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Systematic Review and Meta-analysis
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Clinical viability of single implant-retained mandibular overdentures: a systematic review and meta-analysis

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Abstract. The aim of this meta-analysis was to verify the clinical viability of single implant-retained mandibular overdentures (SIMO). An electronic search of the PubMed and Cochrane databases was performed (end date July 2017); this was supplemented by a manual search of the literature. Only prospective clinical trials and randomized controlled trials (RCTs) that evaluated SIMO with a minimum follow-up of 12 months were included. The meta-analysis was based on the Mantel–Haenszel method. Dental implant and prosthetic failure were the dichotomous outcome measures; these were evaluated through the risk ratio (RR) and odds ratio (OR), with corresponding 95% confidence intervals (CI). Of 499 articles identified, nine fulfilled the inclusion criteria. A total of 205 implants were placed in patients with a mean age of 64.1 years; the cumulative survival rate was 96.6% over a mean follow-up period of 37.3 months. The procedure used (SIMO vs. two implant-retained mandibular overdenture) did not affect dental implant failure ($P = 0.45$) or prosthetic failure ($P = 0.65$): RR 1.06 (95% CI 0.91–1.23) and RR 0.88 (95% CI 0.51–1.51), respectively; OR 2.56 (95% CI 0.27–24.39; $P = 0.41$) and OR 0.44 (95% CI 0.15–1.26; $P = 0.13$), respectively. Within the limitations of this systematic review and meta-analysis, SIMO with a complete denture as the opposing arch may be considered an alternative treatment for completely edentulous patients. However, this study also confirmed the need for more RCTs on this topic.

Key words: overdenture; dental implant; single-implant; meta-analysis.

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Among the factors required for an adequate complete denture, retention and stability are considered fundamental to the success of treatment. The lack of such properties, especially for mandibular prostheses, affects the patient's quality of life and their social relationships[1]. For these patients, implant-supported prostheses may offer relief, comfort, and social well-being[1].

The McGill Consensus Statement on Overdentures (Montreal, Canada) established that mandibular overdentures retained by two implants in the interforaminal area should be the first-choice treatment for all edentulous patients[2]. However, recent studies have stated that a single implant in the midline of the edentulous mandible, also termed a single

median dental implant, may provide suitable retention for an overdenture (single implant-retained mandibular overdenture, SIMO)[3–5], suggesting that this treatment could be successful[6].

Resorption of the alveolar ridge[6], as well as treatment costs[3], may limit the number of dental implants when planning an overdenture implant-retained mandibular prosthesis. This is especially true among elderly patients, who usually have concerns regarding bone grafting surgery or do not have sufficient financial resources, especially in developing countries, where there is a larger contingent of people with economic limitations[5,6]. In this scenario, the use of a SIMO may represent a treatment option for the patient. Therefore, a systematic review and meta-analysis evaluating the clinical outcomes of patients using overdentures (population) retained by a single implant (intervention), compared to patients using overdentures retained by two implants (comparison), through an assessment of dental implant and prosthetic failure, would appear to be of relevance to the dentistry community.

The aim of this meta-analysis was to verify the clinical viability of single implant-retained mandibular overdentures. For this, the systematic review was structured to answer the following focused question: Is the SIMO viable as prosthetic rehabilitation? The null hypothesis for this research was that the SIMO is viable when compared to two implant-retained mandibular overdentures.

Materials and methods

Registry protocol

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist[7]. At the outset, the study was registered in the International Prospective Register of Systematic Reviews (PROSPERO, CRD42014013051).

Eligibility criteria

In order to be eligible, the studies had to present the following characteristics: prospective clinical trial; randomized controlled trial (RCT); studies that only evaluated SIMO, or studies that evaluated single SIMO versus two implant-retained mandibular overdentures; and studies in English published within the last 10 years.

The exclusion criteria were as follows: retrospective studies; case reports; literature reviews; in vitro studies; computer simulations; patients or data repeated in other included articles; studies with less than a 12-month follow-up period; and review analysis.

A specific question was constructed according to the PICO approach. The focused question addressed was: Is SIMO viable as prosthetic rehabilitation? In this process, 'P' represented patients using overdentures that were 'I' retained by a SIMO, 'C' compared to patients using overdentures retained by two implants, with dental implant failure in the SIMO and two implant-retained mandibular overdenture groups being the primary outcome 'O' to be extracted and analyzed by meta-analysis. Prosthetic failure was the secondary outcome.

Information sources

The researchers performed a search of the PubMed and Cochrane Library databases for articles published up until July 2017. Furthermore, a manual search was conducted in order to identify grey literature and registered trials that had not yet been published, as well as a search of the following journals for the period July 2016 to July 2017: *The International Journal of Prosthodontics*, *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *The Journal of Dentistry*, *The International Journal of Oral and Maxillofacial Implants*, *The Journal of Prosthetic Dentistry*, *The International Journal of Oral and Maxillofacial Surgery*, and *The Journal of Oral and Maxillofacial Surgery*.

Research strategy

Two independent researchers (V.E.S.B. and M.V.S.) performed the electronic search of the selected databases. The search terms used were: (1) ''single implant AND overdentures''; (2) ''central implant AND overdenture''; (3) ''midline AND dental implant'', and (4) ''single mandibular implant'' separately.

Study selection

Two investigators (V.E.S.B.) and (M.V.S.) independently selected the studies according to their titles and abstracts, and classified them as 'included' or 'excluded'. Any disagreements were settled through discussion and consensus. Articles selected for inclusion were then read by both investigators, and a manual search was performed of the reference lists.

Data extraction

One of the authors (V.E.S.B.) collected relevant information from the articles, including the authors, year, type of study, follow-up period, loading protocol, number of patients and implants, length and diameter of implants, attachment system used, opposing arch, dental implant and prosthesis complications, and survival rates. Failures included implants removed regardless of the cause, and survivals represented stable implants without signs of pathology, mobility, resistance to removal torque, pain, or peri-implantitis. A second author (F.R.V.) checked all of the information collected. Any disagreements between the investigators were settled by a third author (E.P.P.) through discussion until a consensus was reached.

Risk of bias

Two investigators (A.J.V. and J.F.S.Jr) assessed the methodological quality of the studies according to the Jadad scale[8], which ranges from 0 to 5[8,9]. Scores higher than 3 were classified as representing high quality[9]. Additionally, the evidence level was set according to the guidelines of the Oxford Centre for Evidence-Based Medicine (OCEBM, 2011) (Table 1).

Summary measures

The meta-analysis was based on the Mantel–Haenszel method[9]. Dental implant failure and prosthetic failure were the two dichotomous outcome measures that were evaluated. To assess dental implant failure, the statistical unit for the outcome was the number of implants lost. To assess prosthetic failure, the statistical unit for the outcome was the number of fractures of the denture base or complications affecting the abutments. For recent studies, the risk ratio (RR) and odds ratio (OR), with corresponding 95% confidence intervals (CI), were calculated using a random-effects model[9,10]. The RR values were considered significant when $P < 0.05$. The software program Reviewer Manager 5 (The Nordic Cochrane Centre, Copenhagen, Denmark) was used for the meta-analysis and to produce the funnel plots.

Risk of bias among the studies

An asymmetric funnel plot may indicate publication bias or other biases related to sample size, although the asymmetry may also show a true relationship between trial size and effect size[11]. Heterogeneity was