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# **Occlusal Splints *for*** **Painful Craniomandibular Dysfunction**



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# Foreword

It is a great challenge for any teacher to write a book with the aim of presenting the theory and practice of a particular dental clinical specialty. To accomplish this task successfully requires extensive clinical experience and excellent knowledge of the scientific principles underlying the specialty. Writers engaging in such an endeavor—like the authors of this book—usually have a clear goal in mind: to improve dental health care, which means making innovations in diagnostics and treatment accessible to dental practitioners.

Achieving this goal is a particular challenge given the subject of this book. Therapy for painful craniomandibular dysfunction (CMD) is a field of dentistry that undoubtedly differs greatly from traditional subjects in dental medicine, such as periodontics, restorative dentistry, or oral surgery. In these subject areas, innovation essentially means adapting clinical procedures to new technologies, such as the use of digital resources. The objective of adaptive processes has hardly changed in the past 100 years: to enhance the mechanical perfection of treatment methods while simultaneously increasing the efficiency and safety of the working materials being used. Generations of dentists in education, research, and practice have pursued this objective—in some cases with great success. This was accompanied by a concentration on the results of mechanical working procedures. Every step toward perfection was regarded as clinical progress. Michael Heners coined the term “technomorphic model of dentistry” for this orientation of dental medicine. Based on this model, the mechanically defined actions of the clinician determine the quality of the dental therapy provided. Accordingly, better dental care can only be achieved by optimizing the dental intervention in terms of technique.

In the past 20 years, the technomorphic model has been greatly modified in all areas of dentistry because research and practice have increasingly focused on the biologic principles of dental activity. Nevertheless, many dentists continue to equate better care with better technique.

The authors of this book confront these attitudes from the outset. Better basic treatment of CMD cases cannot be achieved simply by better technique but by a new way of thinking that places patients, their suffering, and what they tell their dentists center stage. Readers will only succeed in adopting a new and different way of thinking if they can free themselves from conventional, outmoded patterns of activity. This book invites them to do so. It offers those with a professional interest a clear guide to help them address the issue of CMD in theory and practice and provide their CMD patients with the best possible treatment. Great emphasis is placed on the importance of history taking. Recognizing this and drawing the necessary conclusions about diagnosis and treatment are key to the new way of thinking, which makes appropriate clinical decisions possible in CMD cases.

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The book is divided into two parts. The first part presents a practical guide to the basic treatment of CMD patients, while the second builds on that basic knowledge by exploring scientific and theoretical principles in more depth. The two parts complement each other to form a “rounded” and complete picture of the present state of the art. This is why readers are strongly encouraged to study both parts. The second part examines scientific perspectives that not only reveal other courses of action but help interested practitioners to critically evaluate their own experiences.

It is possible to improve the treatment of patients with CMD. This book documents the clinical paths that will lead to a targeted and evidence-based therapeutic approach. It is up to all of us—as members of the dental profession—to seize this initiative and pursue the paths that are laid out for us.

**Prof Dr Winfried Walther**

Director

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Karlsruhe, Germany

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# Preface

The publication of this book might prompt some people to think, “Surely not another book about craniomandibular dysfunction (CMD)!” Although this might, at first sight, be a justifiable reaction, the authors are not aware of an entire book dealing with the subject of occlusal splints that has been published in the past decade.

Yet the times are constantly changing and, in the process, scientific advances are being made that inevitably lead to new discoveries. In the area of functional therapy, this is particularly true of the use of occlusal splints to treat painful CMD. There is often a considerable delay, however, before new knowledge makes its way into dental practices. Regrettably, knowledge transfer tends to take a long time (too long), and several aspects promote and negatively reinforce this situation. Three examples of these delaying factors are worth noting:

1. The preference for personal experience (that is not monitored) rather than evidence-based knowledge derived from scientific studies
2. The fact that, despite the unlimited access at least to abstracts from prominent specialty publications, too little use is made of the opportunities for expanding knowledge through open-access electronic libraries (eg, due to a lack of knowledge about how to research relevant journal articles and how these can be acquired, as well as the fact that major publications are only accessible for a fee)
3. The often poorly defined term “patient satisfaction” being used as a practice-specific measure of “success”

In this context it should be clear that patient-centered clinical decisions can no longer be based solely on the practitioner’s individual clinical experience. Experience is undoubtedly important, but it is not enough for scientifically based practice that is supported by evidence. Instead, knowledge of the current state of the art in clinical research (in the form of published study results) is essential in addition to personal experience.

The values, wishes, and concerns of the patient should be regarded as the third, equally significant pillar. Only when these three aspects are incorporated equally into individual decision making on the course of action can this be called scientifically based (commonly known as “evidence-based”) dentistry. Therefore, evidence-based dentistry automatically includes the aspect of participatory decision making. It can thus claim to be both a beneficial and a self-determined form of medicine. On the other hand, evidence-based dentistry does not mean simply following the recommendations drawn from scientific guidelines or systematic reviews; this would be “cookbook medicine,” which in many instances would not do justice to the individual case.

So much for the principle, now for the “reality.” One of the authors of this book recently gave a rather lengthy lecture on the subject of painful CMD for a continuing education program. After about an hour, one audience member raised his voice to complain angrily that what he had heard was hardly any use to his practical work (it is worth noting that he

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had blissfully slept through a substantial part of the lecture). Partly this angry comment and partly the authors' decades of extensive teaching work prompted a thorough rethink and led to the following conclusions—though not necessarily a new realization:

The classic structure of knowledge transfer, especially in print media, has some serious didactic shortcomings. It is widely accepted that the diagnostic routines and treatment models developed in clinical institutions and specialist centers are barely suited to the reality of dentists' offices. Furthermore, treatment and co-therapy recommendations are frequently reduced to succinct pointers, such as “splint therapy,” “home exercises,” or “education,” without providing any real help as to where, when, and how these recommendations should be carried out. Attentive readers will notice that the present authors are not afraid to broach the subject of (even their own) shortcomings and try hard, whenever possible, to rectify them in this book.

Knowledge and the resulting (potential) clinical benefit to dental practice obviously cannot be transmitted directly, especially since only a few dentists—even in universities, as hard as that is to believe—take advantage of access to the specialist scientific literature during the course of their clinical decision making. Furthermore, the experience and expertise of “professionals,” who process the data to make it “easily digestible” even for non-scientists, are required for others to derive benefit from published research results. In the treatment of painful CMD, there is barely any equivalent to the instructions that are familiar from medicine in terms of directives, guidelines, or clinical recommendations (the compulsory nature of these standards of proper medical treatment decreasing in descending order). Another factor is that the patients included in research studies do not usually represent patients treated in dental practices, who account for around 80% of the general demand for CMD treatment. These distortions of the patient populations naturally lead to misunderstandings between clinicians based in a university setting and office-based practitioners (this aspect is dealt with in more depth in relation to “chronic CMD”). These misunderstandings stand in the way of successful treatment of patients with painful CMD, who for the most part are easily treatable. Dental routines such as minimum diagnostics, therapeutic interocclusal records, affordable fabrication of occlusal splints, physiotherapy, and behavior modification therapy tend to be described with only limited practical applicability. Furthermore, these aspects are all too often burdened with inappropriate instructions, which, in the worst case, lack any scientific foundation and, apart from that, frequently take up unnecessary amounts of time in the dental practice. A particularly serious aspect is that the term “rehabilitation” hardly ever crops up in practical day-to-day treatment. Let us not forget: pain reduction or elimination of pain is the original and primary goal of dental treatments.

Motivated by the deficiencies and shortcomings outlined here, the authors are endeavoring to correct these flaws. To accomplish this, they have chosen to adopt an approach that, contrary to the way textbooks are usually structured, puts the cart before the horse, so to speak. To be precise, the first part of the book (A) starts with a brief overview

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chapter on the subject of painful CMD, then presents clinical instructions at the simplest level but based on a high level of external evidence (cooking recipes without detailed explanations). These recommendations are supported by the minimum of diagnostics and can be followed by direct, affordable laboratory fabrication of the required occlusal splint. Necessary and useful co-therapies are addressed with a brief “When?” and “Why?” “Internal proofs” refer to the expanded scientific basis of the procedure, pointing to the relevant chapters in the second part of the book (B). All the background details about the etiology, advanced diagnostic techniques, neurobiology, and pathophysiology are dealt with solely in part B.

The authors feel sure that this primarily pragmatic approach will enable readers, in a self-organizing manner, to develop their knowledge about treatment for painful CMD—from simply taking the right course of action through to developing a high level of expertise. We hope you will find this a fascinating and instructive read. We always welcome any comments or suggestions you may have.

*“Bene docet, qui bene distinguit.” [He teaches well who distinguishes well.]*

—Horace

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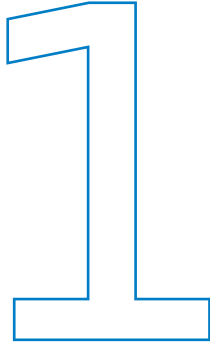
# Part A

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## **Practice of Occlusal Splint Therapy and Coordinative Training**







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# INTRODUCTION

Jens C. Türp

## Craniomandibular Dysfunction

### *Terminology*

Technical terms must be clarified to avoid misconceptions and misunderstandings, especially when describing the factors relating to function. In particular, a distinction must be made between “dysfunction of the masticatory system,” “craniomandibular dysfunction,” and “myoarthropathy of the masticatory system”; these terms should not be considered synonymous. In 2016, the German Society for Functional Diagnostics and Therapy published proposed definitions for these and other important terms for the first time.<sup>1</sup>

### **Dysfunction of the masticatory system**

Dysfunction of the masticatory system refers to a “short- or long-term disturbance of the homeostasis or economy of the masticatory system caused by any structurally or functionally substantiated deviation from normal function, such as functional deficits due to trauma, injury to the structural integrity, and functional/parafunctional stress, including deviations that justify prosthodontic, orthodontic, or surgical measures.”<sup>1</sup>

### **Craniomandibular dysfunction**

Craniomandibular dysfunction (CMD) is classified as “a specific functional disorder that affects the muscles of mastication, the temporomandibular joints (TMJs), and/or the occlusion.”<sup>1</sup> Clinically, CMD encompasses the areas of pain and/or dysfunction.

**Pain** is manifest as:

- Masticatory muscle pain
- TMJ pain
- Toothache of (para)functional origin





**Dysfunction** can appear in the form of:

- Painful or nonpainful limitation of movement of the mandible (aspect aimed at mandibular movements)
- Hypermobility or incoordination of the mandible (aspect aimed at mandibular movements)
- Painful or nonpainful intra-articular dysfunction (aspect aimed at the TMJ)
- Premature contacts interfering with function and gliding obstacles (aspect aimed at the occlusion)

CMD is a collective term that encompasses symptoms not in need of treatment and symptoms that do need treatment. In principle, there is always a need for treatment when pain is present; in the case of dysfunction, the need for treatment is dependent on the severity of the dysfunction.

### **Myoarthropathy of the masticatory system**

Myoarthropathy of the masticatory system (MAP), a term introduced in 1970 by Tübingen dentist Willi Schulte,<sup>2</sup> denotes a subgroup of craniomandibular dysfunction. It refers to symptoms and findings affecting the muscles of mastication, the TMJs, or associated tissue structures; it does not take into consideration the occlusion. This term equates to the term “temporomandibular disorder (TMD).” If pain is involved, these symptoms can be summarized under the heading “myoarthropathic pain.”

### *Etiology*

Numerous mechanisms have previously been held responsible for the etiology of myofascial pains of the muscles of mastication and pains in the TMJs. Nociceptive pain is currently the underlying basis of models for these musculoskeletal symptoms. This nociceptive pain can be triggered by overloading of the tissue and promoted by a number of disposing factors. Microtrauma and local ischemia<sup>3</sup>—together with their structural and functional counterparts, such as activated osteoarthritis,<sup>4</sup> the myofascial trigger point,<sup>5</sup> local muscle fatigue, and aching muscles<sup>6</sup>—essentially serve as overarching pathophysiologic explanatory models. Common to these hypotheses is the assumption that, at the end of the causal chain, afferent nerve fibers and tissue cells release protons<sup>7</sup> and other endogenous algogenic substances (eg, glutamate, substance P, bradykinin, histamine, prostaglandin E, serotonin, potassium ions, adenosine triphosphate) that mediate the excitation and sensitization of nociceptors (group III and IV muscle afferents).

**Modern concepts**<sup>4,8</sup> distinguish between the following influencing factors:

- Predisposing (eg, genetic, structural, systemic, psychologic)
- Initiating (eg, microtrauma, macrotrauma, overloading)
- Sustaining/perpetuating (eg, psychosocial)

The classification into the individual categories is not intended to be rigid. For instance, overload of the sustaining and psychosocial conditions may be the predisposing factor in one patient, whereas the opposite pattern will apply in another patient. It is important to interpret this conceptual framework correctly, in the sense that a single influencing factor is not usually capable of causing musculoskeletal pains.

Meanwhile, there is evidence that endogenous or exogenous substances, such as estrogen,<sup>9</sup> nerve growth factor (NGF),<sup>10</sup> and glutamate,<sup>11</sup> might play a key role in the etiology of painful CMD. The fact that glutamate is able to cause peripheral sensitization without discernible signs of inflammation is extremely important in this context.<sup>11</sup> These new findings have rarely been discussed in the dental literature, but they offer a plausible explanation for the observation, which has long been made and is proven through epidemiologic studies, that females, especially women of child-bearing age, more commonly suffer from myoarthropathic pain than men.<sup>12,13</sup>

### *Epidemiology*

The typical patient with painful CMD is a woman of child-bearing age with pains in the muscles of mastication. Women seek professional assistance because of their symptoms at an overwhelmingly higher rate than men. The more specialized the facility, the higher the proportion of women patients. In university pain centers, the ratio of women to men can be as high as 9:1.

### *Individual Need for Treatment*

The question of whether an individual needs treatment automatically follows from the preceding comments. Traditionally, the range of dysfunction has been widely interpreted in dentistry. In the past, anyone who did not function like an articulator performing symmetric, noise-free movements would have run the risk of being regarded by a dental practitioner as potentially dysfunctional. Fortunately, this view has changed considerably.

### CMD treatment not required

Current thinking is that certain CMD symptoms do not usually require any special (additional) diagnostic investigation and do not need treatment when people are otherwise pain-free:

- *Clicking or popping noises in the TMJs.* The most common cause of TMJ clicking or popping is an anterior position of the articular disc. Clicking or popping noises without other symptoms (pains) are also not an indication for further diagnostics or treatment in the field of orthopedics. Carrying out magnetic resonance imaging for TMJ clicking or popping can thus be viewed as an excessive use of diagnostic tools. If patients report joint pains as well as TMJ noises—if they have painful joint clicking—the pain symptoms, but not the noise, require a more thorough examination and (usually) need treatment. An exception is a very loud clicking or popping of the joints that is not tolerable for the patient and his/her social environment. In this case, the available treatment methods that are indicated need to be fully explored, bearing in mind their particular risk-benefit relationship.
- *Grating noises in the TMJs.* Grating noises in the TMJs are generally a clinical sign of contact between two bone surfaces. However, grating without other symptoms (pain) is not an indication for treatment.
- *Deviation (corrected lateral deviation) of the mandible during mouth opening.*
- *Differences in the extent of maximum laterotrusion to the left and right.* These tend to be more the rule than the exception<sup>14</sup> and reflect the fluctuating asymmetry typical of mammals.
- *Sensitivity on palpation of jaw muscles and/or TMJs detected during a routine functional diagnostic examination.* These areas are not painful during the course of the patient's daily mandibular function.
- *Signs of osteoarthritis on radiographs (dental panoramic radiography).*

All these symptoms, which used to be classified as dysfunctions, are today viewed as a variation from normality. This means the range of normal function—or “eufunction”—has been greatly expanded. Albert Gerber (Zurich) warned as early as 1964 that “not every TMJ that causes discomfort must eo ipso be diseased” and not all discomfort must be treated.<sup>15</sup>

### CMD treatment required

By contrast, further diagnostic investigation and treatment are advisable in certain clinical situations:

- *Painful symptoms in the area of the jaw muscles and/or TMJs.* Pains reported by patients must always be taken

seriously. As a general rule, pain-related information provided by patients must not be doubted in terms of its veracity. This is especially true of the maxillofacial area, since it is extremely unlikely that pains in this area will result in early retirement—unlike back pains, for example. Pains in the region of the jaw muscles or in one or both TMJs are the key symptom in more than 90% of dental patients with painful CMD—and not a reduced range of mandibular movement or TMJ noises. However, a large proportion of patients with myoarthropathic pains do not consult a clinician for treatment. Anxiety about their existing problems is an important factor in whether patients decide to have their symptoms investigated and, if necessary, get therapeutic assistance. Pains in the muscles of mastication and/or TMJs are accompanied by a distinct limitation of the range of mandibular movement in rare cases. Pain-induced repositioning of the mandible (relieving posture) can cause changes in the occlusion of the teeth (premature contacts), which patients may find very disturbing, especially in the case of acute malocclusion.

- *Reduced range of mandibular movement, which usually affects maximum mouth opening.* Limitations of movement are noticeable to some extent on laterotrusion and protrusion of the mandible but far less frequently than during mouth opening. In patients with painful CMD, there are basically two reasons for limited movement of the condyles of the mandible:

1. Mechanical obstacle in one or both TMJs caused by anterior, medial, or lateral displacement of the articular disc or by adhesions in the joint.
2. Reflex adaptation of mandibular movement (“splinting effect”) resulting from pains in the area of the jaw muscles and/or TMJs; the wider the mouth is opened, the greater the intensity of the pain. Voluntary limitations of mandibular movement in terms of a relieving posture can be interpreted as an adaptive mechanism under reflex control that aims to relieve the existing pains and protect the affected anatomical structures.

There is a generally recognized threshold beyond which it is possible to talk of limited mouth opening (= sum of vertical overbite and maximum interincisal distance). The commonly quoted value of 40 mm (or 38 mm in women) is by no means generally accepted as the threshold between “limited” and “not limited.” Essentially, a certain tolerance should be applied to any threshold because the maximum mouth opening possible with identical rotation in the condyles is dependent on the length of the mandibular body. However, dental practitioners must carry out further diagnostic measures in the following cases:

- Limitations of the range of mandibular movement reported by the patient
- Continuous reduction of maximum mouth opening lasting a period of a few days, weeks, or months
- Measured mouth opening of less than 35 mm (clinical rule of thumb)

In these cases, a careful diagnostic investigation (including imaging techniques) is needed to exclude causes other than CMD, especially tumors. A tumor should be suspected until it has been disproved with absolute certainty. It should also be borne in mind that non-neoplastic changes, such as scleroderma and undetected mandibular fractures, can cause limited mouth opening.

It is primarily the patient, not the dentist, who gauges whether diagnosis and treatment are required in a case of painful CMD—unlike with caries or periodontal diseases, for which the dental practitioner usually decides on the need for treatment. This is why screening tests, which aim to identify and treat subclinical, prepathologic dysfunctions, should be viewed as unjustified excessive diagnostics in people who are subjectively symptom-free. This does not mean to detract from the value of carrying out (simple) functional diagnostics prior to major therapeutic interventions for prosthodontics, oral surgery, or orthodontics.

During and/or after examination, the symptoms that have been observed or are troubling the patient must be explained in a one-to-one conversation, based on up-to-date, reliable information that the patient will understand. This applies as well to symptoms that do not require treatment. The patient should be told about the probable cause of the symptoms and whether or not further diagnostic tests and treatment will be required. A useful approach is to draw an analogy for the patient between muscles of mastication and back muscles, and between TMJs and the lumbar spine. In cases of normal variation, patients should also be told what diagnostic and therapeutic measures are not required (according to the most current information) but which might be proposed and carried out elsewhere. Armed with this knowledge, they will be able to argue against such proposals.

### *Diagnoses and Classifications*

To address the lack of standardized diagnostic and classificatory criteria for differentiating myoarthropathies, internationally renowned experts presented a new system of diagnosis and classification in 1992<sup>16</sup> that, despite some shortcomings, quickly gained a high degree of international recognition. The name of the system—Research Diagnostic Criteria for Temporomandibular Disorders, RDC/TMD for short—indicates that it was originally developed for clinical

trials for research purposes. However, it was soon applied in daily practice, often in a less strict form. RDC/TMD enables diagnostic measures and diagnoses to be standardized in a field previously characterized by inaccurate information and systems that were not comparable to each other. In 2014, the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) were published as a further refinement.<sup>17</sup> In both systems, diagnostics and classification are spread over two areas, which are designated as Axis I and Axis II.

#### **Axis I**

Axis I covers the somatic diagnoses (Table 1-1). These are based on information provided by the patient who is consulting a dentist with symptoms affecting the masticatory system and on the results of the clinical examination. The results of a clinical examination are not sufficient to make the somatic diagnoses. What is more decisive is what the patient tells the dentist when complaining of pain, limited mouth opening, or loud noises in the TMJs. The DC/TMD, like the RDC/TMD, distinguishes between pain-related and pain-unrelated diagnoses that arise during the assessment of a patient.

However, as the category-based diagnoses have no implications for therapy, it is usually sufficient in working practice to make the following diagnostic distinctions:

- Myalgia (of the relevant muscle or muscles)
- Arthralgia (of one or both TMJs)
- (Anterior) position (displacement) of the articular disc (with or without reduction)
- Limitation of the mandibular range of movement (maximum mouth opening)

It should be stressed that a patient who, for instance, exhibits tender masseter muscles on palpation of masticatory muscles during a routine functional assessment but finds that the muscles never hurt during daily functioning would not be given a diagnosis of “myalgia of both masseters” but merely “sensitivity on palpation of both masseters.”

#### **Axis II**

Axis II comprises (mostly pain-related) psychosocial parameters, such as depression, anxiety, distress, negative stress management strategies, tendency to somatization, catastrophizing, and impairment in activities of daily living. It is currently regarded as the diagnostic standard to take into account the patient’s pain-associated psychosocial well-being. To do this, it is helpful to use validated filtered questionnaires (see chapter 2). The psychosocial findings, like the somatic diagnoses, have direct and distinctive implications for treatment.

**Table 1-1** Somatic diagnoses of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), which are not compatible with each other

	RDC/TMD (1992)	DC/TMD (2014)
<b>Pain-related diagnoses</b>	Myofascial pain	Myalgia
	Myofascial pain with limited mouth opening	Local myalgia
	Arthralgia	Myofascial pain
	Activated TMJ osteoarthritis	Myofascial pain with referral
		Arthralgia
		Headache attributed to TMD
<b>Pain-unrelated diagnoses</b>	Disc displacement with reduction	Disc displacement with reduction
	Disc displacement without reduction on mouth opening, with limited mouth opening	Disc displacement with reduction and intermittent locking
	Disc displacement without reduction, without limited mouth opening	Disc displacement without reduction, with limited mouth opening
	TMJ osteoarthritis	Disc displacement without reduction, without limited mouth opening
		Degenerative joint disease
		Subluxation

## Diagnostics

### History taking

Taking a CMD-related history forms the essential basis of the diagnostic process. It is a self-contained dental service and is regarded as more important than the subsequent clinical examination of the patient.<sup>18</sup> History taking consists of a medical interview tailored to the particular case history of a patient. To standardize patient details, it is also advisable to use validated filtered questionnaires for assessing the psychosocial impairment of patients suffering from pain.

Immediately before first contact with the treating clinician, it is a good idea for (potential) CMD patients to complete a questionnaire about any functional impairments in their masticatory system; this also contains questions about nonpainful findings. For most patients, however, pain plays an important, if not the major, role. The official definition of pain from the International Association for the Study of Pain (IASP) is “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”<sup>19</sup>

The subsequent discussion of a patient’s pain history picks up relevant answers in the questionnaire and should cover the following areas:

- Main complaints
- Localization of the pain
- Onset of the pain
- Duration of the pain
- Frequency of the pain
- Quality of the pain
- Intensity of the pain
- Factors influencing the pain
- Accompanying symptoms
- Previous treatments
- Patient’s expectation of treatment

Patients should also be asked about psychosocial stress factors before and at the time their pain starts. An appropriate way of assessing the degree of emotional stress is to approach the matter via an “imaginary third person,” which often makes it easier for patients to cope with the



conversation taking an unexpected turn. For instance, the dentist might say: “A lot of patients who have the same kind of symptoms say that ... Is that your experience as well?”

The use of other diagnostic record forms, which patients complete in the dental practice or at home before or after their first dentist-patient contact, is suitable for diagnosing patients with persistent orofacial pain. Pains of this kind are not long-lasting acute pains, but they obey their own rules, which is why more intensive diagnostic investigation is required.

The following tools have proved valuable:

- Pain questionnaire
- Graded Chronic Pain Scale (GCPS)<sup>20</sup>
- Depression anxiety stress scales (eg, the German DASS<sup>21</sup>)

It is particularly important to ask patients about any pains that are localized outside the facial area. Patients who consult their dentist will not normally mention pain occurring outside the jaw region unless they are asked. However, recognition of localized pain or widespread pain makes a big difference to the treatment strategy as well as the prognosis. Patients can even be given this part of the form to complete before the first consultation. To help them record any such pain, the questionnaire includes the outlines of a human figure seen from the front, back, and both sides. Patients are asked to mark all the topographic regions in which they typically experience pain. The result from a clinical point of view is that the pain drawings often provide more information than that obtained from panoramic radiographs in CMD patients. If anything, there is a risk with imaging that normal variations are erroneously interpreted as being linked to clinical signs and symptoms.

A pain history enables a working diagnosis to be made, which is confirmed in many cases during the subsequent examination, but it may also be modified to some extent.

In view of the subjective nature of pain and variables accompanying pain, which can be described by sufferers verbally and/or in writing mainly with questionnaires, some therapists occasionally assume that patients' descriptions are “soft” data. In terms of their quality and significance, these are seen as less valuable than “hard” data obtained from clinical, imaging, and instrumental investigations. However, this view is mistaken because the opposite is often the case: Ideally, the investigations performed after the pain history has been taken merely serve to confirm or modify the diagnosis.

### Clinical examination

Elements of the clinical examination include the following:

- Measurement of the range of mandibular movement (condylar movement with simultaneous assessment of the presence of joint noises; maximum mouth opening; maximum laterotrusion and protrusion of the mandible). It is advisable to use a ruler marked in millimeters to numerically record the range of mandibular movement; the ruler must start immediately at one end with the 0-mm mark.
- Palpation of the palpable muscles of mastication (temporalis, masseter) and the TMJs. Use of a pressure algometer enables clinicians to standardize this examination.
- Occlusal examination. This particularly involves checking for the presence of occlusal contacts in maximum intercuspatation and any changes to the dental hard tissues that have occurred (areas of attrition and abfraction) as evidence of teeth grinding or jaw thrusting.

The findings of the clinical examination are documented on a standardized record form.

### Imaging

In principle, a dental panoramic radiograph, also known as an orthopantomogram (OPG or OPT), should be taken during the diagnosis of patients with symptoms of painful CMD. In view of the concerns patients frequently express over radiographic procedures, it is worth mentioning the favorable risk-benefit ratio given the relatively low radiation exposure of panoramic radiographs. The main purpose of a panoramic radiograph lies in differential diagnosis. Furthermore, it reveals gross morphologic changes in the TMJs, although these changes often have no pathologic significance. The radiographic findings generally play much less of a role than the results of the clinical examination when making the diagnosis and deciding whether CMD patients require treatment.

The use of advanced imaging—primarily cone beam computed tomography (CBCT) and magnetic resonance imaging (MRI)—following pain-focused history taking, clinical examination, and the availability of a recent panoramic radiograph—is reserved for cases in which the anticipated findings of further imaging techniques are likely to have a clear relevance in terms of clarifying the diagnosis and the resulting treatment or prognosis. Such relevance exists if the individual's signs and symptoms or the examination findings cause the clinician to consider in differential diagnostic terms (for the purpose of exclusion or differentiation) diagnoses that may have specific and, in some cases, irreversible therapeutic consequences. Relevance can also apply if the signs and symptoms or the examination findings cannot be satisfactorily influenced despite the initiation of conservative, reversible

therapeutic measures. By contrast, clear relevance does not exist if the findings from the advanced imaging would have no implications for the diagnosis being made and the treatment being adopted but are only being gathered together with other data in the sense of “bulk screening.”

## Treatment

A number of treatment methods are available for patients with the different facets of painful CMD. However, the level of evidence is not high for all of these methods. In this age of evidence-based medicine, unchecked personal experience and advice from recognized authorities that is given without proof is no longer sufficient for patient-centered decision making. Instead, evidence of the benefit of prospective intervention(s) is required. The evidence largely comes from results and findings gained from clinical trials and published in specialist journals.

**Modern treatment of painful CMD** is characterized by an interdisciplinary and multimodal approach, which is always guided by the severity of the symptoms in the individual patient. For instance, a clear distinction must be made between acute, acute persistent, and chronic pains. Painful CMD is a regional variant of musculo-skeletal discomfort that can be found in other parts of the body. Contemporary diagnostics and treatment of painful CMD are therefore based on proven medical concepts.

Treatment recommendations from well-known professional associations suggest that reversible therapies are preferable to invasive interventions.<sup>22-25</sup> The risk-benefit ratio of the available treatment methods must always be considered.

Oral splints are the most commonly used method for CMD treatment in dentistry. Their pain-reducing effect is proven, irrespective of the design and material used.<sup>26</sup> The Michigan splint is regarded internationally as the gold standard because of its favorable risk-benefit ratio<sup>27</sup>; it is also the most widely used type of splint worldwide.<sup>28</sup>

Furthermore, there is a high level of external evidence for physiotherapy self-treatment<sup>29</sup> and drug therapy (eg, nonsteroidal anti-inflammatory drugs taken for a few days for TMJ pains; a few months' administration of low-dose tricyclic antidepressants for persistent pains).<sup>30,31</sup> In addition, physical therapy and professional physiotherapy,<sup>32</sup> muscle-relaxing techniques (including biofeedback and behavioral therapy),<sup>33,34</sup> and acupuncture<sup>35,36</sup> are recommended, even though the degree of efficacy of these methods has been only partly qualified in recent studies.<sup>37,38</sup> The

listed treatment methods should not be selected based on an either/or decision but should be used in a multimodal way depending on the particular case, especially in complex cases.<sup>39</sup>

Dentists who wish to care for the whole range of patients with painful CMD would be wise to build up a network of colleagues from other professional spheres so that they can act skillfully and quickly when necessary. This includes:

- *Physiotherapy.* It is important to ensure that the physiotherapist is very knowledgeable about treatment of the facial region.
- *Pain psychotherapy.* Look online for certified therapists in your local area who offer specialized pain psychotherapy.

Moreover, making contact with the patient's family doctor before treatment is strongly recommended, especially in cases that have become chronic. Other disciplines, such as orthopedics; rheumatology; pain medicine; neurology; or ear, nose, and throat (ENT) medicine, should also be involved in the treatment when necessary.

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