ARE THERE CHANGES IN ORBICULARIS ORIS MUSCLE ACTIVITY DUE TO THE CONVENTIONAL PROSTHETIC TREATMENT OF COMPLETE EDENTATION ?

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Abstract:
Introduction. It is well known that the orbicularis oris muscles, in association with m.buccinator and m. pharyngeal constrictor, form a well defined functional unit, called the „buccinator mechanism", with important role in some orofacial functions. It is also involved in the ″neutral zone″ establishment, as essential feature of complete edentation treatment. The purpose of this investigation was to assess the changes in clinical and electromyographic activity of orbicularis oris muscle (OO) in complete edentulous patients before and after the insertion of dentures. Material and method. Seven patients were included in this study. Electromyographic records of the upper(OOS) and lower(OOI) orbicularis oris muscle were made using the BioEMG II (Bioresearch Assoc.Inc.) surface electromyography device, performed at rest, while whistling and sucking before and 3 days after the insertion of the complete dentures. Results. There was a significant difference between OOS and OOI activity before inserting dentures in all three conditions (p =0.0156) as well as after the prosthesis insertion during sucking and whistling, a more pronounced activity of OOI being obvious. No statistically significant difference in the activity of the mentioned muscle groups before and after insertion of the dentures, in the three recording conditions was observed. Conclusion. Within the limits of the present study, we conclude that in terms of EMG at rest as well as during functional moments of sucking or whistling there are no significant changes in OOI and OOS muscle tone, before and after conventional prosthetic treatment of complete edentation.

Key Words: Orbicularis oris muscle, complete edentation, electromyography

Introduction:

Thirty five years have passed since Perkins et al.[1]based on their neurophysiological studies have shown that the m.orbicularis oris , m.buccinator and m. pharyngeal constrictor form a well defined functional unit , called the „buccinator mechanism", with important role in orofacial function (swallowing, sucking, whistling, chewing, vowel pronunciation, kissing). In this muscle complex m.orbicularis oris in its upper (OOS) and inferior (OOI) part were electromyographically studied to assess their role in mastication [2], swallowing[3] and in some neurosenzorial abnormalities, such as deafness[4, 5].

Given the important morphogenetic role of orofacial muscles, a series of orthodontic studies 〔6, 7〕 have found an increase in electromyographic activity of m.orbicularis oris in centric occlusion and during sucking in patients treated with postural training devices. An earlier study of Gustaffson and Ahlgren〔8〕, investigating children with different morphologies of the lips, showed no electromyographic activity of m orbicularis oris at rest, but have noticed increased activity in chewing and swallowing in children incompetence of the lips, which was notified later by other authors 〔9, 10, 11〕. Tryde and Tallgren〔12〕studying the electromyographic activity of the muscles of the lips during swallowing in dentures wearers found that OOI electromyographic activity was stronger than the OOS one.

Our aim was to assess the changes in clinical and electromyographic activity of OO muscle in complete edentulous patients before and after the insertion of dentures in three essential functional requirements (posture, whistling and sucking) in terms of total edentulous diagnostic, therapy and evolution.

Material and method

Patients. Seven patients (1F and 6 M, mean age 61 years) presented for treatment with conventional mobile prostheses were included in the study. All participants were asked for informed consent regarding the electromyographic examination as a means of evaluating the therapeutical results.

Electromyography. Electromyographic records of the orbicularis oris muscle were made using the BioEMG II (Bioresearch Assoc.Inc.) surface electromyography device , which is specifically intended to record the activity of craniofacial muscles. We used the TA-R channel for OOS and the TA-L one for OOI . The placement of the adhesive surface bipolar electrodes was made according to the anatomical disposition of muscle fibers , parallel to this, on the right side third of each of the two muscles (Fig. 1), in accordance with the protocols proposed by Barrel & Moyers〔13〕 and Vaiman〔14〕. Adhesive ground electrode was attached to the patient's right shoulder.

Fig. 1. Bio EMG II device and electrodes placement

The electromyographic records were performed before and 3 days after the insertion of the complete dentures in the mouth during three conditions: rest, while whistling and sucking. For each of these conditions, from the 10 seconds of recording three sections of 2.5 seconds for the two investigated muscles, were analyzed. The mean amplitude of electromyographic signals calculated by the software device (BioPack) (Fig. 2) were listed in the tables, the results were expressed graphically and statistically interpreted.

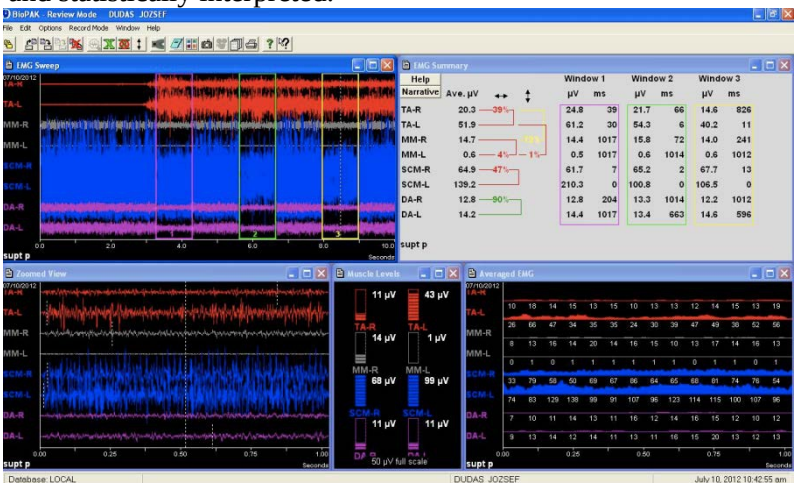

Fig. 2. The BioPack software review mode of the recordings. The TA-R channel for OOS and the TA-L one for OOI were used.

Statistics. For the statistical evaluation of the differences in electromyographic activity before and after the prosthetic treatment, the Wilcoxon matched-pairs signed rank was used. To determine the two-tailed p value at a significance level of 0.05, GraphPad Prism software version 5.0 was used.

Results

The Tables. II, III and IV present the mean amplitude of electromyographic signals picked- up from the investigated muscles of the lips in three conditions of registration. There was a significant difference between OOS and OOI activity before inserting dentures in all three conditions (p=0.0156). After the prosthesis insertion during sucking and whistling, a more pronounced activity of OOI was obvious. No statistically significant difference in the activity of the mentioned muscle groups before and after the insertion of the dentures, in the three recording conditions could be seen (Table I)

Table no. I. Differences in activity of both muscles in the three recording conditions before and after insertion of dentures (Wilcoxon matched-pairs signed rank test).

	Rest two-tailed p value	**Sucking two-tailed p value**	**Whistling two-tailed p value**
OOS 1 vs. OOS 2	0.9325	0.1563	0.8125
OOI 1 vs. OOI 2	0.4375	0.3750	0.0781

Table no. II. The mean amplitude of EMG signals (in microvolts) picked-up from the orbicularis oris muscle at rest (OOS = orbicularis oris superior, OOI =orbicularis oris inferior) before (1) and after (2) insertion of the dentures.

Patient	**OOS 1**	**OOI 1**	**OOS 2**	**00I 2**
D.J	1.2	3.3	1.4	2.3
E.S	4.6	7.6	2.8	1.9
M.I	3.6	4.8	2.6	6.0
M.T	3.0	4.3	3.8	3.5
T.A	2.8	4.0	3.1	4.3
C.L	2.2	3.8	2.8	3.8
Sz.A	3.4	4.4	4.0	3.9

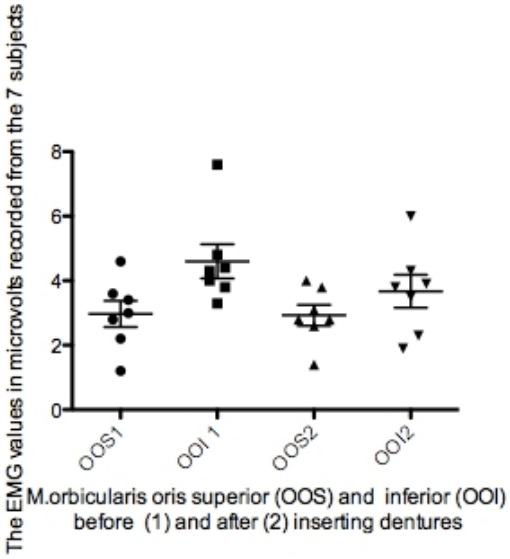

Fig. 5. Distribution of mean values of EMG signals at rest (95% CI)

Table no. III. Mean amplitude of m.orbicularis oris EMG signals (in microvolts) while sucking, before and after inserting dentures

Patient	**OOS1**	**OOI 1**	**OOS2**	**OOI 2**
D.J	22.2	77.3	20.3	51.9
E.S	39.7	68.4	37.0	66.8
M.I	53.0	88.0	44.1	51.4
M.T	38.4	62.3	22.2	50.6
T.A	42.4	78.8	38.0	66.2
C.L	38.2	65.3	44.0	77.1
Sz.A	28.9	60.4	26.0	74.3

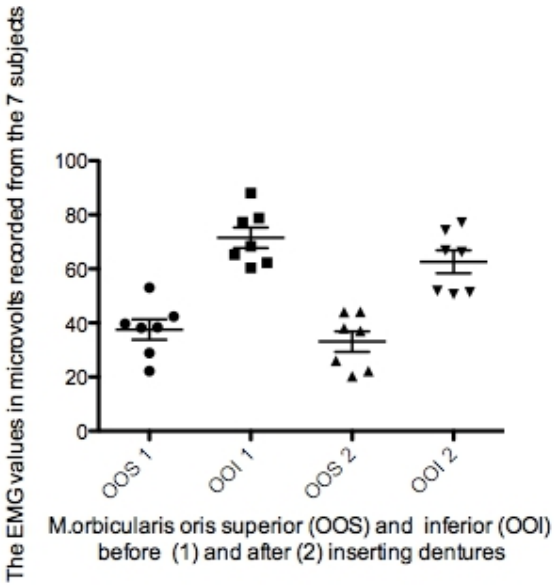

Fig.6. Distribution of EMG signals mean values during sucking (95% CI)

Table no. IV . The EMG signals mean amplitude (in microvolts) of orbicularis oris muscle while whistling, before and after inserting dentures

	OOS1	**OOI1**	**OOS2**	**OOI2**
Patient	17.6	60.1	11.0	35.2
E.S	34.4	82.7	41.9	82.6
M.I	37.2	45.0	43.0	53.9
M.T	49.0	61.6	45.3	50.6
T.A	22.7	61.2	20.2	56.3
C.L	36.4	82.0	34.0	70.0
Sz.A	33.0	72.2	38.0	62.8

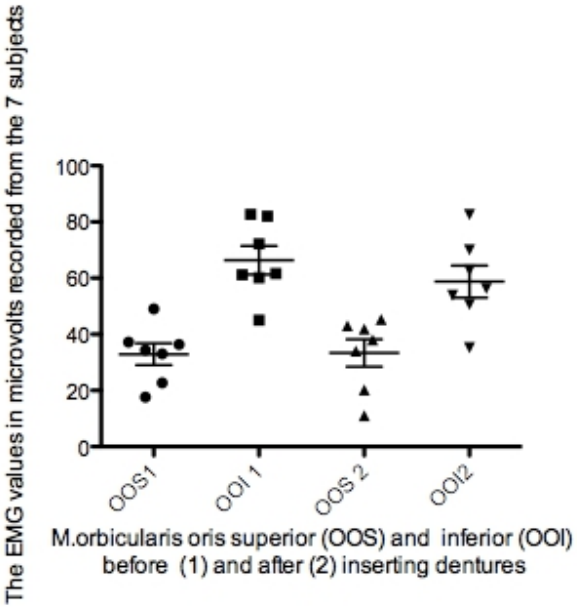

Fig. 7. Distribution of EMG signals mean values during whistling (95% CI)

Discussions

The orbicularis oris muscle is one which by its fiber orientation has a positive action to provide, the stability of the dentures. Placing the artificial teeth so as not to interfere with muscle activity and to enable the retention and stability action of the musculature, is a priority of the complete edentation treatment〔15, 16, 17〕. For this purpose various prosthetic techniques have been imagined〔18, 19, 20, 21〕. The tonicity of OO muscles can be assessed under different electromyographic examination. According to available literature, some studies have evaluated the electromyographic activity of the muscles during different syllables before and after insertion of dentures〔22〕. OOI muscle generally present higher mean values of electromyographic activity compared with those recorded in OOS, both before and after insertion of dentures. Electromyographic values were also higher after insertion of dentures. Redegard Ingervall〔23〕 and have published their research on the orbicularis oris muscles before and after insertion of dentures, but their electromyographic records were achieved in centric occlusion.

The present study used three conditions for electromyographic registration proper to OO muscles functionality (rest, sucking, whistling), two of which are well known functional movements to establish the prosthetic field limits and to place de anterior artificial teeth in the neutral zone. The results showing more elevated electromyographic activity in OOI compared

with OOS in all three conditions before prosthetic rehabilitation, as well as during the whistle and while sucking with the inserted dentures are consistent with those obtained in other functional conditions, earlier presented in this paper.

The BioEMG II device used in our study is specifically destinated to record the head and neck muscle activity and it is the only surface EMG system that is entirely gainless. In the available literature we found orthodontic studies using the BioEMG II electromyographic system for orbicularis oris muscles. Saccucci et al.〔24〕used the BioEMG II to assess the changes caused by the functional devices and found that they improved muscle contraction after treatment. The subject of the thesis developed by Daniela Maria Afonso Estavos 〔25〕in 2011 using BioEMG II electromyographic system was to establish the relationship between the OO muscles and the irregularities in the anterior mandibular arch. She concluded that electromyographic activity of the orbicularis oris muscles can not be related to irregularities in the mandibular arch, in either functional moments. This finding is consistent with those observed by us in complete edentation, the denture insertion actually represents a change in edentulous arch. Orbicularis oris muscle activity has undergone no significant change from the original condition after prosthetic therapy in any of the recorded conditions. The relatively few patients number, however, is a limitation of our study. We also believe that further late electromyographic evaluation after 6 months would be useful, when probably the patient adaptation to dentures may manifest as changes in muscle tone.

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- Conclusion: Within the limits of the present study, we conclude that in terms of EMG at rest as well as in functional moments of sucking or whistling there are no significant changes in OOI and OOS muscle tone , before and after conventional prosthetic treatment of complete edentation .

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