.1 *Disease-specific Functional Limitation: Jaw Functional Limitation Scale*[32,52] **C, D**
- 2.3.2 *Oral Health-related Quality of Life: Oral Health Impact Profile*[53] **C, D**
- 2.3.3 *Health-related Quality of Life: Short Form (SF)-12 (or SF-36)*[54–56] **B, D**
- 2.3.4 *Sleep: Pittsburgh Sleep Quality Index (PSQI)*[57] **B, D**

2.4 Emotional Functioning

- 2.4.1 *Anxiety, Anger (SCL-90-R derived)* **B, C, D**
- 2.4.2 *General Emotions: Profile of Mood States (POMS)*[58] **C, D**

2.5 Global Status Rating

- 2.5.1 *Patient Global Impression of Change (PGIC)*[59] **C, D**

Table 3

RDC/TMD Supplemental Domains

Data regarding these domains were collected as part of the RDC/TMD Validation Project and are being analyzed. These domains are potential markers, outcomes, or contributing factors of TMDs.

Quantitative Sensory Testing
• Pressure pain threshold algometry
Orthopedic Tests
• Jaw compression, traction, and translation
• Static and dynamic resistance testing
• Clenching provocation tests: with and without interdental objects
Occlusal Features
• Structural occlusion
• Functional occlusion