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A novel protocol for occlusal splint adjustment to treat TMD in sleep bruxism

Um novo protocolo para ajuste de placa oclusal no tratamento do bruxismo noturno

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Abstract

Introduction: Sleep bruxism (SB) is a stereotypical movement disorder that is characterized by rhythmic masticatory muscle activity associated with tooth grinding and occasional jaw clenching. **Objectives**: The aim of this study was to determine the relief time for temporomandibular disorders (TMD), cervical and otological signs and symptoms in patients with BS treated with occlusal splints (OS) for a period of 180 days. **Materials and methods**: Thirty patients, between ages 22 and 53 years old, presenting SB and TMD, including cervical and otological symptoms, were enrolled in this study. The patient's treatment protocol consisted of using the OS applying a novel adjustment protocol. The total follow-up period was 180 days. The paired Student t-test was used to compare before and after long-term OS treatment. **Results**: For all

variables, the results were statistically significant ($p < 0.001$). As to the TMD symptoms, in most patients the relief of pain in masseter, temporalis, cervical and TMDs occurred in the 3rd month. Twenty percent of the patients were aware of clenching teeth while awake and reported that this parafunction decreased by the end of 6 months, and 90% reported an improvement in sleep quality as well. **Conclusion**: The use of an OS with a novel adjustment protocol was an effective treatment for TMD sign and symptoms in patients with SB.

Keywords: Sleep bruxism. Temporomandibular disorders. Occlusal splints. Pain.

Resumo

***Introdução**: O bruxismo do sono (BS) é um distúrbio estereotipado de movimento que se caracteriza pela atividade rítmica mastigatória muscular associada com ranger de dentes e apertamento da mandíbula ocasional. **Objetivos**: O objetivo deste estudo foi determinar o tempo de alívio para desordens temporomandibulares (DTM), cervical e sinais e sintomas otológicos em pacientes com BS tratados com placas oclusais (PO) por um período de 180 dias. **Materiais e métodos**: Trinta pacientes, entre 22 e 53 anos, apresentando BS e DTM, incluindo sintomas cervical e otológicos, foram incluídos neste estudo. O protocolo de tratamento do paciente consistiu na utilização da PO com a aplicação de um novo protocolo de ajuste. O período de acompanhamento total foi de 180 dias. O teste t de Student pareado foi utilizado para comparar os efeitos após o tratamento a longo prazo da PO. **Resultados**: Para todas as variáveis os resultados foram significativos ($p < 0,001$). Quanto aos sintomas da DTM, na maioria dos pacientes o alívio da dor no masseter, temporal, cervical e DTM ocorreu no terceiro mês. Vinte por cento dos pacientes autorrelataram ranger os dentes enquanto acordado e informaram que essa parafunção diminuiu até o final de 6 meses, 90% dos sujeitos relataram, também, melhora na qualidade do sono. **Conclusão**: O uso de uma PO com novo protocolo de ajuste foi um tratamento eficaz para os sinais e sintomas de DTM em pacientes com BS.*

***Palavras-chave**: Bruxismo do sono. Distúrbios temporomandibulares. Placas oclusais. Dor.*

Introdução

The demand of many daily activities, work pressure, emotional instability and other internal and environmental factors, may be the cause of the increased prevalence of sleep bruxism (SB) in population, which can be observed in dental office for many professionals who work in this field. Previous work has suggested that parafunctional habits, such as daytime and or nighttime grinding/clenching, nail biting, lip biting and gum usage may impair the masticatory system (1-3). In addition, recent studies have led that neurological pathways, cardiac activation, arousals and breathing should be involved in the genesis of SB (4-6), suggesting prolonged bruxism-induced neuromuscular activity of the masticatory system may play an important role in the etiology of temporomandibular disorder (TMD) and this relationship seems to be very complex, also involving neurologic pathways (7).

According to AAOP, TMD refers to a group of disorders affecting the temporomandibular joint (TMJ), masticatory muscles, and associated structures, and it is important to highlight that otological and cervical symptoms are frequently present (8). Ear symptoms such as otalgia, tinnitus, vertigo, plugged ears, and hypo/hyperacusis may also occur due to the close anatomical relationship between the TMJ, cervical and ear structures (9-11).

Occlusal splint (OS) is the therapy commonly used to treat TMD and SB, with many types of appliances currently available for neuromuscular stabilization. These devices are also known as flat plane, inter-occlusal splint or myo-relaxation splint and are used not only to stabilize the TMJ but also protect the teeth, relax masseter and temporalis muscles, increase inter-vertebral and inter discal space, allow the balance of bite forces and decrease bruxism activity (12, 13). The action mechanism of inter-occlusal appliances is not well understood, although many authors have demonstrated their

efficacy to treat TMD symptoms in periods of from 40 to 365 days (14-16). It should be highlighted that the OS adjustment protocol is important to achieve sign and symptom relief. Authors have suggested that, contrary was thinking in last decades, their use are not only for a determined period, but for a life, to protect the oral structures and diminish the bruxism activity. The aim of this study is to determine the relief time for TMD, cervical and otological signs and symptoms in patients with sleep bruxism applying a novel occlusal splints adjustment protocol over a period of 180 days.

Methods

Subjects

This is a prospective study conducted at the Sleep Laboratory of the Master's and Doctoral Postgraduate Program in Rehabilitation Sciences of the Nove de Julho University (UNINOVE), São Paulo, Brazil. The sample was composed by 37 adult male and female, between ages 22 and 53 years old, presenting sleep bruxism accompanied of TMD signs and symptoms. The inclusion criteria were the presence of sleep bruxism reported by a bed partner during at least 6 months, presence of chronic myofascial pain according to the research diagnostic criteria for TMD (17), cervical discomfort and/or pain, otological symptoms, signs of tooth wear to at least the degree of exposed dentine (18), and present complete natural denture. Exclusion criteria were do not use total or partial prosthesis, never having been treated with OS, absence of any kind of drug usage that could interfere with sleep or motor function and absence of neurological disease. Patients under physiotherapeutic and psychiatric treatment were excluded. Patients with other medical pathologies which could present similar TMD and otological symptoms were also excluded by an experienced physician.

The Student t-test for paired data was used to assess statistically significant changes in measurements before and after long-term OS treatment. A p value of < 0.05 was considered significant. The present study is in accordance with the Helsinki Declaration and the Regulatory Guidelines and Norms for Research Involving Human Subjects of the National Health Board of the Brazilian Health Ministry issued in October 1996. This study received approval from the Human Research Ethics Committee of the Nove de Julho University (Brazil) under process number 329445/2010 and all patients gave their informed consent.

Study protocol

Prior patients participation, dental and medical anamnesis and clinical evaluations were carried out by a single physician, to exclude any otological diseases, and by one experienced dentist. Presence of TMD was based on the Research Diagnostic Criteria (RDC) (17).

The dental anamnesis included a questionnaire which accessed the presence and frequency of masseter, temporalis, cervical and TMJ pain, TMJ noise, headache, and otogical related symptoms, such as, tinnitus, plugged ear, nausea, vertigo, sudden acute ear pain and sleep quality perception. Clinical diagnosis of SB was made under world standards of diagnosis, based upon patient history and orofacial examination (18). Tooth wearing was evaluated with a dental mirror and adequate light. Dental impressions were made by the same dentist and the stone casts were sent to a prosthesis laboratory for construction of the OS, all made by a single dental technician. Then, patients received flat acrylic resin splints (Figure 1) with full coverage of the occlusal surfaces to be worn in the maxilla.

The splint was mounted on a semi adjustable articulator and was fabricated with 2 mm thickness at the level of second molars and the necessary thickness between maxillary and mandible space at the level of other teeth, according each subject occlusion, and it was adjusted to create uniform point contact of the centric cusps against the splint on all occluding teeth. The adjustment protocol was made by a single professional. The OS was used 24 hours a day, except during meals, unless the patient experienced constant pain during masticatory function. Simultaneous occlusal contacts were verified by a 12-µm-thick articulation paper at each appointment, during the six months. The splint adjustments were made once a month to achieve functional neuromuscular stability, to provide conditions for a better disc position and, consequently, to eliminate joint noise and other symptoms.

Figure 1 - A custom-made occlusal splint

According to the adjustment protocol, if the noise and pain did not decreased after the first month, the mandible rotation adjustment was carried out to obtain a larger space between articular fossa and condyle, achieving a better disc position. This adjustment was made by adding a special acrylic resin on the last dental contact of the occlusal splint in the molar region bilaterally. The other teeth had no contact with the splint, which resulted in a counterclockwise rotation of the mandible, thereby allowing sufficient space for disc repositioning. This maneuver was based on the Rickets protocol (19). At each visit, all variables were checked for the presence or absence of initial TMD and for cervical and otological symptoms. For each assessed variable, the response was scored according to its frequency using a visual analogical scale ranged between 0-100 - "none", "rare", "sometimes" and "often" - were considered respectively as 0-25, 26-50, 51-75 and 76-100. These data were recorded on each patient's clinical file. Power test to determine sample strength showed a number of 33 patients to perform this study. All statistical analysis were computed using SPSS (version 11.5, SPSS Japan Inc., Tokyo).

Results

Out of a total of 37 patients who provided written informed consent, 30 subjects completed the protocol. Two patients have moved to another city, 02 presented nausea reflex using OS and 3 did not adapted to splint usage. The mean age of the 30 patients was 37,5 ± 8,7 anos, being 26 females.

Concerning the TMD symptoms, the relief of pain in masseter, temporalis, cervical and TMJ occurred in the third month for most patients; 3 patients found relief after the fifth month and 1 patient presented rare TMJ pain at the sixth month. Six patients presented TMJ noise after 6 months of treatment, among these, 4 patients had TMJ noise "sometimes" and 2 patients had "rare" TMJ noises, 11 presented no noise at the third month and the others had the noises eliminated after 6 months of OS use.

Only 1 patient presented otological symptoms, for vertigo and nausea at the third month, and none of these symptoms were presented by any patients at the sixth month. Twenty-nine patients reported that plugged ear disappeared in up to 3 months, and for only one patient it took 4 months.

For most patients, tinnitus was eliminated after the first month of treatment, but it remained in six patients at the end of the study. Of these patients, two reported tinnitus "sometimes", and one presented it "often". For all variables (Table 1), the results were significant ($p < 0.001$). Twenty percent of patients were aware of clenching teeth during wakefulness and reported that this orofunction had decreased at the end of 6 months. Regarding subject symptoms of quality of sleep, 63% of the patients reported no presence of body pain in the morning and related a restorative sleep at awakening.

Discussion

Few studies have assessed the many signs and symptoms treated with OS (20). Our study showed that the patients presented a decrease in or elimination of the signs and symptoms related to TMD, including otological symptoms, after a period of 6 months of OS usage. One of the most frequent clinical signs in the range of TMD is the presence of a joint click which occurs mainly during the initial phase of mouth opening. In our study using the splint, there was a marked decrease or elimination of the joint noises, considering that this sign disappeared in 26 patients.

We believe that the increase of vertical dimension due to OS usage promotes an increase of joint space which allows the recovery of TMJ region and adjacent structures, favoring the disc repositioning.

Table 1 - Temporomandibular disorder symptoms according to visual analogic scale before (baseline) and after (6 months) occlusal splint treatment

Variables	Baseline	6 months	p-value
Headache	79,7 ± 24,3	8,8 ± 19,2	< 0.001
TMJ pain	74,1 ± 25,9	7,7 ± 14,2	< 0.001
Masseter pain	86,4 ± 20,9	9,9 ± 17,6	< 0.001
Temp pain	84,2 ± 21,2	7,7 ± 16,6	< 0.001
Cervical pain	74,0 ± 21,0	3,3 ± 13,2	< 0.001
TMJ noise	66,2 ± 24,8	16,5 ± 24,1	< 0.001
Pluged ear	74,1 ± 25,9	2,2 ± 12,0	< 0.001
Tinitus	57,3 ± 24,7	18,7 ± 31,0	< 0.001
Ear acute pain	64,0 ± 21,4	1,10 ± 6,0	< 0.001
Vertigo	48,5 ± 20,9	1,10 ± 6,0	< 0.001
Nausea	35,2 ± 12,0	0,0 ± 0,0	< 0.001

Note: TMJ = temporomandibular joint; the values are described as mean ± standard deviation.
Source: Research data.

In patients presenting a delay in joint noise reduction, an extra increase of vertical dimension, achieved with the rotation adjustment, was needed. To our knowledge, the rotation adjustment for TMD treatment was not cited in previous studies, and we surmise that this procedure may be the reason for a significant improvement in TMJ noise, and suggest that it should be routinely included in the TMJ treatment.

We hypothesize that a counter-clockwise rotation of the mandible, resulted from the adjustment rotation, provided a larger intra articular space which reduced the TMJ noise and pain in a short period. Further examinations, including imaging exams (e.g. nuclear magnetic resonance) are necessary to confirm our hypothesis. The exact action mechanism of occlusal splints is not yet completely understood (4, 8). Some theories to explain its mechanism include: alteration or improvement of the occlusal condition, change in peripheral (motor or afferent) impulses to the central nervous system, alteration or raising in the vertical dimension, alteration of the TMJ condylar position, increase in the cognitive awareness and placebo effect. While noise is the most frequent sign of TMD, pain is the most common symptom of this dysfunction, originating from either muscular or articular conditions, or both.

Our study is in accordance with literature since most patients presented no pain at the end of protocol with OS therapy (15, 16). Some studies are in accordance to our results concerning the relief of masticatory muscle and cervical pain as well as otological symptoms. A previous randomized study (13) compared different types of OS to counseling; the results showed that after 90 days of treatment all types of OS were effective in treating TMD symptoms. In another randomized study, in which the focus was on the reduction of parafunctional activity to improve the effectiveness of OS in TMD patients, the sample was divided in 2 groups, one using the OS and instructed to avoid tooth contact for as much time as possible, and the other also using OS but instructed to maintain tooth contact for as long as possible. The authors concluded that OS was effective to treat TMD symptoms in both groups equally, and OS promoted a reduction of intensity of tooth contact even in those patients who were instructed to maintain tooth contact (14).

Another study used electromyography to evaluate the behavior of masticatory muscles before and after OS usage over a period of 60 days, and the result showed a relief of pain but not a decrease in the myoelectrical activity (15). Regarding referred otological symptoms, the TMD and cervical spine

pathology are the most frequent related causes (21). In our study, most of the patients' otological symptoms, such as vertigo, nausea, tinnitus and plugged ear, decreased or disappeared after 2 or 3 months of treatment. We suggest that the ear symptoms decreased due to condyle displacement caused by the minimal increase in the vertical dimension induced by the OS, thereby allowing decompression of TMJ region and related structures, as the muscles of the middle ear are closely related to the masticatory muscles (22).

It has been suggested that neuromuscular dysfunction of the masticatory muscles may trigger alterations in the sound-conducting apparatus because, phylo-genetically, the middle ear bones are interpreted as jaw bones, and the tympanic and palatine tensor muscles are thought to have originated as masticatory muscles, and both are supplied by the trigeminal nerve. Thus, clenching or grinding could not only result in states of tension and contraction in the masticatory muscles, but they could also trigger a secondary reflex contraction in the tympanic and palatine tensor muscle (23). In 1962 it is was found that the TMJ structures were connected to the malleus and that the excursion of the disc and condyle during mandibular movement could induce mobility of the malleus and alter the tension of the tympanic membrane (24). In our sample, 20% of patients were aware of teeth clenching during the day, a percentage coinciding with a previous study that showed a 5% to 25% prevalence of wake-bruxism in the sample studied (2).

It is important to underline that various surveys (25, 26) about TMD treatment have been made in order to obtain information on the knowledge and opinion of practicing dentist and experts and showed discrepancies between expert-knowledge and what is understood by practising dentists in this field. A recent survey demonstrated that although OS is widely used by specialist and practicing dentist, many non specialist still apply irreversible techniques. This means that there is a gap between theses professionals which may delay the TMD treatment among who present this dysfunction. The use of OS on sleep bruxism treatment seems to have no sufficient evidences, but its role seems to be benefit regarding teeth wear (26). It is important to consider that the evaluation of long term results of OS usage is necessary to verify whether the results will be long lasting.

Conclusion

Occlusal splints were effective to treat temporomandibular disorders, cervical and otological signs and symptoms in patients with sleep bruxis, as well improved subjective symptoms. The protocol used to treat the dysfunction may play an important role in the elimination of TMJ pain and noise, since rotation adjustment seems to provide an increase in intra-articular space, allowing disc repositioning in a short period. Further evaluation, with a control group, is needed to evaluate the presence of recurrence of TMJ sign and symptoms in the post occlusal splint treatment period.

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