Headache and jaw locking comorbidity with daytime sleepiness

STEVEN R. OLMOS, DDS, FRANKLIN GARCIA-GODOY, DDS, MS, PHD, PHD, TIMOTHY L. HOTTEL, DDS, MS, MBA & NHU QUYNH T. TRAN, PHD

ABSTRACT: Purpose: To investigate the relationship between craniofacial pain symptoms (painful conditions present in the cranium and face, including jaw joint-related pathology and primary headache conditions) and daytime sleepiness, determined by the Epworth sleepiness scale (ESS), to correlate comorbidity as well as potential predictive factors. **Methods:** 1,171 patients seeking care for chronic pain and/or sleep-related breathing disorders (SRBDs) at 11 international treatment centers were included in the study. Patients completed the ESS and identified their primary craniofacial pain and sleep pathology symptoms. Descriptive statistics and regression analysis were performed to determine comorbidities between craniofacial pain symptoms and daytime sleepiness, and factors predictive of higher ESS scores. **Results:** There was high comorbidity of some craniofacial pain symptoms and high ESS scores, including headaches. In addition, for the first time to our knowledge, orthopedic craniofacial dysfunction (i.e., jaw locking) was correlated with, and predictive of, high ESS scores. (*Am J Dent* 2016;29:161-165).

CLINICAL SIGNIFICANCE: The results of this study establish the need for a patient intake questionnaire inclusive of chronic pain and sleep pathology symptoms for physicians and dentists to collaborate for optimal treatment of patients with craniofacial pain and sleep-related breathing disorders.

✉: Dr. Steven Olmos, TMJ & Sleep Therapy Centre, 7879 El Cajon Blvd., La Mesa, CA 91942, USA. E-✉: steven@tmjtherapycentre.com

Introduction

In the United States, nearly half of adults lived with chronic pain in 2011. Of 353,000 adults aged 18 years or over who were surveyed by Gallup-Healthways, 47% reported having at least one of three types of chronic pain: neck or back pain, knee or leg pain, or recurring pain.[1] One in six patients who visited a general dentist during the last year experienced orofacial pain. Pain in the muscles and temporomandibular joints was reported as frequently as that in the teeth and surrounding tissues in patients visiting general dentists.[2]

Also, 26% of the American population were at high risk of obstructive sleep apnea (OSA), a sleep-related breathing disorder (SRBD), indicating as many as one in four Americans could benefit from an evaluation for OSA.[3] In the same report, 57% of obese individuals were at high risk for OSA.

The relationship between pain and sleep has been well documented in the literature.[4-6] Pain stimulates the sympathetic nervous system and, when profound, it produces plastic changes that are referred to as central sensitization. The fight or flight response of the sympathetic nervous system is designed for use for a limited time, during an emergency. Central sensitization, or sympathetic dystrophy, results in sustained stimulation of the sympathetic state. Stimulating the adrenals results in an increase in cortisol levels that accelerates the metabolic rate, heart rate, and blood volume. This condition prevents the restful transition to sleep and results in insomnia.[7]

In spite of the evidence linking pain and sleep, patients seeking relief from chronic pain, craniofacial pain, and headaches have historically been treated independently from those seeking care for sleep disturbances, SRBDs, and fatigue. This study investigated the relationship between craniofacial pain symptoms and daytime sleepiness, determined by the Epworth sleepiness scale (ESS), to correlate comorbidity as well as potential predictive factors.

Materials and Methods

Patients included in the study were seeking care for chronic pain and/or SRBDs at 11 international dental treatment facilities where practices are limited to the treatment of craniofacial pain, temporomandibular disorders (TMD), and OSA. Data were collected from the TMJ and Sleep Therapy Centres in the U.S. (San Diego, California; Chicago, Illinois; Conejo Valley, Utah), Canada (Eastern Ontario; London, Ontario; Manitoba; Toronto, Ontario; Vancouver, British Columbia), New Zealand (Auckland), and the College of Dentistry, University of Tennessee Health Science Center College of Dentistry, Memphis, Tennessee).

Informed consent was obtained from all individual participants included in the study giving permission to use photographs, X-rays, and records for the purpose of research, education, or publication in professional journals. This study was approved by the Institutional Review Board of the University of Tennessee Health Science Center (13-02374- XM). The study was eligible for exempt review under 45CFR46.101 (b)(2). Craniofacial pain was defined as painful conditions present in the cranium and face, including jaw joint-related pathology and primary headache conditions. At intake, all 1,171 patients in the study were required to complete the Epworth sleepiness scale (ESS), a questionnaire shown to provide a measurement of daytime sleepiness and a standard screening tool for patients with sleep disturbance and SRBDs (Fig 1).[8] On a scale of 0-3, patients were asked to rate how likely they would be to doze off or fall asleep in eight everyday situations (e.g., sitting and reading). The ratings were added together to give a score between 0 and 24. Scores were categorized as < 6, between 6 and 9, and > 9 (i.e., excessive daytime sleepiness), based on the mean values given in the original ESS research for normal controls, primary snoring, and SRBDs, respectively.[8] Patients were also required to identify the craniofacial pain and sleep pathology symptoms that they were experiencing (Table 1).

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Epworth Sleepiness Scale

The Epworth Sleepiness Scale is a set of questions that have been used to evaluate the restfulness of a patient. Though it is not a true test that can prove you have sleep apnea, it certainly can suggest that you are more prone to fall asleep than others and should be evaluated by a physician. The questions are useful assuming that you are sleeping regularly and are in your usual state of health.

For the following situations, answer with one of the following numbers:

0 - would never doze

1 - slight chance of dozing

2 - moderate chance of dozing

3 - high chance of dozing

Situation	Score
Sitting and reading	
Watching television	
Sitting, inactive in a public place	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in traffic	
Total Score	

Patient Name Date

Fig. 1. Epworth sleepiness scale patient questionnaire.

Descriptive statistics were reported for age, gender, headache, eye pain, ear pain, facial pain, jaw pain, jaw locking, jaw noise, and pain when chewing by ESS scores. Mean and standard deviation were determined for continuous data while frequency and percentage were determined for categorical data. There were 24 observations with missing ESS scores. These observations were removed from the analysis. Age normality was examined using Shapiro-Wilk statistics for each ESS score category and was rejected ($P < 0.05$, data not shown). The Kruskal-Wallis test was performed to test the difference in age by ESS score.

Univariate ordinal logistic regression was performed for craniofacial pain symptoms (i.e., headache, eye pain, facial pain, jaw pain, jaw locking, jaw noise, pain when chewing, and gender) to determine the probability of a patient with an ESS score < 6 or between 6 and 9, by the response to each question. The odds ratio indicated how likely a patient experiencing a specific symptom would be grouped in the lower ESS score category compared with patients who did not have that symptom. The proportional odds assumption was checked using a Chi-square test. For all variables, except ear pain, the P-values were greater than 0.05, suggesting that this assumption was not violated. However, the proportional odds assumption for ear pain was violated ($P = 0.035$). As a result, a multinomial logistic regression was performed on this variable.

To investigate which pain symptoms would help predict ESS scores, a multiple proportional-odds cumulative logit regression was performed. All variables that had a P-value less than 0.2 in the univariate analysis were included in the model. If the P-value for the tested variable was greater than 0.05, it was removed from the model unless the presence of this effect changed the odds ratio estimate of any of the remaining factors by at least 20%. The final model had a P-value of 0.1044 for the proportional odds assumption test, suggesting that this assumption was not violated. All analyses were performed using SAS 9.3a and P-values < 0.05 were considered statistically significant.

Table 1. Patient complaints and symptoms questionnaire.

In the table below, please identify your chief complaint as #1 and list all other symptoms in priority.

Headache pain	Kicking or jerking leg repeatedly
Ear pain	Swelling in ankles or feet
Jaw pain	Morning hoarseness
Pain when chewing	Dry mouth upon waking
Facial pain	Fatigue
Eye pain	Difficulty falling asleep
Throat pain	Tossing and turning frequently
Neck pain	Repeated awakening
Shoulder pain	Feeling unrefreshed in the morning
Back pain	Significant daytime drowsiness
Limited ability to open mouth	Frequent heavy snoring
Jaw joint locking	Affects sleep of others
Jaw joint noises	Gasping when waking
Ear congestion	Told that "I stop breathing" during sleep
Sinus congestion	Nighttime choking spells
Dizziness	Unable to tolerate C-PAP
Tinnitus (ringing in the ears)	Tooth grinding
Muscle twitching	Teeth crowding
Vision problems	Other

Results

The frequency of pain symptoms and their association with ESS scores is shown in Table 2. Of the 1,171 patients in this study, 848 (72.4%) were female and 323 (27.6%) were male. The average age of patients was 42.6 years (standard deviation: ± 16.3 years) and there was no difference in age distribution among the three ESS score categories ($P= 0.1215$). Gender had no association with ESS score ($P= 0.1370$).

The two symptoms with the highest frequency were jaw pain (65.9%, n= 772) and headache (55.1%, n= 645). Headache was found to be significantly related to ESS score; specifically, the odds of having an ESS score ≥ 6 versus a normal ESS score of < 6 were 1.36 times higher for patients with headache ($P= 0.0051$). The odds of patients with eye pain (14.3%, n= 167) having an ESS score of > 9 or the combined ESS scores of ≥ 6 and ≤ 9 and > 9 were 1.45 times greater than the odds of those who did not have eye pain ($P= 0.0166$). The odds of being in the two higher ESS score categories for patients with jaw locking (25.2%, n= 295) were 1.31 times greater than those of patients without jaw locking ($P= 0.0321$). However, patients with ear pain, facial pain, jaw pain, jaw noise, or pain when chewing appeared to have no association with ESS score.

To determine which factors or pain symptoms would help predict a patient's ESS score, a multivariable proportional-odds cumulative logit regression was performed (Table 3). The final model suggested that a patient's ESS score was significantly associated with three variables: gender, headache, and jaw locking (Fig. 2). Specifically, given the other variables were held constant in the analysis, the odds of having an ESS score > 9 were 24% lower for female patients relative to male patients ($P= 0.0303$) while they were 1.30 times higher for those with jaw locking relative to those who did not have jaw locking ($P= 0.0362$). The odds of having an ESS score > 9 or the two higher ESS categories combined were 1.39 times greater in patients experiencing headache compared to those who did not experience headache ($P= 0.0035$).

Discussion

In the current study, based on the comparison of subjective complaints there was comorbidity between daytime sleepiness

Table 2. Frequency of pain symptoms and their association with ESS scores.

Variable	Frequency (%) n (%)	ESS score < 6 n (%)	≥ 6 and 9 n (%)	> 9 n (%)	Odds ratio	Interval	P-value
Gender					0.84	(0.66 – 1.06)	0.1370
Female	848 (72.4)	406 (47.9)	218 (25.7)	224 (26.4)			
Male (ref)	323 (27.6)	134 (41.4)	100 (31.0)	89 (27.6)			
Age (mean ± SD)	42.6 ± 16.3	43.8 ± 17.4	41.8 ± 15.7	41.7 ± 14.6			0.1215
Headache					1.36	(1.10 – 1.69)	0.0051
Yes	645 (55.1)	274 (42.5)	183 (28.4)	188 (29.2)			
No (ref)	526 (44.9)	266 (50.6)	135 (25.7)	125 (23.8)			
Eye pain					1.45	(1.07 – 1.96)	0.0166
Yes	167 (14.3)	60 (35.9)	56 (33.5)	51 (30.5)			
No (ref)	1004 (85.7)	480 (47.8)	262 (26.1)	262 (26.1)			
Ear pain					1.20	(0.96 – 1.51)	0.1102
Yes	389 (33.2)	161 (41.4)	123 (31.6)	105 (27.0)			
No (ref)	782 (66.8)	379 (48.5)	195 (24.9)	208 (26.6)			
Facial pain					1.19	(0.95 – 1.50)	0.1317
Yes	370 (31.6)	159 (43.0)	104 (28.1)	107 (28.9)			
No (ref)	801 (68.4)	381 (47.6)	214 (26.7)	206 (25.7)			
Jaw pain					0.99	(0.79 – 1.24)	0.9297
Yes	772 (65.9)	359 (46.5)	204 (26.4)	209 (27.1)			
No (ref)	399 (34.1)	181 (45.4)	114 (28.6)	104 (26.0)			
Jaw locking					1.31	(1.02 – 1.67)	0.0321
Yes	295 (25.2)	116 (39.3)	95 (32.2)	84 (28.5)			
No (ref)	876 (74.8)	424 (48.4)	223 (25.5)	229 (26.1)			
Jaw noise					1.13	(0.91 – 1.40)	0.2619
Yes	547 (46.7)	241 (44.1)	156 (28.5)	150 (27.4)			
No (ref)	624 (53.3)	299 (47.9)	162 (26.0)	163 (26.1)			
Pain when chewing					1.12	(0.90 - 1.40)	0.3092
Yes	478 (40.8)	211 (44.1)	135 (28.2)	132 (27.6)			
No (ref)	693 (59.2)	329 (47.5)	183 (26.4)	181 (26.1)			

The P-values were calculated based on proportional odds regression. Kruskal-Wallis was used for age factor. Chi-square was used for gender. A multinomial logistic regression was used for ear pain because the proportional odds assumption was not met.
Abbreviations: ESS = Epworth sleepiness scale; SD = standard deviation.

Table 3. Multivariate proportional-odds cumulative logit regression.

Predictors	Estimate	Odds ratio	95% confidence interval	P-value
Gender (ref = male)	-0.2699	0.76	(0.60 - 0.98)	0.0303
Headache	0.3286	1.39	(1.11 - 1.73)	0.0035
Jaw locking	0.2643	1.30	(1.02 - 1.67)	0.0362

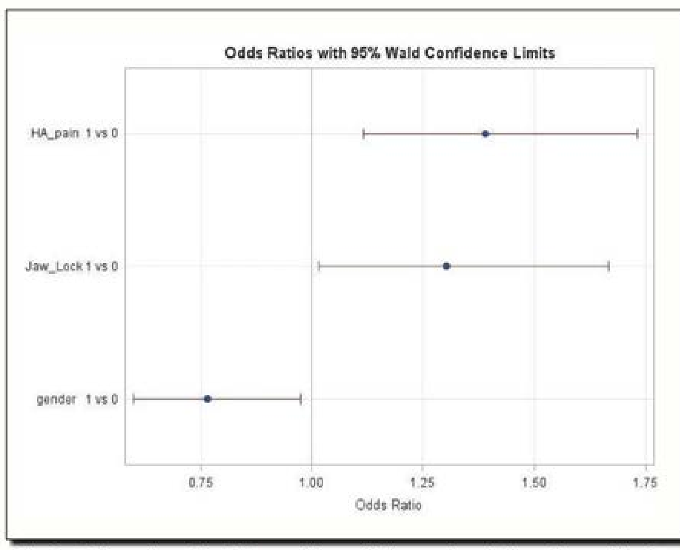

Fig. 2. Odds ratios with 95% confidence limits produced from the multivariate proportional-odds cumulative logit regression.
Gender: male: 0; female: 1. HA_pain: no headache: 0; headache: 1. Jaw_Lock: no jaw locking: 0; jaw locking: 1.

and some craniofacial pain symptoms. More specifically, the odds of having an ESS score ≥ 6 and ≤ 9 or > 9 were 1.39 times higher for patients experiencing headaches after adjusting for gender and jaw locking. Eye pain, another symptom of craniofacial pain, was also correlated with the higher ESS score categories. In addition, for the first time to our knowledge, orthopedic craniofacial dysfunction (i.e., jaw locking) was correlated with, and predictive of, high ESS scores (i.e., excessive daytime sleepiness).

Jaw locking, an orthopedic problem of the jaw, can occur as a result of sleep bruxism (SB), which is classified as a sleep-related movement disorder by the International Classification of Sleep Disorders (diagnosis and coding manual [ICSD-2]) and is the result of sympathetic stimulation.[9-11] SB may cause stretching of the capsular ligaments and ligament laxity, which allows for excessive disc movement, eventually resulting in disc displacement with reduction, then disc displacement without reduction (jaw locking).[12] While SB has previously been linked with daytime sleepiness,[13,14] the results of the current study now link jaw locking with excessive daytime sleepiness.

Similar to jaw locking, in the current study, headache was correlated with the two higher ESS categories, and predictive of high ESS scores. In the literature, studies[15-18] have linked excessive daytime sleepiness with primary headache. In a study[17] of 200 consecutive migraine patients, excessive daytime sleepiness (defined as an ESS score ≥ 10) was present in 37% of patients overall, and in 32.4% and 39.8% of patients with episodic and chronic migraine, respectively. In another study,[18] chronic headache patients showed a higher prevalence of daytime sleepiness than control patients. In children, a headache disorder is a cumulative risk factor for disorders of excessive somnolence (odds ratio: 15.061).[19] The results of the present study confirm the relationship between headache and excessive daytime sleepiness.

Daytime sleepiness can occur due to a disturbance in sleep quantity or sleep quality. Sleep deprivation or fragmentation, primary central nervous system hypersomnias, neurological, psychiatric, cardiac and pulmonary disorders, and medication use, among other factors, may also contribute to daytime sleepiness.[20] However, in clinical practice, OSA is the most common cause of excessive daytime sleepiness,[20,21] which has been reported in up to 87% of patients with OSA.[22] In the original ESS research, patients with OSA syndrome, narcolepsy, idiopathic hypersomnia, or periodic limb movement disorder all had ESS scores > 9; these scores were significantly higher than those of controls or primary snorers (mean ESS scores ± standard deviation of 5.9 ± 2.2 and 6.5 ± 3.0, respectively).[8]

An established relationship exists between OSA and TMD.[23,24] Two studies[23,24] tested the hypothesis that OSA signs and symptoms were associated with TMD: the OPPERA prospective cohort study of adults aged 18-44 years at enrollment (n= 2,604) and the OPPERA case-control study of chronic TMD (n= 1,716). Both studies supported a significant association between OSA symptoms and TMD, with prospective cohort evidence finding that OSA symptoms preceded first-onset of TMD: patients with two or more signs and/or symptoms of OSA had a 73% greater incidence of first-onset TMD.[24] In addition, SB has been linked to maintaining airway patency in OSA and respiratory effort related arousal.[25,26] In the apneic patient, the superficial masseter muscles are specifically stimulated by ventilator stimuli and increasing hypercapnia.[27] It is believed that the actions of jaw opening and muscle clenching, as seen with SB, helps to prevent pharyngeal collapse in patients with OSA.[25,28,29] The association between TMD and SB is debatable, although similar RMMA frequencies and indexes were found in both TMD and headache cases versus controls.[30,31] UARS (Upper Airway Resistance Syndrome) and nasal obstruction may be a mechanism as women with TMD have higher RERA (Respiratory Effort Related Arousals) in relation to TMD pain.[32]

The results of the current study show that both jaw locking and headache are correlated with, and predictive of, ESS scores indicative of excessive daytime sleepiness. Jaw locking and headache are also both common craniofacial pain symptoms of TMD. The comorbidity of primary headaches such as tension-type headache, chronic daily headache, and migraine with TMD has been well established.[33,34] This is especially true for migraine, which is the most prevalent headache in individuals with TMD.[35,36] From a clinical perspective, the current study results, together with the established relationships between OSA and TMD, and headache and TMD, as well as the literature stating that the most common cause of excessive daytime sleepiness is OSA,[20-22] provide evidence indicating the importance of screening patients with a questionnaire that has both craniofacial pain and sleep pathology symptoms. For patients seeking treatment for craniofacial pain, this inclusive questionnaire would investigate whether the patient might also have excessive daytime sleepiness, and, based on previous ESS research,[8,21,22] potentially a SRBD. In addition, understanding the correlation of daytime sleepiness with jaw locking and headache (found in the current study), sleep physicians or dentists treating SRBDs should screen their patients for orthopedic disorders of the jaw joint or TMD. The results of this study are the bridge through which physicians and dentists can collaborate for optimal treatment of patients with craniofacial pain and SRBDs.

Finally, the female patients in this study were less likely than the male patients to have an ESS score of > 9. Recent research demonstrating an increasing prevalence of sleep-disordered breathing has shown a higher incidence of SRBDs in men compared with women (17% and 9% among 50-70 year-olds, respectively).[37] While women seek care for chronic pain at a much higher rate than men in the general population, which is reflected in the higher percentage of female patients compared with male patients in this study, men may be less symptomatic for and tolerant to pain and inflammation until the development of significant dysfunction (e.g., jaw locking) and profound headaches demand their attention.

Although the data in this study were collected in 11 locations from three countries utilizing a standardized data intake, the ESS is a subjective evaluation of daytime sleepiness. Currently, pain and sleepiness can only be measured by subjective patient evaluations. Until such time as these symptoms can be objectively measured, the subjective limitations will be a factor in all research using these types of evaluations.

a. SAS Institute Inc., Raleigh, NC, USA.

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Dr. Olmos is Adjunct Professor and Dr. Garcia-Godoy is Professor, Senior Executive Associate Dean for Research, and Chair, Department of Bioscience Research; Dr. Hottel is Professor, Department of Prosthodontics, and Dean, College of Dentistry; Dr. Tran is Assistant Professor, Department of Preventive Medicine, College of Medicine, University of Tennessee Health Science Center, Memphis, Tennessee, USA.

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