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Clinical Versatility of the Laurell–Gottlow Modified Horizontal Mattress Suture for Predictable Primary Wound Closure and Flap Stabilization in Regenerative Periodontal and Implant Surgery: A Prospective Four-Case Series

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Type of Publication: Case Series

Conflicts of Interest: Nil

Abstract

Background: In contemporary reconstructive periodontal and implant surgery achieving predictable primary wound closure and stable flap adaptation is essential for effective regeneration. The Laurell–Gottlow modified horizontal mattress suture is designed to provide a superior flap stabilization while minimizing wound tension and maintaining precise adaptation of the wound margins. However, the clinical adaptability of this suturing technique in different regenerative surgical scenarios has not been sufficiently documented.

Aim: To evaluate the clinical applicability and versatility of the Laurell–Gottlow modified horizontal mattress suture across different periodontal and implant regenerative surgical procedures, with respect to wound healing and postoperative outcomes.

Methods: This prospective case series evaluated the clinical application of the Laurell–Gottlow modified horizontal mattress suture across four regenerative surgical procedures: immediate implant placement with guided bone regeneration, hemisection with socket preservation, intrabony defect regeneration, and Grade II furcation regeneration. Clinical healing was prospectively assessed based on flap stability, wound margin adaptation, maintenance of primary closure, and postoperative complications, including wound dehiscence and graft or membrane exposure.

Results: Primary wound closure and stable flap adaptation were achieved in all four cases (100%). One case exhibited minor dehiscence (~1 mm), which resolved by 14 days and remained closed at 3 months. Early wound healing was favorable (14-day score: 3–4;

mean 3.5 ± 0.58), with minimal postoperative pain (Day 3 VAS: 1.25 ± 0.50). No graft or membrane exposure was observed. Radiographically at 3 months, favourable bone healing was observed, and a stable furcation healing was observed in one of the cases.

Conclusion: The Laurell–Gottlow modified horizontal mattress suture demonstrated reliable primary wound closure and stable flap adaptation across diverse regenerative periodontal and implant procedures.

Keywords: Wound Closure, VAS Scores, Laurell–Gottlow Modified Horizontal Mattress Suture, Flap Stability

Introduction

Periodontal surgical procedures initiate a complex sequence of biological events directed toward restoration and maturation of the tissues surrounding the tooth. Following surgical injury, healing progresses through overlapping phases of inflammation, proliferation, and tissue maturation, with the initial blood clot providing a provisional scaffold for cellular migration and organization. Subsequent angiogenesis, extracellular matrix deposition, collagen organization, and tissue remodeling progressively transform the initial wound into mature tissue. The biological outcome of periodontal wound healing is influenced not only by the intrinsic regenerative capacity of the tissues but also by the local mechanical environment.[1,2]

The early fibrin clot establishes the initial interface between the surgical flap and the underlying wound bed and is particularly important during the initial stages of periodontal healing. Stabilization of this clot and its subsequent maturation into an organized connective tissue attachment are critical for favorable healing. Experimental studies have demonstrated that disruption of the early wound interface can influence the nature and organization of the tissues formed during healing, providing a biological basis for emphasizing mechanical stability following periodontal surgery[1,2].

Primary wound closure is therefore an important determinant of predictable periodontal healing. Close approximation of the wound margins protects the underlying surgical site, minimizes mechanical disturbance, and facilitates stabilization of the blood clot. However, closure must be maintained throughout the early postoperative period, as excessive flap tension or inadequate stabilization may result in marginal separation and wound dehiscence. Burkhardt and Lang demonstrated that increased flap-closing forces were associated with a higher incidence of postoperative dehiscence, emphasizing the importance of both the magnitude and distribution of forces during wound closure.[1,2]

Flap stability is closely associated with these principles. Following surgery, sufficient immobilization of the flap permits maturation of the fibrin connection between the flap and wound bed, whereas excessive movement may disrupt the developing clot and interfere with tissue organization.[3] Thus, effective surgical closure requires not only approximation of the wound margins but also maintenance of a stable, tension-controlled flap position during the early healing phase.

Within this context, suturing represents an integral component of periodontal surgical treatment. Sutures provide mechanical stabilization, facilitate wound-margin approximation, and maintain the intended position of the tissues during healing. Their effectiveness is influenced by the suture configuration, placement, tissue characteristics, and tension applied. An appropriate technique should provide adequate stabilization while minimizing tissue compression and trauma.[4]

Several suturing configurations have been described in periodontal surgery, including interrupted, sling,

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suspensory, vertical mattress, and horizontal mattress sutures. The horizontal mattress configuration distributes closing forces over a broader area and provides enhanced stabilization of the flap compared with individual interrupted sutures.[4] However, additional interrupted sutures may be required to achieve precise approximation of the wound margins. The effectiveness of the technique therefore depends on achieving an appropriate balance between mechanical stabilization and atraumatic tissue adaptation.

The Laurell–Gottlow modified horizontal mattress suture was developed to address this requirement by combining the stabilizing characteristics of a horizontal mattress configuration with controlled approximation of the wound margins[5]. The technique permits wound closure using a modified mattress configuration without relying on additional interrupted sutures, thereby providing simultaneous flap stabilization and wound-edge adaptation. Its potential clinical advantage lies in achieving stable tissue positioning while minimizing additional tissue perforations and maintaining appropriate wound adaptation[5].

Despite the established importance of primary closure, flap stability, and suturing in periodontal surgery**,** clinical evidence specifically evaluating the Laurell–Gottlow modified horizontal mattress suture remains limited. Existing literature has largely focused on general wound-closure principles, suture materials, flap tension, and conventional suturing techniques, with comparatively limited clinical documentation of this specific modified configuration across different periodontal surgical situations. Consequently, further clinical documentation is warranted to assess its applicability under varied anatomical and surgical conditions.

The present case series therefore aimed to clinically evaluate the application of the Laurell–Gottlow modified horizontal mattress suture in four surgical situations: immediate implant placement with guided bone regeneration, hemisection with socket preservation, intrabony defect regeneration, and Grade II furcation regeneration. These procedures represent differing anatomical configurations and surgical requirements, providing an opportunity to evaluate the adaptability of a single suturing configuration across varied clinical conditions. Flap stability, wound-margin adaptation, maintenance of primary closure, early wound healing, postoperative discomfort, and wound-related complications were assessed to provide a broader clinical evaluation of the technique.

Materials and Methodology

Study design

This prospective case series evaluated the clinical application of the Laurell–Gottlow modified horizontal mattress suture in four patients undergoing periodontal and implant regenerative surgical procedures at Department of Periodontics, Ramaiah Institute of Applied Sciences. The four cases represented different anatomical and surgical situations in which stable flap positioning and maintenance of wound closure were considered important for postoperative healing. The procedures included immediate implant placement with guided bone regeneration, hemisection with socket preservation, intrabony defect regeneration, and Grade II furcation regeneration. All patients were informed regarding the nature of the surgical procedure and provided written informed consent before treatment.

Surgical procedure and suturing technique

All procedures were performed under local anesthesia using standard aseptic surgical protocols. Following completion of the planned surgical intervention, the flaps were repositioned to achieve passive adaptation over the surgical site. The Laurell–Gottlow modified horizontal

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mattress suture was used as the principal suturing configuration for flap stabilization. The technique was initiated by inserting the needle from the external surface of the buccal flap, approximately 3–4 mm from the flap margin. The needle was then passed through the internal surface of the opposing lingual or palatal flap at a corresponding distance from its margin. Subsequently, the needle was passed from the external surface of the lingual or palatal flap approximately 5 mm lateral to the previous point of entry and brought through the internal surface of the buccal flap, thereby creating the horizontal mattress configuration. The needle-bearing end of the suture was then brought over the coronal aspect of the flap and passed through the loop formed by the mattress suture. The suture was subsequently tightened to approximate the wound margins, and the needle-bearing end was tied to the free end using a surgical knot.

Case Series

Case 1: Immediate Implant Placement with Guided Bone Regeneration

The first case involved a patient requiring extraction and replacement of 25.26,27. Following atraumatic extraction, the socket was carefully debrided and evaluated. Immediate implant placement was subsequently performed according to the planned surgical protocol.

Following implant placement, the associated peri-implant defect was managed with guided bone regeneration using osseograft. Following completion of the procedure, the flap was repositioned to achieve passive adaptation over the surgical site.

The Laurell–Gottlow modified horizontal mattress suture was used to stabilize the flap and obtain precise adaptation of the wound margins. The suturing configuration provided controlled positioning of the soft tissues over the implant and regenerative site while maintaining primary closure.

Postoperative healing was favorable, with stable flap adaptation and maintenance of wound closure. No graft or membrane exposure was observed. At 3 months, radiographic evaluation demonstrated favorable bone healing.

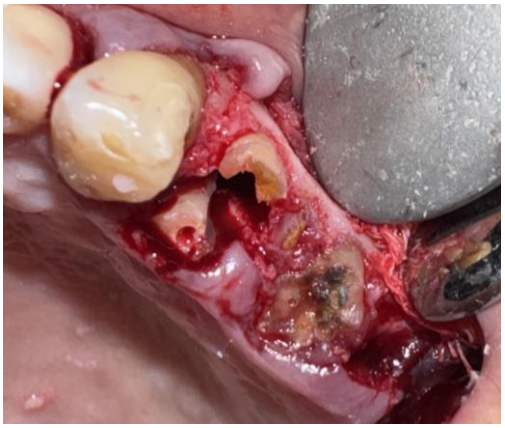


Figure 1: Pre-operative

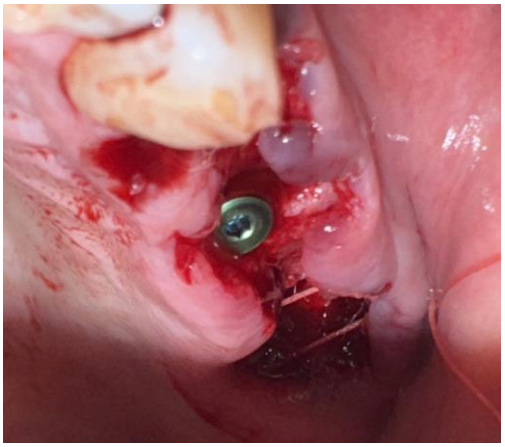


Figure 2: Placement of immediate implant

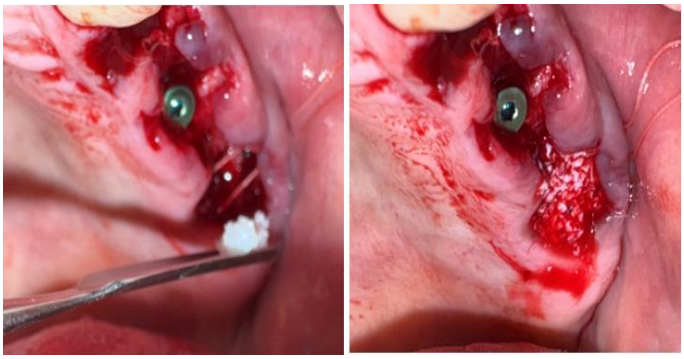


Figure 3: Placement of Osseograft bone graft material

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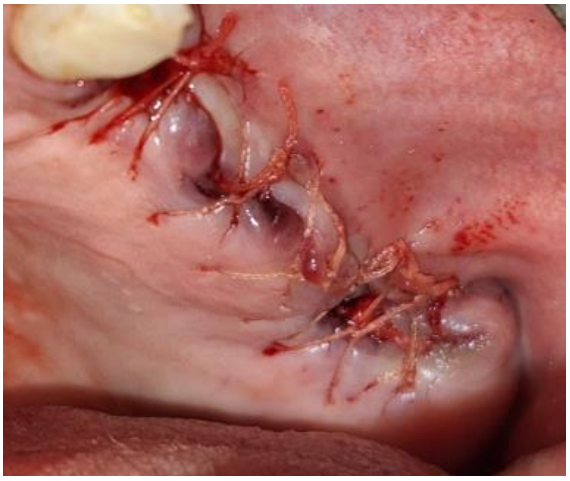


Figure 4: Laurell–Gottlow modified horizontal mattress sutures placed

Case 2: Hemisection

The second case involved mandibular right first molar requiring hemisection and removal of the distal root. Following completion of the planned endodontic procedure, hemisection was performed and the distal root was removed.

The residual socket was thoroughly debrided. Osseograft bone graft material and PRF membrane was inserted into the distal root socket. After completion of the procedure, the flap was repositioned.

The Laurell–Gottlow modified horizontal mattress suture was placed to stabilize the flap and obtain close approximation of the wound margins around the surgical site. Particular attention was directed toward maintaining soft-tissue adaptation around the hemisection and socket preservation area.

Primary closure was achieved following surgery. One case in the series developed a minor wound dehiscence of approximately 1 mm during the immediate postoperative period. The dehiscence resolved completely by the 14-day follow-up, and the surgical site remained closed at 3 months.



Figure 5: Pre-operative view



Figure 6: Pre-operative radiograph



Figure 7: Hemisection done and distal root removed



Figure 8: Bone graft placed

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Figure 9: Laurell–Gottlow modified horizontal mattress sutures placed

Case 3: Grade II Furcation Regeneration

The third case involved a Grade II furcation defect requiring regenerative surgical treatment. Following the reflection of a full thickness mucoperiosteal flap, thorough debridement of the furcation defect was performed. Followed by the debridement osseograft bone material mixed along with PRF was placed at the furcation defect area.

Followed by placement of the graft and PRF, the flap was repositioned with particular emphasis on maintaining stable adaptation over the furcation area. The Laurell–Gottlow modified horizontal mattress suture was used to stabilize the flap and achieve approximation of the wound margins.

Primary wound closure was achieved, and flap stability was maintained during the postoperative period. No exposure of the treated site was observed. At the 3-month follow-up, the site demonstrated stable furcation healing without evidence of deterioration.



Figure 10: Preoperative view



Figure 11: Reflection of full thickness mucoperiosteal flap



Figure 12: Bone graft and PRF



Figure 13: Placement of Bone graft with PRF at the furcation area and placement of Laurell–Gottlow modified horizontal mattress sutures

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Case 4: Regenerative Treatment of an Intrabony Defect

The fourth case involved an intrabony defect requiring regenerative surgical intervention. Following administration of local anesthesia, a full thickness mucoperiosteal flap was reflected to obtain access to the defect and the defect area was thoroughly debrided. After debridement, osseograft bone material was placed at the intrabony defect site.

Followed by the placement of the bone graft, the flap was carefully repositioned over the surgical site. The Laurell–Gottlow modified horizontal mattress suture was used to stabilize the flap and obtain close adaptation of the wound margins.

Primary wound closure was achieved at the completion of surgery, and flap stability was maintained during the postoperative period. Early wound healing was favorable, with no evidence of graft or membrane exposure. At 3 months, radiographic evaluation demonstrated favorable bone healing.



Figure 14: Preoperative view of the intrabony defect



Figure 15: Reflection of mucoperiosteal flap to gain access to intrabony defect



Figure 16: Placement of Bone at the intra bony defect area and placement of Laurell–Gottlow modified horizontal mattress sutures

Results

Table 1: The clinical and radiographic outcomes of the four cases.

Descriptive Statistics of Clinical and Radiographic Outcomes in Case Series					
Variable	Categories / Values	n	%	Mean ± SD	Remarks
Primary Wound Closure	Yes	4	100%	–	Uneventful healing; 1 mm dehiscence resolved by 14 days

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Flap Stability	Stable	4	100%	–	All cases stable
Early Wound Healing Score (14 days)	Range 3–4	–	–	3.5 ± 0.58	Healing favorable in all cases
Wound Dehiscence (None)	14 days	4	100%		One case noted minor immediate dehiscence, closed by 14 days
	3 months	4	100%		All healed
Membrane / Graft Exposure (None)	14 days	4	100%	–	No exposure
	3 months	4	100%	–	No exposure
Pain VAS (Day 3)	Range 1–2	–	–	1.25 ± 0.50	Mild discomfort only
Radiographic Outcome (3m)	Improved	3	75%	–	Favorable bone healing
	Stable	1	25%	–	Stable furcation healing
Overall Success	Yes	4	100%	–	All cases successful

Primary wound closure was achieved at the completion of surgery in all four cases. Three cases demonstrated complete approximation of the wound margins immediately following suturing, whereas one case developed a minor wound separation of approximately 1 mm during the immediate postoperative period. This minor dehiscence resolved completely by the 14-day follow-up, and the wound remained closed at 3 months. Thus, by 14 days, all four cases demonstrated complete wound closure.

Flap stability was maintained throughout the follow-up period in all cases (4/4; 100%). No clinically evident displacement of the repositioned flaps was observed, indicating maintenance of the intended flap position during the early healing phase.

Early wound healing at 14 days was favorable across the case series, with healing scores ranging from 3 to 4 and a mean score of 3.5 ± 0.58. These findings indicated satisfactory progression of soft-tissue healing, with resolution of the minor wound separation observed in one case.

No wound dehiscence was present at either the 14-day or 3-month follow-up. Similarly, no graft or membrane exposure was observed in any case at either evaluation period. All surgical sites remained clinically stable during the 3-month follow-up.

Postoperative discomfort was minimal, with Day 3 VAS scores ranging from 1 to 2 and a mean score of 1.25 ± 0.50, indicating only mild postoperative pain.

At the 3-month evaluation, radiographic improvement was observed in three of the four cases (75%), consistent with favorable bone healing at the treated sites. The remaining case (25%), involving Grade II furcation regeneration, demonstrated stable healing without evidence of deterioration.

Overall, all four cases fulfilled the predefined criteria for a favorable clinical outcome, characterized by stable flap adaptation, complete wound closure by 14 days, absence of graft or membrane exposure, and satisfactory clinical and radiographic healing at 3 months.

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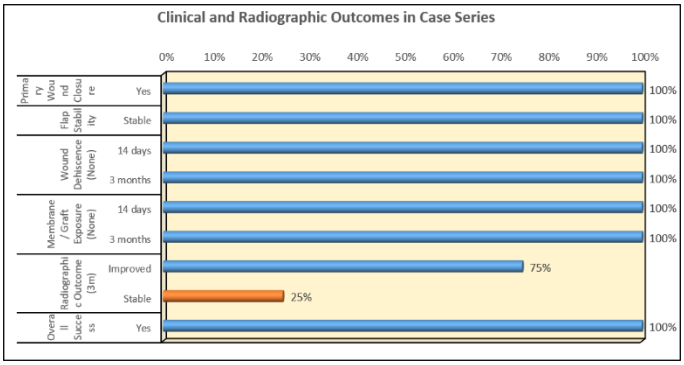


Figure 17: summary of the clinical and radiographic outcomes across the four cases.

Figure 17 provides a visual summary of the clinical and radiographic outcomes across the four cases. Primary wound closure, flap stability, absence of membrane or graft exposure at both 14 days and 3 months, and the overall favorable clinical outcome were observed in all cases (100%). With respect to the 3-month radiographic assessment, three cases demonstrated improvement (75%), whereas one case demonstrated stable healing (25%). Importantly, no category demonstrated an unfavorable or deteriorating outcome.

Discussion

The present prospective case series evaluated the clinical application of the Laurell–Gottlow modified horizontal mattress suture across four periodontal and implant regenerative procedures representing different anatomical configurations and wound-management requirements. The principal observation was that primary wound closure and stable flap adaptation were achieved in all four cases, with favorable early healing and minimal postoperative discomfort.

The maintenance of primary wound closure is an important objective in periodontal and implant surgery because it protects the underlying surgical site during the early stages of healing. However, successful closure is not dependent solely on approximation of the wound margins at the completion of surgery[6]. The flap must remain stable and free from excessive tension during the subsequent healing period. Previous investigations have emphasized the association between increased flap tension and postoperative wound dehiscence, highlighting the importance of tension-controlled wound management.

In the present case series, the Laurell–Gottlow modified horizontal mattress configuration was applied across four procedures with different surgical requirements. These included an implant site associated with guided bone regeneration, a surgically modified tooth and extraction socket following hemisection, an intrabony periodontal defect, and a Grade II furcation defect[6]. Despite the differences in anatomical configuration, the same suturing principle could be adapted to each clinical situation.

The ability of the technique to be used under varied clinical conditions represents one of the principal observations of this case series. The Laurell–Gottlow modification combines the stabilizing characteristics of a horizontal mattress configuration with controlled approximation of the wound margins. This combination may be advantageous when both broad flap stabilization and precise tissue adaptation are required[6].

Stable flap adaptation was observed in all cases throughout the follow-up period. This finding is clinically relevant because excessive flap movement during the early postoperative period may interfere with stabilization of the fibrin clot and subsequent tissue organization[7]. Although the present study cannot establish a direct causal relationship between the suturing technique and the observed healing outcomes, the consistent maintenance of flap position suggests that the configuration was clinically capable of providing adequate stabilization under the conditions evaluated[7].

One case demonstrated a minor wound dehiscence of approximately 1 mm during the immediate postoperative

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period. Importantly, this separation resolved completely by 14 days and remained closed at the 3-month follow-up. No graft or membrane exposure occurred. This observation suggests that the minor wound separation did not interfere with the subsequent healing of the surgical site. It also highlights the importance of evaluating postoperative wound healing longitudinally rather than interpreting an early minor dehiscence as an indication of treatment failure.

Early wound healing was favorable, with 14-day healing scores ranging from 3 to 4 and a mean score of 3.5 ± 0.58. Postoperative discomfort was also minimal, with a mean Day 3 VAS score of 1.25 ± 0.50. Although these findings cannot be attributed exclusively to the suturing technique, they indicate that the surgical procedures and wound closure approach were generally well tolerated.

At 3 months, favorable radiographic bone healing was observed in three cases, whereas the Grade II furcation case demonstrated stable healing of the treated site. These observations should be interpreted cautiously because the present series was not designed to evaluate the regenerative efficacy of the individual procedures or materials. Rather, radiographic and clinical observations were included to document the overall healing of the treated sites following application of the Laurell–Gottlow modified horizontal mattress suture.

A notable feature of the present case series is the evaluation of the suturing technique across different periodontal and implant surgical scenarios rather than restricting its use to a single procedure. The selected cases presented different anatomical conditions and requirements for flap positioning. This approach provided preliminary information regarding the adaptability of the suturing configuration.

However, the present findings should not be interpreted as evidence of superiority over conventional horizontal mattress, interrupted, sling, or other suturing techniques. The case series included only four patients and lacked a control or comparison group. In addition, the procedures differed with respect to their anatomical characteristics, surgical interventions, and regenerative protocols. Therefore, it is not possible to isolate the effect of the Laurell–Gottlow modification from other factors that may have influenced wound healing, including flap design, tissue thickness, surgical handling, operator technique, and postoperative care.

Another limitation is the relatively short follow-up period. Although the 3-month evaluation provided information regarding early and intermediate healing, longer follow-up is necessary to determine the stability of the clinical and regenerative outcomes.

Nevertheless, the present observations provide preliminary clinical documentation of the Laurell–Gottlow modified horizontal mattress suture across varied periodontal and implant surgical conditions. The technique consistently facilitated flap stabilization and wound-margin adaptation in the cases evaluated, while favorable early healing was observed with minimal postoperative discomfort and no graft or membrane exposure.

Future studies should evaluate the technique in larger patient samples using standardized surgical protocols and direct comparison with conventional suturing configurations. Randomized controlled clinical studies may further clarify whether the mechanical characteristics of the Laurell–Gottlow modification translate into measurable improvements in wound stability, primary closure, postoperative healing, or regenerative outcomes.

Conclusion

Within the limitations of this prospective four-case series, the Laurell–Gottlow modified horizontal mattress

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suture demonstrated clinical applicability across different periodontal and implant regenerative surgical procedures. Primary wound closure and stable flap adaptation were achieved in all cases, with favorable early wound healing and minimal postoperative discomfort.

One minor postoperative wound dehiscence resolved completely by 14 days, and no graft or membrane exposure was observed. At 3 months, favorable bone healing was observed in three cases, while stable furcation healing was observed in one case.

These preliminary findings suggest that the Laurell–Gottlow modified horizontal mattress suture may be a clinically useful and adaptable technique for achieving stable flap adaptation and maintaining wound closure across varied periodontal and implant surgical situations. However, controlled studies with larger sample sizes and direct comparison with established suturing techniques are necessary to determine its relative clinical effectiveness.

Clinical Significance

The Laurell–Gottlow modified horizontal mattress suture may offer a practical approach for achieving stable flap adaptation and maintaining primary wound closure in periodontal and implant surgical procedures with differing anatomical and wound-management requirements. Its application across varied regenerative scenarios warrants further investigation in controlled clinical studies.

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