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Review Article

Flap Designs in Periodontal Therapy- An overview

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Abstract

Periodontal flap surgeries are essential procedures in managing moderate to severe periodontitis, allowing better access for debridement and promoting tissue healing. Over time, several techniques such as the Modified Widman Flap, Un-displaced Flap, Apically Repositioned Flap, Papilla Preservation Flap and Conventional Flap have been developed to suit different clinical needs. This article briefly reviews the evolution, indication, and methods of these flap designs with particular focus on their effectiveness, healing potential, and adaptability to anatomical variations including the distal molar region.

Keywords: Periodontitis; Flap Surgery; Incision; Periodontal Pocket

Introduction

Periodontal diseases continue to be one of the most common causes of adult tooth loss, particularly when left untreated or poorly managed. In cases where non-surgical interventions fail to halt disease progression, surgical approaches become necessary to achieve long-term periodontal stability.

Periodontal flap surgery provides essential access to the root surfaces and underlying alveolar bone for therapeutic procedures.A surgical flap refers to a carefully reflected section of soft tissue that allows visibility and instrumentation while preserving vascular supply for optimal healing [1,2]. Over the years, a range of flap designs have been developed, each with specific indications based on clinical goals such as pocket reduction, bone recontouring, or tissue regeneration. A sound understanding of these designs and their applications is crucial for successful outcomes in periodontal therapy.This article aims to provide a structured overview of the commonly used flap designs in periodontal surgery, with their classification, indications and designs in periodontal practice [3].

Definition

A periodontal flap is a section of gingiva or mucosa that is surgically separated from the underlying tissues to provide visibility and access to the bone and root surface. The flap also allows the gingiva to be displaced to a different location in patients with mucogingival involvement [1].

Classification

Periodontal flaps are classified based on the following criteria [1-3]

- Bone exposure after flap reflection
- Placement of the flap after surgery
- Management of the interdental papilla.

Under bone exposure after flap reflection, these are again classified into two types

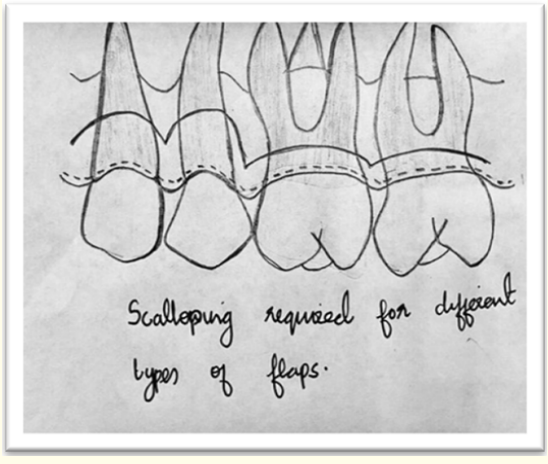

Figure a

Full Thickness Flap

In a full-thickness flap, all layers of soft tissue including the epithelium, connective tissue, and periosteum are carefully reflected, allowing for complete exposure of the alveolar bone. This type of flap is particularly indicated when osseous surgery is planned, as it provides the required visibility and access to the bony structures.

Partial thickness Flap

Partial thickness flap involves the reflection of only the epithelial layer and a superficial portion of the connective tissue, leaving the periosteum and some connective tissue attached to the bone. This ensures that the bone remains covered throughout the procedure. This is also referred as a split-thickness flap, it is commonly indicated in cases where bone exposure is to be avoided, such as in areas with fenestrations, dehiscence, or when performing mucogingival or plastic periodontal surgeries. It is also the flap of choice when apical flap displacement is planned [1,2,4].

Under flap placement after surgery, it is categorized into two types

Undisplaced Flap

This technique removes the soft tissue pocket wall during the initial incision, making it comparable to an internal bevel gingivectomy. Both the gingivectomy and un-displaced flap aim to surgically eliminate the pocket wall. Prior to surgery, it is essential to confirm that an adequate band of attached gingiva will remain after excision to prevent mucogingival complications.

Technique

- Measure pocket depth using a periodontal probe. Create bleeding points on the outer gingival surface to mark the base of the pocket.
- Perform the initial (internal bevel) incision, guided by the bleeding marks and carried slightly apical to the alveolar crest, depending on tissue thickness.
- In thicker gingiva, a more apical incision is required.
- This step also allows for flap thinning, which is easier now than after reflection.
- Make a crevicular incision from the base of the pocket toward the bone, detaching the connective tissue from the tooth surface.
- Reflect the flap using a periosteal elevator.
- Vertical releasing incisions are usually not necessary as the flap is not apically positioned.
- Make an interdental incision using an interdental knife to separate tissue between the teeth from underlying bone.
- Remove the triangular wedge of tissue (created by the 3 incisions) using a curette.
- Debride the area thoroughly, removing all granulation tissue and tags using sharp curettes.
- After scaling and root planning, ensure the flap edge lies at the root bone junction.
- Secure the facial and lingual/palatal flaps using a continuous suture, which anchors around the tooth.
- Cover the site with a periodontal pack [1-3].

Displaced flap

Displaced flaps, can be relocated apically, coronally, or laterally from their original site. Displaced flaps are frequently used in mucogingival surgeries and are used in both full and partial thickness flaps, provided that the attached gingiva is completely separated from the underlying bone to allow tissue mobility. Palatal flaps are generally not displaceable due to the lack of unattached gingiva in the palatal area. The major advantage of apically positioned flaps are their ability to convert the outer wall of a periodontal pocket into attached gingiva, thereby achieving two primary goals, that is pocket elimination and increased width of attached gingiva [5-7].

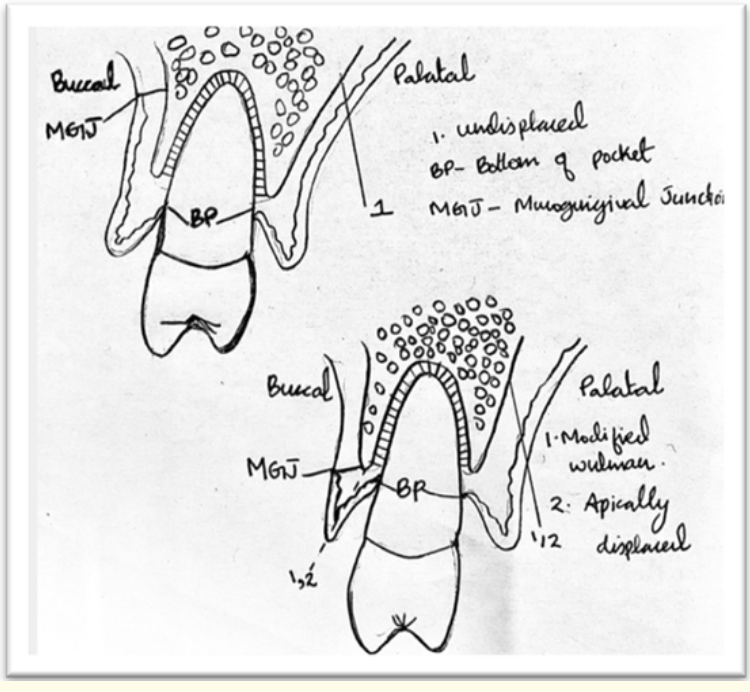

Figure b

Based on the management of the interdental papilla, it is divided into two types

Conventional flap

In a conventional flap, the interdental papilla is split beneath the contact area between adjacent teeth. This allows separate reflection of the buccal and lingual/palatal flaps. The incision typically follows a scalloped pattern, designed to maintain natural gingival contours and preserve as much papillary tissues as possible.

Conventional flaps are indicated when

- The interdental space is too narrow, making papilla preservation impractical.
- The flap needs to be displaced.
- There is a discontinuity of interdental papilla.

Technique

- With a No. 12 blade, make an incision through the base of the pocket to the alveolar crest, splitting the papilla below the contact point.
- Reflect the flap while maintaining its full thickness.
- A thick flap helps to prevent necrosis and ensures coverage over grafts or membranes during healing [1-3].

Papilla preservation flap

This technique is designed to maintain the integrity of the interdental papilla, especially in esthetic and regenerative procedures.

Technique

- Make a crevicular incision around each tooth, avoiding any incisions across the interdental papilla.
- The preserved papilla is included in the facial flap/lingual flap.

- The lingual/palatal incision is a semilunar cut crossing the interdental papilla.
- This incision extends apically from the line angles of the adjacent teeth, ensuring the papilla lies at least 5 mm apical to the papilla crest.
- An Orban knife is inserted into the semilunar incision to sever half to two-thirds of the papillary base.
- The papilla is then dissected from the lingual/palatal aspect and elevated intact along with the facial flap.
- The flap is reflected without thinning, preserving full tissue volume.[8,9]

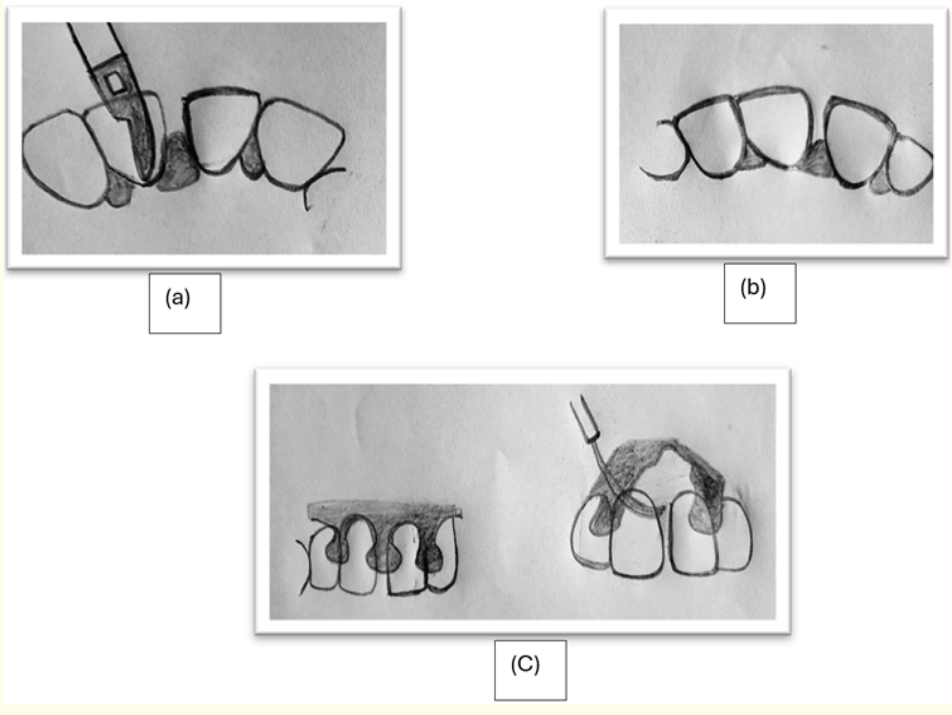

Figure c: Papilla preservation flap. (a) An intra-crevicular incision is made along the lingual/palatal aspect of the teeth with a semilunar incision made across each interdental area. (b) Elevate the interdental papilla from the underlying hard tissue. (c) The detached interdental tissue is pushed through the embrasure with a blunt instrument.

Flap procedures

The evolution of periodontal flap procedures reflects advancements in both surgical technique and therapeutic goals. The undisplaced flap, introduced in the early 20th century, was one of the first techniques aimed at pocket elimination [1-3]. In 1974, Ramfjord and Nissle described the Modified Widman flap, improving access while preserving soft tissue.[5] The apically positioned flap emerged later as a method to reduce pocket depth and increase attached gingiva.[9] By the 1980s–1990s, papilla preservation techniques were introduced to facilitate regenerative procedures in esthetic zones [6].

The Original Widman Flap

In 1918, Leonard Widman was among the first to provide a comprehensive description of a flap surgery technique intended for periodontal pocket elimination. In his publication named "Die operative Behandlung der Pyorrhoea alveolaris", he outlined a mucoperiosteal flap approach that focused on excising both the pocket epithelium and the inflamed connective tissue to enable thorough debridement of the root surfaces.

Technique

- Two vertical releasing incisions were made at the mesial and distal aspects of the area to be treated.
- These were joined by a scalloped reverse bevel incision along the gingival margin to create a flap that includes the pocket epithelium and inflamed connective tissue.
- A mucoperiosteal flap was elevated, exposing 2–3 mm of alveolar bone.
- The collar of inflamed tissue around the neck of the tooth was removed using curettes.
- The root surfaces were scaled and planed; bone recontouring was done if needed to achieve physiological form.
- The flap was repositioned, and interdental sutures were placed to secure it.

Advantages (as per Widman, 1918)

- Promoted primary intention healing and reduced patient discomfort.
- Enabled re-establishment of bone contour in angular defect areas [10].

The Neumann flap

In 1920, Neumann proposed a flap design that shared similarities with Widman's but introduced modifications, particularly in terms of incision design and bone adaptation.

Technique

- An intra-crevicular incision was made to reflect the entire gingival wall and part of the alveolar mucosa.
- Sectional releasing incisions were placed to define the flap extent.
- Granulation tissue and pocket epithelium were removed.
- Debridement of root surfaces and correction of bony contours was done to achieve a smooth horizontal outline.
- The flap was adapted to the alveolar bone at both buccal/palatal and interproximal areas.
- Neumann emphasized the importance of repositioning the flap at the bone crest to eliminate soft tissue pockets [11].

The modified flap operation

In 1931, Kirkland introduced this surgical method for treating 'periodontal pus pockets '. This approach focuses on access for root debridement, without extensive tissue removal.

Technique

- Incisions were made intra-crevicularly, extending apically and laterally from the base of the pocket on both labial and lingual surfaces.
- Flaps were elevated, and exposed root surfaces were mechanically debrided.
- Following cleaning, the flap was repositioned to its original level and secured with sutures.
- No apical displacement of the flap is done.[12]

Apically Repositioned Flap (Friedman, 1962)

In the 1950s and 1960s, advancements in periodontal surgery introduced techniques targeting both soft and hard tissue pocket removal. A major focus during this time shifted toward preserving an adequate width of attached gingiva.

Nabers (1954) initially introduced the concept of "repositioning of attached gingiva", which was later modified by Ariaudo and Tyrrell (1957). Friedman, in 1962, redefined the method and coined the term "apically repositioned flap" to represent this surgical approach. He highlighted that the entire soft tissue unit including both the gingiva and alveolar mucosa was moved in an apical direction, rather than removing any excess tissue [1,2].

Technique

According to Friedman,

- A reverse bevel incision is placed with a Bard-Parker blade (No. 12B or 15), at a distance determined by pocket depth and gingival thickness.
- The incision follows a scalloped pattern to ensure optimal coverage of interproximal bone once repositioned.
- Vertical releasing incisions are made extending beyond the mucogingival junction to permit apical movement of the flap.

- A full-thickness mucoperiosteal flap is raised, incorporating the buccal/lingual gingiva and alveolar mucosa, extending beyond the mucogingival line.
- The marginal collar of tissue, including pocket epithelium and granulation tissue, is excised using curettes.
- Scaling and root planning are carried out on the exposed root surfaces.
- Osseous recontouring is performed with chisels or burs to restore a physiologic alveolar bone shape at a more apical level.
- The flap is repositioned apically and sutured at the level of the recontoured bone crest.
- A periodontal dressing is applied to protect the site and retain the flap during healing.
- Postoperative healing aims to maintain a sufficient zone of attached gingiva and eliminate residual pocketing [13-15].

Modified Widman Flap

Ramfjord and Nissle (1974) introduced the Modified Widman Flap, also known as the 'open flap curettage technique'. Unlike the original Widman flap, which involves apical repositioning and osseous recontouring, this focuses on access for debridement without altering the flap position and bone architecture [1,2].

Technique

- An initial incision is made about 1 mm from the gingival margin on the buccal side, parallel to the tooth's long axis, using a No. 11 Bard-Parker blade.
- An intra-crevicular approach is preferred for shallow (<2 mm) buccal pockets or when esthetics are a concerned.
- The incision is extended interdentally to preserve as much interdental gingiva as possible. A similar method is applied to the palatal aspect, sometimes beginning 1–2 mm from the mid-palatal surface.

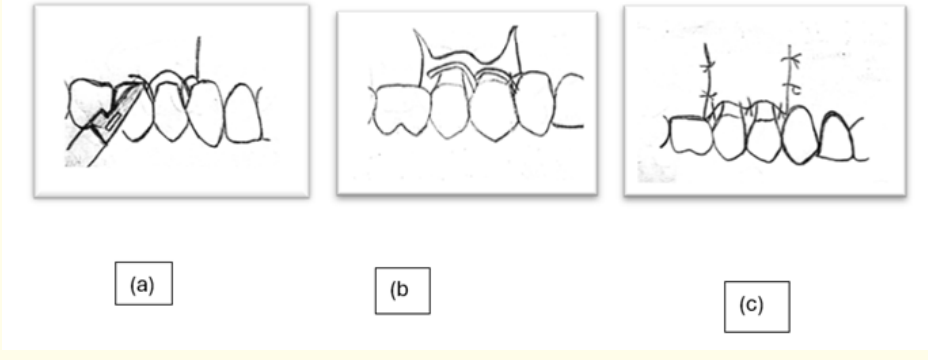

Figure d: (a) Two releasing incisions. demarcate the area scheduled for surgical therapy. A scalloped reverse bevel Incision is made in the gingival margin to connect the two releasing incisions.(b)The collar of inflamed gingival tissue is removed following the elevation of a mucoperiosteal flap.(c)The coronal ends of the buccal and lingual flaps are placed at the alveolar bone crest and secured in this position by interdentally placed sutures.

- Vertical releasing incisions are generally not required.
- A full-thickness mucoperiosteal flap is gently elevated on both buccal and palatal sides, exposing only minimal bone near the crest.
- A second intra-crevicular incision is made around the necks of the teeth down to the alveolar crest to detach the inner collar of tissue.
- A third horizontal incision, close to the bone crest, removes the soft tissue collar from the root surfaces.
- Pocket epithelium and granulation tissue are removed with curettes. The root surfaces are thoroughly scaled, leaving a small zone near the bone crest intact to preserve attachment fibers.

- Angular defects are evaluated and minor bone removal from the outer aspects of alveolar bone may be done to facilitate flap adaptation.
- The flap is repositioned and sutured using individual interproximal sutures to achieve tight adaptation over the bone and roots.
- A surgical dressing may be applied postoperatively and is typically removed with sutures after one week.

Advantages

- Enables close adaptation of soft tissue to root surfaces.
- Minimizes trauma to alveolar bone and surrounding tissues.
- Provides limited root exposure, enhancing esthetic outcomes in anterior regions [4,16,17].

Distal molar surgery

Managing periodontal pockets on the distal aspects of terminal molars can be challenging due to anatomical and tissue-related factors. Bulky fibrous tissue often overlies the maxillary tuberosity (in the upper jaw) and prominent retromolar pads (in the lower jaw), complicating access and healing.

Maxillary Molars – Distal Flap Surgery [1,2].

Treating distal periodontal pockets in the maxillary arch is often less complex than in the mandible due to several reasons such as:

- The tuberosity region having a greater width of fibrous attached gingiva.
- Anatomical adaptability of the maxillary tuberosity allows easier pocket elimination.

However, challenges can still arise due to abruptly ascending tuberosity and limited attached gingiva in some cases.

Technique

Before incision placement, assess the following

- Pocket depth
- Gingival width
- Accessibility of the site
- Make two parallel incisions starting from the distal of the last molar, extending toward the mucogingival junction on the tuberosity or retromolar pad.
- The facio-lingual spacing between the incisions depends on the pocket depth and tissue bulk.
- After removing the tissue strip between incisions and thinning the flaps, ensure flap edges meet without overlapping.
- If overlapping occurs, trim excess tissue using scissors or a sharp blade.
- A transverse incision connects the two parallel cuts at their distal ends, allowing the removal of a rectangular tissue segment.
- Incisions are often joined with those used in the rest of the quadrant.
- The parallel distal incisions should remain within attached gingiva:
- Extending into alveolar mucosa complicates bleeding control and flap management.
- If access is limited, an additional vertical incision can be made at the distal end.
- In the tuberosity area, two distal incisions are generally made at the midline of the tuberosity.
- These cuts extend directly down to bone using a N0.12B blade.
- During partial flap reflection, redundant soft tissue is dissected and removed.
- Then the flaps are repositioned, with close proximity over the bone without tension or gaps.[12,18]

Mandibular molars

Surgical management of distal pockets in mandibular molars presents greater difficulty than in the maxilla due to anatomical and tissue differences. The retromolar pad typically has less fibrous attached gingiva than the maxillary tuberosity and the presence of the ascending ramus shortens the distal flat area behind the last molar, complicating surgical access for deep defects.

Technique

- The two incisions distal to the molar should follow the area with the maximum width of attached gingiva.
- This may be either distolingually or disto facially, depending on anatomical variation.
- Flap thinning should be done using a No.15 blade.
- Thinning is easier before the flap is fully mobilized and detached.

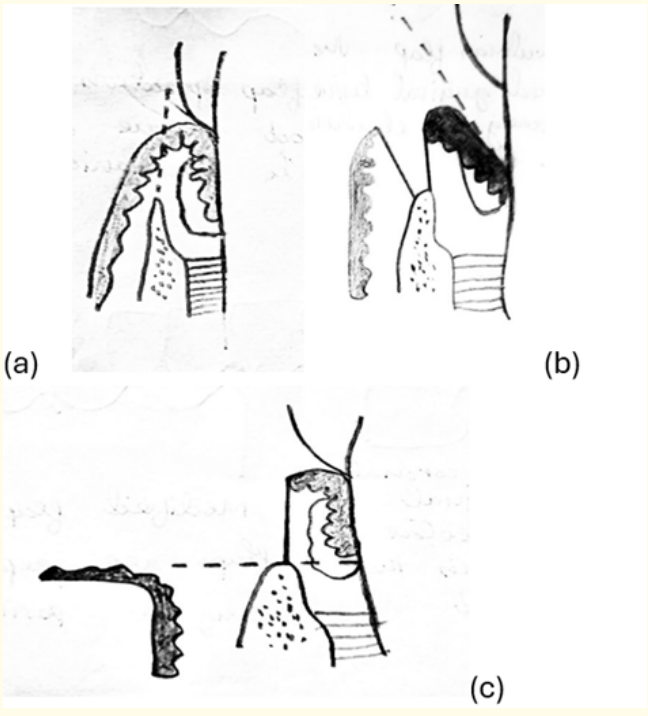

Figure e: Modified Widman flap. (a)The initial incision is placed 0.5-1 mm from the gingival margin and parallel to the long axis of the tooth. (b)Following careful elevation of the flaps, a second intracrevicular incision is made to the alveolar bone crest to separate the tissue collar from the root surface. (c)A third incision is made perpendicular to the root surface and as close as possible to the bone crest thereby separating the tissue collar from the alveolar bone.

- Once reflected, redundant fibrous tissue is excised to improve access and visibility.
- Perform osseous recontouring, if indicated, after soft tissue removal.
- The flap margins are approximated similarly to those in maxillary distal molar surgery, ensuring close adaptation over the treated site [12,19].

Healing following flap surgery [1,2].

- **Within the first 24 hours**: A blood clot forms at the interface between the flap and the underlying tooth or bone surface. This clot comprises a fibrin network that contains numerous polymorphonuclear leukocytes, red blood cells, necrotic cell remnants, and capillaries at the wound margins. Tissue injury at this stage also produces exudate or transudate, along with microbial contamination.
- **By the first to third day**: The space between the flap and the bone or tooth surface becomes narrower. Epithelial cells begin migrating from the flap edge and typically make contact with the tooth during this time.
- **At one week**: Epithelial adhesion to the root surface is established, facilitated by hemidesmosomal attachments and a basal lamina. The initial clot is gradually replaced by granulation tissue that originates from the surrounding gingival connective tissue, the periodontal ligament, and bone marrow.

- **By the second week:** Newly formed collagen fibers start aligning parallel to the root surface.
- **After one month**: The gingival crevice becomes fully covered by epithelium, and a stable epithelial attachment is present. The supracrestal connective tissue fibers begin to assume a more organized, functional orientation

Conclusion

Flap surgical procedures continue to serve as a fundamental component in periodontal therapy, offering controlled access for thorough debridement and facilitating regenerative or resective interventions. Each flap design ranging from the Modified Widman and un-displaced techniques to apically repositioned and papilla preservation flaps has specific indications based on anatomical considerations, pocket morphology, and esthetic relevance. In posterior regions, particularly around maxillary tuberosities and mandibular retromolar pads, flap management requires careful incision planning due to limited keratinized tissue and access challenges. Proper execution in these areas enhances healing outcomes while preserving functional tissue structures. When appropriately selected and performed, these flap techniques contribute significantly to the reduction of periodontal pockets, preservation of gingival attachment, and long-term periodontal stability, forming the basis for successful clinical outcomes in both conventional and regenerative periodontal surgery.

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