

Comparative Evaluation of N-Butyl Cyanoacrylate and Silk Sutures on Healing of Periodontal Flaps: A Clinico Histological Evaluation

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ABSTRACT

Background

The periodontal flap is one of the most frequently employed procedures. Closure of reflected flap is important step in flap surgery. Black silk sutures are most often used material in routine surgical procedures. These suture materials demand more time and effort and expertise from the surgeon. Tissue adhesives have been developed as alternatives to overcome these problems such as cyanoacrylates.

Objective

The present study is an attempt to compare effectiveness of the black silk suture with cyanoacrylate adhesives in closing reflected periodontal flap.

Method

Thirty systemically healthy patients who underwent bilateral flap surgery were given 3-0 black silk sutures on one side and N-butyl cyanoacrylate adhesive on the other side to close a surgical incision. All the participants in the study were recalled on the seventh, 21st, 42nd day. Participants were evaluated for healing and plaque accumulation by assessing the gingival index, plaque index, wound healing index. Biopsy specimens were obtained on seventh and 42nd postoperative day.

Result

The amount of inflammation was less during the first week of healing when cyanoacrylate was compared with silk. However, over a period of 21 days to 42 days, the sites treated with both the materials showed similar healing patterns without any significant difference in the evaluated parameter.

Conclusion

The result of the study showed that the use of cyanoacrylate for the closure of periodontal flaps 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.

KEY WORDS

Cyanoacrylate, Periodontitis, Surgery, Sutures, Wound healing

INTRODUCTION

Periodontitis is a multifactorial disease resulting in inflammation and destruction of the connective tissue attachment of the teeth. Periodontal pocket formation is usually a sequel of the disease. The periodontal flap is one of the most frequently employed procedures, particularly in deep periodontal pockets. Flap surgery for periodontal re-attachment, demands close post-operative adaptation of gingival connective tissue on to the tooth surface.¹⁻³ Over the years many suture materials like silk, nylon, catgut and polylactic acid are being used for the closure of the flaps, but many problems have been associated with the use of sutures in periodontal surgery.^{1,4}

There are a multitude of new materials being tested for their ability to promote wound healing after periodontal surgery, till date no material has been found to be superior to the conventional silk and nylon sutures.^{1,5} Braided silk has a phenomenon of 'wicking,' which makes it a site for secondary infection.^{4,6,7} So, in order to overcome these difficulties, a need for an alternative to sutures is always felt.

Cyanoacrylates were synthesized in 1959 by Coover et al.^{8,9} N-butyl cyanoacrylate is a biocompatible tissue adhesive and is used for closure of wounds. Cyanoacrylates have been used in the closure of organs, skin, mucosa grafts, closure of lacerations, incisions and post-extraction dressings in dentistry. Favorable qualities of these materials include strong bonding in the presence of moisture to the tissues, workable polymerization time, biodegradability and bacteriostatic ability.¹⁰

Hence, the present study is an attempt to evaluate and compare the healing of periodontal flaps when closed with silk sutures and N-butyl cyanoacrylates.

METHODS

The study design was a single center randomized clinical trial conducted from 18th September 2014 to 12th February 2015 at the Department of Periodontics, M.G.V Dental College and Hospital, Nasik, India. Thirty systematically healthy patients who fulfilled the inclusion and exclusion criteria and were willing to participate in the study were recruited from the pool of patients who visit the Out Patient Department. Ethical approval was obtained from the institutional ethical review board before the commencement of the study. Patients were informed about the procedure and written consent was obtained from each patient. Patients with; a minimum of twenty teeth in the oral cavity, more than or equal to 5 mm of probing depth which was indicated for periodontal flap surgical procedures and patients who maintaining good oral hygiene were included in the study (fig. 1). Medically compromised, pregnant, lactating, allergic to medicines, smokers, tobacco chewers and uncooperative patients were excluded from the study.



Figure 1. Preoperative photograph with pocket depth.

Study parameters included in the present study were Plaque Index (PI), Gingival Index (GI), Wound healing Index (WHI), Histological Assessment (HA).¹¹⁻¹³

Any two sextants with comparable probing pocket depth were selected for the study. At least four 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.

The surgical procedure consisted of a full thickness mucoperiosteal flap elevation. The surgical area was debrided and scaled so as to remove the granulation tissue. Through irrigation was done prior to closure of the area with either of the two materials. Selection of the surgical sites for suture and cyanoacrylate was done randomly. Simple loop interdental ligation was done with black braided 3-0 silk sutures in one sextant of the surgical area (fig. 2). The application of N-butyl cyanoacrylate was done in dropwise manner on the other sextant of the surgical area (fig. 3).



Figure 2. Flap closure is done with 3-0 silk suture.

All the participants in the study were recalled on the seventh 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 seventh and 42nd day for histopathological examination.



Figure 3. Flap closure is done with n-butyl-2-cyanoacrylate.

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.

IBM SPSS Statistics version 20 was used to analyze the data. Statistical analysis was performed for intragroup and intergroup comparison. Paired t-test was performed for intragroup comparison and unpaired t-test was performed for intergroup comparison.

RESULTS

In the comparative analysis done between the suture and the cyanoacrylate sites, the following results were obtained.

Clinical Assessment

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

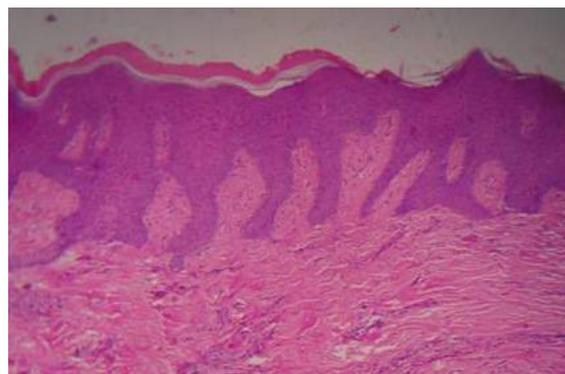


Figure 4. Histological section at the suture site

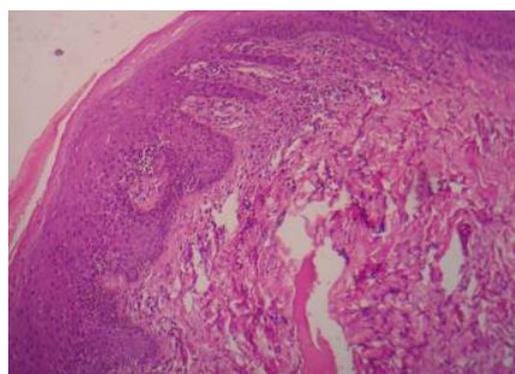


Figure 5. Histological section at n-butyl-2-cyanoacrylate site

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).

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 1. Intergroup comparison of plaque index

Time Interval	Mean PI +SD		Difference in Mean	t value	Significance (P*)
	SS	CS			
Baseline	0.713±0.145	0.733±0.1543	-0.02	0.365	0.3589
7 days	2.613±0.2134	1.753±0.1302	0.86	13.33	0.000*
21 days	1.087±0.1522	1.04±0.0986	0.046	0.983	0.167
42 days	0.743±0.0985	0.74±0.091	0	0	0.5

Table 2. Intergroup comparison of gingival index

Time Interval	Mean GI +SD		Difference in Mean	t value	Significance (P*)
	SS	CS			
Baseline	0.667±0.0816	0.6867±0.0743	-0.02	0.7016	0.244
7 days	1.6067±0.096	1.313±0.064	0.2933	9.83	0.000*
21 days	0.866±0.134	0.946±0.130	0.08	1.655	0.0545
42 days	0.693±0.099	0.693±0.070	0	0	0.5

Table 3. Intergroup comparison of wound healing index

Time Interval	Mean WHI +SD		Difference in Mean	t value	Significance (P*)
	SS	CS			
7 days	1.5867±0.1685	1.1933±0.0594	0.3933	8.529	0.000*
21 days	1.2933±0.1335	1.0867±0.0916	0.2067	4.946	0.000*
42 days	1.0	1.0	-	-	-

Table 4. Comparison between histological parameters

Time Interval	Mean +SD		Difference from Seventh Day	t value	Significance (P*)
	SS	CS			
1. Intergroup comparison of epithelial healing					
7 days	0.4±0.507	0.66±0.488	-0.266	1.468	p=0.07
42 days	0	0	-	-	-
2. Intergroup comparison of inflammatory cell score					
7 days	1.933±0.593	1.2±0.414	0.7333	3.924	p=0.0003*
42 days	1.0±0	1.0±0	-	-	-
3. Intergroup comparison of vascularity score					
7 days	2.333±0.186	1.267±0.153	1.067	4.413	p=0.000*
42 days	1.0±0	1.0±0	-	-	-
4. Intergroup comparison of connective tissue fibers score					
7 days	1.866±0.832	2.4±0.6325	-0.5333	1.97	p= .029*
42 days	2.267±0.457	2.4±0.5071	-0.133	0.7559	p=0.228

Histological Assessment

On examination, there was no statistical significance observed between the epithelium of cyanoacrylate and suture sites on seventh and 42nd day (Table 4), (fig. 4 and 5). Inflammatory cells at cyanoacrylate sites were lesser as compared to suture sites with statistical significance on the seventh day (Table 4), (fig. 4 and 5). Vascularity at cyanoacrylate sites was lesser as compared to suture sites with statistical significance on the seventh day (Table 4), (fig. 4 and 5). Connective tissue fibers observed at cyanoacrylate sites were more as compared to suture sites with statistically significance on seventh day (Table 4), (fig. 4 and 5). 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.

DISCUSSION

Periodontitis is an infectious disease involving the periodontium, resulting in the destruction of the connective tissue attachment of the teeth. Periodontal pockets are most common clinical finding in periodontitis cases. For moderate to deep pockets periodontal flap is one of the most frequently employed procedures. Silk is the most commonly used suture material for approximating the flap margins together after periodontal flap surgery,¹ whereas cyanoacrylate are the most widely used tissue adhesives for closure of traumatized as well as incision wounds.^{8,14}

The present study was carried out to evaluate the healing of periodontal flaps when closed with silk sutures and N-butyl cyanoacrylate and also to compare the healing and tissue response to both the materials.

Thirty systematically healthy patients who fulfilled the inclusion and exclusion criteria and willing to participate in the study were included. A split mouth design was employed so that 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 suture sites (SS) and cyanoacrylate sites (CS). The selection of the sites was done randomly.

The cyanoacrylate material used in the present study was N-butyl cyanoacrylate. This material has got good bonding properties and bond strength to hold the tissue margins together, it has good hemostatic property and to some extent, it is also bacteriostatic in nature.^{8,14-17} It also has good working properties like the flow and fast setting i.e. within 5 to 10 seconds.

The evaluation of the plaque index was done to check clinically the oral hygiene maintenance of the patient. On seventh day when the plaque scores were compared between the suture and the cyanoacrylate sites clinically, the suture sites were found to accumulate more plaque as compared to the cyanoacrylate sites. This can be attributed to the suture threads acting as a site of plaque

accumulation. This is in accordance with the studies by Binnie et al. and Giray et al.^{18,19} However there was no significant difference in the plaque scores between suture and Cyanoacrylate sites at 21st and 42nd day.

The evaluation of the gingival index was done to clinically evaluate the inflammation of the tissues as a response to both the materials. On the seventh day, gingival index scores between the suture and the cyanoacrylate sites showed a significant difference with suture sites exhibiting increased score. This can be attributed to the presence of the silk material within the tissues, which might have provoked the response. This is in concurrence with the results of Macht et al. and Giray et al.^{4,19} However there was no significant difference in the gingival index scores between suture and Cyanoacrylate sites at 21st and 42nd day.

The evaluation of the wound healing index was done to clinically assess the healing response of the periodontal flap after periodontal surgery in both the surgical site. On the seventh day, WHI scores between the suture and the cyanoacrylate sites, showed a significant difference with suture sites exhibiting increased score. A better healing response was exhibited at cyanoacrylate sites in comparison to suture sites. As healing progressed at 42nd day no statistically significant difference was reported in scores between suture and cyanoacrylate sites.

This histological analysis included the assessment of the epithelialization, inflammatory response, vascularity and fibrosis.

The epithelialization did not show any significant difference at seventh or 42nd day at both the suture and cyanoacrylate sites. This was similar to the results reported by Giray et al. and Kulkarni et al.^{18,20} However it is in disparity with the study done by Greer et al. who reported a retardation of the epithelialization with cyanoacrylate which was attributed to the force of the spray gun and also the entrapment of the material within the tissues.¹⁶

When the inflammatory response was compared, at both the sites, there was a statistically significant difference between the suture and the cyanoacrylate sites at seventh day. The cyanoacrylate sites showed less inflammatory cell

response as compared to suture sites. At 42nd day there was no statistically significant difference between the two sites. This is in accordance with studies conducted by Binnie et al. and Giray et al.^{18,19}

There was increased vascularity at the suture sites in comparison to cyanoacrylate sites at seventh day which was statistically significant. The vascularity was normal to hypervascular in both the sites which can be attributed to increased inflammation and not to the endothelial proliferation of vessels as a part of the normal healing process. At 42nd day as the healing progressed the vascularity decreased and was not statistically significant. This is in agreement with the studies conducted by Giray et al.¹⁹

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.^{20,21} However it was in discord with reports of Javelet et al.²² 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.

CONCLUSION

This study has indicated that the use of cyanoacrylate has resulted in less postoperative inflammation and good clinical and histological healing when compared to the silk sutures. Thus it can be concluded that 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.

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