

# Effect of implant loading protocols on failure and marginal bone loss with unsplinted two-implant-supported mandibular overdentures: systematic review and meta-analysis

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**Abstract.** The aim of this study was to compare implant failure and radiographic bone level changes with different loading protocols for unsplinted two-implant-supported mandibular overdentures. An electronic search of two databases (PubMed, Cochrane Library) was performed, without language restriction, to identify randomized controlled trials (RCTs) comparing immediate or early versus conventional dental implant loading protocols for unsplinted two-implant-supported mandibular overdentures. Data were extracted independently by two reviewers. The Cochrane tool was used to assess the quality of included studies. A meta-analysis was performed. Eight RCTs were identified, seven of which were included; one trial was excluded because related outcomes were not measured. Four of the seven studies were considered to have a high risk of bias and three an unclear risk. Meta-analysis revealed no difference between immediate versus conventional or early versus conventional implant loading protocols regarding implant failure (risk difference (RD)  $-0.02$ , 95% confidence interval (CI)  $-0.13$  to  $0.10$ ; RD  $0.09$ , 95% CI  $-0.03$  to  $0.20$ ) or marginal bone loss (mean difference (MD)  $0.09$ , 95% CI  $-0.10$  to  $0.28$ ; MD  $-0.05$ , 95% CI  $-0.12$  to  $0.02$ ) for implants supporting mandibular overdentures. These findings should be interpreted with great caution given the serious numerical limitations of the studies included.

**Key words:** dental implants; implant failure; meta-analysis; implant placement loading protocols; systematic review.

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The prosthetic management of the edentulous patient has long been a major challenge for the prosthodontist. The classical treatment plan for edentulous patients is the conventional complete denture. However, this treatment is associated with several complications, in particular related to stability and retention, leading to constant fear of denture loosening during different jaw movements. These problems occur more frequently with the mandibular denture<sup>1</sup>.

With the advent of dental implants for the retention and/or support of removable prostheses, these functional deficiencies associated with conventional dentures have improved greatly<sup>2,3</sup>.

In the McGill Consensus Statement published in 2002, many investigators agreed that the basic restoration for the edentulous mandible should be an implant-supported overdenture with two implants placed in the anterior mandible<sup>4</sup>. Mandibular overdentures with two implants, retained by unsplinted attachments, are considered a simple and cost-effective treatment option<sup>5-7</sup>.

In the early days of implantology, Brånemark and collaborators empirically advocated an unloaded healing period of 3 months for the mandible and 6 months for the maxilla following implant placement, to facilitate an uneventful osseointegration, avoid soft tissue encapsulation, and improve implant survival rates<sup>8</sup>.

The osseointegration process induced is characterized by an intimate interfacial contact between bone and the implant surface, which determines clinical success. Implant surface macro- and micro-geometry, together with the surgical and prosthodontic protocols employed, appear to determine successful treatment outcomes<sup>9-11</sup>.

Unfortunately, most patients perceive the period between tooth loss and definitive rehabilitation as traumatic and uncomfortable, because provisional prostheses mostly provide compromised function and aesthetics<sup>12</sup>. Substantial benefits may be derived by shortening the provisional prosthesis period, as well as reducing the treatment duration<sup>13</sup>.

In previous systematic reviews, several authors have tried to determine the implant loading time that is most efficient for fixed and removable prostheses<sup>14</sup>, and for removable overdentures with different implant numbers and different prosthetic designs<sup>15-17</sup>. Nevertheless, more robust evidence is needed to determine whether immediate or early implant loading provides the same satisfactory results over time for the unsplinted two-implant-sup-

ported mandibular overdenture, as this treatment approach is considered standard care for the edentulous mandible. This would then encourage routine prescription of an equally efficacious clinical protocol.

The aim of this systematic review was to answer the following question: "In patients requiring unsplinted two-implant-supported overdentures, do the immediate or early implant loading protocols show similar outcomes in terms of implant failure and peri-implant marginal bone levels, when compared to the conventional loading protocol?"

## Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines<sup>18</sup>.

## Eligibility criteria and definitions

Inclusion criteria encompassed the following: (1) Study design: all randomized controlled trials (RCTs), including parallel group and split-mouth designs. (2) Participants: any subject receiving dental implants. (3) Interventions and controls: immediate or early (intervention) versus delayed (control) loading protocols for unsplinted two-implant overdentures. The same type of implant had to be used in both groups. Only those studies with a minimum follow-up of 1 year after loading were considered.

The definitions of the loading protocols used in this review were those reported by Alsabeeha et al.<sup>17</sup>, as follows: (1) for conventional loading, the overdenture is attached in a second procedure after a healing period of 3–6 months, with a two-stage (submerged) implant placement protocol; (2) for early loading, the overdenture with attachment system is in contact with the opposing dentition and placed at least 48 h after implant placement, but not later than 3 months afterwards, with a one-stage (non-submerged) implant placement protocol; (3) for immediate loading, the overdenture with attachment system is placed in occlusion with the opposing dentition within 48 h of implant placement, with a one-stage (non-submerged) implant placement protocol.

The outcome measures were (1) implant failure, defined as implant mobility or the removal of stable implants dictated by progressive marginal bone loss or infection, and (2) radiographic marginal bone level changes on intraoral radiographs taken with a parallel technique, from surgical placement to 1 year in function.

The following were exclusion criteria: non-randomized trials, retrospective studies, case series, and case reports; studies with follow-up of less than 1 year; studies not reporting implant failure and/or marginal bone loss.

## Information sources

The PubMed and Cochrane Library electronic databases were searched to identify RCTs without time or language restrictions, comparing submerged versus non-submerged dental implants. In addition, a manual search of the following implant-related journals was done: *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *European Journal of Oral Implantology*, *Implant Dentistry*, *Journal of Clinical Periodontology*, *Journal of Dental Research*, *Journal of Oral and Maxillofacial Implants*, *Journal of Periodontology*, and the *International Journal of Periodontics and Restorative Dentistry*. Moreover, online databases providing information about clinical trials in progress were checked ([clinicaltrials.gov](http://clinicaltrials.gov); [www.centerwatch.com/clinicaltrials](http://www.centerwatch.com/clinicaltrials); [www.clinicalconnection.com](http://www.clinicalconnection.com)). The last search was performed on 6 March 2017.

## Search strategy

Two reviewers (MHH, AYA) independently performed the search. Combinations of controlled terms (medical subject headings, MeSH) and key words were used whenever possible. The search terms used for the MEDLINE (PubMed) and Cochrane Library databases are shown in [Table 1](#).

## Selection of studies

The full search results from all databases were pooled after the removal of duplicates. Two reviewers (MHH, AYA) then independently performed a thorough screening of the titles and abstracts to produce a shortlist of publications. Articles for full-text analysis were included only with the mutual agreement of the two reviewers. Any disagreements were resolved by discussion and consensus with a third reviewer (AFS).

## Data extraction and management

Data extraction was performed after mutual agreement on the final list of publications for inclusion. Data were extracted independently by the two reviewers (MHH, AYA), who were reciprocally

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