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Department of Stomatology

Doctorate Program in Clinical Medicine and Public Health

TEMPOROMANDIBULAR DISORDERS, WELL-BEING, AND BRUXISM IN PATIENTS WITH FIBROMYALGIA. EFFECT OF TREATMENT WITH OCCLUSAL SPLINTS

International Doctoral Thesis

Autor

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TRASTORNOS TEMPOROMANDIBULARES, BIENESTAR Y BRUXISMO EN PACIENTES CON FIBROMIALGIA. EFECTO DEL TRATAMIENTO CON FÉRULAS OCLUSALES

FACULTAD DE ODONTOLOGIA

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El Dr. Juan Ignacio Rosales Leal, Profesor Titular de la Universidad de Granada informa que el trabajo de investigación titulado “Temporomandibular disorders, well-being, and bruxism in patients with fibromyalgia. effect of treatment with occlusal splintss” realizado por D. María Esteve Rodríguez, ha sido supervisado bajo su dirección y autorizado para su defensa de Tesis Doctoral con Mención Internacional en esta Universidad ante el tribunal correspondiente.

Granada, Abril 2025

Fdo. Dr. Juan Ignacio Rosales Leal

“Lo llaman suerte, pero es constancia.
Lo llaman casualidad, pero es disciplina.
El éxito no se hereda, se construye día a día”

El autor.

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El camino hasta aquí no ha sido fácil, pero he tenido la suerte de recorrerlo acompañada. Sin duda ha sido uno de los más bonitos de mi vida. Este proyecto no solo representa años de estudio y esfuerzo, sino también el apoyo incondicional de muchas personas a las que quiero dedicar estas palabras.

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ABBREVIATIONS

Abbreviations

ABFG
Awake bruxism with fibromyalgia

ABG
Awake bruxism without fibromyalgia

CIs
Confidence intervals

DC/TMD
Diagnostic Criteria/Temporomandibular Disorders

EMG
Electromyographic

ES
Effect size

FM
Fibromyalgia

GAD-7
Generalized anxiety disorder scale 7

HG
Healthy group

IQR
Interquartile range

JFLS-8
Jaw functional limitation scale 8

OHIP-14
Oral health impact profile scale 14

OR
Odds ratios

PSQI
Pittsburgh sleep quality index

REM
Rapid eye movement

SBFG
Sleep bruxism with fibromyalgia

SBG
Bruxism without fibromyalgia

STAB
Standardized Tool for the Assessment of Bruxism

TMDs
Temporomandibular disorders

TMJ
Temporomandibular joint

WHO-5
World health organization well-being index

χ^2
Chi-Square statistic

THESIS SUMMARY

Thesis summary

Temporomandibular joint issues (TMJ) are challenging conditions related to muscles and bones, commonly linked to fibromyalgia, headaches, anxiety, and sleep problems. This study focuses on examining how prevalent and impactful TMJ and teeth grinding are in fibromyalgia cases and the effectiveness of using Michigan-type occlusal splint as a treatment option due to the difficulties in swiftly managing these issues.A detailed analysis was undertaken to explore sudden TMD symptoms, emotional factors, and varied treatment strategies. Furthermore, research included a study comparing TMD in fibromyalgia sufferers to healthy individuals, a trial examining occlusal splint outcomes, and an investigation on their effects on diverse patient groups.The discoveries suggest that individuals with fibromyalgia frequently display more TMD symptoms, such as pain, jaw stiffness, and teeth grinding, along with increased restrictions in daily activities, worry, and poorer sleep. Using mouthguards notably enhanced TMD symptoms, mental well-being, and sleep quality, with limited impact on teeth grinding.While it's rare to encounter emergencies related to TMD, sudden symptoms can require urgent help, and mental health conditions can significantly affect how the issue appears. Taking a collaborative strategy involving prompt identification, various treatments, and specific paths for referrals is crucial in enhancing results for patients.The discoveries endorse the use of teeth guards as a beneficial treatment choice for handling TMD symptoms in individuals with fibromyalgia, emphasizing the importance of additional studies to improve urgent care plans and treatment approaches for the long run.

RESUMEN DE LA TESIS

Resumen

Los trastornos temporomandibulares (TMD) son condiciones musculoesqueléticas complejas que es común que se encuentren asociadas con la fibromialgia, las cefaleas y factores psicológicos como la ansiedad y los trastornos del sueño. Dado su impacto en el bienestar de los pacientes y los desafíos en su manejo agudo, esta tesis tuvo como objetivo evaluar la prevalencia y los efectos de los TMD y el bruxismo en pacientes con fibromialgia, así como el papel terapéutico de las férulas oclusales tipo Michigan. Se realizó una revisión narrativa para examinar las manifestaciones agudas de los TMD, sus influencias psicológicas y los enfoques de manejo multidisciplinario. Además, se llevaron a cabo tres estudios: un estudio de casos y controles que comparó la prevalencia y gravedad de los TMD en pacientes con fibromialgia y controles sanos, un ensayo clínico controlado que evaluó los efectos de las férulas oclusales y un estudio cuasi-experimental que analizó su impacto en diferentes subgrupos de pacientes. Los resultados muestran que los pacientes con fibromialgia presentan una prevalencia significativamente mayor de síntomas de TMD, como dolor, bloqueo mandibular y bruxismo, junto con mayores limitaciones funcionales, ansiedad y reducción de la calidad del sueño. El uso de férulas oclusales produjo mejoras significativas en los síntomas de los TMD, la salud psicológica y la calidad del sueño, aunque su efecto sobre el bruxismo fue mínimo. Si bien las emergencias relacionadas con los TMD son poco frecuentes, los síntomas agudos a menudo requieren una intervención inmediata, y las comorbilidades psicológicas desempeñan un papel clave en su presentación clínica. Un enfoque multidisciplinario que integre un diagnóstico temprano, intervenciones multimodales y vías de derivación específicas es esencial para mejorar los resultados en los pacientes. Estos hallazgos respaldan las férulas oclusales como una opción terapéutica eficaz para el manejo de los síntomas de los TMD en pacientes con fibromialgia y resaltan la necesidad de más investigaciones para optimizar los protocolos de atención en emergencias y las estrategias de tratamiento a largo plazo.

CHAPTER 1

Introduction

CHAPTER 1

Introduction

Temporomandibular disorder (TMDs) is one of the leading causes of dental visit, in addition to dental pain. As a result, dental practitioners must be well-versed in identifying the risk factors of patients most susceptible to TMDs, ensuring accurate diagnosis and selecting the most effective management strategies for optimal treatment outcomes [1]. TMDs refers to a range of conditions involving pain and/or dysfunction of the masticatory muscles and temporomandibular joints[1]. The key symptoms include pain, restricted jaw movement, and joint noises during jaw function[1]. While TMDs is not life-threatening, it can significantly affect a person's quality of life, particularly when symptoms become chronic, as management can be complex and often necessitates a multidisciplinary approach[1]. Mandibular functional limitations in chewing and mobility are key clinical manifestations of TMDs [2]. Thus, early identification and intervention of these limitations can significantly enhance patients' quality of life [2].

TMDs are often comorbid with primary headaches [3]. They are most commonly observed in young adults between the ages of 20 and 40 [4]. Notably, the prevalence of headaches rises in correlation with the number of TMDs symptoms [5]. Studies have shown that 56.5% of individuals with one TMDs symptom experience headaches, while the prevalence increases to 65.1% in those with two symptoms, and further to 72.8% in individuals presenting with three or more TMDs symptoms [5].Structural factors, particularly occlusion, along with psychological factors, have historically been among the most significant etiological considerations associated with the pathology of TMD [4]. In the United States, the prevalence of TMDs is estimated to be between 5% and 15% [6]. The National Institute of Dental and Craniofacial Research has estimated that TMDs cost an

average of $4 billion annually [6]. Currently, the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) proposed by Schiffman et al, accepted as one of the best tools used for TMDs classification [7]. These authors adopted amultidimensional perspective in the evaluation of TMDs, incorporating the study of chronic pain based on the parallels found between patients with TMDs and patients with other chronic pain syndromes [7].According to the DC/TMD, a headache attributed to TMDs is defined as a headache in the temple area that is secondary to pain-related TMDs [5]. This headache is affected by jaw movement, function, or parafunction, and can be replicated during provocation testing of the masticatory system[8] .

Fibromyalgia is a prevalent neurological condition characterized by widespread pain and heightened sensitivity to touch [9]. This syndrome is a chronic pain condition that primarily affects soft tissues [10]. The discomfort tends to fluctuate and affects various parts of the body [9]. Individuals with this chronic ailment commonly experience fatigue, restless legs, headaches, alongside intolerance to exercise, dysmenorrhea, various sensation like experience frequent, severe symptoms of TMDS and sleep disturbances [9]. While fibromyalgia typically emerges in middle adulthood, it can onset during adolescence or later stages of life [11]. It's more prevalent among women but can affect men as well, particularly those with rheumatic conditions like osteoarthritis, lupus, rheumatoid arthritis, or ankylosing spondylitis [12]. The underlying causes of fibromyalgia vary among individuals, but research indicates involvement of the nervous system, especially the central nervous system [13]. Genetics likely play a role in predisposing individuals to fibromyalgia and associated health issues, although they don't solely account for its development [14]. Factors like spinal problems, arthritis, injuries, or physical stressors can trigger its onset [14].The primary symptom of fibromyalgia is widespread musculoskeletal pain, accompanied by common issues like sleep disturbances, fatigue, morning stiffness,

memory problems, tingling sensations, headaches, and exercise intolerance [15]. Well-being is a multidimensional construct that includes physical, psychological, and social aspects of health [16]. Patients may also face depression, digestive problems, an overactive bladder, pelvic pain, and temporomandibular joint disorders, which can vary in intensity and frequency over time [17].

"Nociplastic pain" was introduced as a new pain category in 2017 to encompass primary chronic pain conditions that do not fit into the previously defined categories of nociceptive and neuropathic pain [18]. This novel descriptor includes conditions such as fibromyalgia syndrome, nonspecific low back pain, and other primary musculoskeletal or visceral pain disorders [18]. In these conditions, there is no clear evidence of nociceptor activation or a proven lesion or disease of the somatosensory nervous system causing the pain[18]. Fibromyalgia, as a nociplastic pain condition, exhibits overlapping clinical phenotypes and often presents with incomplete symptoms, especially in the early stages of the illness [18]. The mechanistic approach, which focuses on the nociplastic pain features of fibromyalgia, can aid in the timely diagnosis and effective management of the condition [18]. This nociplastic pain -based perspective extends beyond the traditional confines of fibromyalgia, addressing generalized pain and a wide range of polysymptomatic complaints [18].

Patients with fibromyalgia tend to experience a longer duration of general body pain compared to TMDs, suggesting that fibromyalgia may initially manifest in other areas of the body before affecting the temporomandibular region [19]. Furthermore, fibromyalgia exerts a notable influence on the progression of TMD pain, as both conditions share several clinical features, such as chronic progression, unclear pathophysiology, notable physical and psychological impacts, and common predisposing factors [19].

Research has shown that TMDs are more prevalent in patients with fibromyalgia, with studies highlighting increased involvement of the stomatognathic system in fibromyalgia syndrome and identifying myogenic disorders of the masticatory system as the most frequent symptoms in fibromyalgia patients [20]. Additionally, fibromyalgia appears to present features that serve as predisposing factors and triggers for TMDs [20] .Muscle generators in various regions may contribute to TMDs, as well as neck and facial pain associated with fibromyalgia [21]. Studies further demonstrated that TMDs are more common in fibromyalgia patients compared to those without an fibromyalgia diagnosis, suggesting that fibromyalgia may exacerbate TMD symptoms and indicating a potential link between the two conditions [21]. Therefore, fibromyalgia could serve as an etiologic or aggravating factor for TMDs [22]. Given the high prevalence of TMDs in patients with fibromyalgia, it is crucial to emphasize the importance of evaluating TMD symptoms and signs when diagnosing fibromyalgia [22]. TMDs are a group of conditions smilarly to fibromyalgia, most studies evaluating TMD differences between genders have shown a greater prevalence of TMD in women [23]. TMDs are more prevalent in women, who are three times more likely to be affected than men [24].

Psychosocial disorders and impairments play a crucial role in the development of TMDs [25]. The prevalence of psychosocial factors is notably higher in TMDs patients, with anxiety being a significant comorbidity [25]. Anxiety can influence pain perception and trigger the release of neurotransmitters linked to parafunctional habits [26]. Additionally, it may contribute to hyperactivity in the masticatory muscles, leading to joint overload and exacerbating TMDs symptoms [26]. Moreover, TMDs can have a significant impact on oral health, directly affecting individuals' daily lives, personal experiences, socio-cultural environments, and mental well-being[27]. The discomfort and limitations caused by TMDs can influence not only physical functioning but also emotional and social interactions [27].

The consideration of the biopsychosocial effects of oral health and disease on patients' lives is gaining prominence [28]. It is increasingly recognized that the management of conditions like TMDs should adopt a patient-centered approach, incorporating psychological evaluation rather than focusing solely on physician-centered technical parameters [28]. Health encompasses not only the absence of disease but also the presence of physical, psychological, and social well-being [29]. These aspects can be effectively assessed through social indicators, global self-assessments, and multi-item surveys to provide a holistic view of patient care [29].

Patients frequently consult dentists regarding their TMD and multiple assessment instruments, which have been validated by the scientific community, may be used for history, examination, and/or imaging procedures [30]. These instruments provide evidence-based guidelines for clinicians, streamlining communication regarding consultations, referrals, and prognoses [30]. For instance, previous research suggested including questionnaires to assess TMJ pain, jaw joint noises, jaw locking, or jaw functional limitation scales (e.g., JFLS-8 or JFLS-20, which have emerged as a form for measuring global functional limitation of the jaw) [31]. Also, TMD have been associated with psychosocial distress (e.g., anxiety) so instruments like the generalized anxiety disorder scale (GAD-7) or indicators of sleep quality (e.g., Pittsburgh Sleep Quality Index) and well-being (e.g., the World Health Organization well-being index) may provide valuable information for practitioners.

These symptoms may be accentuated in patients with bruxism, as the repetitive jaw-muscle activity associated with clenching or grinding of the teeth can further aggravate pain and discomfort, potentially worsening both TMD and sleep disturbances [32]. The bruxism can lead to pain in the temporomandibular joint and craniofacial muscles, limited

jaw mobility, and headaches, this oral condition needs to be taken into account when assessing TMD [33]. There is an increase in the occurrence of tension headaches, and increased muscle pain, especially myofascial pain; however, there are currently no studies that accurately relate the manifestation of this disorder in patients with fibromyalgia [33].

The bruxism it is a chronic condition that causes widespread pain and sensitivity, fatigue, and other symptoms such as sleep disturbances or general discomfort [16]. It is a central sensitization syndrome, characterized by chronic musculoskeletal pain, affecting approximately 5% of the global population [34]. Several studies have highlighted the common presence of a painful condition associated with TMDs and fibromyalgia [34]. Both bruxism and fibromyalgia are conditions that may lead to increased pain sensitivity and muscular hyperactivity, which can contribute to the onset and exacerbation of TMD symptoms [34]. Previous studies have suggested that bruxism-induced overloading of the TMJ may be amplified in fibromyalgia patients due to altered pain processing mechanisms associated with central sensitization [35]. Additionally, the presence of bruxism in individuals with fibromyalgia has been linked to increased muscle tension, which may further aggravate TMD symptoms [36]. The TMJ typically functions symmetrically, supported by coordinated muscle activity to facilitate mandibular movements [37]. However, in the presence of dysfunction, the neuromuscular system may initiate a protective co-contraction response, potentially leading to sustained muscle hyperactivity and subsequent myofascial pain [37]. Bruxism can occur during sleep as an activity of the masticatory muscles, particularly during the N1 sleep stage, including brief daytime naps, and may be rhythmic (phasic) or non-rhythmic (tonic) [38]. It is associated with morning headaches, and some studies have highlighted its effect on insomnia [39]. On the other hand, daytime bruxism is described as masticatory muscle activity during wakefulness, characterized by repeated or prolonged contact of opposing teeth and/or jaw

clenching or thrusting [40]. It is not considered a motor disorder in otherwise healthy populations [40].

Sleep disturbances are recognized as a risk predictor for developing painful TMD [35]. There is a proportional and bidirectional relationship between sleep quality and TMD pain, as pain can disrupt sleep, and poor sleep, in turn, exacerbates pain[35]. TMDs affects up to 15% of adults, with as many as 90% of TMDs patients reporting poor sleep quality[41]. Insomnia and sleep apnea are the two most common forms of sleep disturbances observed in individuals with TMDs [41].

The appropriate treatment of TMDs remains controversial [42]. Several treatments have been used, including occlusal appliances, relaxation therapy, educational therapies, pharmacological interventions, and physiotherapy [42]. Occlusal appliances have been used as an important modality for managing TMDs, with the most common category being the stabilization appliance [42]. Several possible beneficial effects of the occlusal appliance are listed, such as the reduction of muscle activity, increase in vertical dimension of occlusion, improvement in occlusal stability, a placebo effect, and cognitive alterations [42].

Occlusal appliances, also known as night guards, orthotic appliances, or oral devices, are commonly used in dental practices [43]. There are several types of occlusal appliances, each designed to address specific conditions [43]. These appliances offer benefits such as reducing tension, decreasing muscle activity, and preventing harmful effects associated with bruxism and TMDs [6]. Treatment options for TMDs may include reassurance, patient education, occlusal appliance therapy, or physiotherapy [6]. Occlusal appliances are particularly effective in stabilizing the occlusion and minimizing dental wear in individuals with TMDs and bruxism [6].

To prevent the negative effects of sleep bruxism, stabilizing and occlusal splint can be used [44]. These splints eliminate occlusal interferences, relax the masticatory and neck muscles through passive stretching, improve occlusal and neuromuscular stabilization, and reposition the mandibular condyles and articular discs [44]. In addition to occlusal splint, treatment for bruxism may involve various therapeutic options, such as patient education about harmful habits, biofeedback, muscle relaxation exercises, short-term medications, botulinum toxin injections, psychotherapy (including stress reduction, lifestyle changes, hypnosis), electrical methods, and correction of speech pattern disturbances [45,46].

CHAPTER 2

Justification and Objectives

CHAPTER 2

Justification and Objectives

Acute orofacial pain and mandibular dysfunction are frequent reasons for emergency department visits, yet there is a lack of comprehensive frameworks to assess and manage these conditions effectively [47]. The first study *"Clinical Variables, Predictive Criteria, And Emergency Management In Temporomandibular Disorders"* addresses this gap by analyzing key clinical variables and predictive criteria for acute episodes, evaluating the role of psychological and comorbid factors in emergency visits, and proposing evidence-based strategies to improve patient outcomes and reduce the burden on healthcare services [48]. Given the multifactorial nature of these disorders, including their association with psychological factors and systemic conditions, a thorough understanding of emergency presentations is essential for optimizing patient care.

To the best of the authors' knowledge, previous research has focused on specific questionnaires/scales which do not usually consider the broader scope of TMD (e.g., by using only one scale). The novelty of the second studies titled *"Analysis of Temporomandibular Disorders in Patients With Fibromyalgia Syndrome: A Case–Control Study,"* lies in the combination of a comprehensive approach, the inclusion of specific psychological factors, and its application in a dental clinical context, which distinguishes this research from previous studies and might have a significant impact on current clinical practice. By linking TMD symptoms not only to fibromyalgia but also to psychological comorbidities such as anxiety and depression, this holistic view that can influence future therapeutic interventions. In addition, there is a lack of research on TMD, bruxism, and well-being in patients with fibromyalgia. Therefore, the hypothesis of the study was that patients with fibromyalgia would experience significantly greater

temporomandibular disorders and bruxism as well as lower well-being compared to the control group.

For the management of sleep bruxism, various types of appliances are available [23]. One such type is the Michigan appliance, which covers the entire dental arch, typically the upper (maxillary) arch [23]. In this appliance, each opposing tooth contacts the appliance plane [23]. Canine guidance is incorporated to facilitate lateral and protrusive movements [23]. There are no studies on the efficacy of occlusal stabilization appliance therapy in the treatment of TMDs, bruxism, and well – being in patients with fibromyalgia [23]. Consequently, the purpose of the current "Effects of occlusal splint on temporomandibular disorders, bruxism and well - being in patients with fibromyalgia: a controlled clinical trial introduction" was to investigate the effect of occlusal appliances on TMDs, bruxism, and well – being in patients with fibromyalgia. The hypothesis of this study is that the intervention will positively impact patients with temporomandibular disorders, bruxism, and overall well-being.

Finally, few studies have explored the combination of these variables and pathologies in patients with fibromyalgia and bruxism. It would be valuable to investigate whether the use of an unloading splint could offer an effective solution for these patients. Therefore, the aim of the fourth study "Effects of occlusal splints on temporomandibular disorders and well-being among fibromyalgia and bruxism patients: a quasi-experimental study" was to evaluate the impact of splint therapy on TMDs symptoms and overall well-being in patients with fibromyalgia and bruxism.

In summary, the coexistence of FM and TMD, along with conditions such as bruxism and headaches, presents a distinct clinical challenge, suggesting shared risk factors or pathophysiological mechanisms [49]. This underscores the need for a comprehensive and

interdisciplinary approach to diagnosis and management. Combining physical, psychological, and lifestyle interventions enables healthcare professionals to better address the diverse needs of these patients, ultimately improving their quality of life and overall health outcomes. This study lays the groundwork for future research and clinical practices that prioritize personalized care and deepen our understanding of the complex interplay between these chronic pain conditions.

Objectives

Article 1: Therefore, the objective of this study is to gather scientific evidence about the clinical variables, predictive criteria, and emergency management in temporomandibular disorders.

Article 2: To analyze temporomandibular disorders (TMD), bruxism, and well-being in patients with fibromyalgia and compare these outcomes with a control group.

Article 3: The purpose of this study was to investigate the effect of occlusal splints on temporomandibular disorders (TMDs), bruxism, and well – being in patients with fibromyalgia. This experimental study assessed the impact of Michigan-type occlusal splints on TMDs, bruxism, and well – being in both fibromyalgia patients and healthy individuals.

Article 4: The purpose of this study was to investigate the effect of occlusal splints on temporomandibular disorders (TMDs), and well – being in patients with fibromyalgia and bruxism. This experimental study assessed the impact of Michigan-type occlusal splints on TMDs and well – being in fibromyalgia and bruxism patients and healthy individuals.

CHAPTER 3

ARTICLE 1:

Clinical Variables, Predictive Criteria, And Emergency Management In Temporomandibular Disorders

CHAPTER 3

Article 1: “Clinical Variables, Predictive Criteria, And Emergency Management In Temporomandibular Disorders”

Introduction

A group of musculoskeletal conditions affecting the TMJ and masticatory muscles, known as TMD, often results in pain, restricted jaw movement, and joint sounds [50]. Their multifactorial etiology includes psychological, physiological, structural, and genetic factors, frequently overlapping with conditions like bruxism, fibromyalgia, and other chronic pain syndromes due to shared mechanisms such as central sensitization [51]. Bruxism, characterized by repetitive jaw muscle activity, is strongly linked to TMD and influenced by psychosocial factors like stress and anxiety[52]. Given the increasing prevalence of TMD-related emergencies, especially among individuals with comorbid conditions, timely diagnosis and effective management are crucial for improving patients' quality of life [53]. This study aims to provide scientific evidence on the clinical variables, predictive factors, and emergency management of TMD, contributing to better treatment strategies.

Materials and Methods

This narrative review was carried out through a comprehensive search of the PubMed and Medline databases to identify relevant literature on temporomandibular disorder (TMD)-related emergencies. The selection criteria included studies that examined clinical manifestations, diagnostic challenges, predictive factors, and therapeutic interventions for acute TMD cases. Particular emphasis was placed on identifying key clinical variables that influence emergency presentations, as well as evidence-based management strategies to optimize patient outcomes. By integrating findings from various sources, this review aims to provide a thorough and up-to-date overview of the assessment and treatment of acute TMD-related emergencies.

Results

While TMD-related emergencies are relatively rare, acute manifestations such as intense pain and mandibular locking require immediate attention to prevent further complications. Psychological factors, particularly anxiety and sleep disorders, play a crucial role in exacerbating both the frequency and severity of TMD episodes in emergency settings. Additionally, stress-related bruxism often contributes to the onset of acute symptoms, further complicating management strategies. Current evidence suggests that a comprehensive, multidisciplinary approach—combining pharmacological treatments, physiotherapy, behavioral interventions, and patient education—significantly improves symptom relief, enhances functional recovery, and reduces the likelihood of recurrence. Early diagnosis and individualized treatment plans are essential in optimizing patient outcomes and preventing long-term disability associated with acute TMD episodes.

CHAPTER 4

ARTICLE 2:

Analysis Of Temporomandibular Disorders, Bruxism, and Well-Being In Patients With Fibromyalgia Syndrome: A Case – Control Study

CHAPTER 4

Article 2: "Analysis Of Temporomandibular Disorders, Bruxism, and Well-Being In Patients With Fibromyalgia Syndrome: A Case – Control Study"

Introduction

This study investigates TMD, bruxism, and well-being in patients with fibromyalgia syndrome. Fibromyalgia, a prevalent neurological condition, causes widespread pain, fatigue, sleep disturbances, and other symptoms [9]. It often overlaps with TMD, which is a common cause of orofacial pain [17]. The study also explores the concept of nociplastic pain, which includes fibromyalgia and other chronic pain conditions without clear evidence of nociceptor activation or nerve lesions [18]. TMD is frequently reported in fibromyalgia patients, and this research aims to compare the presence of TMD, bruxism, and well-being between fibromyalgia patients and a control group [19]. The study hypothesizes that fibromyalgia patients will experience more severe TMD and bruxism, and lower well-being, compared to the control group. This research highlights the need for a comprehensive approach, considering both physical and psychological factors, to improve clinical management.

Methods

Study design

This is an observational study which follows a cross-sectional design. Diagnostic criteria for the assessment of TMD, bruxism, and well-being were used in a clinic context with patients with fibromyalgia and a control group, which was used as a comparison group.

Participants

Participants were selected from a representative sample of the clinical population at the dental clinic. A total of 300 individuals were invited to participate in the study, of which 222 participants (male, n = 102; female, n = 120) were included in this study, resulting in a 74 % response rate. Controls were selected from the same clinic, ensuring that they did not have fibromyalgia and met similar inclusion criteria. Figure 1 illustrates the enrollment process. No advertising was used; participants were selected from the clinic's patient database and contacted directly. Participants, who had been diagnosed with fibromyalgia syndrome were assigned to the fibromyalgia group (n = 36 males and 35 females; age: 36.29 ± 12.73 years old) and the rest of participants were assigned to the control group (n = 66 males and 85 females; age: 35.79 ± 12.14 years old). To participate in this study, the following inclusion criteria were considered: a) the age of each participants had to range from 25 to 70 years old; b) participants had to give informed consent to voluntarily take part in the study; and c) a diagnosis of fibromyalgia. This diagnosis was either made by one of the authors (M.E) according to the ACR 2016 criteria [9] based on the interview responses or by the participants' primary care physicians or rheumatologists in specialized centers. The diagnosis was then confirmed by the study team through a review of medical records and relevant questionnaires. The following exclusion critical were considered: a) edentulous individuals (complete loss of all natural teeth); and b) pregnant women.

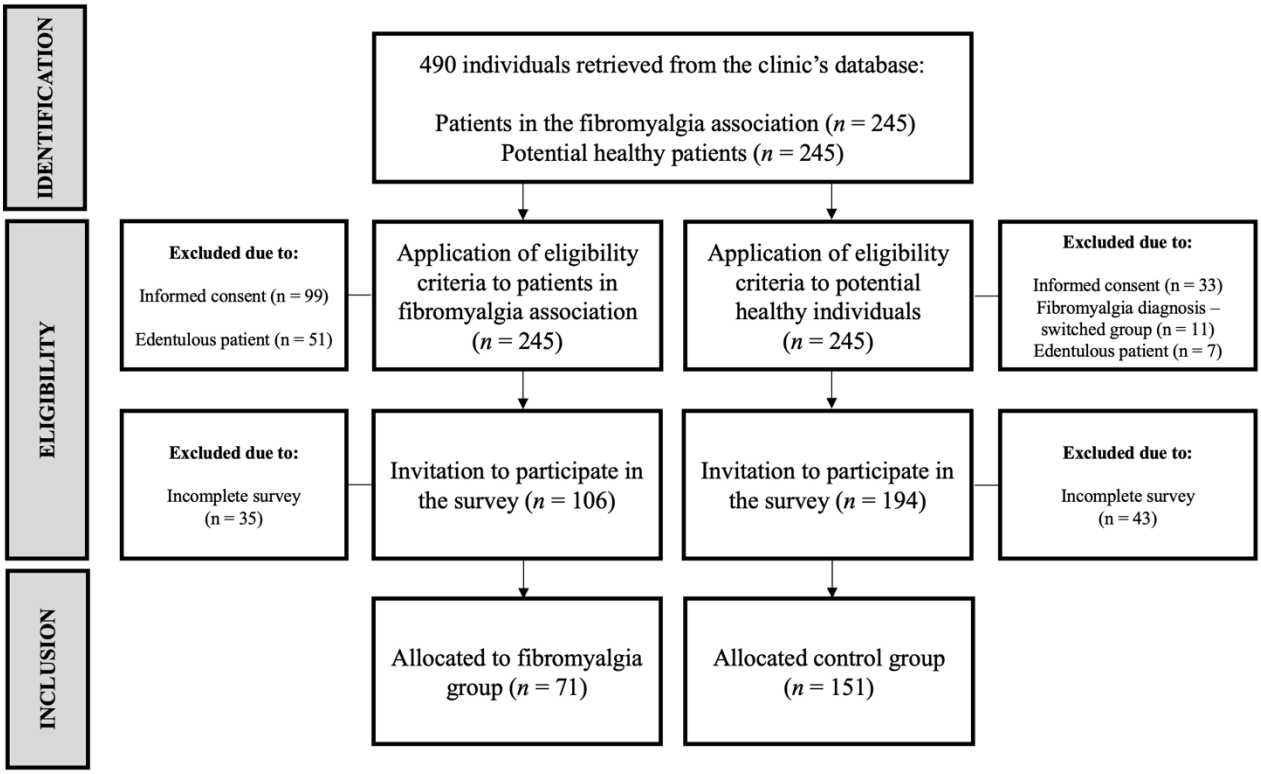

Figure 1. Flowchart illustrating the enrollment process.

Procedures

All participants completed an online questionnaire administered via Google Forms to assess TMD, bruxism, and wellness. This questionnaire had 8 sections. The first 5 sections consisted of numerical variables: 1) Jaw functional limitation scale 8 (JFLS-8) [31]; 2) Generalized anxiety disorder scale 7 (GAD-7) [54]; 3) Oral health impact profile scale 14 (OHIP-14) [55]; 4) World health organization well-being index (WHO-5) [56]; and 5) Pittsburgh sleep quality index (PSQI) [57]. Then, the following sections contained categorial variables with specific questions to measure TMD and bruxism. Specifically, the following variables were measured:

Potential sleep bruxism according to positive responses (i.e., "yes" answer) to any of the following bruxism questions [58]: "a) Are you aware that you clench at night?; b) Has anyone told you that you clench or grind your teeth at night?; c) Do you wake up with a headache?"

Potential awake bruxism [58] if affirming the following question: "Are you aware of clenching or grinding your teeth during the day?"

Joint sounds [30] if affirming the following question: "Have you had any noise(s) in the joint when moving or using the jaw?"

Temporomandibular pain [30]: participant had to confirm that pain in the jaw, temple, ear or front of the ear is always present or comes and goes. Also, the individuals had this disorder if answering yes to the following question: "Did any of the following activities affect (i.e., did the pain improve or worsen) the pain in your jaw or temple on either side? Chewing hard or difficult to grind foods; Open the mouth or move the jaw sideways or forward; Oral habits such as keeping teeth together, clenching, grinding, or chewing gum; Other jaw activities such as talking, kissing or yawning".

Headache attributed to TMD [59] if confirming headaches involving the temple area or any of the following activities changing the individual's headache (making it better or worse) located in the temples on either side: a) Chewing hard or difficult to grind foods; b) Open the mouth or move the jaw sideways or forward; c) Oral habits such as keeping teeth together, clenching or grinding teeth or chewing gum; d) Other jaw activities such as talking, kissing or yawning.

Headache attributed to bruxism [59] if confirming headaches when waking up.

Jaw locking [30] according to positive responses (i.e., "yes" answer) to following questions: a) "Have you ever had your jaw locked or locked, even for a moment, so that you could not fully open your mouth (even if it was for a moment and then unlocked)?"; b) Was that jaw locking or locking severe enough that it limited your mouth opening and interfered with your ability to eat?; c) Did you open your mouth wide, did your jaw lock, even for a moment, so that you could not close your mouth from that wide-open position?; d) When your jaw locked or locked in a fully open position, did you have to do anything such as rest, move, push or maneuver your jaw to get your mouth to close?

Statistical analysis

First, a descriptive statistical analysis of all variables was performed, showing data as mean and standard deviation (mean ± SD) for the numeric variables (i.e., JFLS-8, GAD-7, OHIP-14, WHO-5, and PSQI) and showing data as frequency count and percentage of prevalence for the categorical variables in both groups (i.e., fibromyalgia and control group). Then, a non-parametric test (Mann-Whitney U test) was used to compare

differences between two independent groups (i.e., fibromyalgia and control group) in all numeric variables. Effect sizes were qualitatively interpreted using the following criteria: small effect ($0.1 \leq r < 0.3$), medium effect ($0.3 \leq r < 0.5$), and large effect $r \geq 0.5$ ([60]).

Also, the Chi-Square statistic (χ^2) was used for the categorical variables related to TMD and bruxism in order to analyze whether a dependency relationship with the sample groups might be inferred from the study sample to the population (i.e., analyzing if the relationships were statistically significant). If there was a significant association ($p \leq 0.05$) between the type of population (i.e., fibromyalgia patients and control group) and presence of TMD or bruxism, the null hypothesis for the independence of the variables at the 95% confidence level was rejected and the alternative hypothesis was accepted (i.e., the type of population and TMD were significantly associated). In this regard, Crammer's V was calculated as a measure of the effect size. Finally, the odds ratios (OR) with 95% confidence intervals (CIs) were calculated. All statistical analyses were conducted using IBM SPSS Statistics version 29 (SPSS Inc., Armonk, NY, USA) with the level of significance set at $p \leq 0.05$.

Results

Table 1 shows the frequency (count, n) and prevalence (%) of TMD and bruxism in patients with fibromyalgia and control group. The results showed that the TMD and bruxism were significantly associated with the type of population ($\chi^2 = 8.77 – 57.62$; $p < 0.05$; ES = 0.20 – 0.51). Patients with fibromyalgia had greater prevalence (% values) than control group in TMJ pain (98.6 % vs 66.9 %), headache attributed to TMD (100.0 % vs 73.5 %), jaw locking (43.66 % vs 19.2 %), headache attributed to bruxism (97.2 % vs 70.9 %), and sleep bruxism (77.5 % vs 56.9 %), awake bruxism (54.9 % vs 29.8 %). However, there was a greater prevalence of joint sounds in the control group compared to the fibromyalgia group (59.6 % vs 38.0 %). According to the OR, the fibromyalgia group had higher odds of TMJ pain (OR = 34.65), jaw locking (OR = 3.26), headache attributed to bruxism (OR = 14.19), sleep bruxism (OR = 2.69) and awake bruxism (OR = 2.87).

Table 1. Frequency (count, n) and prevalence (%) of temporomandibular disorders and potential bruxism in patients with fibromyalgia and control group.

Variables		Fibromyalgia N (%)	Control group N (%)	χ^2	*p*	ES	OR (95% CI)
Joint sounds	Yes	27 (38.0)	90 (59.6)	9.02	0.003	0.20	2.40
	No	44 (62.0)	61 (40.4)				(1.35- 4.29)
TMJ pain	Yes	70 (98.6)	101 (66.9)	27.43	< 0.001	0.35	34.65
	No	1 (1.4)	50 (33.1)				(4.68-256.77)
Headache attributed to TMD	Yes	70 (98.6)	111 (73.5)	20.18	< 0.001	0.30	25.23
	No	1 (1.4)	40 (26.5)				(3.39-187.65)
Headache attributed to bruxism	Yes	69 (97.2)	107 (70.9)	20.37	< 0.001	0.30	14.19
	No	2 (2.8)	44 (29.1)				(3.33-60.42)
Jaw locking	Yes	31 (43.7)	29 (19.2)	14.65	< 0.001	0.26	3.26
	No	40 (56.3)	122 (80.8)				(1.76-6.06)
Sleep bruxism	Yes	55 (77.5)	86 (56.9)	8.77	0.003	0.20	2.60
	No	16 (22.5)	65 (43.1)				(1.37-4.94)
Awake bruxism	Yes	39 (54.9)	45 (29.8)	12.96	< 0.001	0.24	2.87
	No	32 (45.1)	106 (70.2)				(1.60-5.14)

Note: TMJ = temporomandibular joint; χ^2 = chi squared; ES = Effect Size; OR: Odds Ratio;

CI: coefficient interval

Table 2 shows the differences in scores registered by the JFLS-8, GAD-7, OHIP-14, WHO-5, and PSQI in patients with fibromyalgia and control group. The scores in the fibromyalgia group were significantly greater compared to the control group in JFLS-8, GAD-7, OHIP-14, and PSQI with a large effect size (ES = 0.51 – 0.73). The WHO-5 showed significantly lower scores in the fibromyalgia group compared to the control group with a moderate effect size (ES = 0.58).

Table 2. Differences between fibromyalgia and control group in JFLS-8, GAD-7, OHIP-14, WHO-5 and PSQI.

Variables	**Fibromyalgia** Median (IQR)	**Control group** Median (IQR)	***p***	**ES**
JFLS-8	16 (8 – 24)	2 (0 – 10)	< 0.001	0.51
GAD-7	13 (11 – 14)	6 (2.5 – 9)	< 0.001	0.61
OHIP-14	31 (26 – 35)	12 (5 – 18)	< 0.001	0.69
WHO-5	7 (4 – 9)	14 (10 – 17)	< 0.001	0.58
PSQI	16 (14 – 18)	8 (5 – 10)	< 0.001	0.73

Note: JFLS-8: Jaw functional limitation scale; GAD-7: General Anxiety Disorder-7; OHIP-14: Oral Health Impact Profile-14; WHO-5: World Health Organization Well-Being Index; PSQI: Pittsburgh Sleep Quality Index (PSQI); IQR: interquartile range. ES: Effect Size

CHAPTER 5

ARTICLE 3:

Effects of occlusal splint on temporomandibular disorders, bruxism and well - being in patients with fibromyalgia: a controlled clinical trial

Chapter 5

Article 3: “Effects of occlusal splint on temporomandibular disorders, bruxism and well - being in patients with fibromyalgia: a controlled clinical trial.”

Introducction

Fibromyalgia syndrome is a chronic pain condition frequently associated with TMDs [10]. Both conditions share overlapping clinical features, such as chronic progression, unclear pathophysiology, and significant physical and psychological impacts [19]. TMDs, which affect the temporomandibular joint and masticatory muscles, are more prevalent in women and can significantly impair quality of life [24]. Among various treatments, occlusal appliances, particularly stabilization devices like the Michigan splint, are widely used for managing TMDs and bruxism [23]. Despite the high prevalence of TMDs in fibromyalgia patients, evidence on the effectiveness of occlusal stabilization splints in this specific population remains limited [23]. Therefore, this controlled clinical trial aims to evaluate the impact of Michigan-type occlusal splints on jaw function, sleep quality, psychological well-being, and bruxism symptoms in fibromyalgia patients compared to a healthy control group. Our hypothesis is that the intervention with occlusal splints will significantly reduce TMD symptoms and improve overall well-being in fibromyalgia patients.

Materials and methods

Study design

This study is a controlled, parallel-group clinical trial that assesses the effects of occlusal splints on TMDs, bruxism, and well-being in fibromyalgia patients and healthy individuals. Participants were non-randomly allocated to the fibromyalgia or healthy control group, with both groups receiving the same intervention. This study was design according to University of Granada.

Participants

A total of 219 participants were included in this study, all patients in this study were patients who came to the dental clinic. Participants, who had been diagnosed with fibromyalgia syndrome were assigned to the fibromyalgia group (n = 69), and the rest of participants were assigned to the healthy group (n = 150), that is, the control group. To participate in this study, the following inclusion criteria were considered: a) the age of each participants had to range from 25 to 70 years old; b) participants had to give informed consent to voluntarily take part in the study; and c) The fibromyalgia group diagnosis for the participants was based on the revised ACR 2016 criteria [9] Those diagnosed with fibromyalgia according to the ACR 2016 criteria were assessed by me based on their interview responses. These criteria are a combination of the ACR 2010 and 2011 criteria, serving as diagnostic criteria when used in clinical settings, but also as classification criteria when used for research purposes or be already diagnosed with this syndrome, it had been made by their primary care physicians or rheumatologists in specialized centers and was confirmed by the study team through a review of medical records and the application of relevant questionnaires. The following exclusion criteria were considered: a) edentulous individuals (complete loss of all natural teeth); and b) pregnant women.

Procedures

All patients received therapy with a Michigan-type occlusal splint and habit counseling and behavioral changes. The stabilizing stabilization appliances were constructed after an occlusal registration and subsequent occlusal adjustment by the doctor. Patients were advised to wear the appliance only at night while sleeping. Patients also received beneficial behavioral changes and were given a printed version of instructions on relaxation techniques, sleep hygiene, diet modification, thermotherapy and pain management, as well as avoidance of dental clenching. In addition, the participants completed a questionnaire for the assessment of temporomandibular disorders, bruxism, and overall well-being before and after to perform the treatment using a Michigan type appliance. The second phase of questionnaires were conducted after 1 month of treatment following the use of the Michigan type appliance. Specifically, this questionnaire had 8 sections. 1) Jaw functional scale 8 (JFLS-8) [31]; 2) generalized anxiety disorder 7 (GAD-7) [54]; 3) oral health impact profile 14 (OHIP-14) [55]; 4) world health organization well-being index (WHO-5) [56]; 5) Pittsburgh sleep quality index (PSQI) [61]; 6) sleep bruxism [58]; 7) awake bruxism [58] ; 8) joint sounds [8]; 9) temporomandibular joint pain [8];10) headache attributed to temporomandibular joint [59]; 11) headache attributed to bruxism [59] ; and 12) jaw locking [8]. Then, the following sections contained categorial variables with specific questions to measure additional TMD, bruxism, and overall well-being, based on the patient's testimony and clinical examination. Specifically, the following variables were measured:

Probable sleep bruxism, according to the Standardized Tool for the Assessment of Bruxism (STAB) [62] and positive responses (i.e., “yes” answer) to any of the following bruxism questions [58]: “a) Are you aware that you clench at night?; b) Has anyone told you that you clench or grind your teeth at night?; c) Do you wake up with a headache?”

Probable awake bruxism was diagnosed using the STAB (21) and based on a positive response to the question: 'Are you aware of clenching or grinding your teeth during the day?

Joint sounds [8], if affirming the following question: “Have you had any noise(s) in the joint when moving or using the jaw?”

Temporomandibular joint pain [30]: participant had to confirm that pain in the jaw, temple, ear or front of the ear is always present or comes and goes. Also, the individuals had this

disorder if answering yes to the following question: "Did any of the following activities affect (i.e., did the pain improve or worsen) the pain in your jaw or temple on either side? Chewing hard or difficult to grind foods; Open the mouth or move the jaw sideways or forward; Oral habits such as keeping teeth together, clenching, grinding, or chewing gum; Other jaw activities such as talking, kissing or yawning".

Headache attributed to temporomandibular joint [59] if confirming headaches involving the temple area or any of the following activities changing the individual's headache (making it better or worse) located in the temples on either side: a) Chewing hard or difficult to grind foods; b) Open the mouth or move the jaw sideways or forward; c) Oral habits such as keeping teeth together, clenching or grinding teeth or chewing gum; d) Other jaw activities such as talking, kissing or yawning.

Headache attributed to bruxism [59] if confirming headaches when waking up.

Jaw locking [30] according to positive responses (i.e., "yes" answer) to following questions: a) "Have you ever had your jaw locked or locked, even for a moment, so that you could not fully open your mouth (even if it was for a moment and then unlocked)?"; b) Was that jaw locking or locking severe enough that it limited your mouth opening and interfered with your ability to eat?; c) Did you open your mouth wide, did your jaw lock, even for a moment, so that you could not close your mouth from that wide-open position?; d) When your jaw locked or locked in a fully open position, did you have to do anything such as rest, move, push or maneuver your jaw to get your mouth to close?

Statistical analysis

First, descriptive statistics were calculated for the numeric variables (i.e., JFLS-8, GAD-7, OHIP-14, WHO-5, and PSQI) as mean and standard deviation (mean ± SD) and for the categorical variables as frequency count and percentage of prevalence in each group (i.e., fibromyalgia and healthy group). These descriptive statistics were obtained before and after the intervention. Then, a non-parametric test (Wilcoxon test) was used to compare pre- and post-test differences in each variable and group in all numeric variables. Cohen's d was calculated to measure the effect size (ES), which was interpreted as follows: 0-0.19 (trivial effect), 0.20-0.49 (small effect), 0.50-0.79 (moderate effect), and 0.80 or higher (large effect) [60]. In addition, McNemar-Bowker test was used to compare pre- and

post-test differences in the categorical variables. Finally, the odds ratios (OR) with 95% confidence intervals (CIs) were calculated. The level of significance set at $p \leq 0.05$ for all the analyses. All statistical analyses were conducted using IBM SPSS Statistics version 29 (SPSS Inc., Armonk, NY, USA).

Results

Table 3 shows the differences pre and post Michigan-type occlusal splints intervention in fibromyalgia and healthy group in JFLS-8, GAD-7, OHIP-14, WHO-5 and PSQI. The intervention had a significant effect on all variables in the fibromyalgia group. The mean score significantly decreased in JFLS-8 ($p < 0.001$, ES = 1.56), GAD-7 ($p < 0.001$, ES = 1.50), OHIP-14 ($p < 0.001$, ES = 2.47), and PSQI ($p < 0.001$, ES = 2.01) in addition to increasing scores on WHO-5 ($p < 0.001$, ES = 0.92). When it comes to the healthy group, significant differences with a smaller effect size were observed in JFLS-8 ($p < 0.001$, ES = 0.81), GAD-7 ($p < 0.001$, ES = 0.34), OHIP-14 ($p < 0.001$, ES = 0.75), and PSQI ($p < 0.001$, ES = 0.29); however, no significant changes were found for WHO-5 ($p = 0.06$, ES = 0.14).

Table 3. Differences pre and post occlusal splint intervention in fibromyalgia and healthy group in JFLS-8, GAD-7, OHIP-14, WHO-5 and PSQI.

Group	Variables	Pre	Post	*p*	ES
Fibromyalgia group	JFLS-8	17.84 ± 12.25	3.06 ± 3.96	< 0.001	1.56
	GAD-7	13.16 ± 3.73	7.32 ± 4.04	< 0.001	1.50
	OHIP-14	30.33 ± 8.07	11.96 ± 6.74	< 0.001	2.47
	WHO-5	6.43 ± 3.62	9.90 ± 3.85	< 0.001	0.92
	PSQI	15.51 ± 2.41	10.74 ± 2.32	< 0.001	2.01
Healthy group	JFLS-8	6.57 ± 9.09	1.17 ± 2.66	< 0.001	0.81
	GAD-7	6.26 ± 4.78	4.72 ± 4.22	< 0.001	0.34
	OHIP-14	12.34 ± 8.92	6.70 ± 5.85	< 0.001	0.75
	WHO-5	13.17 ± 4.95	12.48 ± 4.79	0.06	0.14
	PSQI	7.83 ± 3.57	6.89 ± 2.94	< 0.001	0.29

Note: JFLS-8: Jaw functional limitation scale; GAD-7: General Anxiety Disorder-7; OHIP-14: Oral Health Impact Profile-14; WHO-5: World Health Organization Well-Being Index; PSQI: Pittsburgh Sleep Quality Index (PSQI). ES: Effect Size

Table 4 shows the prevalence (%) of temporomandibular disorders pre and post occlusal appliance intervention in the fibromyalgia and healthy group. A significant reduction in prevalence of TMJ pain ($p < 0.001$), and jaw locking ($p < 0.001$), was found in the fibromyalgia group. However, no significant changes have been observed in sleep bruxism ($p = 1$), awake bruxism ($p = 1$), joint sounds ($p = 0.13$), and headache attributed to bruxism ($p = 0.11$). Regarding the healthy group, significant differences were observed in awake bruxism ($p < 0.001$), joint sounds ($p < 0.001$), TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), headache attributed to bruxism ($p < 0.001$), and jaw locking ($p < 0.001$). Nevertheless, no significant changes were found for sleep bruxism ($p = 0.85$).

Table 4. Frequency (count, n) and prevalence (%) of temporomandibular disorders, bruxism and well – being pre and post occlusal splint intervention in fibromyalgia and healthy group.

Group	Variable	Pre	Post	*p*
Fibromyalgia group	Sleep bruxism	68 (98.6 %)	67 (97.1 %)	1.00
	Awake bruxism	37 (53.6 %)	37 (53.6 %)	1.00
	Joint sounds	42 (60.9 %)	37 (53.6 %)	0.13
	TMJ pain	68 (98.6 %)	35 (50.7 %)	< 0.001
	Headache attributed to TMJ	68 (98.6 %)	41 (59.4 %)	< 0.001
	Headache attributed to bruxism	67 (97.1 %)	61 (88.4 %)	0.11
	Jaw locking	29 (42.0 %)	1 (1.4 %)	< 0.001
Healthy group	Sleep bruxism	117 (78.0 %)	119 (79.3 %)	0.85
	Awake bruxism	45 (30.0 %)	65 (43.3 %)	< 0.01
	Joint sounds	61 (40.7 %)	38 (21.3 %)	< 0.001
	TMJ pain	100 (73.3 %)	32 (21.3 %)	< 0.001
	Headache attributed to TMJ	110 (73.3 %)	37 (24.7 %)	< 0.001
	Headache attributed to bruxism	106 (70.7 %)	51 (34.0 %)	< 0.001
	Jaw locking	29 (19.3 %)	1 (0.67 %)	< 0.001

Note: TMJ = temporomandibular joint.

CHAPTER 5

ARTICLE 4:

Effects of Occlusal Splints on Temporomandibular Disorders and Well-Being Among Fibromyalgia and Bruxism Patients: A Quasi-Experimental Study

CHAPTER 6

Article 4: "Effects of Occlusal Splints on Temporomandibular Disorders and Well-Being Among Fibromyalgia and Bruxism Patients: A Quasi-Experimental Study"

Introducction

TMDs are prevalent conditions characterized by pain, limited jaw function, and joint noises, significantly impacting quality of life [2]. These disorders often co-occur with headaches, anxiety, and bruxism, with psychosocial factors playing a critical role in their onset and progression [5]. Bruxism and fibromyalgia are conditions that have been linked to increased pain sensitivity and muscular hyperactivity, which may contribute to the onset and progression of TMD symptoms. The excessive loading of the TMJ caused by bruxism can be particularly problematic in individuals with fibromyalgia, as they exhibit altered pain processing due to central sensitization [35]. Moreover, research suggests that fibromyalgia patients are more prone to parafunctional habits such as bruxism, potentially worsening TMD-related pain and dysfunction [32]. Bruxism, common in patients with fibromyalgia, exacerbates TMD symptoms, sleep disturbances, and discomfort, further reducing overall well-being [32]. Sleep quality and TMD pain are closely linked in a bidirectional manner [35]. Stabilizing occlusal splints are an effective treatment for managing bruxism and TMDs, improving muscle relaxation, occlusal stability, and sleep quality [44]. Understanding these interactions is essential for evaluating the therapeutic potential of occlusal splints in this specific population. However, limited research explores their impact on patients with fibromyalgia and bruxism. This study aims to evaluate the effects of occlusal splints on TMD symptoms and well-being in this specific population.

Materials and methods

Study design

This is a quasi-experimental study with an experimental design which measures the effect of an intervention on TMDs symptoms and overall well-being in patients with fibromyalgia and bruxism. Diagnostic criteria for the assessment of temporomandibular disorders were used in a clinic context with patients with bruxism, fibromyalgia and bruxism, and a healthy group, which was used as a comparison group. This design was selected due to the ethical considerations associated with withholding treatment from symptomatic patients seeking care. This study was approved by the Institutional Review Board at the University of Granada (Code: blank for review purposes).

Participants

A total of 266 participants were included in this study, all patients in this study were patients who came to the dental clinic. Participants were assigned to one of the following groups: awake bruxism with fibromyalgia (ABFG, n = 37), sleep bruxism with fibromyalgia (SBFG, n = 53), awake bruxism without fibromyalgia (ABG, n = 45), sleep bruxism without fibromyalgia (SBG, n = 85), and the rest of participants were assigned to the healthy group (HG, n = 46), that is, the control group. To participate in this study, the following inclusion criteria were considered: a) the age of each participants had to range from 25 to 70 years old, and b) participants had to give informed consent to voluntarily take part in the study. Also, c) for the bruxism categorization, patients with possible sleep bruxism, and/or possible wakefulness bruxism were selected. Finally, d) the fibromyalgia group diagnosis for the participants was based on the revised ACR 2016 criteria [9]. Those diagnosed with fibromyalgia according to the ACR 2016 criteria were assessed by me based on their interview responses. These criteria are a combination of the ACR 2010 and 2011 criteria, serving as diagnostic criteria when used in clinical settings, but also as classification criteria when used for research purposes or be already diagnosed with this syndrome, it had been made by their primary care physicians or rheumatologists in specialized centers and was confirmed by the study team through a review of medical records and the application of relevant questionnaires. However, the following exclusion criteria were considered: a) edentulous individuals (complete loss of all natural teeth); and b) pregnant women.

Procedures

All patients received therapy with a rigid acrylic upper acrylic occlusal splint and habit counseling and behavioral changes. The occlusal splint was constructed after an occlusal registration and subsequent occlusal adjustment by the doctor. Patients were advised to wear the splint only at night while sleeping. Patients also received beneficial behavioral changes and were given a printed version of instructions on relaxation techniques, sleep hygiene, diet modification, thermotherapy and pain management, as well as avoidance of dental clenching. In addition, the participants completed a questionnaire for the assessment of temporomandibular disorders, bruxism, and overall well-being before and after to perform the treatment using a Michigan type splint. The second phase of questionnaires were conducted after 1 month of treatment following the use of the Michigan type splint based on prior research suggesting that early improvements in TMD symptoms can be detected within this timeframe [63]. Specifically, this questionnaire had 8 sections. 1) Jaw functional scale 8 (JFLS-8) [31]; 2) generalized anxiety disorder 7 (GAD-7) [54]; 3) oral health impact profile 14 (OHIP-14) [55]; 4) world health organization well-being index (WHO-5) [56]; 5) Pittsburgh sleep quality index (PSQI) [61]; 6) sleep bruxism [58]; 7) awake bruxism [58] ; 8) joint sounds [8]; 9) temporomandibular joint pain [8];10) headache attributed to temporomandibular joint [59]; 11) headache attributed to bruxism [59] ; and 12) jaw locking [8]. Then, the following sections contained categorial variables with specific questions to measure additional TMD, bruxism, and overall well-being, based on the patient's testimony and clinical examination. Specifically, the following variables were measured:

Probable sleep bruxism, according to the Standardized Tool for the Assessment of Bruxism (STAB) [62] and positive responses (i.e., “yes” answer) to any of the following bruxism questions [58]: “a) Are you aware that you clench at night?; b) Has anyone told you that you clench or grind your teeth at night?; c) Do you wake up with a headache?”

Probable awake bruxism was diagnosed using the STAB (21) and based on a positive response to the question: 'Are you aware of clenching or grinding your teeth during the day?

Joint sounds [8], if affirming the following question: “Have you had any noise(s) in the joint when moving or using the jaw?”

Temporomandibular joint pain [30]: participant had to confirm that pain in the jaw, temple, ear or front of the ear is always present or comes and goes. Also, the individuals had this disorder if answering yes to the following question: "Did any of the following activities affect (i.e., did the pain improve or worsen) the pain in your jaw or temple on either side? Chewing hard or difficult to grind foods; Open the mouth or move the jaw sideways or forward; Oral habits such as keeping teeth together, clenching, grinding, or chewing gum; Other jaw activities such as talking, kissing or yawning".

Headache attributed to temporomandibular joint [59] if confirming headaches involving the temple area or any of the following activities changing the individual's headache (making it better or worse) located in the temples on either side: a) Chewing hard or difficult to grind foods; b) Open the mouth or move the jaw sideways or forward; c) Oral habits such as keeping teeth together, clenching or grinding teeth or chewing gum; d) Other jaw activities such as talking, kissing or yawning.

Headache attributed to bruxism [59] if confirming headaches when waking up.

Jaw locking [30] according to positive responses (i.e., "yes" answer) to following questions: a) "Have you ever had your jaw locked or locked, even for a moment, so that you could not fully open your mouth (even if it was for a moment and then unlocked)?"; b) Was that jaw locking or locking severe enough that it limited your mouth opening and interfered with your ability to eat?; c) Did you open your mouth wide, did your jaw lock, even for a moment, so that you could not close your mouth from that wide-open position?; d) When your jaw locked or locked in a fully open position, did you have to do anything such as rest, move, push or maneuver your jaw to get your mouth to close?

Statistical analysis

First, descriptive statistics were calculated for the numeric variables (i.e., JFLS-8, GAD-7, OHIP-14, WHO-5, and PSQI) as mean and standard deviation (mean ± SD) and for the categorical variables as frequency count and percentage of prevalence in each group (i.e., fibromyalgia and healthy group). These descriptive statistics were obtained before and after the intervention. Then, a non-parametric test (Wilcoxon test) was used to compare pre- and post-test differences in each variable and group in all numeric variables. Cohen's d was calculated to measure the effect size (ES), which was interpreted as follows: 0-

0.19 (trivial effect), 0.20-0.49 (small effect), 0.50-0.79 (moderate effect), and 0.80 or higher (large effect) [60]. In addition, McNemar-Bowker test was used to compare pre- and post-test differences in the categorical variables. The level of significance set at $p \leq 0.05$ for all the analyses. All statistical analyses were conducted using IBM SPSS Statistics version 29 (SPSS Inc., Armonk, NY, USA).

Results

Table 5 shows the differences pre and post occlusal splint intervention in ABFG, SBFG, ABG, SBG, and HG in JFLS-8, GAD-7, OHIP-14, WHO-5 and PSQI.

The intervention had a significant effect on all variables in the ABFG. The mean score significantly decreased in JFLS-8 ($p < 0.001$, ES = 1.54), GAD-7 ($p < 0.001$, ES = 1.69), OHIP-14 ($p < 0.001$, ES = 3.52), PSQI ($p < 0.001$, ES = 2.01) in addition to increasing scores on WHO-5 ($p < 0.001$, ES = 1.15).When it comes to the SBFG, it also showed significant changes in JFLS-8 ($p < 0.001$, ES = 1.71), GAD-7 ($p < 0.001$, ES = 1.69), OHIP-14 ($p < 0.001$, ES = 2.61), and PSQI ($p < 0.001$, ES = 2.18), and WHO-5 ($p < 0.001$, ES = 1.10). Regarding the ABG, it also showed significant changes in JFLS-8 ($p < 0.001$, ES = 0.98), OHIP-14 ($p = 0.02$, ES = 0.51), AND WHO-5 ($p = 0.01$, ES = 0.35). However, no significant changes have been observed in GAD-7 ($p = 0.21$, ES = 0.21) and PSQI ($p = 0.17$, ES = 0.16). When it comes to the SBG, it also showed significant changes in JFLS-8 ($p < 0.001$, ES = 1.04), GAD-7 ($p < 0.001$, ES = 0.62), OHIP-14 ($p < 0.001$, ES = 1.15), and PSQI ($p < 0.001$, ES = 0.36). On the other hand, no significant changes have been observed in WHO – 5 ($p = 0.59$, ES = 0.06). For HG, significant changes were only observed in PSQI ($p = 0.01$, ES = 0.25). There were no significant differences in JFLS-8 (p = 0.07, ES = 0.16), GAD-7 (p = 0.52, ES = 0.06), OHIP-14 (p = 0.22, ES = 0.17), and WHO-5 (p = 0.07, ES = 0.25).

Table 5. Differences pre and post occlusal splint intervention on JFLS-8, GAD-7, OHIP-14, WHO-5 and PSQI.

Group	Variables	Pre	Post	*p*	ES
Awake bruxism with fibromyalgia	JFLS-8	17.19 ± 12.09	3.3 ± 3.99	< 0.001	1.54
	GAD-7	14.14 ± 3.93	7.70 ± 3.70	< 0.001	1.69
	OHIP-14	32.70 ± 2.66	14 ± 7.03	< 0.001	3.52
	WHO-5	5.19 ± 2.66	8.84 ± 3.62	< 0.001	1.15
	PSQI	15.81 ± 2.37	11.11 ± 2.31	< 0.001	2.01
Sleep bruxism with fibromyalgia	JFLS-8	18.13 ± 11.85	3.11 ± 3.70	< 0.001	1.71
	GAD-7	13.34 ± 3.84	6.91 ± 3.76	< 0.001	1.69
	OHIP-14	30.77 ± 7.57	11.75 ± 7	< 0.001	2.61
	WHO-5	6.77 ± 3.73	10.77 ± 3.55	< 0.001	1.10
	PSQI	15.64 ± 2.43	10.57 ± 2.22	< 0.001	2.18
Awake bruxism without fibromyalgia	JFLS-8	8.53 ± 9.61	1.58 ± 2.78	< 0.001	0.98
	GAD-7	7.44 ± 4.97	6.43 ± 4.74	0.21	0.21
	OHIP-14	14.53 ± 8.83	10.53 ± 6,72	0.02	0.51
	WHO-5	12.60 ± 5.01	10.78 ± 5.42	0.01	0.35
	PSQI	8.78 ± 3.78	8.22 ± 3.27	0.17	0.16
Sleep bruxism without fibromyalgia	JFLS-8	8.47 ± 10.02	0.93 ± 2.24	< 0.001	1.04
	GAD-7	7.31 ± 4.47	4.78 ± 3.63	< 0.001	0.62
	OHIP-14	15.21 ± 8.61	6.71 ± 5.90	< 0.001	1.15
	WHO-5	12.61 ± 4.99	12.89 ± 4.45	0.59	0.06
	PSQI	8.84 ± 3.73	7.59 ± 3.18	< 0.001	0.36
Healthy group	JFLS-8	2.15 ± 5.11	1.46 ± 3.48	0.07	0.16
	GAD-7	4.07 ± 4.56	3.78 ± 4.38	0.52	0.06
	OHIP-14	6.35 ± 6.98	5.33 ± 4.78	0.22	0.17
	WHO-5	14.74 ± 4.93	13.65 ± 4.54	0.07	0.23
	PSQI	5.78 ± 2.49	5.22 ± 1.99	0.01	0.25

Note: JFLS-8: Jaw functional limitation scale; GAD-7: General Anxiety Disorder-7; OHIP-14: Oral Health Impact Profile-14; WHO-5: World Health Organization Well-Being Index; PSQI: Pittsburgh Sleep Quality Index (PSQI). ES: Effect Size

Table 6 shows the prevalence (%) of temporomandibular disorders pre and post occlusal splint intervention in ABFG, SBFG, ABG, SBG, and HG.

A significant reduction in prevalence of TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), and jaw locking ($p < 0.001$) was found in ABFG. However, no significant changes have been observed in joints sounds ($p = 0.63$) and headache attributed to bruxism ($p = 1.00$). When it comes to SBFG, significant differences were observed on the following variables: TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), and jaw locking ($p < 0.001$). On the other hand, no significant changes have been observed in joint sounds ($p = 0.13$), and headache attributed to bruxism ($p = 0.13$). For the ABG, significant differences were observed in all variables: joint sounds ($p = 0.02$), TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), headache attributed to bruxism ($p = 0.01$), and jaw locking ($p < 0.001$).Regarding the SBG, significant differences were observed in all variables: joint sounds ($p = 0.02$), TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), headache attributed to bruxism ($p < 0.001$), and jaw locking ($p < 0.001$).Finally, in HG there were significant changes in TMJ pain ($p < 0.001$), headache attributed to TMJ ($p < 0.001$), and jaw locking ($p < 0.001$). Nevertheless, no significant changes were found for joint sounds ($p = 0.63$), and headache attributed to bruxism ($p = 0.33$).

Table 6. Frequency (count, n) and prevalence (%) of temporomandibular disorders and well – being pre and post occlusal splint intervention.

Group	Variable	Pre	Post	*p*
Awake bruxism with fibromyalgia	Joint sounds	23 (62.2 %)	21 (56.8 %)	0.63
	TMJ pain	37 (100 %)	22 (59.5 %)	< 0.001
	Headache attributed to TMJ	37 (100 %)	24 (64.9 %)	< 0.001
	Headache attributed to bruxism	36 (97.3 %)	35 (94.6 %)	1.00
	Jaw locking	17 (45.9 %)	1 (2.7 %)	< 0.001
Sleep bruxism with fibromyalgia	Joint sounds	35 (66 %)	30 (56.6 %)	0.13
	TMJ pain	53 (100 %)	27 (50.9 %)	< 0.001
	Headache attributed to TMJ	52 (98.1 %)	31 (58.5 %)	< 0.001
	Headache attributed to bruxism	52 (98.1 %)	47 (28.7 %)	0.13
	Jaw locking	24 (45.3 %)	1 (1.9 %)	< 0.001
Awake bruxism without fibromyalgia	Joint sounds	22 (48.89%)	15 (33.3 %)	0.02
	TMJ pain	37 (82.2%)	20 (44.44%)	< 0.001
	Headache attributed to TMJ	39 (86.67 %)	19 (42.22 %)	< 0.001
	Headache attributed to bruxism	35 (77.77 %)	26 (57.68 %)	0.01
	Jaw locking	13 (28.89 %)	1 (0.02 %)	< 0.001
Sleep bruxism without fibromyalgia	Joint sounds	43 (50.6%)	23 (27.1 %)	< 0.001
	TMJ pain	67 (78.8 %)	18 (21.2 %)	< 0.001
	Headache attributed to TMJ	68 (80 %)	22 (25.9 %)	< 0.001
	Headache attributed to bruxism	74 (87.11 %)	29 (34.1 %)	< 0.001
	Jaw locking	18 (21.2 %)	1 (1.2 %)	< 0.001
Healthy group	Joint sounds	12 (26.1 %)	10 (21.7 %)	0.63
	TMJ pain	18 (39.1 %)	7 (15.2 %)	<0.001
	Headache attributed to TMJ	26 (56.5 %)	10 (21.7 %)	< 0.001
	Headache attributed to bruxism	17 (37.0 %)	12 (26.1 %)	0.33
	Jaw locking	8 (17.4 %)	0 (0.0 %)	0.01

Note: TMJ = temporomandibular joint.

CHAPTER 7

Discussion

CHAPTER 7

Discussion

The thesis titled *"Temporomandibular disorders, well-being, and bruxism in patients with fibromyalgia. Effect of treatment with occlusal splints"* comprises three studies that explore the complex relationships between TMDs, well-being, bruxism, and fibromyalgia, as well as evaluating the therapeutic effect of occlusal splints. Each of the studies contributes to a comprehensive understanding from epidemiological, clinical, and therapeutic perspectives.

The first study examines the impact of TMD on emergency department visits, highlighting that while TMD accounts for a small percentage of cases, its associated pain and dysfunction significantly affect patient well-being. The discussion explores the prevalence and severity of key symptoms such as mandibular locking, TMJ pain, and joint noises, emphasizing their variability due to different diagnostic criteria and patient-specific factors [64].

Psychological comorbidities, particularly anxiety, depression, and sleep disturbances, play a crucial role in TMD-related emergencies [65]. Higher GAD-7 anxiety scores and poor sleep quality (PSQI) are linked to increased pain severity and a greater likelihood of seeking emergency care [66]. The study also examines the role of bruxism, noting its strong correlation with stress and psychiatric conditions, though its direct impact on muscle pain remains debated [67,68].

Patients with fibromyalgia and TMD tend to visit emergency departments more frequently due to widespread pain, fatigue, and non-restorative sleep [69]. This overlap in symptomatology suggests a need for a multidisciplinary approach to diagnosis and

treatment. The study also outlines effective emergency management strategies, favoring conservative approaches such as pharmacological treatments, physical therapy, and psychological support [70]. In more complex cases, interventions like trigger-point injections or neuromodulatory medications may be considered [71].

Key clinical variables, including pain severity, mandibular mobility, comorbid anxiety, and recent dental interventions, can help predict emergency department visits in TMD patients [72]. Referral to specialists is recommended when conservative treatments fail, particularly in cases involving persistent pain, myalgia, myofascial pain, or degenerative joint conditions [73]. A biopsychosocial treatment approach and targeted referral pathways can improve patient outcomes and optimize emergency care for TMD.

In the second article, the primary objective of this study was to analyze the TMD, bruxism, and well-being experienced by patients with fibromyalgia syndrome and compare these disorders with a control group. One of the main findings of this study was that patients with fibromyalgia had greater prevalence than the control group in TMJ pain, headache attributed to TMD, jaw locking, headache attributed to bruxism, sleep bruxism, and awake bruxism. Another main finding was that patients with fibromyalgia had greater jaw functional limitation, generalized anxiety, and impact of oral health on an individual's life. In addition, fibromyalgia patients showed lower sleep quality and well-being index.

All these results were in line with the primary hypothesis. For instance, the null hypothesis for the independence of the variables at the 95% confidence level was rejected and the alternative hypothesis was accepted (i.e., the type of population and TMD/bruxism were significantly associated. When it comes to the categorical variables, our findings are consistent with the literature [74]. For instance, a previous investigation observed that the most common sign and symptoms reported by fibromyalgia patients

were TMJ pain, masticatory muscle pain, TMJ sound, and altered jaw movements [74]. Also, it was noted that the majority of subjects exhibited 2 or 3 of these signs concurrently [74]. Among these signs, clicking during mouth opening and closing was the most prevalent when joint sound was present [74]. These findings suggest that many patients with fibromyalgia display clinical features consistent with TMD [74]. In addition, according to the probable diagnosis of bruxism, it appears to be more prevalent among individuals with fibromyalgia [75,76]. Although, other studies support the idea that patients who acknowledge clenching and grinding their teeth are more likely to accept the notion, based on the evidence reviewed, that these behaviors, including sleep bruxism, could serve as indicators of a propensity to respond to emotional stress with muscular tension [76]. Moreover, headaches (highly prevalent since, for instance, 70-73 % of patients with fibromyalgia may suffer from headache) [77–79] were among the most common symptoms used in the diagnosis of TMD, which is also in line with previous investigations. For example, a study highlights a greater occurrence of headaches in individuals diagnosed with fibromyalgia [76]. Based on these findings, the authors recommended screening for concurrent fibromyalgia, showing moderate to severe depressive symptoms, heightened headache intensity, and/or significant headache-related disability [79].

The findings of this study are in line of previous research. For example, in a particular study, which used the JFLS-8 form to assess restricted mandibular function, the scores were also higher among participants in the fibromyalgia group compared to those in the healthy group [76]. Another study delved into the clinical manifestations among individuals dealing with painful TMD alongside coexisting conditions like fibromyalgia[80]. In comparison to controls, those with painful TMD and concurrent comorbidities exhibited heightened symptoms of anxiety and depression using the GAD-7 [80]. Overall, this has been observed in multiple studies involving TMD population and analysis of

psychological well-being and distress since significant differences compared to non-TMD symptoms groups in variables like anxiety, stress, or depression [81,82]. In addition, another study evaluating oral health related quality of life values found that participants more severely affected by fibromyalgia had greater negative oral health related quality of life values [83]. In summary, all these results suggest that the implication of scales like OHIP-14, GAD-7, WHO-5, or JFLS-8 are necessary when evaluating dental conditions in patients dealing with fibromyalgia [83]. Furthermore, another novelty of this study is the addition of sleep quality assessment with tools like the PSQI, whose correlation with TMD is crucial to explore [84,85]. Previous investigations observed that the presence of intra-articular and pain related TMD increased the likelihood of experiencing poor sleep [84,85]. Therefore, analyzing the routine assessment of sleep quality in clinical practice is recommended and therapeutic interventions aimed at enhancing sleep could be beneficial for a more comprehensive treatment approach to TMD [85].

Finally, it is important to acknowledge some of limitations of this study. For instance, data were collected relying on participants responses to the online form. No physical examination was conducted to confirm some of the signs reported by the patients in the questionnaires. Additionally, regarding the tests of quality sleep, other sleep problems such as insomnia, sleep apnea, narcolepsy, periodic limb movement, and rapid eye movement (REM) sleep behavior disorders were not considered. Moreover, another limitation of the study is the potential influence of uncontrolled factors within the fibromyalgia group that may affect the results. For example, the use of medication by fibromyalgia patients and the age differences may have played a role. These and other unmeasured variables make it challenging to determine whether the observed differences are solely due to the fibromyalgia diagnosis."

In addition, this study did not distinguish between closed and open jaw locks, and some diagnostic criteria may present limitations (e.g., possible sleep or awake bruxism). Finally, future research could benefit from specifically analyzing the TMD, bruxism, and well-being experienced by both male and female patients with fibromyalgia.

The third study aims to evaluate the effectiveness of non-invasive treatment using Michigan-type occlusal appliances in reducing TMDs pain, bruxism, and improving well-being among patients with fibromyalgia in comparation with healthy group. The results of our study indicate that the occlusal appliance intervention had a significant positive effect in jaw function, anxiety, oral health impact, well-being, and sleep quality among both fibromyalgia patients and healthy individuals. Additionally, the intervention significantly decreased TMJ pain, and headache attributed to TMJ in fibromyalgia patients; however, no significant changes were observed on variables such as bruxism, joint sounds, and headache attributed to bruxism. Another main finding was that the healthy group experienced significant changes following the intervention, except for sleep bruxism.

Our study found a significant reduction in the JFLS-8 scores for both fibromyalgia and healthy groups, highlighting the effectiveness of occlusal appliance therapy in improving jaw function. Our results align with those of Molina-Torres et al, who reported a reduction in TMD symptoms in fibromyalgia patients after occlusal splint therapy [10]. However, unlike their study, we did not observe significant improvements in bruxism prevalence. This discrepancy may be due to differences in study duration [10]. This study also noted a reduction in anxiety levels, which aligns with our findings of decreased GAD-7 scores post-intervention [10]. Erik et al, indicates considerable decrease in scores on the functional jaw limitation scale and depression, in patients without fibromyalgia treated with

appliance stabilization combined with jaw exercise therapy [86].The consistency of these results underscores the therapeutic potential of occlusal appliances in managing TMDs and associated anxiety in fibromyalgia patients [10]. With regard to the dissemination of the results in reference to the OHIP-14 and the increase in the Well-Being Index scores, we can deduce that there is an improvement in oral health and general well-being [87]. Additionally, the reduction in psychological distress (lower GAD-7 scores) suggests that anxiety management plays a crucial role in the perception of TMD pain. Given the strong biopsychosocial component of both fibromyalgia and TMD, the observed improvements may be partly due to the placebo effect or increased patient awareness of relaxation techniques, as suggested by Shedden-Mora et al [87]. In a study of self-perceived quality of life in patients without fibromyalgia, significant changes were observed in a population with the same intervention as our study [88]. However, there were no significant differences in improvement rates between subjects with acute and chronic pain [88]. The improvement in well-being scores in our study highlights the broader impact of TMDs treatment on patients' quality of life [87].

In addition, a notable improvement in sleep quality, was observed in our study. This finding is supported by Hara et al, who reported that a novel vibratory stimulation-based occlusal appliance effectively alleviated painful symptoms of TMDs and improved sleep quality [89]. The persistence of high sleep bruxism prevalence in the fibromyalgia group, despite overall improvements, suggests a chronic condition that may require adjunctive treatments [89]. This highlights the complexity of managing TMDs in fibromyalgia patients and the need for comprehensive treatment strategies [89]. Moreover, the results of Jiang et al, who emphasized the multifaceted approach needed to treat masticatory muscle disorders and the potential of prosthodontic interventions to reduce TMDs, are consistent

with the findings of our results, where we found a significant reduction in the prevalence of TMJ pain, and headaches attributed to TMJ and bruxism [90].

Despite the overall improvements, our study observed the persistence of a high prevalence of sleep bruxism in the fibromyalgia group is shown with the observations of Balasubramaniam et al, who reported a high prevalence of TMDs in fibromyalgia patients [91]. The lack of improvement in sleep and awake bruxism suggests that occlusal splints may not be sufficient to modify parafunctional habits in the short term [87]. Previous research Harada et al, indicates that bruxism may be primarily regulated by central nervous system mechanisms, requiring longer treatment durations or additional behavioral interventions for significant changes [92]. Regarding the variables that do not show significant changes in the fibromyalgia group, we can deduce that people suffering from this disease have a set of associated comorbidities that hinder the effectiveness of the treatment, especially in the variables that require more time to adapt to our proposed treatment. In addition, due to the osteoarthritis associated with this group of people, it is understandable that joint sounds do not vary.

Finally, it is important to acknowledge some limitations of this study. Specifically, the data were collected based on participants' responses to an online form, and no physical examinations were conducted to verify the signs reported by the patients in the questionnaires. Another limitation of this study is that there is a lack of a control group, which does not take part in an intervention. Finally, since participants were non-randomly allocated, potential selection bias cannot be excluded. Future research should include longer follow-ups, randomized controlled designs, and multimodal interventions to confirm these findings. Since this is research conducted in a clinical context in which every patient that comes to the clinic seeks for a treatment.

Lastly, the four-study aimed to analyze the effect of an occlusal splint intervention on TMDs and overall well-being in five specific groups: (1) patients with awake bruxism and fibromyalgia, (2) patients with sleep bruxism and fibromyalgia (3) patients with awake bruxism without fibromyalgia, (4) patients with sleep bruxism without fibromyalgia, and (5) a group of healthy individuals without bruxism or fibromyalgia. The variables analyzed included measures of mandibular function, anxiety, oral health, well-being, sleep quality, and specific TMJ symptoms, such as joint noises, temporomandibular. The occlusal splint intervention resulted in significant positive effects in ABFB, SBFB, ABG, and SBG. While HG also showed improvements after treatment, these were less pronounced compared to the other groups. The findings of this study suggest that occlusal splints may contribute to improvements in TMD symptoms and psychological well-being in patients with bruxism and fibromyalgia. However, given the study design, these results should be interpreted with caution. The observed benefits may be partially explained by other factors such as behavioral counseling and patient expectations.

Firstly, in the ABFB group, the occlusal splint intervention showed significant improvement in multiple TMD-related symptoms, including TMJ pain, joint noises, mandibular locking, and reductions in JFLS-8 scores. These results suggest that the use of splints may alleviate the overload on the TMJ in patients exhibiting both bruxism and fibromyalgia. Molina-Torres et al, in their study comparing laser therapy on pain trigger points and the use of stabilization splints, concluded that both can be effective therapeutic treatments for reducing pain symptoms and the clicking sounds associated with TMD in patients with fibromyalgia [10]. Additionally, this group showed an improvement in both psychological and physical well-being, as reflected in the scores of the GAD-7, OHIP-14, WHO-5, and PSQI questionnaires. However, in a study by Raphael et al, it was

concluded that after splint treatment, the average mood score did not differ significantly between the subjects [93].

Secondly, for the SBFB group, the intervention also resulted in significant improvements in TMD-related symptoms, particularly in TMJ pain, mandibular locking, and reductions in JFLS-8 scores. Improvements in GAD-7, OHIP-14, WHO-5, and PSQI scores also reflected enhancements in overall well-being and sleep quality. This is consistent with prior studies, such as Gomes et al, which demonstrated that the use of splint therapy in the treatment of sleep bruxism creates a biomechanical balance between the physiological load and that generated by stress [63]. This suggests that such treatment may lead to the stabilization of bruxism by reducing deformations and deviations in the TMJ, thereby decreasing the load on the joint [63].

Patients in the ABG also exhibited significant improvements in mandibular function, as indicated by JFLS-8 scores, along with enhancements in oral health and overall well-being (as measured by OHIP-14 and WHO-5). However, the improvements in anxiety (GAD-7) and sleep quality (PSQI) did not reach statistical significance in this group. This suggests that while the splint has a positive impact on certain aspects of TMD and overall well-being, the effects may be less pronounced concerning anxiety reduction and sleep improvement in patients with bruxism without fibromyalgia. This finding supports studies such as that by Ainoosah et al, which observed that adjustable splints, such as full-occlusion biofeedback splints, were more effective in reducing episodes of sleep bruxism, improving patient-reported symptoms, and enhancing overall well-being [94]. Although our study showed smaller changes in the WHO-5 well-being test, positive post-treatment changes were still observed [94].

In the SBG, the intervention led to significant improvements JFLS-8, GAD-7, OHIP-14, and PSQI. However, the WHO-5 did not show statistically significant changes. These results suggest that for patients with sleep bruxism, the occlusal splint may be beneficial in alleviating specific TMD symptoms and improving physical aspects, but its impact on overall well-being may be limited in comparison to other groups. This finding supports research by Garstka et al, who indicated that the combination of splint use with behavioral and physiotherapy interventions could maximize benefits for patients with bruxism and TMD [95].

Finally, in the HG, significant improvements were only observed in PSQI after the use of the occlusal splint, while other variables, such as JFLS-8, GAD-7, and WHO-5, did not show statistically significant changes. This suggests that while the use of splints may enhance certain aspects of sleep-in healthy individuals, their impact on other aspects of well-being and mandibular function is minimal in the absence of TMD or evident bruxism. These findings align with studies highlighting the importance of combining splint use with additional interventions for those without apparent mandibular or bruxism-related issues. On the other hand, we concur with the statements made by Minakuchi et al [96], in their study, which highlights that for some patients, using the splint at night represents a safe and relatively effective management approach to reduce the frequency and intensity of bruxism [96].

Ultimately, it is also important to acknowledge some limitations of this study. Specifically, the first limitation of this study is the small sample size of registered patients. Another limitation of this that bruxism was assessed using self-reported questionnaires rather than instrumental diagnostic tools, such as polysomnography or electromyography. This may lead to an overestimation of bruxism prevalence, and future studies should aim

to validate self-reported data with objective measures. The assessment of well-being was based on self-reported questionnaires, and its improvements may be indirectly related to pain reduction rather than a direct effect of the intervention. Future research should explore additional dimensions of well-being beyond self-reported questionnaires. Moreover, is that there is a lack of a control group, which does not take part in an intervention, since this is research conducted in a clinical context in which every patient that comes to the clinic seeks for a treatment.

CHAPTER 8

Conclusion

CHAPTER 8

Conclusion

1. In the first study, highlights the clinical characteristics, predictive factors, and management strategies for TMDs in emergency settings. Although TMDs represent a small fraction of emergency visits, acute episodes of pain, mandibular locking, and bruxism require prompt and specific care. Psychological factors, such as anxiety and sleep disorders, significantly influence the clinical presentation and frequency of these visits. Given the bidirectional relationship between TMDs and psychological comorbidities, an integrated biopsychosocial approach is essential. Effective management should combine pharmacological, physical, and psychological interventions to reduce symptoms and prevent chronicity. Early identification and referral of high-risk patients, especially those with complex conditions like fibromyalgia, are key to improving outcomes and patient quality of life.

2. In the second study, showed that patients with fibromyalgia had greater prevalence than the control group in TMJ pain, headache attributed to TMD, jaw locking, headache attributed to bruxism, sleep bruxism, and awake bruxism. Another main finding was that patients with fibromyalgia had greater jaw functional limitation, generalized anxiety, and impact of oral health on an individual's life. In addition, fibromyalgia patients showed lower sleep quality and well-being index.

3. In the third study, provides strong evidence that Michigan-type occlusal splints significantly improve jaw function, reduce anxiety, enhance oral health, and improve sleep quality in fibromyalgia patients with TMDs. Additionally, the intervention led to a significant reduction in TMJ pain, jaw locking, and headaches attributed to TMD, demonstrating the effectiveness of occlusal splint therapy as a non-invasive treatment for TMD symptoms in this population. Despite these benefits, occlusal splints did not significantly reduce bruxism prevalence. This finding suggests that bruxism may be regulated by central nervous system mechanisms rather than occlusal factors alone, highlighting the need for additional behavioral therapy, cognitive interventions, or pharmacological approaches in conjunction with splint therapy. Given these findings, occlusal splints should be considered an effective, non-invasive therapeutic option for managing TMD symptoms in fibromyalgia patients. However, clinicians should be aware that a multidisciplinary approach may be necessary to fully address symptoms such as persistent bruxism. Future research should focus on long-term follow-up studies to assess the sustained effects of occlusal splints beyond one month. Additionally, randomized controlled trials using objective bruxism assessments (e.g., electromyography) are needed to determine the full impact of occlusal splints on parafunctional habits. Exploring multimodal treatment approaches, including behavioral therapy and physiotherapy, may provide further insights into optimizing care for fibromyalgia patients with TMDs.

4. In the fourth study, demonstrates that occlusal splints significantly improve symptoms related to TMDs and overall well-being, particularly in patients with

fibromyalgia (ABFB and SBFB groups). Significant reductions were observed in JFLS-8, GAD-7, OHIP-14, PSQI, and increases in WHO-5, highlighting the multifaceted benefits of occlusal splints for this population. Notably, the intervention also led to a marked decrease in the prevalence of TMJ pain, headaches attributed to TMJ, and jaw locking among fibromyalgia patients, underscoring the potential of occlusal splints as an effective therapeutic option for managing both physical and psychological symptoms in this vulnerable group. Overall, splint therapy effect in TMDs and associated symptoms in patients with fibromyalgia and bruxism, but benefits for healthy individuals are minimal. Further studies may explore the long-term effects and optimize treatment protocols.

REFERENCES

References

1. Ohrbach R, Bair E, Fillingim RB, et al. Clinical Orofacial Characteristics Associated With Risk of First-Onset TMD: The OPPERA Prospective Cohort Study. *J Pain*. 2013;14(12):T33-T50. doi:10.1016/j.jpain.2013.07.018
2. Song YL, Yap AU jin. Impact of pain-related temporomandibular disorders on jaw functional limitation, psychological distress and quality of life in postoperative class III East Asian patients. *Clin Oral Investig*. 2020;24(2):953-961. doi:10.1007/s00784-019-02994-x
3. Tchivileva IE, Ohrbach R, Fillingim RB, et al. Clinical, psychological, and sensory characteristics associated with headache attributed to temporomandibular disorder in people with chronic myogenous temporomandibular disorder and primary headaches. *J Headache Pain*. 2021;22(1):42. doi:10.1186/s10194-021-01255-1
4. Hoffmann RG, Kotchen JM, Kotchen TA, Cowley T, Dasgupta M, Cowley AW. Temporomandibular Disorders and Associated Clinical Comorbidities. *Clin J Pain*. 2011;27(3):268-274. doi:10.1097/AJP.0b013e31820215f5
5. Gonçalves DAG, Bigal ME, Jales LCF, Camparis CM, Speciali JG. Headache and Symptoms of Temporomandibular Disorder: An Epidemiological Study. *Headache: The Journal of Head and Face Pain*. 2010;50(2):231-241. doi:10.1111/j.1526-4610.2009.01511.x
6. Albagieh H, Alomran I, Binakresh A, et al. Occlusal splints-types and effectiveness in temporomandibular disorder management. *Saudi Dent J*. 2023;35(1):70-79. doi:10.1016/j.sdentj.2022.12.013
7. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. *J Craniomandib Disord*. 1992;6(4):301-355.
8. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. *J Oral Facial Pain Headache*. 2014;28(1):6-27. doi:10.11607/jop.1151
9. Wolfe F, Clauw DJ, Fitzcharles MA, et al. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. *Semin Arthritis Rheum*. 2016;46(3):319-329. doi:10.1016/j.semarthrit.2016.08.012
10. Molina-Torres G, Rodríguez-Archilla A, Matarán-Peñarrocha G, Albornoz-Cabello M, Aguilar-Ferrándiz ME, Castro-Sánchez AM. Laser Therapy and Occlusal Stabilization Splint for Temporomandibular Disorders in Patients With Fibromyalgia Syndrome: A Randomized, Clinical Trial. *Altern Ther Health Med*. 2016;22(5):23-31.
11. Queiroz LP. Worldwide Epidemiology of Fibromyalgia. *Curr Pain Headache Rep*. 2013;17(8):356. doi:10.1007/s11916-013-0356-5
12. Carta MG, Moro MF, Pinna FL, et al. The impact of fibromyalgia syndrome and the role of comorbidity with mood and post-traumatic stress disorder in worsening the quality of life. *Int J Soc Psychiatry*. 2018;64(7):647-655. doi:10.1177/0020764018795211

13. Yunus MB. Fibromyalgia and Overlapping Disorders: The Unifying Concept of Central Sensitivity Syndromes. *Semin Arthritis Rheum*. 2007;36(6):339-356. doi:10.1016/j.semarthrit.2006.12.009
14. Park DJ, Lee SS. New insights into the genetics of fibromyalgia. *Korean J Intern Med*. 2017;32(6):984-995. doi:10.3904/kjim.2016.207
15. Okifuji A, Gao J, Bokat C, Hare BD. Management of fibromyalgia syndrome in 2016. *Pain Manag*. 2016;6(4):383-400. doi:10.2217/pmt-2016-0006
16. Matusz K, Maciejewska-Szaniec Z, Gredes T, et al. Common therapeutic approaches in sleep and awake bruxism — an overview. *Neurol Neurochir Pol*. 2022;56(6):455-463. doi:10.5603/PJNNS.a2022.0073
17. Aaron LA, Burke MM, Buchwald D. Overlapping Conditions Among Patients With Chronic Fatigue Syndrome, Fibromyalgia, and Temporomandibular Disorder. *Arch Intern Med*. 2000;160(2):221. doi:10.1001/archinte.160.2.221
18. Bidari A, Ghavidel-Parsa B. Nociplastic pain concept, a mechanistic basis for pragmatic approach to fibromyalgia. *Clin Rheumatol*. 2022;41(10):2939-2947. doi:10.1007/s10067-022-06229-5
19. Hedenberg-Magnusson B, Ernberg M, Kopp S. Presence of orofacial pain and temporomandibular disorder in fibromyalgia. A study by questionnaire. *Swed Dent J*. 1999;23(5-6):185-192.
20. Alonso-Blanco C, Fernández-de-las-Peñas C, de-la-Llave-Rincón AI, Zarco-Moreno P, Galán-del-Río F, Svensson P. Characteristics of referred muscle pain to the head from active trigger points in women with myofascial temporomandibular pain and fibromyalgia syndrome. *J Headache Pain*. 2012;13(8):625-637. doi:10.1007/s10194-012-0477-y
21. Losert-Bruggner B, Hülse M, Hülse R. Fibromyalgia in patients with chronic CCD and CMD - A retrospective study of 555 patients. *CRANIO®*. Published online June 5, 2017:1-9. doi:10.1080/08869634.2017.1334376
22. Ayouni I, Chebbi R, Hela Z, Dhidah M. Comorbidity between fibromyalgia and temporomandibular disorders: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2019;128(1):33-42. doi:10.1016/j.oooo.2019.02.023
23. Lukic N, Saxer T, Hou M, Zumbrunn Wojczyńska A, Gallo LM, Colombo V. Short-term effects of NTI-tss and Michigan splint on nocturnal jaw muscle activity: A pilot study. *Clin Exp Dent Res*. 2021;7(3):323-330. doi:10.1002/cre2.371
24. LeResche L. Epidemiology of Temporomandibular Disorders: Implications for the Investigation of Etiologic Factors. *Critical Reviews in Oral Biology & Medicine*. 1997;8(3):291-305. doi:10.1177/10454411970080030401
25. Resende CMBM de, Rocha LGD da S, Paiva RP de, et al. Relationship between anxiety, quality of life, and sociodemographic characteristics and temporomandibular disorder. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2020;129(2):125-132. doi:10.1016/j.oooo.2019.10.007
26. Reissmann D, John M, Seedorf H, Doering S, Schierz O. Temporomandibular Disorder Pain Is Related to the General Disposition to be Anxious. *J Oral Facial Pain Headache*. 2018;28(4):322-330. doi:10.11607/ofph.1277
27. Karaman A, Sadry S. Evaluation of temporomandibular disorders and oral health-related quality of life with obese patients. *CRANIO®*. 2021;39(6):510-517. doi:10.1080/08869634.2019.1694777

28. Gadbury-Amyot C, Austin K, Simmer-Beck M. A review of the oral health-related quality of life (<scp>OHRQL</scp>) model for dental hygiene: Eighteen years later. *Int J Dent Hyg*. 2018;16(2):267-278. doi:10.1111/idh.12277
29. Yap AU, Qiu LY, Natu VP, Wong MC. Functional, physical and psychosocial impact of Temporomandibular Disorders in adolescents and young adults. *Med Oral Patol Oral Cir Bucal*. Published online 2020:0-0. doi:10.4317/medoral.23298
30. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. *J Oral Facial Pain Headache*. 2014;28(1):6-27. doi:10.11607/jop.1151
31. 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;22(3):219-230.
32. Manfredini D, Lobbezoo F. Relationship between bruxism and temporomandibular disorders: a systematic review of literature from 1998 to 2008. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2010;109(6):e26-e50. doi:10.1016/j.tripleo.2010.02.013
33. Oliveira MT de, Bittencurt ST, Marcon K, Destro S, Pereira JR. Sleep bruxism and anxiety level in children. *Braz Oral Res*. 2015;29(1):1-5. doi:10.1590/1807-3107BOR-2015.vol29.0024
34. Siracusa R, Paola R Di, Cuzzocrea S, Impellizzeri D. Fibromyalgia: Pathogenesis, Mechanisms, Diagnosis and Treatment Options Update. *Int J Mol Sci*. 2021;22(8):3891. doi:10.3390/ijms22083891
35. Slade GD, Ohrbach R, Greenspan JD, et al. Painful Temporomandibular Disorder. *J Dent Res*. 2016;95(10):1084-1092. doi:10.1177/0022034516653743
36. Gui MS, Pimentel MJ, Rizzatti-Barbosa CM. Disfunção temporomandibular na síndrome da fibromialgia: comunicação breve. *Rev Bras Reumatol*. 2015;55(2):189-194. doi:10.1016/j.rbr.2014.07.004
37. Iturriaga V, Bornhardt T, Velasquez N. Temporomandibular Joint. *Dent Clin North Am*. 2023;67(2):199-209. doi:10.1016/j.cden.2022.11.003
38. Toyota R, Fukui K ichi, Kamimura M, et al. Sleep stage-dependent changes in tonic masseter and cortical activities in young subjects with primary sleep bruxism. *Sleep*. 2022;45(4). doi:10.1093/sleep/zsab207
39. Chattrattrai T, Blanken TF, Lobbezoo F, Su N, Aarab G, Van Someren EJW. A network analysis of self-reported sleep bruxism in the Netherlands sleep registry: its associations with insomnia and several demographic, psychological, and life-style factors. *Sleep Med*. 2022;93:63-70. doi:10.1016/j.sleep.2022.03.018
40. Lobbezoo F, Ahlberg J, Raphael KG, et al. International consensus on the assessment of bruxism: Report of a work in progress. *J Oral Rehabil*. 2018;45(11):837-844. doi:10.1111/joor.12663
41. Sánchez Romero EA, Martínez-Pozas O, García-González M, et al. Association between Sleep Disorders and Sleep Quality in Patients with

Temporomandibular Joint Osteoarthritis: A Systematic Review. *Biomedicines*. 2022;10(9):2143. doi:10.3390/biomedicines10092143
42. McNeely ML, Armijo Olivo S, Magee DJ. A systematic review of the effectiveness of physical therapy interventions for temporomandibular disorders. *Phys Ther*. 2006;86(5):710-725.
43. Crout DK. Anatomy of an occlusal splint. *Gen Dent*. 2017;65(2):52-59.
44. Jokubauskas L, Baltrušaitytė A, Pileičikienė G. Oral appliances for managing sleep bruxism in adults: a systematic review from 2007 to 2017. *J Oral Rehabil*. 2018;45(1):81-95. doi:10.1111/joor.12558
45. Minakuchi H, Fujisawa M, Abe Y, et al. Managements of sleep bruxism in adult: A systematic review. *Japanese Dental Science Review*. 2022;58:124-136. doi:10.1016/j.jdsr.2022.02.004
46. Barth SW, Lehner MD, Dietz GPH, Schulze H. Pharmacologic treatments in preclinical tinnitus models with special focus on Ginkgo biloba leaf extract EGb 761®. *Molecular and Cellular Neuroscience*. 2021;116:103669. doi:10.1016/j.mcn.2021.103669
47. Wall T, Nasseh K. Dental-related emergency department visits on the increase in the United States. *American Dental Association*. Published online 2013.
48. Costa YM, Conti PCR, de Faria FAC, Bonjardim LR. Temporomandibular disorders and painful comorbidities: clinical association and underlying mechanisms. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2017;123(3):288-297. doi:10.1016/j.oooo.2016.12.005
49. Moreno-Hay I, Bender SD. Bruxism and oro-facial pain not related to temporomandibular disorder conditions: Comorbidities or risk factors? *J Oral Rehabil*. 2024;51(1):196-201. doi:10.1111/joor.13581
50. McNeill C, Mohl ND, Rugh JD, Tanaka TT. Temporomandibular Disorders: Diagnosis, Management, Education, and Research. *The Journal of the American Dental Association*. 1990;120(3):253-263. doi:10.14219/jada.archive.1990.0049
51. Woolf CJ. Central sensitization: Implications for the diagnosis and treatment of pain. *Pain*. 2011;152(3):S2-S15. doi:10.1016/j.pain.2010.09.030
52. Berger M, Oleszek-Listopad J, Marczak M, Szymanska J. Psychological aspects of temporomandibular disorders – literature review. *Current Issues in Pharmacy and Medical Sciences*. 2015;28(1):55-59. doi:10.1515/cipms-2015-0044
53. Kim C, Choi E, Park KM, Kwak EJ, Huh J, Park W. Characteristics of patients who visit the dental emergency room in a dental college hospital. *J Dent Anesth Pain Med*. 2019;19(1):21-27. doi:10.17245/jdapm.2019.19.1.21
54. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A Brief Measure for Assessing Generalized Anxiety Disorder. *Arch Intern Med*. 2006;166(10):1092. doi:10.1001/archinte.166.10.1092
55. Campos LA, Peltomäki T, Marôco J, Campos JADB. Use of Oral Health Impact Profile-14 (OHIP-14) in Different Contexts. What Is Being Measured? *Int J Environ Res Public Health*. 2021;18(24):13412. doi:10.3390/ijerph182413412

56. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 Well-Being Index: A Systematic Review of the Literature. *Psychother Psychosom*. 2015;84(3):167-176. doi:10.1159/000376585
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(2):193-213. doi:10.1016/0165-1781(89)90047-4
58. Lobbezoo F, Ahlberg J, Glaros AG, et al. Bruxism defined and graded: an international consensus. *J Oral Rehabil*. 2013;40(1):2-4. doi:10.1111/joor.12011
59. Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders, 3rd edition. *Cephalalgia*. 2018;38(1):1-211. doi:10.1177/0333102417738202
60. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. L. Erlbaum Associates; 1988.
61. 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(2):193-213. doi:10.1016/0165-1781(89)90047-4
62. Manfredini D, Ahlberg J, Aarab G, et al. Standardised Tool for the Assessment of Bruxism. *J Oral Rehabil*. 2024;51(1):29-58. doi:10.1111/joor.13411
63. Andre Fidelis de Paula GOMES C, El-HAGE Y, Paula AMARAL A, et al. Effects of Massage Therapy and Occlusal Splint Usage on Quality of Life and Pain in Individuals with Sleep Bruxism: A Randomized Controlled Trial. *Journal of the Japanese Physical Therapy Association*. 2015;18(1):1-6. doi:10.1298/jjpta.Vol18_001
64. Šimunović L, Lapter Varga M, Negovetić Vranić D, Čuković-Bagić I, Bergman L, Meštrović S. The Role of Malocclusion and Oral Parafunctions in Predicting Signs and Symptoms of Temporomandibular Disorders—A Cross-Sectional Study. *Dent J (Basel)*. 2024;12(7):213. doi:10.3390/dj12070213
65. Staniszewski K, Lygre H, Bifulco E, et al. Temporomandibular Disorders Related to Stress and HPA-Axis Regulation. *Pain Res Manag*. 2018;2018:1-7. doi:10.1155/2018/7020751
66. Smith MT, Wickwire EM, Grace EG, et al. Sleep Disorders and their Association with Laboratory Pain Sensitivity in Temporomandibular Joint Disorder. *Sleep*. 2009;32(6):779-790. doi:10.1093/sleep/32.6.779
67. Lobbezoo F, Lavigne GJ. Do bruxism and temporomandibular disorders have a cause-and-effect relationship? *J Orofac Pain*. 1997;11(1):15-23. Accessed December 8, 2024. http://www.ncbi.nlm.nih.gov/pubmed/10332307
68. Lund JP, Donga R, Widmer CG, Stohler CS. The pain-adaptation model: a discussion of the relationship between chronic musculoskeletal pain and motor activity. *Can J Physiol Pharmacol*. 1991;69(5):683-694. doi:10.1139/y91-102
69. Esteve M, Rosales-Leal JI. Analysis of Temporomandibular Disorders, Bruxism and Well-Being in Patients With Fibromyalgia Syndrome: A Case–Control Study. *J Oral Rehabil*. Published online November 18, 2024. doi:10.1111/joor.13908

70. Ghurye S, McMillan R. Orofacial pain – an update on diagnosis and management. *Br Dent J*. 2017;223(9):639-647. doi:10.1038/sj.bdj.2017.879
71. Jeffrey P. Okeson. *Management of Temporomandibular Disorders and Occlusion*. 7th ed.; 2012.
72. Durham J, Newton-John TRO, Zakrzewska JM. Temporomandibular disorders. *BMJ*. 2015;350(mar12 9):h1154-h1154. doi:10.1136/bmj.h1154
73. Renton T. Persistent Pain after Dental Surgery. *Rev Pain*. 2011;5(1):8-17. doi:10.1177/204946371100500103
74. Fraga BP, Santos EB, Farias Neto JP, et al. Signs and Symptoms of Temporomandibular Dysfunction in Fibromyalgic Patients. *Journal of Craniofacial Surgery*. 2012;23(2):615-618. doi:10.1097/SCS.0b013e31824cd81a
75. Bracha HS, Ralston TC, Williams AE, Yamashita JM, Bracha AS. The Clenching-Grinding Spectrum and Fear Circuitry Disorders: Clinical Insights from the Neuroscience/Paleoanthropology Interface. *CNS Spectr*. 2005;10(4):311-318. doi:10.1017/S109285290002263X
76. Sahbaz T, Karacay BC. Investigation of temporomandibular disorders in patients with fibromyalgia syndrome: A case-control study. *J Stomatol Oral Maxillofac Surg*. 2023;124(1):101296. doi:10.1016/j.jormas.2022.09.017
77. Pöyhiä R, Da Costa D, Fitzcharles MA. Previous pain experience in women with fibromyalgia and inflammatory arthritis and nonpainful controls. *J Rheumatol*. 2001;28(8):1888-1891.
78. Vij B, Whipple MO, Tepper SJ, Mohabbat AB, Stillman M, Vincent A. Frequency of Migraine Headaches in Patients With Fibromyalgia. *Headache: The Journal of Head and Face Pain*. 2015;55(6):860-865. doi:10.1111/head.12590
79. Whealy M, Nanda S, Vincent A, Mandrekar J, Cutrer FM. Fibromyalgia in migraine: a retrospective cohort study. *J Headache Pain*. 2018;19(1):61. doi:10.1186/s10194-018-0892-9
80. dos Santos Proença J, Baad-Hansen L, do Vale Braido GV, Campi LB, de Godoi Gonçalves DA. Clinical features of chronic primary pain in individuals presenting painful temporomandibular disorder and comorbidities. *J Oral Rehabil*. 2024;51(2):255-265. doi:10.1111/joor.13598
81. Yap AU, Marpaung C, Rahmadini ED. Psychological well-being and distress: Their associations with temporomandibular disorder symptoms and interrelationships. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2021;132(2):163-171. doi:10.1016/j.oooo.2021.02.012
82. Marpaung C, Yap AU, Hanin I, Fitryanur A. Psychological distress and well-being: their association with temporomandibular disorder symptoms. *CRANIO®*. 2024;42(3):285-291. doi:10.1080/08869634.2021.1971449
83. Guler B, Guler M, Ozkan Y, Bayindir B. Comparison for oral health-related quality of life in fibromyalgia subgroups according to fibromyalgia impact questionnaire: A preliminary study. *Ann Med Res*. 2021;28(4):821. doi:10.5455/annalsmedres.2020.03.236
84. Pimentel MJ, Gui MS, Reimão R, Rizzatti-Barbosa CM. Sleep quality and facial pain in fibromyalgia syndrome. *CRANIO®*. 2015;33(2):122-128. doi:10.1179/2151090314Y.0000000014

85. Yap AU, Cao Y, Zhang M juan, Lei J, Fu KY. Temporomandibular disorder severity and diagnostic groups: Their associations with sleep quality and impairments. *Sleep Med*. 2021;80:218-225. doi:10.1016/j.sleep.2021.01.063
86. Lindfors E, Magnusson T, Ernberg M. Effect of Therapeutic Jaw Exercises in the Treatment of Masticatory Myofascial Pain: A Randomized Controlled Study. *J Oral Facial Pain Headache*. 2020;34(4):364-373. doi:10.11607/ofph.2670
87. Shedden Mora MC, Weber D, Neff A, Rief W. Biofeedback-based Cognitive-Behavioral Treatment Compared With Occlusal Splint for Temporomandibular Disorder. *Clin J Pain*. 2013;29(12):1057-1065. doi:10.1097/AJP.0b013e3182850559
88. Alajbeg IZ, Gikić M, Valentić-Peruzović M. Changes in pain intensity and oral health-related quality of life in patients with temporomandibular disorders during stabilization splint therapy--a pilot study. *Acta Clin Croat*. 2014;53(1):7-16.
89. Hara ES, Witzel AL, de Luca CEP, Ballester RY, Kuboki T, Bolzan MC. A novel vibratory stimulation-based occlusal splint for alleviation of <scp>TMD</scp> painful symptoms: a pilot study. *J Oral Rehabil*. 2013;40(3):179-184. doi:10.1111/joor.12026
90. Jiang T. [Masticatory muscle disorders and treatment from the perspective of prosthodontics]. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2022;57(7):682-687. doi:10.3760/cma.j.cn112144-20220408-00163
91. Balasubramaniam R, de Leeuw R, Zhu H, Nickerson RB, Okeson JP, Carlson CR. Prevalence of temporomandibular disorders in fibromyalgia and failed back syndrome patients: A blinded prospective comparison study. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2007;104(2):204-216. doi:10.1016/j.tripleo.2007.01.012
92. HARADA T, ICHIKI R, TSUKIYAMA Y, KOYANO K. The effect of oral splint devices on sleep bruxism: a 6-week observation with an ambulatory electromyographic recording device. *J Oral Rehabil*. 2006;33(7):482-488. doi:10.1111/j.1365-2842.2005.01576.x
93. RAPHAEL KG, MARBACH JJ. Widespread pain and the effectiveness of oral splints in myofascial face pain. *The Journal of the American Dental Association*. 2001;132(3):305-316. doi:10.14219/jada.archive.2001.0173
94. Ainoosah S, Farghal AE, Alzemei MS, et al. Comparative analysis of different types of occlusal splints for the management of sleep bruxism: a systematic review. *BMC Oral Health*. 2024;24(1):29. doi:10.1186/s12903-023-03782-6
95. Garstka AA, Kozowska L, Kijak K, et al. Accurate Diagnosis and Treatment of Painful Temporomandibular Disorders: A Literature Review Supplemented by Own Clinical Experience. *Pain Res Manag*. 2023;2023:1-12. doi:10.1155/2023/1002235
96. Minakuchi H, Fujisawa M, Abe Y, et al. Managements of sleep bruxism in adult: A systematic review. *Japanese Dental Science Review*. 2022;58:124-136. doi:10.1016/j.jdsr.2022.02.004