Review Article

Patient Satisfaction with Lingualized Occlusion Compared to Bilateral Balanced Occlusion in Conventional Complete Dentures: A Systematic Review

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Abstract

Purpose: The purpose of this systematic review is to determine Lingualized Occlusion (LO) as an alternative occlusal scheme for routine complete dentures in terms of patient satisfaction and comfort.

Material and Methods: Electronic research was conducted using for articles published between January 1, 2000 and July 31, 2020, search PubMed (including MEDLINE), the Cochrane database, and Google Scholar. The inclusion criteria were used to choose studies relating different occlusal schemes for complete denture. The risk of bias was evaluated using the Cochrane's Risk of Bias (ROB -2) tool.

Results: After applying the inclusion and exclusion criteria 12 articles were systematically reviewed. The random sequence generation domain reveals a high risk of bias in the studies with Nadira et al, Mohammad et al, Deniz et al, Kawai et al and Jiyar et al. These authors did not use computers or computer-generated random numbers or random block assessment for random sequence generation. Low risk of bias was found in the studies with Shirani et al, Hedaiat et al, Abdallah et al, Savvas et al and Caitlin et al as they have used tools such as computers or computer- generated random numbers or random block assessment for random sequence generation for random sequence generation thereby decreasing the bias and improving the quality of their study. Thus, most of the studies included in this systematic review revealed that the patient satisfaction levels were significantly higher for lingualized occlusion as compared to bilateral balanced occlusion.

Conclusion: According to this comprehensive review, BBO does not improve satisfaction or masticatory performance. Thus, in terms of quality of life/satisfaction and masticatory function, lingualized occlusion can be deemed a predictable occlusal scheme for complete dentures. As a result, additional research is required to corroborate the study's findings.

Introduction

Health has been defined as "a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity" by the World Health Organization. The onset of edentulism is a prevalent problem in senior people [1]. Though the prevalence of edentulism is decreasing in developed countries, the number of older persons in those communities is increasing. According to the United Nations Population Division (UN 2011), the proportion of India's population aged 60 and more is expected to increase from 8% in 2010 to 19% by 2050 [2]. As a result, more patients will become edentulous as they get older, when they are less able to adapt to the constraints of a complete denture [1]. A complete denture is a removable prosthesis used when all of the teeth in a jaw have been lost and must be replaced prosthetically. In contrast to a partial denture, a complete denture is made when there are no more teeth in an arch, making it a tissue-supported prosthesis. Natural teeth, a partial or complete denture, fixed appliances, or, in some cases, soft tissues can all be used to oppose a complete denture. Because complete dentures rest on the oral mucosa and are in close contact to tissues that are continually changing

owing to muscular action, they are susceptible to a variety of displacement forces of varying magnitude.

According to Fish, complete dentures have three surfaces: the impression or intaglio surface, the polished surface, and the occlusal surface. The design of these three surfaces governs denture retention, stability, and support [3]. Among the principles considered essential for complete denture success is occlusion [3]. Occlusion is defined as the "static relationship between the incisive and masticatory surfaces of maxillary and mandibular teeth or analogues of teeth" (GPT 1994).

Occlusion is thought to have been designed to work efficiently while providing the least amount of harm to the supporting tissues. In a broader sense, a complete denture occlusion is the mechanism that involves the closure of the maxillary and mandibular teeth in centric relation. It happens throughout the mandible's functional and non-functional movements. Any occlusal force applied to one segment of the denture must be matched by force delivered to the other segment, resulting in balanced occlusion [3].

Many authors believe that bilateral symmetrical articulation is essential for treatment success. During eccentric motions, this occlusal idea depicts posterior contacts on both sides of the jaw (working side and balancing side) [9]. According to proponents of balanced articulation, this occlusal concept enhances retention and stability while also providing superior masticatory performance [8].

Bonwill pioneered the concept of balanced articulation in 1878 [10]. He believed that putting the most grinding surfaces into contact with each movement would equalize the action of the muscles on both sides at the same time [9]. As a result, pressure and force would be distributed equally on both sides of the dental arches. However, there is no balancing contact during functional activities such as eating, drinking, speaking, or singing. The term 'Enter Bolus and Exit Balance' was coined in the 1960s to describe the loss of occlusal balance during mastication. Balancing interactions are not observed during mastication and are most likely not physiologically required.

It is regarded as a perfect occlusion for complete dentures [11]. However, BBO may be difficult to attain clinically and time-consuming to master [12], thus a less sophisticated occlusal system that meets clinical needs is required. Several occlusal approaches for complete dentures have arisen to circumvent these restrictions.

Lingualized occlusion is an attempt to maintain the anatomic form's aesthetic and food penetration advantages while retaining the mechanical freedom of the nonanatomic form. In the lingualized idea, anatomic teeth are used for the maxillary denture and modified nonanatomic or semi-anatomic teeth for the mandibular denture. Gysi pioneered the concept of lingualized articulation in 1927. Payne published a report in 1941 on Farmer's posterior setup, which included 30° cusp teeth that were carefully molded to satisfy the concept of lingualized articulation and the particular needs of edentulous individuals [7].

Only the maxillary palatal cusps occlude in the mandibular central fossa with lingualized occlusion. The maxillary posterior teeth are moved slightly to eliminate all buccal cusp contact [7]. Balanced occlusion can be obtained before anterior tooth contact at maximum intercuspation if the horizontal overlap between the anterior teeth is 3-4 mm [7].

The stomatognathic system includes complete denture occlusion, which is more than just the arrangement of maxillary and mandibular teeth [7]. The primary focus is for the health and preservation of the supporting structures. To avoid deflective or excessive stresses transferred to the underlying structures, we must evaluate all biologic, physiologic, and mechanical elements that favour the stability of the denture foundation [7]. Therefore, a less-complicated occlusal scheme fulfilling clinical requirements became necessary [28]. An optimal occlusal surface design/ scheme is essential for successful complete denture retention, stability, and support [1]. The purpose of this systematic review was to determine Lingualized Occlusion (LO) as an alternative occlusal scheme for routine complete dentures in terms of patient satisfaction and comfort.

Materials and Methods

This systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement criteria. The protocol for the systematic review and meta-analysis was registered at the international prospective register of systematic reviews (PROSPERO- CRD42021276452) and followed the Preferred Reporting Items for Systematic Reviews and Meta Analysis - Diagnostic Test Accuracy (PRISMA- DTA) checklist [22]. (Also, it is available at following link. https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=276452.

The research question formulated by using a patient or Population, Intervention, Comparison, and Outcome (PICO) framework [23] (Table 1) was "Is lingualized occlusion an alternative occlusal scheme for routine complete dentures in terms of patient satisfaction and comfort?"

An electronic search of the PubMed (including MEDLINE) and Cochrane Central databases, as well as the Google Scholar search engine, was conducted independently by three authors (N.A.S., J.I., and P.R.T.) using the key concept table, which included keywords, MeSH terms, and free text terms (Supplementary Table 1, available online). The clinical trials database,

Table 1: PICOS element.

Element	Content
Population	Conventional complete dentures
Intervention	Lingualized occlusion
Comparison	Bilateral balanced occlusion
Outcome	Patient satisfaction level
Study design	In- vitro study

PICOS, population, intervention, comparison, outcome, and study design.
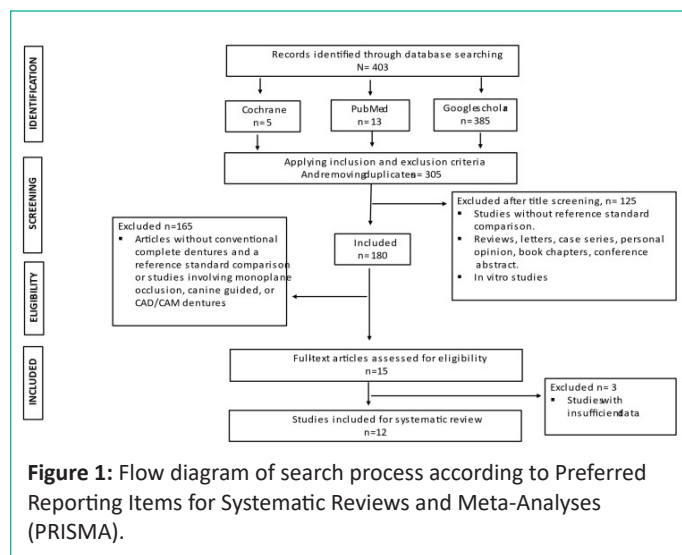

Figure 1: Flow diagram of search process according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

cross-referencing, and non-peer-reviewed literature searches were carried out using the Google Scholar, Greylist, and Open-Grey databases. A hand search was conducted in addition to the electronic search, and reference lists from the selected publications were inspected. Three authors (N.A.S., J.I., and P.R.T.) conducted the search and screening in accordance with the previously stated protocol. Initially, three reviewers (N.A.S., J.I., and P.R.T.) assessed all article titles and abstracts, removing papers that did not match the inclusion criteria. The selected full-text publications were then evaluated and screened independently by the same reviewers. Any disagreements were settled by dialogue. When the three reviewers could not agree, a fourth reviewer (J.N.) was brought in to make the final decision. Randomized control trials, clinical human studies comparing lingualized and bilateral balanced occlusion for conventional complete denture, articles written in English language only and studies between 2000-2021 were included in the risk of bias assessment. Animal studies, In vitro studies, review letters, personal opinions and articles other than English language were excluded. To remove duplicates, the included studies were imported into a software application (Mendeley Desktop, Version 1.19.8; Elsevier, Mendeley Ltd). Figure 1 depicts a PRISMA flowchart with a descriptive description of data selection [14].

Cochrane's risk of bias (ROB -2) tool was used to assess the methodological quality or risk of bias for the included studies across the following domains: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) through its signalling questions which were answered "Yes", "Probably Yes", "No", "Probably No" and "No information". Based on the domains, three authors (N.A.S., J.I., and P.R.T.) independently appraised the risk of bias of all the studies included in the systematic review (Supplementary Table 2, available online). A software tool (RevMan 5.3; The Cochrane Collaboration) was used to graphically exhibit the risk of bias summary and applicability problems.

Results

After deleting duplicates, a total of 403 articles were identified, of which 98 were removed after screening the title, leaving 305 articles. After screening the abstracts, 290 papers were eliminated, leaving 15 articles. After reading the complete text, 12 met the inclusion criteria and were included in the systematic review. Three reviewers (N.A.S., J.I., P.R.T.) independently extracted qualitative data and quantitative data, including occlusal scheme, duration, test performed for patient satisfaction, test performed for masticatory efficiency, study designs from the included studies, summarized in Supplementary Table 3 and available online. For first domain (Random Sequence Generation), all the studies presented with low risk of bias except for Nadira et al 2012, Mohammed at al, Deniz et al, Kawai et al and Jiyar et al [15,17,18,4,24] which reported with high risk of bias. All the included studies reported with low risk of bias for domain second (Allocation concealment), third (Blinding of personnel and participants) and fourth (blinding of outcome assessment). Most of the included studies presented with high risk of bias for domain fifth (Incomplete outcome data) and sixth (self-reporting) except for Kawai et al and Shirani et al. [4,19,20] Only Hedaiat et al reported with high risk of bias for other bias [21] as shown in Figures below. The risk of bias and applicability concern summary is depicted in Figure 2 and 3.
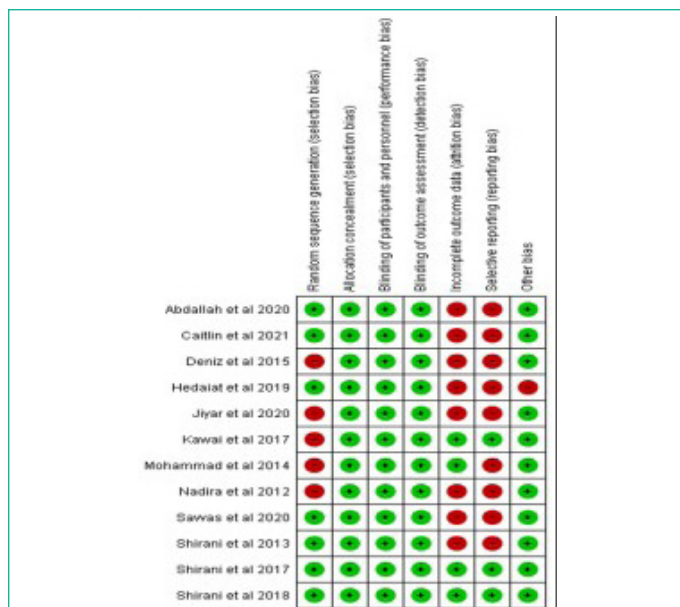

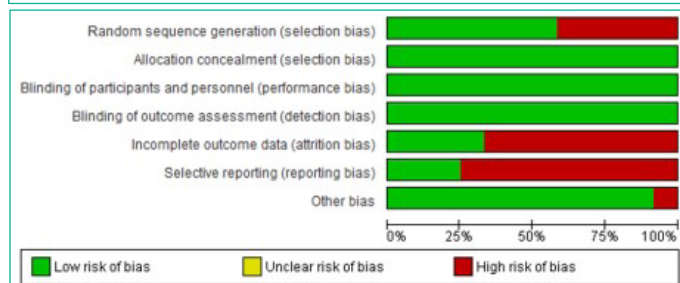**Figure 2:** Risk of bias and applicability concerns summary. (Supplementary)

Figure 3: Risk of bias and applicability concerns graph. (Supplementary)

Discussion

The present study reviewed that the patient satisfaction levels were significantly higher for lingualized occlusion as compared to bilateral balanced occlusion. Twelve studies were selected for analysis. All of the research compared BBO to other occlusal schemes and assessed the impact of occlusal scheme designs on patient satisfaction. The random sequence generation domain reveals a high risk of bias in the studies with Nadira et al, Mohommad et al, Deniz et al, Kawai et al and Jiyar et al. These authors did not use computers or computer-generated random numbers or random block assessment for random sequence generation which could have possibly introduced a bias in their study with respect to the random admission of participants in the study. Low risk of bias was found in the studies with Shirani et al, Hedaiat et al, Abdallah et al, Savvas et al and Caitlin et al as they have used tools such as computers or computer-generated random numbers or random block assessment for random sequence generation for random sequence generation thereby decreasing the bias and improving the quality of their study. Allocation concealment was properly followed for all the studies which are included in this systematic review reveals a low risk of bias. For each patient, two sets of dentures were made using a different occlusal scheme i.e., bilateral balanced and lingualized occlusion. The participants and investigators enrolling participants could not foresee the assignment of the type of occlusion that was delivered.

The blinding outcome has a low risk of bias and was properly followed for all the studies which are included in this systematic review. The outcome was measured after one month in Jiyar et al study, after two months in Shirin et al (2013) study, after three months in Abdallah et al study, after six months in Deniz

et al, Kawai et al and Savvas et al study, after one year in Nadira et al and Hedaiat et al and Caitlin et al study. The incomplete outcome data and selective reporting include the high risk of bias. There were 5 dropouts in Shirani et al (2013) study, 6 dropouts in Kawai et al study, 25 dropouts in Hedaiat et al study, 8 dropouts in Shirani et al (2017), and 3 dropouts in Shirani et al (2018). These dropouts were due to illness, failing to continue and lost intention to continue participating in the study. Abdul (2013) concluded with the help of sieving method that lingualized occlusion scheme was more comfortable and efficient for patients. Nadira et al (2012) reported their results on the DPSQ scale indicated that the patient satisfaction was 66.67% for lingualized occlusion as compared to bilateral balanced occlusion [15]. Mohammad et al (2014) used the 19-item version of OHIP-EDENT to assess patient satisfaction and concluded that lingualized occlusion was more comfortable for the patients [17]. Deiniz (2015) reported patients' satisfaction was higher for lingualized occlusion using an analogue scale. He reported the bilateral balanced occlusion scores for maxillary and mandibular dentures are 4.5 and 3 on the VAS scale respectively, whereas the lingualized occlusion scores for maxillary and mandibular dentures are 5 and 4 on the VAS scale respectively [18]. Kawai et al. (2017) found that only LO individuals with severely atrophied mandibles improved in general satisfaction and total OHIP scores between baseline and 6 months (satisfaction: p = 0.003, OHIP total score: p = 0.0007). 4 Shirani et al used the 19-item version of Oral Health Impact Profile for Edentulous Patients questionnaire and the Visual Analogue Scale (VAS) in their randomised clinical trial to provide evidence that BO is as effective as LO for the fabrication of complete dentures [20].

Hedait et al assessed the items associated to patient satisfaction using a 19-item version of the Oral Health Impact Profile for Edentulous Patients (OHIP-EDENT) and seven 100-mm line visual analogue scales (VASs). There were no significant differences in general patient satisfactions or total OHIP-EDENT ratings across the four groups, according to 21 pairwise comparisons. Jiyar et al reported that the average amount of walnuts that passed through the sieve in LO dentures was (1.78g) at the fourth visit, but it was (1.18g) in BBO dentures. When evaluating the amount of chewed walnuts that passed through the sieve in the second, third, and fourth visits, there was a statistically significant difference between the LO and BBO complete denture schemes (p=0.037, 0.001, and 0.000) [24].

Abdallah et al (2020) instructed participants in their study to chew and swallow 14 of a cookie (coated with pudding and barium powder) with and without denture to measure masticatory duration, number of chewing cycles, number of swallows, oropharyngeal residue, and penetration aspiration observation at baseline, 2 weeks, and 3 months after denture insertion. After 3 months of denture implantation, the lingualized occlusion group demonstrated a statistically significant reduction in masticatory length and number of chewing cycles (p0.05) compared to the BBO group, implying that lingualized occlusion is preferred by patients over balanced occlusion [25].

Savvas et al used the Oral Health Impact Profile-20 (OHIP-20) and the Complete Denture Satisfaction (CDS) questionnaires and found that the mean number of early adjustment visits was the same for both the BBO and LO denture groups and that there were no statistical differences in patient satisfaction levels between the BBO and LO denture groups. Caitlin et al. (2021) used satisfaction and Quality of Life (QoL) indices (the Denture Satisfaction Questionnaire [DSQ] and General Oral Health Assessment Index [GOHAI], respectively) to conclude that the occlusal scheme for posterior teeth had no effect on patient-reported subjective outcomes [27]. The lingualized occlusal plan, on the other hand, required far less changes.

Limitations of this study included that there should be long-term studies with proper follow-up without significant loss of participants. Moreover, there should be larger sample size included in the studies to help make the results significant. Researchers should ensure a lesser number of dropouts by adequately informing and educating the participants of the significance and duration of the study. The study should have proper randomization to ensure random admission of participants to avoid any bias and to make the results significant. Double-blinding which is between the patient and the examiner should be followed to make the study more significant. Another limitation that was faced during the conduction of this systematic review was that the meta-analysis could not be carried out for the included studies. This was due to multiple available patient satisfaction scales or grading systems that were used in different researches and no standardisation of the patient satisfaction scales recommended. The researchers have used different test to perform for patient satisfaction like OHIP-EDENT, OHIP-20, CDS, DSQ, GOHAI, DPSQ, VASA Questionnaire. Hence, researchers should be encouraged to use patient satisfaction tools which classify the data into ordinal form so as to make meta-analysis possible.

Conclusion

According to the findings of this comprehensive review, BBO does not improve satisfaction or masticatory performance. Thus, in terms of quality of life/satisfaction and masticatory function, lingualized occlusion can be deemed a predictable occlusal scheme for complete dentures. As a result, additional research is required to corroborate the study's findings.

Author Statements

Systematic Review

Evaluation of patient satisfaction with lingualized as compared to bilateral balanced occlusion for conventional complete dentures: a systematic review.

Acknowledgments

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