EVALUATION OF TEMPOROMANDIBULAR JOINT NOISE IN PARTIALLY EDENTULOUS PATIENTS

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ABSTRACT

In order to evaluate the presence of TMD (temporomandibular disorder), dissatisfaction related to the use of removable partial dentures (RPD) and the effect of the treatment on temporomandibular joint noises, 13 female patients with Kennedy class I and II mandibular arch were selected. Another 13 young, asymptomatic, dentate patients, also female, were used as reference. After four years, 38.4% were found to have a moderate or severe degree of TMD. Over the four years, the degree of TMD increased in 46.15% of the patients, was not affected in 20.07%, while in 15.38% it decreased or the patients remained free from signs and symptoms. About 30% of the patients at the second year, and 46% after the fourth year, had complaints regarding retention and stability. It was concluded that there is no relationship between TMD and the condition of partially edentulous Kennedy class I and II, but patient dissatisfaction increased after the second year, and temporomandibular joint noise was reduced significantly with the replacement of the teeth.

Key words: *Removable partial denture; temporomandibular joint.*

AVALIAÇÃO DOS RUÍDOS NA ARTICULAÇÃO TEMPOROMANDIBULAR EM PACIENTES PARCIALMENTE DESDENTADOS

RESUMO

Para avaliar a presença de DTM, a insatisfação ao uso da prótese parcial removível (PPR) e o efeito do tratamento sobre os ruídos articulares foram selecionados 13 pacientes com arco mandibular classe I e II de Kennedy. Outras 13 jovens assintomáticas, dentadas, também do sexo feminino, foram utilizadas como referência. Após quatro anos, verificou-se que 38,4% apresentavam DTM num grau moderado ou severo. O grau de DTM aumentou ao longo dos quatro anos em 46,15%; em 20,07% se manteve inalterado; em 15,38% diminuiu ou as pacientes se mantiveram livres de sinais e sintomas. Cerca de 30% das pacientes no segundo ano, e 46% após o quarto ano apresentavam queixas a respeito da retenção e estabilidade. Concluiu-se que não há relação entre DTM e a condição de parcialmente desdentado classe I e II de Kennedy, mas a insatisfação da paciente aumenta após o segundo ano, contudo, o ruído articular diminui significantemente com a reposição dos dentes.

Palavras Chave: *Dentadura parcial; articulação temporomandibular.*

INTRODUCTION

Designing a free-end removable partial denture is a complex matter because of the different movements allowed by the supporting tissues – teeth and mucosa. Thus, the larger the edentulous area, the greater the saddle movement will be and the greater the torque on the abutment teeth[1]. Therefore, when back teeth are lost, the effect on the stomatognathic system gives rise to contradictory opinions. A short dental arch reaching the second premolar allows adequate mandibular function because it can adapt to the functions and therefore the incidence of Temporomandibular Dysfunction (TMD) does not increase[2]. This adaptive capacity occurs because the overload on the Temporomandibular Joint (TMJ) and on the remaining teeth is reduced significantly with the loss of the molars and the 2nd premolar. In this case, the clenching force is controlled by a self-regulating neuromuscular system[3]. Moreover, when the missing teeth are substituted, masticatory performance in partially edentulous patients is lower than in patients with full dentition[4]. Masticatory capacity in patients after replacing teeth with a removable partial denture is influenced by gender, bite force and number of teeth substituted[5].

On evaluating the process of aging, occlusal support and TMJ conditions on the influence of bite

force, Ikebe et al.[6] found that bite force decreased with age and this decrease was more related to the deterioration of occlusal surface than to aging itself. Tooth loss produces an overload on the TMJs and favors the development of alterations in joint structures, becoming more evident as age increases, mainly in patients with arthritis[7]. By means of histological studies of temporomandibular joints in young adults, Pullinger et al.[8] also found that the thickness of the joint tissue in the condyles ranged from 0.21 to 0.41 mm, and the smallest thickness was found in individuals lacking molar support. The authors concluded that the loss of molars produced an increase in compressive load in the anterosuperior condylar region; nevertheless, it did not always produce degeneration.

The removal of the occlusive support of the first and second molar produced an average cranial displacement of the condyle of 0.56 mm[9]. This posterior position of the condyle often allows compression at the posterior edge of the disc, which allows displacement of the joint disc and the appearance of joint noise at the beginning of mouth opening and the end of closing[10]. By analyzing the TMJ noises, Ögütcen-Toller[11] showed that clicking and crepitation are signs of joint disorder, with clicking indicating disc displacement with reduction, and crepitation indicating degenerative disease.

On the other hand, the loss of posterior teeth does not increase the risk of TMD, and tooth replacement does not improve the function[12]. These results contradict those cited by Luder[13], who says that degenerative alteration in the TMJ depends on a mechanical factor, which occurs, particularly, with the loss of posterior teeth.

There is noise in 44.3% of partially edentulous patients (Kennedy Class I and II); with greater incidence in bilateral edentulous patients, occurring at the end of mouth opening and the beginning of mandible elevation in 55.7% of the cases[14]. In unilateral edentulous patients, clicking is more frequent on the side of the free end [15]. In other studies of totally edentulous patients, joint noise was reported as rare. However, when noise is present, it is of the crepitation type and related to the erosive alteration of the shape of the joint surface[16].

Studies by Ciancaglini et al.[17] show that 60.2% of patients with loss of occlusal support suffer functional disturbances and/or temporomandibular dysfunction and these findings suggest that occlusal support is a relevant factor in mastication and development of TMD.

Although some authors [3,4,12] suggest that posterior tooth replacement does not prevent TMD from developing, the results found by other authors [9,13] show that the absence of the posterior mandibular teeth can accelerate the development of degenerative joint diseases in the TMJ.

Because joint noise is one of the first signs of intra-joint disorder and its origin is a highly controversial issue in literature, this study seeks to assess: 1) presence of TMD in Kennedy class I and II patients; 2) the percentage of dissatisfaction due to the prolonged use of removable partial denture; and 3) the effect of treatment by replacing posterior mandibular teeth on controlling joint noise.

MATERIALS AND METHODS

For this study, 26 female patients were selected. Thirteen of them had Kennedy class I and II mandibular arch and were 38 to 70 years old (average age approximately 55 years). The 13 remaining patients were used as a control group, and were young, asymptomatic, dentate women, averaging 24 years of age. The determining conditions for selecting the patients for the control group were Angle class I occlusion and absence of signs and symptoms of TMD.

The patients in the experimental group underwent clinical and radiographic examination, and joint vibration analysis. The clinical examination consisted of two phases: history taking and physical examination. History was taken using the Fonseca et al.[18] questionnaire to determine the degree of temporomandibular disorder.

The physical examination consisted of intra and extra-oral inspection. The extra-oral examination determined patients' ability to move the mandible sideways, mouth opening capacity and the trajectory of mandibular movements. After that, the muscles of mastication and of the temporomandibular joint were palpated to identify sensitive areas and joint noises. During the intra-oral inspection, hygiene, number and distribution of abutment teeth and the quality of the alveolar edge and mucosa were evaluated.

The patients had a periapical radiographic examination to evaluate the condition of the abutment

Fig. 1: Front and lateral view of the patient with transducers installed on temporomandibular joints.

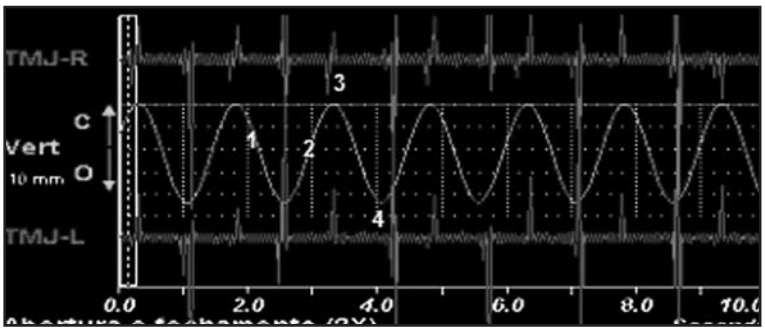

Fig. 2: Joint vibration analysis record: 1, mandible opening cycle; 2, closing cycle; 3, vibration corresponding to occlusal contact; 4, joint noise at beginning of closing.

teeth and the degree of bone implantation, and periapical and crown conditions.

After screening, the patients from the control and experimental groups underwent a joint vibration analysis to evaluate the presence and loudness of the joint noises. Transducers (piezoelectric accelerometer) were placed on the TMJs, connected to a compatible computer with SonoPAK/I software installed (System-Bio-Research, INC, Milwaukee, Wisconsin) (Fig. 1).

Once the transducers were in place, the patient was asked to open her mouth wide, and the interincisal distance was measured with a ruler in millimeters and used to calibrate the device. Then the patient was guided to make opening and closing mandibular movements following a cursor on the computer screen. When the synchronization of the movement was confirmed, the record was accepted and recorded on hard and floppy discs.

To ensure that the record was accurate, it was observed on screen, to check that the vibration corresponding to occlusal contact was located in the transition area between mouth opening and closing (Fig. 2).

The analysis was repeated three times for each patient, in four different cycles, and the average loudness of joint noise was measured in Hertz, during the initial phase of the treatment.

Then the patients in the experimental group underwent occlusal treatment by having their missing teeth replaced with the removable partial denture (RPD). All the dentures were made with corrective impression of the edentulous area using the altered cast technique.

One year after joining the study, the patients underwent further clinical examinations and joint vibration analysis, which were repeated two and four years after treatment. The results were recorded in tables and subject to statistical calculation. The normality test revealed a non-normal distribution, and a non-parametric test was required. The Kruskal Wallis test was selected, applying a 5% significance level.

RESULTS

After four years, about 30.76% of the patients wore the RPD at night. Only one patient stopped wearing the denture, after a fracture in the clinical crown of the abutment tooth. Thirty per cent of the patients in the second year, and 46% after the fourth year complained about retention and stability (Table 1).

Clinical evaluation showed that after four years, five patients (38.4%) had moderate or severe TMD with signs and symptoms indicating the need for treatment. The degree of TMD was found to have increased in six patients (46.15%), remained unchanged in three patients (20.07%), decreased in only two patients (15.38%), while another two patients remained free from TMD symptoms throughout the control period.

Although it was recommended that patients should not wear dentures while sleeping, nearly 31% did so.

Joint noise was found to decrease progressively over the time that RPDs were used, as shown in Table 2. Vibrations were more frequent towards the end of mouth opening and closing. At the beginning of the treatment, all the patients had some degree of TMJ vibration. After one year of use, only one patient (7.69%) had no TMJ noise. In the second year, five patients (38.46%), and after four years, six patients (46.15%) had no TMJ noise.

At the first visit, only two patients had joint noise greater than 100 Hz. In most of the study group,

TABLE 1. Clinical evaluation of the degree of Temporomandibular Dysfunction (TMD) and the information regarding the removable partial denture at the first visit (FV) and after 4 years.

PAT	CLASS	PRESENCE OF TMD		SATISFACTION			USE AT NIGHT
		FV	4 YEARS	FV	2 YEARS	AFTER 4 YEARS	
2	I-MAND	SLIGHT	SEV	No	No	No	No
3	II-MAND	SLIGHT	SLIGHT	No	No	No	No
5	II-MAND	SLIGHT	N-TMD	No	No	Does not use mandibular	No
10	II-MAND	SLIGHT	MOD	No	Slight Movement	Lost Retention	Yes
15	I-MAND	SLIGHT	SLIGHT	No	No	No	No
16	II-MAX	N-TMD	SLIGHT	No	No	No	No
26	I-MAND	N-TMD	MOD	No	Slight Movement	No retention	No
34	II-MAND	SLIGHT	N-TMD	No	No	No	Yes
48	I-MAND	N-TMD	N-TMD	No	No	No retention	Yes
54	II-MAND	SLIGHT	MOD	No	Slight Movement	Discomfort (at the clasp)	No
62	I-MAND	SLIGHT	MOD	No	Slight Movement	Lack of stability	No
79	II-MAND	N-TMD	N-TMD	No	No	No	Yes
81	I-MAND	SLIGHT	SLIGHT	No	No	No	No

PAT. = Patient
MAND.= Mandibular
N-TMD = No Temporomandibular Dysfunction
TMD = Temporomandibular Dysfunction
FV = First Visit
MOD. = Moderate

vibrations ranged from 9.8 to 67.3 Hz in the opening cycle and 10.8 to 60 Hz during mouth closing.
Statistical analysis showed that at the beginning of opening there was a significant difference ($p \leq 0.05$) between the vibrations recorded at the first visit and those recorded after the first year of wearing the denture. No difference was found for the second and fourth years (Table 2).
There was no statistically significant difference in the middle of opening, beginning and middle of closing when we compared the vibration recorded at the first visit to the vibration recorded in the first, second and fourth years. At the end of opening and end of closing, vibrations decreased over the years. The difference between the first visit and the first year of denture use was not significant; however, as from the second year, the difference was significant. The noises both at the end of opening and the end of closing had significantly different values at the first visit compared to the asymptomatic dentate group (Table 2).
In the dentate patients of the control group, no joint noise was found during the clinical examination. Nevertheless, the joint vibration analysis identified average joint vibrations of 3.5 Hz in five patients (38.46%), which were recorded in several positions of the mouth opening and closing cycles (Table 2).

DISCUSSION

There are several problems to solve regarding free-end removable partial dentures. Firstly, despite the recommendation to remove dentures for sleeping at night, a variable percentage of patients wore their dentures continually. Some authors, such as Chandler & Brudilk [19] believe that the rate of continuous use is as high as 70 to 80%, while others, such as Vanzeveren et al. [20] say it is 25 to 30%, a percentage similar to the 30.7% found for patients in this study. Secondly, there is more saddle movement due to the difference in resilience of the alveolar edge and the abutment tooth. Moreover, the alveolar bone tissue support suffers resorption, increasing its movement during mastication. The effect of this movement was evaluated in a study by Igarashi et al.[21], who found that the increase in stress on the neighboring tooth is nearly 40% when malleable

TABLE 2. Average vibrations recorded at the beginning, middle and end of mouth opening of the 13 patients at the first visit and after 1, 2 and 4 years' treatment, and of the 13 asymptomatic dentate patients in the control group.

CONTROL TIME	OPENING						CLOSING					
	BEGINNING		MIDDLE		END		BEGINNING		MIDDLE		END	
	L	R	L	R	L	R	L	R	L	R	L	R
FIRST VISIT (A)	0	0	1.0	2.5	56.4	35.1	0	0	0	0	23.9	16.3
	A	A	A	A	A	A	A	A	A	A	A	A
1st YEAR (B)	6.6	6.50	0	0	40.1	39.4	0	0	0	0	52.7	13.1
	a	a	A	A	A	A	A	A	A	A	A	A
2nd YEAR (C)	0	0	0.8	1.3	17.0	16.0	0	0	0	0	11.6	5.1
	A	A	A	A	a	a	A	A	A	A	a	a
4th YEAR (D)	0	0	0	0	16.7	8.5	0	0	0	0	4.4	2.2
	A	A	A	A	a	a	A	A	A	A	a	a
ASYMPT DENTATE	1.3	0.9	0.5	1.0	1.0	0.7	0	1.1	0	0	3.4	2.2
	A	A	A	A	a	a	A	A	A	A	a	a

Analysis among columns: Upper and lower case letters show significant statistical differences among groups.

L = Left R = Right

ASYMPT DENTATE = Asymptomatic dentate

wire clasps are used, 58% with Ackers clasps and 80% with retainers on telescopic crowns. The patients observed in this study used Roach clasps, and although they were adequate, as time went by, the torque induced a certain degree of mobility in the abutment tooth due to the resorption of the alveolar bone support[22]. Only one patient in this study had a fracture of the tooth's clinical crown. In this case, in addition to the crown having a filling, the use of the denture enabled a more intensive induction of the torque on the abutment tooth due to bone resorption.

When the clasp arm induces torque on the abutment tooth, in addition to the destruction of support tissues, there may be a loss in clasping function that retains the denture and keeps it stable. In this regard, it was found that after the second year of use, 30.7%, and after the fourth year, 46% of the patients in this study complained of lack of denture retention and stability. To avoid these alterations, both in support tissues and in clasp retention capacity, denture rebasing was needed within an average of three years. After this control period without periodical readjustment of the base, nearly 46% of the patients required a denture replacement to maintain their satisfaction[23].

Thirdly, in patients with Kennedy class I and II arches whose RPDs were worn by use, the TMJs are overloaded. Although some studies such as those by Hattori et al.[3] and Sato et al.[4] suggest that the lack of posterior teeth does not produce an increase in joint load, in patients in this study it was shown that there was a correlation between the absence of posterior teeth and joint vibration at the time of the first visit. This suggests that the lack of posterior occlusal support may somehow have affected the balance between joint structures.

The imbalance in the TMJ structures may have various causes, but the increase in compression on joint surfaces[9,24], condylar displacement[25] or lack of physical condition in muscles of mastication[26] seem to be important factors responsible for various types of joint noise.

Compression on joint surfaces may occur: 1) with the disc in the correct anatomical relation, where forces act on the thinnest part against the surface of the temporal bone; 2) the condyle may be positioned posteriorly and compression may occur on the posterior edge of the joint disc. In the first condition, compression may produce alteration in the lubrication mechanism and increase the friction of joint surfaces[27] and consequently, there may be adherence or erosion of the fibrous tissue lining the joint surfaces[28]. When there is adherence, it is accompanied by a limitation of opening when the patient awakens. However, when the joint structures become unstuck, there is a click and the patient can move her mandible freely again. This alteration can

only be identified by means of the clinical history of the disease, and was not found for any patient during this study. On the other hand, if compression produces erosion[16], as the disc passes over these irregularities, it produces low-intensity vibrations, usually in the middle of opening and closing. This condition was found in some patients both at the first visit and after two years of post-operational follow-up.

However, this compression may occur at the posterior edge of the disc and produce morphological alterations. When there is compression at the posterior edge of the disc, in addition to thinning the disc, it may allow stretching of the retrodiscal ligaments. When this happens, the disc is displaced forward and produces joint noises with vibratory intensity related to the degree of morphological alteration of the edge and of the posterior ligaments that connect the disc to the condyle and the temporal bone. When the missing teeth are replaced, the vertical dimension and occlusion are reestablished and the joint structures acquire a more stable anatomical position, so that during mastication, the condyle is positioned at the central part of the disc and does not compress the posterior edge, does not make the disc move, and eliminates joint vibration during mouth opening and closing.

On the other hand, some patients with unilateral or bilateral absence of posterior teeth do not have joint vibration, notwithstanding studies such as those of Martinez et al.[14] and Ciancaglini et al.[17] showing they have greater prevalence. Therefore, in addition to the orthopedic imbalance of the mandible, there must be another associated factor, such as stress, for morphological alteration and joint noise to develop.

Patients lacking posterior support may develop the habit of chewing with their front teeth, which requires the mandible and condyle to be projected forwards, thus avoiding their cranial displacement[9]. The lack of teeth damages the masticatory efficiency in these patients, and allows some physical deconditioning of the mandibular muscles. In this case, when the mandible moves, the joint structures vibrate at intensities below 30 Hz, barely recorded during the examinations with sensitive equipment.

In this study, it was found that on replacing teeth, the patient regains occlusal stability. However, this stability is only efficient for keeping the intra-joint structures of the TMJ stable as from the second year of constant denture use, improving a little more after the fourth year. Physical conditioning of mandible elevator muscles might be a determining factor for maintaining the integrity of the joint.

CONCLUSION

Patient follow-up over four years showed that, using this methodology:

There was no relationship between TMD and Kennedy class I and II partially edentulous condition.

Patient dissatisfaction increases after the second year and reaches 46% during the fourth year of denture use.

Joint noise decreases after posterior tooth replacement with statistically significant reduction after two to four years of denture use.

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