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RESEARCH ARTICLE

Salivary Cortisol levels in the Etio-pathogenesis of Occlusal Disharmony and Psychological Stress in Myofascial Pain Dysfunction Syndrome - A Short Term Clinical Study

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Abstract

Myofascial pain dysfunction syndrome (MPDS) is a multifactorial, and still poorly understood. The predisposing factors of occlusal disharmony have been shown to play a significant role in the etiology. The aim of the current study was to evaluate the correlation between occlusal disharmony and salivary cortisol levels in patients with MPDS. Twenty patients suffering from MPDS were enrolled as a study group. The same age and sex group was matched with healthy individuals to be considered as a control group. The salivary samples were collected between 14:00 − 17:00 clock from both groups and the cortisol levels were analyzed with the competitive enzyme-linked immunosorbent assay method. The mean salivary cortisol level of the MPDS group showed a highly significant difference ($P < 0.001$) from the control group. A positive correlation was found between occlusal disharmony and the salivary cortisol levels in MPDS patients. These findings confirmed that occlusal disharmony plays a vital role in the etio-pathogenesis of MPDS.

INTRODUCTION

Mastication is a process consisting of a functional homeostatic balance of the stomatognathic system including teeth, periodontium, masticatory musculature, temporomandibular joint and the psyche of each individual. In the case of imbalance of a number of factors acting either individually or combined, the myofascial pain or myofascial pain dysfunction syndrome (MPDS) was expressed as a temporomandibular disorder (TMD) (Kasrovi et al., 2000). Several theories have been emerged recently in attempts to link the causal factors for myofascial pain. Among these theories "Biopsychosocial Model", that is considering the role of biological and psychosocial factors in the etiology of myofascial pain (Marbach and Lipton, 1987, Grzesiak, 1991). Occlusal disharmonies is one of these factors, which has physical, psychological, and social effects (Bernabe et al., 2009). In an animal model, the placement of acrylic caps on the lower incisors of rats increased plasma corticosteroid levels (Yoshihara et al., 2001). In another study using accelerated senescence-prone mice, the bite raising in aged mice increased plasma corticosteroid levels (Kubo et al., 2007). Furthermore, in a human study, patients with a severe occlusal disharmonies requiring surgical correction showed improvement in disease-specific oral health-related and anxiety after jaw surgery (Azuma et al., 2008). These findings suggested that a relatively occlusal disharmony might lead to psychological stress. Ekuni et al., (2011) investigated the relationship between impacts on daily performance attributed to occlusal disharmonies and psychological stress in healthy young Japanese adults (n = 641; 329 males and 312 females); they conclude that, impacts on daily performance attributed to occlusal disharmonies contributed to psychological stress, especially interpersonal sensitivity and depression in young Japanese adults (Ekuni et al., 2011).

Physiological stress is known to induce various adaptational responses of physiologic systems, including increased activity in the hypothalamic pituitary adrenocortical (HPA) system, which promotes cortisol secretion from the adrenal cortex (Marbach et al., 1990), with many bodily effects. Cortisol, known as a stress hormone and has been used as an indicator in stress evaluation studies (Jones et al., 1997, Koray et al., 2003, Yoshihara et al., 2005). The evaluation of cortisol in saliva has gained interest in anxiety investigation, because it provides measurement of unbound cortisol compared to serum (Nagakura et al., 2012). Collecting saliva is a quite stress free and does not require trained staffs, and changes in environmental conditions like temperature and motion and even growth of organisms do not alter the concentration of cortisol in salivary samples (Safarzadeh E, (2005)).

The aim of this study was to evaluate the relationship between occlusal disharmony and salivary cortisol levels in patients with myofascial pain, and to correlate the role of occlusal disharmony in inducing psychological stress.

Material and Methods

Study Participants: This study was conducted in Faculty of Dentistry at the Qassim University in collaboration with Dental Department at Arras General Hospital, Qassim province, Kingdom of Saudi Arabia, after approval by the institutional ethics committee (Code No.: EN/22/2014). Twenty male patients with average age group of 22.36 years old (Table 3), seeking treatment for MPDS in the form of temporomandibular disorder (TMD) were participated in this study, and diagnosed using the research diagnostic criteria for TMD (RDC-TMD) Axis I, group I (Schiffman et al., 2010). The control group included twenty healthy male volunteers with the same age group 22.23 years old (Table 3). The unification of gender in this study is to reduce the possibility of biasing of a single experimenter across genders.

Table 1: Inclusion Criteria for MPDS and Controls.

Procedures		Standards
MPDS	History	Positive to one of the following: • Pain in the jaw, temple, ear / in front of ear. • Pain modified with jaw movement.
	Clinical Exam.	Positive for all of the following: • Conformation of pain location in the muscles of mastication. • Report of familiar pain with palpation of one of muscles of mastication. • Present occlusion disharmony.
Controls	History	Negative to all of the following: • Pain in the muscles of mastication …etc. • Pain with jaw movement.
	Clinical Exam.	Negative to all of the following: • Pain location in the muscles of mastication • Report of familiar pain with palpation of the temporalis or masseter muscles • Present occlusion disharmony. • Dental prosthesis.

Table 2: Exclusion Criteria for MPDS and Controls.

	Standards
History	Positive to one of the following: • Systemic rheumatic, neurologic/neuropathic, endocrine, immune/autoimmune diseases or wide spread pain. • Radiation treatment to head and neck. • Trauma or TMJ surgery. • Presence of non-TMD orofacial pain disorders. • Use of narcotic pain medication, muscle relaxants, antidepressant drugs, or steroid therapy • Contraindications for imaging
Clin. Exam.	Positive to one of the following: • Presence of non-TMD orofacial pain disorders. • Presence of complete denture. • Panoramic radiograph is positive for osseous or odontogenic lesions.

Extra and Intra-oral evaluation: The Extra-oral examination composed of some measures added to the regular examination procedures, includes the myofascial palpation test and the modified joint palpation test (Schiffman et al., 1992). The myofascial palpation test performed at the RDC/TMD-specified muscle sites in the masseter and temporalis muscles. Addition to regular intra-oral examination, joint-play tests (i.e., traction, and compression) (Lobbezoo-Scholte et al., 1993, Lobbezoo-Scholte et al., 1994), bite test with unilateral and bilateral placement of cotton rolls, and a 1-minute clench were performed. The occlusal evaluation included registering the teeth number, overbite, crossbite, and midline discrepancy (Schiffman et al., 1992). Occlusal intercuspal contacts will be appraised using Shim stock (Almore International) in maximum intercuspal position (MIP) (Anderson et al., 1993). Centric relation position (CR) to MIP slides was also assessed (PE., 2007).

X-ray: A panoramic radiographs were obtained, and interpreted to rule out any dental or osseous diseases.

Specimens' Collection: Unstimulated Salivary samples from both the study and control groups were collected between 14:00 and 17:00 clock, when salivary cortisol levels are considered to be stable on the basis of circadian rhythm (Kirschbaum and Hellhammer, 1989). Participants were asked not to chew gum, eat or drink any liquids except water for two hours before sampling saliva. They asked to rinse their mouth for 30 seconds with clean water. Unstimulated saliva will be collected for 5 minutes into a graduated sterile tube kept on ice (Navazesh, 1993). For the control group, saliva was collected in two stages, one after initial clinical examination to check the appropriateness of the participant, and the second after two weeks of induced occlusal interference Fig 1.

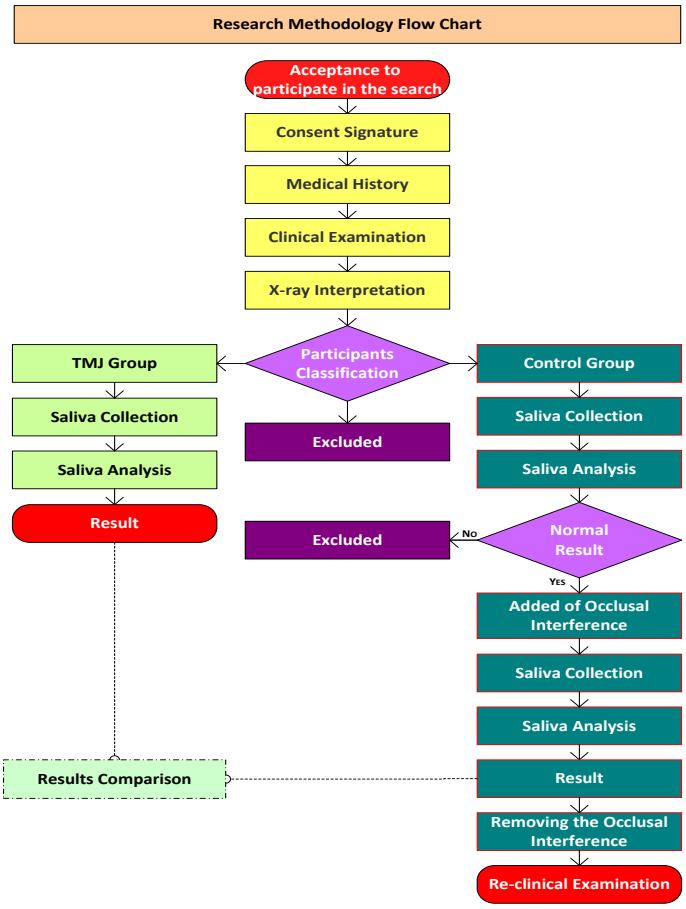

Figure 1: Research Methodology

Saliva Analysis: Salivary cortisol measured by competitive Enzyme Linked Immunosorbent Assay (ELISA) method, with Cortisol EIA (Diametra kit, Korea). The normal cortisol concentrations that were given as a guideline according to the kit were in the range of 3-10 ng/ml in the morning time and 0.6-2.5 ng/ml in the evening collected samples.

Addition and Removal of Occlusal Interference: Occlusal Interference was created to the control group by fitting stainless steel crown Fig 3, (3M ESPE) on the lower first right molar without any preparation or cementation, the margins are kept just below the contact area 2 mm. away from the gingival margin. Elastic separators, Fig 2, (3M ESPE) were placed in the mesial and distal of the lower first right molar to create a small space prior to placement of stainless steel crown (Ghosh and Nanda, 1996, VanderWeele et al., 1998).

Figure 2: Elastic separator inserted into the mesial and distal of the lower first right molar.

Figure 3: Stainless steel crown on the lower first right molar without any preparation or cementation

After two weeks, the control group participants with temporary crown were recalled for collecting salivary samples and the same procedure was followed for collection of sample as previously mentioned. During the same visit the stainless steel crown were removed. Participants were re-called week later for clinical examination to make sure there are no side effects related to past occlusal interferences.

Statistical Analysis: Statistical analysis was carried out using Paired t-test and Independent t-test to compare the Cortisol levels between the test group and control group (Table 4) as well before and after the intervention within the control group (Table 5).

Results

The present study was conducted in 40 subjects to evaluate the relationship between occlusal disharmony and salivary cortisol levels. The MPDS group consisted of twenty patients who were clinically diagnosed with myofascial pain. The control group consisted of twenty healthy male volunteers who were clinically evaluated and the average age range was matched with MPDS group Table 3.

Table 3: Demographic Data of the Study and Control Groups

Group	Gender	Mean age and SD
MPDS	M	22.36 ± 1.32
Control	M	22.23 ± 0.51

Salivary cortisol values were compared between MPDS group and the control group. The mean was used to compare the values between different groups. The mean salivary cortisol levels were 3.035±0.123 ng/ml in the MPDS patients and 2.040±0.143 ng/ml in the controls before creating the occlusal interference. Salivary cortisol levels in MPDS group showed statistically high significant values when compared to control group p<0.001, (Table 4).

Table 4: Comparison of the Salivary Cortisol Levels between MPDS & Controls before creating the occlusal interference to the control.

	Mean ± SD	Independent t-test (p)
MPDS	3.035±0.123	23.634 (p<0.001)*
Control	2.040±0.143	

*significant at p<0.05

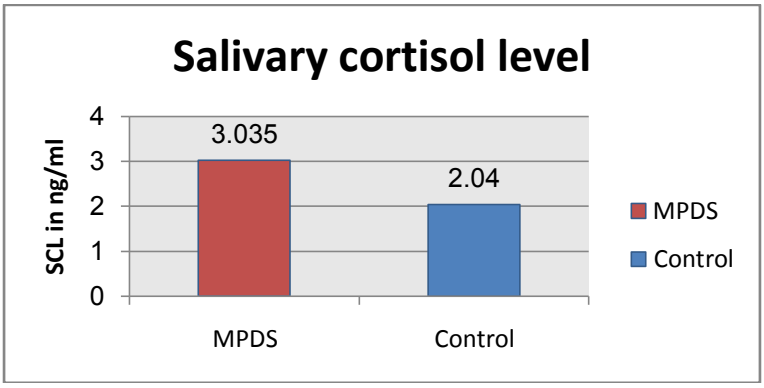

Figure 4: Shows the salivary cortisol levels between MPDS & control group.

The mean salivary cortisol levels were 2.040±0.143 ng/ml in the controls before invention the occlusal interferences and 2.735±0.104 ng/ml after created the occlusal. Salivary cortisol levels in the control group with the occlusal interference were increased with a statistically significant value at p<0.001 after occlusal interferences were created, (Table 5). This suggests the strong correlation between occlusal interferences, increased cortisol levels and MPDS.

Table 5: Comparison of the salivary cortisol levels in control group before and after creating the occlusal interference to the control group.

Group	Mean ± SD	Paired t-test (p)
Control Before	2.040±0.143	20.672 (p<0.001)*
Control After	2.735±0.104	

*significant at p<0.05

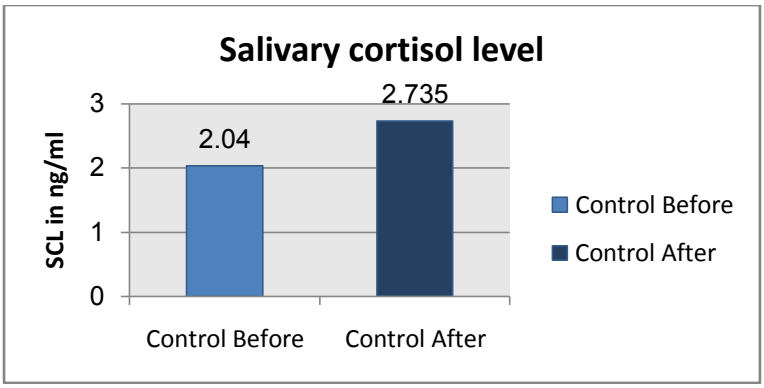

Figure 5: Shows the salivary cortisol levels in the control group before and after creating the occlusal interference.

Discussion

However many researches concerned with the role of occlusal interference in inducing MPDS, it is considered a source of argument(Clark et al., 1999, Dodic et al., 2009).This study was planned to evaluate the relationship between occlusal disharmony and salivary cortisol levels in patients with myofascial pain, and to correlate the role of occlusal disharmony in inducing psychological stress. The results of this study showed that, MPDS patients had significantly higher salivary cortisol level when compared to control subjects (Table 4). When the occlusal disharmony was created to the control group, it showed significantly higher salivary cortisol level when compared to the results before creating occlusal disharmony (Table 5).

The results of the present study coincides with the findings of previous studies conducted by Kubo *et al* (Kubo et al., 2007), Yoshihara *et al* (Yoshihara et al., 2005), Areso *et al* (Areso et al., 1999), Linuma *et al* (Iinuma et al., 2008), and Lchihashi *et al* (Ichihashi et al., 2007), by showing significant correlation between occlusal disharmony and cortisol levels. However, Budtz-Jørgensen *et al.*(Budtz-Jorgensen, 1981) showed that the increased cortisol levels returns to basal values when the occlusal disharmony is returned to the normal state.

These results supported the hypothesis that, an abnormal sensory input, as a consequence of occlusal disharmony, suppresses the learning and memory ability. Consequently, it leads to chronic activation of the HPA system (Areso et al., 1999) and increase in cortisol levels by occlusal disharmony. Further, it impairs the negative feedback system of the HPA axis in the hippocampus *(the hippocampus is part of a system that commands many bodily functions, located in the brain , and responsible for long-term memory)* (Ono et al., 2010), which later promotes the secretion of cortisol (Brizzee et al., 1980). Enhanced secretion of corticosteroids activated neuronal responses by occlusal disharmony may trigger cognitive impairments (Seeman et al., 1997). Therefore, the results of the current study emphasized the importance of the prosthetic design during treatment and clarified the role of special clinical care taken by the clinicians in restoring teeth. Maintaining the normal occlusion will preserve cognitive functions of learning and memory, while the malocclusion may adversely impair those functions.

An increased cortisol levels due to large HPA responses to repeated occlusal disharmony might make the patient susceptible to various diseases like; cardiovascular diseases, chronic stress, several oral pathologies, MPDS and xerostomia (Bosch et al., 2003, Bergdahl and Anneroth, 1993).

Limitations of the present study could be summarized as; small sample size, long term data would be required to confirm the effects of occlusal disharmony, stress and release of cortisol as well as, obtaining the data of cortisol levels after treatment of occlusal disharmony in MPDS patients or removal of occlusal interferences in control group.

Conclusion

Despite the limited sample size of this pilot study, the results demonstrated a significant correlation between occlusal disharmony and salivary cortisol levels in patients with myofascial pain dysfunction. Special care should be taken in maintaining vertical height and harmonious occlusion during prosthetic treatment especially in denture design and prosthetic full mouth rehabilitation cases.

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