TMJ Vibrations in Asymptomatic Patients Using Old and New Complete Dentures

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Abstract

Purpose: The aim of this study was to assess the presence of temporomandibular joint (TMJ) noises in subjects with severe bone resorption, who have worn the same complete dentures for over 10 years, and 5 months after treatment with increments of acrylic resin on the occlusal surface after having new dentures in place.
Methods: After applying the research diagnostic criteria (RDC)/temporomandibular disorder (TMD) questionnaire, 20 asymptomatic subjects were assessed before and 5 months after the new dentures were put in place. Joint vibrations were assessed by the Sono Pak program by selecting the vibrations that occurred during the opening and closing cycle.
Results: The means of the results revealed a nonnormal distribution and were submitted to Kruskal-Wallis statistical analysis ($p < 0.05$). The vibration means were of low intensity ($\leq$9.96 Hz). After rehabilitation, there was a reduction in the vibrations ($\leq$5.2 Hz) statistically significant only at the end of mouth opening with the old dentures when compared with the other cycles.
Conclusion: The intensity and number of occurrences of joint vibrations were reduced after 5 months of wearing new dentures.

Several epidemiological investigations have reported on the signs and symptoms of temporomandibular disorders (TMDs) in complete denture wearers.[1] Most studies have found no correlation between signs and symptoms of TMDs and factors relating to overall quality of the dentures and the occlusal status of the dentures;[2,3] however, some studies found that occlusal instability was a potential factor contributing to the development of TMD among complete denture wearers.[1] Incorrect vertical dimension and centric relation were the most frequent causes of TMD among complete denture wearers;[4-6] however, others did not find that discrepancies in vertical dimension of existing complete dentures affected the severity of TMD.[2,5,7-10]

Temporomandibular joint (TMJ) sounds are important signs of TMD and are routinely recorded in subjects with suspected TMD; however, verbal descriptions of sounds recorded by auscultation are not suited for comparisons between observers.[11-13] Therefore, many attempts have been made to instead record TMJ sounds electronically when collecting such data for statistical analysis.[11,12] Different types of sensors have been used, such as microphones,[11,12,14,15] accelerometers,[16,17] or a combination of microphone and stethoscope.[18] The sites chosen for placing the microphone have also differed between authors. Some have recorded with the microphone in contact with the skin above the zygomatic arch.[13] Others placed the microphone in the auditory meatus.[14,19]

Few studies on TMJ vibration in subjects following the exchange of old dentures for new satisfactory dentures are found in the literature. This article relates a longitudinal study in patients with complete dentures, verifying the presence of joint vibrations before and 5 months after wearing new dentures.

Materials and methods

To conduct this study, 20 edentulous subjects with complete maxillary and mandibular dentures, worn for over 10 years were selected by means of anamnesis and clinical examinations. All subjects presented diminished occlusal vertical dimension (OVD), with deficient dental occlusion. Twelve women and eight men aged between 74 and 84 years were selected for the study. All presented severe bone resorption, particularly of the mandibular arch, in accordance with Ortman et al.[20] Individuals presenting diabetes, cardiovascular or articular alterations, hypertension, cancer, or history of TMD were excluded from the study according to exclusionary criteria.

All patients were asymptomatic and presented no signs or symptoms of TMD, as defined by the Dworkin and Leresche

research diagnostic criteria (RDC) questionnaire.[2] The questionnaires were administered by two examiners before the new dentures were inserted and again 5 and 12 months after denture insertion. Two examiners, calibrated according to RDC/TMD standards, performed the clinical evaluations in accordance with RDC/TMD standards.

The subjects with their old dentures were defined as the control group. Data from the control group were compared to the posttreatment data, which allowed within-subject comparisons. The selected subjects were informed about the treatment and signed an informed consent form in accordance with the recommendations of the Human Research Ethics Committee.

Clinical evaluations revealed the following conditions: severe decrease in lower face height yielding poor facial esthetics, inadequate fit of complete dentures, worn denture teeth, clinically perceptible deficiency in OVD, acquired protrusive maxillomandibular relationships secondary to resorption, and angular cheilitis.[8] The deficiencies in preoperative OVD were corrected by adding increments of acrylic resin to the occlusal surfaces[9] of the teeth in the old mandibular dentures. The new complete dentures were made according to the procedure recommended by Zarb et al.[4]

The technique for denture fabrication consisted of preliminary impressions using stock trays and condensation silicone impression material (Zetaplus, Zhermack, Rovigo, Italy). The preliminary casts were fabricated to make custom trays for definitive impressions. Border molding was performed with heavy body condensation silicone (Zetalabor, Zhermack), and the definitive impressions were made with zinc-enolic paste (Pasta Lysanda Zincoenólica, Lysanda, São Paulo, Brazil) syringed around the borders of the trays until the trays were completely covered. The definitive impressions were poured with dental stone type IV (Durone, Dentsply, Petropolis, Brazil) to obtain the master casts.

The maxillary cast of each patient was mounted in a semiadjustable articulator (Whip Mix Corporation, Louisville, KY) using a facebow. OVD was established by using the physiological rest positions associated with phonetic and esthetic techniques.[4] Centric relation was established according to dynamic records based on physiological movements of the jaw, including opening, closing, and lateral movements performed by the patient.[4] These records were performed to position the mandibular casts in the articulators. Artificial teeth were selected, and bilateral balanced articulation was obtained. The dentures were waxed, processed, finished, and polished for insertion and follow-up.[4] The new dentures showed improved facial esthetics, adequate fit, correct maxillomandibular relationships, and anatomical teeth with cusp inclination of 20°.

To perform this examination, transducers were placed (piezoelectric accelerometer) on the right and left joints. This system was connected directly to a signal amplifier, which was connected to the internal circuit of a computer with SonoPAK/I (Bio-Research, Inc, Milwaukee, WI) software installed.

After placing the transducers with the aid of a millimetric ruler, the mouth opening amplitude (inter incisal distance) was measured and used to calibrate the appliance. Next, the patient performed mandibular opening and closing movements, following a cursor on the monitor screen. All subjects were allowed to train for 1 minute to synchronize mouth opening and closing when following the cursor movement. After synchronism, recordings were made in 10 seconds.

After performing the examination, the good quality of the recording was verified. To do this, the recording was opened on the computer screen and, using the mouse, the cursor was placed over the vibration corresponding to occlusal contact, which should be positioned in the area of transition between mouth opening and closing. The vibrations found in the mandibular movement cycles were marked and used to verify the presence of joint noise, as well as to assess its vibratory intensity.

For each patient, the analysis was repeated three times, in four cycles with old dentures and after 5 months with new dentures. The means were printed on paper and considered as the quantity of vibratory energy, measured in Hertz.

Statistical analysis of the vibration recordings was performed by applying the Comparison of Variance Test to compare the articulation sides. A test of data normality was performed and revealed a nonnormal distribution that demanded application of the nonparametric Kruskal-Wallis test at a level of significance of 5%.

Results

Seventeen subjects presented joint vibrations during mouth opening and closing. Three subjects did not present vibrations. The articulation vibrations in the 17 subjects during the mouth opening and closing cycles with old and new dentures on the left (L) and on the right (R) articulation sides varied between 0 and 25 Hz.

Analysis of vibratory intensities of TMJs showed that a numerical reduction in vibrations occurred, without statistical significance, however, at the beginning and in the middle of the opening cycle and at the end of the closing cycle on both sides. After the new dentures had been put into place, an increase in vibrations in the middle of the opening cycle was also verified, without statistical significance (Table 1). The mean values of vibrations (Hz), at the end of the opening cycle with the old dentures, in comparison with the new dentures, showed no statistically significant differences; however, when compared with the other cycles, it was possible to note that statistically significant differences occurred at the end of opening with the old dentures ($p < 0.05$) (9.96 Hz side L, 9.3 Hz side R).

Discussion

Despite the vibrations (Hz) registered in the joints of the subjects with old dentures and 5 months after treatment with new dentures, these vibrations did not present a high intensity. The vibrations absent or present at the beginning of the examination should be discussed with regard to possible occurrences.

In spite of the importance of joint noises as a diagnostic means, many of these are not always perceived by the patient. This was verified in 17 of the 20 asymptomatic subjects with old dentures assessed in this study. Similar asymptomatic subjects may be found in the literature.[11] This occurs because some vibration presents levels of intensity below the capacity of perception by the human ear[13] or because it occurs together with occlusal contact at the end of closing.[8] These are causes that prevent the patient from identifying joint noise, but which

Table 1 Means of vibrations (Hz) of 17 subjects during the mouth opening and closing cycles with old and new dentures on the left (L) and on the right (R) articulation sides

	Cycles											
	Opening						Closing					
	Beginning		Middle		End		Beginning		Middle		End	
Mean	L	R	L	R	L	R	L	R	L	R	L	R
Old	3.56 a	2.52 b	0.00 a	0.00 b	9.96 A*	9.30 B*	5.61 a	2.42 b	2.55 a	3.72 b	3.47 a	3.61 b
New	0.00 a	0.00 b	0.89 a	1.30 b	5.20 Aa	4.87 Bb	2.95 a	2.70 b	0.00 a	0.00 b	3.12 a	2.75 b

Letters a or A indicate means of joint vibration (Hz) left side and letters b or B, right side.

Lowercase letters compared with uppercase letters indicate statistically significant difference ($p < 0.05$).

*statistically significant difference ($p < 0.05$).

are easily found by means of the electrovibratographic examination.[13,21] Vibrations in the TMJ area can be observed with significant portions in the inaudible area below 20 Hz, both during mandibular rest and during jaw movements, whether the subjects have audible joint sounds or not.[13,21] The overload that occurs at the joint surfaces of the TMJ appears to be responsible for the damage to the covering tissues of this joint and for the alteration of the lubrication mechanisms.[22] Emotional tension appears to be a cause of parafunctional habits such as tooth clenching and has been recognized as one of the predisposing factors for some vibrations. Moreover, occlusal[5] and systemic[22] factors have also been blamed. Subjects with the habit of clenching their teeth may also have an increase in friction between the joint surfaces and cause erosions responsible for low-intensity vibrations.[23,24]

Lack of denture stability, the habit of clenching to keep the dentures stable, and age are factors that may have contributed to the increase in friction on joint surfaces, due to alterations in the lubrication mechanism, which could cause erosions in the fibrous tissue that covers the condyle and the temporal bone joint surfaces. During joint structure movements, the passage of the disk through these irregularities could produce vibrations captured during the examination at the end of closing. These results are in agreement with those of Agerberg.[1] The tooth clenching and unilateral mastication in subjects wearing old dentures cause noises in the TMJ and leave the mastication muscles more sensitive.[6] With the exchange of old dentures for new satisfactory dentures, re-establishment of equilibrium occurs (occlusal and OVD),[5,10] and the tooth clenching habit disappears and produces a reduction in joint vibrations and masticatory muscle sensitivity.

Some of the subjects in this study, who had dentures worn out from use, could have produced some occlusal imbalances, caused by some degree of condylar displacement. When premature contact produces change in the mandibular position with latero-protrusive sliding,[13] one of the condyles is displaced backwards and produces compression at the posterior edge of the disk, causing morphological alterations that facilitate the anterior displacement of the disk. This displacement may have various stages, depending on the alterations taking place in the disk. Stage I or low-intensity vibrations that occur at the beginning of opening characterize displacement of the disk. After new dentures had been placed, and OVD was re-established, the vibrations could change place and occur in the middle of opening (Table 1). This suggests that the morphological alterations to the disk are responsible for these vibrations. As the morphological alteration to the disk increases, it is positioned more toward the anterior region, and vibrations begin to occur during the middle of opening and are of a vibratory intensity of over 50 Hz.[6] These sonorous characteristics, however, were not verified in any of the subjects, as they were all asymptomatic.

A reduction in signs and symptoms in TMJs has been shown after 3 years of occlusal stabilization with new dentures, but subjects who continue to clench their teeth may not present as asymptomatic, even with the new dentures.[3] The TMJs that presented low vibratory intensity at the end of mandibular closing are suggestive of condylar dislocation or increase in sinovial liquid, frequent in TMJs with an inflammatory process.[12]

Joint hypermobility coming from decreased physical fitness is another condition that leads joint structures to vibrate more easily during the passage of sinovial liquid from the anterior to the posterior compartment, as proposed in studies by Olivieri et al.[12] The lack of muscular conditioning may be explained by the vibrations at the end of opening and at the beginning of closing, which arose in patient two with the new dentures, due to the lack of complete adaptation reported by him. The continued tooth clenching habit while wearing the dentures was associated with this. The means of low-intensity vibrations (Hz) that occurred at the end of opening (9.96-L/9.3-R) and at the beginning of closing (5.61-L/2.42-R) indicate a certain degree of joint hypermobility with the old denture (Table 1). In these cases, after denture replacement and re-establishment of masticatory function, the elevator muscles are reconditioned and come closer to the joint surfaces, and the vibrations (Hz) no longer occur, or their intensity is diminished at the end of opening (5.2-L/4.87-R) and beginning of closing (2.95-L/2.7-R). The absence of molar support produces increased compressive load in the anterior region of the condyle positioned against the posterior slope of the temporal bone, which could alter the smoothness of the joint tissue surface.[3]

The re-establishment of OVD could also place the condyle slightly forward and thus diminish the compression at the posterior edge of the disk. This could eliminate the inflammatory process and the TMJ vibrations as a result of stabilizing

occlusion, improving the redistribution of the occlusal forces with reduction of load in limited areas, and improving the lubrication mechanism,[2,22] adapting the disk over the condyle, and muscular conditioning.[25] Furthermore, by re-establishing lubrication, the occurrence of disk adherence to the joint surface could be prevented.[11]

In this study, subjects who wore old dentures, with a reduction in OVD, presented vibrations (Hz) at the beginning of opening (3.56-L/2.52-R), in the middle of closing (2.55-L/3.72-R), and at the end of closing (3.47-L/3.61-R), during the electrovibratographic examination. Furthermore, the intensity of these vibrations was diminished after new dentures were put in place (0.00-L/0.00-R; 0.00-L/0.00-R; 3.12-L/2.75-R). Dervis,[5] who found improvement in TMD signs, also observed these data and symptoms after new dentures were put in place, due to the correct re-establishment of OVD.

The addition of acrylic resin to old dentures, restoring posterior contacts, and re-establishing occlusion and OVD, before new dentures were put into place, improved mandibular equilibrium and, thereby considerably reduced various signs and symptoms, among them, TMJ vibrations.[26] In addition, adequate re-establishment of occlusion improved masticatory function and allowed muscular strengthening, which approximated the condyle structures/temporal bone disc. Thus, this could significantly diminish some vibrations at the end of mouth opening and the beginning of closing, as found on both sides of the majority of the subjects with new dentures. Gay and Bertolami[27] observed that the joint noises in asymptomatic subjects who wore old dentures are more frequent at the end of the opening cycle. The results of the present study corroborate those of the above study, in which the asymptomatic subjects presented low-intensity noises (below 30 Hz) during recordings, these being more frequently recorded at the end of mouth opening and the beginning of mouth closing. With occlusal equilibrium and correctly re-established OVD, vibrations remained because of the absence of adaptation to and functional education for the new dentures, inducing continued tooth clenching.[1,5] Physical therapy is indicated to remodel the structure of the articular disk and strengthen the elevator muscles of the mandible. After some exercise, the vibrations tend to disappear.[13] With the placement of new complete dentures, 5 months were not enough for remodeling of the joint structures, allowing the structures to move silently even with a reduction in vibrations.

Most patients with old dentures were comfortable and functional. Providing new complete dentures to patients with TMJ often results in reduction of their symptoms, but this reduction may be small in some patients.[5]

Some patients did not present complete reduction of TMJ vibrations with new denture insertion. This may result from several factors, such as a parafunctional habit of teeth clenching, which may generate erosions in TMJ and alteration on lubrication mechanism, allowing an inflammatory process.

The presence of hypermobility due to the lack of muscular conditioning without adaptation to the new dentures associated with occlusal imbalance with the old denture caused some degree of condylar displacement and morphological alteration. All these factors are responsible for anterior displacement of the disk and TMJ vibrations.

The three patients, who did not exhibit vibrations before and after new denture insertion probably did not present teeth clenching. This preserves the TMJ without morphological alterations and allows satisfactory muscular conditions.

The limitations of the present study are the subjective answers of the patients in the questionnaire (RDC). In addition, a 1-year follow-up may not be enough time for complete reduction of vibrations.

Conclusion

Joint vibration reductions were statistically significant only at the end of mouth opening with the old dentures.

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