ACP AMERICAN COLLEGE OF PROSTHODONTISTS
Your smile. Our specialty.®

Comparisons of Patient Satisfaction Levels with Complete Dentures of Different Occlusions: A Randomized Clinical Trial

Mohhamadjavad Shirani, DDS,[1] Ramin Mosharraf, DDS, MSc,[2] & Mohammadkazem Shirany, BSc[3]

[1]Dentist, Dental Students' Research Committee, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Associate Professor, Dental Materials Research Center, Department of Prosthodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[3]PhD student, Department of Statistics, University of Michigan, Ann Arbor, MI

Keywords
Patient satisfaction; complete denture; balanced dental occlusion; lingualized occlusion.

Correspondence
Dr. Ramin Mosharraf, Associate Professor, Dental Material Research Center and Department of Prosthodontics, School of Dentistry, Isfahan University of Medical Sciences, Hezar-Jarib Ave, Isfahan, 8174673461 Iran.
E-mail: mosharraf@dnt.mui.ac.ir

Financial support was provided from Isfahan University of Medical Sciences (grant number 190052).

This trial was registered in ClinicalTrials.gov and IRCT as "NCT01493232" and "IRCT201110097749N1," respectively.

The authors declare no potential conflicts of interest.

Accepted July 10, 2013

doi: 10.1111/jopr.12101

Abstract

Purpose: There is a lack of evidence to recommend a particular type of posterior occlusal form for conventional complete dentures. The type of posterior occlusal scheme can affect complete denture stability, retention, and patient satisfaction. The objective of this study was to compare patient satisfaction to three types of complete denture occlusion using a randomized, crossover controlled trial.
Materials and Methods: Three sets of complete dentures were made for each of 15 patients (mean age = 58.87 ± 15.02 years). They received (1) fully bilateral balanced occlusion (BBO), (2) lingualized occlusion, and (3) buccalized occlusion (BO) denture sets in random order. After wearing each set for 6 weeks, patient satisfaction was assessed using a 19-item version of the Oral Health Impact Profile for Edentulous Patients (OHIP-EDENT). Each question was scored on a 1 to 5 scale for patients' problems with dentures (for these ordinal variables, 1 = "never" and 5 = "very often"). These items were first analyzed by Friedman tests and then by Wilcoxon rank tests for 80% test power at the 0.05-alpha level (d = 0.7).
Results: BO resulted in lower avoidance of particular foods and physical disability scores than fully BBO.
Conclusions: With the caution of small sample size, the results of this study provide evidence that use of BO can improve food avoidance and physical disability aspects of patient satisfaction with complete dentures.

A patient's quality of life is greatly affected by his/her satisfaction with complete dentures.[1] Support, retention, and stability are fundamental considerations for a successful prosthesis.[2-4] More patient problems are associated with mandibular conventional complete dentures (CCDs),[1,5] particularly in female patients.[6,7] The stability and retention of mandibular dentures are important factors related to patient satisfaction with CCDs.[8] Meticulous preparation of impressions and polishing and balancing occlusal surfaces improve retention and stability.[2,9]

Unfavorable tongue positions, CCD design defects, unhealthy mucosal conditions, and excessive denture wearing times will increase patient complaints.[10-13] Because of the effects of masticatory postarticulation forces on denture retention and stability, dentures must be adjusted perfectly.[14] Bonwill described how the teeth should be adjusted to obtain balanced occlusion without interference.[15] Occlusal harmony is important for patient comfort. Thus, occlusal adjustments by both laboratory remounts and clinical procedures can increase patient comfort.[16]

It has been stated that dentures with lingualized occlusion (LO) are more stable. Thus, it is the occlusion of choice for patients with severe ridge resorption.[14] Greater chewing ability has been reported for patients with LO or fully bilateral balanced occlusion (FBBO) dentures compared to monoplane occlusion dentures.[17] Clough et al[18] in a crossover randomized clinical trial found that LO was superior to monoplane occlusion in terms of chewing ability and patient comfort. Similar conclusions were reached for better chewing efficacy

and patient preferences for LO and FBBO than for monoplane occlusion.[19] Patients reported greater denture retention satisfaction with LO than with FBBO.[20] At the Dental Hospital of Manchester, Sutton and McCord[21] fabricated three sets of dentures for 45 patients and followed up each set for 8 weeks. Patients reported greater satisfaction with LO dentures than with monoplane occlusions, particularly with regard to sore spots, and also reported that FBBO provided better masticatory function than did a 0° occlusal form. Perfect physiology of restorations in terms of biomechanical concepts in occlusion provide for better stomatognathic system health.[22]

In light of the previously cited studies, although LO and FBBO provide relatively better CCD satisfaction, some patients still have problems with dentures, particularly mandibular problems. Further, the necessity for complete dentures is not likely to decrease in the near future, and investigators should pay close attention to improving CCDs.[23] In this study, we sought to present and evaluate a new occlusal scheme[14,18,21,24-27] for the first and to compare patient satisfaction with it to LO and FBBO. Buccalized occlusion (BO) provides for simple occlusal adjustments and less occlusal interference and surface contacts between maxillary and mandibular teeth. Consequently, there should be fewer mandibular denture loadings and dislodgings because of its movements, and possibly greater CCD retention without unpleasant dark spaces between maxillary and mandibular buccal cusps in centric positions. Our null hypothesis was that there would be no difference in patient satisfaction with complete dentures fabricated with either a fully bilateral balanced, lingualized, or buccalized occlusion.

Materials and methods

Patient satisfaction with complete dentures with different types of occlusions was compared in a crossover randomized clinical study. For each patient, three sets of complete dentures were made using different posterior occlusal schemes: FBBO, LO, and BO in a completely balanced manner. Fifteen patients used these sets in a random order. After wearing each set for a 6-week period, patient satisfaction was recorded. The Isfahan Regional Bioethics Committee granted ethical approval for our study protocol.

For cluster sampling, after selection of five prosthodontists, we enrolled edentulous patients of their students, in the Torabinejad Dental Research Center. The inclusion criteria were as follows: having ideal maxillomandibular relationships (cl I and mild cl II, cl III Skeletal base classification); absence of severely resorbed ridges; and completely edentulous for at least 3 months. These patients also had to provide written informed consent. Exclusion criteria were uncontrolled systemic disease, mental problems, and unwillingness to remain in the study. Uncooperative patients before tooth selection were not allowed to continue in the study.

A list was prepared with 15 rows, for which the types and order of dentures were determined randomly in three categories in front of each number. Patients were arranged randomly in this list using a random number generator created with a calculator when tooth size and color were selected. Five patients were assigned to each intervention category. One intervention group first received FBBO, then LO, and finally BO. A second group received LO, BO, and FBBO, respectively, and the third group received BO, FBBO, and LO, in that order.

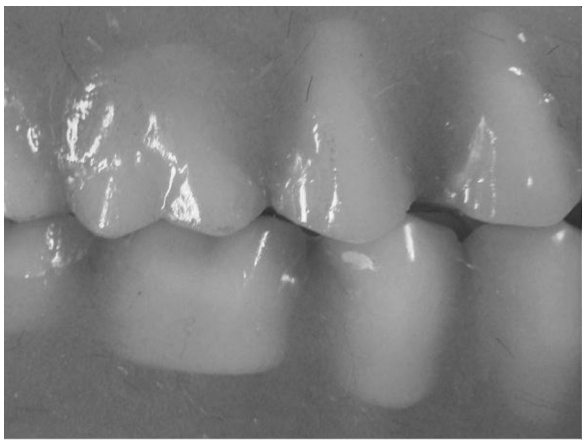

Figure 1 Buccal view of fully bilateral balanced occlusion.

Clinical procedures were performed by dental students. All clinical and laboratory procedures that appeared to be similar (duplicating definitive casts, making a record base, verifying records, LO and BO set arrangements, denture waxing, remounting and occlusal adjustments, finishing and polishing, denture insertion, and recall appointments) were performed by one student and observed by one experienced prosthodontist (MR).

The denture fabrication process consisted of making a preliminary impression with irreversible hydrocolloid (Iralgin; Golchay, Tehran, Iran) and pouring with type II stone (Dental Stone; Pars Dandan, Tehran, Iran), making a special autopolymerizing resin (Acropars; Marlik, Tehran, Iran) tray, border molding with a modeling plastic impression compound (Impression Compound; Kerr, Salerno, Italy), making a zinc oxide eugenol (Luralite; Kerr) definitive impression, boxing it, and pouring the final cast with type III stone (Dental Stone). Each final cast was duplicated three times using reversible hydrocolloid (Grun, Hinrigel, Germany). After recording the maxillomandibular relationship with the modeling plastic impression compound on wax rims (Modeling Wax; Dentsply, Hoorn, UK) over an autopolymerizing baseplate, final casts were mounted[28] with an average value articulator (Free Plan; Pars Dandan), and an anatomic 30° tooth set was selected (Teeth Mold; Myerson, Laventille, Trinidad & Tobago) with the same size and color for each of the three sets.

All students arranged an FBBO set with anterior teeth and attempted to fit it in. An FBBO (Figs 1 to 3) was defined as the bilateral, simultaneously anterior, and posterior occlusal contact of teeth in centric and eccentric positions.[29] After final tooth adjustment and registering the verifying records by one experienced prosthodontist for all patients, two other sets of eight maxillary and mandibular incisors in the articulator were arranged by putty index (Speedex; Coltene, Alstatten, Switzerland) so that the position of the anterior teeth would be similar for each three sets in each of the 15 patients, and posterior mandibular teeth were articulated against the FBBO maxillary teeth. An LO (Figs 4 to 6) tooth arrangement was described not only by articulation of the maxillary palatal cusps with the

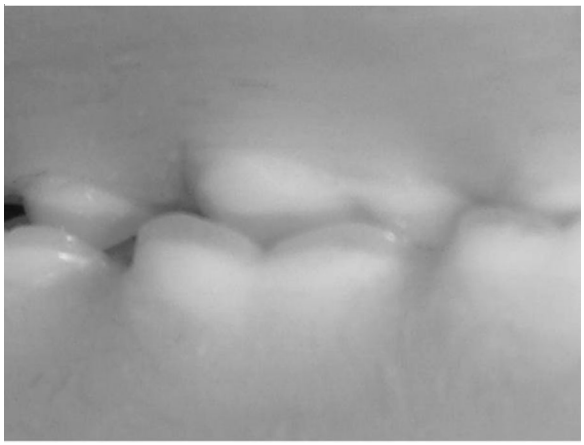

Figure 2 Lingual view of fully bilateral balanced occlusion.

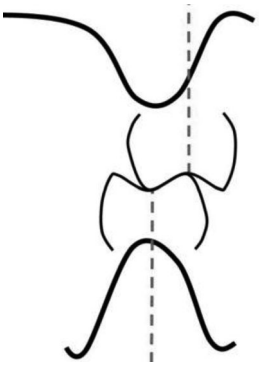

Figure 3 Fully bilateral balanced occlusion.

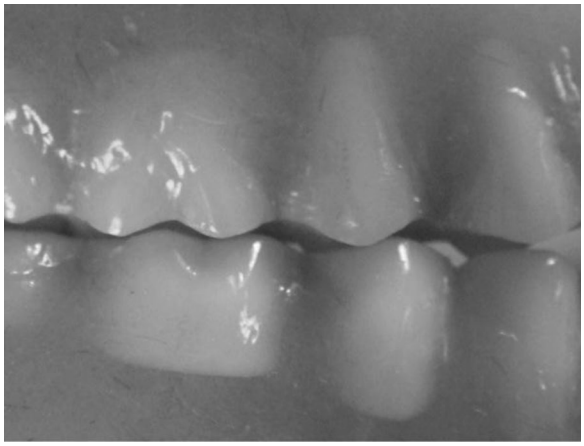

Figure 4 Buccal view of lingualized occlusion.

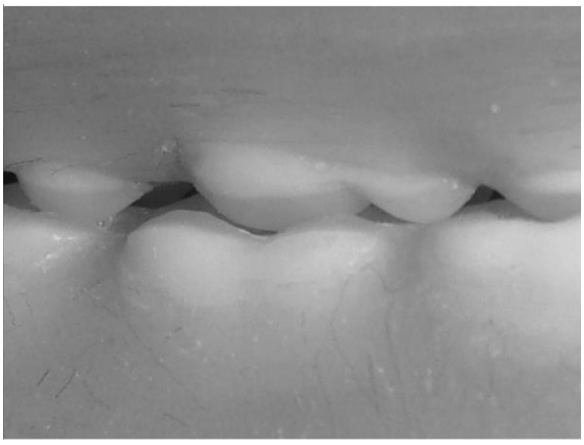

Figure 5 Lingual view of lingualized occlusion.

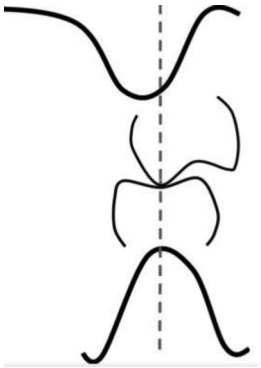

Figure 6 Lingualized occlusion.

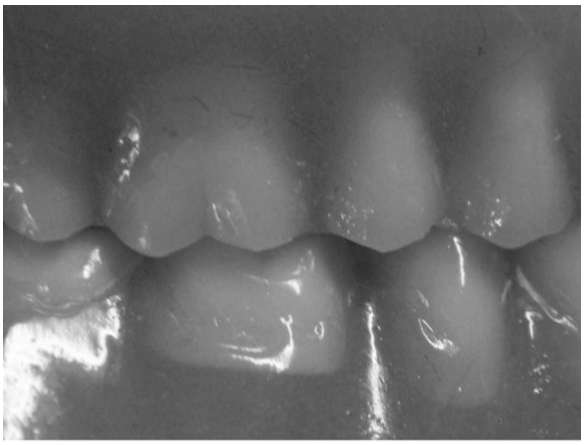

Figure 7 Buccal view of buccalized occlusion.

opposing mandibular occlusal surfaces but also by maxillary buccal cusps, which were not allowed to contact the mandibular teeth in centric or eccentric positions. The contacts at the balanced side were between maxillary palatal and mandibular buccal cusps.[26] When BO (Figs 7 to 9) sets were to be arranged, mandibular posterior teeth were primarily moved and tilted somewhat to the lingual until mandibular buccal cusp tips were located against the mandibular ridge crest. After grinding the lingual slopes of the maxillary buccal cusps, they were arranged in position so that buccal cusps were about 0.5 mm higher than palatal cusps. Finally, the four remaining cuspids were positioned. After tooth arrangement was complete, denture sets were waxed.

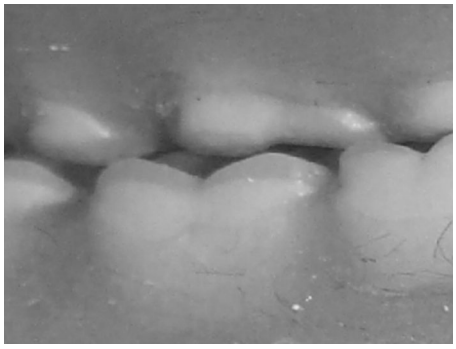

Figure 8 Lingual view of buccalized occlusion.

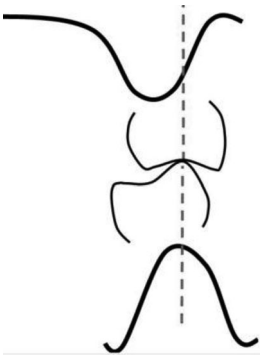

Figure 9 Buccalized occlusion.

They were flasked and processed by the same flasking procedure (Flask; Ash, Plymouth, UK), wax was removed, a thin foil substitute was painted, packed with resin (Ivoclar Vivadent, Schaan, Liechtenstein, Germany), cured by machine (Type 5518; Kavo, Warthausen, Germany), and deflasked. These procedures were performed by one technician. Dentures were remounted using an average articulator value by remounting casts, and occlusal adjustments were made to achieve BO. Buccal slopes of lingual cusps and lingual slopes in buccal cusps were reduced for mandibular teeth of LO sets. BO was adjusted with all mandibular buccal cusps articulating to opposite surfaces of maxillary posterior teeth, all maxillary palatal cusps were reduced about 0.5 mm, and there was no contact between these and mandibular teeth in centric and eccentric positions. The contacts were settled to be between maxillary palatal and mandibular buccal cusps for the balancing side.

Finishing and polishing were performed using laboratory carbide burs (Carbide Bur; Renfert, Hinzingen, Germany), super-flex and soft-flex abrasive paper (Schleifpapier; Matador Wasserfest, Leipzig, Germany), and pumicing (White Pumice; Hess Pumice, Malad City, ID) with a prepared rag wheel.

Patients were blinded to the dentures they wore. A 4-hour period between changes in dentures between two sets was set as a wash-out period.[30] During the study, only one set of dentures was retained by the patients at a time until all three sets were delivered. After wearing each set for a 6-week period, according to the predetermined list, patient satisfaction was evaluated by interview using the Oral Health Impact Profile for Edentulous Patients (OHIP-EDENT) questionnaire. Interviews were conducted by one impartial interrogator for all patients. In previous studies, the 14-, 19-, 20-, and 49-question versions of this questionnaire were presented.[1,21,31] Due to the length of the 49-item version of the OHIP-EDENT, it is not applicable in the clinical setting.[1] The extra item in the 20-question version in contrast with the 19-question version is an item about unclear speech, whose influence can already be observed in the discomfort items as 'self-conciousness'. On the other hand, the 14-question version may change the efficacy of the instrument.[31] For this study, a 19-question version (of 49 items) of the OHIP-EDENT was used. Each question was scored on a 1-to-5 scale. For these ordinal variables, 1 = "never" and 5 = "very often." Each question was weighted.[1] The 19 questions pertained to seven domains as follows: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. When the domain's scores were to be calculated, the weights for each item were considered. After translating this questionnaire, content validity was verified by two experienced prosthodontists, and face validity was investigated in a pilot study. Cronbach's alpha ($\alpha = 0.906$) and the intraclass correlation coefficients were determined to confirm test reliability.

Based on previous similar studies, 14 patients with each method were required for 80% test power to identify significant differences in median values at the 5% level ($d = 0.7$); however, because of three comparison groups, considering Bonferroni adjustment, $p < 0.0167$ ($0.05/3 = 0.0167$) was deemed to be significant. One patient was added to divide them into three equal groups. The alpha level was verified in all tests at 0.05. Data analysis was performed using SPSS version 16.0 statistical software (SPSS, Inc., Chicago, IL) by a statistician blinded to the study patients and treatments. Data were first compared by Friedman tests. Then a Wilcoxon test was used to compare the paired results for the different groups.

Thirty-six patients were initially examined by an experienced prosthodontist, out of which 30 were selected for this study. These patients were asked to provide written informed consent within 1 week; 20 signed these informed consent forms. Three patients refused to continue participating before tooth selection during the clinical procedures. Two were excluded due to noncooperation. One left during the study because of incompatibility with the first set of dentures, and another patient was entered instead. Finally, 15 patients (8 males, 7 females) completed the 18-week follow-up period.

Results

Figure 10 shows a flow chart for the patients throughout this study. First, *p*-values from Friedman tests between the three denture sets were determined for each question (Table 1). Then, those questions with $p \leq 0.1$ were examined by Wilcoxon signed rank tests (Table 2). The frequencies, mean values, and standard deviations of the identified items from Table 2 are shown in Table 3. FBBO was scored significantly higher for

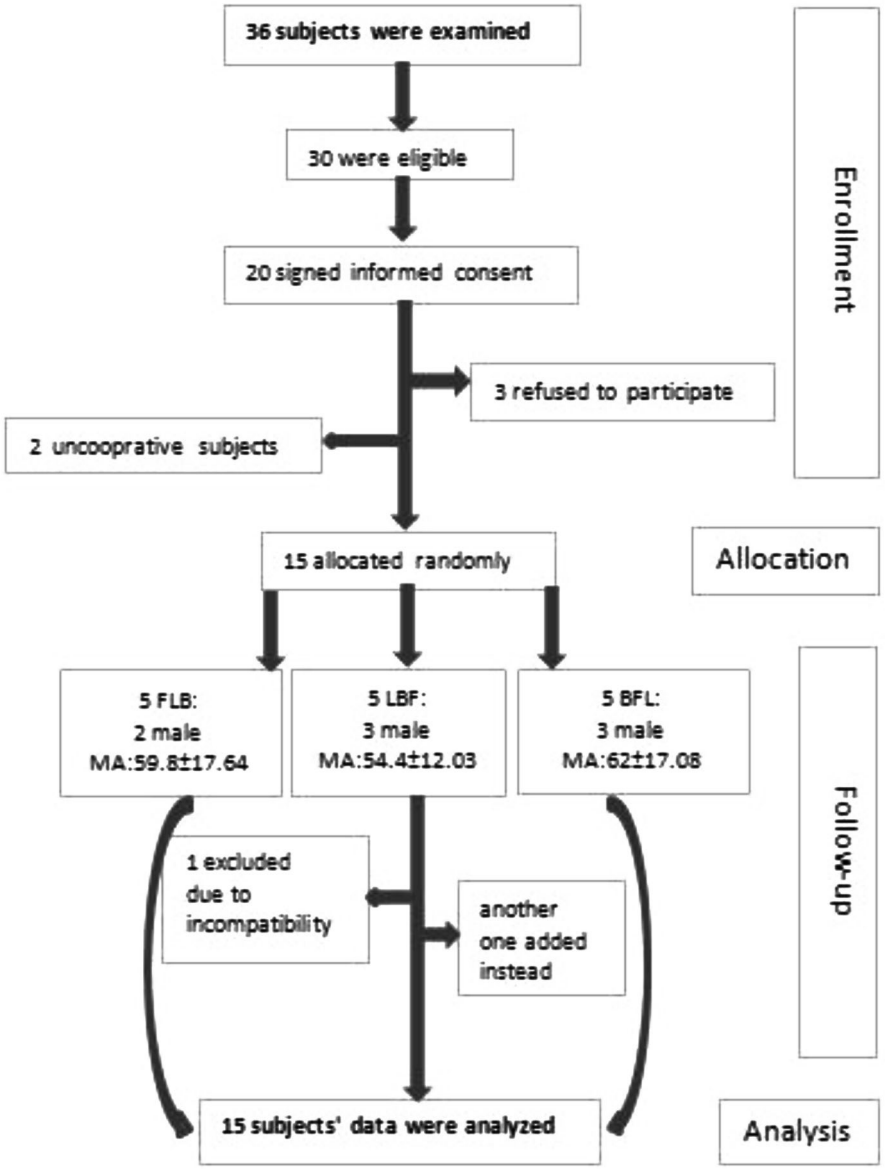

Figure 10 Diagram of trial phases. F: Fully bilateral balanced occlusion. L: Lingualized occlusion. B: Buccalized occlusion. MA: Mean Age ± Standard deviation (years).

uncomfortable eating than LO, and also higher for avoiding particular foods than both LO and BO. FBBO was scored significantly lower for uncomfortable dentures than LO. No other significant differences were found after comparing the other items.

Each domain score's median was calculated using the weights noted in Table 1, and the total score was also calculated for each set (Table 4). Table 5 shows the *p*-values for these scores derived from Wilcoxon signed rank tests. FBBO had a significantly higher score for physical disability than BO. Cronbach's alpha values for the FBBO, LO, and BO denture sets were 0.864, 0.896, and 0.924, respectively.

Discussion

The null hypothesis of our study was that there would be no differences in patient satisfaction with complete dentures made with either a fully bilateral balanced, lingualized, or buccalized occlusion; this hypothesis was rejected. With FBBO, patients had more unpleasant eating experiences than with LO, and a greater tendency to avoid eating some foods than with LO and BO. The reason for these differences may have been worse masticatory performance with FBBO than BO with regard to a more occlusal contact surface that causes more dislodging of dentures on eccentric movements and force to penetrate

Table 1 OHIP -EDENT and *p*-values from the Friedman test

Domain	Question	Weight	Items	*p*-value
FL	1	1.253	Chewing problems	0.06[a]
FL	2	1.181	Food catching	0.54
P1	3	1.213	Pain in mouth	0.06[a]
P1	4	0.998	Uncomfortable eating any food	0.008[a]
P1	5	1.264	Sore spots	0.02[a]
FL	6	1.472	Fitting improperly	0.12
P1	7	1.002	Uncomfortable denture	0.009[a]
P2	8	2.006	Worried about dental problems	0.42
P2	9	1.902	Self-conscious due to denture	0.60
D1	10	1.266	Avoid eating some foods	0.001[a]
D1	11	1.351	Unable to eat	0.65
D1	12	0.952	Interrupted meals	0.17
D2	13	1.393	Upset because of denture problems	0.36
D2	14	1.437	Embarrassed by denture problems	0.60
D3	15	1.572	Avoid going out	0.13
D3	16	2.555	Less tolerant with family	0.03[a]
D3	17	1.236	Irritable with other people	0.47
H	18	1.545	Dislike other peoples' company	1
H	19	1.567	Lower life satisfaction	0.77

FL = functional limitation.
P1 = physical pain.
P2 = psychological discomfort.
D1 = physical disability.
D2 = psychological disability.
D3 = social disability.
H = handicap.
[a]Items with $p < 0.1$ for analysis in the next step (Table 2).

Table 2 *p*-values from the Wilcoxon signed rank test

Question	FBBO vs. LO	FBBO vs. BO	LO vs. BO
1	0.050	0.111	0.527
3	0.167	0.167	1
4	0.013[a]	0.031	0.257
5	0.124	0.112	0.564
7	0.014[a]	0.157	0.046
10	0.010[a]	0.006*	1
16	0.063	0.317	0.102

[a]Significant at $p < 0.0167$.

Table 3 Frequencies, mean values, and standard deviations of questions 4, 7, and 10

	Frequencies						
Question	1	2	3	4	5	Mean	Std dev
4 FBBO	5	6	0	2	2	2.33	1.44
4 LO	13	1	0	0	1	1.33	1.04
4 BO	11	2	1	0	1	1.53	1.12
7 FBBO	12	1	1	0	0	1.33	0.72
7 LO	8	5	0	2	0	1.73	1.03
7 BO	11	2	1	1	0	1.47	0.91
10 FBBO	5	5	2	2	1	2.27	1.28
10 LO	11	2	2	0	0	1.40	0.73
10 BO	11	5	0	2	0	1.40	0.73

1 = never; 2 = hardly ever; 3 = occasionally; 4 = fairly often; 5 = very often.

Table 4 Weighted median values of domains and sum scores

Domain	FBBO	LO	BO
FI	9.13	7.81	8.77
P1	7.95	6.68	5.47
P2	3.90	3.90	5.81
D1	6.10	4.52	3.56
D2	2.83	2.83	2.83
D3	5.36	5.36	5.36
H	3.11	3.11	3.11
Sum	41.10	35.92	34.57

Table 5 Domains' *p*-values from the Wilcoxon signed rank test (*significant at $p < 0.0167$)

Domain	FBBO vs. LO	FBBO vs. BO	LO vs. BO
FI	0.020	0.093	0.413
P1	0.034	0.041	0.497
P2	1	0.305	0.222
D1	0.114	0.009*	0.313
D2	0.593	0.285	0.891
D3	0.028	1	0.041
H	0.715	0.593	0.564
Sum	0.048	0.026	0.27

Example: FI = (1.253 × question 1 score) + (1.181 × question 2 score) + (1.472 × question 6 score).
Sum score = FL + P1 + P2 + D1 + D2 + D3 + H.

the cusps into foods.[14] The inability to perform activities was described as "physical disability."[1,31]

Clough et al[18] fabricated dentures for 30 patients in a crossover randomized clinical trial. The dentures were worn for a 3-week period and then exchanged. They found that LO was superior to monoplane occlusion in terms of chewing ability, patient comfort, and esthetics. In 2007, Sutton and McCord[21] prepared three sets of dentures for 45 patients and followed up each set for 8 weeks. Patients reported greater satisfaction with LO dentures than with monoplane occlusions, particularly with regard to sore spots, and also reported that FBBO provided better masticatory function compared with a 0° occlusal form.

Masticatory efficiency was evaluated using objective food tests and a subjective questionnaire by Khamis et al.[19] They found patient preference for the FBBO and LO as opposed to monoplane occlusion by their improved ability to chew hard foods with no differences between these two (FBBO, LO). Similar conclusions were reached for better masticatory efficiency for LO[18] and FBBO than monoplane occlusion.[21] However, Kydd[27] found no differences between complete dentures when assessed for masticatory efficiency for these three occlusal schemes. Furthermore, Matsumaru[14] suggested that patients with severely resorbed ridges treated with FBBO present decreased masticatory efficiency in contrast with LO, while Kimoto et al[20] reported no significant differences between these two.

The findings of this study were similar to those of previous trials that compared LO and FBBO.[18,21] FBBO is not

obligatory for a successful complete denture. Only simple occlusal adjustments are needed for LO and BO. Additionally, LO and BO present less occlusal interference and surface contacts between maxillary and mandibular teeth and, consequently, fewer mandibular denture loadings and dislodgings on laterotrusion movements.[16,24] Therefore FBBO presents worse masticatory performance,[8,14,26] a distinct FBBO disadvantage. With BO in centric position, occlusal forces are transferred to ridge crests because of the direction of resorption in which the mandibular crest is moved buccally rather than toward the maxilla in molar regions.[30] BO increased retention and stability, and it can be used successfully in patients with a more buccally inclined posterior mandibular ridge crest than one inclined toward the maxilla. A new BO was perceived to be successful, although the investigators proposed that the occlusal design for patients should be selected based on the conditions of their ridges.

The limitations of this study included the small number of patients, restrictions for performing the clinical procedures, a short wash-out period, and assistance by multiple students; however, the students were instructed similarly, and in addition, all steps should be similar when performed by one student. Another limitation was the lack of prefabricated tooth molds for BO. Perhaps tooth grinding and loss of tooth glaze biased the results by enticing patients. The short duration of follow-up and no matching for age and gender were also limitations. Bias was minimized by close attention to simulation during denture fabrication, insertion, and the follow-up period, and by randomly allocating patients according to a predetermined list. The effect of intervention was increased by one mounting procedure with a single record, one verifying record, indices for teeth arrangement, and insertions by the same person. Future patient-oriented investigations on comparing patient satisfaction with dentures should be made based on maxillomandibular relationships and locations of ridge crests after designing BO tooth molds with smaller mandibular posterior teeth, particularly lingual parts for preserving neutral zones.

Conclusion

With the caution of our small sample size, the results of this study provided proof of principle that in patients within ideal maxillomandibular relationships with mild and moderately resorbed ridges, FBBO scored significantly higher for uncomfortable eating and avoiding particular foods than LO. Also, FBBO scored significantly higher for avoiding particular foods and physical disability than BO. Furthermore, FBBO scored significantly lower for uncomfortable dentures than LO.

Acknowledgments

The authors gratefully acknowledge the Isfahan Regional Bioethics Committee for ethical approval, and Dr. Behnaz Ebadian.

References

1. Adam RZ: Do complete dentures improve the quality of life of patients? Department of Restorative Dentistry, Faculty of Dentistry and World Health Organisation (WHO) Oral Health Collaborating Centre, University of the Western Cape, 2006
2. Jacobson T, Krol A: A contemporary review of the factors involved in complete denture retention, stability, and support. Part I: retention. J Prosthet Dent 1983;49:5-15
3. Jacobson T, Krol A: A contemporary review of the factors involved in complete dentures. Part III: support. J Prosthet Dent 1983;49:306-313
4. Jacobson T, Krol A: A contemporary review of the factors involved in complete dentures. Part II: stability. J Prosthet Dent 1983;49:165-172
5. Celebic A, Knezovic-Zlataric D: A comparison of patient's satisfaction between complete and partial removable denture wearers. J Dent 2003;31:445-451
6. Divaris K, Ntounis A, Marinis A, et al: Patients' profiles and perceptions of complete dentures in a university dental clinic. Int J Prosthodont 2012;25:145-147
7. Pan S, Awad M, Thomason JM, et al: Sex differences in denture satisfaction. J Dent 2008;36:301-308
8. Fenlon MR, Sherriff M: An investigation of factors influencing patients' satisfaction with new complete dentures using structural equation modelling. J Dent 2008;36:427-434
9. Patil PG: Conventional complete denture for a left segmental mandibulectomy patient: a clinical report. J Prosthodont Res 2010;54:192-197
10. Bohnenkamp DM, Garcia LT: Phonetics and tongue position to improve mandibular denture retention: a clinical report. J Prosthet Dent 2007;98:344-347
11. Brunello DL, Mandikos MN: Construction faults, age, gender, and relative medical health: factors associated with complaints in complete denture patients. J Prosthet Dent 1998;79:545-554
12. Nikawa H, Makihira S: Research projects related to complete dentures published in 2008 by members of the Japan Prosthodontic Society. J Prosthodont Res 2009;53:103-106
13. Turker SB, Sener ID, Özkan YK: Satisfaction of the complete denture wearers related to various factors. Arch Gerontol Geriatr 2009;49:e126-e129
14. Matsumaru Y: Influence of mandibular residual ridge resorption on objective masticatory measures of lingualized and fully bilateral balanced denture articulation. J Prosthodont Res 2010;54:112-118
15. Engelmeier RL: Early designs for the occlusal anatomy of posterior denture teeth: part III. J Prosthodont 2005;14:131-136
16. Shigli K, Angadi GS, Hegde P: The effect of remount procedures on patient comfort for complete denture treatment. J Prosthet Dent 2008;99:66-72
17. Sutton A, Worthington H, McCord J: RCT comparing posterior occlusal forms for complete dentures. J Dent Res 2007;86:651-655
18. Clough HE, Knodle JM, Leeper SH, et al: A comparison of lingualized occlusion and monoplane occlusion in complete dentures. J Prosthet Dent 1983;50:176-179
19. Khamis MM, Zaki HS, Rudy TE: A comparison of the effect of different occlusal forms in mandibular implant overdentures. J Prosthet Dent 1998;79:422-429
20. Kimoto S, Ghunji A, Yamakawa A, et al: Prospective clinical trial comparing lingualized occlusion to bilateral balanced occlusion in complete dentures: a pilot study. Int J Prosthodont 2006;19:103-109
21. Sutton A, McCord J: A randomized clinical trial comparing anatomic, lingualized, and zero-degree posterior occlusal forms for complete dentures. J Prosthet Dent 2007;97:292-298

22. Racich MJ: Orofacial pain and occlusion: Is there a link? An overview of current concepts and the clinical implications. J Prosthet Dent 2005;93:189-196
23. Carlsson GE, Omar R: The future of complete dentures in oral rehabilitation. A critical review. J Oral Rehabil 2010;37:143-156
24. Becker CM, Swoope CC, Guckes AD: Lingualized occlusion for removable prosthodontics. J Prosthet Dent 1977;38:601-608
25. Farias-Neto A, Carreiro Ada F: Complete denture occlusion: an evidence-based approach. J Prosthodont 2013;22:94-97
26. Phoenix RD, Engelmeier RL: Lingualized occlusion revisited. J Prosthet Dent 2010;104:342-346
27. Kydd WL: The comminuting efficiency of varied occlusal tooth form and the associated deformation of the complete denture base. J Am Dent Assoc 1960;61:465-471
28. Heydecke G, Vogeler M, Wolkewitz M, et al: Simplified versus comprehensive fabrication of complete dentures: patient ratings of denture satisfaction from a randomized crossover trial. Quintessence Int 2008;39:107-116
29. The glossary of prosthodontic terms. J Prosthet Dent 2005;94:10-92
30. Zarb GA, Bolender CL: Prosthodontic Treatment for Edentulous Patients (ed 12). St. Louis, Mosby, 2004, p. 259
31. Allen PF, Locker D: A modified short version of the oral health impact profile for assessing health-related quality of life in edentulous adults. Int J Prosthodont 2002;15:446-450