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Original Article

Comparison of Masticatory Performance of Bilateral Balanced Occlusion and Lingualized Occlusion in Complete Denture Patients

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ABSTRACT

Objective: To compare the masticatory performance of complete dentures with lingualized occlusion (LO) versus those with bilateral balanced occlusion (BBO).

Study Design: Randomized Controlled Trial (NCT06811818).

Place and Duration of Study: Armed Forces Institute of Dentistry Rawalpindi, Pakistan from Jun to Dec 2024.

Methodology: Using Block Randomization approach, a total of 146 participants aged 45–65 years were randomly assigned to two groups: Group-LO (n=73) received complete dentures with lingualized occlusion, while Group-BBO (n=73) received dentures with bilateral balanced occlusion. Masticatory performance was evaluated by having participants chew 15 g of peanuts, with the masticated material collected, sieved, dried, and weighed. Statistical analysis was performed using Student's t-test, with significance set at $p<0.05$.

Results: The mean age was comparable between groups (LO: 52.33±3.66 years; BBO: 52.29±4.42 years). The mean weight of masticated peanuts was significantly higher in the Group-LO (2.25±0.23 g) than in the Group-BBO (2.08±0.34 g, $p<0.001$). Among females, the Group-LO showed a significantly higher mean weight (2.25±0.17 g) compared to the Group-BBO (2.11±0.32 g, $p=0.02$). Similarly, among males the Group-LO performed better (2.24±0.27 g) than the Group-BBO (2.03±0.36 g, $p=0.008$).

Conclusion: Complete dentures with lingualized occlusion have superior masticatory performance compared to bilateral balanced occlusion, with significant improvements observed in both genders.

Keywords: Bilateral balanced Occlusion, Complete Denture, Lingualized Occlusion.

How to Cite This Article: *Khattak S, Butt MM, Sherazi S, Khan S, Sharif M, Shahbaz M. Comparison of Masticatory Performance of Bilateral Balanced Occlusion and Lingualized Occlusion in Complete Denture Patients. Pak Armed Forces Med J 2026; 76(Suppl-1): S147-S151.*
DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-1.13245

INTRODUCTION

According to the World Health organization, health is a state of complete physical, mental and social well-being and not merely the absence of disease.[1] Good oral health is needed not only for esthetics, but also for ensuring abilities and a healthy body and mind.[2] Complete edentulous patients also suffer from quality of life and oral function tooth loss.[3] Complete dentures are the primary restorative solution for such patients, due to missing teeth being replaced with a prosthesis made of acrylic bases and artificial teeth.[4]

The occlusion of complete dentures affects their stability and functionality to a great extent, more particularly bilateral balanced occlusion (BBO) and lingualized occlusion (LO) are the most used approaches. The two designs are amenable to anatomical and non-anatomical tooth moulds on application.[5]

Bilateral balanced occlusion requires the occlusal contacts between maxillary and mandibular teeth in maximum intercuspation at the beginning of movement and maintained occlusal contacts during functional movements.[6] The working, balancing, and protrusive pathways, decided occlusally on the occlusal surfaces of the teeth, comprise the set of these movements. This occlusal scheme is thought to be ideal for complete dentures because stability and denture retention are enhanced during oral functions.[7]

However, lingualized occlusion emphasizes patient comfort, function, and esthetics which are parallel to clinical and patient goals for enhanced quality of life. The principle of lingualized occlusion therefore is to stabilize the prosthesis by utilization of maxillary palatal cusps as primary supportive elements cooperate with mandibular teeth occlusal surfaces.[6] This design reduces the lateral forces applied to the denture, increases chewing efficiency, and increases the prosthesis stability during functional activities.[8]

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Received: 28 Feb 2025; revision received: 08 Jul 2025; accepted: 09 Jul 2025

Occlusal schemes have much influence on masticatory performance and their selection is important for optimal results in complete denture wearers.[9] A systematic review carried out by Salvie *et al*., included 12 studies with various assessment tools and methodologies summarized that patient satisfaction was 67% for the LO compared to BBO as well as OHIP score was significantly improved in LO group with p value of 0.0007.[10] This study aims to evaluate and compare the masticatory efficacy between two habituation occlusal schemes, as a reference for clinicians when prescribing one over the other to their patients.

The objective of this study was to compare masticatory performance of complete denture wearers having lingualized occlusion over that with bilateral balanced occlusion of the opposing teeth.

METHODOLOGY

This randomized controlled trial was conducted at the Department of Prosthodontics, Armed Forces Institute of Dentistry Rawalpindi, Pakistan over a duration of six months following approval from Ethical Committee/Institutional Review Board (IRB) (vide letter no.918/Trg dated May 13, 2025) and was registered on ClinicalTrials.govt with the name of Masticatory Performance in bilateral balanced occlusion and lingualized occlusion in complete denture" (NCT06811818). The sample size of 146(73 per group) was calculated using the Open Epi calculator with a 95% confidence interval and 80% test power, based on 1.40±0.46 g in balanced occlusion and 1.21±0.35 g of masticated peanuts at swallowing in lingualized occlusion from a previous study.[11]

In this prospective, randomized, single-blind study, a total of 146 patients in need of complete dentures were enrolled. All the participants received treatment in the Department of Prosthodontics Armed Forces Institute of Dentistry (AFID) from June 1 2024, to December 31, 2024. The procedure was explained and an informed consent form was signed by each patient. Demographic Details were recorded on data collection form.

Inclusion Criteria: Edentulous patients aged between 45–65 years, of both genders, with no prior complete denture experience visiting for provision of prosthesis and willing to participate in the study were included.

Exclusion Criteria: Patients unwilling to participate, not falling into the age range criteria of 45-65 years, having congenital or acquired orofacial defects, or having any soft tissue pathology, e.g, epulis fissuratum, or individuals with neuromuscular disorders were excluded from the study.

Grouping of participants was carried out through block randomization (Figure). Participants were equally divided into two groups. Group-BBO as bilateral balanced occlusion group and Group-LO as lingualized occlusion group with 73 participants each. Block size used was four (4), having two participants from each group. A total of 36 blocks of size 4 were used for 144 participants. Remaining two participants were manually allocated to the groups to create randomization and balance. This block randomization process ensures balance of the number of participants in each treatment group and minimizes the bias in the treatment assignment, irrespective of the confounding variables such as age or gender, which were measured after the randomization process by descriptive statistics and frequency distribution.

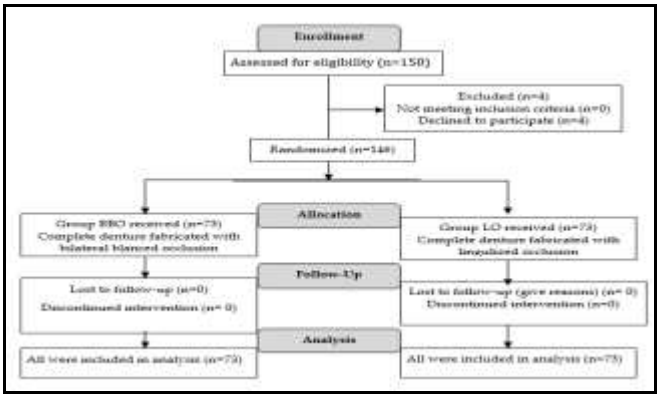

Figure-: Flow Chart for Patient Selection

Group-LO received complete dentures with lingualized occlusion, while Group-BBO received complete dentures with bilateral balanced occlusion. Each participant was provided with 15 g of peanuts and instructed to chew them until they were ready to swallow. The chewed material was then spat into a designated container, and participants were asked to rinse their mouths with water, with the rinse being collected in the same container. The collected material was sieved through a 10-mesh screen to eliminate debris, followed by drying on blotting paper for 30 minutes. The dried material was subsequently weighed using an electronic balance with a precision of 0.01 g.

Descriptive statistics were presented as Mean±SD for normally distributed data and median with interquartile range (IQR) for non-normally distributed

data. Normality was assessed using the Shapiro–Wilk test. Age was skewed while weight was normally distributed. Statistical analysis was conducted to evaluate masticatory efficiency, measured by the mean weight of chewed peanuts. Group comparisons were performed using the Student's t-test for normally distributed data. A *p*-value<0.05 was considered statistically significant. All analyses were performed using R software (version 4.3.3).

RESULTS

The median age of participants in the Group-LO (Lingualized Occlusion) was 52.0 years (IQR: 55.0 - 49.0), which was comparable to the Group-BBO Bilateral Balanced Occlusion (BBO) 52.0 years (IQR: 56.0 - 48.0). The Group-LO had a higher proportion of males (n=45, 61.64%) compared to females (n=28, 38.36%). The Group-BBO exhibited a greater proportion of females (n=43, 58.90%) relative to males (n=30, 41.10%) (Table-I).

Table-I: Comparison of Descriptive Statistics Among Groups (n=146)

Variable (s)	Group-LO (Lingualized Occlusion) (n= 73)	Group-BB0 (Bilateral Balanced Occlusion) (n= 73)
Age(years), Median(IQR)	52.0(55.0-49.0)	52.0(56.0-48.0)
Gender, n (%)		
Female	28(38.36%)	43(58.90%)
Male	45(61.64%)	30(41.10%)
Age Group n (%)		
≤55 years	53(72.60%)	47(64.38%)
>55 years	20(27.40%)	26(35.62%)

In the Group-LO 53 participants (72.60%) were aged 45–54 years, and 20 participants (27.40%) were aged 55–60 years. In the Group-BBO 47 participants (64.38%) were aged 45–54 years, while 26 participants (35.62%) were aged 55–60 years.

The mean weight in the Lingualized Occlusion group was 2.25±0.23 g, significantly higher than the Bilateral balanced Occlusion group (2.08±0.34 g), with a *p*-value of <0.001 (Student's t-test). (Table-II)

Among females, the mean weight was significantly higher in the Lingualized Occlusion group (2.25±0.17 g) compared to the Balanced Occlusion group (2.11±0.32 g, *p*=0.02). Similarly, among males, the Lingualized Occlusion group showed a higher mean weight (2.24±0.27 g) than the Balanced Occlusion group (2.03 ± 0.36 g, *p*=0.008). These differences were statistically significant (Table-III).

Table-II: Comparative Analysis of Masticated Peanut Weight at 15 seconds (n=146)

Variable	Group-LO (Lingualized Occlusion) (n=73)	Group-BBO (Bilateral Balanced Occlusion) (n=73)	*p*-value
Weight (gm) of chewed peanuts after 15 seconds	2.25±0.23	2.08±0.34	<0.001*

** independent samples t test*

Table-III: Comparative Analysis of Masticated Peanut Weight at 15 seconds among genders (n = 146)

Gender	Group-LO (Lingualized Occlusion) (n=73)	Group-BBO (Balanced Occlusion) (n=73)	*p*-value*
Female, n=71	2.25±0.17	2.11±0.32	0.02
Male, n=75	2.24±0.27	2.03±0.36	0.008

** independent samples t test*

Table-IV: Comparative Analysis of Masticated Peanut Weight Among Age groups (n=146)

Variable	Group-LO (Lingualized Occlusion) (n = 73)	Group-BBO (Bilateral Balanced Occlusion) (n = 73)	*p*-value*
45-54 years (n=100)	2.26±0.24	2.07±0.37	0.003
55-60 years (n=46)	2.20±0.22	2.09±0.28	0.150

**independent samples t test*

Table-IV compares the weight of masticated peanuts after 15 seconds across age groups in both occlusion types. In participants aged 45–54 years, the mean weight was significantly higher in the lingualized occlusion group (2.26±0.24 g) compared to the balanced occlusion group (2.07±0.37 g, *p*=0.003). However, in participants aged 55–60 years, no significant difference was observed between the lingualized occlusion group (2.20±0.22 g) and the balanced occlusion group (2.09±0.28 g, *p*=0.15).

DISCUSSION

In this study, the mean weight of masticated food was significantly higher in the Group-LO compared to the Group-BBO both in the overall cohort and in male and female subgroups. Specifically, the mean weight in the Lingualized Occlusion group was 2.25±0.23 g,

while the Balanced Occlusion group had a mean of 2.08±0.34 g, with a *p*-value of <0.001. This difference remained statistically significant when analyzed separately for males and females, indicating that Lingualized Occlusion may have a superior impact on masticatory performance. Similar results were found by another study in Pakistan by Butt *et al*.[12] who conducted a randomized control trial which concluded that the mean weight of masticated peanuts in LO was 2.15± 0.21gm as compared to BBO group of 1.85±0.21gm with statistically significant p value of 0.001 ensuring LO scheme as a preferable choice for complete denture.[12] In another study by Khan *et al*.[13] it was found that masticatory efficiency was higher in complete denture patients with Lingualized Occlusion (LO) compared to those with Bilateral Balanced Occlusion (BBO) (mean masticated peanut weight 5.30±0.89 g vs. 9.45±2.10 g, *p*=0.021). Kimoto *et a*l., reported significantly higher denture retention with LO group with p value of 0.03.[14] But little clinical outcome data is available to compare BBO with the LO design.These studies support the notion that Lingualized Occlusion provides better masticatory performance and comfort in complete denture wearers.

Consistent with the work of Tsurumaki[15] which assessed dentures made with anatomical teeth disposed in bilateral balanced occlusion, or lingualized occlusion the results revealed that lingualized occlusion dentures provided chewing ability quite more efficiently than acrylic occlusion dentures. These results indicate that the lingualized occlusion presents a greater cutting potential than the bilateral balanced occlusion.

Additionally, another comparative study carried out by Ali *et al*.,[16] indicated that with increasing time patients' adaptability increased with dentures having lingualized occlusion and their control over their dentures also enhanced as compared to bilateral balanced occlusion. According to his study lingualized occlusion has single point of contact between upper and lower teeth directing forces to the central fossa of mandibular teeth which enhances the stability of the dentures, whereas in bilateral balanced occlusion there are two points of contact between the cusps of maxillary and mandibular posterior teeth which creates sliding motion resulting in lateral forces on the complete denture and decreased control of patient while chewing .

Moreover, a study by Grech *et al*.,[17] assessed patient-reported outcomes on different occlusal schemes and found that complete denture wearers with lingualized occlusion experienced improved comfort, stability, and chewing efficiency, further supporting our results. Another randomized controlled study carried out by Poljak *et al*.,[18] concluded that patients wearing complete dentures for the first time show significantly higher satisfaction with lingualized occlusion as compared to bilateral balanced occlusal scheme.

Similarly, Bhambhani *et al*.,[7] conducted a systematic review comparing occlusal schemes in complete dentures and found that lingualized occlusion was the preferred choice for better function and adaptability, which is in agreement with our findings.

However, study done by EI Agamy *et al*.,[19] concluded that no significant difference was present between the masticatory performance of two occlusal schemes, dentures using the either scheme penetrated the food bolus well and provided adequate stability and stress distribution. Another study done by Wang *et al*.,[5] showed contrary results according to which chewing efficiency was better in complete dentures fabricated with bilateral balanced occlusion along with less wear of the teeth than the dentures with lingualized occlusion. Similarly, a cross over study done by Kumar *et al*.,[20] revealed contrary results to that of our study concluding that mastication, retention and patient comfort was better in bilateral balanced occlusal scheme dentures than that of lingualized occlusion.

LIMITATIONS OF STUDY

The restricted age criteria limit the generalizability of the findings, as the results may not be applicable to a broader population, particularly younger or older individuals outside the studied range. The relatively short study duration prevents an evaluation of the long-term effects of different occlusal schemes on masticatory performance. The use of a single test material (peanuts) may not fully capture the complexity of masticatory function across various food textures. The reliance on a single measurement per participant further constrains the ability to account for intra-individual comprehensive understanding of masticatory efficiency across different occlusal schemes variability. Future research should aim to address these limitations by including a more diverse age cohort, extending follow-up periods, conducting multi-center trials, and integrating both subjective and objective assessments. Moreover, employing a variety of test materials and repeated measurements would provide a more

CONCLUSION

This study shows that Lingualized Occlusion generally leads to better chewing efficiency, particularly among younger participants who performed significantly better compared to those with Balanced Occlusion. Gender-wise males showed improved efficiency with Lingualized Occlusion while females also benefited slightly. For older participants (55–60 years) no significant difference was observed. Thus concluding that Lingualized Occlusion may be a more effective option for optimizing masticatory performance, especially in younger individuals that require complete denture for prosthetic rehabilitation.

ACKNOWLEDGEMENT

The authors wish to pay gratitude to AFID for the resources provided in conducting the research.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SK & MMB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SS & SK: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

MS & MS: Data acquisition, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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