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Full Length Research Paper

Posture alterations related to temporomandibular joint dysfunction

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The temporomandibular joint (TMJ) is directly connected with the cervical and scapular area through a common neuromuscular system. Therefore, postural alterations of the cervical spine may cause TMJ disorders and vice versa. The present study aims to compare the surface area described by the motions of the corporal center of pressure (CCP), before and after the installation of the occlusal splint in subject's bearers of temporomandibular disorders (TMDs). The evaluation was carried out through a computerized baropodometric platform, in which the data related to the motion of the CCP were registered, before and after the installation of the occlusal splint. A statistically significant variation was verified at a 5% probability level ($p<0.05$) among the baropodometric measures, due to the decrease of the area described by the motion of the CCP. In TMDs bearer patients, the installation of the occlusal splint changed the surface described by the CCP, resulting in postural stability increase.

Key words: Temporomandibular joint, dental occlusion, temporomandibular joint disorders, posture.

INTRODUCTION

The stomatognathic system is a functional unit of the body in which tissues of different and various origins and structures act harmoniously, carrying out diverse functional tasks. This system consists of skeletal components (maxilla and mandible), dental arches, soft tissues (salivary glands, nervous and vascular supplies), temporomandibular joint (TMJ) and muscles (Kondo and Aoba, 1999). Such structures are interconnected and related; when active, they aim at reaching maximum efficiency with the protection of all the involved tissues (Motoyoshi et al., 2002).

Both structures that constitute the stomatognathic area influence and are influenced by human body posture. Any imbalance in the occlusion may result in a TMJ overload, influencing the muscular nets that make up the musculoskeletal system (Clark et al., 1993; Igarashi et al., 2000; Svanholt et al., 2009; Tecco et al., 2008). Also, tensions accumulated in other points of the body may be reflected on TMJ (Caradonna and Alves, 1997).

The malocclusion that caused the masticatory muscles responses, might also affect the postural muscles - not only the ones of the head (Clark et al., 1993) and neck (Shimazaki et al., 2003), but the ones of the pelvis as well. On the other hand, the temporomandibular joint disorders treatment (TMDs) is capable of promoting posture improvement, spontaneously solving cervical spine deviations (Ries and Bérzin, 2008).

The orthostatic position of the skull is kept by a complex muscular mechanism involving head, neck and shoulder girdle muscles (Seatom, 1979). Since TMJ, cervical spine and occlusion are intimately related, a functional abnormality or the position of one of them may affect the function or the position of the others (Browne et al., 1998; Francesquini et al., 1998; Mannheimer and Rosenthal, 1991; Valdez, 2002; Wright et al., 2000). Thus, the relationship between body posture and the use of interocclusal devices (occlusal splint) utilized in the

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Figure 1. Occlusal splint.

therapeutics of TMDs, whose treatment should involve the participation of a multidisciplinary team, has been better understood, thanks to research accomplished over the last years (Francesquini et al., 1998).

Such knowledge interests the dentists and physiotherapists. The installation of the inter-occlusal device, besides interfering in the occlusion, may bring benefits to the postural system. The existent relationship between the muscles of the head and the cervical area with the stomatognathic system confirms that head and body postural changes take to an adverse TMJ biomechanical process, leading to temporomandibular dysfunction or vice versa (Francesquini et al., 1998).

This study compared the surface area described by the motions of the corporal center of pressure (CCP), before and after the installation of the occlusal splint, aiming at verifying the influence of this device upon the posture of the body.

MATERIALS AND METHODS

This study was carried out under the terms and conditions of the October 10th, 1996, National Health Council`s resolution 196 and monitored by the Ethical Research Committee of the Fluminense Federal University. The sample consisted of 37 subjects, (13 males and 24 females), selected among patients that sought treatment in Fluminense Federal University Orthodontic Postgraduate Clinic, located in the city of Niterói, Rio de Janeiro State. As inclusion criteria, they should be TMDs bearers, diagnosed by clinical examination as well as by their answers to a questionnaire. These subjects reported that they had not used occlusal splints as a way of prevention and/or treatment. Patients that presented previous foot and ankle pathologies, frequent physical complaints and other associated pathologies, such as calcaneal spur, plantar fascitis and acute or sub acute traumas were excluded.

From the selection on, the patients received explanations about the objectives of the research as well as on the procedures they would be submitted to, which did not involve any health risk. All of the subjects were informed that they could, whenever they wished, give up participating in the experiment.

Occlusal splints

The occlusal splints were made of the patients' dental arches molds, in alginate (Technew, Rio de Janeiro, Brazil), and later filled with type IV plaster (Vigodent, Rio de Janeiro, Brazil), creating individual models, cut out and lubricated with acrylic resin insulation (SSwhite, Rio de Janeiro, Brazil). The occlusal platform was covered with chemically activated colorless acrylic resin (Clássico, São Paulo, Brazil), extended by vestibule until approximately the teeth prosthetic equator, being then cut out so as to leave the occlusal plane smooth and flat, providing homogeneous anterior and posterior contacts in centric relation position. Side movements were elaborated in canine guidance, made in the very occlusal platform, just as the incisal guidance, during the protrusion movement. The plates presented approximately 2 mm thicknesses in the posterior region (Figure 1).

Baropodometric exam

The digital baropodometric static exam was accomplished by a professional physiotherapist. For the patients' identification, the necessary data were collected as follows: name, age, gender, weight, height and shoe size, which were considered essential for the calibration of the equipment.

Soon afterwards, the patients were positioned in erect standing, still and barefoot on the measuring and gauging platform (A.M Cube, Goult, France) (Figure 2), at 150 cm of the wall, with feet 2

Figure 2. Platform footwork AM3-IST.

Figure 3. Patient standing on the platform.

cm apart on the intermalleolar line and abducted at 30°, so that both feet would lean on the active surface of the baropodometer, with their arms hanging beside the body in a relaxed way (Figure 3).

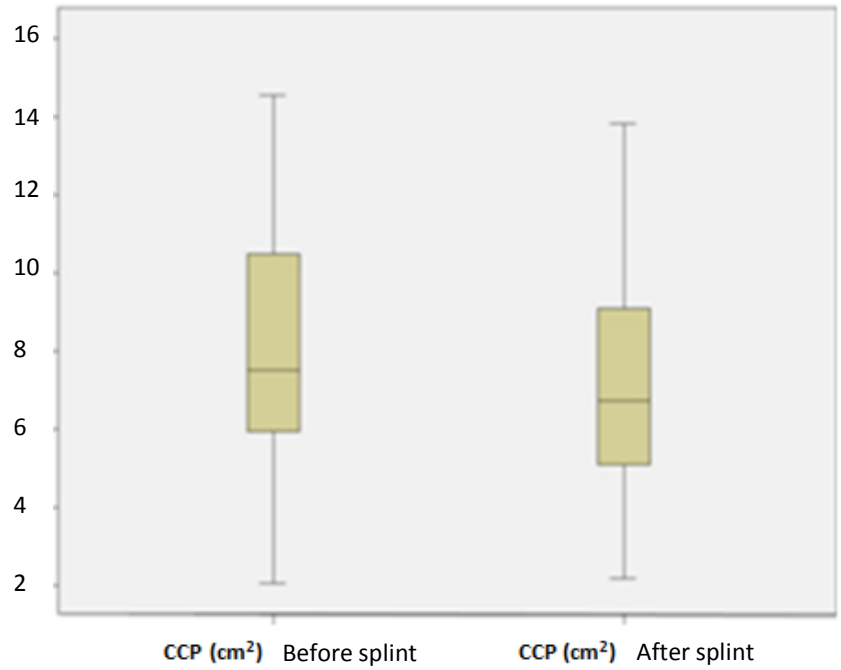
They were told to keep their eyes at a fixed point calibrated towards the patient's sight and height, marked on the examination room wall, in order to reduce the postural oscillations due to the movement of the eyes. Moreover, they were requested neither to drink any alcohol nor do any physical exercises 24 h before the exam.

Surface areas formed by the motions of the CCP were measured in two moments: in mandibular rest position and later, with the

Table 1. Comparison between the moments before and after the installation of the occlusal splint, relative to the motion area of the corporal center of pressure (CCP) (cm^2).

	Before splint (n=37)			After splint (n=37)			*p*
CCP	$\overline{X}$	$\overline{X}$ - SD	$\overline{X}$ + SD	$\overline{X}$	$\overline{X}$ - SD	$\overline{X}$ + SD	
	8.163	4.796	11.530	7.078	3.958	10.198	0.037*

*Statistical significance at the probability level of 5% ($p < 0.05$). Arithmetic means ($\overline{X}$), standard deviations (SD) and Student´s *t* test (n=37).



Graph 1. Corporal center of pressure (CCP), before (left) and after (right) the installation of the occlusal splint.

occlusal splint installed. The results were obtained with the aid of a microcomputer with an Intel Core 2 Duo T6600 processor, with 3 GB memory (Dell, Hortolândia, Brazil).

Statistical analysis

Arithmetic means ($\overline{X}$) and standard deviations pattern (SD) were calculated. To test the differences among the means, Student´s *t* test was used. The probability level of 5% ($p < 0.05$) was adopted. To calculate the error of the method, the intra-class correlation coefficient was used.

RESULTS

The error of the method was calculated by using nine cases selected at random. It was verified that it was equal to 0.619 cm^2. Table 1 shows the arithmetic means and the standard deviations values relative to the motion area of the CCP, with the mandible in rest position, the occlusal splint installed, as well as Student´s *t* test result. As seen, there was a statistically significant difference when comparing the means of the areas described by the CCP.

Graph 1 shows the results under the form of box plot, regarding the two measured moments of the values of the areas described by the corporal center of pressure (CCP). After the installation of the splint, the maximum value and the median decreased, while the minimum value increased.

DISCUSSION

The present study analyzed the influence of the occlusal splint on the surface resulting from the motions of the

CCP through the electronic baropodometry test carried out before and after the installation of an occlusal splint.

The occlusal splints were used to promote an optimal functional occlusion and, consequently, reorganize the reflex neuromuscular activity and reduce the abnormal muscular activity, allowing a near-normal muscular function, since it is known that TMDs treatment favors posture improvement, spontaneously solving cervical spine deviations (Ries and Bérzin, 2008).

The evaluation was accomplished through a computerized baropodometric platform, where the data connected with the motion of the CCP resulting from the somatosensorial control of the orthostatic posture stability, and were registered before and after the installation of the occlusal splint. Baropodometry is an objective and quantitative exam that analyzes plantar pressures and the surface resulting from the motion the CCP on a platform made up of sensors (Donatelli, 1996). Such an evaluation constitutes the scientific foundation of many procedures effectiveness.

The subjects that made up the sample were guided to stay with their trunk erect during the baropodometric exam. This guidance was considered fundamental for the success of the experiment because, in orthostatic position, the first source of information on the gravitational line comes from the feet soles, full of pressure receivers. Besides other neurosensory sources, it is through these neuroreceptors, also present in dental occlusion, that the subject gets stabilized in relation to space (Gagey and Weber, 2000).

The outcome of the present experiment disclosed the variation between the values of the baropodometry exams carried out before and after the installation of the occlusal splint, with the decrease of the area described by the motion of the CCP, which favored the postural stability. The occlusal imbalance is capable of influencing the postural system (Bracco et al., 2004; Ferrario et al., 1996; Gangloff et al., 2000; Michelotti et al., 2006). A proprioceptive disturbance caused by alteration of the localized tonic muscle balance is an informative element that will change global tonic postural balance, disturbing both the postural oscillations of the CCP and perception of the corporal reference in the environment.

Therefore, the installation of the occlusal splint, reestablishing the balance of the occlusion, was also capable of generating benefits to the postural system. On the other hand, an important aspect, such as the afterwards maintenance of this balance could not be explained because of the patients short-term follow-up. Since this cause-effect relation is yet not thoroughly known, other studies on the matter should be carried out.

Conclusion

In TMD patients, the occlusal splint installation changed the surface described by the CCP, thus increasing postural stability.

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