



The Flapless Approach in Dental Implantology: Evidence-Based Insights and Clinical Considerations

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Abstract

Background: Flapless implant surgery offers a less invasive alternative to conventional flap methods by preserving tissue and blood supply. However, it lacks direct bone visualization, making precise placement and anatomical risk management challenging. This review discusses the biological basis, clinical evidence, limitations, and case selection for flapless versus open flap surgery.

Methods: A narrative literature review was conducted using electronic databases. Randomized clinical trials, systematic reviews, meta-analyses, and comparative studies on flapless and conventional techniques were qualitatively analyzed for biological principles, outcomes, limitations, and selection criteria.

Results: Evidence shows flapless implant surgery is effective with proper patient selection, offering similar survival rates to conventional methods and advantages in bone preservation, soft tissue healing, and comfort. CBCT and digital guides enhance accuracy and reduce risks. However, sites with poor bone volume, thin tissue, or requiring grafting are better suited for open flap surgery.

Conclusions: Flapless implant surgery is reliable and patient-friendly when cases are carefully chosen, providing less trauma and faster healing. Digital tools have improved its safety, but it is not appropriate for all situations. Clinician judgment is crucial to choosing the right technique for each patient.

Keywords: Flapless; Implant; Osseointegration; Minimally; Invasive; Peri-Implant; Periosteal Vascularization; Computer-Guided; Surgery

Introduction to Flapless Implant Surgery

The development of dental implantology by Brånemark in 1952 marked a turning point in oral rehabilitation. Since then, dental implants have evolved considerably, offering meaningful aesthetic and functional improvements within the oral cavity and contributing to the overall restoration of the stomatognathic system [1].

When planning implant placement, surgeons must carefully weigh the decision to raise a gingival flap, as this choice carries both aesthetic and functional implications for the mucosal and osseous structures. Flapless implant surgery stands out as a conservative and highly aesthetic alternative, significantly reducing bone tissue loss by preserving crestal bone and soft tissues while avoiding the resorption associated with flap reflection. The procedure is shorter, requires no sutures, and is generally associated with fewer complications, less pain, and minimal postoperative swelling [1]. It also reduces intraoperative bleeding

and shortens the healing period by minimizing surgical trauma, allowing for better maintenance of surrounding structures and a smoother soft tissue recovery following implant placement. By forgoing incisions, flapless surgery protects and preserves tissue vascularity, greatly reducing perioperative discomfort, and the interdental papilla remains undisturbed throughout [2]. Interproximal bone is likewise preserved, as the periosteum and interdental papilla are left intact, which in turn protects bone nutrition and prevents resorption. Recent evidence suggests that this less traumatic approach delivers the greatest clinical benefits, including accelerated healing, fewer complications, and greater patient acceptance, all while maintaining the integrity of both hard and soft tissues [3].

The long-term success of dental implants depends primarily on direct osseointegration between the implant and bone, but it also relies on other key factors, including the quality of the surgical technique, prosthetic rehabilitation, and the patient's own commitment to implant care and oral hygiene. For this reason, patient education is an essential part of treatment [2]. Despite its many advantages, flapless surgery does present certain limitations. The most notable is the inability to directly visualize the underlying bone topography, which increases the risk of improper perforation and makes it more difficult for the operator to identify anatomical landmarks intraoperatively.

By contrast, the conventional flap technique carries its own set of disadvantages, as it is associated with a higher risk of interproximal crestal bone loss, peri-implant bone resorption, alterations to the mucoperiosteal system, damage to the interdental papilla, and disruption of bone nutrition through compromised vascularization [4,5]. Clinically, this translates to greater postoperative pain, swelling, delayed recovery, and a more complicated healing course. Recognizing these limitations encourages a shift toward more refined surgical approaches that better preserve oral anatomy and offer patients a higher standard of conservative, health-restoring care [6].

Biological Principles and Healing

Understanding the capacity of hard and soft tissues to regenerate and repair is fundamental to achieving osseointegration in clinical implant dentistry [7]. The term osseointegration was originally introduced by Brånemark to describe the process by which a direct structural and functional bond is established between living, organized bone tissue and the surface of a load-bearing implant. This bond is critical for implant stability and is considered an absolute prerequisite for implant loading and the long-term clinical success of endo-osseous dental implants [7]. From a histological standpoint, osseointegration implies that the implant and the surrounding bone establish a direct, intimate connection, with no intervening soft tissue layer between them [8].

Osseointegration follows a well-defined, biologically driven sequence that unfolds in three distinct stages. The first involves the formation of woven bone, which serves as the initial framework for implant incorporation [8]. The second stage is characterized by adaptation of the bone mass to the mechanical load placed upon it, marked by the deposition of lamellar and parallel-fibered bone. The third and final stage involves a more refined structural adaptation through bone remodeling, in which the bone continuously reorganizes itself to better withstand the functional demands placed on the implant over time [9].

The blood supply to the underlying bone comes from three key sources: the major vessels above the periosteum, the vascular network of the periodontal ligament, and the vessels within the alveolar bone itself. When a mucoperiosteal flap is reflected during surgery, the periosteal blood supply is compromised, forcing the bone to rely solely on its internal vasculature [10]. This becomes particularly problematic in cortical bone, which has a naturally limited internal blood supply. As a result, some degree of bone resorption during the healing process is considered an expected consequence of flap reflection [5].

Several studies have noted that the bone resorption associated with flap surgery can significantly reduce blood supply to the implant site, which in turn may jeopardize the final aesthetic outcome. This was particularly well demonstrated in a 2009 experimental study by Kim, et al., conducted in dogs, which found that implant sites treated with the flapless approach had markedly richer peri-implant vascularization compared to sites where conventional flap surgery was performed. These findings strongly suggest that avoiding flap reflection helps preserve tissue vascularity, creating a more favorable biological environment for healing and better overall clinical results [10].

Clinical Advantages of the Flapless Technique

The flapless technique is recognized as a minimally invasive approach, making it a compelling alternative to conventional flap elevation. In carefully selected cases, current evidence has shown excellent outcomes, particularly in terms of soft tissue preservation [12]. Some studies have reported improved soft tissue healing and lower probing depth values with the flapless technique compared to the conventional flap approach. This may be related to the reduced soft tissue manipulation involved, which in turn promotes a more favorable postoperative healing course [13].

One of the most consistently noted advantages of this technique is a reduction in postoperative discomfort. Patients treated with the flapless approach have reported fewer symptoms such as pain and irritation compared to those treated with conventional flap surgery [12]. Another meaningful benefit is the reduction in overall surgical time. Because flap elevation and suturing are not required, the procedure can be performed more efficiently, simplifying the clinical protocol and reducing chair time for the patient [14].

The technique may also contribute to more favorable esthetic outcomes, particularly in cases where the appearance of the peri-implant tissues is a priority. The less invasive nature of the procedure helps preserve the existing tissue architecture during surgery, which is often reflected in the final esthetic result [15]. In addition, some studies have reported that flapless implant placement may contribute to better preservation of crestal bone levels, though outcomes can vary depending on the clinical situation. Maintaining bone levels over time helps support more stable peri-implant conditions in the long run [15,16].

It is worth noting that this technique is not universally indicated. Proper diagnosis, thorough surgical planning, and careful case selection are essential to achieving the desired results. Each case must be evaluated individually to determine whether the flapless approach is truly the most appropriate option [16]. From a biological standpoint, one of the reasons the flapless technique is so effective at conserving soft tissue is precisely because it does not require flap elevation. As a result, the blood supply to the surrounding tissues is better maintained, which is critical for healing. This preservation of vascularity helps sustain the natural morphology of the soft tissues and offers better support for multidisciplinary treatment approaches, such as the combination of implant therapy and periodontal management [17].

Although the flapless technique has been associated with reduced discomfort and better soft tissue preservation, some studies have noted that its long-term outcomes are largely comparable to those achieved with the conventional flap approach [16]. Still, the overall experience tends to be more comfortable for patients, and the technique may be especially well suited for individuals with dental anxiety or relevant systemic conditions. These qualities make it a genuinely attractive option in contemporary implant dentistry [17]. Regardless of these advantages, the clinician's experience and judgment remain fundamental to a successful outcome. Because the procedure is performed without direct visualization of the bone, case selection should be guided not only by the minimally invasive nature of the technique, but also by a careful assessment of each patient's individual anatomy and clinical needs [18].

Limitations and Potential Complications

Modern dental implantology has evolved beyond simple osseointegration toward a patient-centered model that prioritizes minimally invasive protocols. A central point of clinical debate remains the comparison between flapless implant surgery and the conventional open-flap approach. By evaluating data from recent literature, this review examines how these techniques compare regarding implant survival, marginal bone loss, and patient satisfaction [19,20].

Survival Rates and Clinical Predictability

A fundamental measure of any surgical intervention is the long-term viability of the implant. Evidence indicates that flapless surgery is a highly predictable alternative to conventional methods. When clinicians use precise diagnostic tools such as CBCT imaging and surgical guides to compensate for the lack of direct visualization, survival rates remain virtually comparable to those achieved with conventional surgery [19]. While the open-flap approach allows for direct inspection of the bony architecture, reducing the risk of iatrogenic complications such as fenestrations or dehiscence, the "blind" nature of the flapless technique does not appear to compromise biological integration. Longitudinal data suggest that by avoiding periosteal reflection, the local blood supply remains intact, which may support more robust early-stage healing [20].

Marginal Bone Stability

Marginal bone loss serves as a critical indicator of long-term implant success. Conventional surgery requires elevation of a mucoperiosteal flap, which severs supraperiosteal vessels and triggers a transient inflammatory response, often resulting in minor early resorption [20]. Flapless surgery significantly mitigates this trauma. Studies show that patients undergoing flapless procedures frequently exhibit reduced marginal bone loss during the first year of loading compared to those treated with conventional methods [21]. This preservation of cortical bone is attributed to the maintenance of periosteal microcirculation and a reduction in postoperative inflammation. Maintaining the soft tissue architecture creates a more stable biological seal, which is essential for preventing future peri-implant complications [20].

Patient Satisfaction and Morbidity

The most notable differences between these two approaches are found in patient-reported outcomes. Conventional surgery is often associated with significant postoperative swelling, pain, and the need for sutures, all of which extend the recovery period. By contrast, the flapless approach is defined by its minimally invasive profile. Patients consistently report higher satisfaction levels due to shorter operative times and a marked reduction in postoperative morbidity [21]. The absence of sutures and reduced surgical trauma allow for a faster return to daily activities, making it a preferred option for patients with dental anxiety or those seeking quicker rehabilitation [22].

While conventional surgery remains the standard for complex cases requiring extensive grafting, flapless surgery offers meaningful advantages for routine applications. Both techniques achieve high survival rates, but the flapless method tends to perform better in terms of marginal bone preservation and overall patient experience [23,24]. As digital planning continues to refine surgical accuracy, flapless protocols are increasingly positioned to become the preferred standard for optimizing both biological stability and clinical comfort [24].

Comparison With Conventional Implant Surgery

Some clinical studies have examined the relationship between marginal bone loss, probing depth, and patient satisfaction in the context of implant-supported removable prostheses in the mandible [25]. These studies evaluate mucosal health, peri-implant tissue condition, marginal bone loss, and patient satisfaction using validated correlation measures. Their findings suggest that peri-implant tissue health is closely related to attached gingiva width and oral hygiene, underscoring the importance of regular maintenance in implant overdenture wearers [25].

Long-term evidence further supports the durability of implant-supported rehabilitations. A retrospective study tracking 174 implants over a minimum observation period of 20 years evaluated biological and functional performance across various types of prosthetic rehabilitations. Both implant survival and bone levels remained stable throughout the follow-up period, confirming that well-planned implant restorations can deliver lasting results [26].

The prosthetic rehabilitation of the atrophic posterior mandible presents a significant clinical challenge due to limited bone volume and proximity to critical anatomical structures. A randomized clinical trial comparing fixed prostheses, removable prostheses, and implant-assisted prostheses assessed plaque index, probing depth, implant stability, and marginal bone loss across all three modalities. Fixed restorations supported by either short or long implants proved equally successful and yielded higher patient satisfaction than implant-assisted partial dentures [27].

Other evidence points to a clinical correlation between conventional and guided surgery regarding implant survival and marginal bone loss. Notably, guided surgery introduces an important variable that may improve outcomes: precision. A five-year retrospective study comparing conventional freehand implant placement to fully guided surgery in the esthetic zone found no significant difference in marginal bone loss between the two approaches, though guided surgery showed advantages in esthetic outcomes and soft tissue stability over time [28].

The condition of peri-implant soft tissues plays a crucial role in marginal bone stability. Adequate mucosal thickness and quality are associated with more favorable crestal bone levels over time. Marginal bone loss remains one of the primary parameters for assessing implant prognosis, as it can compromise biological, mechanical, and prosthetic outcomes. Careful planning and monitoring are therefore essential to ensure long-term peri-implant tissue stability and patient satisfaction [29].

Clinical Indications and Case Selection

Flapless implant surgery has gained significant traction in modern implantology owing to its minimally invasive nature, its capacity to preserve both hard and soft tissues, and the level of comfort it offers patients. Unlike conventional surgery, which requires lifting a mucoperiosteal flap to expose the underlying bone, the flapless approach allows implants to be placed directly through the soft tissue without full flap elevation [30]. Evidence suggests this technique reduces postoperative morbidity and promotes favorable tissue outcomes, though its success is highly dependent on careful case selection and thorough preoperative evaluation [31].

Adequate bone volume is one of the most consistently cited requirements for flapless implant surgery. Because the surgeon does not have direct visualization of the alveolar crest, bone dimensions in both width and height must be confirmed before the procedure. Systematic analyses indicate that patients with at least 6 mm of horizontal bone width and sufficient vertical bone height are good candidates, as inadequate bone volume increases the risk of implant malposition or cortical perforation [31]. Cone-beam Computed Tomography (CBCT) and other three-dimensional imaging tools are essential to allow clinicians to virtually assess bone morphology and identify and avoid critical anatomical structures [32,33].

Soft tissue conditions are equally important in case selection. Clinical studies consistently show that flapless surgery yields the best results when an adequate band of keratinized mucosa and a thick, soft tissue biotype are present [31]. Conversely, thin biotypes or sites with active inflammation are less suitable, as insufficient keratinized tissue may compromise healing and aesthetic outcomes, sometimes requiring flap elevation to achieve proper soft tissue management [32].

Digital planning tools have transformed the safety profile of flapless surgery. Computer-guided implantology and three-dimensionally planned surgical guides allow for controlled implant placement with precise angulation and depth, which is especially critical when the surgical field is not fully exposed [34]. Systematic reviews confirm that guided flapless surgery improves placement accuracy, though outcomes remain dependent on bone quality and the clinician's experience with digital workflows [35].

Although flapless implant surgery offers clear clinical benefits, it is not suitable for every patient or every site. Cases requiring bone augmentation, sites with insufficient soft tissue, or areas in close proximity to important anatomical structures may require conventional flap surgery [35]. Proper case selection based on available bone, soft tissue health, and digital planning is essential to minimize complications and optimize both functional and aesthetic outcomes [30].

Conflict of Interest

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations, and therefore was exempt.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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