

DETERMINATION OF MASTICATORY EFFICIENCY IN PATIENTS WITH FIXED FULL IMPLANT-SUPPORTED PROSTHESES: DYNAMIC STUDY

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Abstract

Introduction. There are multiple methods described in literature about chewing efficiency evaluation. The Gravimetric method was firstly introduced in 1901 and is still used nowadays for assessment of implant-prosthetic treatment.

Aim. Dynamic evaluation of masticatory efficiency in full fixed implant supported restorations.

Material and Methods. There were 63 patients included in this study from which 43 women and 20 men. Patients were divided in two groups: study group (33 edentulous patients) and control group with 30 (dentate patients). Patients from study group received 204 dental implants that were immediately loaded with provisional acrylic dentures. The evaluation of masticatory efficiency was performed using 5g of almonds that were chewed until swallowing reflex appears, counting the number of chewing cycles as well. The test was performed immediately after fixation of the prostheses and repeated after 6 months.

Results. After statistical analysis, 3 out of 4 parameters had significant differences. These differences were found between the control and study groups both immediately after prosthesis fixation and 6 months after. However, there were no difference within the study group at different periods of time (initial and 6 months after).

Conclusions. The use of implant-supported prostheses increase the quality of life, esthetics, confidence and masticatory efficiency of full edentulous patients. However, the last one still remains lower than in dentate patients.

Key Words: masticatory efficiency, implant-prosthetic rehabilitation, immediate loading.

Introduction

Complete edentulism is an irreversible, debilitating condition that represents the final stage of dental

pathologies, with a high impact over the patients' overall health status [1, 2, 3]. Many studies demonstrate the presence of multiple changes induced by the teeth loss and the incapacity of conventional removable dentures to restore the comfort,

masticatory efficiency and performance [4, 5, 6, 7].

One of the first functions that are impaired in partial edentulism is mastication and it is directly related to the number of lost teeth. In cases of full edentulism the mastication process suffer major changes often being performed on patient's mucosa.

The masticatory efficiency in full edentulous patient wearing a conventional complete denture is just 1/6 of a dentate one for hard food [7].

Beside the avoidance of hard food, edentulous patients consume predominantly food mainly consisting from carbohydrates and fat [2]. Lee Yung has shown a decrease of consumed products that contain Vitamine C, magnesium, calciu in these patients [8].

Implant-prosthetic rehabilitation proved to restore better the functions of stomatognathic system than conventional dentures [9, 10].

Giannakopoulos Nikolaos et al [10] realized a study with 30 patients in order to determine the adaptation degree of masticatory system to conventional and implant-supported prostheses. Patients were divided in 3 groups: initial with complete dentures, 72 hours after fixation of implant-supported prostheses and 3 months after. Three sieves with different diameters of the holes were used, the remained particles were later scanned for evaluation of their size. There were statistic differences between the third and first two groups, but no differences between the first two. This can be explained by gradual adaptation of the masticatory system to the new prostheses.

Different materials have been already used for evaluation of masticatory efficiency like almonds, optocal, chewing gums, carrot, meat. All of them have different texture and hardness giving different results [12, 13, 11]. The chewed product can be scanned, weighted or sieved through one or multiple sieves to assess the average particle sizes.

Material and methods

Study was based on 63 patients (43 women and 20 men) aged between 38 and 68 years (median 57, interquartile deviation 10). Patients were divided in two groups: the study one consisted of 30 subjects and 33 in the control group. The study was approved by the Ethics Committee of State University of Medicine and Pharmacy "N.Testemitanu" from Chisinau, Republic of Moldova, nr 43. From 16.03.2018.

Inclusion criteria for the study group were:

1. Uni-/ bimaxillary edentulous patients that received immediately loaded implant supported prostheses.
2. Patients without acute TMJ or masticatory muscle disorders that could impair the mastication.
3. Patients without allergies to almonds.
4. Patients that received implant-supported prostheses with minimum 10 dental units.

The masticatory efficiency was calculated for both groups using 5g of almonds. Patients were instructed to count

the chews until a deglutition reflex appears then spit it all and rinse thoroughly. The almonds were washed and dried at room temperature until completely dry and sieved later through a 1.68 mm sieve.

No drying device was used due to the fact that almonds were stored at room temperature and humidity, thus using the thermostat or any other device could over dry the almonds. The remained amount was weighted using calibrated electronic wights. The chewing time was also calculated. The obtained data were introduced into Excel table with the following parameters: mastication time (*time*), number of chewing strokes (*cycles*), the percentage of almonds that passed through the sieve (*mastic*) and chewing frequency.

The chewing test was performed only once for the control group (LC) and twice for the study group: initially after prostheses fixation (LS) and after 6 months (LSF) in order to appreciate the adaptation of the masticatory system to the prostheses.

Data were introduced to RStudio software with evaluation of average with standard deviation, median with interquartile deviation, maximum and minimum for quantitative variables. Comparative evaluation was done using non-parametric tests in accordance between groups (variations of Wilcoxon tests for dependent and independent groups were used).

Results

Comparative analysis between the study group initially (LS) and control group (LC) has shown a statistical difference in 3 parameters out of 4 (Table 1, Figure 1).

Patients from study group after prosthesis fixation had a longer mastication time till the deglutition reflex ($W = 138$, $p\text{-value} = 9.259e-07$), the number of chewings was higher ($W = 45.5$, $p\text{-value} = 0.0006039$) but the quality of mastication was decreased ($W = 911.5$, $p\text{-value} = 1.032e-08$).

This result could be considered normal for the patients with immediately loaded implant-supported prostheses because the overall number of teeth is smaller. This could lead to a compensatory mechanism by increasing the chewing strokes and time [12, 13].

However, 10 patients from study group had 12 teeth on one arch, despite that there was no statistical difference between the 10 or 12 teeth on the arch in this group. Dellavia et al mention that 10-12 teeth are enough for a normal mastication [14].

The statistical analysis between study group after follow-up period and control group has shown also differences in 3 parameters out of 4. Mastication time comparing to control group was increased ($W = 60$, $p\text{-value} = 4.15e-06$), the number of chewing strokes was higher ($W = 274$, $p\text{-value} = 0.002394$) and the quality of mastication was lower ($W = 898$, $p\text{-value} = 3.032e-08$).

Table 1. Descriptive statistics of masticatory efficiency in control group (LC), control group initially (LS) and after 6 months follow-up (LSF).

		LC (N=33)	LS (N=30)	LSF (N = 30)	Wilcoxon test (LC vs LS)	Wilcoxon test (LC vs LSF)	Wilcoxon paired test (LS vs LSF)
mastic(%)							
	Mean (SD)	83.0 (11.9)	60.0 (11.7)	63.0 (12.6)	W = 911.5, p-value = 1.032e-08	W = 898, p-value = 3.032e-08	V = 140, p-value = 0.09592
	Median (IQR)	86.8 (8.70)	59.1 (19.3)	66.0 (17.3)			
	[Min, Max]	[38.0, 95.2]	[40.7, 83.1]	[24.4, 81.3]			
time(s)							
	Mean (SD)	30.8 (10.3)	48.3 (12.2)	47.7 (14.8)	W = 138, p-value = 9.259e-07	W = 160, p-value = 4.15e-06	V = 276, p-value = 0.2098
	Median (IQR)	31.6 (8.82)	48.8 (12.2)	46.3 (17.1)			
	[Min, Max]	[10.0, 61.0]	[24.8, 83.0]	[23.9, 89.1]			
cycles(n)							
	Mean (SD)	33.8 (12.9)	44.7 (10.4)	46.1 (16.3)	W = 245.5, p-value = 0.0006039	W = 274, p-value = 0.002394	V = 189, p-value = 0.7584
	Median (IQR)	31.0 (20.0)	47.0 (11.8)	47.5 (20.0)			
	[Min, Max]	[16.0, 65.0]	[15.0, 65.0]	[14.0, 84.0]			
frequency(c/s)							
	Mean (SD)	1.13 (0.359)	0.976 (0.289)	0.984 (0.278)	W = 613, p-value = 0.1062	W = 599.5, p-value = 0.1524	V = 192, p-value = 0.5888
	Median (IQR)	1.07 (0.445)	0.937 (0.331)	0.966 (0.301)			
	[Min, Max]	[0.555, 2.00]	[0.231, 1.60]	[0.432, 1.77]			

Note: abbreviations – mastic – the almond percentage that passed through the 1.68mm sieve, time– mastication time, cycles – number of mastication strokes, frequency – chewing frequency, mean (SD) – mean (standard deviation), Median (IQR) – median (interquartile deviation), Min – minimal value, max – maximum value, df – degree of freedom.

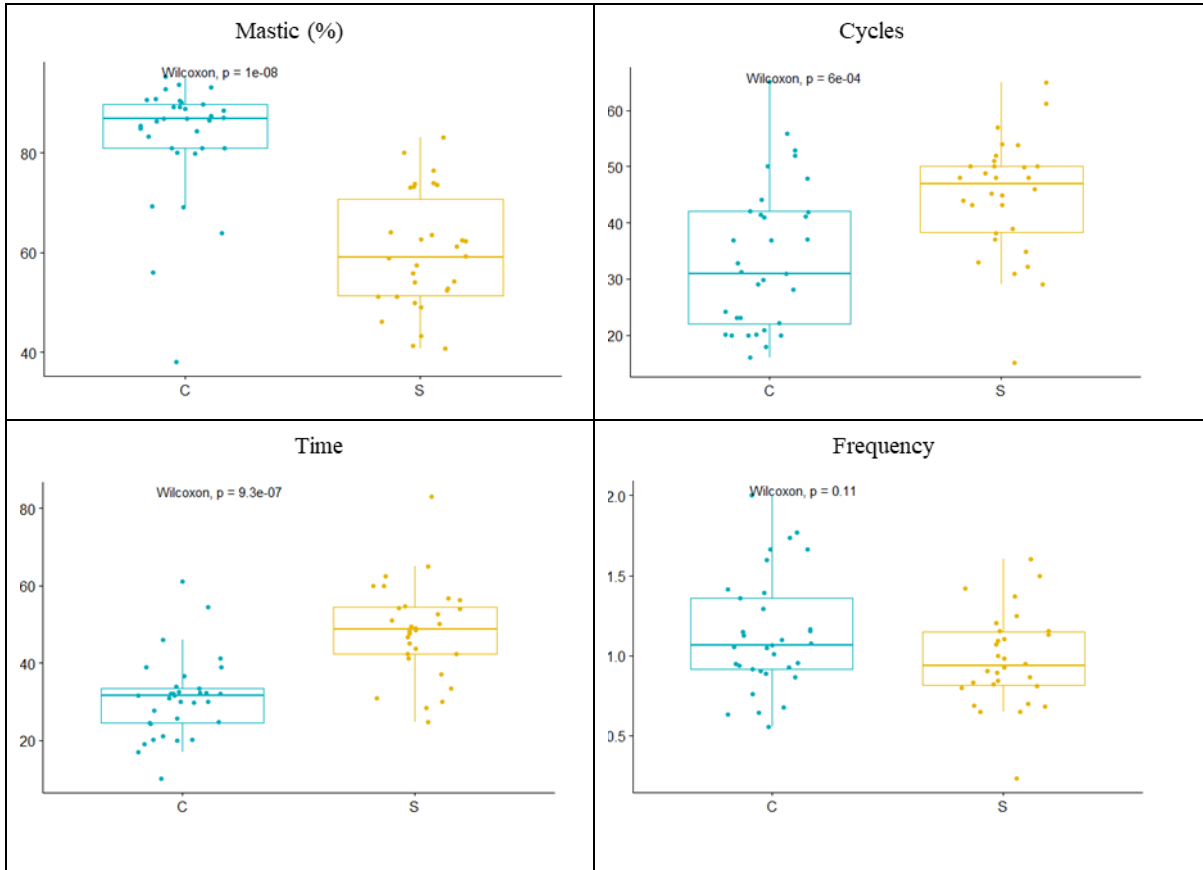
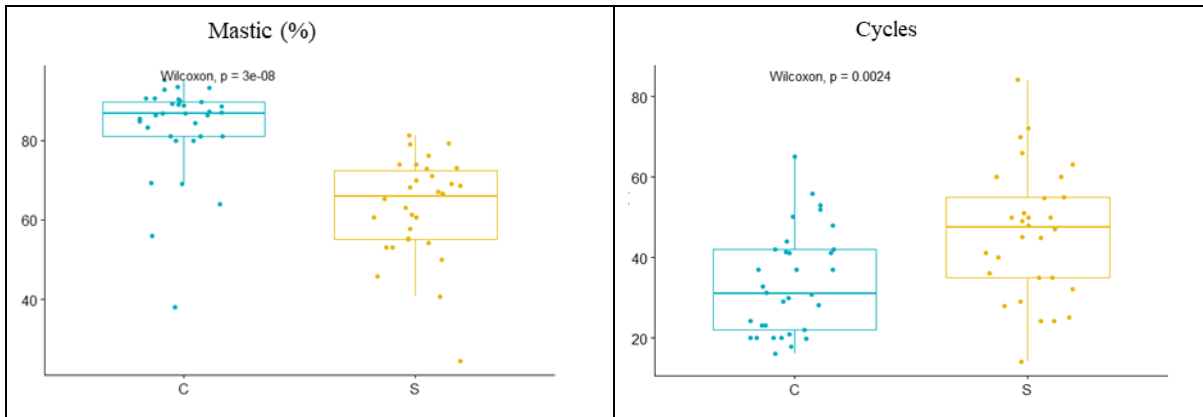


Figure 1. Comparative analysis of masticatory efficiency indices in study group (S) and control group (C).



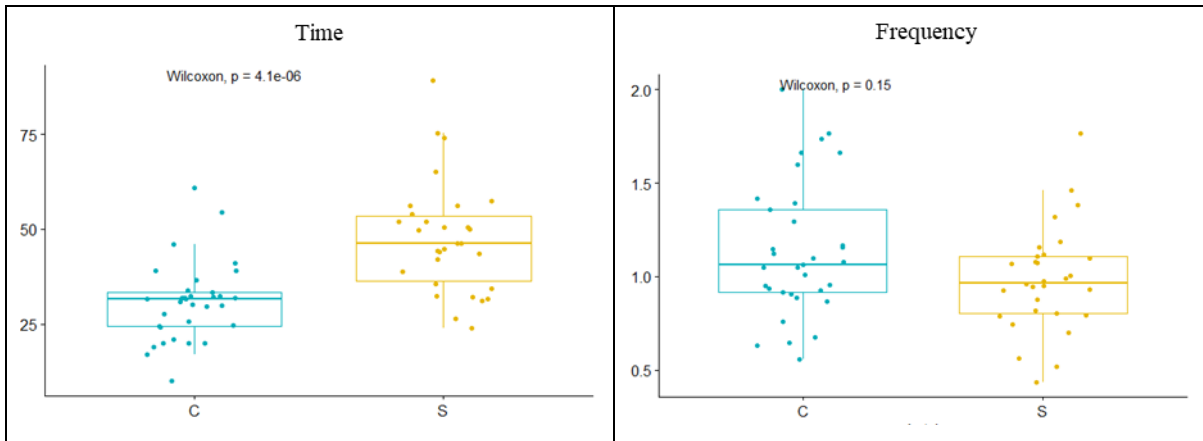


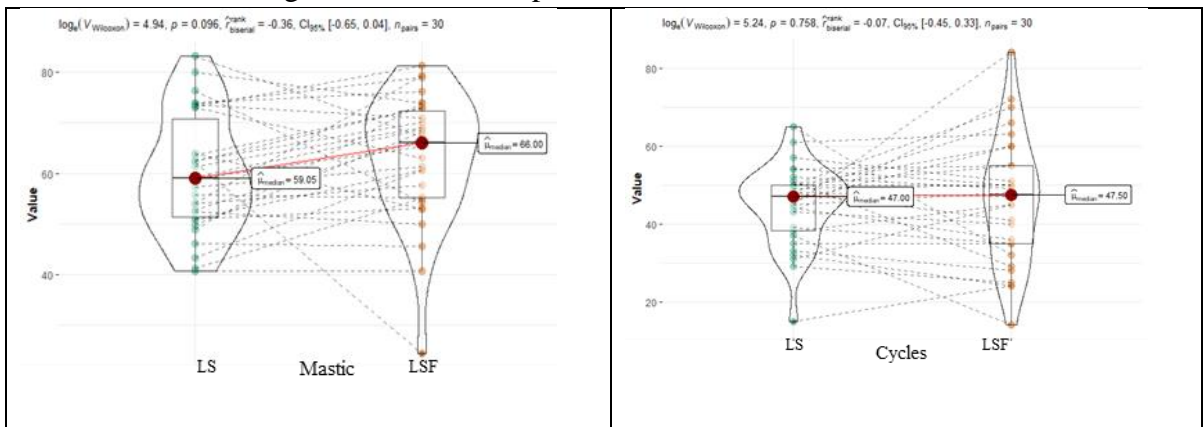
Figure 2. Statistical comparison of masticatory efficiency indices in the study group six months after (S) and control group (C).

It is important to mention that despite the difference in other parameters, the frequency of mastication is similar in all the groups (Table 1). This is explained by the fact that mastication cycles and time were proportionally higher in the study group preserving the same ratio 1:1.

Comparison inside the study group initially and 6 months after did not show any statistical differences (Figure 3). However, the *mastic* parameter in LS and LSF had the following results $V = 140$, p -

value = 0.09592. This might mean that in mastication had a small improvement that could be significantly higher if the number of subjects or follow-up time would have been higher as well.

There was no clinical derangement during mastication for both study subgroups (LS and LSF) and the slight improvement of almond grinding doesn't seem to have a clinical impact on mastication performance assessed by the patient.



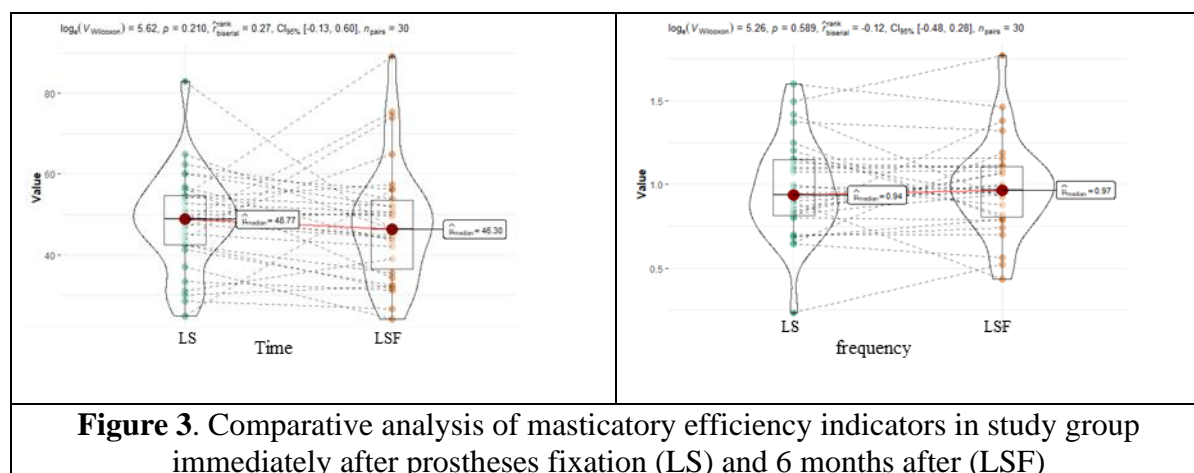


Figure 3. Comparative analysis of masticatory efficiency indicators in study group immediately after prostheses fixation (LS) and 6 months after (LSF)

Discussions

Implant-prosthetic rehabilitation is nowadays a treatment standard for complete edentulism, especially the 2 implant supported overdentures [15]. The improved mastication of implant prostheses compared to conventional ones is demonstrated in different studies [8,10,16 18, 19].

The literature data is contradictory having results that show improvement of masticatory efficiency in time and others that did not found any differences [17-37]. However, it is still doubtful if these restorations have the same masticatory efficiency as natural dentition does. Van der Bilt A., has shown that even prostheses in partial edentulism doesn't fully restore the masticatory efficiency [13].

According to the results of our study, the use of implant-supported-prostheses with 10 or 12 teeth on the arch do not restore neither immediately nor after

6 months the masticatory efficiency that a dentate patient has. The small changes that have occur in dynamic are clinically negligible and might change if the subject number and observation time would have been bigger.

Conclusions

The use of fixed implant-supported prostheses provided a comfortable and esthetic rehabilitation of fully edentulous patients in a short period of time. Though the patients did not complain on quality and comfort during mastication, we were not able to confirm a fully recovery of masticatory efficiency that a dentate patient has. Implant-supported prostheses have shown worse results in 3 out of 4 evaluated masticatory parameters when comparing to control group. There were no changes in these parameters inside the study group when comparing the same subjects initially at prostheses fixation and 6 months after.

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