Revista Odontológica Mexicana

Facultad de Odontología

Vol. 17, No. 1 • January-March 2013

pp 26-32

ORIGINAL RESEARCH

Varied sensory-motor adaptation to new dentures among full denture wearers and non wearers

Diferente adaptación sensorio-motora a nuevas dentaduras, entre no portadores y portadores de dentaduras completas

Alberto Enrique Nuño Licona,*,§ Mónica Núñez,* Fernando Ángeles Medina,*
Araceli Galicia Arias,* Nicolás Pacheco Guerrero*

ABSTRACT

Teeth loss elicits significant changes in the sensory-motor activity of patients thus afflicted. These changes can in turn be affected upon placement of a full denture (FD). Overall changes can alter mastication processes, to the point of affecting the patient's general state of health, as would be the case when impinging on proper feeding. This shows the importance of studying masticatory muscles response to the placement of a full denture. It is as well opportune to compare patients who have previously worn dentures with new denture wearers, since it must be borne in mind they could present different functional states. To this end, electromyographic records (EMR) were conducted in masseter muscles of 29 patients before (1st session) at 8 and 30 days (2nd and 3rd session) of FD placement. Two groups were tailored: Group 1 (G1) (n = 15, 12♀, 5♂, average age 67.2 years) those who had previously worn a full denture, and group 2 (G2), (n =12, 8♀, 4♂, average age 66.5 years) comprising individuals who had never before worn a full denture. Results indicated there was functional difference among muscles of patients having previously worn FD when compared to muscles of patients who had never worn a FD. Lesser EMG amplitude was found in G1 when compared to G2 in the first session as well as lesser ability to generate masticatory cycles. In the long run, this could also bear upon masticatory ability decrease and patients quality of life. It is necessary to continue this type of studies to substantiate recorded results of the present study, as well as to implement measures geared at contributing to improved FD adaptation.

RESUMEN

La pérdida de las piezas dentarias provoca cambios importantes en la actividad sensorio-motora de los pacientes que la sufren, cambios que a su vez pueden afectarse al colocar una dentadura completa (DC) y todos en conjunto pueden alterar el proceso de la masticación a tal grado que se afecten condiciones generales de salud como, por ejemplo, una adecuada alimentación, por lo que ha sido importante estudiar la respuesta de los músculos masticatorios ante la colocación de una DC y además comparar entre aquellos pacientes que previamente han usado DC y aquellos que la utilizan por vez primera, considerando que pudiera existir un estado funcional diferente. Para ello se hicieron registros electromiográficos (EMG) en los músculos maseteros de 29 pacientes, antes (1ª sesión), a los 8 y 30 días (2ª y 3ª sesión respectivamente) de la colocación de la DC. Formando dos grupos: el grupo 1 (G1) (n = 15; 12♀, 5♂, edad promedio 67.2 años) aquellos que previamente estaban usando ya una DC y el grupo 2 (G2) (n = 12; 8♀, 4♂, edad promedio 66.5 años) los que nunca antes la habían usado. Los resultados indican que existe una diferencia funcional entre los músculos de aquellos pacientes que previamente han usado una DC con respecto a la de los músculos de los pacientes que no han usado antes DC. Se registró menor amplitud EMG en la 1ª sesión en el G1 con respecto al G2 y una menor capacidad de generar los ciclos masticatorios, ello podría influir, también a largo plazo, en una disminución de la capacidad masticatoria y en la calidad de vida de los pacientes. Es necesario continuar este tipo de estudios tanto para corroborar los resultados reportados en el presente trabajo como para que, en su caso, se implementen medidas que coadyuven a una mejor adaptación a la DC.

Key words: Full denture, masseter electromyography, sensory motor integration.
Palabras clave: Dentadura completa, electromiografía de maseteros, integración sensorio-motora.

INTRODUCTION

Edentulous patients experiment important changes which affect sensory-motor activity of the stomatognathic system.[1] Loss of posterior teeth can by itself elicit unbalance of muscle activity patterns. Prolonged use of full dentures (FD), sometimes for

* Physiology Laboratory, Research Division, Graduate School, National School of Dentistry, National University of Mexico (UNAM).
§ National Rehabilitation Institute (Instituto Nacional de Rehabilitacion), Research Division, Physiology Laboratory.

many years, has been associated to a marked activity of masseter muscles. This in turn can be related to muscle efforts generated by the progressive decrease of denture retention.[2] In some cases, adaptation of a new FD can be difficult both in new wearers as in patients having already worn dentures. This could be due to a different muscle response and is seldom taken into account in clinical practice. With respect to muscle activity, 30 days after initiating use of a FD, an increase in electromyographic (EMG) interference pattern (IP) recording amplitude has been reported.[3] Nevertheless there are also reports[4] pointing out that FD wearers present a lesser amplitude of integrated EMG activity than that recorded in subjects with natural dentition.

It is possible that different reports of recorded EMG response could be due to the fact of disregarding whether patients had previously worn full dentures or not. With respect to this latter point, it has been demonstrated there is presence of biochemical changes in rats masseter muscles, induced, at initial stages, by occlusal alterations created experimentally.[5] On the other hand, it has been suggested[6,7] that inherent instability in full denture wearers when combined with parafunctional habits, can precipitate a vicious circle which alters function, and elicits muscle pain as well as alterations in other tissues.

All the aforementioned factors affecting motor and sensory activity of the stomatognatic system could as well bear influence in the response to placement of a full denture. For these reasons, the aim of the present study was to study, with the help of electromyographic (EMG) records, the recording of the Interference Pattern (IP) as well as the recording of its integration (I), and the activity of masseter muscles in edentulous patients, before and up to three months after placing a FD. The present study also aimed at achieving a comparison between two different groups of subjects: those who had previously used a FD and those who were first time users, so as to elicit whether there could be a different functional state.

MATERIALS AND METHODS

EMG records of masseter muscles IP and I activity in 29 patients who attended the Prosthetic Service of the Graduate School, National School of Dentistry, National University of Mexico (UNAM) requesting placement of a FD. EMG recordings were performed before placing a FD (1st session), and at 8 and 30 days (2nd and 3rd sessions). Patients were divided into two groups: Group 1 (G1) (n = 15, 12♀5♂, average age 67.2 years) patients were previous users of a FD, and group 2 (G2) (n = 12; 8♀, 4♂, average age 66.5 years) corresponding to patients never having previously worn a full denture.

Recording was bi-polar. To this effect 5 mm diameter surface electrodes were used (Grass E5G) and placed upon the skin covering muscle belly at approximately 1 cm in front of the ear and 1 cm above the lower angle of mandibular ramus. Electrodes were connected to the pre-amplifiers terminals (Grass 7P3B) connected to the amplifiers (Grass 7DAG) of channels 1 and 3 for IP activity and to channels 2 and 4 for I activity in a 4 channel Grass polygraph (model RPS7C8B). Recorded activity was the following: 30 second maximum voluntary contraction, and later (two minutes later) chewing a sweet (standard colloid sweet) until its deglutition (60 seconds later).

FD were manufactured at one-week intervals. All of them were made following the same technique and using the same materials.

In order to analyze EMG recording amplitude as well as number of masticatory cycles, average values were obtained from each one of the recording sessions. In-Stat 3 statistical program was used to analyze differences in their variables.

RESULTS

Table I shows values of EMG recording amplitudes in microvolts (μv), in interference patterns as well as in integrated recordings obtained from masseter muscles in G1 patients before initiating design and placement of a FD. The recordings were also obtained when using the old prosthesis and when not using it. No statistical significant differences were found between these two situations. *Tables II and III* show EMG values obtained in respectively 2nd and 3rd recording sessions, for G1 when wearing the new FD.

When performing statistical analysis, it was observed there was a significant decrease in integrated EMG for G 1 of average values of 2nd session when compared to 1st. Statistical significant boundary was found to appear between 3rd session when compared to 1st *(Figure 1)*.

Tables IV, V and VI present EMG recording values in IP as well as those obtained from the respective recording sessions in G2 patients. In the G2 group, no statistically significant differences were established when comparing average values in all recording sessions.

When comparing EMG recording values obtained in all sessions among study groups it was found that

values obtained in the first PI recording session were significantly lower in G1 as compared to G2 *(Figure 2)*.

The third recording session revealed the fact that I values obtained for G1 were also significantly lower than those of G2 *(Figure 3)*.

Figure 4 shows average values obtained when recording masticatory cycles present in a 10 second span during the process of chewing a gummy candy, performed by all patients in all recording sessions. A, C and E bars correspond to G1 1st, 2nd and 3rd sessions, respectively. B, D and F bars

Table I. Amplitude values in μv of EMG recordings in interference pattern (IP) and integrated (I) recordings obtained in each of the G1 group patients, using (with) or not using (without) FD. Recordings taken at the 1st session.

	Right	Left	Right	Left	Right	Left	Right	Left
Age	IP with	IP with	Integrated with	Integrated with	IP without	IP without	Integrated without	Integrated without
66	60.00	72.22	160.00	66.66	30.00	133.33	38.88	50.00
63	20.00	33.33	106.66	33.33	15.00	11.11	193.33	0.00
77	10.00	66.66	386.66	88.88	10.00	61.11	333.33	77.77
71	55.00	100.00	240.00	55.55	50.00	77.77	293.33	100.00
83	0.00	22.22	146.00	0.00	0.00	22.22	0.00	0.00
73	10.71	5.55	80.00	25.00	7.14	8.33	86.60	20.83
67	10.00	44.44	66.66	88.88	5.00	11.11	0.00	11.11
74	10.00	38.88	226.60	55.55	0.00	33.33	35.71	33.33
71	8.33	9.09	8.69	0.00	8.33	4.54	4.34	0.00
52	16.66	9.09	17.39	0.00	16.66	9.09	21.73	0.00
73	41.66	31.81	34.78	11.11	83.33	54.54	73.91	22.22
52	8.33	9.09	2.17	0.00	4.16	9.09	4.34	0.00
71	23.80	26.31	10.00	9.52	0.00	21.05	0.00	9.52
65	9.75	10.52	0.00	0.00	29.26	42.10	10.00	9.75
72	48.78	52.63	25.00	39.02	19.51	0.00	10.00	0.00
61	29.26	21.05	0.00	9.75	19.51	21.05	0.00	9.75
52	14.63	21.05	0.00	0.00	19.51	26.31	0.00	0.00

Table II. Amplitude values recorded in μv of EMG recordings of interference pattern (IP) and integrated recording obtained from masseter muscles from G1 patients at 2nd recording session.

Right	Left	Right	Left
IP	IP	Integrated	Integrated
9.09	35.00	0.00	26.66
33.33	22.72	17.39	0.00
26.66	27.27	26.08	0.00
16.66	40.00	13.04	16.66
12.50	54.54	8.69	33.33
41.66	13.63	26.08	0.00
41.86	31.57	24.39	10.00
48.78	31.57	10.00	4.87
29.26	15.78	20.00	0.00
31.57	48.78	34.14	50.00
25.00	21.05	0.00	33.33

Table III. Amplitude values expressed in μv of EMG recordings in interference pattern (IP) as well as integrated recording obtained from masseter of G1 patients during 3rd recording session.

Right	Left	Right	Left
IP	IP	Integrated	Integrated
41.60	30.00	13.04	0.00
10.00	19.04	0.00	4.00
83.30	73.68	0.00	0.00
46.15	24.00	44.44	0.00
19.04	29.26	31.57	21.05
166.66	52.63	0.00	58.82
27.70	40.00	4.30	47.30
27.27	28.57	20.51	30.00

Table IV. Amplitude values expressed in μv of EMG recordings in interference pattern (IP) as well as integrated recording obtained from masseter muscles in G2 patients during 1st recording session.

	Masseter R	Masseter L	Masseter R	Masseter L
Age	IP	IP	Integrated	Integrated
75	45.00	226.00	11.11	16.66
77	30.00	77.77	426.00	116.66
73	10.00	22.22	80.00	38.88
53	25.00	27.27	30.43	16.16
49	8.33	0.00	18.18	11.11
80	33.33	18.18	56.52	16.66
76	33.33	27.27	47.82	33.33
57	4.82	5.26	0.00	0.00
82	34.14	31.37	25.00	19.51
60	68.29	42.10	70.00	34.14
60	46.51	130.00	25.00	100.00
56	95.23	90.00	928.00	117.64

Table V. Amplitude values expressed in μv of EMG recordings in interference pattern (IP) as well as integrated recordings obtained from masseter muscles in G2 patients during 2nd recording session.

Masseter R	Masseter L	Masseter R	Masseter L
IP μv Con	IP μv	Integrated μv	Integrated μv
41.60	50.00	30.43	27.27
8.33	10.00	0.00	0.00
48.78	21.05	10.00	0.00
48.78	31.37	20.00	9.75
90.00	25.00	260.00	0.00

Table VI. Amplitude values expressed in μv of EMG recordings in interference pattern (IP) as well as integrated recordings obtained from masseter muscles in G2 patients during 3rd recording session.

Masseter R	Masseter L	Masseter R	Masseter L
IP	IP	Integrated	Integrated
39.08	40	40	25.00
71.42	65	110	111.11
42.85	25	0	30.43

correspond to 1st, 2nd and 3rd sessions of Group 2. In the first recording session, a statistically significant difference was found between both groups ($p < 0.01$ Tukey-Kramer test); G2 exhibited the greater number of cycles. A significant decrease in cycle numbers was observed in the second session ($p < 0.01$). The 3rd session showed recovery. *Figure 5* shows integrated EMG scope average values in these masticatory cycles for each session. Masticatory cycle numbers exhibited similar behavior.

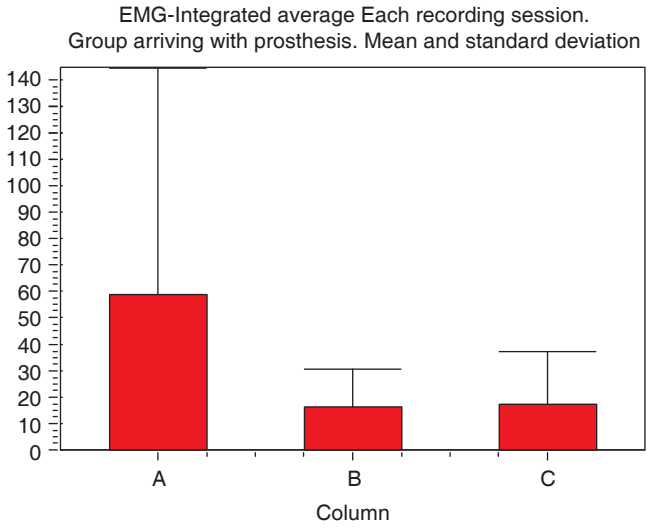

Figure 1. Shows average values of integrated EMG recordings obtained from masseter muscles of G1 patients (denture wearers) in each of the recording sessions. Significant decrease was observed from first to second session ($p < 0.05$, T test).

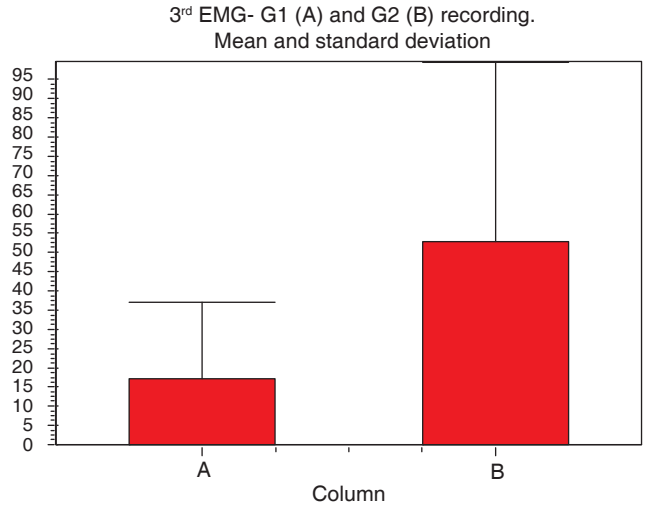

Figure 3. Average values of integrated EMG activity obtained from 3rd recording session for G1 (A), and G2 (B). Difference is significant ($p < 0.01$, T test).

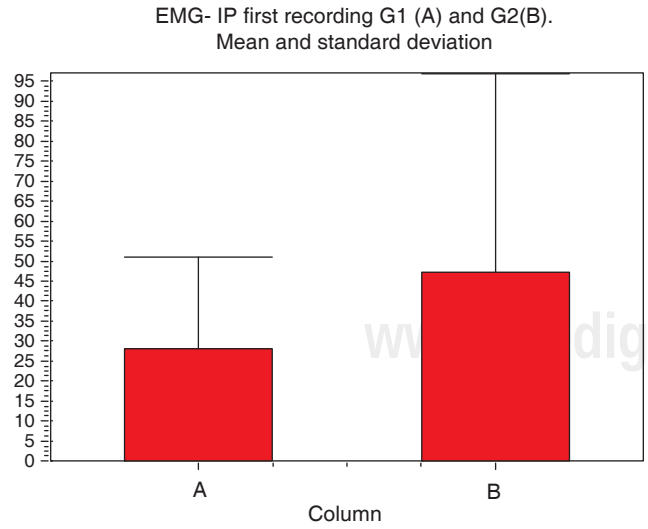

Figure 2. Comparison of average EMG-PI values obtained from G1 (A) patients and those obtained in G2 group at first recording session. Difference is significant ($p < 0.05$, T test).

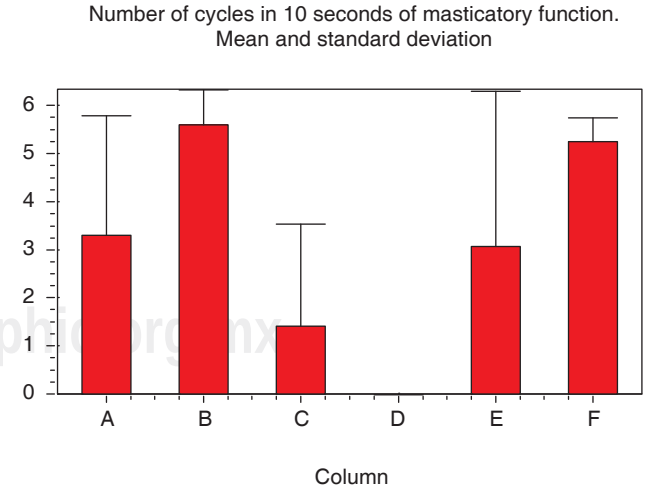

Figure 4. Average values of number of cycles obtained in 10 second masticatory period for G1 (A, C, and E) and for G2 (B, D and F), in each of the three sessions. It was noted that in G2, in 2nd session there was practically no mastication (D); at 3rd session it had been recovered at baseline.

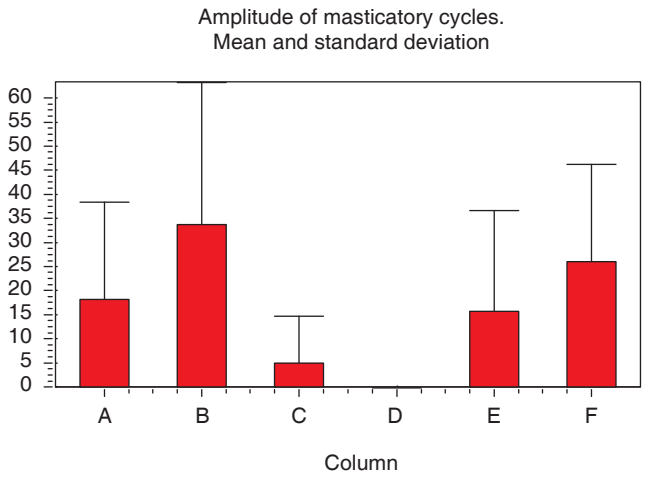

Figure 5. Scope (mV) average values expressed in μv are shown for cycles counted in 10 seconds of masticatory activity, shown in similar fashion to *figure 4*, for G1 (A, C and E) and G2 (B, D and F). 1st, 2nd and 3rd sessions, respectively.

DISCUSSION

Results show there is a functional difference in muscles of patients having previously worn FD with respect to muscles of non wearers. Lesser IP amplitude recorded in G1 first session when compared to G2 indicates lesser motor unit activity in masseter muscles of G1 patients. This could elicit lesser ability to generate masticatory cycles in this group. The response in following sessions was to decrease IP amplitude even more. This was found to be in agreement with other reports.[4] G2 did not show differences in this respect. This would indicate there were no changes with respect to motor units in this group. There are reports indicating an increase in IP of masticatory muscles in patients who wear a FD for the first time.[3,8] Nevertheless, none of the papers mention whether patients had previously worn FD.

Besides significant differences found among groups, IP recording for the first session, as well as I activity in the third session were lesser for G1, which tends to indicate lesser electrical activity in this group. This would imply the fact that prolonged use of devices in the oral cavity elicits changes in muscular activity. This would then be the cause of the difference found in this study between G1 and G2 from the first recording session. We could therefore suggest that ability to generate muscle electrical activity is decreased in former FD wearers. This could even bear repercussion in the lesser number of masticatory cycles generated within a masticatory period, decreasing thus their effectiveness.

It has been demonstrated[9] that FD wearers experience chewing problems which significantly impair their quality of life. This is especially true in senior citizens. It therefore would be advisable to conduct this type of EMG studies in a larger number of patients wearing dentures for the first time. These studies could also be routinely conducted to verify results presented in this paper and also, if pertinent, implement measures to help FD better adaptation. This could be the application of an exercise regime which could improve patients' functional muscle condition.

CONCLUSIONS

Loss of teeth entails changes in the EMG activity of masseter muscles. Use of a FD seems to elicit, in the long run, decrease of electrical activity in the aforementioned muscles. This has been related to the presence of smaller motor units as well as the decrease in number of masticatory cycles per time unit. The aforementioned facts could also influence, in the long run, the decrease in patients' masticatory capacity and quality of life.

Routine EMG studies of masticatory muscles will give rise to an objective assessment of these events and the possible preventive and therapeutic measures which could be adopted.

REFERENCES

1. Miralles R, Bull R, Manns A, Roman E. Influence of balanced occlusion and canine guidance on electromyographic activity of elevator muscles in complete denture wearers. *J Prosthet Dent* 1989; 61 (4): 494-498.
2. Tallgren A. An electromyographic study of the behaviour of certain facial and jaw muscles in long term complete denture wearers. *Odontol* TS-KR 1963; 71: 425-444.
3. Nuño-Licona A, Ángeles MF, Pacheco SME, Sarabia VA, García MC. Actividad electromiográfica (EMG) de los músculos masetero y temporal en pacientes edéntulos antes y después del uso de prótesis completa. *Practica Odont* 1990; 11 (8): 54-56.
4. Miralles R, Berger B, Ide W, Manns A, Bull R, Carvajal. Comparative Electromyographic study of elevator muscles in patients with complete dentures and natural dentition. *J Oral Rehab* 1989; 16: 249-255.
5. Bani D, Bani T, Bergamini M. Morphologic and biochemical changes of the masseter muscles induced by occlusal wear: studies in rat model. *J Dent Res* 1999; 78 (11): 1735-1744.
6. Von Gonten AS, Rugh JD. Nocturnal muscle activity in the edentulous patient with and without dentures. *J Prosth Dent* 1984; 51 (5): 709-712.
7. Piancino MG, Farina D, Talpone F, Castroflorio T, Gassino G, Margarino V, Bracco P. Surface EMG of jaw-elevator muscles

and chewing pattern in complete denture wearers. *J Oral Rehabil* 2005; 32 (12): 863-870.
8. Al-Jabrah OA, Al-Shumailan YR. Prevalence of temporomandibular disorder signs in patients with complete *versus* partial dentures. *Clin Oral Investig* 2006; 10 (3): 167-173.
9. Koshino H, Hirai T, Ishijima T, Tsukagoshi H, Ishigami T, Tanaka Y. Quality of life and masticatory function in denture wearers. *J Oral Rehabil* 2006; 33 (5): 323-329.

Mailing address:
Alberto Enrique Nuño Licona
Laboratorio de Fisiología, División de Investigación,
Unidad de Estudios de Postgrado,
Facultad de Odontología,
Ciudad Universitaria (UNAM),
México, D.F.
Tel: 00 52 55 56 22 5561
E-mail: an.el.20@gmail.com