International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

The Evaluation of the Electrical Activity of the Chewing Muscles

Mimoza Canga MD, PhD[1], Vito Antonio Malagnino MD, DDS[2]

[1]University of Medicine Tirana, 9400 Albania

[2]Sapienza University of Rome, 00185 Italy

Abstract: ***The aim of the study was to evaluate the relation between the teeth occlusion and electrical activity of the chewing muscles. Materials and method: The analyzed sample included 40 adult healthy patients 20 males and 20 females 20-40 years old, mean age 30 years old. Results: We calculated the mean values of the number of teeth contact for each group. The first group had a contact number =241, the second group 126. Excluding the second molars, there was a uniform distribution in the posterior section. 20% of the contact of the first group and 24.6% of the second group were in the first molars, 22% and 19.8% respectively were in premolars. The POC was estimated for each patient. In the first group the mean values were: 86, 80 % for Temporal muscle, 84.7% for Masseter muscle, mean POC value was 85, 75%; 124, 3µV/µV.s % was the activity of Temporal muscle and 96, 4 µV/µV.s %was the activity of Masseter muscle, 109, 8µV/µV.s% mean activity. In the second group the mean values were85, 38% POC for Temporal muscle, 85, 85 % POC for Masseter muscle, 85, 61 % mean POC. 89, 20 µV/µV.s% was the value of activity of Temporal muscle, 74, 90 µV/µV.s% was the value of activity of masseter muscle and 82, 05 µV/µV.s% was the mean value of both muscles. Conclusions: The results of this study prove the sistematic influence of the occulsal contacts on the activity of the chewing muscles during contraction.***

Keywords: teeth occlusion, electrical activity, chewing muscles, Temporal muscle, Masseter muscle.

1. Introduction

There are two common types of electrodes used in the studies of muscle dynamics, the superficial and the needle electrodes. [3], [6], [12], [13], [16]. The needle electrodes are more superior compared to the superficial ones because they provide more detailed information on the function of all the motoric system: motoneuron, neuro-muscular system and the muscel itself. The distance between the muscle and the electrode is constant [2], [4], [7].However, the use of needle electrodes has the risk of the infection and in the same time they are painful too [8], [10]. Electromyogrammeis quantified from measuring the height of the activity potential and the frequency of the individual potential of the activity [15]-[17]. Superficial electromyography was used for the first time by Moyers. He noticed thay the normal ratio of teeth with each other is affected from the muscular balance [1], [11], [15]-[16].

2. Aim

To study the relation of teethocclussion and the electrical activity of the muscles in healthy individuals.

3. Material and Method

The analyzed sample included 40 adult healthy patients; 20 males and 20 females 20-40 years old, mean age 30 years old.The selection criteria was: the total dental formula up to the second permanent molars; first class Angle in the canine level and first permanent molars; the absence of anterior and lateral crossbites, overjet between ±2 and ±5mm, overbitebetween ±2 dhe±5mm, the absence of the signs or symptoms of disorders on the level of the temporo-mandibular joint (anoise or a click) or pain during palpation in the temporo-mandibular joint and the chewing muscles also.

Table 1: The distribution of the patients by age and gender during 2011-2013

Gender	Number	%
Male	20	50 %
Female	20	50 %
Age group		
20-30 years	15	37, 5 %
30-35 years	15	37, 5 %
35-40 years	10	25%

To reduce in maximum the skin injuries under the electrodes we treated the skin with alchool swabs before positioning them. Male patients were supposed to be shaved, females without any make up. In all patients we used the active catheter, bipolar electrodes with disposable 10 mm diameter surfaces and with adistance between the electrodes of 21±1 mm.The electrodes were positioned on two muscles: masseter and anterior temporal in this way: The masseter muscle: the muscle was palpated in order to avoid the inner part of the muscle, the electrode was positioned along the line that joins the outer ear up to the mandible angle. For the temporal muscle the operator palpated the muscle during the maximal contraction and separated the big axial of the zygomatic process of the frontal bone; the electrode was applied along the paralele line 2 cm behind the temporal process of the zygomatic bone. For the images we used the Bausch joint paper. The patient had the teeth partially closed in a way to let the operator perform the paper positioning process, which correlated to the occlusal surface of the teeth. The patient closed the teeth forcefully (MVC) ina way that the occlusal contacts were done with the oposite dental arch. This procedure was performed individually for each tooth along the upper arch starting to the element 17- 27.

Table 2: Analyzing of the oclussal contacts for all the patients in the study according to their respective teeth

1.7	4.7
1.6	4.6-4.7
1.5	4.5
1.4	4.5-4.4
1.3	4.3
2.1	3.1
2.3	3.3-3.4
2.5	3.5
2.6	3.6-3.7
2.7	3.7

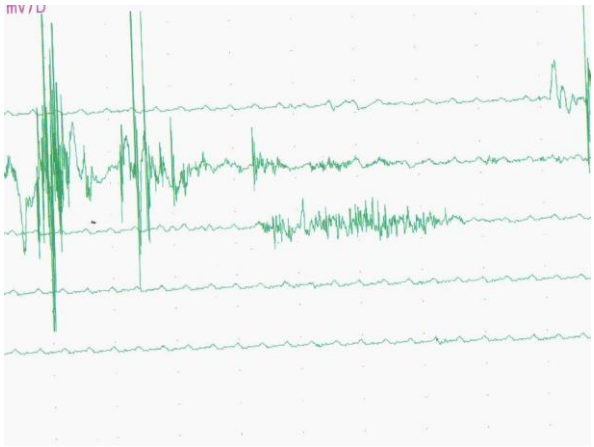

Figure 1: Patient: L. GJ The electromyographic potential in maximal contraction

Figure 2: Patient: M.F Theelectromiographic potential during relax

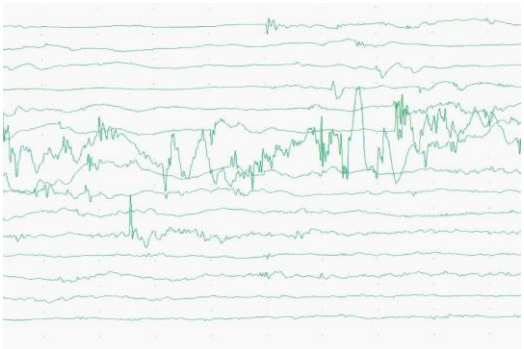

Figure 3: Patient: I.M. The graphic presentation of the muscle activity from the zone under the curbe of electric activity depending on the time, the width of the electrical signal (in percentage). In the abscise: time in seconds; in ordinates:µV/µV.s%.

4. Results

The recording results of tooth contacts were placed in such a way that the upper arch elements had one or more contact with the lower arch elements. The tests showed that some patients had a significant number of contacts, while some patients had a limited number of contacts of their teeth. The patient sample was divided into two groups, the patients whose contacts equal to 10 or greater were placed in the first group and patients with contact number less than 10 were placed in the second group. Were calculated the mean number of contacts for each group. The first group had a number of contacts of 241 while the second group had 126 contacts. Apart from the second molar, there was a uniform distribution in terms of the posterior section of the teeth. 20% of the contacts of the first group and 24.6% of the contacts of the second group were on the first molar, 22% of the contacts of the first group and 19.8% of the contacts of the second group were on the premolars. Regarding the frontal teeth there was a discrepancy in the distribution of dental contacts: in canine and incisives in the first group showed 10% and 10.5% ofdental contacts, while in the second group only 4.68% of contacts were on the canines and 2.34% of contacts in incisive teeth. POC was calculated for each patient.In the first group the mean values were: 86.80% for the temporal muscle and 84.70% for the masseter muscle, the mean value of POC was 85.75%, 124, 3µV / µV. s% was the activity of the temporal muscle and 96.4 µV / µV.s% was the activity of themaseter muscle, 109, 8µV / µV. S % is the mean activity. In the second group the mean values were 85.38% for temporal muscle POC; 85.85% masseter muscle POC; 85.61% mean POC. 89.20 µV / µV.s% was the activity of the temporal muscle, 74.90 µV / µV.s% was the activity of the masseter muscle and 82.05 µV / µV.s% is the mean activity value for both muscles.

5. Discussion

This study evaluated the electrical activity of the chewing muscles and the number of contacts between opositearches in healthy adults with normal occlusion Class I Angle of the molars and bilateral canine. The distribution of teeth contacts was uniform in both groups. Contacts donepresented these frequencies: at the level of the molars 90.75% of themolars in the first group and 88.54% of the molars of the second group have at least one contact, in the level of premolars 85.32% of first premolarsand second premolarsof the second group and 70.73% of first premolarsand second premolars of the second group, in the level of canine 55.30% of the contacts of the first group and 13.50% in the second group, in the incisives level were observed 30.25% of the contacts in the first group and 4% in the second group. In the first group were noticed three molars without any contact (6%), while in the second group eight molars have no contact with any element (11%), in complex these percentages are consistent with the literature, while in the second group the percentage of 27% is higher. The first group of analyzed patients in this study presented symmetry index values between 80% and 90%, while the second group represented symmetry index values between 70% and 90%, in both groups the muscles represent a satisfactory degree of the muscular symmetry.

Table 3: The occlusogramme of the patients who have a higher than 10 contact number

Patients	17	16	15	14	13	12	11	21	22	23	24	25	26	27
1°	47	47 46	45	45 44	43			31		33 34		35	36 37	37
1b	47	46	45	44	43	42	41	31 32			34			37
1c	47	47 46	46	45	44						35	35 36	37	37
1d	47	46			43		42 41			33 34	34		36	37
1e	47	47 46	46 45	44	43		41	41	33	34	34 35	35 36	36	37
1f	47		45	44	44 43	42	41	31 32	32		34		36	37
1g	47	47 46	45	45 44	44 43					33	34 35	35	36	37
1h	47	46	46 45			43	41	32			34 35	35 36	36 37	37
1i	47	47 46	46 45	45 44	44						34 35	35 36	36	37
1j	47	47 46	46 45	44	43	43	41			33	34 35	35 36	36	37
1k		46	45	45 44							34 35	35 36	36	37
1l	47	47 46	46 45	45	43	43	41	33		33	34	35	36	37
1m	47	47 46	46 45								34 35	35 36	36	37
1n	47	47 46	46 45	46 45	43			32		33	34 35	35 36	36	37
1r	47	47 46	46 45	46 45	43						34 35	35 36	36	37
1p	47	47 46	46 45	46 45	43						34 35	35 36	36	37
1q	47	47 46	46 45	46 45							34 35	35 36	36	37
1z	47	47 46	46 45	46 45	43						34 35	35 36	36	37

Table 4: The occlusogramme of the patients who have a lower than 10 contact number

Patients	17	16	15	14	13	12	11	21	22	23	24	25	26	27
2°		46	45								34	36	36	37
2b	47		45	44							34	35	36	37
2c	47	46 47	45	44							34		36	37
2d	47	46	45				41					35		37
2e	47	46		44							34		36	37
2f	47		45	44							34	35	36	37
2g	47		45	44						33	34	36		37
2h	47	46		44	43	42					34		36	37
2i	47	46											36	37
2j	47	46	45	44	43						34	35	36	37
2k	47	46											36	37
2l	47	47	45	45	43			33		33	34	35	36	37
2m		47	45								34	35	36	37
2n	47	47	45	46						33	34	35	36	37
2r	47	46		46							34	35	36	37
2p	47	47	45	45							34	35	36	37
2q	47	46	45	45							34	35	36	37
2z	47		45	45									36	37

Table 5: The presentation of the teeth contacts according to the patients' groups

	17	16	15	14	13	12	11	21	22	23	24	25	26	27	Total
Gr I	17	30	28	24	16	5	8	9	2	9	29	27	19	18	241
Gr II	16	15	13	13	3	1	1	1	0	3	14	12	16	18	126

Table 6: The distribution of the teeth contact number on each element for both groups

	Group I	Group II
Second molars	35	34
First molars	49	31
First premolars	55	25
Second premolars	53	27
Canines	25	24
Incisives	24	3

Table 7: The distribution in percentage of the number of teeth contacts on each dental element

	Group I	Group II
Second molars	14%	26.5%
First molars	20%	24, 6%
First premolars	22%	19, 8%
Second premolars	21%	21, 4%
Canines	10%	4.68%
Incisives	10.5%	2.34%

Table 8: Masseter muscle POC (MM) and temporal muscle POC (TA), mean POC in the group of patients with teeth contacts equal or higher than 10 (values are in percentages)

Patients	POC MT	POC MM	MEAN POC
1°	82, 04	86, 63	84, 33
1b	85, 85	77, 81	81, 83
1c	87, 77	86, 51	87, 14
1d	89, 38	90, 04	89, 71
1e	85, 86	80, 31	83, 08
1f	85, 63	85, 01	85, 32
1g	90, 08	86, 52	88, 30
1h	89, 44	87, 31	88, 37
1i	80, 41	81, 42	80, 91
1j	87, 14	87, 11	87, 12
1k	87, 89	85, 99	86, 94
1l	83, 71	81, 01	82, 36
1m	85, 95	80, 32	83, 13
1n	89, 36	87, 77	88, 56
1r	90, 07	87, 07	88, 57
1p	87, 71	84, 47	86, 09
1q	84, 04	79, 99	82, 01
1z	90, 07	89, 09	89, 58
Mean	86, 80	84, 70	85, 75
DS	3, 1	3, 5	3.3

Table 9: POC for the Masseter and Temporal muscles, mean POC in the group of the patients with teeth contact number lower than 10

Patients	POC MT	POC MM	Mean POC
2°	81.09	88.73	84.91
2b	86.95	78.01	82.48
2c	88.79	88.04	88.41
2d	89.01	90.01	89.51
2e	84.95	81.42	83.18
2f	85.83	85.99	85.91
2g	89.01	88.52	88.76
2h	88.77	88.41	88.59
2i	80.45	84.78	82.61
2j	87.16	87.34	87.25
2k	88.89	86.22	87.55
2l	83.64	84.39	84.01
2m	84.86	86.69	85.77
2n	80.89	88.31	84.60
2r	84.62	85.35	84.98
2p	87.88	86.32	87.10
2q	83.72	84.49	84.10
2z	80.42	82.39	81.40
Mean	85.38	85.85	85.61
DS	3, 1	5, 7	4.4

Table 10: The activity of the Masseter muscle (MM) and Temporal muscle (TA), mean values of the muscle activity in the group of patients with teeth contact number equal or higher than 10, values expressed in µV/µV%

Patients	ActivityTA	Activity MM	Meanactivity
1a	186, 4	146, 1	166, 2
1b	168, 9	151, 0	159, 9
1c	121, 2	116, 2	118, 7
1d	132, 8	128, 2	130, 5
1e	96, 9	42, 7	69, 8
1f	126, 7	99, 8	113, 2
1g	100, 6	104, 1	102, 3
1h	127, 6	121, 1	124, 3
1i	161, 6	98, 6	130, 1
1j	88, 1	67, 8	77, 9
1k	103, 6	114, 0	108, 8
1l	146, 5	151, 2	148, 8
1m	111, 2	102, 8	107, 0
1n	162, 4	99, 7	131, 0
1r	96, 4	43, 7	70, 0
1p	97, 9	58, 7	78, 3
1q	104, 2	101, 7	102, 9
1z	107, 0	103, 5	105, 2
Mean	124, 3	96, 4	109, 8
DS	30, 03	33, 51	31, 77

Table 11: The activity values for the Masseter muscle (MM) and temporal muscle (TA), the mean values of the activity in the group of patients qith teeth contact number equal or lower than 10 (Values are expressed in µV/µV%)

Patients	Activity TA	Activity MM	Mean activity
2a	91, 1	80, 2	85, 6
2b	84, 9	58, 7	71, 8
2c	114, 8	96, 7	105, 7
2d	81, 3	26, 2	53, 7
2e	106, 4	84, 1	95, 2
2f	106, 2	104, 8	105, 5
2g	96, 7	98, 1	97, 4
2h	86, 6	81, 2	83, 9
2i	56, 8	63, 8	60, 3
2j	84, 9	61, 4	73, 1
2k	82, 8	59, 1	70, 9
2l	84, 4	74, 4	79, 4
2m	92, 8	84, 0	88, 4
2n	104, 1	97, 1	100, 6
2r	89, 9	78, 4	84, 1
2p	56, 8	61, 0	58, 9
2q	89, 9	61, 4	75, 6
2z	94, 7	76, 1	85, 4
Mean	89, 2	74, 9	82, 05
DS	16, 8	24, 1	20.45

6. Conclusions

The results of this study performed in healthy patients with natural teeth prove the systematic influence of the occlusal

contact on the activity of the chewing muscles during contraction.

References

[1] Anderson G.C., Schulte J.K et al.”Reability of the evalution of occlusal contacts in the intercuspalposition”.JProsthet Dent 1993. 70:320-323.
[2] Athanasio P.O., et.”Occlusal tooth contact in natural normal adult dentition in centric occlusion studied by photocclusion technique.Scand”.J Dent Res 1989, 97: 439-445.
[3] Armijo-Olivo S, Gadotti I, Kornerup M, Lagravère MO, Flores-Mir C.”Quality of reporting masticatorymuscleelectromyographyin2004:asystematic review”.JOralRehabil. 2007; 34:397-405.
[4] Bakke M., ET.”Clinicalsignificante of isometric bite force versus electrical activity in temporal and masseter muscles”.Scand.J Dent Res 1989, 97539-551.
[5] Bakke.M. Michler L., et al.”Occlusal control of mandibular elevator muscles”.Scand J Dent Res 1992. 100:284-291.
[6] BazzottiL.”Electromyographytensionandfrequencyspectrumanalysisatrestofsome masticatorymuscles, beforeandafterTENS”.Electromyographyandclinical neurophysiology. 1997 Sep; 37(6):365-78.
[7] Bossy J.”Bases morphology des fonctionssensitives et sensorielles.In : Bossy J.(ED), neuro-anatomie.Collectionanatomie”Clinique.Springer – Verlag, Paris, pp410-412, 1990.
[8] Cavazzuti PP, Monzani D, et al.”Equitest Dans evaluation des troubles cranio-mandibulares –in posture et equilibre su la direction”de Lacour M. –Solal ed.marseille 2002.Nazionale AIPP Firenze, 27-28 novembre 2003.
[9] Castroflorio T, Icardi K, Torsello F, Deregibus A, Debernardi C, Bracco P.”Reproducibility ofsurfaceEMG in thehuman masseterand anterior temporalismuscle areas”.Cranio.2005 Apr; 23(2):130-7.
[10] Chan HJ, Woods M, Stella D.”Mandibular muscle morphology in children with different vertical facial patterns. A 3 – dimensional computed tomography study”. Am J OrthodDentofacialOrfhop. 2008:133:10.e1-10.e13
[11] Charalampidou M, Kjellberg H, Georgiakaki l. Kiliaridis S.” Masseter muscle thickness and mechanical advantage in relation to vertical craniofacial morphology in children”. ActaOdontal Scand. 2008; 66:23-30
[12] ElFalouW, DucheneJ, HewsonD, KhalilM, GrabischM, LinoF.”Asegmentation approach to long duration surface EMG recordings”. J Electromyogr Kinesiol. 2005; 15:111-119.
[13] Ferrario V.F. “Aggiornamenti sulle basi biologiche e sugli aspetti clinici dell ATM. In: Progressi in odontoiatria”. Utet, Torino, 1988; 4: 101-150.
[14] Ferrario V.F.”Sforza.C. An electromyographic investigation of masticatory muscles symmetry in normo-occlusion subjects”. J Oral Rehabil 2000; 27: 33-40.
[15] Ferrario V.F., Sforza.C.”Relationship between the number of occlusal contacts and masticatory muscle activity in healthy young adults”. Cranio 2002; 20:91-8.
[16] Ferrario V.F., Sforza.C.”Maximal bite forces in healthy young adults as predicted by surface electromiographicy”. J Dent 2004; 32: 451-57
[17] Okano N, Baba K, Igarashi Y.”Influence of altered occlusal guidance on masticatory muscle activity during clenching”. J Oral Rehabil. 2007; 34:679-684.
[18] Ogawa T, Koyano K, ET al.”Characteristics of masticatory movement in relation to inclination of occlusal plane”. J Oral Rehabil 1997; 24:652-7.