The Effect of Complete Denture Occlusion on Function and Patient Quality of Life: Systematic Review

ABSTRACT

Edentulism presents an ongoing challenge for prosthodontic dentistry. Many aspects of complete denture construction lack contemporary evidence[3]. One such aspect is denture occlusion. Balanced occlusion (BO) has become the prevailing occlusal scheme. It has been suggested that canine guidance (CG) is unsuitable for complete denture occlusion due to an increased risk for tipping of the prostheses[3]. However it may be indicated in patients with minimal alveolus resorption[4]. There has been limited evidence suggesting the superiority of either occlusal scheme over another[5]. This article investigates the available literature assessing complete denture occlusion by means of clinical trials or reviews of evidence. We utilised PRISMA guidelines[6] to investigate the effect of complete denture occlusal scheme (balance occlusion vs. canine guidance) on functional or quality of life. Seven studies were included for review. All studies were poor to moderate quality with the majority lacking randomisation, blinding and demographic data from the study sample. The available evidence suggests that the differences between occlusal schemes may be small, challenging the notion that BO may be the optimal occlusal scheme. There is a need for high-quality clinical research, investigating both chewing ability and quality of life in complete denture wearers in the long-term.

INTRODUCTION

Edentulism is estimated to affect nearly 4 million individuals (based on data from the Office of National Statistics on the UK population size between 2009 and 2016 and the Adult Dental Health Survey 2009).[2,7] Despite statements from both Canada and Britain relating to the cost-benefit of the oral rehabilitation of edentate patients,[8,9] conservative removable complete prostheses remain the mainstay of treatment for this population. As such, it is prudent to rehabilitate these individuals in the most effective way possible, to maximise the effects on oral health-related quality of life, psychosocial health and general health.

This notion must comply with the principles of evidence-based dentistry; a paradigm in which one should strive to use the best quality of scientific evidence to support clinical decision-making and treatment provision.

Many aspects of complete denture prosthesis construction, however, seem to lack contemporary research evidence upholding the current standards of evidence-based dentistry. Whilst this may be an indication that some aspects of this treatment are well understood it has equally been suggested that this aspect of healthcare has fallen foul to the "old truths" of oral rehabilitation;[3,4] whereby taught facts are simply presumed to be correct in the absence of sound evidence.

Keywords

Complete Denture
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Lingualized Occlusion
Quality of Life

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Given, therefore, that edentulism continues to affect such a large population and that conventional removable prostheses remain the mainstay of treatment it is essential to investigate aspects of treatment that may improve patient outcomes and quality of care.

It may be suggested that one such aspect of treatment relates to denture occlusion. Balanced occlusion (BO) has become the prevailing occlusal scheme and may be accompanied by various anatomic tooth forms. It is suggested that this occlusal scheme improves denture stability in function whilst also increasing patient comfort by spreading occlusal loads throughout the arch with working and non-working side cusps in guidance to prevent tipping of the prostheses. Despite this, it is suggested that such an occlusal scheme is poorly maintained following denture provision due to differential rates of denture tooth wear.[3]

An alternative occlusal scheme, canine guidance (CG), aligns with the commonly utilised occlusal scheme in dentate individuals. It has classically been suggested that canine guidance is unsuitable for complete denture occlusion as the anteriorly placed and unbalanced occlusal forces result in tipping of the prostheses impairing comfort and stability. It has been suggested that this may, however, be indicated in patients with minimal alveolus resorption.

Despite the presumptions made about both occlusal schemes, there has been limited evidence suggesting the superiority of either occlusal scheme over another, either in terms of function (for example by assessment of masticatory efficiency) or quality of life.

Sound evidence-based selection of an appropriate occlusal scheme may:

- Improve quality of life
- Reduce the complexity of complete denture construction
- Simplify the process of adjusting occlusion

The present article investigates the available literature, assessing complete denture occlusion by means of clinical trials or reviews of evidence. Its objectives are to:

- Delineate the benefits and consequences of BO and CG on functional or quality of life parameters in complete denture wearers
- To identify if one occlusal scheme is superior to the other with respect to function or quality of life
- To summarise the available evidence in a manner that may guide service provision and support the current evidence base

MATERIALS AND METHODS

PROTOCOL DESIGN

The protocol for this study was constructed following an extended literature review process to define the research question in a PICO format (population, intervention, control, outcome). This conforms to PRISMA guidance and enables a standardised research question to be constructed. The protocol and report were constructed using the "Preferred Reporting Item for Systematic Reviews and Meta-analyses (PRISMA) guidance.[6]

FOCUSED QUESTION

The focused question adopts a PICO format:

What is the effect of complete denture occlusal scheme (balance occlusion vs. canine guidance) on functional ability or quality of life in edentate individuals?

TYPES OF STUDY

The review accepted human clinical trials, whether randomised or not and systematic reviews published in the English language, which investigate comparatively the effect of BO and CG on functional parameters (such as masticatory efficiency) or quality of life (for example by utilising the oral health impact profile OHIP-EDENT).

Articles that were not clinical trials or systematic reviews were excluded. Those published in a language other than English without an available translation were also excluded. Furthermore, articles which were not accessible either digitally or in printed journals were excluded. These are summarised in figure 1.

A publication date range was not set due to the extensive range of publication dates and the lack of more contemporary clinical trials.

SEARCH STRATEGY

A series of preliminary searches were carried out to characterise the field and involved available textbooks,[10,11] available "clinical papers"[12,13] and protocols. These were utilised to identify appropriate search criteria.

Literature searches were carried out using advanced search tools or Boolean operators as appropriate on Pubmed, EBSCOHost, Cochrane Library, CENTRAL database and Google Scholar. Search terms were "denture" AND "occlusion" (Title). This simple combination was used as more complex terms and combinations identified no further studies whilst some combinations also resulted in fewer articles being identified. This is postulated to, at least partly, be the result of the highly variable terminology used in removable prosthetics.

Reference lists from all articles were appraised to identify any further articles.

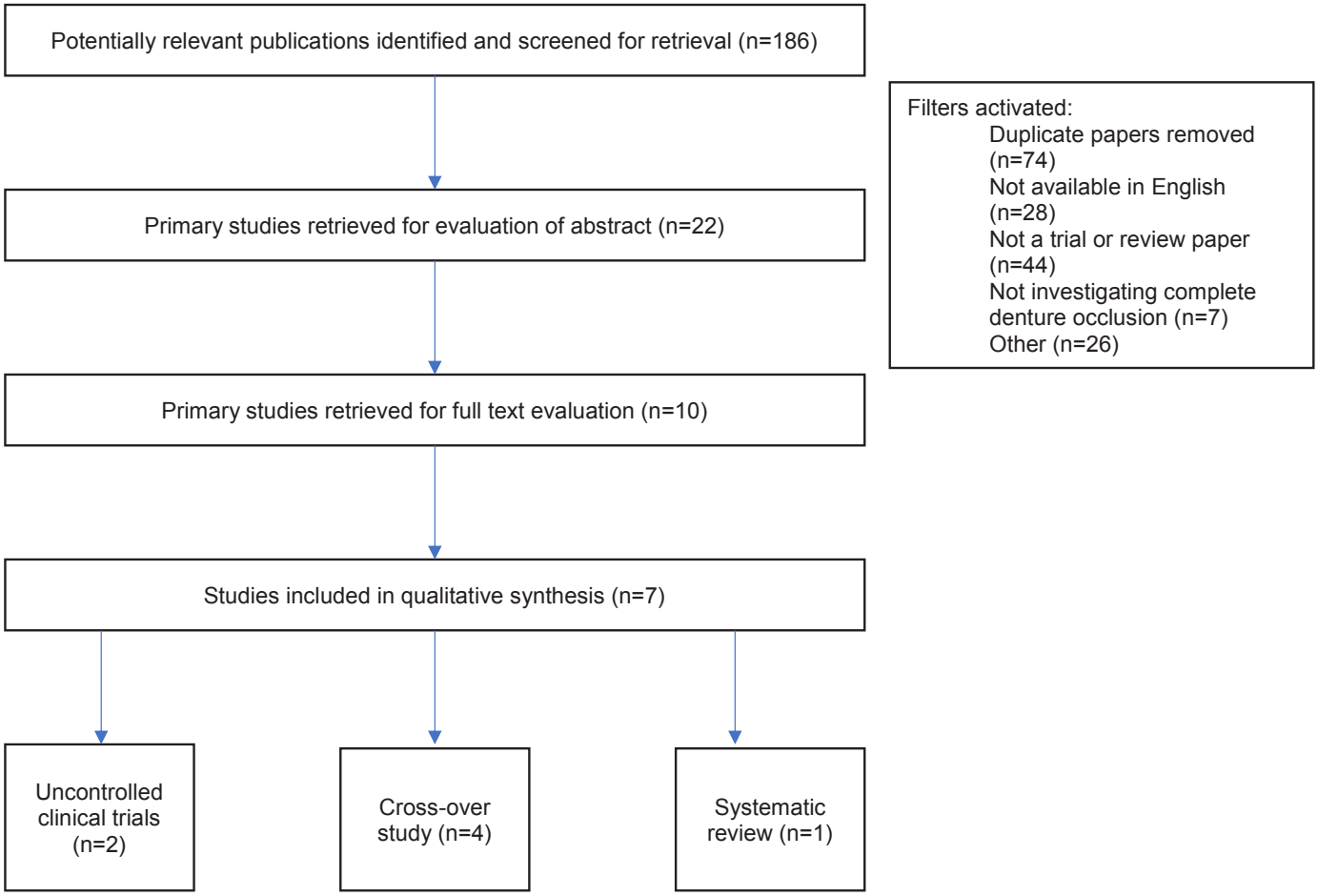

Figure 1: Summarising the procedural flow involved with the literature search and selection process

SELECTION AND REVIEW OF STUDIES

A Microsoft Excel® spreadsheet was used to collate a list of studies from all searches. Duplicates were removed and the list was disseminated to reviewers. Articles were systematically reviewed independently and were excluded in order as:

1. Not available in English (translation not available)
2. Not a comparative clinical trial or systematic review
3. Not investigating complete denture occlusion

Articles were excluded based on the title if exclusion criteria were clearly met. Any remaining articles were accessed for abstract and subsequently full text if suitable. The majority of excluded articles fulfilled multiple exclusion criteria.

Results of the article selection process were discussed between two researchers and concordance was reviewed. Any discrepancies were discussed to reach a consensus.

DATA EXTRACTION

Studies were summarised in Table 2, outlining study characteristics based on the PICO criteria:

1. Author, year – describing the study authors and year of publication
2. Population/problem – describing the demographic features of the population from which the sample was selected
3. Intervention – describing the intervention undertaken
4. Comparison – describing the comparison utilised
5. Outcome – describing the experimental findings

ASSESSMENT OF METHODOLOGICAL QUALITY

Full-text articles were independently assessed using a hierarchical review process using various tools:

1. CASP tool (using relevant criteria)
2. Centres for Evidence-Based Medicine (CEBM) criteria
3. PRISMA criteria as appropriate
4. Cochrane Risk of Bias Tool

Articles were scored and categorised based on criteria relating to methodological quality, risk of bias, data extraction, analysis and findings. Data were summarised on a Microsoft Excel® spreadsheet and discussed between both reviewers. Any discrepancies were reviewed until a consensus was gained.

All findings were summarised in a tabulated format outlining the author and year of publication and findings from the appraisal of each study.

RESULTS

STUDY SELECTION

The initial search identified 186 articles. Articles were filtered as outlined in figure 1. The majority of articles fulfilled more than one of the exclusion criteria. Reasons for exclusion are summarised in Table 1.

Table 1. Summarising the reasons for exclusion as defined by the hierarchical exclusion approach outlined in the method. It is important to note that many articles fulfilled multiple exclusion criteria, however this approach labels each excluded article with only one criterion based on the hierarchical exclusion approach.

Reasons for exclusion	Number of articles
Paper identified in multiple databases	74
Paper not available in English	28
Not a trial of review paper	44
Not investigating complete denture occlusion	7
Other	26

QUALITY ASSESSMENT

Seven studies were included following full review. The quality of included studies was poor to moderate with the majority of studies lacking randomisation, blinding and demographic data from the study sample. Furthermore, most studies lacked an in-depth investigation of all of the relevant variables along with sound statistical analysis. These factors both precluded the undertaking of any meta-analysis.

Findings from studies are summarised in Tables 1 and 2.

DISCUSSION

This article investigated the relationship between complete denture occlusal scheme and function or quality of life. This was based on the need to optimise patient care and utilisation of healthcare resources. It is hoped that such review may enable a more objective and evidence-based provision of care for edentate patients.

This study identified a broad range of research methodologies across a wide timespan. Two-thirds of articles were published within the past 10 years. A large number of articles were excluded as they were not clinical trials or reviews. Indeed, the vast majority of research utilised logical reasoning and expert opinion to draw conclusions on the ideal occlusion for complete denture wearers; perhaps supporting the notion of "old truths" in prosthetic dentistry. The majority of these articles were published more than 10 years ago.

It is clear that both the quantity and quality of research literature investigating complete denture occlusion experimentally is limited. The majority of studies lacked a robust scientific methodology that is expected in order to draw evidence-based conclusions for utilisation in clinical practice. Nonetheless, in-depth analysis of these articles provides some useful insights into the findings presented.

There is a lack of consensus amongst articles as to how and to what degree denture occlusion might influence denture stability, patient chewing ability and quality, and quality of life. Some studies seem to suggest no difference between BO and CG when assessing some of all of these variables, whilst others are suggestive of a slight preference for CG, particularly when compared to lingualized occlusion rather than a classical BO set-up. Indeed, one study[14] identified greater masticatory efficiency in nine of twelve patients with BO whilst other studies[4] seem to suggest improved chewing ability in patients with CG or no difference between occlusal schemes.[15] Furthermore, a study by Peroz *et al.*[16] suggests that patients prefer the aesthetic appearance and chewing abilities with CG dentures when compared to BO dentures. This study reports that whilst patients reported no difference in denture stability, there was a clinically detectable improvement in stability of CG dentures with protrusive and laterotrusive movements and a reduced stability of CG dentures with eccentric movements. It is important to note that both the quality of these studies, as well as the methodology used to ascertain chewing ability varied between these studies; studies with more robust methodology identified smaller differences in chewing ability between occlusal schemes.

There is a lack of evidence correlating optimal occlusal scheme and ridge morphology and there is a dearth of research investigating quality of life in the long term for these patients. This prevents an effective assessment of denture occlusion and investigation of the impact of differential denture tooth wear (postulated to impair the maintenance of BO) on quality of life and chewing abilities.

One study (Miralles *et al.* 1989),[17] albeit with a high risk of bias and small sample sizes, suggested that patients with BO require greater muscle activity during eccentric jaw movements whilst those with CG may have similar or slightly improved chewing ability. This is suggestive that CG occlusal schemes may be more efficient in their utilisation of muscle mass during the masticatory process. Some authors go on to suggest that this may furthermore be beneficial in the management of parafunctional activity in these patients as BO may furthermore promote the development of greater muscle tone. This has, however, not been investigated clinically in the long-term.

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Table 2. Summarising the findings from the included studies by study type, methodology, results, risk of bias and findings

Author, year	Study type	Methodology	Results	Risk of bias	Findings
Farias-Neto and Carreiro, 2013[5]	Systematic review	Comparison of articles investigating complete denture occlusion. Literature search between 1950 and 2012 across a broad range of data bases and utilising search terms "denture" and "occlusion"	7 articles included investigating a variety of aspects of complete denture occlusion. Critical assessment of articles lacking with discussion consisting of a narrative review	Unknown	Equivocal
Farias-Neta et al., 2010[15]	Double-blinded crossover trial	Study sample n=24. Mean age 59.7. No determination of power for sample size. All patients previously worn CD. Randomisation to BO-CG and CG-BO groups with all subjects wearing dentures for 3 months with each occlusion scheme. Dentures fabricated using traditional techniques with undergraduate dental students. Dentures constructed in BO and modified with composite resin canine ramps to achieve CG. Assessed masticatory efficiency and patient reporting chewing ability	1 patient from BO-CG and 2 from CG-BO left study after 3 months. ITT analysis not undertaken. All remaining patients happy with occlusion at the end of the study. No statistically significant difference for masticatory efficiency (p=0.095) or chewing rating (p=0.298)	Moderate methodological quality with risk of selection bias (at recruitment and dropout)	Equivocal but suggestive of no difference in chewing ability between occlusal schemes. Risk that study is underpowered
Peroz et al., 2003[16]	Single-blinded crossover trial	Study sample n=22. Assessment of subjective characteristics related to patient satisfaction and clinical factors including retention during eccentric function.	Patients found CG significantly more satisfying in aesthetic appearance, retention and chewing ability, whilst clinical assessments suggested CG dentures lost retention more commonly in eccentric movements whilst also suggesting increased stability in laterotrusive and protrusive movements	Moderate risk of bias	Suggestive that patients preferred aesthetics and stability of CG with difference in reported chewing ability. CG appear to have better stability in laterotrusive and protrusive movements, but reduced stability in eccentric movements (although this is not reported by patients)
Miralles et al, 1989[17]	Uncontrolled study	Study sample n=9 (M:F 1:8) with mean age 58.7. No determination of power for sample size. All patients screened for stomatognathic dysfunction. EMG recording undertaking when wearing dentures with different occlusal scheme	Results lacking thorough statistical analysis. Lower EMG activity suggestive of reduced temporalis activity with CG vs BO with a similar but less significant difference with the masseter muscle. Authors suggest that this is beneficial in chewing efficiency	High risk of bias	Equivocal but suggestive that reduced muscle activity is required to obtain laterotrusive movements in CG. Risk that study is underpowered. Study lacking thorough statistical analysis
Trapozzano, 1960[14]	Uncontrolled study	Study sample n=12 involving uncontrolled investigation of complete denture occlusion by means of patient feedback and chewing ability.	7 patients showed no preference based on occlusion, 3 preferred a non-balanced occlusion and 2 preferred balanced occlusion.	Poor methodological quality with resultant high risk of bias, particularly as a result of subject uncontrolled variables lacking statistical analysis	Equivocal with study carrying a high risk of bias, lack of control, randomisation or blinding and lacking power calculation or thorough statistical analysis of the results

table 2 continued overleaf...

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Heydecke et al., 2007[4]	Single-blinded crossover trial	Study sample n=20. Investigation of subjective and objective parameters relating to "simplified" and "conventional" denture construction techniques with simplified technique omitting facebow transfer, utilising CG and wax occlusal rims	Patient rating of chewing ability better with CG and simplified technique ($p<0.05$)	Low risk of bias	Suggestive that the majority of the sample preferred and had better chewing ability with CG vs LO. Does not assess BO. High risk of confounding due to concurrent assessment of other variables
Grunert et al., 1994[18]	Crossover study	Study sample n=17. Assessment of individuals with splints overlying complete dentures involving EMG activity. Utilising non-standard methodology with high risk of confounding from methodology used	Significant increase in muscle activity with BO	High risk of bias due to patient recruitment, methodology for assessment	Equivocal due to the small sample size, lack of significant data, high risk of bias and confounding

Finally, some studies which utilise a crossover design (Peroz *et al*. 2003,[16] Heydecke *et al*. 2007)[4], suggest an improvement in quality of life for patients with CG occlusion. These findings are nonetheless equivocal due to the short follow-up period, different adaptation times, small sample sizes, high risk of bias and lack of robust investigative methodology.

Both of these occlusal concepts (CG and BO) have simultaneous bilateral contact in centric occlusion, but manage guidance in very different ways; potentially placing very different forces on the prosthetic appliances and underlying supporting tissues. It has been suggested that canine-guidance is unsuitable for the provision of complete dentures as it is likely to place significant tipping forces on the dentures, resulting in anterior tipping of the lower denture along with possible displacement of the upper denture in a class 1 occlusion. The studies identified in this review seem to challenge this notion, but nonetheless are unable to enable a clear evidence-based conclusion to be drawn.

CONCLUSION

The currently available evidence precludes the notion of any occlusal scheme providing an improved function or quality of life, either in all or specific patients (for example with specific ridge morphologies). The available evidence suggests that the differences between occlusal schemes may be small, challenging the notion that BO may be the optimal occlusal scheme. Nonetheless there is a need for high-quality clinical research, investigating both chewing ability/quality as well as quality of life in complete denture wearers in the long-term, particularly given that the majority of identified studies lack determination of statistical power for sample size calculation, randomization, blinding, thorough assessment of all relevant variables and robust statistical analysis.

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