Int. J. Oral Maxillofac. Surg. 2015; 44: 892–901
http://dx.doi.org/10.1016/j.ijom.2015.02.013, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Systematic Review and Meta-Analysis
Dental Implants

Implant survival rates, marginal bone level changes, and complications in full-mouth rehabilitation with flapless computer-guided surgery: a systematic review and meta-analysis

V. Moraschini[1], G. Velloso[2], D. Luz[1], E. Porto Barboza[1]
[1]Department of Periodontology, School of Dentistry, Fluminense Federal University, Niterói, Rio de Janeiro, Brazil; [2]São Leopoldo Mandic College, Niterói, Rio de Janeiro, Brazil

V. Moraschini, G. Velloso, D. Luz, E. Porto Barboza: Implant survival rates, marginal bone level changes, and complications in full-mouth rehabilitation with flapless computer-guided surgery: a systematic review and meta-analysis. Int. J. Oral Maxillofac. Surg. 2015; 44: 892–901.

Abstract. This systematic review evaluated the implant survival rate, changes in marginal bone level, and complications associated with guided surgery for the treatment of fully edentulous patients followed up for longer than 1 year. A comprehensive literature search was conducted in MEDLINE/PubMed and the Cochrane Central Register of Controlled Trials (CENTRAL) to retrieve studies published up until July 2014 that met predefined eligibility criteria. Thirteen studies were included. In studies on the guided surgery technique, a survival rate of 97.2% and a mean marginal bone loss of 1.45 mm were found during 1–4 years of follow-up. However, associated complications, such as implant loss, prosthesis or surgical guide fractures, and low primary stability, were often found, and there is a learning curve to achieve treatment success. Further longitudinal comparative studies should improve the technique and its success rate.

Key words: guided surgery; flapless surgery; implant survival; marginal bone level; dental implants.

Accepted for publication 11 February 2015
Available online 17 March 2015

Since the development of osseointegrated implants[1] and the publication of the first longitudinal studies evaluating their success and survival,[2,3] the primary focus of contemporary implant dentistry has been the investigation of less invasive and more predictable surgical techniques that result in reduced treatment times.

In the last few years, clinical studies have reported excellent results for the techniques developed to replace bone regeneration procedures and avoid implant

placement close to critical anatomical areas, such as the maxillary sinus and the mandibular nerve. Krekmanov et al. described a distal implant inclination technique for use in cases where implant placement in the posterior region is contraindicated.[4] The combination of distal tilted implants, immediate prosthetic loading, and a smaller number of implants has recently been recommended for use with All-on-Four (four implants)[5] and Novum (three implants)[6] systems, which have survival rates comparable to those of conventional techniques. However, the accurate placement of tilted implants or implants close to important anatomical areas using free-hand techniques remains a challenge for surgeons.

The advent of cone beam computed tomography (CBCT) has contributed to the development of guided surgery techniques.[7] The use of CBCT to plan the placement of implants and the use of surgical guides, aided by specific software, preclude the use of a flap. The advantages of not raising a mucoperiosteal flap are reduced surgery times, fewer postoperative complications such as pain and bleeding, and greater patient comfort.[8] Moreover, recent studies have found better healing and lower rates of alveolar and peri-implant bone loss when using this technique.[9,10]

This systematic review and meta-analysis evaluated implant survival rates, changes in marginal bone levels, and complications associated with guided surgery for the treatment of fully edentulous patients followed up for longer than 1 year.

Materials and methods

Development of a protocol

The method used in this systematic review was adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[11] and the recommendations made by Needleman.[12] Clinical questions were developed and organized according to the PICO[13] framework for evidence-based practice.

Focused question

The focused question was 'What are the implant survival rates, marginal peri-implant bone changes, and complications of guided surgery for the treatment of fully edentulous patients after a 1-year follow-up?'

Search strategy

The search strategy was adapted from the PRISMA guidelines (http://www.prisma-statement.org). The electronic search and the PICO strategy are shown in Table 1.

Selection criteria

Randomized clinical trials (RCTs), controlled clinical trials (CCTs), prospective and retrospective cohort studies, and case series (with $\geq$10 cases) were sought. The following inclusion criteria were applied: (1) studies in the English language; (2) studies in edentulous humans over 18 years of age (maxilla and/or mandible); (3) studies with a minimum follow-up of 1 year; (4) studies with the inclusion of at least 10 volunteers.

Animal studies, cadaver studies, case series ($<$10 cases), reports of techniques, implants installed in areas of bone regeneration, studies with a follow-up period of $<$1 year, studies in patients with decompensated systemic diseases, studies in patients using bisphosphonates, studies that only analyzed accuracy, and those including patients with periodontal disease without prior treatment, were excluded.

Screening process

Two independent reviewers (V.M.F. and G.V.) searched for and screened studies by first analyzing titles and abstracts. In a second phase of the study, the complete texts were selected for careful reading and analysis according to eligibility (inclusion and exclusion) criteria for future data extraction. Differences between reviewers were resolved by discussion and consensus. Cohen's kappa was used to measure the agreement of searches made by the two reviewers.

Quality assessment

The Newcastle–Ottawa (NOS) scale, available at http://www.ohri.ca/programs/clinical_epidemiology/nosgen.pdf, was used to evaluate the quality of non-randomized studies (prospective and retrospective cohort studies) included in this review. A score ranging from 1 to 9 was assigned to each study, according to the items assessed by the scale.

Heterogeneity assessment and data extraction

Data on the study design, follow-up time, participant characteristics, methods, implant survival, prosthesis survival, marginal

Table 1. Systematic search strategy (PICO strategy).

Focus question	What are the implant survival rates, marginal peri-implant bone changes, and complications of guided surgery for the treatment of fully edentulous patients after a 1-year follow-up?
Search strategy	
Population	(1) MeSH terms: edentulous jaws OR edentulous maxilla OR edentulous mandible OR edentulous ridge OR complete edentulism OR rehabilitation edentulous OR edentulous implant
Intervention	(2) MeSH terms: guided surgery OR guided implant OR implant guided OR implant guided surgery OR dental implant guided OR dental implant guided surgery OR flapless implant surgery OR flapless surgery OR full arch rehabilitation Text words: full mouth rehabilitation OR computer-assisted implant surgery OR immediate loading OR full arch restoration OR flapless guided implant surgery, flapless computer guided implant surgery OR immediate loading OR immediate function
Comparisons	Not applicable
Outcomes	(3) MeSH terms: survival OR implant survival OR dental implant survival OR dental implant complications OR implant accuracy OR dental implant accuracy OR implant bone resorption OR dental implant bone loss OR prospective study OR retrospective study OR randomized controlled trial OR controlled trial
Search combination	1 AND 2 AND 3
Database search	
Language	English
Electronic databases	MEDLINE/PubMed and Cochrane Central Register of Controlled Trials (CENTRAL)

MeSH, medical subject heading.