Content available at: https://www.ipinnovative.com/open-access-journals

IP International Journal of Periodontology and Implantology

Journal homepage: https://ijpi.in/

Original Research Article

Comparative evaluation of wound closure and healing following periodontal flap surgery using silk sutures and N-Butyl cyanoacrylate tissue adhesive in stage II/III periodontitis: A short-term clinical study

Natasha Handoo[1*], Gurpreet Kaur[1], Navneet Kaur[1], Tania Goutam[1], Lolakshi Kachroo[1]

[1]Dept. of Periodontology and Oral Implantology, National Dental College and Hospital, Dera Bassi, Punjab, India

Abstract

Background: Primary closure after periodontal flap surgery is critical to ensure stable clot formation, minimize bacterial ingress, and promote uneventful healing. Conventional silk sutures are widely used but may act as plaque-retentive factors and exacerbate inflammation. N-butyl cyanoacrylate (NBC) adhesive polymerizes rapidly, providing immediate hemostasis, bacteriostatic action, and tissue sealing.

Materials and Methods: Twenty patients with Stage II/III periodontitis were randomly allocated into two groups: Group I (n=10) underwent flap closure with 3-0 braided silk sutures, and Group II (n=10) received closure with NBC tissue adhesive. Outcomes evaluated at day 7 and day 21 included tissue color, incision margin approximation, bleeding on palpation, suppuration, and pain using a 10-point visual analogue scale (VAS). Landry's Healing Index was used for overall healing assessment. Statistical analysis was performed using SPSS v23; independent t-tests and Chi-square/Fisher's exact tests were applied with significance at $p \leq 0.05$.

Results: At day 7, NBC showed significantly superior outcomes across all parameters: improved tissue color ($p=0.041$), incision margin adaptation ($p=0.025$), less bleeding ($p=0.021$), reduced suppuration ($p=0.041$), and lower VAS scores (1.3 vs 3.0; $p=0.001$). By day 21, no significant intergroup differences were observed ($p>0.05$ for all), although both groups exhibited excellent healing.

Conclusion: NBC tissue adhesive offers superior early healing and greater patient comfort compared with silk sutures, with comparable outcomes at three weeks. NBC represents a reliable alternative to conventional sutures in periodontal flap surgery.

Keywords: Periodontitis, Flap closure, N-butyl cyanoacrylate, Silk sutures, Wound healing, Tissue adhesives, Visual analogue scale.

Received: 13-09-2025; **Accepted:** 03-10-2025; **Available Online**: 03-11-2025

1. Introduction

Periodontitis is a multifactorial, progressive disease characterized by chronic inflammation and the subsequent destruction of connective tissue and supporting bone, ultimately leading to tooth loss if inadequately managed.[1] Surgical intervention, particularly the periodontal flap procedure, remains a cornerstone in the management of moderate to deep periodontal pockets, providing access for debridement and regeneration.[2] However, surgical success does not solely depend on the removal of pathogenic deposits; it is also significantly determined by the precise adaptation and stable closure of the repositioned mucoperiosteal flaps.

Conventionally, wound closure has been achieved using a variety of suture materials, with braided silk sutures being the most widely adopted in oral and periodontal procedures. Silk sutures are valued for their ease of handling, knot security, and affordability. Nonetheless, their multifilament structure predisposes them to a "wicking" effect, whereby bacteria and debris can travel along the suture to the surgical site, increasing the risk of secondary infection and provoking a more pronounced inflammatory response in the delicate oral tissues.[3,5] This challenge is made more complex in the oral environment due to constant moisture and microbial load, both of which can compromise healing and patient comfort. In search of alternatives, the development of tissue adhesive materials—most notably cyanoacrylates—has generated significant interest in clinical practice.

*Corresponding author: Natasha Handoo
Email: dr.natashahandoo@gmail.com

http://doi.org/10.18231/j.ijpi.13350.1759739534

Since their synthesis in the 1950s, cyanoacrylates have evolved to include formulations like n-butyl cyanoacrylate, which are biocompatible for human use and exhibit rapid polymerization even in moist conditions.[4] N-butyl cyanoacrylate offers several advantages over traditional suturing: it forms a flexible polymer barrier that not only approximates wound margins without puncturing tissue but also exhibits hemostatic and inherent antimicrobial properties.[6,8] This can minimize operative time, reduce the risk of infection, eliminate the trauma associated with needle penetration, and improve patient-reported outcomes such as pain and discomfort.[9] Despite these promising features, the adoption of cyanoacrylate adhesives is not yet universal, partly due to varying clinical experiences, cost considerations, and the need for high-quality comparative evidence. Existing literature shows both techniques to be effective, but direct, controlled comparisons—particularly those incorporating both objective healing indices and patient-centered outcomes—are still needed to provide clear clinical guidance.[11-13]

The current study was thus designed to fill this gap by systematically comparing the clinical effectiveness of closure with silk sutures and n-butyl cyanoacrylate after periodontal flap surgery, assessing not only healing and inflammation but also pain, suppuration, and overall patient experience judged at critical early and late postoperative intervals.

2. Materials and Methods

2.1. Study design

This clinical study was designed to compare wound closure and healing outcomes following periodontal flap surgery using two different closure materials: silk sutures and n-butyl cyanoacrylate tissue adhesive. Power of the study was calculated and a total of 20 patients diagnosed with Stage II and Stage III periodontitis with GradeA-C rate of progression were selected from the Outpatient Department of Periodontology and Oral Implantology at the National Dental College & Hospital, Derabassi, Punjab.

The two independent groups to be compared will be of equal size n, and to be drawn from population. Sample size has been calculated by using the formula:

$$n = (r+1)/r \times SD^2 \times (Z\beta - Z\alpha)^2 / (d)^2$$

n = Sample size; r = 1; (r+1)/r = 2; SD = 0.04; $Z\beta = 0.95$; $Z\alpha = 1.96$; d = 0.25

Minimum 19.84917 – 20 sample are required in the study.

The study employed a randomized design. surgical sites were divided into two groups for wound closure: Group 1 (Site 1) received closure with silk sutures, and Group 2 (Site 2) received closure with n-butyl cyanoacrylate tissue adhesive. The surgical procedure involved conventional periodontal flap surgery with thorough debridement and wound closure by the either silk suture or cyanoacrylate. Post-operative clinical parameters were recorded at the 7th and 21st days.

2.2. Inclusion and exclusion criteria

To ensure the reliability and safety of the study, specific inclusion and exclusion criteria were established for patient selection. The study included patients who were diagnosed with Stage II or Stage III periodontitis, with grade A-C rate of progression having PPD 5mm-8mm based on the classification by the American Academy of Periodontology (AAP 2017), Stage I and IV were not included so as to maintain the uniformity and remove bias. Patients possessing a minimum of 20 natural teeth. Both male and female patients aged between 25 and 65 years. Patients who had not received any periodontal therapy or antibiotic therapy for at least six months prior to the study were enrolled. Patients also provided informed written consent to participate. Exclusion Criteria were- Patients with known sensitivity or contact dermatitis to cyanoacrylates or formaldehyde, Patients with systemic diseases or medically compromised conditions that could affect wound healing, Patients diagnosed with molar-incisor pattern of periodontitis or periodontitis related to systemic diseases, Current smokers, Pregnant or breastfeeding women, Teeth with periapical diseases or increased mobility of tissues at the surgical sites, Patients with known healing disorders or chronic alcoholism.

2.3. Clinical parameters

The study assessed several clinical parameters relevant to wound healing and patient comfort, measured at two post-operative follow-up intervals: on the 7th and 21st days.

1. Visual Analogue Scale (VAS) for Pain: A 4-centimeter horizontal line divided into four segments from "no pain" (0) to "very severe pain" (3) allowed patients to quantify their pain. Scores range from 0 (no pain) to 3 (pain severe enough to disrupt normal activities).[14]
2. Healing Index of Landry, Turnbull, and Howley: This index evaluates periodontal wound healing using a 5-level scoring system based on four parameters—tissue color, response to palpation, presence of granulation tissue, and incision margin integrity. Scores range from 1 (very poor healing) to 5 (excellent healing).[15]
3. Tissue Color: Indicates the degree of inflammation and vascularization. Healing is reflected by a normal pink gingival color, while redness or discoloration suggests ongoing inflammation. The study showed a significant difference at 7 days favoring the cyanoacrylate group, and by 21 days, both groups had similar favorable outcomes.
4. Bleeding on Palpation: Reflects tissue inflammation and capillary fragility. Presence of bleeding is a sign of delayed healing or infection. At 7 days, significantly less bleeding was noted with

cyanoacrylate; by 21 days, differences diminished with both groups showing improvement.[16]

5. Incision Margin: Assesses how well the wound edges approximate and epithelialize. Better approximation promotes primary intention healing. The cyanoacrylate group showed better incision margin scores at 7 days, but by 21 days, both groups had comparable healing.
6. Suppuration: Indicates presence of infection at the surgical site. Early postoperative evaluation showed less suppuration with cyanoacrylate; at 21 days, infection rates were low and similar in both groups.
7. Pain Assessment: Using Visual Analogue Scale (VAS) and Face Pain Scale (FPS), pain was significantly lower in the cyanoacrylate group at 7 days, indicating better postoperative comfort. By 21 days, pain levels were minimal and comparable between groups.

Together, these parameters offer a comprehensive clinical appraisal of tissue healing quality, inflammation, infection control, and patient comfort following periodontal flap closure either by traditional silk sutures or n-butyl cyanoacrylate adhesive. The study generally favors cyanoacrylate for enhanced early healing, less inflammation, and reduced postoperative pain, with comparable outcomes by 3 weeks post-op. The scoring system is applied at postoperative 7th day and 21st day to assess comparative healing outcomes between the silk suture group (Group I) and the n-butyl cyanoacrylate adhesive group (Group II) is given in **(Table 1)**.

2.4 Statistical analysis

Collected clinical data were entered into Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 23.0. Descriptive statistics such as mean, standard deviation, frequency, and percentages were calculated for each clinical parameter. To assess differences within groups over time (intragroup comparison), the Wilcoxon Signed Rank Test was employed, suitable for paired ordinal data and non-normally distributed variables.

Table 1: Clinical parameters and their scoring system used in the comparative study of wound healing after periodontal flap surgery with silk sutures and n-butyl cyanoacrylate tissue adhesive

Clinical Parameter	Score Description	Score Values & Meaning
Tissue Color	Evaluates redness and healing status of gingiva	1 - Very Poor: >50% red gingiva
		2 - Poor: >50% red gingiva
		3 - Good: 25%-50% red gingiva
		4 - Very Good: <25% red gingiva
		5 - Excellent: All pink tissues
Bleeding on Palpation	Assesses tendency to bleed on pressure	1 - Very Poor: Bleeding present
		2 - Poor: Bleeding present
		3 - Good: No bleeding
		4 - Very Good: No bleeding
		5 - Excellent: No bleeding
Incision Margin	Evaluates epithelialization and margin closure	1 - Very Poor: Not epithelialized, loss beyond margin
		2 - Poor: Not epithelialized, exposed connective tissue
		3 - Good: No exposed connective tissue
		4 - Very Good: No exposed connective tissue
		5 - Excellent: Complete epithelialization, margins closed
Suppuration	Presence of pus/discharge indicating infection	1 - Very Poor: Suppuration present
		2 - Poor: Suppuration present
		3 - Good: Suppuration absent
		4 - Very Good: Suppuration absent
		5 - Excellent: Absence of suppuration
Pain (VAS Scale)	Visual Analog Scale of pain experienced	0 - No pain
		1 - Mild pain
		2 - Severe pain
		3 - Very severe pain
		4 - Severe pain
		5 - Worst pain imaginable

For evaluation of differences between groups at individual time points (intergroup comparison), the Independent Samples t-test or Analysis of Variance (ANOVA) was applied depending on the data distribution and number of groups. The Shapiro-Wilk test was used to verify the normality of data distribution, and Levene's test assessed homogeneity of variances. Statistical significance was accepted at a p-value less than or equal to 0.0.[17] Comprehensive statistical analysis enabled comparison of pain levels, inflammatory response, wound closure quality, and other healing parameters between the silk sutures and n-butyl cyanoacrylate tissue adhesive groups, enhancing the validity and reliability of the study conclusions.

3. Results

This study offers a thorough comparative evaluation of wound closure and healing outcomes following periodontal flap surgery using silk sutures versus n-butyl cyanoacrylate tissue adhesive in patients with Stage II and III periodontitis. Periodontitis, defined as a multifactorial inflammatory disease resulting in the progressive destruction of connective tissue around teeth, often requires surgical intervention with precise wound closure to achieve optimal healing and restoration of the dento-gingival complex. Traditional closure methods employ braided silk sutures, which, while established and effective, can increase local tissue trauma, serve as a nidus for bacterial retention, and provoke a heightened inflammatory response due to their multifilament nature. This background has led to the exploration of alternative closure materials such as tissue adhesives, particularly n-butyl cyanoacrylate, that polymerize rapidly in the moist oral environment, eliminate the need for needle punctures, and demonstrate inherent hemostatic and bacteriostatic properties.[19,27,28] In the present randomized clinical design, twenty patients diagnosed with Stage II or III periodontitis were enrolled and divided into two groups: Group I underwent periodontal flap closure with silk sutures 3-0. Suture were selected because of easy availability and low cost, while Group II received closure with n-butyl cyanoacrylate tissue adhesive **(Figure 1)**. The clinical outcomes were assessed at both the 7th and 21st postoperative days, using validated indices and scales including the Healing Index of Landry, Turnbull, and Howley (evaluating tissue color, incision margin, bleeding on palpation, and suppuration), as well as patient-reported pain through the Visual Analogue Scale (VAS) and Face Pain Scale (FPS).

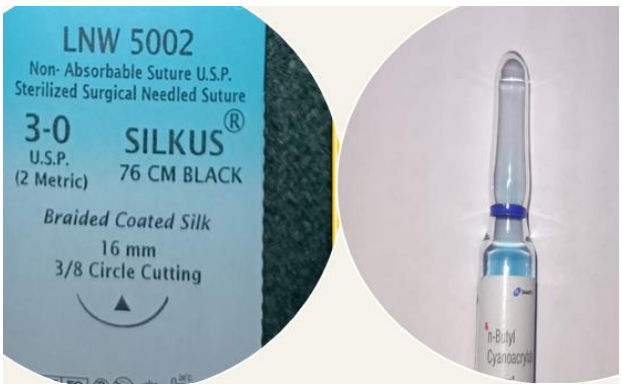

Figure 1: Silk Sutures used vs n-butyl Cyanoacrylate

The early postoperative findings (at day 7) consistently favored the cyanoacrylate adhesive group. Group II demonstrated significantly better tissue coloration, fewer bleeding events on palpation, better adaptation and approximation of incision margins, and lower levels of suppuration compared to the silk suture group, with p-values reflecting statistical significance across these parameters. Importantly, patient comfort was markedly improved in the adhesive group as quantified by both VAS and FPS pain scores, which were considerably lower than those reported in the silk cohort (mean VAS 1.3 vs. 3.0; FPS 1.3 vs. 2.5; both p = 0.001), highlighting the advantage of suture less closure in reducing postoperative discomfort **(Figure 2)**.

Figure 2: 7th day follow up with cyanoacrylate adhesive (left side) and silk sutures (Right side)

By the 21st postoperative day, both groups exhibited substantial clinical improvement with convergence in healing indices. The majority of patients in both groups were scored as having "Very Good" or "Excellent" outcomes for tissue color, incision margin integrity, and absence of suppuration or bleeding **(Figure 3)**. Differences between the groups were no longer statistically significant, suggesting that while cyanoacrylate provides superior early healing and comfort, both techniques are ultimately effective in promoting favorable long-term outcomes after periodontal flap surgery.[29-30]

Figure 3: 21st day follow up with Cyanoacrylate adhesive (left side) and silk sutures (Right side)

This investigation confirms that n-butyl cyanoacrylate tissue adhesive is a safe and efficient alternative to silk sutures, offering reduced postoperative pain and expedited early healing without compromising final healing status. These findings are consistent with prior comparative clinical and histological studies and support the incorporation of tissue adhesives as a preferred modality for wound closure in periodontal surgeries where patient comfort and quick recovery are prioritized.

The clinical study comparing wound healing after periodontal flap surgery using silk sutures and n-butyl cyanoacrylate tissue adhesive revealed the following detailed results and analysis:

3.1 Tissue color

1. On the 7th day, a significant difference (p=0.041) was observed between the groups. The cyanoacrylate group had better tissue color outcomes, with 30% of patients demonstrating "Very Good" healing and 60% showing "Good" healing, while the silk suture group had no "Very Good" scores and 40% had "Poor" healing. The disparity suggests that the tissue adhesive supports faster tissue color normalization.
2. By the 21st day, the tissue color scores showed no significant difference (p=0.200), with both groups showing predominantly "Very Good" to "Excellent" outcomes, implying comparable tissue color recovery over time. **(Figure 4)**

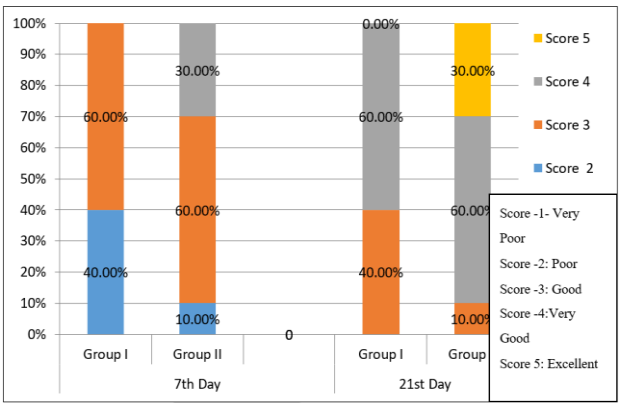

Figure 4: Comparison of tissue color on 7th day and 21st day for both groups

3.2 Bleeding on palpation (BOP)

1. A significant difference was found at 7 days (p=0.021), where the cyanoacrylate group performed better, with 40% "Very Good" scores and only 10% poor scores, in contrast to 60% "Poor" and no "Very Good" scores in the silk suture group. This demonstrates superior hemostatic effect of cyanoacrylate initially.
2. At 21 days, the difference diminished (p=0.071), with both groups improving, with most patients rated "Very Good" or "Excellent," indicating effective resolution of bleeding in the longer term for both suturing methods. **(Figure 5)**

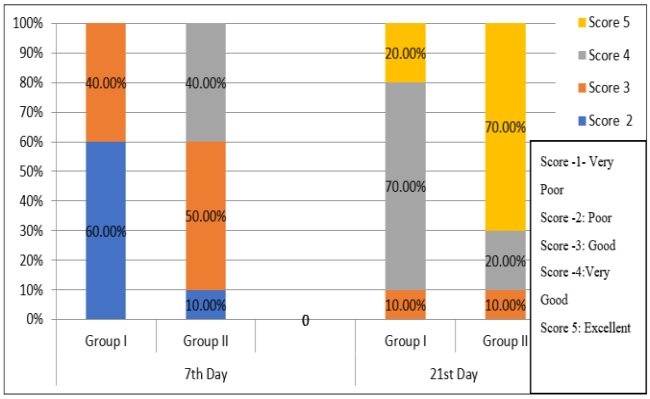

Figure 5: Comparison of BOP on 7th day and 21st day for both groups

3.3 Incision margin

1. On the 7th day, significant superiority of cyanoacrylate was evident (p=0.025) with 50% "Very Good" ratings, while silk suture cases only had 80% "Good" and no "Very Good" scores. This points to better wound margin approximation with cyanoacrylate in the early healing phase.
2. By 21 days, incision margin healing was similar in both groups (p=0.165), showing that both techniques ultimately lead to satisfactory incision closure. **(Figure 6)**

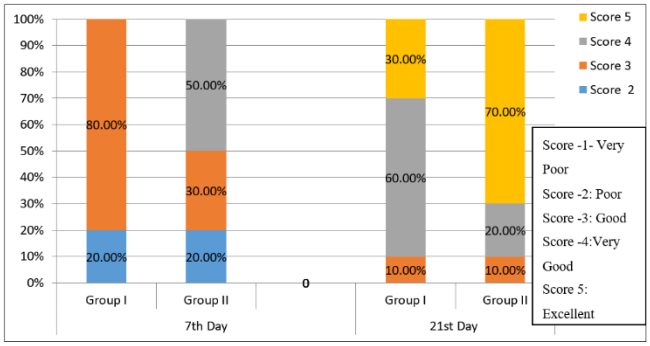

Figure 6: Comparison of Incision Margin on 7th day and 21st day for both groups

3.4 Suppuration

1. On 7 days, the cyanoacrylate group exhibited significantly less suppuration (p=0.041), with 40% "Very Good" and 60% "Good" scores versus only "Good" scores in 90% of silk suture cases and no "Very Good" ratings. This suggests reduced infection or inflammation with tissue adhesive in the early phase.
2. At 21 days, both groups showed comparable rates of suppuration improvement, predominantly "Very Good" to "Excellent," with no statistical difference (p=0.081). **(Figure 7)**

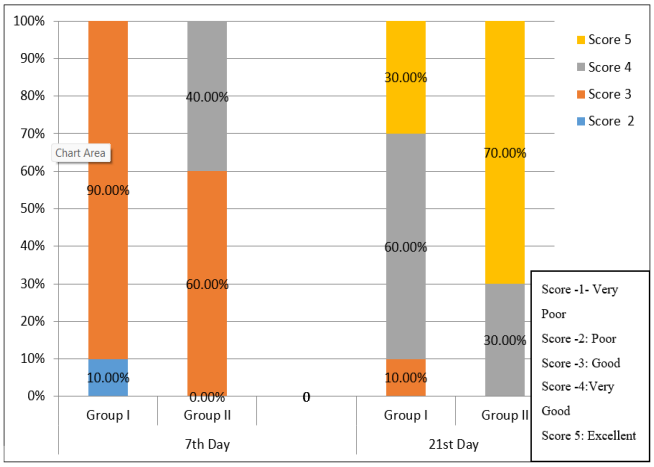

Figure 7: Comparison of suppuration on 7th day and 21st day for both groups

3.5 Pain Assessment (VAS and FPS)

1. On the 7th day, patients with cyanoacrylate reported significantly less pain on both Visual Analogue Scale (mean 1.3 vs. 3.0, p=0.001) and Faces Pain Rating Scale (mean 1.3 vs. 2.5, p=0.001) compared to silk sutures. This reflects the less traumatic nature of adhesive closure.
2. By 21 days, pain scores had diminished to near zero in both groups, with no significant difference, indicating similar comfort in later healing **(Figure 8).**

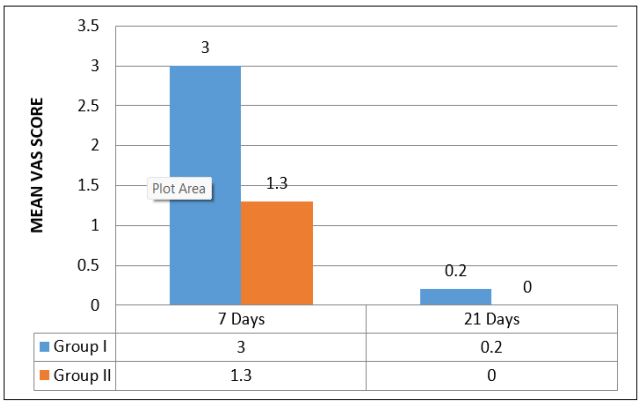

Figure 8: Comparison of VAS on 7th day and 21st day for both groups

4. Discussion

The principles of wound closure emphasize re-establishing functional soft tissue structural support, reducing wound tension and achieving everted skin edges. Precise approximation of wound margins and proper wound closure produces the most natural esthetic appearance and minimizes the need for later scar revision (Suthar P et al. 2020).[17] Although healing culminates uneventfully, in most instances, a variety of intrinsic and extrinsic factors can impede or facilitate the process. Understanding wound healing at multiple levels—biochemical, physiologic, cellular, and molecular—provides the periodontist with a framework for basing clinical decisions aimed at optimizing the healing response. Wound healing process is divided into four phases. Hemostasis is the first phase, inflammation is the second phase, proliferation is the third phase and maturation is the fourth phase. Immediately after injury, platelets adhere to the injured site and soon the adhered platelets change their shape and release chemical mediators for clotting. Finally, this activates fibrin to form a clot. In inflammatory phase, inflammatory cells are released into wound and engulf the pathogen and dead cells. In the proliferation phase, growth of newly formed cells occurs. Angiogenesis, new collagen formation, epithelial tissue formation, granulation tissue formation and wound contraction occurs. During maturation period type III collagen is replaced by type I collagen. Wound healing is affected by local and systemic factors.

Soft tissue wounds heal in three general ways: primary intention, secondary intention and tertiary intention. Healing by primary intention is preferable as there is less scarring and the healing is rapid. In primary intention, wound edges are re-approximated with sutures, staples and tissue adhesive like N-Butyl-2 cyanoacrylate. Attainment of ideal wound closure is the important factor for healing at surgical site. The wound closure material should re-approximate the wound edges properly for sufficient period for healing to occur. Usually intra oral incision is closed with suture material like vicryl and silk suture materials. Suture material is commonly used for wound closure than staples and tissue adhesives because former has the properties like better tensile strength, low dehiscence rate, proper wound closure. But it has disadvantages like crosshatched marks, needle penetration of normal tissue on either side of the wound, tissue reactivity, anxiety, and it is a time-consuming procedure. However various disadvantages like prolonged duration of surgery and anesthesia, maximal tissue reactivity, risk of needlestick injury, undesirable trauma to intact tissue on either side of the wound, permanent suture tracts, pain and anxiety during removal have been reported. Another significant disadvantage reported is the phenomenon of 'wicking,' which makes it a site for retention and ingress of bacteria into the tissues and thus a reservoir of secondary infection. So, in order to overcome these difficulties, a need for an alternative was always felt. Surgeons have been using tissue sealants and adhesives since the early nineteenth century.

There are presently four types of tissue adhesives: fibrin sealants, collagen-based sealants, synthetic polymer-based materials, and proteinbased sealants. The creation of natural glues, surgical staples and tapes to substitute sutures has supplemented the armamentarium of wound closure techniques. The use of tissue adhesives has long appealed to surgeons and they have been extensively studied them for diverse applications.

Cyanoacrylates were first described in 1949 and their first reported use as clinical adhesives was 10 years later by Coover. Initially it was rejected because of not biocompatibility to the tissue and more inflammatory

reaction. Later in 1964 Tennese Eastman lab developed longer molecular cyanoacrylate, which one better biocompatibility and produces less inflammatory reaction. Members of the cyanoacrylate family include methyl, ethyl, propyl, butyl, hexyl, heptyl and octyl cyanoacrylates. Methyl-2-cyanoacrylate was the first cyanoacrylate compound to be used as a surgical tissue adhesive. Although methyl-2- cyanoacrylate was a breakthrough advancement in surgical tissue adhesives, its popularity and use were significantly limited when many investigations demonstrated a concerning level of histotoxicity. Thereafter, ethyl-2-cyanoacrylate, containing a slightly longer carboxyl group, was developed.

By 1970s, N-butyl-2-cyanoacrylate was developed and proven to be much less harmful to tissues while offering substantial bonding strength. Chemically N-butyl-2-cyanoacrylate is a monomer. As they are in liquid form, they have the ability to penetrate the irregular surface of the tissues with a strong adhesion and perform a firm union of incision lines. The adhesiveness is maximized by spreading the monomer in a very thin film. It is a sterile tissue adhesive and a free-flowing fluid. It stops bleeding instantly (hemostatic).

Adhesives like n-butyl cyanoacrylate not only required less time for wound closure than did traditional methods, but also reduced the prevalence of infection and improved esthetics. The early short-chain tissue adhesives were effective but had limited use because they underwent rapid degradation into byproducts that had significant tissue toxicity. However, longer-chain cyanoacrylates degrade slowly, which limits the accumulation of toxic byproducts in the tissues and makes them safe for topical skin closure.

Therefore, in 1998, the U.S. Food and Drug Administration approved the use of the first topical skin adhesive. The following three cyanoacrylate compounds are now used as topical skin adhesives: 2-octyl-cyanoacrylate (Dermabond and SurgiSeal), n-2-butylcyanoacrylate (Endocryl, Histocryl, Indermil, GluStitch, Peri-Acryl, and LiquiBand) and 2-ethyl-cyanoacrylate (Epiglu).

Advantages of N Butyl 2 cyanoacrylate over suture material includes easy including handling, shorter duration of application, comfortable for anxiety and fear of patient, better bacteriostatic property, eliminate the risk of needle prick injury, decreased healing time, hemostatic property and better esthetic property. The present study compared wound closure and healing following periodontal flap surgery using silk sutures and n-butyl cyanoacrylate tissue adhesive in patients with stage II and stage III periodontitis. Clinical parameters including pain, tissue color, incision margin, bleeding on palpation, and suppuration were evaluated on the 7th and 21st postoperative days.

Pain scores, assessed using VAS and FPRS, were significantly higher in the silk suture group on the 7th day (VAS: 3.0; FPRS: 2.5) compared with the cyanoacrylate group (VAS: 1.3; FPRS: 1.3) ($p = 0.001$). This supports previous findings that cyanoacrylates provide greater patient comfort due to the avoidance of needle penetration and tissue trauma (Khurana et al., 2016).[9] By the 21st day, pain subsided in both groups with no significant differences, indicating comparable long-term analgesic outcomes. Tissue color, reflecting inflammation and vascularization, was superior with cyanoacrylate at the 7th day, with 30% of patients rated "Very Good," while no such ratings were recorded in the silk group ($p = 0.041$). The reduced inflammatory response may be attributed to the bacteriostatic action of cyanoacrylate compared with the wicking and bacterial retention properties of silk sutures (Castelli et al.).[4] By the 21st day, both groups demonstrated favorable healing with no significant differences. Incision margin integrity was significantly better in the cyanoacrylate group on the 7th day (50% "Very Good" vs. 0%; $p = 0.025$), reflecting its ability to approximate wound edges without additional trauma from suturing (Kulkarni et al., 2007; Kumar et al., 2013).[4,16] However, by the 21st day, healing was comparable between groups ($p = 0.165$). Bleeding on palpation was also better controlled with cyanoacrylate on the 7th day (40% "Very Good" vs. 0%; $p = 0.021$), consistent with its hemostatic and protective barrier properties (Abullais et al., 2016).[6] At 21 days, both groups showed favorable hemostatic outcomes. Suppuration was significantly lower in the cyanoacrylate group at the 7th day (40% "Very Good" vs. 0%; $p = 0.041$), likely due to its antimicrobial properties and the absence of bacterial wicking associated with silk sutures. By the 21st day, both groups exhibited satisfactory outcomes.

Overall, n-butyl cyanoacrylate demonstrated several clinical advantages over silk sutures, including painless application, shorter operative time, improved early healing, and reduced inflammation, findings consistent with earlier studies (Kumar et al., 2013; Khurana et al., 2016; Vaaka et al., 2018).[16] Nonetheless, limitations such as reduced tensile strength and brittleness must be acknowledged, particularly in high-tension wounds. In contrast, silk sutures, though mechanically reliable, are associated with increased inflammation, bacterial colonization, and patient discomfort, which may delay early wound healing (Castelli et al., 1978).[4]

Silk sutures, while a gold standard with superior mechanical strength, possess disadvantages related to tissue irritation, inflammation, potential for bacterial ingress through wicking, and patient discomfort, all of which can delay healing (Castelii et al., 1978).[4] These drawbacks were reflected in the higher early postoperative pain and inflammation scores observed in the present study.

The small sample size, possibility of complications other than the criteria involved in our study, shorter period of follow up, absence of an objective measurement technique, and the cost of tissue adhesive were limitations of the study. Future studies are required to evaluate long term results of intraoral usage to further its application. Further prospective

studies are needed to substantiate these results, and to assess the overall cost effectiveness of tissue adhesives compared to surgical sutures in low tension elective procedures. Further studies with larger sample sizes and longer follow-up durations will be valuable to confirm the long-term stability and functional outcomes of tissue adhesives in periodontal surgery. Moreover, comparisons with other suture materials such as absorbable synthetic sutures could elucidate additional clinical nuances. Advances in cyanoacrylate formulations to enhance flexibility and tensile strength may broaden their applications.[31-35]

5. Conclusion

In conclusion, this study demonstrates that n-butyl cyanoacrylate tissue adhesive offers significant early postoperative benefits over silk sutures in periodontal flap surgery, including reduced pain, superior tissue color, better wound closure, decreased bleeding, and lower suppuration rates. Both techniques provide favorable healing outcomes by 21 days post-operation, but cyanoacrylate adhesives provide an efficient, painless, and bacteriostatic. Alternative to conventional suturing.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Levin MP. Periodontal suture materials and surgical dressings. *Dent. Clin. N Am*. 1980;24(4):767-81. https://doi.org/10.1016/S0011-8532(22)02848-8
2. Macht SD, Krizek TJ. Sutures and suturing--current concepts. J Oral Surg. 1978;36(9):710-2. https://pubmed.ncbi.nlm.nih.gov/355612/
3. Dasgupta S, et al. Tissue reactions evoked by non-absorbable sutures. *Indian J Surg*. 1995;57:27-30.
4. Castelli WA, Nasjleti CE, Caffesse RE, Diaz-Perez R. Gingival response to silk, cotton, and nylon suture materials. *Oral Surg, Oral Med, Oral Pathol*. 1978;45(2):179-85. https://doi.org/10.1016/0030-4220(78)90083-X
5. Herod EL. Cyanoacrylates in dentistry: a review of the literature. *J (Can Dent Assoc.)*. 1990;56(4):331-4.
6. Javali M, Bhat M, Abullais S, Khader M, Chavan A. Closure of Periodontal Flap with N Butyl Cyanoacrylate: A Report of Three Cases with Literature Review. *ARC J Dent Sci*. 2016;1(2):22-5. http://dx.doi.org/10.20431/2456-0030.0102005
7. Bhaskar SN, Frisch J. Use of cyanoacrylate adhesives in dentistry. *J Am Dent Assoc*. 1968;77(4):831-7. https://doi.org/10.14219/jada.archive.1968.0310
8. Kulkarni S, Dodwad V, Chava V. Healing of periodontal flaps when closed with silk sutures and N-butyl cyanoacrylate: a clinical and histological study. *Indian J Dent Res*. 2007;18(2):72-7. https://doi.org/10.4103/0970-9290.32424
9. Khurana JV, Mali AM, Mali RS, Chaudhari AU. Comparative evaluation of healing after periodontal flap surgery using isoamyl 2-cyanoacrylate (bioadhesive material) and silk sutures: A split-mouth clinical study. *J. Indian Soc Periodontol*. 2016;20(4):417-22. https://doi.org/10.4103/0972-124x.194267
10. Kulkarni S, Dodwad V, Chava V. Healing of periodontal flaps when closed with silk sutures and N-butyl cyanoacrylate: a clinical and histological study. *Indian J Dent Res*. 2007;18(2):72-7. https://doi.org/10.4103/0970-9290.32424
11. Saquib AS, Chavan A, Dani NH, Al-Qahtani NA, Al-Qahtani SM, Priyanka N. Comparative Evaluation of N-Butyl Cyanoacrylate and Silk Sutures on Healing of Periodontal Flaps: A Clinico Histological Evaluation. *Kathmandu Univ Med J*. 2018;16(63):253-8. https://pubmed.ncbi.nlm.nih.gov/31719316/
12. Chandra S, Shashikumar P, Nisha S. Comparative Evaluation of N-Butyl Cyanoacrylate with Braided Silk Suture after Periodontal Flap Surgery: A Randomized Controlled Trial. *World J Dent*. 2021;12(4):328-32. https://doi.org/10.5005/jp-journals-10015-1847
13. Sadatmansouri S, Moradi SH. Effect of cyanoacrylate adhesive on tissue healing after periodontal surgery. *J Res Dent Maxillofac Sci*. 2020;5(4):13-9. https://doi.org/10.29252/jrdms.5.4.13
14. Gangwani KD, Shetty L, Kulkarni D, Seshagiri R, Chopra R. Piezosurgery versus conventional method alveoloplasty. *Ann Maxillofac Surg*. 2018;8(2):181–7. https://doi.org/10.4103/ams.ams_162_18
15. Thakker J, Karvekar S, Pattar V, Nivethitha D. Comparative evaluation of cyanoacrylate bioadhesive material and silk sutures on healing of periodontal flaps: a systematic review and meta-analysis. *J Clin Diagn Res*. 2025;27:385–405. https://doi.org/10.70135/seejph.vi.5273
16. Kumar MS, Natta S, Shankar G, Reddy SH, Visalakshi D, Seshiah GV. Comparison between Silk Sutures and Cyanoacrylate Adhesive in Human Mucosa- A Clinical and Histological Study. *J Int Oral Health*. 2013;5(5):95-100. https://pmc.ncbi.nlm.nih.gov/articles/PMC3845291/
17. Suthar P, Shah S, Waknis P, Limaye G, Saha A, Sathe P. Comparing intra-oral wound healing after alveoloplasty using silk sutures and n-butyl-2-cyanoacrylate. *J Korean Assoc Oral Maxillofac Surg*. 2020;46(1):28 https://doi.org/10.5125/jkaoms.2020.46.1.28
18. O'neil TC. Antibacterial properties of periodontal dressings. *J Periodontol*. 1975;46(8):469. https://doi.org/10.1902/jop.1975.46.8.469
19. Gerardi D, Burdo P, Turkyilmaz I, Diomede F, Mendes GD, Piattelli M et al. Clinical Applications and Efficacy of Cyanoacrylates in Oral Surgery and Periodontology: A Scoping Review. *Med (Kaunas)*. 2025:17;61(7):1286. https://doi.org/10.3390/medicina61071286
20. Basma HS, Saleh MHA, Abou-Arraj RV, Imbrogno M, Ravida A, Wang HL et al. Patient-reported outcomes of palatal donor site healing using four different wound dressing modalities following free epithelialized mucosal grafts: A four-arm randomized controlled clinical trial. *J Periodontol*. 2023;94(1):88-97. https://doi.org/10.1002/JPER.22-0172
21. Avelli L, Asa'ad F, Acunzo R, Pagni G, Consonni D, Rasperini G. Minimizing Patient Morbidity Following Palatal Gingival Harvesting: A Randomized Controlled Clinical Study. *Int J Periodontics Restor Dent*. 2018;38(6):e127-34.
22. Gerardi D, Burdo P, Turkyilmaz I, Diomede F, Mendes GD, Piattelli M et al. Clinical Applications and Efficacy of Cyanoacrylates in Oral Surgery and Periodontology: A Scoping Review. *Med (Kaunas)*. 2025;61(7):1286. https://doi.org/10.3390/medicina61071286
23. Gautam J, Sood A, Chaudhry S, Ghumman S, Chopra A. Beyond the Needle: A Comparative Evaluation of Silk Sutures and Cyanoacrylate for Periodontal Flap Closure. *Cureus*. 2024;16(3):e56604. https://doi.org/10.3390/medicina61071286
24. Gerardi D, Burdo P, Turkyilmaz I, Diomede F, Mendes GD, Piattelli M et al. Clinical Applications and Efficacy of Cyanoacrylates in Oral Surgery and Periodontology: A Scoping Review. *Medicina*. 2025;61(7):1286. https://doi.org/10.3390/medicina61071286
25. Saquib AS, Chavan A, Dani NH, Al-Qahtani NA, Al-Qahtani SM, Priyanka N. Comparative Evaluation of N-Butyl Cyanoacrylate and Silk Sutures on Healing of Periodontal Flaps: A Clinico Histological Evaluation. *Kathmandu Univ Med J*. 2018;16(63):253-8.
26. Gautam J, Sood A, Chaudhry S, Ghumman S, Chopra A, Sood Sr A. Beyond the Needle: A Comparative Evaluation of Silk Sutures and Cyanoacrylate for Periodontal Flap Closure. *Cureus*. 2024;16(3). https://doi.org/10.7759/cureus.56604.

27. Saquib AS, Chavan A, Dani NH, Al-Qahtani NA, Al-Qahtani SM, Priyanka N. Comparative Evaluation of N-Butyl Cyanoacrylate and Silk Sutures on Healing of Periodontal Flaps: A Clinico Histological Evaluation. *Kathmandu Uni Med J*. 2018;16(63):253-8. PMID: 31719316
28. Camacho-Alonso F, Águila OG, Ferrer-Díaz P, Peñarrocha-Oltra D, Guerrero-Sánchez Y, Bernabeu-Mira JC. Cyanoacrylate versus Collagen Membrane as a Sealing for Alveolar Ridge Preservation: A Randomized Clinical Trial. *J Funct Biomater*. 2024;15(10):279. https://doi.org/10.3390/jfb15100279
29. Gautam J, Sood A, Chaudhry S, Ghumman S, Chopra A, Sood SA. Beyond the Needle: A Comparative Evaluation of Silk Sutures and Cyanoacrylate for Periodontal Flap Closure. *Cureus*. 2024;16(3). https://doi.org/10.7759/cureus.56604
30. Mahardawi B, Jiaranuchart S, Rochanavibhata S, Siriwat K, Mattheos N, Pimkhaokham A. Cyanoacrylate tissue adhesive versus silk sutures for mandibular third molar surgery: a systematic review and meta-analysis. *Clin Oral Investig*. 2024;28(3):180. https://doi.org/10.1007/s00784-024-05578-6
31. Kulkarni SS, Chava VK. Comparison of cyanoacrylate and silk sutures on healing ofcoral wounds-an animal model study. *Indian J Dent Res*. 2003;14(4):254-8.
32. Medeiros I, Pascoal S, Castro F, Macedo JP, Lopes O, Pereira J. Tissue adhesives for closure of intraoral surgical incisions: A systematic review and meta-analysis. *Int Wound J*. 2024;21(10):e70047. https://doi.org/10.1111/iwj.70047
33. Negre A, Sy K, Sabri H, Kalani K, Wang HL, Agossa K. Cyanoacrylate Adhesive Versus Sutures for Free Gingival Graft Fixation: A Systematic Review and Meta-Analysis of Clinical Outcomes. *J Esthet Restor Dent*. 2025;37(11):2368-2378. https://doi.org/10.1111/jerd.13504
34. Gerardi D, Burdo P, Turkyilmaz I, Diomede F, Mendes GD, Piattelli M et al. Clinical Applications and Efficacy of Cyanoacrylates in Oral Surgery and Periodontology: A Scoping Review. *Med (Kaunas)*. 2025;61(7):1286. https://doi.org/10.3390/medicina61071286
35. Santmartí-Oliver M, Bazal-Bonelli S, Sánchez-Labrador L, Beca-Campoy T, Pérez-González F, Cobo-Vázquez CM, et al. Cyanoacrylate versus suture as flap closure methods in mandibular third molar surgery: a split-mouth randomized controlled clinical study. *Med Oral Patol Oral Cir Bucal*. 2024;29(4):e458. https://pubmed.ncbi.nlm.nih.gov/38907642/

Cite this article: Handoo N, Kaur G, Kaur N, Goutam T, Kachroo L. Comparative evaluation of wound closure and healing following periodontal flap surgery using silk sutures and N-Butyl cyanoacrylate tissue adhesive in stage II/III Periodontitis: A short-term clinical study. *IP Int J Periodontol Implantol*. 2025;10(3):123-131.