

Impact of different flap approaches on the outcome of dental implant surgeries – A review.

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ABSTRACT

Objective: This paper reviews the impact of different flap approaches in dental implant surgeries, focusing on their influence on outcomes and the principles guiding their use.

Background: Implant dentistry aims to restore aesthetics and functionality in edentulous patients through osseointegrated implants. Flap elevation during implant placement enhances visibility of landmarks but may lead to complications like morbidity, discomfort, and tissue loss. Various flap designs and principles are employed to address these challenges.

Methods: The review analyzes diverse flap designs, principles, and their implications in implant dentistry, emphasizing their impact on esthetics, bone preservation, and surgical outcomes.

Results: Different flap approaches like flapless, vestibular incision, papilla sparing, and others are assessed in terms of their advantages, limitations, and impact on soft tissue aesthetics, bone resorption, and surgical success. Principles guiding flap design and management for esthetic implant therapy are also outlined.

Conclusion: Preserving inter-dental papilla through appropriate flap designs is crucial in preventing bone denudation and subsequent resorption post-implant placement. Adhering to principles and employing suitable techniques ensures consistent and favorable esthetic outcomes in dental implant surgeries.

Application: This review highlights the significance of flap approaches in implant dentistry, offering insights into optimizing surgical techniques and promoting patient-centered outcomes, contributing to enhanced esthetic and functional restoration.

Keywords: Bone density, flaps, implant surgery, implants, surgical techniques.

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Introduction

The current preferred method for rehabilitating missing teeth involves dental implants, lauded for their functional and aesthetic advantages and boasting high survival rates. The field of implant dentistry has transitioned from traditional flap therapy to a more esthetically driven discipline, propelled by advancements in material sciences and a deeper understanding of occlusion.^[1] Consequently, there has been a quest among clinicians to adopt techniques

that expedite treatment, such as flapless or minimally invasive surgical procedures coupled with immediate placement and loading.^[2] However, the long-term success of implants hinges on various primary and secondary factors, including surgical aspects that can lead to marginal bone loss and, ultimately, late implant failure.^[3] The surgical technique employed significantly impacts implant survival, with the conventional approach involving flap elevation for

improved visualization and optimal implant positioning.^[4]

Over the past three decades, modifications to conventional surgical techniques have incorporated aesthetic considerations, particularly in critical aesthetic zones. When faced with limited bone quality, elevating a mucoperiosteal flap aids in visual assessment of bone morphology and quality, ensuring maximum bone-to-implant contact and achieving primary stability during implant placement.^[5] Furthermore, flap elevation facilitates proper visualization, potentially reducing the risk of complications like dehiscence and fenestration, thus minimizing associated discomfort and morbidity. Studies dating back to the 1970s have indicated a link between flap elevation and adverse effects like gingival recession and bone resorption around natural teeth.^[6] Post surgical tissue loss resulting from flap elevation has been documented, impacting the aesthetic outcomes of implants, particularly along the margins of anterior teeth.^[7]

Flap design:

Thoroughly assessing the clinical scenario to determine the most suitable flap design is a crucial element in achieving success in each specific case. During implant surgery, a range of flap designs are at the surgeon's disposal. Factors that significantly influence flap design encompass the location of the implant site, identification of anatomical structures, necessity for soft or hard tissue grafting, as well as the number of implants intended for placement, among others. In instances where an ample amount of keratinized tissue and appropriate ridge dimensions are present, a flapless or less invasive flap approach may be considered suitable. Conversely, cases involving substantial vertical and/or horizontal ridge deficiencies may necessitate a more extensive flap elevation to facilitate manipulation of either hard or soft tissue as required. The selection of the most appropriate

flap design is contingent upon a comprehensive evaluation of the individual clinical circumstances to optimize the outcomes of the implant procedure. In situations where a tension-free closure is essential, a vertical releasing incision is frequently integrated.^[3] Gomez-Roman et al. highlighted the significance of employing a limited flap design for single-tooth implants, as it helps prevent potential loss of the papillae and reduces interproximal crestal bone loss. Attaining favorable esthetic outcomes consistently relies on the utilization of appropriate surgical techniques and principles.^[8,9]

Type of flap reflection:

A comprehensive comprehension of the intended procedure is crucial when planning for implant surgery to determine the necessary type of flap reflection. Two commonly performed flap reflections in implant surgery include the full-thickness mucoperiosteal and partial-thickness mucosal flap reflections (Figure 1). In clinical scenarios where an ample amount of underlying hard and soft tissue is available, the routine choice is a full thickness mucoperiosteal flap. Conversely, when simultaneous augmentation of both hard and soft tissues is necessary, a combination of full-thickness and split-thickness flap reflections is often employed.^[8]

Principles of flap design in dental implantology^[10]

- **Principle 1:** Utilizing new scalpel blades and sharp periosteal elevators is crucial for making precise incisions and effectively elevating flaps, ensuring the preservation of mucosal viability. Clear, precise incisions are imperative to prevent unnecessary retraction, while elevating the flap necessitates adept and flawless use of a dedicated periosteal elevator.
- **Principle 2:** Optimal visibility of the operative site is paramount during surgical

procedures. Some recommendations suggest making the incision longer than strictly necessary to expose the operative area, thereby enhancing visibility of the bone. It is important to note that longer incisions do not necessarily impede healing; in fact, they tend to heal at a similar rate to shorter incisions.

- **Principle 3:** The periosteum serves as the major vascular supply to the bone; therefore, at most, only a minimal amount, if any, of the periosteum should be removed.
- **Principle 4:** If papillae are involved, they should not be bisected but elevated in total.
- **Principle 5:** If the implant procedure is to involve the alveolar ridge, the incision should be made at the crest within the linea alba.
- **Principle 6:** If tension-relieving incisions are required to avoid stretching or tearing the tissues, these incisions should be made obliquely to ensure broad-based flaps.
- **Principle 7:** Flexibility in positioning the surgical guide⁴ must be provided.
- **Principle 8:** Ensuring adequate identification of critical anatomical landmarks is imperative in surgical procedures. Evaluating, protecting, and preserving the location and trajectory of blood vessels and nerves throughout the surgical process is crucial. Beyond a general understanding of these structures, precise awareness of their specific locations, such as the mental foramina and incisal canal, is essential. This detailed knowledge is an integral aspect of preoperative planning, safeguarding against inadvertent damage to vital structures during the procedure.
- **Principle 9:** Identification of the contours of the adjacent teeth, as well as the concavities or protrusions on the surface of the bone, is essential and will facilitate implant placement.
- **Principle 10:** It is also essential to ensure that all wounds have clean edges, which will facilitate closure and optimize healing by primary intention.
- **Principle 11:** Permitting the raising of a full mucoperiosteal flap ensures that it has a good vascular supply. Insufficient blood supply compromises the survival of the non-reflected tissue, which can lead to necrosis as well as the potential for a deleterious aesthetic result. The choice of flap design should allow for maintenance of optimal and sufficient blood supply to all parts of the mobilized tissues as well as the soft tissues in the surrounding area.
- **Principle 12:** Flap blood perfusion must be maintained up to the point at which the ratio of length to the width of the parallel pedicle flap equals 2:1. The length/width ratio requirement usually favors a slight trapezoidal shape of the flap.
- **Principle 13:** The tissue flap must be kept moist at all times to help avoid shrinkage and dehydration of the tissue. With prolonged duration of the surgical procedure, the involved tissues are at risk of drying out, especially when a high degree of hemostasis has been achieved.
- **Principle 14:** The goal is always to minimize scarring and avoid vestibular flattening.
- **Principle 15:** It is imperative to provide for closure away from the submerged fixture installation or augmentation site.
- **Principle 16:** As with any operative technique, the minimization of postsurgical bacterial contamination improves outcome and decreases morbidity.
- **Principle 17:** Minimal tension during re-approximation and after suturing is important to avoid impairment of the circulation at the wound margins. Shrinkage of the reflected tissue with

wound dehiscence will ultimately lead to increased scar formation.

- **Principle 18:** Tissue trauma, such as stretching, tearing, or distortion, should be avoided through appropriate and careful reflection and manipulation of tissue flap. Excessive trauma from retraction may cause increased swelling and delay healing.
- **Principle 19:** The integrity of the periosteum should be maintained throughout. The periosteum will serve as a barrier against the connective tissue cells so that these cells cannot invade the bone cavity during the healing process and prevent a complete bone fill.
- **Principle 20:** Providers should avoid oblique relieving incisions over prominent root surfaces because recession may result if there is an underlying bony dehiscence.
- **Principle 21:** In cases of reduced quantity of keratinized tissue, it is beneficial to position the crestal incision toward the palatal aspect, the area where more keratinized tissue as it extends onto the palatal mucosa.
- **Principle 22:** When employing graft materials or membranes during procedures, it is advisable to incorporate relieving incisions at a minimum of one tooth proximal to the augmentation area. Principle 23 emphasizes that in situations where uncertainty arises regarding the necessity to expose anatomical structures like the incisive nerve, or when augmentation techniques might be necessary, opting for a wider flap design that includes the papillae becomes obligatory.
- **Principle 24:** For larger implant sites that are 8 mm and larger, choose a mesiodistal crestal incision of 5-6 mm to allow for nonreflection of papillary tissue. For sites that are less than or equal to 7 mm mesiodistally, there is a need to reflect the papillae.

- **Principle 25:** Atraumatic wound handling avoids tension and pressure to the flap that may lead to impaired blood flow and interrupted lymph drainage.
- **Principle 26:** Controlling intraoperative bleeding (adequate hemostasis) is necessary to avoid the possibility of hematoma formation, another causative factor in delayed wound healing.
- **Principle 27:** Practitioners should strive to eliminate the formation of any dead space in which fluids might collect after wound closure.
- **Principle 28:** The use of proper suture materials with an atraumatic needle must be practiced. Further, practitioners must have exceptional surgical knotting and suture selection techniques.
- **Principle 29:** Avoid any local or external pressure on the wound during the healing period. Educate patients about the importance of postoperative care.
- **Principle 30:** In situations involving non-submerged implants, it is recommended to reposition the flap edge upward postoperatively. This is aimed at preventing excessive growth of the gingiva above the healing cap or cover screw. Achieving this involves orienting the connective tissue (periosteum) toward the healing cap rather than positioning the epithelium in that direction.

The advantages and disadvantages of various flap designs have been enumerated in Table no. 1.

Flap design and management considerations for esthetic implant therapy^[11]:

The planning and execution of incisions within the esthetic zone should adhere to biological principles and consider the desired esthetic outcome. Various incision and flap

designs have been identified for implant and implant-related surgeries in this zone, including flapless, vestibular incision, papilla sparing, envelope, triangular, and trapezoidal techniques. Proper surgical planning requires time and a multidisciplinary approach, ensuring comprehensive treatment planning and appropriate case selection for each technique to minimize complications. Specifically tailored incision planning should be conducted with a focus on the desired esthetic result. Emphasizing patient-driven outcomes through diagnostic mock-ups or esthetic try-ins during the initial stages of therapy aids in treatment planning. Utilizing a multidisciplinary approach and prioritizing biologically predictable results for each surgery is essential. Employing a flapless or vestibular incision technique, when suitable, minimizes anterior maxillary surgical interventions critical for predictable esthetic outcomes. Therefore, prior to any surgical procedure, thorough consultation involving a discussion of expected outcomes and treatment options is imperative with the patient and treatment team.

Guidelines for implant placement advocate for the implant-abutment interface to be positioned 3 mm apically and 2 mm palatally to the gingival zenith at the alveolar bone crest. These guidelines consider the biologic width along the abutment and the stability of thicker buccal tissue following implant placement. In surgical contexts, a flapless approach is often favored to maintain soft tissue aesthetics. Studies have indicated that single implants placed using a flapless approach exhibit less soft tissue recession compared to those placed using a flap approach. Preserving supracrestal gingival fibers has been linked to predicting postsurgical attachment levels. A direct correlation exists between crestal bone height and the stability of soft tissue indicators influencing esthetic success.^[12-18] For

predictable soft tissue aesthetics, a crestal bone height of 5.0 mm or less is deemed necessary. After extraction, buccal bone resorption results in substantial vertical reduction of the buccal crest. Immediate implants placed with a flapless technique do not prevent alveolar bone resorption and show no impact on dimensional changes of the extraction socket over time compared to those placed with a flap. Both flapless and flap implant placement techniques exhibit high success rates; however, a flapless protocol, by avoiding potential scars and trauma to supracrestal gingival fibers, may offer superior esthetic outcomes in certain clinical scenarios. Flap designs based on need for flap advancement is shown in the figure 1.

Conclusion

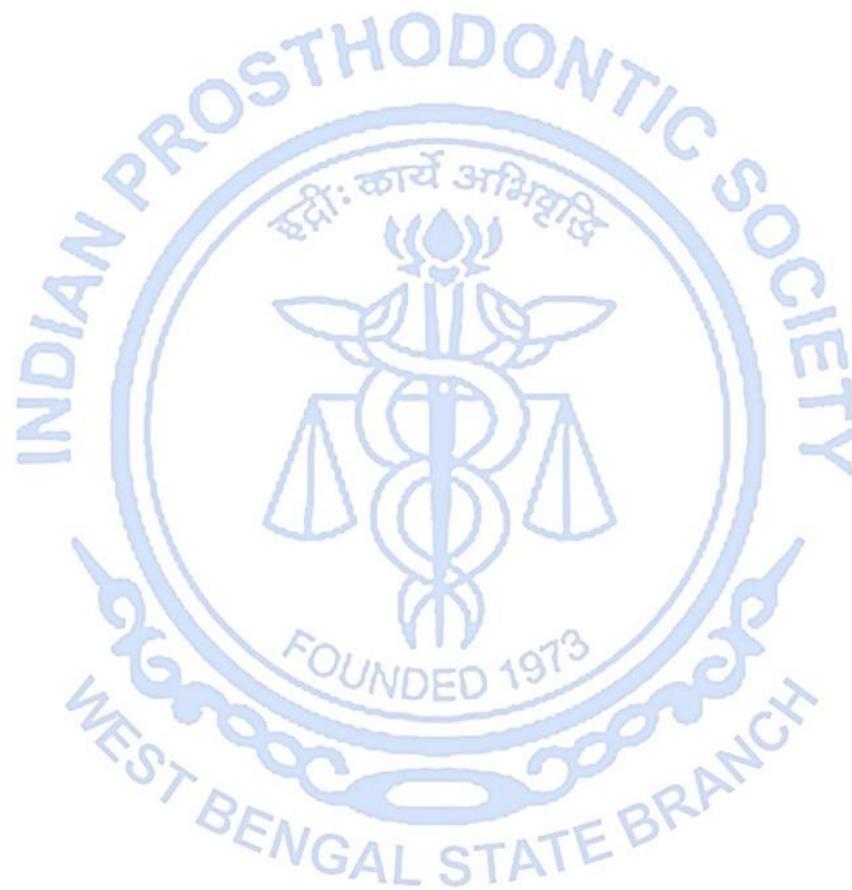
Preserving inter-dental papilla through different flap designs is crucial, as it aids in preventing the denudation of interproximal bone near adjacent teeth from the periosteum. This preservation plays a vital role in averting deleterious effects on bone nutrition, consequently leading to reduced resorption following dental implant placement. By adhering to these principles and employing appropriate surgical techniques, consistent and favorable esthetic outcomes can be reliably achieved.

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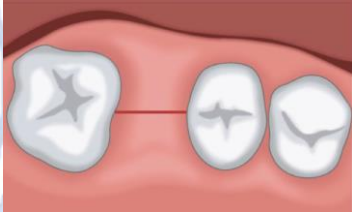


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TABLES**Table No. 1**

DESIGN	ADVANTAGES	LIMITATION	DIAGRAM
Punch Flap	<ul style="list-style-type: none"> • Minimal surgery • Minimal postoperative pain/discomfort • Suitable for one-stage surgery 	<ul style="list-style-type: none"> • Simultaneous bone grafting is not possible • Minimal exposure to the bone for thickness evaluation • Require sufficient keratinized mucosa 	
Half punch	One-stage implant surgery with possible simultaneous bone grafting	Minimal exposure to the bone for thickness evaluation	
Mid crestal incision	<ul style="list-style-type: none"> • This flap can be used for both one- and two-stage implant surgery • Buccal and palatal/lingual bone grafting is possible 	<ul style="list-style-type: none"> • Requires sufficient buccal and palatal tissues 	
Palatal/lingual crestal incision	<ul style="list-style-type: none"> • Suitable in cases when there is less buccal tissues available to raise full thickness flap. • Bone grafting can be performed buccally or palatally/lingually. • Suitable for both one- and two-stage implant surgery 		
Mesial papilla preservation flap	<ul style="list-style-type: none"> • Good aesthetic results • Minimal surgery and soft tissue manipulation 	<ul style="list-style-type: none"> • Not suitable if bone grafting is required • Used for the second stage of implant surgery to help get maximum aesthetic results by preserving the papilla 	

Distal papilla preservation	preserve the distal side of the defect to allow bone grafting.		 Distal Papilla Preservation
Double papilla preservation	<ul style="list-style-type: none"> • More aesthetic results • Suitable for the second stage of implant surgery where the mobilization of a good amount of tissues may be required. 	<ul style="list-style-type: none"> • Vascularity may be compromised in the narrow space. 	
Book flap	<ul style="list-style-type: none"> • Wide exposure allows observing the undercut lingually or buccally • Easy to lean and perform alveoplasty • Easy to perform bone cutting and splitting. 	<ul style="list-style-type: none"> • Bone devitalization and subsequent remodeling resorption in narrow ridge • Less predictable outcomes 	
Triangular flap	<ul style="list-style-type: none"> • Adequate visibility • Less tension on closure • Easy to modify 	<ul style="list-style-type: none"> • Limited access • Increased tension when grafting • Potential for bone loss and recession • Increased disruption of blood supply 	
Trapezoidal flap	<ul style="list-style-type: none"> • Good visibility • Tension free closure • Good access to additional sites 	<ul style="list-style-type: none"> • Potential for bone loss and recession • Increased disruption of blood supply 	
Vestibular incision	<ul style="list-style-type: none"> • Less invasive • No disruption of papillae 	<ul style="list-style-type: none"> • Limited Access • Low visibility 	

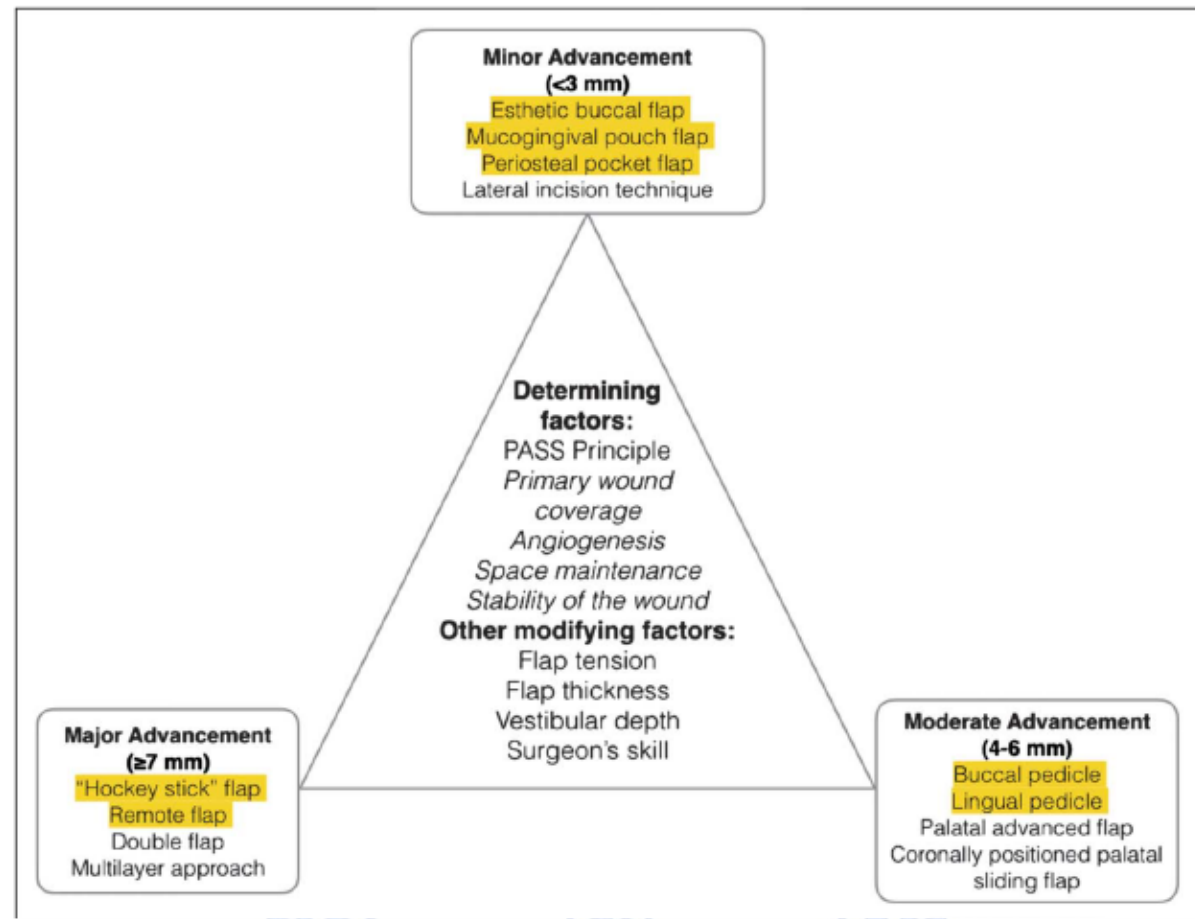
FIGURE

Figure 1: Principles for achieving passive flap extension. This figure categorises the surgical flap designs based on the amount of flap advancement that may be achieved by each technique, shown in the boxes on each axis. The authors recommendation for each category based on experience, are highlighted in yellow. The centre of the triangle lists determining factors which are key principles that determine the degree of flap advancement and success of the guided bone regeneration (GBR) procedure. "Other modifying factors" also may have an effect on flap advancement.