

Comparison of chewing activity in patients requiring complete denture with two different occlusions

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Background and Objectives: The loss of natural teeth causes many problems; one of major problems that are associated with edentulousness is the hypotonicity of muscles of mastication and decreasing the ability of the patient to chew food properly. Treatment of edentulous patients with complete denture will increase the muscle tonicity and chewing activity. The purpose of this study is to clinically compare patient's chewing ability between lingualized occlusion complete denture and bilaterally balanced occlusion complete dentures.

Materials and methods: Two sets of complete dentures with different occlusions were fabricated for ten patients. The patients received bilaterally balanced occlusion (BBO) complete denture and lingualized occlusion (LO) complete denture in random order. The patients wear each set of complete denture for one month. During this month, chewing activity tests were performed for the patients in four different time intervals. The results of these tests were analyzed using t-test and paired t-test to compare between the lingualized occlusion and bilaterally balanced occlusion complete denture and also to compare the results of each time interval with each other.

Results: The mean amount of the walnuts that passed through the sieve in LO dentures were (1.78g), during the fourth visit while it was (1.18g) in BBO. There were statistically significant difference between LO and BBO schemes of complete denture when measuring the amount of the chewed walnuts that passed through the sieve in second, third and fourth visit ($p=0.037$, 0.001 and 0.000).

Conclusion: Within the limitations of this study, it has been concluded that the chewing ability was higher in patients who were provided with complete dentures fabricated with the LO scheme as compared to those patients who received complete dentures made with BBO scheme. This was due to the fact that LO technique resulted in functionally better complete dentures as compared to the ones made by BBO technique

Keywords: Lingualized occlusion, Bilateral balanced occlusion, Sieve test.

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Introduction

The goal of a prosthodontics treatment for edentulous patients requiring complete dentures is to restore the patient to a state of normal functioning, health and optimum health.¹ For a successful treatment of edentulous patients with complete denture, an optimal occlusal surface design is essential in providing retention, stability and support. Unfavorable masticatory forces can induce undesirable denture movement; however, these can be reduced by ensuring contact between the maximum number of teeth on both sides of the arch during centric and all excursive mandibular movements.^{2,3} Ideal occlusion is an occlusion compatible with the stomatognathic system providing efficient mastication and good

esthetics without any physiologic abnormalities.⁴

Search for an ideal occlusion for complete denture fabrication has been going on for more than two centuries in an effort to find the tooth form that can provide maximum retention, stability and masticatory efficiency without compromising the health of the underlying tissues.⁵ Although there is no exact proof that one concept of occlusion can be considered adequate in all patients, and a specific scientific evidence to suggest that a perfect tooth form or position or material exists which can ensure success of the complete denture prosthesis,¹ bilateral balanced occlusion (BBO) and lingualized occlusion (LO) are the two most widely used occlusions in fabrication of complete denture for treatment of edentulous patients, in which anatomic and non-anatomic molds of teeth can be used in both concepts of occlusion.^{6,7}

Bilateral balanced occlusion is described as the occlusal contacts of maxillary and mandibular teeth primarily (centric jaw relation) in maximum inter-cuspation, and their continuous contacts during movements from centric jaw relation along specific working, balancing, and protrusive guidance pathways developed on the occlusal surface of the teeth. It is considered as an ideal occlusion for complete dentures.⁸ However, BBO may be difficult to achieve clinically, as well as time consuming to master,⁹ therefore, a less complicated occlusal scheme fulfilling clinical requirements become necessary.¹⁰

LO advocated in the 1940s as a substitute to BBO,¹¹ is defined as denture occlusion that articulates only the maxillary palatal cusp with the mandibular occlusal surface in centric, working and non-working mandibular position.¹² This means that the buccal cusps of the upper and lower teeth take no part in articulation, which makes tooth arrangement and occlusal correction much simpler and easier to provide than for BBO.³ LO gives the patient improved comfort, function and appearance, quality of life goals wanted by the clinician and patient alike. The principles of the LO aims to stabilize the prosthesis.¹⁰

There are many methods to evaluate the chewing or functional efficiency of the

patients.^{13,14} Sieve method is the most popular method used in evaluating the chewing activity of patients.¹⁵

This study was designed to evaluate and compare the chewing activity between BBO complete dentures and LO dentures. Also to assess the chewing activity of patients with different occlusions of complete denture over time.

Materials and methods

Ten patients with no experience with previous complete denture reporting to the Department of Prosthodontics, in Hawler Medical University, College of dentistry were included in this study. The committee of higher education in Hawler Medical University, College of Dentistry approved the protocol for this study. Patients with class II or class III jaw relation,¹⁶ highly resorbed ridges,¹⁶ clinical symptoms of temporomandibular disorder,¹⁷ and any systemic disease¹⁷ that could affect the outcome of this study were excluded for this study.

Fabrication of a complete denture. Two sets of conventional complete denture were fabricated for each patient. The only difference between the complete dentures was in tooth mold and tooth arrangement. For the lingualized occlusion complete denture, anatomic, acrylic denture teeth (Denture Pe, A3 shade) were used for the maxillary arch, and modified non-anatomic acrylic denture teeth were used for the mandibular arch. For modification, the cusps of the posterior teeth were grinded so that they would be like non-anatomical or zero degree teeth. Occlusal contacts were focused between the maxillary palatal cusp and the mandibular central fossa in the lingualized occlusion. The buccal cusps of both maxillary and mandibular teeth appear realistic, but they didn't in occlusion or excursion. First the modified mandibular posterior teeth were set following the antero-posterior (curve of Spee) and medio-lateral (curve of Wilson) compensating curves. The maxillary teeth were set with only the palatal cusps in contact with the mandibular teeth; this was done by tilting the maxillary posterior teeth buccally. In lingualized occlusion the maxillary and mandibular teeth were arranged such that only the

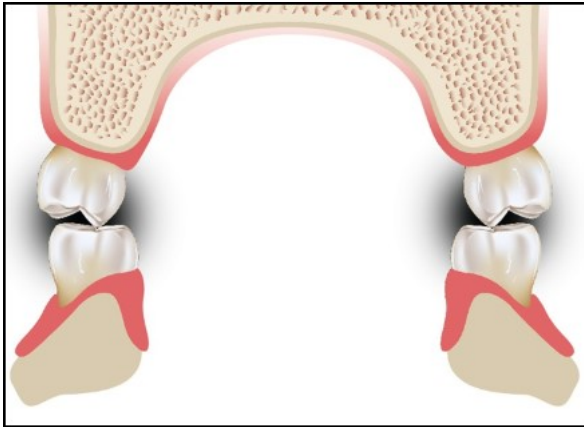


Figure 1: teeth arrangement in dentures with lingualized occlusion.

maxillary palatal cusps of posterior teeth would contact with central fossa of mandibular posterior teeth (Figure 1). There was 1-1.5 mm space (no contact) between the maxillary and mandibular anterior teeth in centric occlusion, to prevent dislodgement of the dentures during occlusion. Anatomic teeth were used for bilateral balanced occlusion dentures, in both maxillary and mandibular teeth. The maxillary anterior teeth were arranged first, followed by the maxillary posterior teeth. The maxillary and mandibular anterior teeth were arranged in a class I jaw relationship. The maxillary posterior teeth were arranged in a way that ensures the correct buccolingual positioning of the mandibular teeth. This was done by engraving a canine-retromolar pad reference line on the mandibular occlusal rim from the distal of lower canine to the retromolar pad. The line corresponding to the crest of the ridge represents the central fossa of the mandibular teeth; this in turn corresponds to the maxillary palatal cusps. Arranging the maxillary teeth followed by arrangement of the mandibular teeth. The mandibular teeth were set in a softened wax at a slightly higher level, when the articulator was closed; the upper teeth pushed the lower teeth into occlusion. During occlusion in centric jaw relation and protrusive jaw movement, the palatal cusps of the maxillary posterior teeth would contact with the central fossa of the mandibular posterior teeth and the buccal cusps of the mandibular posterior teeth would contact with the central fossa of the maxillary posterior teeth (Figure 2).

Chewing activity test. A sieve system⁷ as used in this study to measure the chewing activity of patients with lingualized and bilateral balanced occlusion complete dentures. A 10 mesh sieve was constructed from a sheet of woven wire, 10 mesh, A4

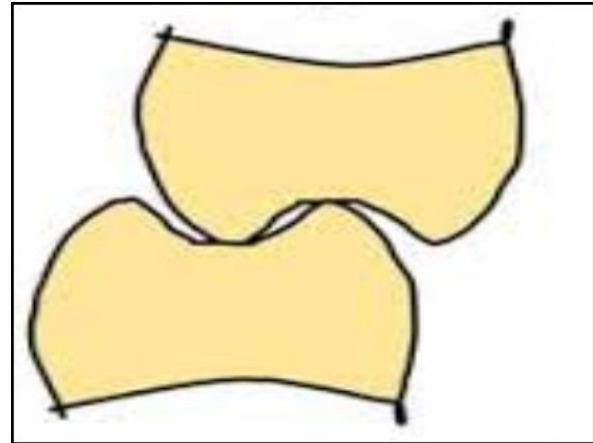


Figure 2: teeth arrangement in dentures with bilateral balanced occlusion.



Figure 3: 10 mesh sieve.

size, 2 mm hole, 0.2 mm wire, heavy stainless steel and a commercially available sieve. The mesh of the commercially available sieve was removed and the 10 mesh sheet was soldered to the sieve as shown in Figure 3.

During the chewing activity test, the patients were seated in a dental chair in an upright position, and three portions of walnut, each of 3gm was weighed in an electrical balance with an accuracy of 0.01g.⁷ The patients were asked to chew each portion of walnut separately for fifteen seconds and spit them on a plastic

disposable bowl covered with an absorbent paper without swallowing the walnuts. The chewed walnuts were left to dry for twenty-four hours in a room temperature. After the walnuts were completely dry, they were weighed on the electrical balance. Then the chewed walnuts were put into the 10 mesh sieve, the sieve was shook enough until all the small particles that could pass through the holes of the sieve, came out. Then the amount of the walnut particles that were remained on the sieve was measured on the electrical balance. The amount of the remained walnuts was subtracted from the original amount of the spitted walnuts and the result would give us the amount of the

walnut particles that passed through the sieve holes.

Statistical Analysis. Data were presented as mean and standard deviation values. Paired t-test was used to compare chewing ability between LO and BBO concepts of complete denture, also paired t-test was used to compare between the visits of each type of occlusal concepts. The significant level was set at $p \geq 0.05$.

Results

The results of chewing activity for both schemes of complete denture occlusion, which are the LO and BBO are shown in (Table 1). We can state that the mean values

Table 1: Descriptive Statistics and Paired T-test of chewing activity in all visits for the LO and BBO Complete dentures.

Visit	Methods	N	Mean/ g	Std. Deviation	P-Value
1 st Visit	Lingualized Spitted Walnuts	10	7.610	0.398	0.935
	Balanced Spitted Walnuts	10	7.600	0.362	
	Lingualized Remained on Sieve	10	7.120	0.262	0.134
	Balanced Remained on Sieve	10	7.270	0.267	
	Lingualized Passed through Sieve	10	0.490	0.331	0.133
	Balanced Passed through Sieve	10	0.330	0.189	
2 nd Visit	Lingualized Spitted Walnuts	10	7.810	0.296	0.147
	Balanced Spitted Walnuts	10	7.620	0.405	
	Lingualized Remained on Sieve	10	7.060	0.310	0.237
	Balanced Remained on Sieve	10	7.160	0.232	
	Lingualized Passed through Sieve	10	0.750	0.392	0.037
	Balanced Passed through Sieve	10	0.460	0.303	
3 rd Visit	Lingualized Spitted Walnuts	10	8.050	0.255	0.038
	Balanced Spitted Walnuts	10	7.860	0.369	
	Lingualized Remained on Sieve	10	6.780	0.210	0.881
	Balanced Remained on Sieve	10	6.730	0.964	
	Lingualized Passed through Sieve	10	1.270	0.371	0.001
	Balanced Passed through Sieve	10	0.820	0.319	
4 th Visit	Lingualized Spitted Walnuts	10	8.220	0.181	0.011
	Balanced Spitted Walnuts	10	8.010	0.331	
	Lingualized Remained on Sieve	10	6.440	0.250	0.038
	Balanced Remained on Sieve	10	7.100	0.897	
	Lingualized Passed through Sieve	10	1.780	0.361	0.001
	Balanced Passed through Sieve	10	1.180	0.410	

of both LO and BBO are very close to each other at all three variables specifically the first and second visits With 7.610g and 7.60g for the amount of spitted walnuts in LO and BBO. It is clear that the gap is not reasonably big at the first visit. In addition, another important activity was measuring the amount of walnut particles which passed through the sieve after chewing. There was also no big change between both LO and BBO with 0.490g as well as 0.330g respectively. The second and third visit also showed no such interesting discussion since the mean values are all close to each other. However, at the fourth visit both type of denture occlusion implemented different figures. In measuring the spitted amount walnuts with LO the mean value of the spitted walnuts was 8.220g while this number is fewer in Balanced with 8.010g. Likewise, the amount of spitted walnuts that passed through the sieve recorded by 1.780g in LO dentures, whereas this figure was relatively lower in BBO with 1.180g. This argument can be easily seen in Table 1.

The results of paired t-test showed that there was no significant result in their mean values of chewing activities for both occlusal schemes during the first visit. During the second, third and fourth visit the p-value for the amount of the walnuts that passed through the sieve were (0.037, 0.001, 0.00) respectively which indicates that there is a significant difference between the LO and BBO denture as seen in Table 1.

Discussion

In order to minimize the confounding, it was better to put a limitation for the age and gender when selecting the patients, because the neuromuscular coordination is better in younger and male patients than in old and female ones with reference to the chewing ability.¹⁸ But only those Patients were selected that visited Hawler Medical University, College of Dentistry, Prosthodontics department and accepted the protocol of this study and signed the consent of this study regardless of age and gender.

The complete dentures were randomly distributed among the patients. Some of the patients received a complete denture with LO and followed up for one month, then the denture was taken from the patient and after

one week the other complete denture was given to the patient and vice versa. This was done to make the chewing ability of the patients for each occlusal concept as close as possible to each other in the first visit.

The patients chewing ability was similar to each other in both occlusal schemes during the first visit and there were no statistically difference between the LO and BBO dentures when measuring the amount of spitted walnuts after chewing and the amount of the walnut particles that passed through the ten-mesh sieve. Although there was no significant difference between the two occlusal concepts during the first visit, it is important to mention that the particle sizes of the chewed walnuts with the LO dentures were almost similar to each other and they were regular, while the particle sizes of the chewed walnuts were of different sizes and irregular, some were very large particles and some were small, this is because the dentures with LO had better stability during chewing the walnuts, while when the patients were chewing with dentures of BBO, they were complain about difficulty and pain due to denture movements during chewing. This was because there was one point of contact between the maxillary posterior teeth and mandibular posterior teeth and this point was between the palatal cusps of maxillary posterior teeth and the middle fossa of mandibular teeth. When the patients was occluding with LO dentures, the forces of the chewing was directed directly to the middle of the teeth of lower arch from the palatal side of the maxillary teeth which prevents denture movements during chewing, on the other hand when the patients were chewing with the BBO dentures, there were two points of contact between the maxillary and mandibular posterior teeth and there was a sliding (lateral) force between the cuspal inclinations maxillary and mandibular posterior teeth since both the upper and lower posterior teeth in BBO dentures were of anatomic denture teeth, while this lateral force during chewing was not present in LO dentures because the mandibular posterior teeth of LO dentures were of non-anatomical teeth with zero degree cusps. This makes the dentures with BBO to move

from their location in a higher rate, thus the patients loss control over the dentures and could not chew all the food particles, that's is why the chewed walnuts with the BBO was of different sizes during the first visit.

But during the second, third and fourth visit there were a significant different between the LO and BBO dentures when measuring the amount of the walnuts that passed through the sieve. This indicates that by time the patients' adaptability to dentures with LO will increase better when compared to dentures with BBO and thus the chewing ability. When patients have good control over dentures, they will chew foods more comfortably and the muscles of mastication will work in a regular form and the force that patients can apply to the food during chewing will increase. If we notice closely, we can see that during the third and the fourth visits, there is also a significant difference between the amount of the walnuts that the patient spitted, it means that the patients with LO dentures could spit more walnuts after chewing when compared to patients with BBO dentures. This indicates that patients had better control over the LO dentures after one week of insertion.

Overall the results of this study indicates that dentures with both occlusal concepts increase the chewing ability but with different rate. LO dentures increase the chewing ability with a higher rate and less time when compared to BBO dentures. This is similar to the results of the study done by Koide (19) who investigated the chewing ability of edentulous patients wearing complete dentures arranged with LO and BBO. It was found that dentures with LO offered a higher ability of chewing food, higher masticatory efficiency, and displayed faster as well as smoother masticatory movement, and showed chewing patterns that were closer to the chopper type compared with bilateral balanced occlusion.

The result of this study also confirms the conclusion of a study carried out by Gomibuchi et al. (20) who compared dentures with anatomical teeth either arranged for LO or BBO dentures. Patients in their study expressed better chewing ability with LO dentures, suggested that LO is effective in masticating or cutting foods,

and are the form of occlusion having a high cutting potential compared to BBO.

Kimoto et al. (21) stated in their study that edentulous patients provided with complete dentures fabricated with LO scheme experienced and expressed greater satisfaction with their denture retention and resulted in greater masticatory performance than BBO dentures. But the present study, occlusal schemes didn't show any effect on the denture retention, only the stability of the denture during chewing.

Unlike the outcome of this study, Ono and Hatake(22) did not found any significant difference between complete dentures arranged with LO and BBO schemes. It was reported in their study that the chewing ability of patients with LO and those with BBO were 44.5% and 46.8% respectively.

A number of authors^{19-21,23} have proposed that LO as the most beneficial occlusal concept for complete dentures fabrication. The complete dentures arranged with LO significantly affect chewing ability in highly resorbed ridges. But the results of this study showed that LO dentures also improve the patients chewing ability in patients with favorable ridge height. That is why the concept of LO ought to be applying in prospect for fabrication of complete dentures. With the use of specific moulds of teeth, the scope and practicality of LO scheme can bring forward favorable results in terms of patient's satisfaction.

Conclusion

Within the limitations of this study, the conclusion is that chewing ability was higher in patients who were provided with complete dentures fabricated with the LO scheme as compared to those patients who received complete dentures made with BBO scheme. This was due to the fact that LO technique resulted in functionally better complete dentures as compared to the ones made by BBO technique. In addition to that more research work needs to be carried out assess the benefits of these occlusal schemes.

Conflicts of interest

The authors reported no conflict of interests.

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