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Systematic Review
Dental Implants

Outcomes of implants placed with three different flapless surgical procedures: A systematic review

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Abstract. The aim of this systematic review was to evaluate the outcomes of flapless surgery for implants placed using either free-hand or guided (with or without 3D navigation) surgical methods. Literature searches were conducted to collect information on survival rate, marginal bone loss, and complications of implants placed with such surgeries. Twenty-three clinical studies with a minimum of 1 year follow-up time were finally selected and reviewed. Free-hand flapless surgery demonstrated survival rates between 98.3% and 100% and mean marginal bone loss between 0.09 and 1.40 mm at 1–4 years after implant insertion. Flapless guided surgery without 3D navigation showed survival rates between 91% and 100% and mean marginal bone loss of 0.89 mm after an observation period of 2–10 years. The survival rates and mean marginal bone loss for implants placed with 3D guided flapless surgery were 89–100% and 0.55–2.6 mm, respectively, at 1–5 years after implant insertion. In 17 studies, surgical and technical complications such as bone perforation, fracture of the surgical guide, and fracture of the provisional prosthesis were reported. However, none of the identified methods has demonstrated advantages over the others. Further studies are needed to confirm the predictability and effectiveness of 3D navigation techniques.

Keywords: flapless surgery; minimally invasive procedure; guided surgery; 3D navigation; 3D planning; dental implants.

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Nowadays, the placement of dental implants is considered a standard procedure for the replacement of lost teeth. However, the original two-stage protocol as described by Brånemark in the early 1970s,[1–3] imposed a lengthy treatment time, two surgical interventions, and consequently a greater risk of complaint and discomfort for patients.[4] In addition, the use of the flap approach for the surgical placement of dental implants is often associated with postoperative bleeding, pain, soft and hard tissue loss, and possible scarring.[5–7] Over the last decades, further developments of the original method have been reported, such as the one-stage surgical procedure with delayed, early, or immediate loading of implants, aiming to simplify the surgical technique and decrease patient discomfort.[8–16]

The concept of flapless implant surgery has been advocated as a means to achieve a shorter treatment time.[17–19] Flapless implant surgery is defined as a surgical procedure used to prepare the implant osteotomy and to place the implant without elevation of a mucoperiosteal flap.[20]

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Table 1. Treatment workflow for conventional and 3D guided surgery.

Conventional protocols		3D navigation protocols
Free-hand surgery	Guided surgery without using 3D navigation systems	
Diagnostic imaging (OPG, CT, CBCT)	Fabrication of radiographic template (current prosthesis or new set-up)	Fabrication of radiographic template (current prosthesis or new set-up)
Implant surgery	Diagnostic imaging (OPG, CT, CBCT)	Diagnostic imaging (CT, CBCT)
	Fabrication of surgical template (transformation of scan template in dental laboratory)	Virtual 3D implant planning (3D navigation software)
	Delivery of surgical template/try-in	Fabrication of surgical template (transformation of scan template in dental laboratory or central fabrication)
	Implant surgery	Delivery of surgical template/try-in
		Implant surgery

OPG, orthopantomogram; CT, computed tomography; CBCT, cone beam computed tomography.

The flapless method involves a one-stage approach that requires minimal removal of soft tissue to gain access to the alveolar ridge for gradual widening of an osteotomy, implant placement, and abutment connection.[21,22] Some authors have suggested that flapless implant placement may be performed in extraction sockets in order to preserve the vascular supply and existing soft tissue contours, thus optimizing the healing of peri-implant tissues.[23,24]

Implant placement has been proposed either by preparing the soft tissue using a motor-driven circular tissue punch at the centre of the implant placement site, or trans-gingivally with a round bur to penetrate the soft tissue directly into the bone.

Both concepts have been applied by clinicians, and it has been claimed that, compared to the traditional surgical procedure, a flapless surgical approach has potential advantages for the patient and the surgeon.[25] These advantages include improved patient comfort, less pain, no need for sutures, shorter surgery time, reduced healing time, and accelerated recuperation.[17,26–29] With less postoperative bleeding and swelling, this approach offers the clinician the possibility to adjust the provisional appliance immediately.[4,30–33]

Despite many advantages, flapless implant surgery has generally been regarded as a blind procedure because of the difficulty in evaluating alveolar bone contours and angulations. In addition, with regard to the implant site and inclination of the implants, the surgeon is guided only by the anatomy of the patient if not using any navigation system. The latter includes an increased risk of malposed angle or depth of implant placement, the decreased ability to contour osseous topography when necessary to facilitate restorative procedures, and the surgeon's inability to manipulate soft tissues.[25,34]

Today, the contemporary method of computer-guided implantology is aimed at a more precise preoperative planning of the implant placement and the restoration.[25,26,35] Guiding the implant drilling and placement is claimed to resolve problems associated with blind surgery and to avoid possible perforations due to mispositioning.[36–38] Moreover, this 'downward' concept establishes the correct implant position during the diagnostic stage according to the planned definitive restoration. The location and angulation of the implants are determined by the aesthetic, occlusal, morphological, and biomechanical criteria obtained from a diagnostic wax-up.

The introduction of cone beam computed tomography (CBCT), three-dimensional (3D) implant planning software, image-guided template production techniques, and computer-aided surgery are undoubtedly important achievements in optimizing 3D implant positioning with respect to both prosthetic and anatomical parameters.[39] After the preoperative evaluation of the implant site, the transfer of planning and insertion of implants can be accomplished via a surgical guide[33] or computer-assisted navigation[40] (static and dynamic procedures).[41,42] Nevertheless, critical factors regarding increased radiation dose (CT or CBCT), costs (planning software, surgical guides, CBCT), effort (familiarity with 3D implant software), time (preoperative planning), and even accuracy of the transfer of implant planning to the surgical field, require further improvement.[43] Many reports exist on the different guided techniques, the accuracy of the position of the implants compared to the virtual digital planning, and clinical and patient-centred outcomes.[41,42,44–46]

A large number of reports have been published over the last two decades on the subject of flapless surgery. Various treatment concepts involving navigation and 3D guided surgery – as well as standard surgical protocols – have been proposed, which may or may not include the use of a surgical guide (Table 1).[20,47] However, the use of such sophisticated techniques raises important questions about whether they improve the long-term outcome of the implants.

The aim of this systematic review was to evaluate the outcomes of flapless surgery for implants placed with free-hand or guided surgical methods, the latter either with or without 3D navigation.

Materials and methods

Search strategy

An electronic literature search of the PubMed database, complemented by manual searching, was performed to gather information on flapless implant placement and its effect on success and survival rates of implants, marginal bone level alterations, and biological and technical complications after the placement of dental implants. The search included articles published from 1970 to January 2013 in the dental literature. The search was limited to studies in English or German, using the keywords 'flapless surgery', 'minimally invasive procedure' in combination with 'guided surgery', '3D navigation', 'three dimensional planning', 'dental implants' (with different keywords connected with OR and AND). Every search was complemented by manual searches of the reference lists of all selected full-text articles.[48] Review articles, as well as references from identified studies, were also used to identify relevant articles.

Selection criteria

The following inclusion criteria were applied to determine which studies were included in this systematic review: (1) clinical studies: randomized controlled clinical trials (RCTs), controlled trials, prospective and retrospective studies;