FIXED PROSTHODONTIC TREATMENT AND MASTICATORY MUSCLES FEEDBACK

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ABSTRACT

INTRODUCTION

Fixed prostheses represents a mechanical structure which not only makes anatomic replacement of missing teeth, but at the same time respect the physiological functions and harmonized with all the elements of the masticatory system.The aim of this study was to assess changes on the EMG values of masticatory muscles, masseter and temporalis three months after rehabilitation of missing teeth with fixed prosthodontics prostheses.

METHODS

The study involved 40 patients aged 20 to 59 years which we have treated according to following protocol:a) Anatomic and Functional examination of dental occlusion and electromyographic examination of masticatory muscles masseter and anterior temporal; b) Prosthetic rehabilitation of dental defects with fixed dental bridge; c) Three months after prosthetic rehabilitation we re-evaluated electromyographic examination of masticatory muscles.

RESULTS

There were a significant correlation between the number of missing teeth, occlusal interferences, and electromyographic values of masticatory muscles.There were significant differences among electromyographic values before and after prosthetic rehabilitation.

CONCLUSION

We thus conclude that among limited unilateral defects on dental arches there is place for prosthetic treatment of the occlusion as prophylactic treatment for muscular activity.

Key Words: Electromyography, occlusal interference, masticatory muscle, fixed dental rehabilitation.

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INTRODUCTION

" Even the whitest of teeth are no good whatsoever if you cannot chew with them ." Aristophanes, Greek philosopher.

We live in a social world and the way we look has a strong impact on relationships with the others . Facial appearance and smile have an important role on the implementation and maintenance of a normal pattern of behavior with a strong emotional sense.The view of the face has become a symbol which represent the individual person , while the smile is considered as a window to the personality of the person. Teeth plays an important role in feeling comfortable not only in relation to ourselves but also in relation to others. Tooth loss not only affects the functional integrity and aesthetic of the masticatory system , but at the same time is accompanied by psycho-emotional discomfort feeling of the person. The emotional individual's need to feel beautiful is not characteristic only of the modern trend of our time , but has roots on the birth of humanity. Were Etruscans in 630 year b.c that documented this ancient trend on building humanity 's first dental prosthesis for the replacement of missing teeth.It's very interesting fact,that at the Etruscan's time ,the dental prostheses were held only by female patients , which appeared to be more concerned about the aesthetic view. Nowadays the susceptibility of people related to tooth loss has changed, and their demands are not only aesthetic but primarily functional.In daily practice the majority of our patients aren't aware about the occlusal problems that they carry on. Anatomic examination reveals an irregular occlusal relief ,which may not interact in harmony with other component of masticatory system as TMJs , masticatory muscles ,periodontal ligaments, etc.This situation is certainly worse with the loss of teeth and of course with the installation of occlusal deflective contacts. Over 50 % of teeth which do not have contact with their antagonist teeth are involved in occlusal interferences [1].

These occlusal interferences are capable to induce damaging incentives to inhibit normal muscle function and of course to damage the relationship between the mandible and the skull [2 , 3,4]. Occlusal interferences caused by malposition of the crown of the tooth promote a sensory impulse initiated by periodontal receptors which are the first one to detect the occlusal interferences , and helped by all proprioceptors of stomatognathic system to inform the CNS for the disturbing element[4].Consequently,the mandibular movement pattern is modified aiming to avoid the occlusal interferences ,with a displacement of the mandible and dislocation of the condylar process [5,6] leading inexorably to the hyperactivity of masticatory muscles . Hypertonicity of masticatory muscles [7,8] is caused from the duration in time of functional loads ,and this hypertonicity is capable to cause structural damage [9 ,10] and syndrome trigger points [11] .

On the other side of the mandible shift creates opportunities for the emergence of new occlusal interferences , which will

cause other changes related to occlusal contacts and the pattern movement of the mandible to reach the maximum intercuspation position (PIM)[4].

Neuromuscular system with time can lose the ability of suitability and patient will suffer symptoms of temporomandibular disorders [3, 4 ,5 ,6,12] . It is very important the determination and avoidance of the occlusal interferences, which disturbs the pattern movement of the front side of the mandible and will inhibit the retrusion movement , which is a very important physiological movement of the mandible during chewing and swallowing. Nowadays, we have a very wide range of types of prosthetic reconstruction for replacement of dental defects ranging from the simplest to the most complexes. Certainly, the dentist must be careful in determining of the specific diagnosis for every single case. Fundamental importance in the life of any prosthetics reconstruction is the interaction between biological / anatomical component of masticatory system and prosthetic component of reconstruction.

So , we have to make fixed prosthetic reconstruction which not only should avoid to trigger the receptorialsystem of all elements of the masticatory system , but at the same time to be able to regulate and modulate thiscomplex receptorial system nearest as possible to the standards of " biological harmonization ".The aim of this study was to assess changes on the EMG values of masticatory muscles, masseter and temporalis three months after rehabilitation of missing teeth with fixed prosthodontics.

MATERIAL AND METHOD

The study involved 40 patients aged 20 to 59 years old. The patient came in dental clinic with the main complain of application of fixed dental prosthesis.

INCLUSION CRITERIA:

1.Subject with limited defects on dental arches (III and IV Class of Kennedy).

2.Subject with natural dental arches without any prosthodon tic reconstruction.

EXCLUSION CRITERIA:

1.To test subjects that do not have history of temporo mandibu lar disorders

2.To test subjects had not undergone any orthodontic treat ment.

From every subject enrolled in this study a written informed consent was obtained. Clinical examination and prosthodontic reconstruction were performed for every patient by a single dentist examiner, meanwhile the EMG examination before and after reconstruction were performed by a single neurophysiologist. All EMG examination before and three months after reconstruction were performed at the same chronologic time (9 a.m -10 a.m).

The study were conducted according the following protocol:

1. Clinical examination of subjects and EMG examination of masseter and temporalis anterior muscles.
2. Oral rehabilitation with fixed prosthodontic reconstruction (Fig.1).

Fig.1: The Prosthodontic Reconstruction with fixed Rehabilitation

3. EMG examination of masseter and temporalis anterior muscles three months after prosthodontic rehabilitation (Fig.2).

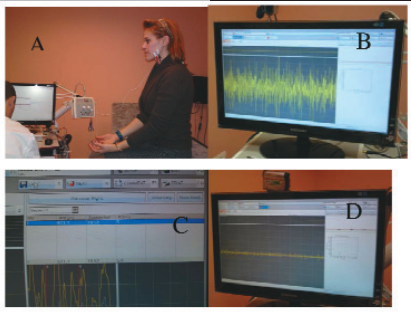


Fig.2: The Electromyographic Examination

Electromyographic activity was recorded by surface electrodes over anterior temporalis and masseter muscles of each sides in maximum voluntary clenching on teeth.

The International Society of Electrophysiology and Kinesiology (ISEK) has established standardized guidelines for electromyography evaluations.

Electromyographic Equipment: Recordings are made on 4 channels of simultaneous EMG signal (Neurowerk system).

Positioning of the Patient: During the whole EMG examination, the volunteers sit relaxed and upright in a straight-back chair without head support, with the Frankfurt occlusal plane parallel to the floor. They keep their eyes opened and arms on their legs.

Electrodes: We used skin surface active electrodes (Neurowerk disposible electrodes 32KE13.) with a contact diameter of 10 x 2 mm, parallel bars of pure silver (Ag), spaced 10 mm apart and fixed to acrylic resin of 20x 20mm.

Electrode Placement Procedures :The electrode placement were conducted according to the positioning criteria described by Cram and Kasman(Cram JR, Kasman GS).

RESULTS:

Table nr 1: *The dates of subjects enrolled in this study*

The code of the patient	Age	Gender	Defect	Missing teeth
1	30	M	Bilateral	14;15;25
2	32	M	Bilateral	16;22;36
3	20	F	Unilateral	46
4	34	F	Bilateral	44;37
5	28	M	Unilateral	15
6	31	F	Bilateral	14;15;16;22;23;24;26;35;36;44;46
7	45	M	Unilateral	35
8	29	F	Bilateral	15;36;46
9	25	M	Bilateral	16;26
10	29	F	Unilateral	46
11	37	M	Bilateral	16;25;36;46
12	32	M	Bilateral	36;46
13	37	F	Unilateral	25;26
14	41	F	Bilateral	12;13;14;16;22;23;25;26;36;46
15	56	F	Bilateral	15;16;25;26;35;36
16	45	F	Unilateral	11;12;13
17	57	F	Bilateral	36;37;44;46;47
18	49	M	Bilateral	36;46;47
19	30	F	Bilateral	25;36;45
20	46	M	Bilateral	13;35;36;46
21	39	M	Bilateral	36;46
22	42	F	Bilateral	15;16;24;35
23	53	M	Bilateral	15;16;24;25;46
24	58	M	Bilateral	16;24;25;36;44
25	36	F	Bilateral	15;16;23;24;26;35;45
26	54	M	Bilateral	14;15;16;25;27;36;37;45;46
27	41	M	Bilateral	14;16;24;25
28	58	F	Bilateral	16;36;37;46;47
29	37	M	Bilateral	24;25;36;46;47
30	34	M	Bilateral	16;17;25;26;36;45;46
31	45	M	Bilateral	16;24;26;36
32	40	F	Bilateral	36;45;46
33	59	M	Bilateral	14;16;23;24;36;37;45;47
34	48	F	Bilateral	13;26;45;46
35	35	F	Bilateral	36;47
36	33	M	Bilateral	36;47
37	31	F	Bilateral	36;46
38	36	F	Bilateral	35;36;46;47
39	57	M	Bilateral	15;36;45;46;47
40	52	M	Bilateral	14;16;24;26

RESULTS

Statistical Index:

The three statistical index are calculated according to formulas described by Naeije, et al.,[13].

1.Muscular Asymmetry Index: AI

In order to quantify asymmetrical masticatory muscle activity, the asymmetry index described by was calculated for each subject and for each muscle from the averaged masseter and temporalis anterior potentials during mandibular postural position:

AIM = (MMl - MMr) / (MMr + MMl) %

AI TA = (TAr - TAl) / (TAr + TAl) %

AI Tot = (MMr + TAr - MMl - TAl) / (MMr + TAr + MMl + TAl) %

Asymmetry indices ranged from -100% to +100%, where a negative number indicates a left-side muscle dominance and a positive number a right-side one.

2.Activity Index: AcI

The relative contributionof masseter and temporalis anterior muscles was compared using the activity index ,this index was calculated from the averaged potentials recorded during each test:

AcITot = (MMr + MMl - TAr - TAl) / (MMr + TAr + MMl + TAl) %

Activity indices also ranged from -100% to +100%,where a negative number indicates a prevalent temporalis anterior activity and a positive number a prevalent masseter activity.

3.Torque Index: ToI

A torque index was calculated from the EMG averaged potentials to assess if there was a latero deviation effect on the mandible resulting from the forces produced by the TA muscle of one side and contralateral MM muscle, i.e., right TA and left MM (right side couple), left TA and right MM (left side couple). As a result of the TA on one side being directed upward and backward, and the result of the contralateral MM being directed upward and onward, a force couple is produced which may deviate the jaw on the TA side.Physiologically, the couple is counter balanced by an analogous couple generated on the other side, otherwise, a mandibular rotation on the horizontal plane will take place. In order to evaluate the presence of a resultant couple, a torque index (ToI) was calculated from the EMG averaged potentials recorded during each test:

ToITot =(TAR +MML -TAL -MMR)/(TAR +MML +TAL +MMR)%

This index is mathematically similar to the activity and asymmetry ones, ranging from -100% to +100%; positive values indicate a stronger right side couple, negative values a stronger left side one. Means and standard deviations were calculated for the values of asymmetry, activity and torque indices, considering the positive and negative values separately. Means and standard deviations were also calculated for EMG potentials in each group .

Statistical Tests:

1. Chi Square test
2. Non-parametric test of Mann-Whitney.
3. Wilcoxon test
4. Student T Test
5. The Correlation Coefficient of Pearson & Spearman

Tabla nr2:*The dates offunctional examination of occlusion*

The code of the patient	K.E	I.P prot	I.B prot	I.P lat	I.B lat
1		32		16	24
2				45	26
3				16	
4				14	27
5				16	
6	17		25	17	
7					15
8			38;47	47	
9		22	25	22	
10					47
11					26;47
12					37;47
13	24				36
14				27	45
15				17;27	14
16	14		16		
17				38;48	44
18				37;48	37
19				46;44	
20				34	37
21					47
22					17
23				17;47	26
24				16	16
25				17;46;36	36;46
26				17;47;28;38	28;38
27				35	15
28				38	16
29				48	
30				18;48;27;37	
31					25;27
32				37	47
33				48;38	48
34				44	
35					37
36				48	
37					37
38				16;37	
39				48	
40				15;25	

Table nr 3: *The values ofEMG examination of masticatory muscles before and after prosthodonticrehabiliatation*

The code of the patient	MR1	ML1	TR1	TL1	MR2	ML2	TR2	TL2
1	531,75	422,41	813,24	839,21	547,12	470,21	824,43	850,75
2	412,49	471,75	800,03	804,89	490,76	500,34	801,95	860,73
3	456,92	494,31	719,96	802,58	512,39	540,89	758,34	886,21
4	405,24	391,87	599,87	603,45	390,87	400,17	604,59	704,35
5	511,10	472,39	608.73	678,55	578,04	498,67	650,23	768,49
6	407,33	402,82	701,21	743,01	478,31	465,95	753,90	802,79
7	509,11	403,21	608,34	610,32	535,25	465,53	636,71	695,16
8	486,68	409,86	704,70	597,98	497,92	453,31	690,37	653,98
9	273,86	359,76	507,12	507,00	378,53	451,16	570,68	591,84
10	375,42	383,19	504,07	505,32	429,38	401,59	542,83	579,31
11	536,12	479,45	698,54	650,13	560,13	503,47	710,12	707,19
12	403,29	435,17	693,54	660,34	425,74	470,00	704,76	713,63
13	390,69	397,31	587,12	600,12	412,12	412,85	630,41	687,36
14	307,84	291,78	599,36	653,00	361,30	300,43	625,83	697,41
15	401,86	367,29	604,34	578,92	418,26	350,47	621,65	658,43
16	499,80	484,73	609,38	586,26	520,39	497,85	632,34	659,86
17	375,42	383,19	657,51	660,85	400,12	402,45	698,67	700,64
18	385,29	376,54	598,86	570,58	407,16	398,78	629,45	630,73
19	521,17	479,32	790,48	790,14	540,86	503,12	810,23	849,96
20	443,36	421,19	701,36	720,61	402,15	460,47	745,39	786,49
21	407,71	420,63	689,64	658,53	410,24	453,86	720,43	660,73
22	371,83	392,07	568,91	587,74	390,16	407,60	610,61	631,11
23	271,26	297,13	482,53	503,48	305,18	350,16	549,05	583,85
24	337,31	331,77	578,45	540,81	350,65	375,34	636.84	599,78
25	354,79	372,03	506,97	578,32	375,73	380,49	569,71	631,26
26	304,39	299,96	498,78	555,48	300,25	320,75	547,83	591,71
27	402,34	418,79	568,31	510,34	390,36	454,72	604,52	585,27
28	401,12	474,38	609,37	659,46	390,56	500,31	640,14	607,15
29	399,12	422,52	589,45	561,94	408,51	469,39	653,70	611,49
30	372,34	384,29	567,57	549,81	430,32	406,12	600,75	599,68
31	309,21	299,87	603,35	643,71	380,51	354,62	640,79	703,51
32	398,39	407,95	587,37	539,79	470,43	451,96	678,90	610,83
33	368,56	324,39	609,84	580,43	401,91	305,31	670,76	640,73
34	319,08	346,09	645,38	702,55	398,56	372,58	709,54	785,39
35	479,42	384,21	679,48	718,36	500,34	401,26	765,82	793,85
36	554,00	446,09	616,39	706,07	587,27	489,19	697,39	780,27
37	486,68	409,86	522,48	489,56	507,53	425,53	587,48	586,41
38	312,39	309,24	486,59	573,69	376,40	335,73	560,32	608,36
39	229,14	284,28	479,34	438,49	298,08	302,54	547,48	529,41
40	407,95	384,29	504,12	562,61	457,20	402,43	596,28	604,39

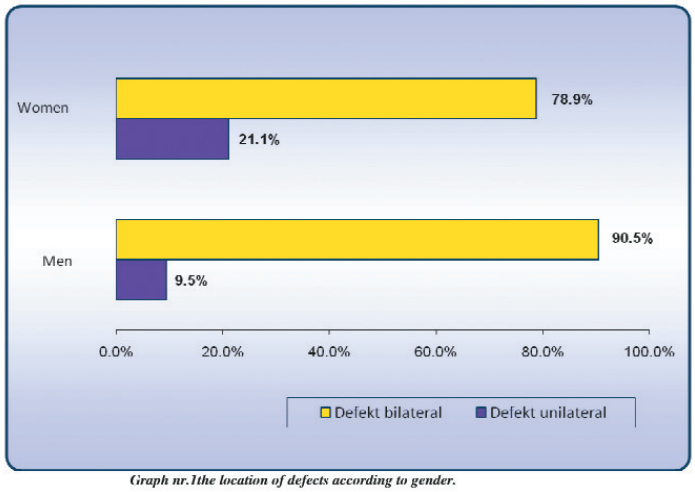
Variable	Number	Percentuage
Gender:		
Men	21	52.5
Woamn	19	47.5
Age: (Mean ± SD)	40.5 ± 10.5	
Group-age:		
20-34 years	14	35.0
35-45 years	14	35.0
≥ 46 years	12	30.0

Table 4. Socio-demographic characteristicof the subjects (N=40).

DISCUSSION

From Table nr..4 is easily noticed that the participants are almost at the same percentuage from the two genders , this is because:

1. Our study is not focused on a specific gender.
2. The subject are referred to the dental clinic with the mean request the prosthodontic rehabilitation of the dental defects.



Graph nr.1the location of defects according to gender.

From the Graph nr.1 we can notice that 21,1% of women had unilateral defect,meawhile unilateral defect at men is at 9,5%. Bilateral defects are referred at 78,9% of women and 90,5% of men.

Table.5:Electric muscular activity for men and women at the first examination. Mean Value and Standard Deviation.

Variable	Mean value of muscular activity ± Standard deviation		
	Total (N=40)	Men (n=21)	Woman (n=19)
Right Masseterbefore rehabilitation	403.0 (79.5)	398.6 (92.5)	408.0 (64.5)
Left Masseterbefore rehabilitation	393.4 (58.1)	388.4 (61.9)	399.0 (54.7)
RightTemporalis before rehabilitation	612.6 (87.3)	610.4 (94.8)	615.0 (80.8)
Left Temporalisbefore rehabilitation	620.6 (94.6)	612.1 (101.0)	630.1 (88.8)

Table.6:Electric muscular activity for men and women three months after rehabilitation. Mean Value and Standard Deviation.

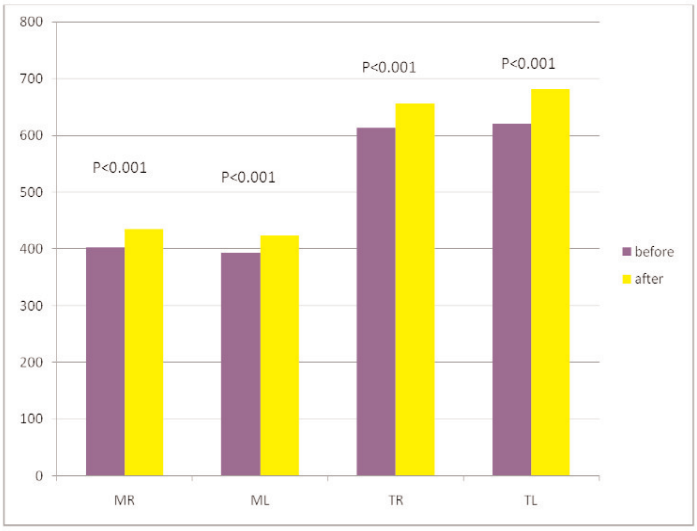
Variable	Mean value of muscular activity ± Standard deviation		
	Total (N=40)	Men (n=21)	Woman (n=19)
Right Masseterafter rehabilitation	435.4 (75.4)	430.7 (89.0)	440.6 (58.8)
Left Masseterafter rehabilitation	422.7 (63.5)	423.9 (66.1)	421.3 (62.3)
Right Temporalisafter rehabilitation	655.8 (76.3)	654.3 (78.2)	657.5 (76.2)
Left Temporalisafter rehabilitation	680.8 (92.0)	671.2 (93.9)	691.3 (91.3)

Table.7: The Bivariate Correlation between the number of missing teeth and muscular activity. Coeficient of Correlation of Spearman.

MR1	TR1	ML1	TL1
-0.530*	-0.233	-0.476*	-0.202

*** The correlation are significant at the level <0.01**

It can be noticed that the correlation between the number of missing teeth and muscular activity is negative, so with the increase of number of missing teeth is noticed the decrease of muscular activity. The correlation is statisticly significant.



Graph nr.2:Electric activity of masseter and temporalis anterior muscles before and after prosthodontic reconstruction.

At Graph nr.2 is noticed that electric activity of masticatory muscles was improved three months after prosthodontic reconstruction, increasing the mean values of electric potentiales (μV). These changes are statisticaly significant because the value of P <0.001.

Table.8:The bivariate correlation between muscularasymmetry index AI M, AI TA and AI total with the number of missing teeth. The Coefficient of Correlation Spearman.

Factor	AI M Before	AI TA Before	AI Total Before
The number of missing teeth	0.232	0.344*	0.192

*** The correlation aresignificant at the level<0.01**

At Table nr.8 is noticed that, before rehabilitation, with the increase of number of missing teeth, the absolute value of indexes AI M, AI TA and AI Total is increased, indicatingdeterioration of the situation.

Table.9:The bivariate correlation between muscular activity index ACI total with the number of missing teeth. The Coefficient of Correlation Spearman.

Factor	ACI Tot Before
The number of missing teeth	0.432

*** The correlation aresignificant at the level<0.01**

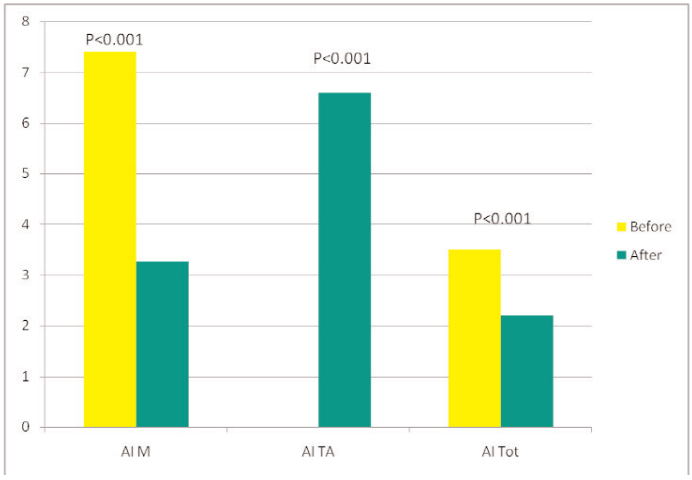
At Table nr.9 is noticed that, before rehabilitation, with the increase of number of missing teeth, the absolute value of indexes ACI Tot is increasing,indicating deteriorationof the situation.

Table.10:The bivariate correlation between torque index ToI total with the number of missing teeth. The Coefficient of Correlation Spearman.

Factor	ToI Tot Before
The number of missing teeth	-0.002

*** The correlation aresignificant at the level<0.01**

At Table nr.10 is noticed that, before rehabilitation, with the increase of number of missing teeth, the absolute value of indexes ToI is decreasing, indicating deteriorationof the situation.



Graph nr.3: The changes on average value of the asymmetry index before and after prosthodontic reconstruction.

At Graph nr.3 we see that the average value of the asymmetry index for masseter, temporalis muscles and total asymmetry index approaches to the 0 value,so the activation between muscles is done more symmetric (as asymmetry index of 0 means absolute symmetry). This difference is statistically significant because the value of P <0.001 (by T Test).

Table. 11. Index of muscular activity total (AcI Tot), before rehabilitation and 3 months after according to the gender. Average Values and Standard Deviation.

Variable	Average values ± standard deviation		
	Total (N=40)	Men(n=21)	woman (n=19)
AcI Total before rehabilitation	21.75 (6.34)	21.90 (6.22)	15.34 (5.03)
AcITotalafter rehabilitation	15.14 (5.01)	21.58 (6.62)	14.92 (5.12)

From Table nr.11 is easily to noticed that :the average values of muscular activity index is reduced compared the values before and after rehabilitation,by making more symmetrical the activation between masseter and anterior temporalis muscle. This difference is statistically significant because the value of P<0.001 (according to Test Wilcoxon).

Table.12: Index of torque total (ToI Tot), before and 3 months after rehabilitation, according to the gender. Average Value and Standard Deviation.

Variable	Average value± standard deviation		
	Total (N=40)	Men(n=21)	Woman (n=19)
ToI Total before rehabilitation	81.13 (4.22)	82.69 (3.93)	79.40 (3.93)
ToI Total after rehabilitation	89.17 (4.48)	91.24 (4.26)	86.89 (3.60)

At Table nr.12 we can notice that:the average values of index of muscular torsion(average expressed in absolute value) for the subjects in the study is increasing. Thisdifference is statistically significant because the value of P<0.001 (Wilcoxon Test).

CONCLUSION

1. Patients are referred to the dental clinic for replacement of teeth when dentalarch defects are relatively expressed with the main consequences the installationofocclusal discrepancies.
2. In this study is noticed a significant negative correlation between the number of missing teeth and electromyographic-values of the masticatory muscles: As far as the number of missing teeth is increased, the more is weakened the muscular activity of the anterior temporalis muscle and masseter.
3. Electrical activity of the masticatory muscles three months after the prosthodontic rehabilitation is improved by increasing the average electric potential (MuV) . These changes are significant and strong as the value of $P < 0.001$ substantially lower than the limit of statistical significance (0.05) (According to the Student T test).

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