Vol. 00 No. 00 ■■ 2019

Clinical efficacy of a simplified approach to managing chronic temporomandibular disorders: evidence from a 1-year case series

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Objective. Chronic temporomandibular disorder (cTMD) produces orofacial pain and limited jaw function and impacts on quality of life. A clinical case series of patients referred to a hospital specialist service is described here.

Study Design. In a 1-year consecutive case series of 162 patients with cTMDs, each patient had been managed with self-awareness and jaw exercises, as well as oral appliances. Pain severity and chewing function were scored by using a visual analogue scale (VAS), and quality of life was assessed by using the Oral Health Impact Profile–Temporomandibular Dysfunction (OHIP-TMD).

Results. Females comprised 87% (average age 49 years). Treatment time averaged 20.8 months, and the average pain duration was 2.8 years. The mean VAS pain score fell from 6.9 (standard deviation [SD] 1.6) to 2.0 (SD 1.9) after treatment, giving a "large" effect size of 3.1. Chewing difficulty improvement also showed a "large" effect size (2.5). For the 33 patients for whom longitudinal OHIP-TMD data were available, the mean pretreatment and posttreatment scores of 51.2 (SD 20.9) and 26.2 (SD 17.7) showed a "large" effect size of 1.2.

Conclusions. A simple noninvasive protocol for managing cTMD with self-help, exercises, and oral devices resulted in clinically and statistically meaningful improvements in pain, function, and quality of life. (Oral Surg Oral Med Oral Pathol Oral Radiol 2019;000:1–8)

Temporomandibular disorder (TMD) is a heterogeneous group of musculoskeletal disorders characterized by orofacial pain, accompanied by pain and dysfunction of the masticatory muscles and the temporomandibular joints (TMJs).[1] Signs and symptoms vary but include masticatory muscle and TMJ pain, restricted jaw movement, joint sounds and locking, headache, and otalgia. TMD-related orofacial pain has been reported to occur in 4% to 12% of the population, with signs and symptoms peaking in 20- to 40-year-olds, and with a female-to-male ratio of 2:1. Fewer than 1 in 8 sufferers seek treatment, suggesting that the problem may be self-limiting in some individuals.[2] Progression to severe and/or chronic pain is not common but is associated not only with pain and limited jaw function but also with psychological effects and impacts on quality of life.[3]

The notion of TMD being special dental conditions—as arguably proposed by Prentiss[4] in 1918 —changed over time from the concept of the primary cause being aberrations in oral structures consequent to occlusal effects. There has been increasing evidence that established TMD is not caused by such aberrations or to be viewed in isolation; rather, they result from the interaction among various physical, psychological, and environmental factors.[5] In 1992, and building on the work of Engel,[6] Dworkin et al.[7] proposed a new model for TMD, integrating physical or pathophysiologic features of pain with psychological, social, and cultural influences determining the significance of the painful experience in the individual. In established TMD, this approach shifts understanding of pain expression from the physical change. Accordingly, a dual-axis approach to the classification, assessment, and management of orofacial pain (including TMD) has been developed, with Axis I focusing on the physical diagnosis and Axis II on pain-related disability and psychological status. This Research Diagnostic Criteria for TMD (RDC/TMD) model of Dworkin et al. has now been superseded by the Diagnostic Criteria for TMD (DC/TMD),[8] further expansion of which provides an increasingly comprehensive taxonomy of conditions associated with TMD.[9] Although this detail is invaluable in research, from a practical perspective, these classifications may still be too complex for specific application to a patient presenting to a busy clinic,[10,11] or, as has been stated earlier, "the new DC/TMD is not any more succinct than the RDC/TMD

Statement of Clinical Relevance

Chronic temporomandibular disorders are recommended to be managed in a multidisciplinary manner, but this may not be available in all centers. We discuss an alternative, simplified strategy which was shown to be efficacious in an audit.

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Received for publication Dec 9, 2018; returned for revision May 26, 2019; accepted for publication Jun 7, 2019.

2212-4403/$-see front matter
https://doi.org/10.1016/j.oooo.2019.06.008

and so is likely to remain a research instrument. In time, the DC/TMD may be further refined into a shorter protocol more suited to everyday clinical needs."[12] Development of the DC/TMD continues,[13] but a pragmatic readily applicable scheme for everyday clinical use does not seem to be available yet.

Substantial advances in understanding TMD have arisen from the comprehensive Orofacial Pain Prospective Evaluation and Risk Assessment (OPPERA) project.[14] This has provided strong support for the multifactorial nature of TMD, also emphasizing that the established condition has features in common with several other chronic pain conditions, which may include low back pain, fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome, headache, and interstitial cystitis. The OPPERA work has also found several stronger-than-expected genetic associations with various biologic pathways, supporting the notion of genetic susceptibility to multiple inputs that may contribute to TMD.[15] The OPPERA work continues, investigating not only the sociodemographic and clinical factors that predict TMD, pain amplification, and psychological factors affecting TMD onset and persistence but also the genetic factors influencing the risk of TMD onset and persistence.[16] Persisting TMD is now understood as not including conditions arising from specific pathologic states but comprising multisystem problems with overlapping comorbidities, with physical signs and symptoms, behavioral change, emotional responses, and social interactions, all of which are manifestations of central nervous system dysregulation. Other works on pain perception and processing have pointed to both peripheral and central contributions, resulting in the notion of central sensitization in chronic TMD.[17]

Determining the etiology of TMD remains problematic,[18] and the range of treatments proposed is large.[19] In accordance with clinicians' training and beliefs, management strategies vary enormously in complexity, ease of application, invasiveness, aggressiveness, risks and benefits, cost, and cost-effectiveness. However, studies have shown that regardless of treatment methods, resultant pain relief is more or less equal, with only moderate effect-size differences, even if a particular treatment has been shown to be efficacious.[20]

Multidisciplinary specialist clinic approaches are widely advocated in the management of chronic TMD; however, access to such services can be very limited or even unavailable in some locations. Accordingly, for some time, patients with orofacial pain referred to a hospital specialist service—and there diagnosed with chronic TMD—have been managed by using a simple protocol independent of multidisciplinary clinical services, while still adhering to the "*Primum non nocere*" principle. Patient feedback had been broadly favorable, and the current report presents a case-series analysis and evaluation, with pre- and posttreatment measurements of pain and function, along with oral-health-related quality of life (OHRQoL), the latter undertaken on a subset of patients.

MATERIALS AND METHODS

We reviewed a clinical case series of 162 patients with longstanding orofacial pain (i.e., persistent or intermittent pain lasting longer than 3 months), referred over a 12-month period (September 2015 to September 2016) to the specialist Oral Medicine service at Christchurch Hospital, Canterbury District Health Board, New Zealand. These patients were seen over the study period, either as new or follow-up patients. The patients had been diagnosed with chronic TMD in the clinic according to a summary DC/TMD classification. They were treated by using the normal Canterbury District Health Board protocol, with the treatment goals of reducing pain and improving function and quality of life. We recorded patients' age, sex, medical history, pain descriptors, duration and associated symptoms, Angle classification, palpation sensitivity, and range of motion, along with self-reported bruxism (or clinical evidence of a history of bruxism), and chewing difficulty.

Self-reported pain severity and ability to chew were both measured (using a visual analogue scale) and OHRQoL also recorded. The latter was measured by using the short-form Oral Health Impact Profile-TMD (OHIP-TMD) questionnaire.[21] Not all cases could be assessed by using the OHIP-TMD instrument because it was not available during the earlier stages of data collection. Screening orthopantomography was carried out on all patients. All baseline measurements were repeated at review.

Treatment methods were, in all cases, very simple; that is, all patients received individually prescribed awareness raising and self-help instruction. This included heat application and therapeutic exercises (principally passive and active stretch and isometric exercise), as well as advice on avoiding exacerbating habits, augmented by oral appliance therapy with use of full-coverage flat-plane hard acrylic devices for sleep-time wear. All patients were reviewed at 3-monthly intervals and the treatment concluded when both the clinician and the patient were satisfied with the level of improvement in pain, function, and quality of life, with the proviso that the patient could return, if necessary. The nonresponders who continued with the management program, were given the opportunity to attend a multidisciplinary chronic pain clinic.

After confirmation of the internal consistency reliability of the OHIP-TMD (Cronbach's alpha = 0.85), summated scale scores were computed. Descriptive statistics were generated, and differences among means

were tested for statistical significance by using analysis of variance; observed differences in categorical variables were examined by using χ^2 tests. Differences in OHIP-TMD and pain level scores before and after treatment were analyzed by using Wilcoxon's test. Effect sizes were calculated as the mean change in score divided by the standard deviation (SD) of the mean score at baseline.

RESULTS

Females comprised 87% of the sample, with an average age of 49 years (range 14−90 years); the average age for males was 42 years (range 17−74 years). The elapsed time of treatment averaged 20.8 months (SD 7.3; median 6), indicating that half the patients were seen within 6 months of the initial assessment; the SD of 7.3 suggests that there were a smaller number with quite long follow-up times. Some 83.8% of the cohort was diagnosed with mixed joint/muscle symptoms at baseline and the remaining 16.2% with muscle symptoms alone. No patient in this series presented with only joint symptoms.

Data on the numbers participating in the various assessments are presented in Table I. Self-rated pain assessment had the greatest participation rate, with 162 patients providing pretreatment ratings and 80.6% of patients providing posttreatment ratings. The numbers were a little lower for functional assessment (difficulty with chewing), but the posttreatment assessment rate was higher, at 88%. Pretreatment OHIP-TMD data had been collected for only 28.7% of those with posttreatment data; this was because the instrument itself was not available until relatively late in the collection of data in this case series.

The mean pretreatment visual analogue scale pain score was 6.9 (SD 1.6), and the mean posttreatment score was 2.0 (SD 1.9). The pain duration averaged 2.8 years; there was no association between duration of pain and clinical outcomes. Considering that higher chewing score indicates better function, chewing difficulty pretreatment score was 6.2 (SD 1.1), and posttreatment score was 8.9 (SD 0.7). There was both substantial pain relief and improved jaw function after treatment (Wilcoxon's signed rank test; $P < .05$).

Table I. Overview of numbers in the study, by assessment

Measure assessed	Number
Pain level before treatment	162
Pain level after treatment	131
Difficulty chewing before treatment	149
Difficulty chewing after treatment	132
OHIP-TMD before treatment	33
OHIP-TMD after treatment	33
OHIP-TMD data collected only after treatment	82

OHIP-TMD, Oral Health Impact Profile−Temporomandibular Dysfunction.

The sample's TMD symptom and pain characteristics at baseline are summarized in Table II. Pain in either TMJ was reported by over half, with just under one-quarter reporting it in both joints. Facial pain on either side was reported by more than one-third, with left-side pain being more common among older patients; conversely, bilateral pain (reported by about one-third) was more common in the younger age group. Headache was reported by around 1 in 4, and there were no differences by sex or age group. Although retro-orbital pain was relatively uncommon, ear symptoms were reported by almost two-thirds of patients (and were more commonly reported by females and those in the older age group).

Data on changes in self-rated pain levels and difficulty with chewing are presented in Table III. On average, there was a considerable fall in pain level, with a large effect size. Almost 9 of 10 patients experienced improvement by at least 3 points on the 10-point scale. Improvement in chewing function was almost as significant, with a large effect size and well over half the patients showing improvement by at least 3 points.

In comparing the characteristics of those with longitudinal OHIP-TMD data with and of those who did not have these data are presented in Table IV. There were no systematic differences between them with respect to sex or age group.

The OHIP-TMD data before and after treatment are summarized in Table V. These show large decreases in mean OHIP-TMD score (representing large effect sizes), with the overall change involving halving of the mean score. The largest effect sizes were observed among males and those who were older.

Identification of those who experienced alleviation of pain or improvement in chewing function by 3 or more scale points enabled us to allocate the 99 patients with data on pain and function changes and postoperative OHIP-TMD scores to 1 of 4 categories of improvement (Table VI). Almost 6 of 10 showed improvement in both aspects, whereas 1 in 12 showed none; 3 of 10 showed improvement in chewing only, and the smallest proportion showed improvement in pain only. The highest mean posttreatment OHIP-TMD was seen in those with no change, whereas the lowest was observed in those with improvement in both aspects.

DISCUSSION

This case series analysis supports clinical experience with regard to a simple, minimally invasive approach to management of chronic TMD resulting in good patient outcomes. The more usual approach to chronic TMD management involves specialist multidisciplinary

Table II. Overview of TMD symptom and pain characteristics at baseline characteristics, by sex and age group (brackets contain column percentages unless otherwise indicated)

	Sex		*Age group*		
	Male	*Female*	*9–40*	*41+*	*All*
TMJ pain					
Pain in right TMJ	13 (5)	83 (60.6)	44 (66.7)	52 (55.3)	96 (60.0)
Pain in left TMJ	16 (69.6)	77 (56.2)	38 (57.6)	55 (58.5)	94 (58.5)
Pain in both TMJs	6 (26.1)	31 (22.6)	19 (28.8)	18 (19.1)	37 (23.1)
Facial pain					
Pain on right side	7 (30.4)	54 (39.4)	27 (40.9)	34 (36.2)	61 (38.1)
Pain on left side	10 (43.5)	50 (36.5)	17 (25.8)	43 (45.7)*	60 (37.5)
Pain on both sides	6 (26.1)	45 (32.8)	28 (42.4)	23 (24.5)*	51 (31.9)
Headache					
Right temporal	8 (34.8)	54 (39.4)	30 (45.5)	32 (34.0)	62 (38.8)
Left temporal	9 (39.1)	58 (42.3)	29 (43.9)	38 (40.4)	67 (41.9)
Frontal	5 (21.7)	51 (37.2)	23 (34.8)	33 (35.1)	56 (35.0)
Other symptoms					
Retro-orbital pain	2 (8.7)	20 (14.6)	6 (9.1)	16 (17.0)	22 (13.8)
1+ ear symptoms	10 (43.5)	92 (67.2)	34 (51.5)	68 (72.3)*	102 (63.8)

*$P < .05$.

TMD, temporomandibular disorder; *TMJ,* temporomandibular jaw.

Table III. Pain level and chewing difficulty before and after treatment (brackets show standard deviation [SD] unless otherwise indicated)

	*Pain level/10**	*Difficulty chewing/10**
Number with data for comparison	128	130
Mean pretreatment score (SD)	6.9 (1.6)	6.2 (1.1)
Mean posttreatment score (SD)	2.0 (1.9)	8.9 (0.7)
Mean change in score (SD)	−4.9 (2.1)*	2.7 (1.2)
Effect size	3.1 (“large”)	2.5 (“large”)
Number showing change by 3+ points	112 (87.5%)	79 (60.8%)

*Note that a higher pain score indicates worse pain, whereas a higher chewing score indicates better function.

†$P < .05$; Wilcoxon’s signed rank test.

Table IV. Comparison of cross-sectional and longitudinal OHIP-TMD samples (brackets contain column percentages unless otherwise indicated)

	Cross-sectional sample	*Longitudinal sample*	*Both combined*
Sex			
Male	18 (14.2)	5 (15.2)	23 (14.4)
Female	109 (85.8)	28 (84.8)	137 (85.6)
Age group (years)			
9–40	55 (43.3)	11 (33.3)	66 (41.3)
41+	72 (56.7)	22 (66.7)	94 (58.8)
Total number (%)	**127 (79.4)**	**33 (20.6)**	**160 (100.0)**

clinical services, to which not all centers have ready access; these constraints have prompted the development of empirical management strategies for this hospital clinic, being supported, as far as is able, by the evidence base. The findings presented in this report on apparently simple but effective management strategies suggest that at least some chronic orofacial pain conditions can be dealt with in a less intrusive manner.

This case series analysis was performed in a reasonably large number of cases and shows large effect sizes for improvements in pain, function, and OHRQoL. However, the weaknesses of the study must also be mentioned. First, all cases were assessed and treated by a single clinician, who had not been calibrated formally. Second, the evaluation relied on self-report instruments only, rather than objective clinical observations; however, given that TMD manifests almost entirely symptomatically, there is no other valid way to undertake the assessments. Third, not all participants could be compared by using the OHIP-TMD instrument because it was not available during the early part of the study. Fourth, the follow-up period varied considerably because of clinic schedules; however, the consistent findings suggest that this was not a critical issue. Fifth, the case-series design meant that there were no control patients who did not receive the intervention, and so we cannot definitively state that the observed improvements would not have occurred anyway, even in the absence of treatment. However, the large effect sizes and the consistency in the findings suggest that the treatment was, indeed, effective (although this should be confirmed with a randomized control trial design), but it should be noted that treatment duration was not factored in.

The DC/TMD provides an ever-expanding list of clinical problems that can be associated with the TMJ and associated structures and undergoes continuous revision.[9] The DC/TMD system is complex, however,

Table V. Before- and after-treatment OHIP-TMD scores in the longitudinal OHIP sample, by sex and age group (brackets contain standard deviations unless otherwise indicated)

	Mean OHIP-TMD before treatment	*Mean OHIP-TMD after treatment*	*Mean change in score*	*Effect size*
Sex				
Male	43.2 (16.0)	21.8 (11.6)	−21.4 (15.1)*	1.3 ("large")
Female	52.6 (21.6)	26.9 (18.7)	−25.7 (15.0)*	1.2 ("large")
Age group (years)				
9−40	60.1 (26.0)	34.6 (19.6)	−25.5 (16.1)*	1.0 ("large")
41+	46.7 (16.8)	21.9 (15.5)	−24.8 (14.5)*	1.5 ("large")
All combined	51.2 (20.9)	26.2 (17.7)	−25.0 (14.8)*	1.2 ("large")

*$P < .05$; Wilcoxon's signed rank test.
OHIP-TMD, Oral Health Impact Profile−Temporomandibular Dysfunction.

Table VI. Mean posttreatment OHIP-TMD scores by combined pain-chewing function improvement category, for the 99 patients with data on pain and function changes and postoperative OHIP-TMD scores

	Number (%)	*Mean posttreatment OHIP-TMD score (SD)*
Categorized improvement (by 3+ scale points)		
Neither pain nor chewing	8 (8.1)	41.5 (16.1)*
Pain only	4 (4.0)	36.5 (13.9)
Chewing only	30 (30.3)	38.6 (20.9)
Both improved	57 (57.6)	28.6 (18.4)
All combined	**99 (100.0)**	**33.0 (19.3)**

*$P = .07$.
OHIP-TMD, Oral Health Impact Profile−Temporomandibular Dysfunction.

and can be difficult to use in day-to-day clinical practice. For this series, participants were classified according to the simplified DC/TMD−based scheme, providing categories for chronic pain per se while still allowing recognition of the many "red flag" conditions that may mimic TMD.[22]

There is a well-established association between TMD symptoms, general well-being, and quality of life.[23,24] The OHIP-TMD provides a validated patient-centered, biopsychosocial outcome measure for assessing quality of life in patients with TMD.

The use and mode of action of occlusal appliances (which arguably justifies "dental ownership" of TMD) remains controversial.[25-27] In this study, oral appliances were not used for treating any peripheral or occlusal issues: The latter have long been challenged.[28] Chronic pain is pathologic, with the patient having lost the warning function of nociceptive acute pain, and it is associated with nervous system dysfunction, including sensitization of supraspinal and second-order neurons at the dorsal horn/trigeminal nucleus level, disrupted antinociceptive activity, and genetic vulnerability.[29] There is increasing awareness of the complexity of pain processing producing an individualized neurosignature, characterized by central sensitization and plasticity[30]; there is growing evidence that central sensitization is predominant in many cases.[31,32] For example, recent meta-analyses have demonstrated differences in widespread pressure pain sensitivity in patients with TMD and in controls.[33] Considering genetic susceptibility to chronic TMD, the number of people who would be susceptible to chronic TMD should be similar to published data for chronic pain, at around 20% to 30% (Figure 1). Thus, some patients may not be so susceptible to chronic TMD, and the condition could be self-limiting. Conversely, in a pain-susceptible individual, management to focus exclusively on a peripheral "mechanical" etiology may not be appropriate. Neuroimaging and functional magnetic resonance imaging (fMRI) have allowed for the study of brain signature in chronic TMD.[34] As with several forms of chronic pain (including fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome, headache, and interstitial cystitis), fMRI of TMD sufferers has demonstrated central neural differences, suggesting changes in central neural processing. For some time, there has been evidence that this brain activity can be influenced by altering proprioceptive input by using various methods, including oral appliances.[35-37] It must be emphasized that in this case series, these devices were provided with the anticipation of some impact on central processing and a placebo effect, if any.

The effects of risk factors for chronic TMD are not mutually exclusive, and many questions about the relative effects of the various treatment modalities remain unanswered.[19] Although there is evidence that changing peripheral neural inputs may result in observable changes in fMRI images, it is not clear whether this represents an actual reversal of the central changes seen in chronic pain or partly relates to what happens with oral appliance therapy. Nor is there evidence that in other types of chronic pain, the therapeutic triad of self-awareness, exercises, and altering proprioception gives outcomes as favorable as those reported in this study. Future direction in this field will most probably focus on the lessons learned from the OPPERA and DC/TMD efforts. The OPPERA study was timely and has provided a focus for research and clinical application. That study identified 3 groups of patients with differing genetic predispositions—the first with low pain sensitivity and low psychological distress, the second with higher pain sensitivity, and the third with both higher pain

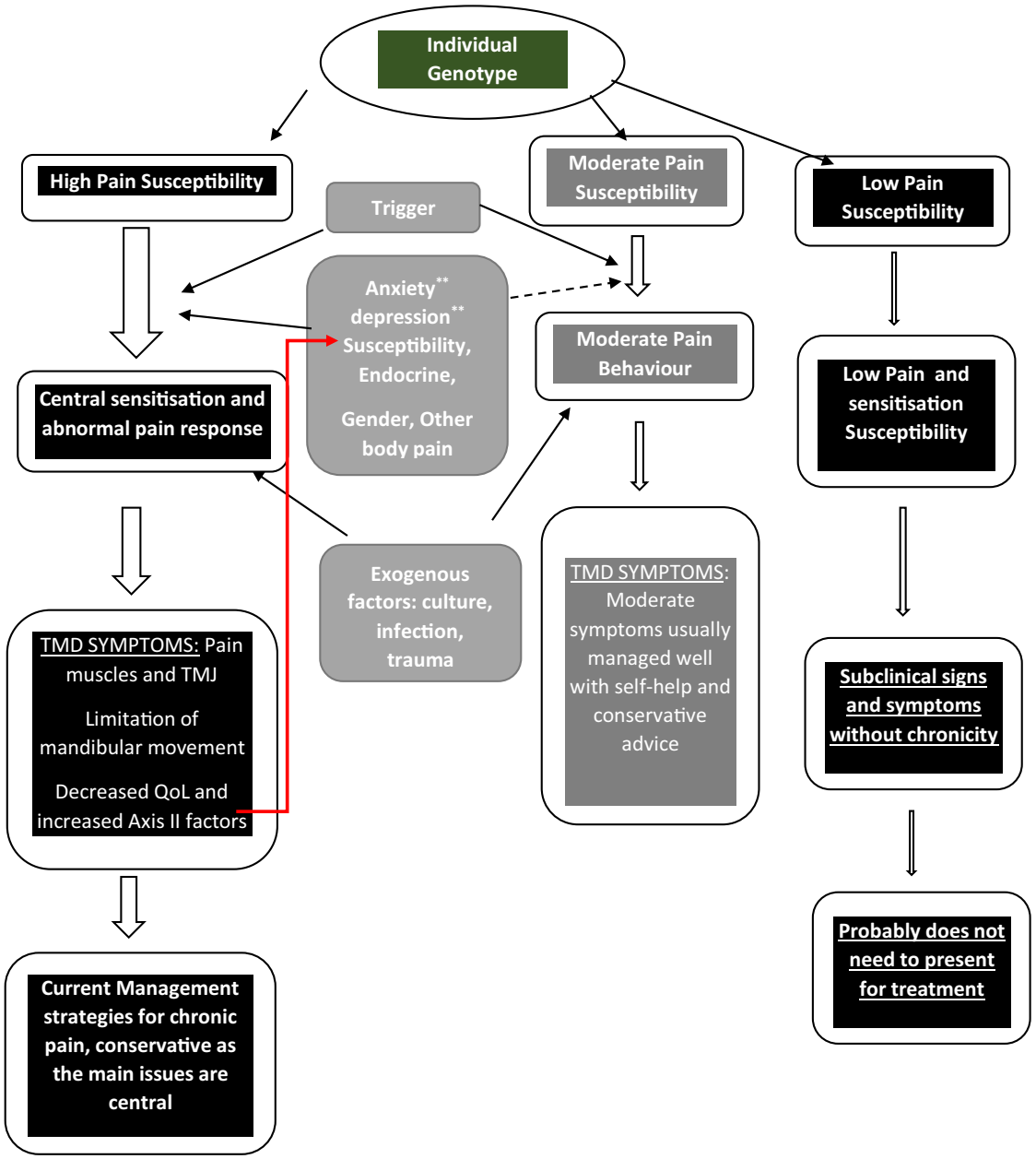

Fig. 1. Summary of risk factors and management pathway.
*Also under genetic control. *QoL*, quality of life; *TMD*, temporomandibular disorder; *TMJ*, temporomandibular joints.

sensitivity and psychological distress.[29] In the future, genetic profiling might identify "at risk" individuals and allow for appropriate pharmacologic interventions. In addition to investigating genetic susceptibility, the OPPERA studies continue to examine factors that promote the transition from acute to chronic TMD. Figure 1 summarizes the multifactorial etiology of chronic TMD, indicating that patient presentations will vary, depending on their susceptibility to the different contributing factors.

The development of effective evidence-based treatments has been frustrated by a lack of understanding of the central and peripheral adaptations and of the psychosocial influences of chronic TMD. Future research in neuroscience, and especially imaging systems, is expected to provide information on the interplay between the central and peripheral mechanisms in TMD and perhaps clarify the role of occlusal appliances in the management.[38,39] In some individuals, persistent peripheral noxious signaling is needed to

sustain centralized pain,[40] whereas in others, it has found that elimination of peripheral inputs leads to global improvement in pain sensitivity.[41] In the context of this report, the central impact of cognitive behavior, physical therapy, and placebo also remains unclear—these are unlikely to be mutually exclusive. The power of the placebo effect must be recognized, as was emphasized by Greene et al.,[42] who presented a checklist of 30 verbal, conditioned, social cues that enhance (and depress) treatment effectiveness. Neuroimaging studies have elucidated certain brain mechanisms underlying the placebo response, which also involves release of endogenous analgesics.[43] Recent studies have elaborated on the genetic basis of molecular mechanisms mediating that placebo response.[44]

It is no longer acceptable or appropriate to regard chronic TMD as a localized orofacial pain condition. A multidisciplinary team approach to the management of chronic TMD is widely advocated, and there is considerable literature on the effectiveness of the various components that might make up such a service. These include patient education and self-care advice, medication, physical therapy, occlusal devices, psychological counseling, biofeeedback, hypnotherapy, acupuncture, and (very occasionally) invasive procedures, such as arthrocentesis. Each entity has its sometimes-vigorous advocates, yet there is not a great deal of information on the overall success rates for the individual patient with chronic TMD treated with such a multimodal approach.[45] In a publicly funded health care system, various constraints can limit access to pain clinic services, which, in an "ideal world," might be readily available. From a practical perspective, a protocol that allows patients to successfully take charge of their own pain management should be cost-effective and resource conserving.[46]

CONCLUSIONS

Although the "one size fits all" approach evaluated in our study could be regarded as simplistic, even naïve, our findings support the effectiveness of a simple protocol for managing patients with TMD and chronic pain through patient education, self-help strategies that increase cognitive awareness, modification of neural inputs (in this series, with oral appliances), and placebo effects, as well as meeting the treatment goals of restoration of function, decreased pain, and improved quality of life. Ideally, randomized control trials should now be conducted to confirm the efficacy of this simple clinical approach compared with other treatment methods to support the recommendation that conservative, reversible treatments should be regarded as first-choice therapy for chronic TMD.

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