



COMPARATIVE EVALUATION OF HEALING AFTER USING N-BUTYL CYANOACRYLATE (TISSUE ADHESIVE) OR SILK SUTURE ON PERIODONTAL FLAP CLOSURE- A CLINICAL STUDY

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Abstract

Aim: The aim of this study to compare and evaluate the healing after using N-butyl cyanoacrylate (tissue adhesive) or silk suture on periodontal flap closure.

Material and methods: The randomized clinical trial was conducted in Department of Periodontics at Vananchal Dental College and Hospital, Garhwa, Jharkhand, India from January 2021 to January 2022. 50 healthy patients who fulfilled the inclusion and exclusion criteria and were included in this study. Plaque Index (PI), Gingival Index (GI), Wound healing Index (WHI), Histological Assessment (HA) all the study parameters were included in the present study.

Results: At baseline postoperative in the suture sites, the mean plaque score was 0.736 ± 0.165 which was reduced to 0.741 ± 0.0997 at a 42-day interval. In the cyanoacrylate sites, the mean plaque score at the baseline recall visit was 0.767 ± 0.1697 and at the 42-day interval, it was 0.738 ± 0.094 . The mean gingival index in the suture sites at the baseline and 42 days interval was 10.688 ± 0.0745 Vs 0.675 ± 0.087 respectively. In the cyanoacrylate sites, it was 0.6785 ± 0.0744 at the baseline day and 0.675 ± 0.069 at the 42 days follow-up. Wound Healing index score observed at cyanoacrylate sites was also lesser as compared to suture sites with statistical significance at 7th day indicating that wound healing was better when flaps were closed with cyanoacrylate as compared to silk sutures. There was no statistical significance observed between the epithelium of cyanoacrylate and suture sites on 7th and 42nd day. Inflammatory cells at cyanoacrylate sites were lesser as compared to suture sites with statistical significance on the 7th day. Vascularity at cyanoacrylate sites was lesser as compared to suture sites with statistical significance on the 7th day.

Conclusion: The closure of periodontal flaps with cyanoacrylate results in better initial post-operative healing as compared to closure with silk suture and that this method of closure can be advocated in a routine surgical periodontal practice

Keywords: Cyanoacrylates, Flap surgery, Silk sutures, Tissue adhesives

Introduction

Periodontal plastic procedures are of utmost important for the regeneration of lost periodontal tissues. Healing of the oral mucosa through primary closure is appreciable after surgical procedure. Primary closure of wound shows less scare, fast healing & less pain.¹ Closure of surgical area through suturing has been found to be standard technique from ancient times.² Various evolution come forward for the closure of wound which includes staples, adhesive tapes, adhesive glues, and fibrin sealants have to accelerate the healing.³

Periodontitis has been successfully treated with a variety of methods throughout the years. One of the most commonly performed treatments, especially in the case of moderate to deep pockets, is the periodontal flap. In order to restore a healthy dentogingival unit, it is necessary to perform a close post-operative adaptation of the flap onto the prepared root surface and to maintain this adaptation for an extended length of time.^{4,5} Materials such as silk, nylon, steel, catgut, and polyglycolic-polylactic acid derivatives are being utilised to close the flap after it has been surgically closed during the procedure. However, the use of sutures in periodontal surgery has been linked with a number of complications.⁴

Coover and colleagues discovered cyanoacrylates as tissue adhesives in 1959, and they were the first to use them. Cyanoacrylates have the general formula $CH_2=CH-COOR$, where R may be any of the methyl, propyl, or butyl radicals in the cyanoacrylate chain.⁶ Several investigations on animals have been conducted using either methyl or butyl cyanoacrylates as the active ingredient.⁷ When administered to L929 fibroblasts, DeRenzis and Aleo examined the relative cytotoxic effects of methyl, isobutyl, and octyl-cyanoacrylate to see which was the most hazardous. The methyl cyanoacrylate had the most cytotoxic effects, whereas the isobutyl and octyl cyanoacrylates had less severe impacts on the cells.⁸

Periodontal wound healing is an important event in the treatment outcome. Primary closure of the site can assure wound stability and promote early tissue maturation and healing. Initial wound stabilization is achieved by suturing during the early wound healing phase; however, sutures can harbor microorganisms and delay the healing response. Soni et al. compared sutures with cyanoacrylates for wound closure and found the time required in the cyanoacrylate group was significantly less for wound closure than the suture.⁹ Another study aimed at evaluation of hemostasis, inflammation, and infection postsurgery in cyanoacrylate and suture concluded that hemostasis was immediately achieved with cyanoacrylates with no intraoral tissue reactions and any complications.¹⁰ Nevins et al. used cyanoacrylate in extraction socket as a protective layer with collagen membrane and found its biocompatibility in periodontal tissue regeneration.¹¹ Gumus and Buduneli showed significantly less graft contraction, minimal postoperative pain, and no bleeding complications in the cyanoacrylate group in comparison with suture and microsurgery.¹² N-Butyl cyanoacrylate is a newer tissue adhesive material that is biocompatible with the stronger tissue-binding property even in moist environments and can be used as an alternative to silk, nylon, or staples. This unique property of tissue-binding of cyanoacrylate was utilized in this study to compare the efficacy of N-butyl cyanoacrylate with braided silk sutures after a periodontal flap surgery in terms of wound healing, postoperative pain experienced by study subjects, and the time required for completion of flap closure.

Material and methods

The randomized clinical trial was conducted in Department of Periodontics at Vananchal Dental College and Hospital, Garhwa, Jharkhand, India from January 2021 to January 2022. Ethical

approval was obtained from the institutional ethical review board before the commencement of the study. 50 healthy patients who fulfilled the inclusion and exclusion criteria and were included in this study.

Inclusion criteria

- Patients with moderate to severe generalized periodontitis (i.e., probing depth of ≥ 5 mm)
- Both anterior and posterior quadrants were considered
- Minimum of 20 teeth in the oral cavity
- 20 to 55 years of age of the patients.

Exclusion criteria

- Patients with known systemic diseases and/or drug therapy.
- Deleterious habits of smoking or tobacco chewing.
- Pregnant or lactating mothers.

Plaque Index (PI), Gingival Index (GI), Wound healing Index (WHI), Histological Assessment (HA)¹³⁻¹⁵ all the study parameters were included in the present study.

Any 2 sextants with comparable probing pocket depth were selected for the study. At least 4 teeth were included in each surgical site. A split-mouth design was employed in each patient. Each patient acted as his/her own control and thus the comparison was standardized. The selection of the sites was done randomly as: 1) Suture sites (SS): closed with 3-0 silk suture. 2) Cyanoacrylate sites (CS): closed with N-butyl cyanoacrylate.

It was necessary to do a full thickness mucoperiosteal flap elevation as part of the surgical operation. The surgical region was debrided and scaled in order to eliminate any granulation tissue that may have formed there. Prior to the sealing of the region with either of the two materials, irrigation was carried out through the area. The surgical sites for suture placement and cyanoacrylate application were chosen at random. In one sextant of the operative region, a simple loop interdental ligation was performed using black braided 3-0 silk sutures in one loop. Application of N-butyl cyanoacrylate was done in a dropwise manner on the opposite sextant of the surgical region on the other side of the surgical area.

All the participants in the study were recalled on the 7 day for removal of the suture and the remaining cyanoacrylate material. The participants were evaluated at seventh, 21st and 42nd day for gingival inflammation and plaque accumulation by assessing GI and PI respectively, whereas WHI was used to assess healing. The biopsy specimens were obtained at 7th and 42nd day for histopathological examination.

To assess the healing of the tissues histologically, punch biopsies were obtained involving the epithelium and a part of connective tissue, so as not to completely expose the alveolar bone at the biopsy sites. The biopsy specimens were obtained along the vertical releasing incision from both the cyanoacrylate and suture Sites.

Statistical Analysis

The statistical studies were carried out using the SPSS Statistics 21.0 software. The analysis of variance (ANOVA) was used to compare intra group differences at various time periods. For the purpose of comparing two groups, an independent student t-test was used. The threshold of significance was fixed at 0.05 for all tests.

Results

The control group consisted of 25 subjects with 11 women and 14 men. The mean age in this group was 41 $\pm$ 0.77 years, ranging from 21 to 55 years. The test group consisted of 25 subjects with 10 women and 15 men (mean age 38 $\pm$ 0.44.)

Table 1. Intergroup comparison of plaque index

Time Interval		Mean PI +SD	Difference in Mean	t value	Significance (P*)
	suture sites	cyanoacrylate sites			
Baseline	0.736±0.165	0.767±0.1697	-0.03	0.359	0.37
7 days	2.556±0.2236	1.692±0.1402	0.81	12.33	0.000*
21 days	1.099±0.1635	1.12±0.0896	0.041	0.975	0.17
42 days	0.741±0.0997	0.738±0.094	0	0	0.5

Table 1 shows the comparison of plaque scores between suture sites and cyanoacrylate sites at different time intervals. At baseline recall postoperative in the suture sites, the mean plaque score was 0.736±0.165 which was reduced to 0.741±0.0997 at a 42-day interval. In the test group, the mean plaque score at the baseline recall visit was 0.767±0.1697 and at the 42-day interval, it was 0.738±0.094.

Plaque index score observed at cyanoacrylate sites was lesser as compared to suture sites with statistical significance at 7th day indicating that plaque control was better when flaps were closed with cyanoacrylate as compared to silk sutures (Table 1).

Table 2: comparison of gingival index between suture sites and cyanoacrylate sites at different time intervals

Time Interval		Mean GI +SD	Difference in Mean	t value	Significance (P*)
	suture sites	cyanoacrylate sites			
Baseline	0.688±0.0745	0.6785±0.0744	-0.03	0.6932	0.233
7 days	1.623±0.088	1.223±0.058	0.2845	10.63	0.000*
21 days	0.812±0.105	0.876±0.122	0.07	1.748	0.0512
42 days	0.675±0.087	0.675±0.069	0	0	0.5

Table 2 shows the comparison of gingival index between suture sites and cyanoacrylate sites at different time intervals. The mean gingival index in the suture sites at the baseline and 42 days interval was 0.688±0.0745 Vs 0.675±0.087 respectively. In the cyanoacrylate sites, it was 0.6785±0.0744 at the baseline day and 0.675±0.069 at the 42 days follow-up. Gingival index score observed at cyanoacrylate sites was lesser as compared to suture sites with statistical significance at seventh day indicating that gingival inflammation was lesser when flaps were closed with cyanoacrylate as compared to silk sutures (Table 2).

Table 3: Intergroup comparison of wound healing index

Time Interval		Mean GI +SD	Difference in Mean	t value	Significance (P*)
	suture sites	cyanoacrylate sites			
7 days	1.6521±0.1587	1.1893±0.0587	0.4025	9.254	0.000*
21 days	1.3033±0.1236	1.0898±0.0897	0.2127	4.125	0.000*
42 days	1.1	1.1	-	-	-

Table 3 shows the comparison of wound healing index between suture sites and cyanoacrylate sites at different time intervals. The mean wound healing index at the 7th -day recall visit was 1.6521±0.1587 and 1.1 at the 42-days follow-up period in the suture sites. In the cyanoacrylate sites at the 7th days mean wound healing index was 1.1893±0.0587 which was reduced to 1.1 at the 42 days follow-up.

Wound Healing index score observed at cyanoacrylate sites was also lesser as compared to suture sites with statistical significance at seventh day indicating that wound healing was better when flaps were closed with cyanoacrylate as compared to silk sutures. As the healing progressed there was no statistically significant difference observed in any of the clinical parameters between cyanoacrylate and suture sites on 21st and 42nd day (Table 3)

Table 4: Comparison between histological parameters

Time Interval		Mean GI +SD	Difference in Mean	t value	Significance (P*)
	suture sites	cyanoacrylate sites			
Intergroup comparison of epithelial healing					
7 days	0.4.2±0.512	0.69±0.477	-0.257	1.474	p=0.06
42 days	0	0	-	-	-
Intergroup comparison of inflammatory cell score					
7 days	1.893±0.583	1.4±0.423	0.7125	3.894	p=0.0002*
42 days	1.1±0	1.1±0	-	-	-
Intergroup comparison of vascularity score					
7 days	2.223±0.174	1.257±0.141	1.062	4.393	p=0.000*
42 days	1.1±0	1.1±0	-	-	-
Intergroup comparison of connective tissue fibers score					
7 days	1.898±0.851	2.5±0.6120	-0.5254	1.91	p= .025*
42 days	2.274±0.448	2.5±0.5147	-0.141	0.7449	p=0.231

Histological Assessment

On examination, there was no statistical significance observed between the epithelium of cyanoacrylate and suture sites on seventh and 42nd day. Inflammatory cells at cyanoacrylate sites were lesser as compared to suture sites with statistical significance on the seventh day. Vascularity at cyanoacrylate sites was lesser as compared to suture sites with statistical significance on the seventh day. Connective tissue fibers observed at cyanoacrylate sites were more as compared to suture sites with statistically significance on seventh day. As the healing progressed there was no statistical significant difference observed in any of the histological parameters between cyanoacrylate and suture sites on the 42nd day. (table 4)

Discussion

The tissue changes that occur as a result of periodontal disease require surgical intervention many times. Primary closure and stabilization of flaps become an important aspect of postoperative healing. Since sutures have their own drawbacks quest for quicker and safer adhesives is always there. N-Butyl cyanoacrylate is one such tissue adhesive that has shown promising results in animal studies.¹⁶

The N-butyl-2-cyanoacrylate has been used widely in the field of medicine and dentistry. It is used as an adhesive tissue and has hemostasis, bacteriostatic, and rapid adhesion to both soft and hard tissues. It has a long half-life and biocompatible with gradual resorption. It can set in presence of moisture and blood in 5-10 seconds and releases heat on the setting. In dentistry, it has been used as a wound-healing agent in procedures like free gingival graft, apicoectomy, root sectioning, bonding of fractured tooth fragments. Intraoral wound closure in cases of biopsies, fractures, excision, and surgeries.¹⁷ This adhesive acts as a hemostatic agent in the extraction site. In the field of esthetic surgery, it is used in wound closure, skin grafting, face, and brow lifts.

Biocompatibility and excellent functioning characteristics in the presence of moisture have been shown, and the setup time is between 5 and 10 seconds. The purpose of this research was to evaluate the effectiveness of N-butyl cyanoacrylate and braided silk sutures in the closure of

periodontal flaps, as well as the effects of the sutures on wound healing and postoperative discomfort experienced.

The assessment of the plaque index was carried out in order to assess clinically the patient's ability to maintain good oral hygiene. When the plaque scores were compared between the suture and cyanoacrylate sites on the seventh day, it was discovered that the suture sites had accumulated much more plaque than the cyanoacrylate sites, according to clinical findings. This may be ascribed to the fact that the suture threads serve as a location for the buildup of plaque. These findings were consistent with those of investigations conducted by Binnie et al.⁷ and Giray et al.¹⁸, as well as other researchers. At the 21st and 42nd days, however, there was no statistically significant difference in plaque scores between the suture and Cyanoacrylate sites.

The assessment of the gingival index was carried out in order to clinically assess the inflammation of the tissues as a result of the exposure to both of the substances. During the seventh day of the study, the gingival index scores between the suture and cyanoacrylate sites revealed a statistically significant difference, with the suture sites showing an increase in score. This may be ascribed to the presence of the silk material inside the tissues, which may have elicited a reaction from the immune system. Macht and colleagues¹⁸ and Giray and colleagues¹⁹ have found findings that are consistent with each other. However, at the 21st and 42nd days, there was no statistically significant difference in gingival index scores between the suture and Cyanoacrylate sites.

When periodontal surgery was performed, an assessment of the wound healing index was carried out to clinically evaluate the healing response of the periodontal flap in both the surgical site and the non-surgical site. On the seventh day, there was a statistically significant difference in WHI scores between the suture and cyanoacrylate sites, with the suture sites having a higher score than the other sites. When comparing cyanoacrylate sites to suture sites, it was found that the healing response was much superior. As healing proceeded, no statistically significant difference in scores was seen between the suture and cyanoacrylate sites by the 42nd day.

Epithelialization, inflammation, vascularity, and fibrosis were all evaluated in this histological study, as well as other aspects of the patient's health.

The epithelialization at the suture and cyanoacrylate sites did not reveal any statistically significant differences at the seventh or 42nd day, respectively. This was comparable to the findings published by Giray et al. and Kulkarni et al.^{18,20}, which were also similar. However, this is in contrast to the findings of Greer et al., who found that cyanoacrylate caused a delay in the formation of epithelization, which they ascribed to the power of the spray gun as well as the trapping of the material inside the tissues.²¹

After seven days, when the inflammatory response was evaluated between the two sites, it was found that there was a statistically significant difference between the suture and the cyanoacrylate sites. When compared to suture sites, the cyanoacrylate sites exhibited a lower level of inflammatory cell response. The difference between the two locations was no longer statistically significant on the 42nd day of the experiment. This is consistent with the findings of investigations performed by Binnie et al.⁷ and Giray et al.¹⁸

Seven days after suture placement, there was a statistically significant increase in vascularity at the suture sites in contrast to the cyanoacrylate placement sites. There was a normal to hypervascular vascularity present in both locations, which may be ascribed to increased inflammation rather than endothelial proliferation of arteries, which occurs as a normal component of the healing process. As the healing process proceeded, the vascularity reduced to the point where it was no longer statistically significant. This is consistent with the findings of the experiments performed by Giray et al.¹⁸

There were increased connective tissue fibers in Cyanoacrylate sites in comparison to suture sites on the seventh day which was statistically significant which can be attributed to the normal healing process in that region. When the connective tissue was evaluated, it was found to be well organized as the healing progressed in both the groups and was statistical non-significant at 42nd day.

In the present study, there was a correlation between the clinical and histological findings i.e. the intensity of the clinical inflammation reflected in the histological picture as well. This was similar to those reported by Kulkarni et al. and Bhasker et al.^{20,22} However it was in discord with reports of Javelet et al.²³ who did not find any correlation between the clinical and histological features at 3 weeks, while there was a correlation between both over 10-20 weeks.

Strength and Limitations

Previous studies were done only in anterior teeth, this study with an adequate sample size assesses the material both in anterior and posterior teeth. However, due to ethical reasons, histological sections of the sutured and cyanoacrylate sites were not taken to correlate the clinical findings.

Conclusion

By comparison to silk sutures, this research found that the use of cyanoacrylate resulted in reduced postoperative inflammation and better clinical and histological healing when compared to the use of silk sutures. Consequently, it may be concluded that the use of cyanoacrylate for the closure of periodontal flaps resulted in superior initial post-operative healing when compared to the use of silk suture, and that this technique of closure can be recommended in a regular surgical periodontal practise.

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