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Assessment of Levels of Salivary Cortisol and Stress in Patients with Signs and Symptoms of Temporomandibular Joint Disorders

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Abstract

Introduction: The temporomandibular joint disorders (TMD) has represented a major diagnostic and therapeutic challenge today. Objective: This study aimed to assess the relationship between levels of salivary cortisol and stress in patients with signs and symptoms of TMD. Methods: 30 volunteers of both sexes, aged between 20 and 50 years and those with signs and symptoms of TMD. Been reported stress levels through Stress Inventory for adults of Lipp (ISSL), Perceived Stress Analysis and analysis of salivary cortisol. Results: The sample consisted of 55.2 % of participants were female and 44.8 % male. The percentage of participants who had stress according to the ISSL was 69% and the phase of resistance was the most significant at 65%. There was a predominance of psychological Stress (76.9 %). Women showed a higher frequency of stress than men in ISSL and also higher rates in the Perceived Stress Scale. Cortisol levels in both groups were above the reference values and observed results in the levels of cortisol in the morning higher in men compared to women.

Keywords: Temporomandibular joint, temporomandibular disorders, stress, cortisol

1. Introduction

The temporomandibular joint (TMJ) is a component of the stomatognathic system, providing a dynamic system and is considered the most complex joint in the human body.

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The ATM differs from other joints not be coated with hyaline cartilage, but by a layer of avascular fibrous tissue, this being resistant fabric compressive forces. It is intended to provide hinge and gliding movements. (Okeson, 2008).

Dysfunctions related to temporomandibular joint have been a major diagnostic and therapeutic challenge, due to the degree of difficulty and multifactorial nature of cases and the anatomical and physiological complexity of the structures involved (Barreto et al, 2010;. Luther et al., 2010). The complex group of disorders that affect the TMJ are related to vulnerability in developing this joint pathologies, the most common being related to the articular disc related, inflammatory and degenerative (Boulox, 2012).

It is understood by temporomandibular dysfunction (TMD), a collective and complex description of signs and symptoms that affect the masticatory muscles, TMJ and associated structures. Considered a functional disorder of the TMJ that is characterized by symptoms such as pain in the damaged joint, changing the movements of the jaw, limited jaw opening, preauricular pain, earache, tinnitus, headache, among others (McWhorter, 2011; Korszun et al, 1998). Such a condition has represented a significant cause of physical and psychological weakness in a large segment of the population. The etiology of TMD is extensively studied and considered multifactorial, with psychological stress has been commonly noted in studies as an important triggering factor of this condition, as well as responsible for maintaining the same (Wu, et al, 2011;. Urban et al ., 2009; Barreto et al 2010).

Wu et al. (2011) in their study with mice concluded that psychological stress can lead to symptoms such as abnormal jaw movements, facial pain and fatigue of muscles, but also result in dramatic changes in energy metabolism of masticatory muscles. The same way the increase in serum cortisol concentration and adrenocortinotrófico hormone (ACTH) changes the infrastructure of ATM and induces inflammation of the same.

The general stress response mechanism consists of two biochemical sequences: a quick mediated by the hormones adrenaline and noradrenaline, and another slow mediated by the hormone cortisol. The cortisol, steroid hormone, synthesized in the zonafasciculata of the cortex of the adrenal gland is commonly used as an indicator of stress levels and its secretion depends on the levels of ACTH. (Fumihiko et al, 2004;.Sapolsky 1991).

The stress response begins when the brain is able to perceive a stressor, a stimulus or situation that produces a physiological response (Selye, 1956).

According to surveys in various parts of the world, patients with high levels of stress are more susceptible to bruxism, disorders related to temporomandibular joint disorders (TMJ) and in general, emphasizing the implications of excessive stress on physical and mental health is human. The American Academy of Orofacial Pain (AAOP) established in the fourth edition of its manual, new guidelines for the diagnosis and classification of different forms of TMD, dividing them into two big groups (muscular and articular TMD). The attempt to isolate a clear and universal cause of TMD has not been successful, making it relevant to take into account psychosocial factors such as anxiety, stress and depression, as well as the pathophysiological or traumatic bruxism (Luther et al, 2010; McWhorter, 2011; Carrara et al, 2010).

Due to these assumptions, it is necessary a greater understanding about the factors related to the psychophysiology of stress and its influence on the worsening of these cases, as well as the participation of cortisol, which in humans is the main corticosteroid and participating in the modulation system stress. The study of these systems in the processes of disorders involving the temporomandibular joint is justified by the possibility to predict periods of increased bruxism and consequent aggravation of the symptoms of TMD.

The objective of this study was to evaluate the relationship between salivary cortisol levels and stress in patients with signs and symptoms of TMD, through theStress Symptom Inventory of Lipp (ISSL) and Analysis of Perceived Stress. With the intention of providing a more comprehensive view of the human being in respect to quality of life, seeing the possibility of a diagnosis of pathologies involving more precise TMJ and plan effective rehabilitation treatment.

2. Methods

2.1 Sample and Research Design

The present study was characterized as a transverse, quantitative and qualitative experimental study, including 30 volunteer subjects from Porto Alegre and its metropolitan area, recruited in the same dental office in the city of Porto Alegre.

Individuals with signs and symptoms of TMD related in the interview, questionnaire, confirmed in imaging studies and aged between 20 and 50 years of both sexes were included in the research.

Those individuals with autoimmune diseases, neoplasms, hormone use in the class of glucocorticoids were excluded. As well, as patients on antidepressants and antianxiety medications. Pregnant women were excluded due to increased levels of CRH secreted by the placenta.

2.2 Experimental Design

After signing the Informed Consent Form Form (ICF), anamnesis was carried out and completed the health questionnaire, and the questionnaire to check for signs and symptoms of TMD. Saliva collection tube with a specific collector for analysis of salivary cortisol was also performed.

2.3 Assessment of stress levels through the Symptom Inventory Lipp Stress (ISSL)

The assessment of stress levels was performed by applying the Inventory of Stress Symptoms for adults Lipp (ISSL), which was developed and validated in Brazil (Lipp, 2005) .The participants were instructed on completing the Symptom Inventory Lipp Stress and collect saliva on the same day.

2.4 Perceived Stress Scale (PSS)

Participants received the questionnaire on the Perceived Stress Scale in the full version, 14 questions, were asked to read and respond according to the instructions for application. The PSS was answered the same day the ISSL and the collection of cortisol.

2.5 Collection and Analysis of Cortisol

Participants received salivetes in a sealed and individually identified with their names kit. One trial was performed after waking and another night being the two collections held at the same informational dia. An informative written for saliva collection was given to each participant containing the necessary for correct performance of collection care.

After the realization of the collection participants were instructed to keep the bottles in the refrigerator until the next day when they handed over to the researcher. Saliva samples were stored in salivete frozen and taken to the laboratory for Immunology Research Center and Graduate of Methodist University IPA.

The tubes were centrifuged at 1000 rpm for 20 minutes and frozen at -20 saliva. For salivary cortisol measurement by enzyme immunoassay technique with conjugated antibody (ELISA) was used. A commercial kit for direct immunoassay - Cortisol Elisa Kit (DBC, Canada) and procedures for the experiment followed all the directions from the manufacturer was used for analysis.

2.6 Statistical Analysis

Based on the analysis results, we calculated the mean ± standard deviation for each of the scalar variables. For categorical variables the data are presented as percentage frequency. The normality test used is Shapiro Wilk. For parametric variables, by Student t test for independent samples. To compare the levels of stress was applied analysis of variance (ANOVA) with post hoc Bonferroni.Foi adopted a value of $p \leq 0.05$ for statistically significant data and the statistical program used was SPSS17. 0 for Windows.

2.7 Ethical Considerations

This study was approved by the Ethics Committee on Human Research of the Methodist University with IPA on 08/09/2013 n ° 379 119. All information collected that could identify the patient were kept confidential, protecting the principles of respect, beneficence, non-maleficence and justice. The Instrument of Consent was structured in easy to understand with all the necessary information on the query language. Course being the study, the patient signed the consent form and got a copy of this.

The procedure for disposal of biological and chemical waste occurred as a n.316/2002 CONAMA Resolution (BRAZIL, 2002).

3. Results

This study evaluated the relation of TMD to the levels of stress and cortisol in men and women with a mean age of 34.89 ± 7.57 years. The sample consisted of 55.2% female and 44.8% male.

Considering the assessment of symptoms of stress Lipp, 31.0% of subjects evaluated showed no symptoms of stress while 69.0% had symptoms of stress.

Table 1 presents Results from subjects with and without stress according to the Inventory of Stress Symptoms Lipp (ISSL) and cortisol levels in both periods according to the groups with and without stress. Of individuals who were identified stress, 5% were alert phase, phase 65% resistance and 30% of near exhaustion phase with predominantly psychological stress of 72.7% and 27.3% of physical stress.

The group with stress symptoms was also divided according to the classification phase of stress. The "Alert" group had an individual female, predominantly psychological stress, cortisol average of day and night at 19.75 and 19.58 mg / dl, respectively, aged 47 and perceived stress scale of 24; since the resistance group had 13 subjects (53.8% male and 46.2% female), with 76.9% of individuals had a predominance of psychological stress (n = 10) and 23.1% with predominance physical stress (n = 3), salivary cortisol concentrations day and night 25.94 ± 2.45 and 19.24 ± 6.28 mg / dl respectively age of 36 ± 8.15 years and scale of perceived stress 27.23 ± 5.24. Finally, the group near exhaustion contained six individuals (16.7% male and 83.3% female), 50% with predominantly psychological stress (n = 3) and 50% with a predominance of physical stress (n = 3), salivary cortisol concentrations of 26.38 ± 2.11 and 13.91 ± 5,55µg / dl, respectively, age of 33.16 ± 5.19 years and the perceived stress scale of 34.16 ± 3.97. In the comparison group, only the values of perceived stress differed between groups "resistance" and "almost exhausted" With respect to perceived stress the mean score of the subjects in our study was 27.28 ± 5.92.

Table 1. Individuals with or without Symptoms of Stress through the Lipp Inventory of Stress

	Individuals without stress (n=9)	Individuals with stress (n=20)
Gender (female/men)	4/5 (44.4%/55.6%)	12/8 (60%/40%)
Cortisol Morning (ng/mL)	26.05±3.24	25.74±2.66
Cortisol Night (ng/mL)	15.86±4.41	17.66±6.27
Scale of Perceiver Stress	22.62±3.15*	29.15±5.77

Legend: Values presented in mean ± standard deviation
* Significant difference between groups ($p<0.05$) (Student independent t-test)

Cortisol levels were assessed in the morning and evening. The overall mean found for the morning was 25.84 ± 2.81 (mg / dl) and in the evening the cortisol level was 17.10 ± 5.74 (mg / dl). Individuals who showed symptoms of stress were separated by sex as shown in Table 2.

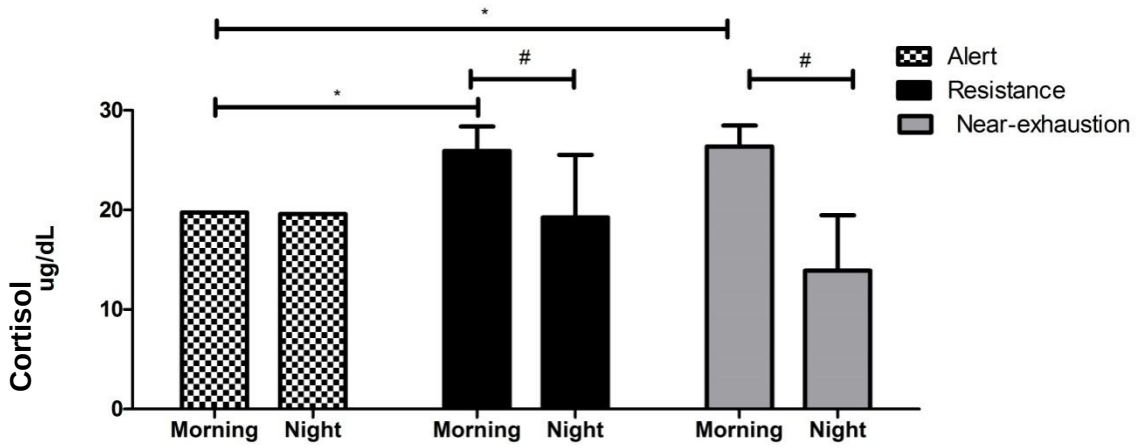
Table 2. Difference between sexes of Individuals with the Presence of Stress Symptoms According to Lipp Inventory Stress

	Women (n=12)	Men (n=8)
Age (years)	34.66 ± 8.4	37.2 ± 6.3
Cortisol Morning (ng/mL)	24.51 ± 2.56*	27.28 ± 2.0
Cortisol Night (ng/mL)	16.24 ± 5.91	19.78 ± 6.59
Scale of Perceived Stress	30.66 ± 5.39*	26.87 ± 5.91

Legend: Values presented in mean ± standard deviation.
* Significant difference between groups ($p<0.05$) (Student independent t-test)

Individuals with this stress according to Stress Symptm Inventory of Lipp were divided into groups according to the symptoms and cortisol levels were analyzed. There was a significant difference in individual alerting phase with the resistance group and the near exhaustion ($p = 0.05$). Was also identified difference between morning and evening cortisol in resistance and near exhaustiongroups ($p = 0.05$).

Figure 1 - Individuals with stress according to the ISSL Groups x Cortisol



4. Discussion

Various studies have demonstrated the need for an understanding of the possible factors involved in the aggravation of TMJ disorders. So far there is no knowledge about works that have studied the relation between salivary cortisol and stress in patients with temporomandibular disorder (TMD).The present study investigates the relation between stress levels and salivary cortisol in patients with TMD symptoms.

It is known that the etiology is considered multifactorial TMD and psychological stress has been considered an important factor in the triggering and maintenance of this pathology (Korszun et al., 1998).

Considering that our sample consisted of patients with TMD and who were long exposed to triggering factors, we analyzed the presence of stress in the sample, most people (69%) had symptoms of stress by assessing the Inventory stress for adults Lipp.

These data corroborate the literature that indicates that stress is a strong etiologic factor for TMD (Korszun et al, 1998;. Wu et al 2011;.Jones et al., 1997).

Among the individuals who were identified stress, 65% were in the resistance. It is known that this phase occurs when the offending agent is of long duration or intensity is too much for the person. In this case the adaptive reserve power is used in an attempt to seek balance (Lipp et al. 1996).

After analyzing the Lipp Inventory of Stress was observed that there was a higher prevalence of psychological distress (76.9%). This fact was expected due to the multifactorial nature of TMD and these data corroborate the findings ofWu, et al., (2011), demonstrate the relationship between psychological stress and changes of structures related to the ATM as well as the change in energy metabolism of masticatory muscles resulting in the onset of symptoms and dysfunction TMJ. In this study the increase in serum cortisol concentration was also related to pathology.

In another study by Goulart Junior and Lipp (2008) using the ISSL and conducted with teachers, the results confirmed the greater vulnerability to problems related to psychological symptoms (59.6% of participants) .One interesting factor observed in the study was was not obtained the sample with 100% stress, although it was found that 69% showed symptoms of stress. This may be related to individual levels of stress tolerance and individual perception on the effects of stress on each person. Delboni, (2007) reported that levels of stress tolerance are different for each individual. People with more elastic limits have greater resistance to it. But when undergoing constant and increasing tension inevitably as any elastic will break, which means body and mind get sick. The lower an individual's reaction to stress, less physical symptoms related to it will occur. We can not discard the wrong completing the questionnaire by patients, since the symptoms of stress can be difficult to identify and the Lipp Inventory, which must be performed without interference from the researcher.

Another analysis conducted by the group was perceived stress scale that indicates the perception of stress globally, independent of aggressive agents (Luft et al. 2007).

Although there is no cut-off point on the scale of perceived stress, observed that the group with no stress according to Lipp had a score of 22.62 ± 3,15diferente statistically stress of individuals who had a score of 29.15 ± 5, 77.

This result is important since we observed this difference in scores indicating a cutoff between stressed and non-stressed individuals. Some authors emphasize the importance of obtaining a cutoff justifying that when evaluating a continuous variable precision is gained, allowing further consideration of a set of individual factors, while others understand the perceived stress as a continuous variable that must be analyzed as such (Dancey and Reidy, 2005; Streiner, 2002).

Considering the values obtained of perceived stress in relation to gender, it was found that women presented higher levels of perceived stress than men. Similar results were observed by Luft et al., (2007), in this paper the indices related to perceived stress levels appear significantly higher in women than in men. It is noteworthy that as observed in other studies, women had a higher frequency of stress than men when applied to the ISSL. Rossetti et al., (2008) applied the ISSL in the Federal Police of São Paulo servers and concluded that most of the participants remained in the resistance and females had a higher frequency of stress levels (59%) compared with male sex.

Paulino et al., (2010), in a study of students graduate from a private university in São Paulo, concluded that 88% of women were stressed, lying for the most part in the resistance stage of stress with predominant psychological symptoms. The authors attributed this female susceptibility to stress, the female role and sociocultural triple workday that includes employment, study and family. The same way Pafaro and Martino (2004) evaluated a group of 33 staff nurses from a hospital pediatric oncology center in Campinas (SP) and a significant prevalence of symptoms of stress in women was found, when compared to men, which corroborates our results.

Although there was no statistically significant difference in cortisol levels between subjects with and without stress is important to note that in both groups, cortisol levels were above the reference values for a healthy population. According to Jones et al. (1997), psychological factors associated with TMD may lead to an increase in cortisol in some patients, but lower cortisol response was found unexpectedly in a small group of patients with TMD. Consequently it is possible to find increases and decreases in cortisol levels in patients with pain. The authors reported lower cortisol responses in patients with TMD to chronic stress, which may be related to the fact that chronic stress being possibly affecting upregulation of receptors that affect the ability of the adrenal cortex in sustaining the continued secretion of cortisol.

In another study by Matzner (2012) did not correlate with stress and cortisol levels in healthy subjects and that the level of stress was induced by sleep deprivation.

As Xavier et al. (2005) cortisol levels expected for the morning range between 7 to 24 ug / dL, and the night <6 ug / dL. Therefore the levels found in this study were about 2.6 times higher than the average night. This may represent a favoring factor for sleep bruxism that propitiates the functional overload of the stomatognathic system. The involuntary forceful contact between the occlusal surfaces of the teeth during mandibular functional movements would not exceed the physiological tolerance in related structures, causing tooth wear, pain and consequently dysfunction. Bruxism has been considered an important factor contributing to the changes in the TMJ and associated with signs and symptoms of TMD. The muscle forces are considered a relevant factor for the pain and inflammation of the tissue retrodiscal (Barbosa et al 2008;.De Freitas et al 2011;. Martins et al 2007;. Pereira et al, 2009;. Santos et al., 2006).

Only when the sample of individuals with stress was separated by gender was observed that the results found in the group of men in the levels of cortisol morning shift was higher compared to women.

As seen in Figure 1, one can identify the group in the alert phase of cortisol showed a lower index compared to individuoas in the resistance near exhaustion and, in turn morning. This fact indicates an influence of stress on cortisol levels in the progression of . We know that the warning phase is not harmful for the organism, provided that the return to homeostasis occurs. As Lipp (2005) some kind of stress is always necessary, as in the phase of alert humans automatically prepares for the action, but when it exceeds the adaptability of the subject, can become detrimental to the functioning of the body.

Although it has been observed a significant presence of psychological stress and elevated cortisol levels compared to reference values, we believe that more studies are needed so that other factors are identified as biomarkers for the DTM. Resilience is an example since individuals with high levels of resiliency feature adaptive factors that mask the expected signs and symptoms. It is also known that the individual response contributes to different results as can be seen in TMD patients who showed no signs of stress composing 31% of the sample.

Junior Santos and Alves (2007) in research on stress and coping strategy used the ISSL and agree with the fact that the stressor event itself does not have the ability to determine the stress level of the subject, dependsdepends on the subjective assessment and interpretation given to the stressor.Therefore how the individual perceives and reacts to stress and its adaptive power concerns an individual response. Data from this study corroborate previous findings that show the relationship between psychological factors and cortisol responses may vary, and there are great individual variations in cortisol response in apparently homogeneous groups, as in the case of patients with signs and symptoms of TMD .

In conclusion, the results of this study show that most of the sample TMD patients (69%) had stress and the phase of resistance was the most significant (65%), according to the ASSI. Higher prevalence of psychological distress occurred, confirming the relation between diseases involving the TMJ and stress. Thus the prevalence of stress levels, a higher incidence of psychological stress and the prevalence of resistance phase in the sample confirms the influence of these factors in the etiology of TMD.

Regarding gender, higher levels of stress in the ISSL and perceived Stress Scale were found in women compared to men, signaling the importance of the need for future studies with this population.

This study alerts us to a relationship between TMD and chronic conditions and the possibility of resilience to stress, which may mask the individual's perception of their own symptoms, thereby justifying further studies on the relationship between stress and cortisol x human resilience.

Conflicts of Interest

The authors declare no potential conflicts of interest.

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