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The Prevalence of Temporomandibular Disorders in Fibromyalgia Patients Compared to That of Failed Back Syndrome Patients: A Blinded Prospective Study

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ABSTRACT OF THESIS

The Prevalence of Temporomandibular Disorders in Fibromyalgia Patients Compared to That of Failed Back Syndrome Patients: A Blinded Prospective Study.

The purpose of this study was to determine the prevalence of temporomandibular disorders (TMD) in fibromyalgia (FM) patients compared to failed back syndrome (FBS) patients. In addition, the FM and FBS patients were assessed and compared with regard to their psychosocial dysfunction. The study included 51 adult patients (FM = 32, FBS = 19) recruited from a physical medicine and rehabilitation clinic and a FM workshop. Questionnaires included an orofacial pain questionnaire and a battery of psychological questionnaires that included the Symptom Check List-90-Revised, the Pittsburgh Sleep Quality Index, the Multi-dimensional Pain Inventory, the Post-traumatic Stress Disorder Checklist-Civilian Version, and Multidimensional Fatigue Symptoms Inventory-short form. Each patient underwent a clinical examination by a dentist who was blind to the diagnostic category and if applicable was diagnosed with TMD based on the Research Diagnostic Criteria for TMD. Fifty three percent of the FM patients reported having face pain compared to 11% of the FBS patients (P=0.002). Of those FM patients who reported face pain, 71% fulfilled the criteria for TMD. The psychometric data revealed that the FM patients had higher scores for somatization (P=0.02) and obsessive-compulsive (P=0.009) subscales compared to the FBS patients. The mean score of medication used to sleep was higher among the FM patients compared to FBS patients (P=0.002). Eighty seven percent of the FM patients reported a stressful event (P=0.036). Of those FM patients who reported a stressful event 42.3% were deemed post-traumatic stress disorder positive. FM patient also had higher scores for general fatigue (P<0.0001), emotional fatigue (P=0.008), physical fatigue (P<0.0001) and mental fatigue (P<0.0001) as compared to FBS patients. The high prevalence of TMD and psychosocial dysfunction among FM patients suggests a dysfunctional hypothalamic-pituitary-adrenal axis and dysregulated autonomic nervous system.

KEYWORDS: Prevalence, temporomandibular disorders, fibromyalgia, failed back syndrome and psychosocial dysfunction.

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May 31, 2006

The Prevalence of Temporomandibular Disorders in Fibromyalgia
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A Blinded Prospective Study.

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THESIS

Ramesh Balasubramaniam

The Graduate School

University of Kentucky

2006

The Prevalence of Temporomandibular Disorders in Fibromyalgia
Patients Compared to That of Failed Back Syndrome Patients:
A Blinded Prospective Study.

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THESIS

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A thesis submitted in partial fulfillment of the
requirements for the degree of Masters of Science
at the University of Kentucky

By

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2006

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Chapter 1. Introduction

Fibromyalgia (FM) is defined as a syndrome of widespread pain and stiffness of the locomotor system. Symptoms last at least 3 months with the presence of palpable tenderness at 11 or more of 18 established areas involving all four body quadrants. This definition is based on findings from a study performed by the Multicenter Criteria Committee to define FM and was later adopted by the American Academy of Rheumatology (ACR) [1]. A more detailed explanation of the ACR criteria for FM is illustrated in Figure 1 and Table 1. In addition, the Multicenter Criteria Committee highlighted symptoms commonly associated with FM such as sleep disturbances, fatigue, paresthesias, anxiety, headache and irritable bowel syndrome (IBS) [1]. FM is estimated to affect 2% of the general population, with a large female preponderance. The syndrome increases in prevalence with age [2].

FM may be classified as primary or secondary, depending on the nature of its onset [3]. The primary form occurs in adults without association to a known

illness, whereas secondary FM is based on preexisting underlying medical disorders such as rheumatoid arthritis, infection, stress, or trauma inducing the condition [4] [5]. In spite of the above mentioned classification, the exact etiology of FM remains elusive and is further complicated by comorbid conditions. These comorbidities include that of other "functional somatic syndromes" such as chronic fatigue syndrome (CFS), irritable bowel syndrome (IBS), temporomandibular disorders (TMD), multiple chemical sensitivities, and tension-type headache, all of which, including FM, have a degree of overlap in core symptoms [6] [7].

Temporomandibular disorders (TMD) is a collective term embracing a number of clinical problems that involve the masticatory musculature, the temporomandibular joints and associated structures [8]. It includes a subset of musculoskeletal diagnoses which typically involve the temporomandibular joint (TMJ) and/or the muscles of mastication. Common TMJ diagnoses include degenerative joint disorders like osteoarthritis, arthralgia or disk displacements and are associated with preauricular pain, limited functional jaw movements, jaw clicking and/or locking. Muscle disorders include myofascial pain, typically presenting as myalgia with local trigger points in muscle bands that can refer pain to a remote site. Limited range of jaw movement secondary to reports of muscle fatigue is also commonly observed [9] [8] [10] [11].

In spite of large percentages of the general population exhibiting signs and symptoms of TMD [12], the need for treatment is estimated to range between 3.6-7% [13] [14] [15] [16] [9] [17] [18]. This highlights the fact that TMD cases are cyclic in nature,

often self-limiting and mild, and rarely progress to a severe disabling chronic state [19] [20] [9] [21].

Table 1.   The American College of Rheumatology 1990 Criteria for the Classification of FM * [1]

1.   History of widespread pain

   Definition. Pain is considered widespread when all of the following are present: pain in the left side of the body, pain in the right side of the body, pain above the waist, and pain below the waist. In addition, axial skeletal pain (cervical spine or anterior chest or thoracic spine or low back) must be present. In this definition, shoulder and buttock pain is considered as pain for each involved side. "Low back" pain is considered lower segment pain.

2.   Pain in 11 of 18 tender point sites on digital palpitation.

   Definition. Pain, on digital palpitation, must be present in at least 11 of the following 18 tender point sites:
   Occiput: bilateral at the suboccipital muscle insertions,
   Low cervical: bilateral, at the anterior aspects of the intertransverse spaces at C5-C7.
   Trapezius: bilateral, at the midpoint of the upper border.
   Supraspinatus: bilateral, at origins, above the scapula spine near the medial border.
   Second rib: bilateral, at the second costochondral junctions, just lateral to the junctions on the upper surfaces.
   Lateral epicondyle: bilateral, 2 cm distal to the epicondyles.
   Gluteal: bilateral, in upper outer quadrants of buttocks in anterior fold of muscle.
   Greater trochanter: bilateral, posterior to the trochanteric prominence.
   Knee: bilateral, at the medial fat pad proximal to the joint line.

   Digital palpitation should be performed with an approximate force of 4 kg. For a tender point to be considered "positive" the subject must state that the palpation was painful. "Tender" is not to be considered "painful."

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*For classification purposes, patients will be said to have fibromyalgia if both criteria are satisfied. Widespread pain must have been present for at least 3 months. The presence of a second clinical disorder does not exclude the diagnosis of fibromyalgia.

Figure 1: Locations of FM tender points on the human body as defined by the American College of Rheumatology 1990 criteria for the classification of FM [1]
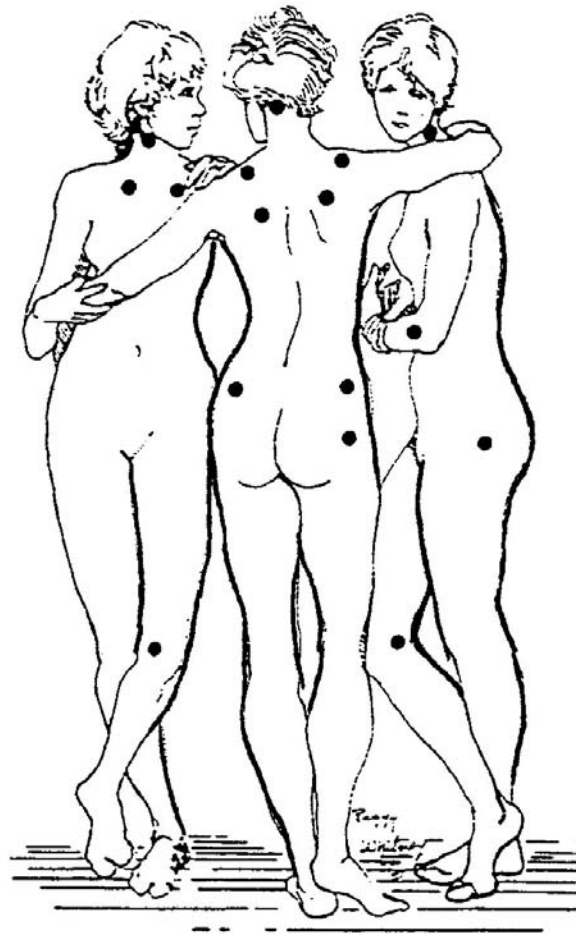
Table 2. Prevalence of frequently observed symptoms and signs in FM (% of patients) [5]

Widespread pain with tender points	100
Generalized weakness, myalgias, arthralgias	80
Nonrestorative sleep	80
Fatigue	70
Stiffness	60
Tension headache	53
Dysmenorrhea	40
Irritable colon, functional bowel disease	40
Subjective numbness, swelling, tingling	35
Livedo reticularis or skin hyperaemia	30
Complaints of fever	20
Complaints of swollen glands	20
Complaints of dry eyes	20
Subjective significant cognitive dysfunction	20
Significant psychopathology	5-20
Nocturnal myoclonus, restless leg syndrome	15
Female urethral syndrome	12
Vulvodynia or vaginismus	10
Concomitant reflex sympathetic dystrophy	5

Chapter 2. Purpose of the Study

The aim of the present study is to determine the presence of TMDs in FM patients compared to failed back syndrome (FBS) patients. It is hypothesized that FM patients will exhibit greater signs and symptoms of TMDs when compared to FBS patients. It is also hypothesized that both FM and FBS patients will exhibit significant psychosocial dysfunction.

Chapter 3. Review of the Literature

3.1. Temporomandibular Disorders

Temporomandibular Disorders is a subclassification of musculoskeletal disorders that can cause pain in the orofacial region [12]. In the past, TMD was considered a syndrome representing one disorder commonly referred to as "TMJ," but it is now considered a collective term representing various related disorders of the masticatory system [8] [12] [22]. Pain originating from the masticatory muscles or TMJs is the most common complaint and is frequently accompanied by limited and/or asymmetric mandibular movement, and joint clicking and/or crepitation [8].

To date, there is no universal known cause of TMD, although numerous associative factors have been identified. It is likely that there is no one etiology for TMD. Certain factors may affect the dynamic balance of the masticatory system and increase the risk for dysfunction and pathology, rather than promote ongoing adaptive physiologic health and function [23] [8].

3.1.1 Prevalence of Temporomandibular Disorders

Prior to addressing the prevalence of TMD, it is important to recognize that until recently there were essentially no evidence-based guidelines for the diagnosis and classification of TMD. The available cross-sectional epidemiological studies were heterogeneous in TMD terminology, data collection

and interpretation of the variables studied [8]. Poor correlation between signs (abnormal jaw movement, joint sounds, pain upon palpation) and symptoms (face pain, joint pain) of TMD also led to questionable interpretation of their clinical significance [17]. The standardization of TMD diagnoses was addressed by the Research Diagnostic Criteria (RDC) committee with aims to improve the poor quality of past epidemiology studies in TMD [24].

Okeson summarized the prevalence of commonly reported symptoms and examined signs of TMDs based on 17 studies [12]. It was reported that signs and symptoms of TMD are common in the general population. Report of at least one TMD symptom ranged from 14% to 74%, and clinical findings of at least one TMD sign ranged from 15% to 88% [25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41]. Careful interpretation of these studies is pertinent as clinical signs are often unknown to the patient and their relevance should be scrutinized [42]. As previously mentioned, in spite of the high prevalence of TMD signs and symptoms, various studies showed that the need for treatment ranged only between 3.6-7% [13 14 15 16 9 17 18]. Although TMD symptoms requiring treatment are uncommon complaints, TMD signs were found to increase with age in children and young adults. In fact, TMD symptoms are more frequently reported in patients between 20-40 years but not often in those who are older than 60 years [42 43 21 44 45 46]. This highlights the cyclic and rarely progressive nature of TMD signs and symptoms [19 20 9 21]. It is also worth mentioning that in spite of the low overall prevalence of TMD [47], the societal cost as measured by yearly work days lost is significant. It is reported that 17.8 million work days are lost each

year in the United States due to disabling TMD for every 100 million full-time working adults [16].

3.1.2 Etiology and Pathophysiology of Temporomandibular Disorders

The etiology of TMD remains elusive which is partly due to its unknown pathophysiology. The pathophysiology of TMD is multifactorial and varies depending on the subclassification of TMD. For example, the pathophysiology of masticatory myofascial pain is likely different than capsulitis of the TMJ [8].

Currently there are certain factors that are recognized as associated with TMD but not necessarily causal. These factors may predispose, initiate and/or perpetuate TMD under different circumstances [48] [49] [50]. They may affect the dynamic equilibrium of the masticatory system [23] shifting it from an adaptive physiologically healthy system to that of dysfunction and pathology. Although speculative, the imbalance towards dysfunction and pathology is potentially influenced by the psychological status of TMD patients [51]. The psychological status of TMD patients will be discussed more extensively in the following section.

The etiology of TMDs may be due to trauma, anatomic considerations, pathophysiology and psychological issues. Trauma may be direct such as a blow to the mandible, indirect such as acceleration-deceleration injury or microtrauma such as clenching and grinding of teeth [8]. Anatomic factors that are associated with and may possibly represent TMD etiology may be divided into skeletal and occlusal relationships. Skeletal factors include articular eminence steepness,

skeletal malformations and inter-arch and intra-arch discrepancies. Occlusal factors include discrepancies between retruded contact and intercuspal position, loss of molar support, extensive overbite, overjet and crossbite. The roles of anatomic factors are currently believed to be less significantly associated with TMD than previously thought and this will be explained under the TMD and psychological issues section [8].

As previously mentioned, the pathophysiology of TMD is not currently known but the speculations are numerous and varied. Factors may be systemic such as degenerative, endocrine, infectious and rheumatologic. Temporomandibular disorders secondary to pathophysiologic factors may include FM as a systemic causative factor. On the other hand, local pathophysiologic factors include synovial fluid viscosity, intracapsular pressure, and female hormone levels [8].

As an illustration of the role of female hormones on TMD pathophysiology, an increase in TMD pain was noted in women during lowest estrogen levels or rapid estrogen change [52]. It has been suggested that exogenous hormones in the form of oral contraceptives may reduce fluctuations in estrogen during the menstrual cycle. Therefore, exogenous hormones may be beneficial in chronic TMD patients as they counteract estrogen depletion in late luteal and menses phases of the menstrual cycles and avoid rapid estrogen changes experienced during ovulation [53].

Psychological factors may affect the ability of TMD patients to cope with difficult life situations. The relationship between psychological distress and

physiological consequences particularly has been established among TMD patients with Post-traumatic Stress Disorder (PTSD) [54] [55]. It is to be determined if psychological factors cause TMD or are the result of TMD or both. The following section will discuss the relationship between TMD and psychological factors more extensively [8].

In summary, regarding the pathophysiology and etiology of TMD, much controversy remains. Many factors have been identified that may predispose, initiate and/or perpetuate TMD. Further studies are needed to determine the significance of these factors. It is likely that the relationship between psychological distress and its physiological consequences will determine the ability of the system to adapt versus to be prone to dysfunction and pathology.

3.1.3. Temporomandibular Disorders and Psychosocial Issues

The RDC for TMD involve two axes. Axis I is comprised of the physical conditions of masticatory myofascial pain (MM) and/or TMJ pain. Axis II is comprised of the psychological conditions and its effects in producing and/or influencing the pain experience [24].

The link between TMD and psychological issues has been previously established [56] [57] [58]. In contrast to healthy controls, TMD patients have higher levels of depression and anxiety [59] [51] [60] [61] [62] [63]. In addition, MM pain patients frequently have more psychological issues compared to TMJ pain patients, with elevated levels of depression, pain disability, and increased exposure to major life stressors [64] [65] [66] [55] [67].

To further understand the link between TMD and psychological issues, McEwen in 1998 proposed the allostatic load theory. The theory suggests long-term overactivity of the allostatic systems which are comprised of the autonomic nervous, cardiovascular, metabolic, immune systems and hypothalamic-pituitary-adrenal (HPA) axis is detrimental in chronic pain [68]. It has been established that the activity of the sympathetic portion of the autonomic nervous system is increased by emotional stress. This is characterized by an increase in the arterial blood pressure, blood flow to muscles, muscle activity, and mental activity, commonly referred to as the "fight or flight" response [69]. Under acute stressful conditions, this increased autonomic activity is favorable. However, persistent chronic stressors, including major life events, may have long term consequences on the person's physical health [68]. It has been established that chronic emotional stress can contribute to pain and can increase pain severity as a result of overactive central nervous, autonomic and musculoskeletal systems [70]. Indeed, chronic TMD patients demonstrate increased cardiovascular activity and altered breathing rate compared to normal controls [63].

Thayer and Friedmann (2002) [71] described a self-organizing dynamic system that governs the behavior of living systems. The ability of the system to function efficiently when challenged by environmental demands is often secondary to efficient inhibitory processes. The authors also suggested that the process of sensitization is not always determined by overall hyperactivity. It may be the result of a loss of inhibitory neural processes leading to maladaptive

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activation of fewer brain pathways. Therefore, loss of inhibitory control may be critical for efficient adaptability.

It is believed that the dysregulation of the HPA-axis may predispose individuals for the development of chronic pain [72], though neuroendocrinologic investigations involving TMD have reported inconsistent findings. Jones et al (1997) found that TMD patients had increased or typical levels of cortisol released in response to stress compared to healthy controls [73]. On the contrary, Venable (2003) reported hypocortisolism among TMD patients consistent with findings of other stress-related disorders such as FM and chronic fatigue syndrome [74]. However, Korszun et al (2002) in a study involving 15 female TMD patients revealed hypercortisolism compared to a control group [75]. It seems logical that cortisol levels may fluctuate with transient stressors, as demonstrated by actual stress of venipuncture or anticipatory anxiety associated with venipuncture [76]. In summary, chronic pain disorders, including TMD, are potentially related to dysregulation of the HPA-axis.

As previously mentioned, the overall data [59,51,60,61,62,63,64,65,66,55,67] suggest TMD patients exhibit significant psychological dysfunction. A model integrating the physical signs and symptoms and psychological distress in TMD has been detailed [51]. Carlson et al (1998) studied and integrated the psychological and physiological parameters of muscle pain TMD patients. This study involved monitoring emotional and physiological responses (heart rate, blood pressure, respiration, skin temperature, and muscle activity) of muscle pain patients and age, sex and weight matched normal controls. Patients and controls

completed a series of questionnaires prior to a laboratory evaluation consisting of a psychosocial stressor and pressure pain stimulation at multiple body sites. The muscle pain patients reported greater fatigue, disturbed sleep, depression, anxiety, menstrual symptoms and less self-deception than normal controls. In addition, muscle pain patients had lower end tidal carbon dioxide levels and lower diastolic blood pressures at rest than normal controls. The authors suggested a central nervous system link between the physiology and psychology in muscle pain TMD patients that affected their ability to recover physiologically [51]. Other studies have reported data from TMD patients that implicated altered sensory pain experiences as a result of dysfunction in the modulatory controls of the central nervous system [77] [78]. This is further data concerning the role of a dysfunctional central nervous system contributing to the pathophysiology of TMD.

3.1.4. Temporomandibular Disorders and Sleep Disturbance

There is a strong relationship between sleep and chronic pain [79] [80] [81] [82]. However, it is yet to be established whether chronic pains produce a sleep disturbance or a sleep disturbance is significant in the instigation of chronic pains. It has been suggested that progression of an acute muscle pain to a chronic pain condition may be perpetuated by sleep disturbances [83]. In fact stage-four deprivation led to musculoskeletal symptoms such as muscle tenderness and stiffness in healthy patients, but such symptoms were not observed following disruption of the rapid eye-movement (REM) sleep. This suggests that poor sleep quality of the deeper sleep stages may be linked to

chronic pain conditions. The musculoskeletal symptoms are likely a consequence of the failure to restore the metabolic functions of the body systems that occur in deeper sleep stages [84]. Sleep disturbances are common complaints of TMD patients; [85] [86] [87] with higher preponderance among muscle pain patients compared to TMJ pain patients [66] [88].

3.1.5. Summary

From the aforementioned review it is apparent that a more precise prevalence of TMD is yet to be determined. This is due to previous studies having heterogeneous TMD terminology, varied data collection strategies and differences in interpretation of the variables. Likewise, TMD pathophysiology and etiology is yet to be determined, although numerous associated factors have been identified. The relationship between TMD and psychosocial issues is established but its impact also remains to be determined. It has been proposed that dysregulation of the HPA-axis and autonomic nervous system as well as loss of inhibitory neural modulation are associated with TMD as well as other chronic pain conditions.

3.2. Fibromyalgia

Sir Edward Gowers coined the term fibrositis (old term for FM) to further classify lumbago in the early 20th century [89]. However, Smythe and Moldofsky first recognized the consistent palpable soft tissue tender points associated with widespread pain of fibrositis [90]. Since that time, there has been much debate on the credibility of persons presenting with signs and symptoms of a generalized musculoskeletal system pain consistent with FM. The financial burden these patients pose on governments and insurance companies is significant [91] [92] [93]. This motivated, in part, the development of the FM classification criteria in 1990 by the ACR, which are now used throughout the world for investigating this enigmatic condition [1]. In spite of ongoing criticism of the subjective nature of FM complaints, the classification is moderately sensitive (88.4%) and specific (81.1%) and hence useful for distinguishing FM from other chronic pain syndromes [1]. Physical findings of FM are based on palpation pressure of 4 kilograms resulting in pain in at least 11 of the potential 18 tender points including skeletal muscles, ligaments and bursae. Pain upon palpation felt in these tender points is thought to represent allodynia. For details of the classification, see Table 1 and Figure 1.

The prevalence of FM in the adult population is estimated to be 2% (0.5% males and 1.5% females) with the highest prevalence being in women between the age of 50-60 years [1] [94]. It has been reported that 6-10% of patients in a physician's waiting room meet the classification criteria for FM [95]. FM patients typically describe their pain as persistent, diffuse, deep, aching, throbbing, and/or

stabbing pain associated with dysesthesia. Apart from the obvious reporting of pain and associated typical tender points, FM patients commonly present with symptoms of anxiety, depression, sleep disturbances, dizziness, morning stiffness, physical fatigue, IBS and interstitial cystitis [96] (Table 2). The comorbidity of FM with other conditions such as chronic fatigue syndrome, IBS, TMD, chronic headaches and interstitial cystitis may be related to a reduction in pain threshold and tolerance mediated by central nervous system mechanisms. In addition, these conditions are marked by a heightened sensitivity to both physical and psychological stress [96 97 7 98 99].

3.2.1 Etiology and Pathophysiology of Fibromyalgia

The etiology of FM is not known. An autosomal dominant inheritance for FM has been reported but no gene abnormalities have been identified [100]. Histologic and electromicroscopic studies have failed to discover skeletal muscle abnormalities [101].

The preponderance of females with FM may provide some insight to the pathophysiology of FM. Epidemiology studies have revealed a lower pain threshold for females compared to males in healthy populations [94 102]. This may be explained by the lower levels of 5-hydroxytryptophan (5-HT) synthesis and metabolism. A radiology study involving CNS positron emission tomography revealed lower conversion rate of methylated analog of 5-HT to 5-hydroxyindole acetic acid among healthy adult females. These data suggest a gender-related difference in antinociceptive activity. Interestingly, in spite of a large female

preponderance for FM, a relationship between FM and circulatory sex hormones has not been established [103] [104].

FM patients may present with neuroendocrine dysfunction involving the HPA-axis, the sympatho-adrenal system, the hypothalamus-pituitary-thyroid axis or the hypothalamic-pituitary-growth hormone axis [105] [106] [107] [108]. It has been suggested that abnormalities in serotonin and norepinephrine availability in the CNS may explain the neuroendocrine dysfunction [109]. Studies have also revealed lower adenosine triphosphate (ATP) levels in the red blood cells of FM patients [110] [111] and this may explain low levels of platelet serotonin since ATP is required for serotonin platelet binding and uptake.

One third of FM patients had a drop in blood pressure, some with episodes of syncope, when undergoing tilt-table testing suggesting an autonomic nervous system dysfunction [112]. Studies on diurnal heart rate variability among FM patients revealed sustained sympathetic tone at night [113]. A sustained dysfunctional sympathetic tone may be due to a loss of inhibitory neural pathways leading to maladaption [114] [71]. These findings suggest that like TMDs, FM patients experience a loss of inhibitory control.

Serum studies of FM show abnormal biochemical levels of tryptophan, serotonin, substance P [96], and growth hormone. Dysregulation of diurnal cortisol production has also been documented [106]. These neurochemical abnormalities may suggest a facilitation or failure in inhibition of nociception leading to central sensitization and increased pain perception. They may affect the dynamic

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equilibrium of the system that shifts it from an adaptive physiologically healthy system to that of dysfunction and pathology [114] [71].

Taken together, the pathophysiology and etiology of FM remain unknown. However, much progress has been made in understanding factors associated with the syndrome. The old school of thought whereby FM patients were once considered depressed somatizers is now considered unlikely. Abnormal CNS neurochemicals such low 5-HT and high substance P are more likely explanations of the pain amplification represented in FM.

3.2.2. Fibromyalgia and Psychosocial Issues

As previously discussed, the pathophysiology of FM remains an enigma. It has been reported that FM may merely represent somatic manifestations of an affective disorder, further supported by the lack of an objective measure of this syndrome [115]. Interestingly, rheumatoid arthritis (RA) was also once considered an affective disorder [116] [117]. Studies involving RA and FM reported FM patients as having higher scores compared to RA patients for hypochondriasis, hysteria, psychotic behavior, paranoia, and schizophrenia as measured by the Minnesota Multiphasic Personality Inventory (MMPI) [118]. Similarly, another study reported that FM patients had a 70% lifetime rate of major affective disorder compared to 13% among RA patients. Of the FM patients with major depression, 64% reported the onset of affective symptoms occurring at least one year after the diagnosis of FM. This suggests that FM patients are depressed as a result of their somatic symptoms, rather than that major depression resulted in somatic

manifestations. However, this study also revealed that 10% of 1st degree relatives of FM patients were depressed compared to only 3% of the RA patients [115].

It is has been established by various studies that depression does exist among FM patients but whether it is significantly more prevalent among FM patients compared to other chronic pain patients remains controversial. Some studies suggest that FM patients are more depressed than RA patients [4] [119] whereas others suggest that although depression may exist, there is no difference in the prevalence of depression among the two groups of patients [120] [121] [122] [123]. It is likely that the presence of depression and anxiety may amplify the pain and fatigue experienced by FM patients [124]. The reverse outcome is likely as well, whereby affective symptoms may be the result of chronic pain, fatigue, sleep disturbances and a reduced quality of life.

3.2.3 Fibromyalgia and Sleep Disturbances

FM patients frequently complain of disturbed, non-refreshing sleep [96] [1]. It has been suggested that increased pain in FM patients may contribute to sleep disturbances and sleep disturbances may result in increased pain in FM patients [79]. Polysomnographic studies have reported intrusion of alpha frequency electroencephalogram during non-rapid eye movement sleep among FM patients [125] [126]. Interestingly, FM-like symptoms may be associated with sleep disturbances in healthy patients [127]. Whether sleep disturbances have a role in the pathophysiology of FM is to be determined.

3.2.4 Summary

From the above mentioned review, it is apparent that FM remains a perplexing condition. Further studies on its prevalence, etiology and pathophysiology are pertinent as it may improve existing treatment strategies and motivate research for newer treatments. The key to deciphering this difficult condition probably lies in understanding the role of autonomic nervous system dysfunction and loss of inhibitory neural modulation.

3.3. Temporomandibular Disorders and Fibromyalgia

Numerous studies in the past have suggested relationships between FM and TMD [128] [129] [130] [131] [132] [133] [134]. The conclusions drawn from these studies seem logical based on the definition of FM as a form of non-articular rheumatism characterized by widespread muscle pain, tenderness to palpation and stiffness of the locomotor system [94]. It seems reasonable that FM may encompass TMD, which is a collective term embracing a number of clinical problems that involve the masticatory musculature, the TMJ and associated structures [8].

Hedenberg-Magnusson et al (1999) suggested that FM is a cause of TMD. The authors investigated TMD symptoms based on a questionnaire completed by a large sample of FM patients. Ninety-four percent of these patients described TMD pain which reportedly followed pre-existing FM pain of long duration. Patients also reported headache, facial pain, jaw fatigue and difficulty chewing and opening the mouth [128]. Because of subjective reporting of TMD symptoms, the conclusion that FM causes TMD should be cautiously considered since

objective clinical findings were not performed and the design does not allow inference of comorbidity. FM and TMD share common symptoms such as generalized pain sensitivity, sleep and concentration difficulties and headaches [135] which may influence symptom reporting.

Plesh et al (1996) investigated prevalence and symptom severity of both FM and TMD among FM and TMD patients using the ACR and RDC for TMD criteria respectively. They concluded that these are separate disorders; however, FM patients commonly reported TMD symptoms but it was rarely the case that TMD patients reported FM [129]. Eighteen percent of TMD patients fulfilled the FM criteria, whereas 75% of FM patients met the criteria for TMD. This study also revealed that FM patients had lower pain thresholds with more frequent and more severe symptoms such as pain, sleep disturbances, and fatigue than TMD patients. In addition, FM patients reported more functional disability, work difficulty and overall health dissatisfaction [129]. In support of the study by Plesh et al (1996), Pennacchio et al (1998) revealed that 97% of FM patients had signs and symptoms of TMD. These signs and symptoms included pain or tenderness of the masseters, temporalis and TMJs, history of trauma, facial asymmetry, bruxism and limited range of mandibular movement. Contrary to the study by Plesh et al. (1996), Pennacchio et al. (1998) found that the type, intensity, description and quality of pain were similar in both TMD and FM patients [136]. Therefore, it was suggested that FM and TMD share common symptoms [135]. The extent of the relationship between FM and TMD based on these common symptoms needs to be studied further.

Cimino et al. (1998) compared clinical and psychological features of FM and masticatory myofascial pain syndrome patients. Clinical findings of muscle palpation did not reveal any difference between the two groups, nor were there differences in active and passive mouth opening. Similarly, both groups had elevations in psychological distress scores but there were no significant differences between the groups [137].

Comorbidity between myofascial pain (myalgia) of FM and TMD has been reported as well. In a study by Dao et al. (1997) which included myogenous TMD patients, many patients had pains in various body sites. Similarly, FM patients exhibited comparable facial pain to that of TMD patients. The authors suggested that FM should be a differential diagnosis for TMD patients with primary muscle complaints. In spite of these observations, FM was considered far more debilitating with respect to number of pain sites, somatic symptoms and level of pain intensity than was TMD. The authors suggested that TMD and FM are distinct clinical disorders [138]. In addition, it was suggested that the presence of facial pain may be due to a decrease in pain threshold associated with FM, as proposed by Wolfe [94] [138].

According to Rhodus et al (2003), the prevalence of TMD based on a questionnaire among FM patients was 67.6% compared to 20% among controls. In addition, 60% of FM patients were depressed and anxious but this was not statistically different from controls with TMD [99]. This was confirmed by an earlier study that reported presence of psychopathological profiles for depression and anxiety among FM patients and TMD patients [139].

The above studies imply a relationship between TMD and FM. However, the relationship is unclear as many of the studies were retrospective or observational, not blinded, uncontrolled, questionnaire based and, most often, had small sample sizes. Similarly, some of the studies did not use the ACR classification for FM and many studies did not define TMD or failed to use the RDC for TMD classification. If a clear relationship does exist between FM and TMD, it is likely related to the dysregulation of the HPA axis and dysfunction of the autonomic nervous system, as well as the disturbances in peripheral and central inhibitory control mechanisms [97] [140].

3.3.1. Summary

This review highlights a relationship between FM and TMD. Although many uncertainties exist, signs and symptoms of TMD may be present in FM patients. It is therefore not unlikely that FM may be an etiologic factor for TMD. Based on these previous findings, this study will examine the presence of signs and symptoms of TMD in FM patients compared to failed back syndrome (FBS) patients as well as evaluate the differences in psychosocial distress.

Chapter 4. Experimental Design and Methods

4.1. Participants

This was a prospective study that involved recruiting patients visiting the Physical Medicine and Rehabilitation Clinic and patients from a FM workshop organized by the Center for the Advancement of Women's Health at the University of Kentucky between March 2005 and April 2006. The research was approved by the Institutional Review Board for the Protection of Human Patients. The study sample included 32 FM and 19 FBS patients. The FM patients for the study had received a diagnosis by a physical medicine and rehabilitation specialist or rheumatologist, based on the criteria for the classification of FM as established by the ACR [94]. The diagnosis of FBS was based on persistent or recurrent, chronic lower back pain after at least one failed surgical procedure of the lumbasacral spine [141] [142] [143]. All interested patients were required to sign an informed consent and were compensated $20 for their time.

4.2. Inclusion and Exclusion Criteria

Patients who presented with the following characteristics were included in the study:

1. At least 18 years of age.

2. A primary diagnosis of FM or FBS.

3. Pain duration of at least 6 months.

Patients who presented with the following characteristics were excluded from the study:

1. Other chronic pains unrelated to the primary diagnosis.

2. Uncontrolled metabolic diseases (e.g uncontrolled diabetes).

3. Neurological disorders (e.g trigeminal neuralgia).

4. Uncontrolled vascular diseases (e.g. uncontrolled hypertension).

5. Neoplasia.

6. Current psychiatric treatment.

4.3. Questionnaires

Prior to the examination, all patients were given an orofacial pain questionnaire and a battery of psychological assessments. The orofacial pain questionnaire included questions about the patient's orofacial complaints and medical history. The psychological questionnaires included the Symptom Check List-90-revised (SCL-90-R) [144], the Pittsburgh Sleep Quality Index (PSQI) [145], the Multi-dimensional Pain Inventory (MPI) [146], the Post-traumatic Stress Disorder Checklist-Civilian Version (PCL-C) [147], and Multidimensional Fatigue Symptoms Inventory-short form (MFSI-SF) [148].

4.3.1. Orofacial Pain Questionnaire

All patients completed this questionnaire which gathered demographic data, presence of face or headache pain, and medical history. Patients with current face pain were required to provide details on its location, onset, severity,

quality, and aggravating and ameliorating factors. Presence of mouth pain, headache, and TMJ sounds and dysfunction were also solicited. Disability or intentions to seek disability was also established.

In addition, the orofacial pain questionnaire included qualitative descriptors from the McGill Pain Questionnaire for self-report of the pain experience [149]. These characterizations of pain are divided into sensory and affective classifications. The sensory category included terms such as throbbing, shooting, stabbing, and aching, while the affective category contained terms such as sickening, exhausting, and punishing (Appendix 1).

4.3.2 Psychometric Measures

The psychological questionnaires included the SCL-90-R [144], the PSQI [145] the MPI [146], PCL-C [147], and MFSI-SF [148].

The SCL-90-R [144] was used to assess current psychological symptom status of the patients on nine dimensions. These dimensions include: somatization, obsessive-compulsive behavior, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. It consists of a 90-item multi-dimensional self-report inventory which is scored on a five-point scale of distress (0-4). A subscale score ≥63 was deemed clinically significant. Test-retest reliabilities range from r = 0.78 to 0.90 for non-patient samples, and internal consistencies range from 0.77 to 0.90 [144].

The MPI [146] was used to determine pain severity, as well as to provide a pain profile classification of each subject. It included three sections and contains

28

61 questions. The MPI pain profile classification is based on pain level, social and physical activities, affective distress, social support, and feelings of life control. Test-retest reliabilities of the individual scale scores range from r = 0.68 to 0.86, and internal consistencies range from 0.73 to 0.90 [146]. Patients were classified into three prototypic profiles namely dysfunctional, interpersonally distressed and adaptive copers. Patients who report a high level of pain, distress, and disability and who feel pessimistic and helpless about their condition are classified as dysfunctional. The interpersonally distressed category includes patients with the same characteristics as dysfunctional and in addition report poor social support. Patients who report low levels of pain, disability, and distress are classified as adaptive copers. Other classification categories include hybrid, anomalous and unanalyzable profiles. The hybrid profile represents a combination of prototypic profiles. The anomalous profile classification was used when no sense can be made of the MPI scale scores to establish a particular theory. Random responding, reading or responding difficulties, or faking bad or good responses contributes to allocation of the anomalous profile. When data are missing and statistical analyses of the scores are not possible the unanalyzable profile is allocated.

The PSQI [145] was used to gather information regarding the amount of hours the subject sleeps each night, the amount of hours in bed each night, how often the subject is awakened and why, as well as how difficult it is for the subject to return to sleep upon awakening. A PSQI total score of > 5 categorized subjects as poor sleepers. The PSQI has exhibited test-retest stability (full scale r

= 0.85), good overall internal consistency (α = 0.83), and provides a valid and reliable assessment of overall sleep quality and disturbance [145] [150].

The PCL-C instrument includes 15 itemized statements about significant traumatic stressors that the subject may have experienced. The items listed include: military combat, violent attack, being kidnapped, taken hostage, terrorist attack, torture, incarceration, natural or man-made disaster, severe auto accident, being diagnosed with a life-threatening illness, sudden injury/serious accident, observed someone hurt or killed, learning that her/his child has a life-threatening illness, and an others category. Subsequently, the subject is asked to identify the most significant stressor, indicate the date of occurrence and appraise how much the most significant stressor has bothered her/him in the past month on the 17-item measure. These questions are graded from 1 (not at all) to 5 (extremely) to indicate the impact of the most significant traumatic stressor. Based on the subject's answers a likely diagnosis of PTSD may be ascertained according to the DSM-IV. A cut-off score of ≥41 on the 17-item measure was deemed as PTSD positive and a score of <41 was deemed PTSD negative. The PCL-C has exhibited sensitivity = 0.85, specificity = 0.90, positive predictive power = 74%, negative predictive power = 95%, test-retest stability (r = 0.96), good overall internal consistency (alpha = 0.92), and provides a valid and reliable assessment of the presence of PTSD symptoms [151] [147].

The MFSI-SF identifies 5 facets of fatigue: 1) global experience of fatigue; 2) somatic symptoms of fatigue; 3) cognitive symptoms of fatigue; 4) affective symptoms of fatigue; and 5) behavioral symptoms of fatigue [148]. Each facet is

calculated from the mean of six sub-scores of fatigue-related symptoms. The shortened version (MFSI-SF) which consists of 30 statements was used for this study. Patients were asked to rate each statement according to how true it has been for them over the past 7 days along a 5-point scale (0 = not at all; 4 = extremely). There are no formal reliability and internal consistency data for this assessment. However, de Leeuw et al. (2005) reported high overall internal consistency for each of the subscales (.88 < alpha < 0.96) using a TMD patient population and age and sex healthy controls [152].

4.4 Clinical Examination

The orofacial pain examination involved a thorough clinical assessment by a dentist who was blinded to the clinical diagnosis of the patients. The dentist was unaware with regard to whether he examined a FBS or FM subject. The clinical examination was carried out using a modified version of the examination protocol that has been used at the University of Kentucky, Orofacial Pain Center for many years (Appendix 2). The dentist was trained at the Orofacial Pain Center and had performed numerous similar clinical examinations. Based on the clinical data and according to the RDC for TMD, a list of prioritized diagnoses were made [24]. These diagnoses were verified by two other dentists trained at the University of Kentucky, Orofacial Pain Center. If there was a disagreement between the two dentists as to the RDC diagnoses for TMDs, a discussion was held among the three dentists and consensus as to the appropriate diagnoses was reached.

4.5 Statistical Analyses

The analyses of the data involved comparing the FM and FBS patients. The sociodemographic data, namely age, was tested using the Student's t-test. Gender, education, marital status, and smoking were tested using Fisher's exact test, and employment and disability were tested using the Chi-square test.

Comparison of the presence of orofacial pains between FM and FBS patients involved statistical analyses using SAS 9.1 (SAS Institute Inc.) namely the two sample t tests comparing mean scores between the two groups, or Chi-square / Fisher's Exact tests comparing the outcome percentages between the two groups were conducted. For the binary outcomes, odds ratio and 95% confidence interval of the odds ratio were calculated. In addition, further analysis for the comparison of the percent of patients meeting RDC for TMD criteria between patients who reported face pain and those who did not was tested using the Fisher's Exact test and Chi-square test.

Comparison of pain severity and pain duration between FM and FBS patients who reported face pain were tested using the two sample t-test. Similarly, comparison of SCL-90-R symptoms dimensions, MPI categories, MFSI-SF and PSQI scores between FM and FBS patients were also tested using the two sample t-test. Frequency of MPI profile classification among FM and FBS patients was tested using Fisher's exact test and the Chi-square test. Comparison of the percentage of patients who reported a stressful life event and those who met the PTSD criteria between FM and FBS patients was tested using Fisher's exact test. Pearson's correlation was performed to determine

correlations between sleep disturbances and fatigue-related symptoms among FM and FBS patients. Significance level for all comparisons was set at P=.05.

Chapter 5. Results

5.1 Sample size, Sociodemographic Characteristics, Prevalence, Severity and Duration of Temporomandibular Disorders

The total sample was comprised of 51 adult patients (male = 6; female = 45). The FM group comprised of 32 patients (male = 0; female = 32) with a mean age of 52.2 ± 7.8 years. The FM group (P=0.002) differed with respect to gender from the FBS group which comprised of 19 patients (male = 6; female = 13) with a mean age of 50.0 ± 9.1 years. The two groups also differed with respect to their education level (P=0.03), where a greater number of FM (40.5%) patients had college degrees in comparison to FBS (21%) patients. Tobacco use was significantly more prevalent among the FBS (42%) compared to FM (3%) patients (P<0.0001). There were no significant differences between the two groups in regard to age (P=0.36), marital status (P=0.60), employment (P=0.55), and disability (P=0.48; see table 3).

Fifty three percent of the FM patients reported face pain compared to the 11% of the FBS group (p=0.002). The FM patients were 9.6 times more likely to report face pain than the FBS group. The FM patients also reported a greater prevalence of headache (78%) compared to the FBS patients (63%) but this difference was not statistically significant (P=0.25). Almost the same percentage of FBS patients (42%) and FM patients (41%) reported mouth pain (see table 4).

Of the FM patients who reported face pain, 71% fulfilled the clinical RDC for TMD criteria. Of those FM patients who did not report face pain, 47% fulfilled the clinical RDC for TMD criteria. However, within the FM group, the patients who reported face pain were not significantly more likely to meet clinical RDC for TMD criteria compared to the patients who did not report face pain ($P=0.17$, odds ratio=2.74, 95%C.I.=0.64-11.75). Also, within the FBS group, the patients who reported face pain (50%) were not significantly more likely to meet the clinical RDC for TMD criteria compared to the patients who did not report face pain (12%) ($P=0.30$, odds ratio=7.5, 95%C.I.=0.32-173.28; see table 5).

.   The various RDC for TMD diagnostic subcategories were allocated for both FM and FBS patients. No significant difference was found for any of the diagnostic subcategories between the two groups ($P > 0.05$; see table 6). Seventy four percent of the FM patients received a muscle diagnosis which included 32% myofascial pain and 42% myofascial pain with limited opening. Two out of the three FMS patients who met the RDC criteria for TMD received a muscle diagnosis and these two patients were diagnosed with myofascial pain with limited opening (66%). Twenty one percent of the FM patients were diagnosed with a disk displacement with reduction and this included any participant having internal derangements in either or both joints. Arthralgia was diagnosed in 16%, TMJ osteoarthritis in 26% and TMJ osteoarthrosis in 37% of the FM patients.

Pain severity was measured based on a 0-10 visual analogue scale and reported as 5.2 ± 2.1 and 3.5 ± 0.7 for the FM and FBS patients respectively.

Pain duration was calculated to be the time in months from when the pain began through to the examination. Pain duration reported by patients was 50.3 ± 117.2 and 53.5 ± 72.8 months for the FM and FBS patients respectively. No significant differences were found for mean pain severity and mean pain duration between FM and FBS patients (see table 7).

5.2 Psychometric Data

5.2.1 Symptom Check List-90-Revised

Analyses of SCL-90-R data revealed numerically higher scores on all subscales for FM as compared to FBS patients, although these differences were not statistically significant for most scales (see table 8). The FM patients had statistically significant higher scores for somatization (P=0.02) and obsessive-compulsive (P=0.009) subscales compared to the FBS patients. The FM patients had clinically relevant subscale scores for somatization, obsessive-compulsive and depression, whereas the FBS patients had a clinically relevant subscale score for somatization.

5.2.2 Multidimensional Pain Inventory Profile Classification

The FM patients had numerically higher scores on "pain severity", "interference", "affective distress", "punishing responses", "household chores", "outdoor work", and "activities away from home" scales and had lower scores on "life control", "support", "soliciting responses", "distracting responses", "social

activities", and "general activities level" scales than the FBS patients. However, these differences were not statistically significant (P>0.05; see table 9).

When possible, patients were classified in one of the three main MPI profiles. Twenty five percent of the FM patients were classified as "dysfunctional", 31% were classified as "interpersonally distressed" and 28% were classified as "adaptive copers". No significant differences (P>0.05) were found between the FM patients and the FBS patients with regard to the MPI main profile classification (see table 10).

5.2.3 Pittsburgh Sleep Quality Index

Both FM and FBS patients had elevated PSQI total scores suggesting poor sleep but there was no significant difference between the two groups. The mean score for "use of sleep medication" was significantly different between the FM and FBS patients (P=0.002) whereby the FM patients had a higher score for sleep medication use than the FBS patients. None of the other PSQI scales showed significant differences between the FM and FBS groups (see table 11).

5.2.4 Post-traumatic Stress Disorder Checklist- Civilian Version

There were significant differences between the FM and FBS groups in the percentage of patients reporting a stressful life event (P=0.04, odds ratio=5.2, 95% C.I.=1.28-21.18). Eighty seven percent of FM patients reported a stressful life event compared to 56% of FBS patients. FM patients were 5.2 times more likely to report a stressful life event compared to FBS patients (see table 12).

Of the FM patients who reported a stressful life event, 42.3% were deemed PTSD positive compared to 30% of the FBS patients. However, there was no statistical evidence that FM patients were more likely to have PTSD positive symptoms than FBS patients ($P=0.71$, odds ratio=1.71, 95% C.I.=0.36-8.15) (see table 13).

5.2.5 Multidimensional Fatigue Symptoms Inventory-short form

FM patients had significantly higher general fatigue ($P<0.0001$), emotional fatigue ($P=0.008$), physical fatigue ($P<0.0001$) and mental fatigue ($P<0.0001$) than FBS patients. The FBS patients had a higher vigor score than the FM patients but this difference was not statistically significant (see table 14).

It appears that among the FBS patients the PSQI total score, sleep latency, sleep duration, sleep efficiency, sleep disturbances, and daytime sleep dysfunction are correlated with one ore more fatigue related symptoms ($P<0.05$; see table 15). Among FM patients, it appears that the PSQI total score, subjective sleep quality, sleep latency, sleep duration and sleep efficiency are correlated with one or more fatigue related symptoms ($P<0.05$; see table 16).

Table 3: Comparison of Sociodemographic Characteristics between FM and FBS Patients.

	FM (n=32) n (%)	FBS (n=19) n (%)	P
Age [a]			
Mean±SD	52.2±7.8	50.0±9.1	0.36
Range	35-72	34-65	
Gender [b]			0.002*
Male	0 (0%)	6 (32%)	
Female	32 (100%)	13 (68%)	
Marital Status [b]			0.60
Single	4 (12.5%)	3 (16%)	
Married	24 (75%)	12 (63%)	
Divorced	4 (12.5%)	3 (16%)	
Widowed	0 (0%)	1 (5%)	
Employed [c]			0.55
Yes	11 (34%)	5 (26%)	
No	21 (66%)	14 (74%)	
Education [b]			0.03*
High school	14 (44%)	8 (42%)	
Associate or Technical	5 (16%)	5 (26%)	
BS/BA	9 (28%)	0 (0%)	
Graduate Degree or Professional Degree	4 (12.5%)	4 (21%)	
None of the Above	0 (0%)	2 (11%)	
Disability [c]			0.48
Yes	17 (53%)	12 (63%)	
No	15 (47%)	7 (37%)	
Tobacco Use [b]			<0.0001*
Yes	1 (3%)	8 (42%)	
No	31 (97%)	11 (58%)	

[a] t test assuming unequal variance

[b] Fisher's exact test

[c] Chi-square test

n=number of patients

%=percentage

SD=standard deviation

* Statistical significant difference

Table 4: Comparison of Presence of Orofacial Pains between FM and FBS Patients.

Outcome	FM (n=32) n (%)	FBS (n=19) n (%)	P[+]	Odds Ratio of FM vs. FBS (95% C.I.)
Reported Face Pain			0.002*	9.6 (1.9-48.7)
Yes	17 (53%)	2 (11%)		
No	15 (47%)	17 (89%)		
Reported Mouth Pain			0.92	0.94 (0.30-3.0)
Yes	13 (41%)	8 (42%)		
No	19 (59%)	11 (58%)		
Reported Headache			0.25	2.1 (0.6-7.3)
Yes	25 (78%)	12 (63%)		
No	7 (22%)	7 (37%)		

* Statistical significant difference
[+] Chi-square test
%=Percentage

Table 5: Comparison of FM and FBS Patients who Reported Face Pain to those who did not Report Face Pain (for patients who met the Clinical RDC for TMD Criteria).

Group	Outcome	Reported Face Pain n (%)	Did Not Report Face Pain N (%)	P	Odds Ratio (95% C.I.)
FM	Met RDC for TMD Criteria [a, b]			0.17	2.7 (0.6-11.8)
(n=32)	Yes	12 (71%)	7 (47%)		
	No	5 (29%)	8 (53%)		
FBS	Met RDC for TMD Criteria or Not [c]			0.30	7.5 (0.3-173.3)
(n=19)	Yes	1 (50%)	2 (12%)		
	No	1 (50%)	15 (88%)		

[a] pertains to the clinical findings that fulfilled the RDC for TMD criteria
[b] Chi-square test
[c] Fisher's exact test
n=number of patients
%=percent

Table 6: Comparison of TMD Diagnoses between FM and FBS Patients (for
Patients who met Clinical RDC for TMD)

TMD Diagnosis	FM (n=19)	FBS (n=3)	P *	Odds Ratio (95% C.I.)
Myofascial Pain [b]			0.53	NA
Yes	6 (32%)	0 (0%)		
No	13 (69%)	3 (100%)		
Myofascial Pain With Limited Opening [b]			0.57	0.36 (0.03-4.7)
Yes	8 (42%)	2 (67%)		
No	11 (58%)	1 (33%)		
Disk Displacement With Reduction [b]			1.00	NA
Yes	4 (21%)	0 (0%)		
No	15 (80%)	3 (100%)		
Disk Displacement Without Reduction, With Limited Opening [b]			1.00	NA
Yes	0 (0%)	0 (0%)		
No	19 (100%)	3 (100%)		
Disk Displacement Without Reduction, Without Limited Opening [b]			1.00	NA
Yes	0 (0%)	0 (0%)		
No	19 (100%)	3 (100%)		
Arthralgia [b]			0.47	0.38 (0.03-5.8)
Yes	3 (16%)	1 (33%)		
No	16 (84%)	2 (67%)		
Osteoarthritis of the Temporomandibular Joint [b]			1.00	NA
Yes	5 (26%)	0 (0%)		
No	14 (74%)	3 (100%)		
Osteoarthrosis of the Temporomandibular Joint [b]			1.00	1.2 (0.09-15.3)
Yes	7 (37%)	1 (33%)		
No	12 (63%)	2 (67%)		

* Fisher's exact test

NA=not available due to zero frequencies
n=number of patients
%=percentage

Table 7: Comparison of Pain Severity and Pain Duration between FM and FBS Patients who Reported Face Pain.

Outcome	Group	n	Mean	SD	P*
Pain Severity (0-10)	FM	17	5.2	2.1	0.29
	FBS	2	3.5	0.7	
Pain Duration (Month)	FM	17	50.3	117.2	0.97
	FBS	2	53.5	72.8	

* two sample t test
n=number of patients
SD=standard deviation

Table 8: Comparison of SCL-90-R Symptom Dimensions between FM and FBS Patients.

SCL-90-R Symptom Dimensions	Group	n	Mean	SD	P[+]
Somatization	FM	31	70.5	7.9	0.02*
	FBS	19	65.0	8.2	
Obsessive-Compulsive	FM	31	69.7	10.4	0.0009*
	FBS	19	60.1	8.6	
Interpersonal Sensitivity	FM	31	60.8	9.8	0.052
	FBS	19	54.1	14.2	
Depression	FM	31	64.4	9.0	0.37
	FBS	19	61.8	10.8	
Anxiety	FM	31	61.3	11.6	0.17
	FBS	19	56.4	13.1	
Hostility	FM	31	56.6	10.9	0.30
	FBS	19	53.1	12.0	
Phobic Anxiety	FM	31	55.2	12.1	0.63
	FBS	19	53.7	8.1	
Paranoid Ideation	FM	31	56.6	12.0	0.36
	FBS	19	53.5	11.4	
Psychoticism	FM	31	60.0	10.9	0.72
	FBS	19	58.9	8.6	

[+] two sample t test
n=number of patients
SD=standard deviation
* Statistically significant difference

Table 9: Comparison of MPI Categories between FM and FBS Patients.

MPI Scale	Group	n	Mean	SD	P*
Part I					
Pain Severity	FM	32	46.0	11.1	0.08
	FBS	19	39.5	14.9	
Interference	FM	32	46.7	10.3	0.47
	FBS	19	44.4	12.5	
Life Control	FM	32	49.3	7.0	0.19
	FBS	19	52.2	8.3	
Affective Distress	FM	32	46.9	7.6	0.059
	FBS	19	42.0	10.5	
Support	FM	29	43.6	10.1	0.29
	FBS	18	46.7	8.4	
Part II					
Punishing Responses	FM	30	51.4	10.2	0.065
	FBS	18	46.2	7.0	
Soliciting Responses	FM	30	48.2	10.1	0.11
	FBS	18	52.6	7.4	
Distracting Responses	FM	30	45.4	8.8	0.33
	FBS	18	47.8	7.3	
Part III					
Household Chores	FM	32	54.8	10.0	0.17
	FBS	19	51.1	8.4	
Outdoor Work	FM	32	51.5	8.3	0.09
	FBS	19	47.4	7.6	
Activities Away From Home	FM	32	50.9	9.7	0.63
	FBS	19	49.6	8.2	
Social Activities	FM	32	45.0	9.8	0.32
	FBS	19	47.3	6.0	
General Activity Level	FM	32	51.3	8.7	0.30
	FBS	19	48.7	8.1	

* two sample t test
n=number of patients
SD=standard deviation

Table 10: Comparison of MPI Profile Classification between FM and FBS Patients.

MPI Classes	FM (n=32)	FBS (n=19)	P	Odds Ratio (95% C.I.)
Dysfunctional [c]			0.61	0.72 (0.21-2.5)
Yes	8 (25%)	6 (32%)		
No	24 (75%)	13 (68%)		
Interpersonally Distressed [b]			0.17	3.9 (0.75-20.0)
Yes	10 (31%)	2 (11%)		
No	22 (69%)	17 (49%)		
Adaptive Coper [c]			0.52	0.67 (0.20-2.3)
Yes	9 (28%)	7 (37%)		
No	23 (72%)	12 (63%)		

[b] Fisher's exact test.
[c] Chi-square test.
N=number of patients
%=percentage

Table 11: Comparison of PSQI Scores between FM and FBS Patients.

PSQI Score	Group	Mean	SD	P[+]
PSQI Total Score	FM	12.9	3.9	0.45
	FBS	12.0	4.6	
Subjective Sleep Quality	FM	1.8	10	0.77
	FBS	1.7	0.7	
Sleep Latency	FM	1.9	0.9	0.59
	FBS	2.1	10	
Sleep Duration	FM	1.7	0.9	0.21
	FBS	2.1	0.9	
Sleep Efficiency	FM	1.3	1.2	0.20
	FBS	1.8	1.3	
Sleep Disturbances	FM	2.0	0.7	0.10
	FBS	1.7	0.5	
Use of Sleep Medication	FM	2.4	1.0	0.002*
	FBS	1.3	1.3	
Daytime Sleep Dysfunction	FM	1.8	1.0	0.06
	FBS	1.3	1.0	

[+] two sample t test
SD=standard deviation
* Statistically significant difference

Table 12: Comparison of Reported Stressful Life Events between FM and FBS Patients.

Reported a Stressful Life Event	FM (n=30)	FBS (n=18)	P*	Odds Ratio (95% C.I.)
Yes	26 (87%)	10 (56%)	0.036	5.2 (1.3-21.2)
No	4 (13%)	8 (44%)		

* Fisher's exact test
n=number of patients
%=percentage

Table 13: Comparison of PTSD Symptoms between FM and FBS Patients who Reported Stressors.

PTSD Symptoms	FM (n=26)	FBS (n=10)	P*	Odds Ratio (95% C.I.)
Positive	11 (42.3%)	3 (30%)	0.71	1.7 (0.36-8.2)
Negative	15 (57.7%)	7 (70%)		

*Fisher's exact test
n=number of patients
%=percentage

Table 14: Comparison of Fatigue-related Symptoms (MFSI-SF) between FM and FBS Patients

Fatigue-related Symptoms	Group	n	Mean	SD	P[+]
General	FM	32	3.1	0.8	<0.0001*
	FBS	19	1.8	1.1	
Emotional	FM	32	2.1	1.0	0.008*
	FBS	19	1.2	1.0	
Physical	FM	32	2.6	0.8	<0.0001*
	FBS	19	1.4	0.9	
Mental	FM	32	2.4	1.0	<0.0001*
	FBS	19	1.1	0.8	
Vigor	FM	32	1.3	0.7	0.15
	FBS	19	1.6	0.8	

[+] two sample t test.
N=number of patients
SD=standard deviation
* Statistically significant difference

Table 15: Correlations between PSQI Scores and Fatigue-related Symptoms (MFSI-SF) among FBS Patients.

Variable	General (n) (correlation[+]) (P)	Emotional (n) (correlation[+]) (P)	Physical (n) (correlation[+]) (P)	Mental (n) (correlation[+]) (P)	Vigor (n) (correlation[+]) (P)
PSQI Total Score	19 0.45 0.053	19 0.50 0.03*	19 0.55 0.02*	19 0.50 0.03*	19 -0.44 0.06
Subjective Sleep Quality	19 0.27 0.26	19 0.28 0.25	19 0.32 0.19	19 0.42 0.07	19 -0.07 0.78
Sleep Latency	19 0.08 0.74	19 0.46 0.047*	19 0.40 0.09	19 0.08 0.73	19 -0.22 0.36
Sleep Duration	19 0.34 0.15	19 0.38 0.11	19 0.56 0.01*	19 0.39 0.10	19 -0.28 0.25
Sleep Efficiency	19 0.35 0.14	19 0.32 0.18	19 0.46 0.046*	19 0.46 0.0496*	19 -0.45 0.06
Sleep Disturbances	19 0.33 0.17	19 0.22 0.36	19 0.52 0.02*	19 0.23 0.35	19 -0.54 0.02*
Use of Sleep Medication	19 0.27 0.26	19 0.31 0.19	19 0.05 0.85	19 0.16 0.52	19 -0.24 0.32
Daytime Sleep Dysfunction	19 0.49 0.03*	19 0.36 0.12	19 0.48 0.04*	19 0.64 0.003*	19 -0.35 0.14

* Statistically significant difference

+ Pearson's correlation

Table 16: Correlations between PSQI Scores and Fatigue-related Symptoms (MFSI-SF) among FM patients.

Variable	General (n) (correlation[+]) (P)	Emotional (n) (correlation[+]) (P)	Physical (n) (correlation[+]) (P)	Mental (n) (correlation[+]) (P)	Vigor (n) (correlation[+]) (P)
PSQI Total Score	32	32	32	32	32
	0.50	0.43	0.40	0.45	-0.28
	0.004*	0.01*	0.02*	0.01*	0.11
Subjective Sleep Quality	32	32	32	32	32
	0.41	0.15	0.19	0.08	-0.15
	0.02*	0.40	0.31	0.65	0.42
Sleep Latency	32	32	32	32	32
	0.35	0.37	0.25	0.59	-0.15
	0.0499*	0.04*	0.17	0.0004*	0.41
Sleep Duration	31	31	31	31	31
	0.50	0.33	0.23	0.19	-0.30
	0.004*	0.07	0.22	0.30	0.10
Sleep Efficiency	31	31	31	31	31
	0.38	0.17	0.06	0.27	-0.15
	0.03*	0.36	0.74	0.14	0.42
Sleep Disturbances	32	32	32	32	32
	0.18	0.28	0.23	0.22	-0.24
	0.33	0.12	0.21	0.24	0.18
Use of Sleep Medication	32	32	32	32	32
	0.09	0.24	0.31	0.34	-0.04
	0.63	0.18	0.08	0.06	0.82
Daytime Sleep Dysfunction	32	32	32	32	32
	0.21	0.21	0.33	0.15	-0.23
	0.25	0.24	0.06	0.41	0.21

* Statistically significant difference

+ Pearson's correlation

Chapter 6. Discussion

This study investigated the prevalence of symptoms and signs of TMD in FM patients compared to another chronic pain patient sample, namely FBS. Fifty three percent of the FM patients compared to 11% of the FBS patients reported face pain. In this study FM patients were 9.6 times more likely to report face pain than the FBS patients. The greater prevalence of face pain among FM patients compared to FBS patients seems logical based on the definition of FM as a form of non-articular rheumatism characterized by widespread muscle pain, tenderness to palpation and stiffness of the locomotor system [94]. It seems reasonable that FM may encompass TMD, which is a collective term embracing a number of clinical problems that involve the masticatory musculature, the TMJ and associated structures [8]. Other studies have reported facial pain prevalence between 68-97% in FM patients [99] [128] [138] [136].

Of the FM patients who reported face pain, 71% met the clinical RDC criteria for TMD. The prevalence of TMD among FM patients in the current study is consistent with a study by Plesh et al. that reported that 75% of FM patients met the RDC criteria for TMD [129]. Interestingly, 47% of FM patients who did not report face pain also had the relevant signs meeting the clinical RDC criteria for TMD. Previous studies have reported incongruence between reported TMD symptoms and the clinical finding of TMD signs. Patients may not report non-troublesome symptoms, whereas the clinician may find signs that are clinically significant [9] [34]. Therefore, prevalence values of previous TMD studies may

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overstate the clinical significance of the patient complaints and thus mild and/or transient symptoms and signs may inadvertently be misinterpreted and lead to over treatment [8]. Alternatively, failure to report face pain among FM patients who had TMD signs may be due to the fact that these patients may have assumed or had been previously informed that their face pain was an extension of the FM pain, rather than a separate entity.

FM patients who met the clinical criteria for RDC muscle diagnoses included 32% who had myofascial pain and 42% who had myofascial pain with limited opening. Therefore, muscle pain was diagnosable in 74% of the FM patients. This prevalence of muscle pain among FM patients was lower than had been previously reported in other studies [99] [129] [128] [138]. This may be due to the examiner in this study being blinded as to primary diagnosis (FM or FBS) of the recruited patients, therefore diminishing possible selection bias. In addition, many of the previous studies did not use the RDC for TMD criteria and rather relied on patient reported symptoms alone [128] [138] or carried out clinical examination without established diagnostic criteria [99].

Disk displacement with reduction was diagnosed among 21% of FM patients. It should be noted that this diagnosis included painless clicking of the TMJ that may be coincidental and not clinically relevant to FM. It has been reported that disk displacement with reduction, which includes clicking of the TMJ, may occur in a third of asymptomatic patients and therefore should not be used as an exclusive sign of the presence of TMDs requiring treatment [153].

Arthralgia was diagnosed in 16% of the FM patients and TMJ osteoarthritis was diagnosed in 26% of FM patients. Therefore, 42% of TMJs of FM patients were painful on palpation and during function. A previous study, reported that 80% of FM patients had pain or tenderness upon palpation of the TMJ. However, this study did not use the RDC criteria for TMD and therefore comparisons with our results were not possible [136]. Osteoarthrosis of the TMJ was diagnosed in 37% of FM patients. This may be an underestimation as radiographic imaging of the TMJs, was not performed. Therefore, TMJs that "exhibit erosion of normal cortical delineation, sclerosis of parts or all of the condyle and articular eminence, flattening of joint surfaces and osteophyte formation that did not exhibit crepitus" [24] may have been missed and this could potentially lead to an underdiagnosis of TMJ osteoarthrosis in the present sample.

Previous studies have highlighted significant psychological symptoms among FM patients [154] [118] [115]. The FM patients had elevated SCL-90-R scores on somatization, obsessive-compulsive, and depression symptoms subscales as defined by a subscale score ≥63. Of interest were elevated subscale scores among FM patients for somatization (P=0.02) and obsessive-compulsive (P=0.009) compared to the FBS group. Studies comparing psychosocial findings between patients with FM and patients with rheumatoid arthritis suggested an association between FM and somatization [155] [121] and obsessive compulsiveness [119]. It has been established that FM patients present with multiple symptoms given the comorbidities associated with the syndrome, i.e. pain, sleep

disturbances, fatigue, etc. [5] [7]. The multiple symptoms of FM may be expressed as somatization and this in turn results in an internal focus on one's health. The reverse is also likely whereby internal focus on one's health may lead to somatization. This preoccupation with internal somatic states may manifest itself as elevations of depression and obsessive-compulsive symptoms in an attempt to cope with the FM symptoms. It would not be surprising that obsessive-compulsive symptoms may represent cognitive and behavioral adaptation to pain. Compromised cognitive, affective and behavioral responses could result from excessive long-term preoccupation with one's health. This may lead to dysregulatory psychopathology and maladaptive behavioral responses [156]. In turn, maladaptive behavioral responses may lead to maladaptive physiological response which is understood to be a failure in inhibitory control and therefore perpetuate the symptoms of FM [114] [71] [157] [158].

The combination of the autonomic, attentional and affective systems into a dynamic functional and structural network enables the living system to self-organize [71] [114]. As described by Thayer and Lane (2000), these systems are likely modulated by inhibitory processes which in turn enable sustained functioning of the living system when confronted by stressors. Hence, in a compromised system such as that of FM patients, dis-inhibition (inhibitory failure) in the face of changing environmental demands may lead to maladaptive behavior which in turn, may hinder recuperation and normal functioning [114]. The lack of significant differences among other SCL-90-R subscales between the two groups may be due to the fact that both FM [118] [115] and FBS [159] [160] are chronic

debilitating conditions that are frequently associated with psychosocial symptoms.

In the present study, FBS patients exhibited an elevation of the somatization score on the SCL-90-R. Previous studies have suggested that abnormal preoperative psychological features including depression, hysteria, hypochondriasis, conversion and somatization may predispose patients to greater post-operative pain after lumbar disk surgery [161]. Others have suggested that FBS patients have "emotional problems" including elevated depression and somatic pain scores [162] [163]. Numerous studies have suggested poor outcomes involving reoperation of FBS patients with psychological problems [164] [165] [166] [167]. Therefore, it is not surprising that FBS patients in the present study exhibited elevation of the somatization subscale score on the SCL-90-R.

Based on the PSQI total score, both the FM and FBS patients were considered poor sleepers defined by a PSQI total score of >5. Previous studies have associated poor sleep quality with FBS [168] [169]. It has been postulated that poor sleep may contribute to the pain complaint of FBS [169]. Further studies on sleep disturbances are needed to understand its role in FBS. On the other hand, it has been well established that FM patients frequently complain of disturbed, non-refreshing sleep [96] [1]. Likewise, healthy patients may express FM-like symptoms if their normal sleep architecture is disturbed [127]. It is not understood whether increased pain in FM patients may contribute to sleep disturbances or sleep disturbances may result in increased pain among FM patients [79]. Interestingly, apart from FM patients having a significantly larger score for use of

sleep medication, both groups of patients were not different with respect to all other PSQI scores. Use of sleep medication among FM patients is common and often prescribed as part of the treatment for poor sleep related to FM. Sedatives, such as benzodiazepines, zolpidem tartrate, zaleplon, antidepressants, such as amitriptyline and muscle relaxants, such as cyclobenzaprine, are often used to improve sleep [170] [171] [172] Therefore, the implied causative relationship of FM symptoms with poor sleep (architecture) could explain the higher use of sleep medications endorsed by FM patients compared to FBS patients.

There is a strong relationship between sleep and chronic pain [79] [80] [81] [82]. A previous study reported that stage-four deprivation led to muscle tenderness and stiffness in healthy subjects, but such musculoskeletal symptoms were not observed following disruption of the rapid eye-movement (REM) sleep. Therefore poor sleep quality of the deeper sleep stages may be linked to chronic pain conditions. This may be a consequence of the failure to restore the functions of the body systems such as metabolic processes that occur in deeper sleep stages [84]. Although speculative, poor deep sleep quality may lead to musculoskeletal pain, which in turn, may contribute to a fragmented sleep cycle.

Previous literature suggests that PTSD may coexist with FM [173] [174]. Suggestions that the two entities exist because of care seeking selection bias among FM patients, failure of FM patients to cope with life stress and confounding arousal symptoms between PTSD and FM has been refuted [175]. Although exploratory, it is likely that FM and PTSD share psychobiological risk factors [175]. A significantly higher number of FM patients (87%; P=0.036) than

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FBS patients (56%) reported a stressful life event. Of those FM patients who reported a stressful life event, 42.3% were PTSD positive based on a score of greater than 41 on the PCL-C. Previous studies reported that more than 50% of FM patients had significant levels of PTSD symptoms [174] [173]. Sherman et al. found in a sample of FM patients that pain level, disability and affective distress was greater in those patients reporting PTSD symptoms than those who did not report such symptoms. Sherman and colleagues suggested that PTSD-like symptoms may influence the adaptative ability of FM patients. Therefore, failure to assess the presence of these symptoms may impede successful outcomes [173]. Further studies are required to elucidate the relationship between FM and PTSD.

Presence of fatigue-like symptoms among FM patients has been previously reported [96] [1] [135] [7]. FM patients had significantly higher general, emotional, physical and mental fatigue scores than FBS patients. FM has been shown to have comorbidity with chronic fatigue syndrome, and patients often share common symptoms [176] [177] [178] [135] [179] [180]. Both conditions are marked by a heightened sensitivity to physical and psychological stress [96] [97] [7] [98]. Previous studies have revealed that fatigue in chronic pain was related to symptoms of somatization and depression and to a far lesser degree sleep disturbances [152] [181]. In fact, it has been reported that somatization [152] [181] and depression [181] are major predictors of fatigue. It is likely that the multiple symptoms of FM such as wide spread pain, fatigue, sleep disturbances etc. may be the result of high somatization and depression scores in FM. That is, preoccupation with one's health may manifest as elevations of depression and somatization symptoms in

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an attempt to cope with the FM symptoms. The failure to cope may result in dysregulation of autonomic nervous system and in turn compromised cognitive, affective and behavioral responses apparent as fatigue-like symptoms [182] [156]. Maladaptive behavioral responses may lead to maladaptive physiological response and therefore perpetuate the fatigue-like symptoms of FM [157] [158]. Interestingly, sleep disturbances are frequently reported by chronic pain patients but are not thought to be the cause of fatigue [181]. Both the FM and FBS patients had sleep disturbances based on the PSQI but there were no significant differences between the two groups. However, the FM patients were significantly more fatigued than the FBS patients. Interestingly, both FM and FBS patients revealed correlations between one or more PSQI scores and fatigue-related disturbances. This study is not in agreement with previous studies that suggests that fatigue is unrelated to quantitative measures of sleep [181] [183].

The high prevalence of TMDs and psychosocial distress among FM patients could be manifestations of either a dysfunctional HPA axis, and/or a dysregulated autonomic nervous system and in turn results in alterations of the peripheral and central pain facilitation and inhibitory pain mechanisms [97] [140]. Therefore, a facilitation or failure in inhibition of nociception may lead to central sensitization and increased pain perception. This in turn may affect the dynamic equilibrium of the system and shift it from an adaptive physiological state to that of dysfunction and pathology [114] [71]. This may further explain the comorbidity of FM with other conditions such as chronic fatigue syndrome, IBS and interstitial cystitis, which may be related to a reduction in pain threshold and tolerance

mediated by central nervous system mechanisms. In addition, these conditions are marked by a heightened sensitivity to both physical and psychological stress [96] [97] [7] [98]. Therefore, the multiple symptoms presentation of FM, which may include pain, non-restorative sleep, fatigue, depression, obsessive-compulsiveness, and somatization, is likely influenced by maladaptive physiological states.

The sociodemographic data revealed that all FM patients were females and this was significantly different when compared to the FBS patients. This is consistent with other reports that suggest FM is more prevalent among women [1] [94]. The mean age of FM patients in this study was 52 years and other studies have suggested a similar age distribution of FM among women in the general population [94] [2] [184].

Sixty-six percent of the FM patients were unemployed and 53% were receiving disability. Previous studies have reported that 30% of FM patients worked shorter hours or less physically demanding jobs and 15% received disability from inability to work [185] [91] [92]. Another study reported that 41% of patients were unable to work [129]. The large number of unemployed subjects and subjects receiving disability in the current study may be a result of the recruitment protocol. Patients in this study were recruited from a Physical Medicine and Rehabilitation clinic and a FM workshop possibly targeting subjects who are actively seeking treatment and who may have greater severity of the condition.

A previous study reported that 22% of FM patients smoke tobacco and the study adjusted for age and education level [186]. Interestingly, in the current study only one FM patient used tobacco and this was significantly different compared to FBS patients. Recent data on the prevalence of smoking in the United States reported that 23.4% of males and 18.5% of females in the total population smoke [187]. Therefore, a rational explanation of the low prevalence of tobacco use among FM patients in this study is difficult. Further research on the use of tobacco among FM patients is required to establish its prevalence. Interestingly, 42% of the FBS patients in this study used tobacco. It has been suggested that heavy tobacco use is common among FBS patients [142] and is a major risk factor for developing lower back pain [188] [189] as well as failure of bony union associated with FBS [190].

The present study has limitations in spite of its prospective design. A major concern of this study was the small sample sizes in each of the groups. Therefore, detailed statistical analysis of the study variables was not possible. Another major concern was that the study involved FBS patients as a control group which many consider a poorly defined clinical condition [141] [142] [143]. Similarly, much debate persists on whether FM as a clinical condition exists. As a result, comparisons between two poorly defined conditions may have led to questionable findings and interpretation. On the other hand this was the first study that investigated the prevalence of TMDs in FM that employed a chronic pain population sample for comparisons.

Because of the recruitment protocol, the participating patients may not represent a sample of the general population. All patients were actively seeking treatment for their condition at a tertiary care center and this may have resulted in an overestimation of the prevalence of TMDs among FM patients. In addition, the prevalence of psychosocial distress in both FM and FBS patients may not be a representative of the subjects with these conditions in the general population. Therefore, the patients in this study could represent a selective pain population compared to those patients seen at a general practice.

With respect to the prevalence of TMD, the RDC embraces all TMD diagnoses, including painless clicking and crepitation of the TMJs. As previously discussed, asymptomatic clicking of the TMJ and TMJ crepitation without imaging evidence of condylar bone remodeling may be coincidental and not be of clinical relevance. Therefore, this may have led to an overestimation of the prevalence of TMDs in FM patients.

Finally, the subjects in this study were required to complete a history form that was not verified in an interview. Hence, errors in reporting may have occurred. Additionally, since the examiner was blind to diagnostic category, further verification of the information supplied by the patient was not accessible at the time of the clinical examination. Similarly, the blinded examination was performed by one dentist who was not calibrated in accordance to the RDC for TMD [191] [192] [193]. Therefore, the reliability of the clinical finding was not determined. However, the clinical findings were verified by two other dentists trained at the University of Kentucky, Orofacial Pain Center. If there was a disagreement

between the two dentists as to the RDC diagnoses for TMDs, a discussion was held between the two dentists and the dentist that performed the blind examination and consensus as to the appropriate diagnoses was reached.

Chapter 7. Conclusion

The present study replicates and extends previous investigations addressing the relationship between TMD and FM. Fifty three percent of FM patients reported face pain. Of those FM patients who reported face pain, 71% fulfilled the RDC criteria for TMD. Interestingly, 47% of FM patients who did not report face pain also fulfilled the RDC criteria for TMDs. Therefore, this study confirms our hypothesis that the prevalence of TMD is greater among FM patients than among FBS patients. Both the FM and FBS patients reported high levels of psychosocial distress, but somatization, obsessive compulsive, fatigue and medication needed for sleep disturbances were significantly higher for FM patients than for FBS patients. Eighty seven percent of the FM patients also reported a stressful event and approximately 42% of these patients were PTSD positive. These results suggest that a dysfunctional HPA axis and dysregulation of the autonomic nervous system are linked to the high prevalence of TMD and significant psychosocial distress among FM patients.

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Appendix 1: Orofacial Pain Questionnaire Form

ID _____

Date_____

Your reason for visiting the clinic today?   [ ] Fibromyalgia   [ ] Lower back pain

Age:_____ Date of Birth:_____ Sex: [ ]Male   [ ]Female

Marital Status:[ ] Single   [ ] Married   [ ] Divorced   [ ] Widowed

Number of Children_____

Are you presently employed?   [ ] Yes   [ ] No

Occupation:_____

Education: [ ] Completed High school
                [ ] Completed Associate or Technical Degree
                [ ] Completed College Degree (BS/BA)
                [ ] Completed Professional Degree (i.e., MD, JD, MBA)
                [ ] Completed Graduate Degree (i.e., MS, PhD)
                [ ] Did not complete any of the above

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OROFACIAL PAIN STUDY QUESTIONNAIRE

In this questionnaire we are interested in your face or jaw pain and headaches. Please <u>do not</u> answer these questions below with regard to back pain or fibromyalgia.

1.   Do you currently have pain in your face or jaw? [ ] Yes   [ ] No
   If no, go to question 10

2.   If yes, when did your face/jaw pain begin? _____
                         (month / date / year)

3.   How did your face/jaw pain begin?

[ ]Jaw Surgery   [ ]Blow to jaw / head / neck
[ ]Motor vehicle accident   [ ]Dental work
[ ]Chewing   [ ]Tooth extraction
[ ]Orthodontics (braces)   [ ]Stressful Situation
[ ]Nothing; pain just came on
[ ]Other_____

4.   What is the usual severity of your face/jaw pain? (Circle the appropriate number)

0	1	2	3	4	5	6	7	8	9	10

No Pain   Extreme Pain
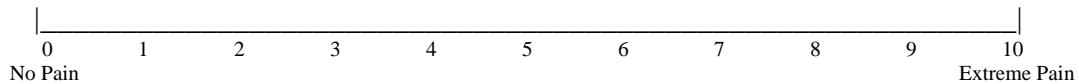
5.   Describe the way your face/jaw pain typically feels:

[ ] Throbbing   [ ] Gnawing   [ ] Splitting
[ ] Shooting   [ ] Hot / Burning   [ ] Tiring-exhausting
[ ] Stabbing   [ ] Aching   [ ] Sickening
[ ] Sharp   [ ] Heavy   [ ] Fearful
[ ] Cramping   [ ] Tender   [ ] Punishing - Cruel

6. Where is your face or jaw pain located? Please check the following areas based on the location of your pain.

1. Forehead   [ ] Right side [ ] Left side   [ ] Both sides

2. Temples   [ ] Right side [ ] Left side   [ ] Both sides

3. Inside the ear   [ ] Right side[ ] Left side   [ ] Both sides

4. Jaw joint   [ ] Right side [ ] Left side   [ ] Both sides

5. Jaw   [ ] Right side [ ] Left side   [ ] Both sides
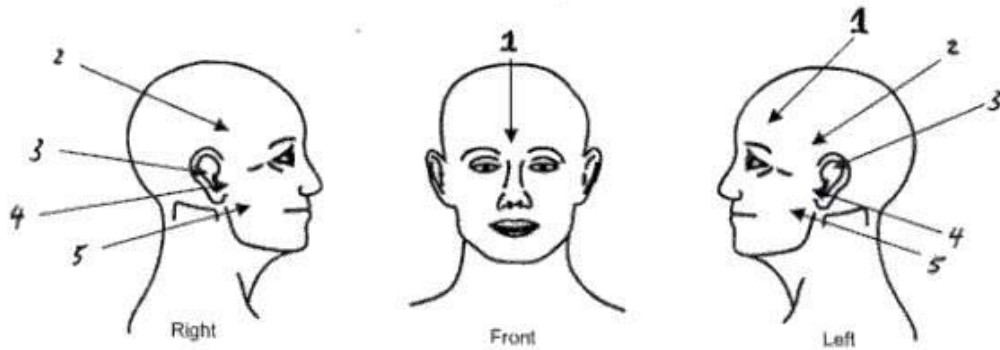
7. How long does your face or jaw pain typically last?

[ ]Less than 1 minute   [ ]6-12 hours
[ ]1-10 minutes   [ ]13-24 hours
[ ]Less than 1 hour   [ ]Several days
[ ]1-5 hours   [ ]Constant

8. Which of the following causes or aggravates your jaw or face pain?

[ ]Chewing   [ ]Opening mouth wide   [ ]Hot or cold foods/drinks
[ ]Talking   [ ]Lack of sleep   [ ]Damp or cold weather
[ ]Yawning   [ ]Playing musical instrument   [ ]Stress/emotional upset
[ ]Laughing   [ ]Riding in car for long period   [ ]Sitting for long period
[ ]Singing   [ ]Eating certain foods   [ ]Exercise
[ ]Other_____

9.   Which of the following relieves the pain?

[ ]Exercise   [ ]Massage of the area   [ ]Warm soak/compresses
[ ]Heat   [ ]Holding jaw in certain position   [ ]Ice/cold compresses
[ ]Sleep   [ ]Moving/manipulating jaw   [ ]Pain medication
[ ]Time   [ ]Relaxation   [ ]Nothing helps
[ ]Other_____

10.   Do you have any painful teeth or other painful areas in your mouth?
       [ ]Yes   [ ]No   If Yes, please check the following based on the location of
       your pain.

Teeth	[ ] Yes	[ ] No
Tongue	[ ] Yes	[ ] No
Gums	[ ] Yes	[ ] No
Roof of mouth	[ ] Yes	[ ] No
Cheek	[ ] Yes	[ ] No
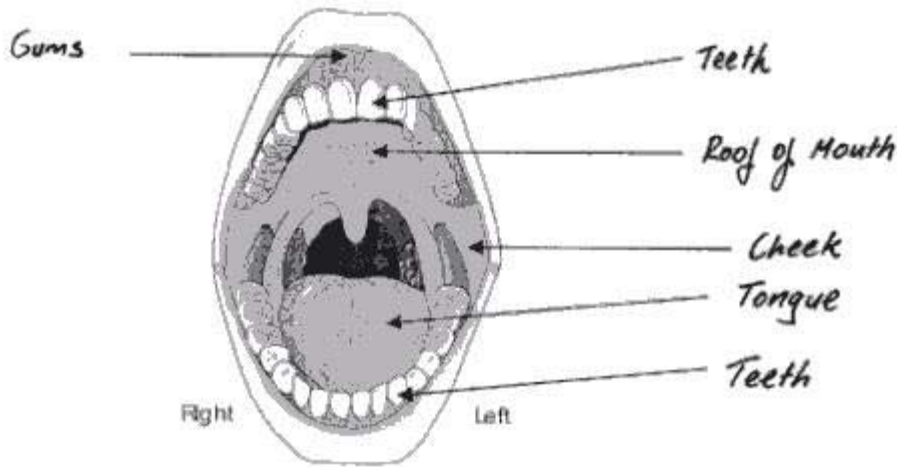
11.   Are you bothered by headaches?

       [ ]Yes
       [ ]No   If no, skip to question number 12.

       1) How painful are your headaches usually?

       |_____|
       0   1   2   3   4   5   6   7   8   9   10
     No Pain   Extreme Pain
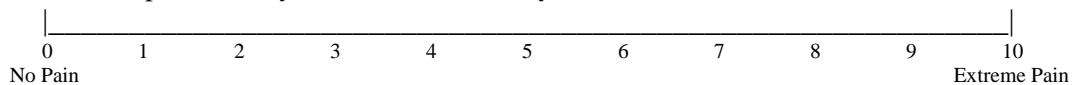
2) Do you have headaches as often as once per week?
             [ ]Yes   [ ]No

3) How long do your headaches last?
         [ ] less than 1 hour   [ ] greater than 1 hour but less than 24 hrs
         [ ] greater than 24 hours   [ ] constant headache

4) Is there any nausea or vomiting associated with your headaches?
         [ ]Yes   [ ]No

5) Are there vision changes associated with your headaches?
         [ ]Yes   [ ]No

6) Are you disabled (unable to function normally) by your headaches?
         [ ]Yes   [ ]No

7) Has a doctor diagnosed you with
[ ] Migraine   [ ] tension type headache
[ ] Other _____

12.   Are you aware of your jaw making sounds?

[ ]Yes   [ ]No

If yes, please answer the following questions, if no, go to question #13.

Which side?   [ ]Right   [ ]Left   [ ]Both sides

Describe the nature of the sound:
[ ]Clicking   [ ]Grating   [ ]Popping   [ ]Cracking
[ ]Other_____

When do you notice the sounds?
[ ]Early opening   [ ]Moving jaw to the side
[ ]Middle opening   [ ]Chewing
[ ]Wide opening   [ ]While closing

Is the sound always present?
         [ ]Yes   [ ]No

Do you feel that the sounds are related to your jaw or face pain or headaches:
         [ ]Yes   [ ]No

13   Has your jaw ever locked open?

[ ]Yes   [ ]Right side   [ ]Both sides
[ ]No   [ ]Left side

Date of first occurrence_____   (month / date/ year)

14   Has your jaw ever locked closed or partially closed?

[ ]Yes   [ ]Right side   [ ]Both sides
[ ]No   [ ]Left side

Date of first occurrence_____(month / date/ year)

15   How many times has your jaw locked open or closed during the past year?
        [ ] none   # of times_____

16   Do you have pain when your jaw locks open or closed?

[ ]Yes   [ ]No

17   Have you noticed any other oral habits or practices that aggravate or cause your face /jaw pain or headaches?

[ ]Clenching the teeth   [ ]Grinding the teeth
[ ]Chewing ice   [ ]Chewing finger nails
[ ]Chewing pencil/paper clips   [ ]Chewing cheek/lips
[ ]Chewing gum   [ ]Playing wind instruments/violin
[ ]Holding phone between ear and shoulders[ ]Other_____

18.   For each of the beverages listed below, write in the average number that you will drink each day:

Caffeinated coffee   _____cups/day
Caffeinated soft drink   _____cans/bottles/day
Caffeinated Tea   _____cups/day
Decaffeinated beverages including juices and milk _____cups/day
Alcoholic beverages ____ drinks/cans/day
Water _____ cups/day

19.   Do you use tobacco?   [ ] no   [ ] yes

20. Are you receiving or applying for disability? [ ] no [ ] yes
    For: [ ] Face or jaw pain
            [ ] Fibromyalgia
            [ ] Chronic lower back pain
            [ ] Depression / Anxiety
            [ ] Other, please specify _____

21. Are you taking or supposed to be taking and medicine, drugs or pills of any kind?
    Taking   Supposed to be taking

    _____   _____
    _____   _____
    _____   _____
    _____   _____
    _____   _____
    _____   _____
    _____   _____
    _____   _____
    _____   _____

Please check the box for any condition which you have had in the past or have now.

(1) Cardiovascular
- ☐ Congestive Heart Failure
- ☐ Heart Attack
- ☐ Angina Pectoris or Chest Pain
- ☐ High Blood Pressure
- ☐ Heart Murmur
- ☐ Mitral Valve Prolapse
- ☐ Rheumatic Fever
- ☐ Congenital Heart Defect
- ☐ Artificial (Prosthetic) Heart Valve
- ☐ Arrhythmias
- ☐ Heart Pacemaker or Defibrillator
- ☐ Coronary By-Pass
- ☐ Coronary Angioplasty
- ☐ Heart Transplant
- ☐ Aneurysm
- ☐ Other Heart Problems

(2) Hematologic
- ☐ Blood Transfusion
- ☐ Anemia
- ☐ Hemophilia
- ☐ Leukemia
- ☐ Sickle Cell Anemia
- ☐ Tendency to Bleed Longer Than Normal

(3) Neurologic
- ☐ Vision Problems
- ☐ Glaucoma
- ☐ Earache, Ringing in Ears
- ☐ Hearing Loss
- ☐ Severe Headaches
- ☐ Fainting or Dizzy Spells
- ☐ Stroke
- ☐ Epilepsy, Seizures or Convulsions
- ☐ Psychiatric Treatment
- ☐ Panic Attacks
- ☐ Phobias

(4) Gastrointestinal
- ☐ Stomach/Intestinal Ulcers
- ☐ Colitis
- ☐ Irritable Bowel Syndrome
- ☐ Persistent Diarrhea
- ☐ Hepatitis
- ☐ Liver Disease
- ☐ Yellow Jaundice
- ☐ Cirrhosis
- ☐ Eating Disorder
- ☐ Gastric Acid Reflux

(5) Pulmonary
- ☐ Hay Fever
- ☐ Sinus Trouble
- ☐ Allergies or Hives
- ☐ Asthma
- ☐ Chronic Cough
- ☐ Emphysema
- ☐ Chronic Bronchitis
- ☐ Tuberculosis (TB)
- ☐ Breathing Difficulties
- ☐ Sarcoidosis

(6) Dermal / Musculoskeletal
- ☐ Allergy to Latex (Rubber)
- ☐ Skin Rash
- ☐ Dark Mole(s) (Recent changes in appearance)
- ☐ Osteoarthritis
- ☐ Rheumatoid Arthritis
- ☐ Systemic Lupus
- ☐ Artificial (Prosthetic) Joint
- ☐ Fibromyalgia
- ☐ Chronic Fatigue Syndrome
- ☐ Scleroderma
- ☐ Sjogren's Syndrome
- ☐ CRPS I (RSD)
- ☐ CRPS II (Causalgia)

(7) Endocrine
- ☐ Diabetes
- ☐ Thyroid Disease
- ☐ Taking Cortisone or Other Steroids
- ☐ Hormone Replacement Therapy

(8) Genitourinary
- ☐ Urinate Frequently
- ☐ Kidney, Bladder Problem
- ☐ Dialysis
- ☐ Kidney Transplant
- ☐ Sexually Transmitted Disease (Syphilis, Gonorrhea, Chlamydia or Genital Herpes)
- ☐ HIV Positive
- ☐ Multiple Sexual Partners
- ☐ Interstitial Cystitis
- ☐ Endometriosis

(9) Other Conditions
- ☐ Anxiety Disorder
- ☐ Depression
- ☐ Frequent Sore Throats
- ☐ Enlarged Lymph Node or "Gland"
- ☐ Use Tobacco
- ☐ Use Alcohol
- ☐ Use Injectable Drugs
- ☐ Drug or Alcohol Addiction (Recovery or Current)
- ☐ Tumor or Cancer
- ☐ Radiation Therapy
- ☐ Chemotherapy
- ☐ Sleep Apnea
- ☐ Snoring
- ☐ Disease, Problem or Condition not listed

If yes, list
_____
_____
_____
_____
_____

Appendix 2: Orofacial Pain Examination Form

ID: _____   **Date:**_____

<div align="center">

Orofacial Pain Examination

</div>

<u>Cranial Nerve Examination:</u>

(II)   Gross Vision,   WNL:_____

(III)   (III, IV, VI) Extraocular Muscles   WNL:_____

   Pupils (Equality, Reaction, Accommodation) WNL:_____

(V)   Sensory (V_1, V_2, V_3)   WNL_____

(V)   Motor (Function, Symmetry)   WNL:_____

(VII)   Motor (Facial Muscles)   WNL:_____

(VIII) Gross Hearing   WNL:_____

    EAC and TM   WNL:_____

(IX, X) Gag Reflex   WNL:_____

(XI)   Shoulder Shrug/Lateral Head Movement WNL:_____

(XII)   Tongue Protrusion   WNL:_____

<u>Balance/Coordination:</u>

WNL :_____

       (Tests: finger to nose; alternate hands; toe to heel walking)

<u>Cervical Range of Movement:</u>

	Pain				*Restriction*		
Flexion / Extension	None ☐	Ex	☐ Flex	☐	None ☐	Ex	☐ Flex	☐
Rotation (70 degrees)	None ☐	Right ☐ Left	☐		None ☐	Right ☐ Left	☐
Lateral Tilt (60 degrees)	None ☐	Right ☐ Left	☐		None ☐	Right ☐ Left	☐

General Comments:_____

_____

Muscle and Joint Palpation Examination:

Codes: 0= no pain, 1= tenderness, 2= pain, 3= pain with withdrawal, T= trigger point,
(if there is pain referral, draw an arrow to depict direction and location)

	Right	*Left*
Temporalis		
Anterior	_____	_____
Middle	_____	_____
Posterior	_____	_____
Masseter		
Superior	_____	_____
Inferior	_____	_____
SCM	_____	_____
Occipital	_____	_____
Trapezius	_____	_____
Paracervical	_____	_____
Cervical Spine	_____	
TMJ		
Lateral Capsule	_____	_____
EAC	_____	_____
Splenius Capitis	_____	_____

Pain on Mandibular Function:

pain with opening: [ ] No [ ] Right [ ] Left
pain with clenching: [ ] No [ ] Right [ ] Left
with right lat movement: [ ] No [ ] Right [ ] Left
with left lat movement: [ ] No [ ] Right [ ] Left

Provocation Tests:

Clenching on separator:
bilaterally: [ ] No [ ] Right [ ] Left
right: [ ] No [ ] Right [ ] Left
left: [ ] No [ ] Right [ ] Left

Resisted Movements:
resisted protrusion: [ ] No [ ] Right [ ] Left
resisted right lateral: [ ] No [ ] Right [ ] Left
resisted left lateral: [ ] No [ ] Right [ ] Left

Manual loading of TMJs
[ ] no pain [ ] Right [ ] Left

Range of Mandibular Movement:

Closed

10mm   10mm

R ___mm   L ___mm

Draw
deflection
or
deviations

or

straight   Opened

Max protrusive movement ___mm

Max comfortable opening ____mm
Max opening by patient ____mm
Max assisted opening ____mm

End Feel: [ ] Soft [ ] Hard [ ] Not Indicated

Intracapsular Interferences:

	opening click	*closing click*

Right TMJ   [ ] No [ ] Yes at ____mm   [ ] No [ ] Yes at ____mm
Left TMJ   [ ] No [ ] Yes at ____mm   [ ] No [ ] Yes at ____mm

Clicking during:
        Right lateral movements: [ ] No [ ] Right [ ] Left
        Left lateral movements   [ ] No [ ] Right [ ] Left

The click is: **The click is eliminated by protrusion**
        [ ] very repeatable   [ ] No [ ] Yes at ____mm of protrusion
        [ ] not very repeatable
        [ ] there is no click   ***Crepitus:*** [ ] No   [ ] Right   [ ] Left

Intraoral Examination:

Intraoral Muscle Palpation:

	Right	*Left*
Temporal Tendon	_____	_____
Medial Pterygoid	_____	_____
Anterior Digastric	_____	_____

Soft Tissue: [ ] WNL _____
        _____

Periodontal Health [ ] WNL, _____
        _____

General Description of Dentition:_____
        _____
        _____

Tooth Wear: Anterior teeth [ ] none [ ] enamel only [ ] enamel and dentin
            Posterior teeth [ ] none [ ] enamel only [ ] enamel and dentin

Occlusal Examination:

Profile: [ ] Orthognathic   [ ] Retrognathic   [ ] Prognathic

Anterior tooth relationship: [ ] Class I [ ] Class II, Div 1 [ ] Class II, Div 2   [ ] Class III [ ] Open bite

Posterior tooth relationship: [ ] Class I [ ] Class II [ ] Class III [ ] Open bite (right, left or both)

Circle the areas of occlusal contacts; cross missing teeth

Intercuspal Position

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

R   *none*   *L*

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

Non-Working

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

R   *none*   *L*

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

Protrusive

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

R   *none*   *L*

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

Working Contacts

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

R   *none*   *L*

M_3 M_2 M_1 P_2 P_1 C I_2 I_1 I_1 I_2 C P_1 P_2 M_1 M_2 M_3

Vita

Bibliographical information
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Education

July 2004 – Present	Masters and Certificate in Orofacial Pain anticipated: End of Fall 2006 University of Kentucky, College of Dentistry, Lexington, Kentucky
July 2003 – June 2004	Fellowship in Orofacial Pain University of Kentucky, College of Dentistry Lexington, Kentucky
January 1997 – December 2000	Bachelor of Dental Science University of Western Australia, School of Oral Health Sciences Perth, Western Australia
January 1995 -1996	Bachelor of Science University of Western Australia Perth, Western Australia

Professional positions held

June 2002 – June 2003:	Associate dentist: Dr. Gemma Chen, Karrinyup Road Dental Centre, Perth, Western Australia.
January 2001 – June 2003:	Associate dentist: Dr. Peter Blaize, Byford Dental Centre, Perth Western Australia.
January 2001 – June 2002	Associate dentist: Drs. John Camacho & Dominic Longo, Crystal Brook Dental Centre, Perth Western Australia.

Professional Publications

Balasubramaniam R., Van Sickels J., Falace D. Condylar resorption following temporomandibular joint arthroscopy in a patient with essential thrombocythemia. Journal of Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics 2006 May; 101(5):581-7.

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