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Healing and Flap Closure Time with N-Butyl Cyanoacrylate and Silk Suture: A Split-mouth Study

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ABSTRACT

Introduction: Silk suture is the most commonly used material in periodontal flap surgery. However, healing thereafter may be compromised due to accumulation of food particles into the suture knots and bacterial ingress into the site. Recently, n-butyl cyanoacrylates have emerged in periodontics that may overcome the limitations of intraoral usage of silk suture.

Objective: To compare effectiveness of n-butyl cyanoacrylate with silk suture in the closure of periodontal flaps by assessing healing and flap closure time.

Methods: A split-mouth study was carried out amongst 16 patients indicated for bilateral periodontal flap surgeries in Periodontology and Oral Implantology Unit, National Academy of Medical Sciences (NAMS), Bir Hospital from 2022 September to 2023 August. Each patient served as his own control creating two sites: control site (4-0 silk suture) and test site (n-butyl cyanoacrylate); and flap closure time (FCT) for both sites was recorded. Inter-site comparison with Plaque index (PI), Papillary marginal attachment index (PMAI), and wound healing index (WHI) was performed for 3rd, 7th, and 30th post-operative days.

Results: The FCT was statistically higher for control site than test site. Similarly, PI and PMAI were statistically increased in the control site on 3rd and 7th post-operative days ($p < 0.005$). There was no change in WHI between the sites.

Conclusion: This study suggests that n-butyl cyanoacrylate is as effective as silk suture for the closure of periodontal flaps. The easier application, less flap closure time and requirement of little armamentarium make n-butyl cyanoacrylate a promising alternative.

Keywords: Flap closure time; healing; n-butyl cyanoacrylate; periodontal flap surgery; silk suture.

INTRODUCTION

Proper wound closure with appropriate materials should be prioritised to promote healing of intraoral wounds as they are continuously exposed to bacteria.[1] Silk suture has been the standard material for wound closure since ancient times.[2,3] However, due to certain limitations of intraoral suture usage like tissue trauma due to needle penetration, bacterial ingress into operated site, accumulation of food particles into suture knots, longer suturing time and second visit for suture removal; an easier way of wound closure using tissue adhesives is gaining momentum.[4]

Discovered by Coover in 1959, cyanoacrylates are tissue adhesives with bacteriostatic and haemostatic properties[2] that are well tolerated by the living tissues.[4] Moreover, they offer pain free and quick application, which ultimately reduce discomfort for patients and operative time for clinicians.[4] These tissue adhesives can be beneficial in elderly and anxious patients. They also can eliminate the possibility of needle stick injuries caused by the use of sutures.

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There is a paucity of literature regarding the use of cyanoacrylates in Nepali population for closure of periodontal flaps. Therefore, this study was designed to compare effectiveness of n-butyl cyanoacrylate with silk suture in the closure of periodontal flaps by assessing healing and flap closure time.

METHODS

A hospital-based comparative split-mouth study was conducted in Periodontology and Oral Implantology Unit, Department of Dental Surgery, National Academy of Medical Sciences (NAMS), Bir Hospital, Kathmandu, Nepal from 2022 September to 2023 August. Ethical approval was obtained from the Institutional Review Board (IRB) of NAMS, Bir Hospital (Reference number: 272/2079/80). This study adhered to the tenets of the Declaration of Helsinki as revised in 2013. Based on non-probability convenience sampling method, 16 patients were enrolled in this study. Before commencing the study, all participants were thoroughly explained the nature, risks and benefits of the clinical investigations and associated procedures. Written informed consent was obtained from each participant of the study who voluntarily agreed.

Patients between the age groups of 30 years and 60 years with stage III and stage IV generalised or localised periodontitis (probing depth of ≥6 mm) indicated for bilateral periodontal flap surgical procedures were included in this study. Patients with known systemic conditions that can influence periodontal status (diabetes mellitus, prolapsed heart valve, leukaemia, renal diseases, intellectually disabled); known history of medication intake that can influence periodontal status (calcium channel blockers, anticonvulsants, immunosuppressants, non-steroidal anti-inflammatory drugs) were excluded from this study. Similarly, smokers and tobacco users (in any form); pregnant or lactating mothers; patients who have received periodontal treatment in the last three months and patients on antibiotics within the last three months were also excluded from this study.

Detailed history was taken and thorough clinical examination was performed before starting the treatment. Preoperative orthopantomogram (OPG) preferably or intraoral periapical (IOPA) radiograph was advised. All the participants were treated with non-surgical periodontal therapy at multiple visits with regular evaluation of tissues in between. The non-surgical periodontal therapy consisted of instructions for oral hygiene, plaque control, and supra- and sub-gingival scaling and root planing with manual (Gracey curettes) and ultrasonic instruments. One month after the completion of non-surgical therapy, participants were reviewed and flap surgery was planned.

A split-mouth design was employed so that on comparison, each patient served as his/her own control and any bias was ruled out. Any two sextants with comparable probing pocket depth were selected for the study and were assigned as control site (suture, Figure 1) and test site (cyanoacrylate, Figure 2). The side with more discomfort to the patient was taken for flap surgery at the first intervention. The selection of the sites was done randomly. Just before the procedure, the patient was made to choose

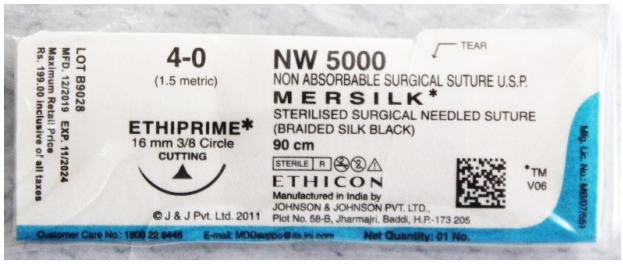


Figure 1: Silk suture.

Figure 2: N-butyl Cyanoacrylate.

between 'Control = suture' or 'Test = cyanoacrylate' by using an envelope. The same patient during his/her second flap surgery on the contralateral side was considered as alternate group of test/control.

Under all aseptic conditions and precautions, local anaesthetic solution of 2% xylocaine containing 1:1,00,000 epinephrine was locally infiltrated into the operation site. Crevicular incision was given on buccal and lingual aspects using Bard-Parker number 12 or 15 surgical blades. Periosteal elevator was used gently and with caution with support of non-operating hand to raise the full thickness flap to prevent tearing of flap or papillae loss. Debridement and thorough root planing was done with curettes (Gracey curettes, Hu-Friedy, USA). In the control site, the flap was sutured with 16 mm 3/8 circle cutting 90 cm 4-0 black braided non-absorbable surgical silk suture (Figure 3) with independent loop sutures. The test site was made free of blood or any moisture before applying cyanoacrylate. After holding the flap in the final closure position, n-butyl cyanoacrylate (Figure 4) was applied in a drop-wise manner at the flap margins and was pressed with finger for 10-15 seconds until a thin film of set cyanoacrylate is formed.

Time required for the closure of the flaps (FCT) was noted in minutes using digital stopwatch for each site. Analgesic drug Paracetamol 500 mg and Ibuprofen 400 mg combination thrice daily for three days was prescribed in both groups to control pain and to reduce inflammation post-surgery. In addition, 0.2% chlorhexidine gluconate mouthwash twice daily for two weeks was prescribed. Post-operative instructions were given. All the patients were recalled after one week to remove the sutures and any excess cyanoacrylate (Figure 5 and Figure 6). Patients were evaluated for the following parameters; Plaque index (PI, Silness and Loe, 1964),[5] Papillary marginal attachment index (PMAI, Schour and Massler, 1948)[6] and Wound healing index (WHI, Huang, 2005)[7] on 3rd, 7th, and 30th post-operative days.

The collected data were entered into the computer database using Microsoft Excel Sheet and exported to IBM SPSS Statistics version 20 (IBM Corp., Armonk, N.Y., USA) for statistical analysis. The Shapiro-Wilk test was applied to test the normality of data and on this basis, parametric tests (paired t-test) were used for normally distributed data and non-parametric tests (Wilcoxon signed-rank test) were applied for skewed data. Descriptive analysis of the data was presented in the form of mean, standard deviation, median and interquartile range. Paired t-test was used to find the difference in mean PI score between test and control sites at 3rd, 7th, and 30th post-operative days and PMAI score between test and control sites at 3rd post-operative day. Wilcoxon signed-rank test was used to find the difference in median time for flap closure between test and control sites, median PMAI score at 7th and 30th post-operative days and median WHI score at 3rd and 7th post-operative days. The level of significance was set at p-value <0.05.

Figure 3: Silk suture site – Intraoperative.

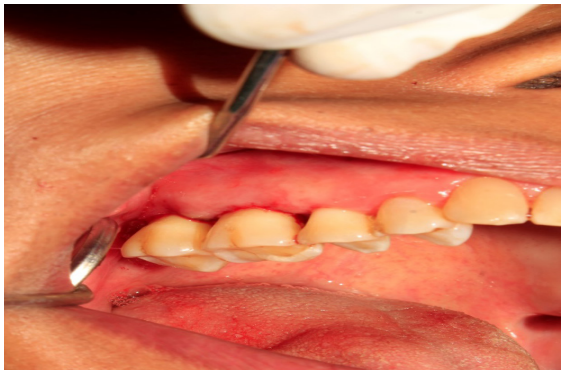


Figure 4: Cyanoacrylate site – Intraoperative.

Figure 5: Suture site - seventh post-operative day.

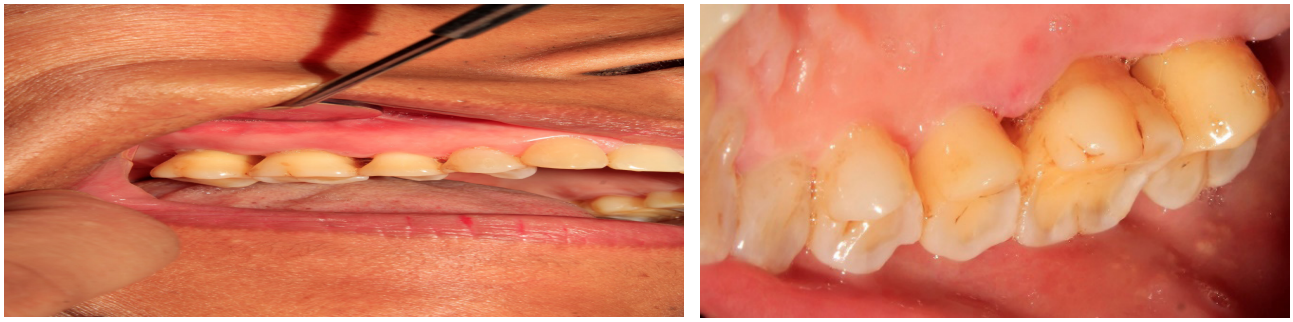


Figure 6: Cyanoacrylate site seventh post-operative day

RESULTS

Out of the 16 study participants, majority (62.5%) were female. The age of the study participants ranged from 31-60 years with mean age 43.44 ± 9.74 years. On comparing time for flap closure, it was found to be higher for control site than test site and this difference was found to be statistically significant (Table 1).

The PI scores on 3rd and 7th post-operative days were found to be higher in control site than in test site and these differences were found to be statistically significant (Table 2).

Similarly, the PMAI score was found to be higher in control site than in test site at 3rd and 7th post-operative days and this difference was found to be statistically significant (Table 3 and Table 4).

There was no change in WHI scores between test and control sites at 3rd, 7th; and 30th post-operative days (Table 5).

Table 1: Comparison of flap closure time after periodontal flap surgery in test (cyanoacrylate) site vs control (silk suture) site.

Study parameters	Test			Control			p-value
	Median	Interquartile range		Median	Interquartile range		
		Q1	Q3		Q1	Q3	
Time for flap closure (minutes)	2.82	1.42	5.39	5.24	3.51	6.86	0.004*

Wilcoxon signed-rank test; * = p-value <0.05 statistically significant.

Table 2: Comparison of Plaque Index score at 3rd, 7th, and 30th post-operative days after periodontal flap surgery in test (cyanoacrylate) site vs control (silk suture) site

Time interval (days)	Plaque index score		Difference in mean	p-value
	Test (Mean ± SD)	Control (Mean ± SD)		
Three	0.97 ± 0.47	1.28 ± 0.57	-0.31	0.044*
Seven	0.47 ± 0.26	0.75 ± 0.41	-0.28	0.045*
Thirty	0.67 ± 0.37	0.92 ± 0.38	-0.25	0.084

Paired t-test; * = p-value <0.05 statistically significant.

Table 3: Comparison of Papillary Marginal Attachment Index score at 3rd post-operative day after periodontal flap surgery in test (cyanoacrylate) site vs control (silk suture) site.

Time interval (days)	PMAI score		Difference in mean	p-value
	Test (Mean ± SD)	Control (Mean ± SD)		
3	3.43 ± 1.69	5.15 ± 1.77	-1.72	0.001*

Paired t-test; * = p-value <0.05 statistically significant.

Table 4: Comparison of Papillary Marginal Attachment Index score at 7th and 30th post-operative days after periodontal flap surgery in test (cyanoacrylate) site vs control (silk suture) site.

Time interval (days)	Test			Control			p-value
	Median	Interquartile range		Median	Interquartile range		
		Q1	Q3		Q1	Q3	
7	1.00	0.00	1.92	3.00	2.13	4.00	0.001*
30	0.00	0.00	0.49	0.00	0.00	0.00	NA

Wilcoxon signed-rank test; * = p-value <0.05 statistically significant; NA: Not applicable.

Table 5: Comparison of Wound Healing Index score at 3rd and 7th post-operative days after periodontal flap surgery in test (cyanoacrylate) site vs control (silk suture) site.

Time interval (days)	Test			Control			p-value
	Median	Interquartile range		Median	Interquartile range		
		Q1	Q3		Q1	Q3	
3	2.00	1.08	2.00	2.00	2.00	2.25	NA
7	1.00	1.00	1.00	1.42	1.00	2.00	NA
30	1.00	1.00	1.00	1.00	1.00	1.00	NA

NA = Not applicable due to nature of data.

DISCUSSION

Silk suture has been the most preferred suture material for approximating the flap margins after flap surgeries mainly because of its nature, easy availability, and costeffectiveness compared to other available alternatives.[4] As sutures and intraoral suturing techniques have their own drawbacks,[8] newer materials like tissue adhesives are being tested for primary wound closure and stabilisation of flaps.[9] N-butyl cyanoacrylate is one such tissue adhesive that has shown promising results in animal and human studies.[10] It is shown to be biocompatible with good bonding properties and has a fast setting time of 5-10 seconds.[9]

This study compared flap closure time, plaque index, Papillary Marginal Attachment index, and wound healing index between suture site and cyanoacrylate site on 3rd, 7th, and 30th post-operative days. The flap closure time was found to be higher for suture site than for cyanoacrylate site, which is in accordance with Narsingyani et al. (2023),[4] Akhter et al. (2023),[11] Chandra et al. (2021),[9] and Suthar et al. (2020).[12] This finding can be explained by the ease of application as well as good working and handling properties of cyanoacrylate.[9]

Plaque index was evaluated to check the oral hygiene maintenance by the patient. The results of this study indicated that the suture sites were found to accumulate more plaque as compared to the cyanoacrylate sites on 3rd and 7th post-operative days. This can be attributed to suture threads acting as a retentive site of plaque accumulation on early post-operative days but once the sutures were removed on 7th day, there was no difference in the plaque accumulation between the sites. These findings are in accordance with the studies by Chandra et al. (2021),[9] Sankari et al. (2020),[13] Saquib et al. (2018),[3] Parmar et al. (2013),[2] and Giray et al. (1997).[14]

Tissue response to both suture and cyanoacrylate was evaluated by PMA index. The higher PMA index scores on suture sites than on cyanoacrylate sites on 3rd and 7th post-operative days were similar with the findings of studies by Parmar et al. (2013)[2] and Aeran et al. (2022).[15] Macht and Krizek (1978) attributed these findings to the presence of silk material within the tissue, which might have provoked the response leading to clinically appearing redness more on the suture sites.[16] Levin (1980) believed that silk was treated as a foreign protein by the body and it had a tendency to increase the inflammatory response.[17] However, Giray et al. (1997) attributed it to the trauma during suturing and to the increased plaque accumulation at the suture site.[14]

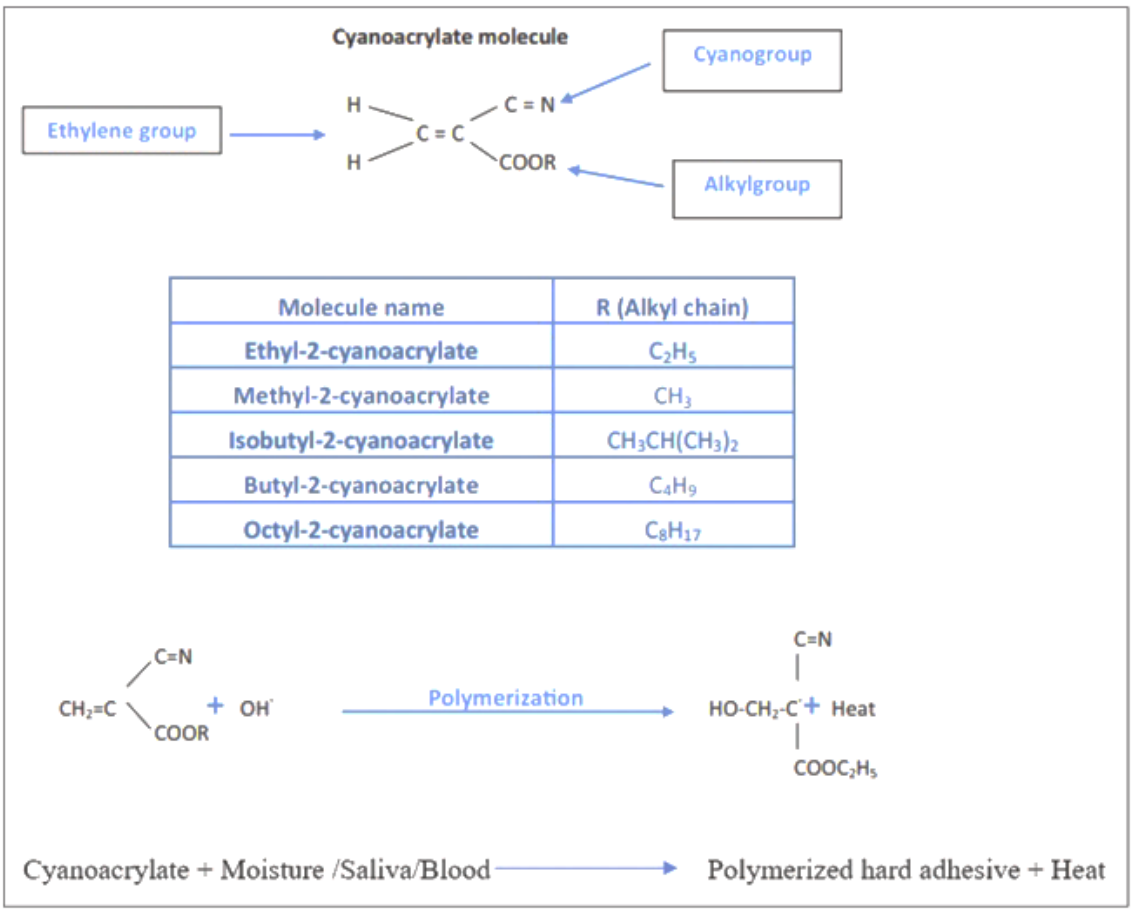
Wound healing index was used to assess the healing response of the periodontal flaps in both the sites. There were no differences in the wound healing index scores between the sites, which may be due to the use of clinical parameters to assess wound healing. In fact, healing of any wound is better assessed by histological examination rather than use of clinical parameters. These results are similar to the results of the studies by Suthar et al. (2020).[12] However, in contrast with these results, Saquib et al. (2018),[3] Chandra et al. (2021),[9] and Sankari et al. (2020)[13] confirmed better healing response at cyanoacrylate

sites in comparison to suture sites in early post-operative days.

Histologically, many studies have assessed inflammation, vascularity, scar formation, and fibrosis to evaluate wound healing between the suture and cyanoacrylate sites.[2, 3, 14] Most of them had demonstrated that there is reduced inflammation in cyanoacrylate treated sites than in suture treated sites.[2, 18] Whereas, vascularity, scar formation and connective tissue fibres were more marked on the suture site than on the cyanoacrylate sites.[3, 14]

Cyanoacrylates are the most widely used tissue adhesives for the closure of traumatised as well as incision wounds.[3] They have strong bonding properties and strength to hold tissue margins together. Tissue adhesion property of cyanoacrylate is by valence bonding and Van der Waal's force.[1] Cyanoacrylate monomer principally consists of cyan group, alkyl group, and ethylene group (Figure 7). Cyan and alkyl groups are highly electronegative that cause carbons in ethylene to polarise. Ethylene in acrylate group is responsible for polymerisation of monomer in the presence of anionic structures. Polymerisation changes the structure of cyanoacrylates and provides adhesive properties. The chemical reaction is exothermic; and amount of heat released depends upon the chemical structure and agents (thickeners, stabilisers, etc.) added. Addition of blue dye to liquid monomer makes it apparent during application, hence cyanoacrylates are also popularised as 'BLUE GLUE'.[4]

The lower homologs such as methyl, ethyl, propyl were found to be cytotoxic as they degraded faster due to their shorter alkyl groups so their use in medicine was discontinued, however, higher homologs, like n-butyl, isoamyl and octyl cyanoacrylates were considered safe as they degraded slower in the body making them relatively safer and better tolerated.[13] In their electron microscopic study of oral mucosa, Giray et al. (1997) observed that n-butyl cyanoacrylate is non-cytotoxic and can be used as an alternative to



Molecule name	R (Alkyl chain)
Ethyl-2-cyanoacrylate	C_2H_5
Methyl-2-cyanoacrylate	CH_3
Isobutyl-2-cyanoacrylate	$CH_3CH(CH_3)_2$
Butyl-2-cyanoacrylate	C_4H_9
Octyl-2-cyanoacrylate	C_8H_{17}

Figure 7: Chemical structure and polymerisation reaction of cyanoacrylate.[4]

sutures.[14] These materials are not absorbable and are sloughed from the surface of the skin and mucosa seven to 10 days after application.[19] Cyanoacrylate is degraded in the body by breaking the C=C bond and is eliminated from the body through urine and faeces.[1] While studying mandibular fracture osteosynthesis, Mehta et al. (1987) reported negative blood and urine samples and no changes in chromosomal studies concluding butyl cyanoacrylates as non-toxic materials.[20]

Cyanoacrylates in periodontal surgery have been particularly used as a sealing glue, accomplishing the main concern of adaptation of flap edges after an incision. They exhibit good bacteriostatic properties[21, 22] as they have strong electronegative charge of the polymer and ability to form a mechanical barrier that prevents the entry of any material or organisms.[23] In addition, they are reported to increase epithelial keratinisation and have minimal inflammatory response leading to decreased healing time.[4] They also provide immediate haemostasis,[1, 23] which is attributed to their ability to form a mechanical barrier at the wound site, which favours the coagulation process and allows haemorrhage control.[24]

Cyanoacrylates can be used as an alternative to sutures to avoid anaesthetic procedures during suturing. Similarly, suturing techniques demand a high level of clinical dexterity, time and patience from surgeons[1] and are associated with high risk of transmission of fatal diseases such as Acquired Immuno-deficiency Syndrome (AIDS), Hepatitis through accidental needle stick injury.[2] Thus, cyanoacrylates can help to eliminate psychological stress during suturing as well as suture removal. Patients have also reported high satisfaction levels for this material.[19, 25] However, they cannot be used in areas of high tension, areas subjected to friction, and areas showing infection and/or contamination with exudate. In addition, they cannot be used in patients with allergy to cyanoacrylate.[26] High cost of cyanoacrylate adhesives compared to silk suture[27] and reduced tensile strength[19] are some of their disadvantages.

The main limitation of this study was the inability to perform histological examination to evaluate healing of the wounds. Randomised controlled trials and multicentred studies with large sample size are recommended in future to validate the findings.

CONCLUSION

This study concludes that n-butyl cyanoacrylate is as effective as silk suture for the closure of periodontal flaps in terms of clinical healing. Its use is a reliable technique that can overcome most of the complications faced on using conventional silk sutures in the closure of periodontal flaps. Due to ease of manipulation, time saving and safety factors; this study recommends day-to-day use of n-butyl cyanoacrylate for sealing the incision margins intra-orally after periodontal flap surgery; however, the relative high cost of n-butyl cyanoacrylate should be taken into consideration.

Conflict of interest: None.

REFERENCES

1. Kumar MS, Natta S, Shankar G, Reddy SHK, Visalakshi D, Seshiah G. Comparison between silk sutures and cyanoacrylate adhesive in human mucosa-a clinical and histological study. J Int Oral Health. 2013;5(5):95.
2. Parmar CSM, Kumar KDSBS. Evaluation and Comparison of Healing of Periodontal Flaps when Closed with Silk Sutures and N-Butyl Cyanoacrylate: A Clinico–Histological Study. Adv Hum Biol. 2013;3(1):7-14.
3. Saquib A, Chavan A, Dani N, Al-Qahtani N, Al-Qahtani S, Priyanka N. Comparative Evaluation of N-Butyl Cyanoacrylate and Silk Sutures on Healing of Periodontal Flaps: A Clinico Histological Evaluation. Kathmandu Univ Med J (KUMJ). 2018;16(63):253-8.
4. Narsingyani RG, Patel SM, Sood RA, Bhimani KK, Makwana SV, Savani RR. Attached Oral Mucosal Wound Closure using Blue Glue-A Prospective Clinical Study. Ann Maxillofac Surg. 2023.
5. Silness J, Löe H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand. 1964;22(1):121-35.
6. Schour I. Prevalence of gingivitis in young adults. J dent Res. 1948;27:733-4.
7. Huang LH, Neiva RE, Wang HL. Factors affecting the outcomes of coronally advanced flap root coverage procedure. J Periodontol. 2005;76(10):1729-34.
8. Faris A, Khalid L, Hashim M, Yaghi S, Magde T, Bouresly W, et al. Characteristics of Suture Materials Used in Oral Surgery: Systematic Review. Int Dent J. 2022;72(3):278-87.

9. Chandra S, Shashikumar P, Nisha S. Comparative Evaluation of N-Butyl Cyanoacrylate with Braided Silk Suture after Periodontal Flap Surgery: A Randomised Controlled Trial. World J Dent. 2021;12(4):328-32.
10. Kulkarni SS, Chava VK. Comparison of cyanoacrylate and silk sutures on healing of oral wounds--an animal model study. Ind J Dent Res: Official Publication of Indian Society for Dental Research. 2003;14(4):254-8.
11. Akhter J, Kalita S, Goyal R, Jaiswal P, Ramalingam K, Yadav D, et al. A Comparison Between the Effectiveness of Isoamyl 2-Cyanoacrylate Tissue Adhesive and Silk Sutures in Wound Closure Following Minor Oral Surgical Procedures: A Prospective Clinical Study. Cureus. 2023;15(7).
12. 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.
13. Sankari M, Nambi G. A comparative study on the effectiveness of Iso–amyl cyanoacrylate tissue adhesive to silk sutures in the closure of periodontal flap: A split-mouth study. Res J Pharm Technol. 2020;13(8):3671-4.
14. Giray C, Atasever A, Durgun B, Araz K. Clinical and electron microscope comparison of silk sutures and n-butyl-2-cyanoacrylate in human musosa. Aust Dent J. 1997;42(4):255-8.
15. Aeran H, Tuli A, Sharma I. A clinico-histological comparative evaluation of healing of periodontal flaps when approximated with silk sutures and n-butyl cyanoacrylate. Int J Oral Health Dent. 2022;8:222-6.
16. Macht S, Krizek T. Sutures and suturing--current concepts. J Oral Surg (American Dental Association: 1965). 1978;36(9):710-2.
17. Levin MP. Periodontal suture materials and surgical dressings. Dent Clin N Am. 1980;24(4):767-81.
18. Vastani A, Maria A. Healing of intraoral wounds closed using silk sutures and isoamyl 2-cyanoacrylate glue: A comparative clinical and histologic study. J Oral Maxillofac Surg. 2013;71(2):241-8.
19. Sagar P, Prasad K, Lalitha R, Ranganath K. Cyanoacrylate for intraoral wound closure: a possibility? Int J Biomater. 2015;2015.
20. Mehta M, Shah K, Bhatt R. Osteosynthesis of mandibular fractures with N-butyl cyanoacrylate: a pilot study. J Oral Maxillofac Surg. 1987;45(5):393-6.
21. Avery B, Ord R. The use of butyl cyanoacrylate as a tissue adhesive in maxillo-facial and cranio-facial surgery. Br J Oral Surg. 1982;20(2):84-95.
22. López-Jornet P, Camacho-Alonso F, Gómez-García F. Evaluation of biochemical the two cyanoacrylates: an experimental study in rats. J Biomater Appl. 2009;24(3):197-207.
23. Malhotra V, Rao JD, Arya V, Sharma S, Singh S, Luthra P. Evaluating the use of octyl-2-cyanoacrylate in unilateral cleft lip repair. Nat J Maxillofac Surg. 2016;7(2):153.
24. Buric N. Use of N-butyl cyanoacrylate with metacryloxisulfolane (glubran 2) surgical glue for flapless closure of oroantral communication. Implant Dent. 2013;22(3):238-43.
25. Barbosa FI, Corrêa DS, Zenóbio EG, Costa FO, Shibli JA. Dimensional changes between free gingival grafts fixed with ethyl cyanoacrylate and silk sutures. J Int Acad Periodontol. 2009;11(2):170-6.
26. Borie E, Rosas E, Kuramochi G, Etcheberry S, Olate S, Weber B. Oral applications of cyanoacrylate adhesives: a literature review. Biomed Res Int. 2019;2019.
27. Souza SCd, Briglia CH. Comparative study of the use of ethyl cyanoacrylate adhesive and intracutaneous suture for cutaneous excision closure. Revista Brasileira de Cirurgia Plástica. 2011;26:566-72.