

Comparison between Silk Sutures and Cyanoacrylate Adhesive in Human Mucosa- A Clinical and Histological Study

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ABSTRACT

Background: Closing the surgical incision is an important step in the surgical procedures, the success of surgery is sometimes compromised by the defective suturing techniques or improper suturing materials, black silk sutures are more or less most often used materials in the day today surgical procedures, but these suture materials demand more time and effort from the surgeon and there is a need to substitute these materials with more user friendly and more successful wound closing materials such as cyanoacrylates. This study intends to compare effectiveness of the black silk sutures with cyanoacrylate adhesives in closing the surgical incisions.

Materials & Methods: 10 patients of age group between 15-30 years who underwent bilateral apicoectomy were given 3-0 black silk sutures on one side and n-butyl-2cyanoacrylate adhesive on the other side of the frenum to close the surgical incision, and a clinical comparison was made on the 1st, 2nd, 3rd, and 7th post-operative days, on the seventh postoperative day following removal of sutures, small punch biopsies were obtained from both the sites and the tissue specimens were examined under transmission electron microscope.

Results: Clinical observations revealed that on the 3rd and 7th postoperative days epithelialization was better on the sides treated with n-butyl-2cyanoacrylate but the sites closed with black silk suture showed significant inflammation and scar formation, electron microscopic observation of both tissue specimens revealed that sutured tissue specimens showed dense inflammatory infiltrate but the sites treated with cyanoacrylate adhesive showed less inflammatory infiltrate and uniform distribution of neutrophils, lymphocytes, histocytes and eosinophils unlike the sutured specimens which showed more scar tissue and dense infiltrate concentrated along the margins of the gap.

Conclusion: This study has indicated that the use of cyanoacrylate glue has resulted in less postoperative inflammation and good clinical and histological healing when compared to the silk sutures.

Key Words: Cyanoacrylate glue, n-butyl-2cyanoacrylate, Silk sutures.

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Introduction

Healing by primary intension demands a proper closure of surgical wounds, this needs close approximation of wound edges with appropriate means and methods, complications of healing after surgery may result because of any of the following reasons or a combination of them,

1. Inadequate preoperative assessment
2. Faulty or traumatic surgery
3. Inadequate post-operative care

The wounds in general pose a challenge of reinfection/infection during healing process, this is even more true in case of oral wounds because of the increased challenge in the form of plaque and food

and impaired wound healing. A carefully planned surgery needs proper immobilization of healing area and this can be achieved by proper wound closure technique with appropriate material such as sutures or tissue adhesives.

Surgical sutures have been in use since the time immemorial and various materials ranging from human hair to the presently used silk sutures have been tried in the process of achieving a hassle free closure of wounds, but in spite of sophisticated suture materials and techniques there are occasions when the wound closure is not upto the intended level and may present with complications like fistulation and granuloma formation, which is supposed to result mainly because of incompatibility of suture materials per se, moreover, these suture materials have a spectrum of drawbacks such as cutting through the



Fig. 1: Pre Operative IOPA's showing Bilateral Lesions

debris, hence an increased attention to prevent the incidence of infection is needed in the form of maintaining an aseptic environment and careful manipulation of tissues during surgical process to prevent or minimize the post-operative complications



Fig. 2: Clinical Picture of the 7th Postoperative day

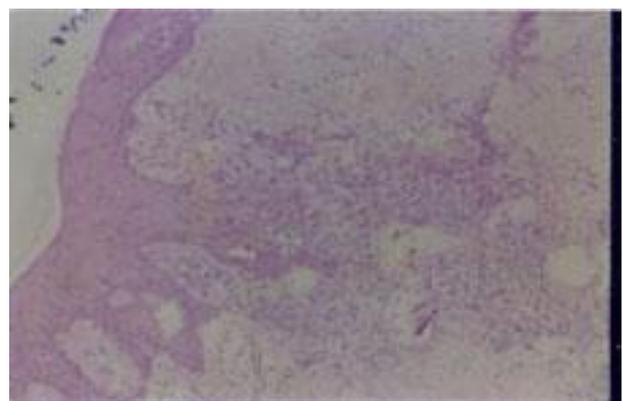


Fig. 3: Histological picture of the site where Cyanoacrylate Glue was used.

parenchymal and inflammatory tissues during suturing, exhibition of capillary action by braided or twisted black suture materials etc, leading to increased

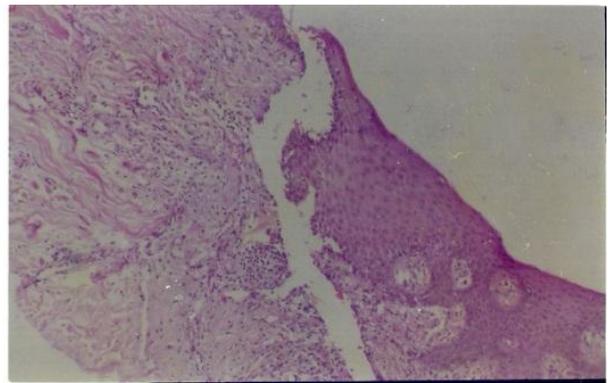


Fig. 4: Histological figure where 3-0 Silk Suture was used

risk of wound infection, adding to this, the need for suture removal on the 7th postoperative day in case of non-resorbable suture materials poses inconvenience to the patient and chance of early/delayed resorption of suture material in the case of absorbable sutures paves way for wound dehiscence or wound reinfection, apart from these, the manipulation of tissue margins using these suture materials demand a high level of clinical judgement, dexterity, time and patience from surgeon and exact control over the force application on the suture to avoid excess/inadequate tension in the suture while suturing which if not there will result in tearing of the wound margins/necrosis in case of excess forces or else, slackness in suture resulting in gaping between the wound margins resulting in incomplete healing or reinfection/scarring, more over the emergence of diseases like AIDS, Hepatitis etc. which carry high risk of transmission through needle prick also apprehends the operators in executing this process, this has led to the introduction of easier way of wound closure by means of using tissue adhesives which are supposed to minimize the effort and also avoids the risk of needle prick and tissue tears while closing the wound margins, hence the use of these tissue adhesives is gaining momentum and presently there is an increased need to critically

polymerization and it should provide strong and flexible bond, should be tissue compatible (non-toxic), biodegradable, easily applicable and non-carcinogenic. Among many materials tried, Butyl cyanoacrylate fulfils most of the properties required by a tissue adhesive, this materials' adhesive properties were discovered in 1959¹ when initially the alkyl forms and ethyl forms were tried as tissue adhesives, but were discontinued because of their toxic reactions with the tissues and in their place N-butyl-2-cyanoacrylate (Histoacryl) has been tried since it exhibited advantages like achieving immediate haemostasis, and apart from being easy to use it also possessed bacteriostatic properties and rapid adhesion to hard and soft tissues.

The use of cyanoacrylates in the repair of organs, skin, vessels, nerves, mucosa grafts, closure of laceration wounds and incisions has been done successfully in surgical applications^{2,3,4} and treatment of extraction sockets, fixation of mandibular fractures, healing of intra oral wounds, fixation of free gingival grafts, healing of periodontal flaps were also found successful with the application of this cyanoacrylate,⁵⁻¹⁷ it has been reported that butyl and isobutyl cyanoacrylates are non-carcinogenic and non-toxic in living organisms unlike ethyl and methyl cyanoacrylate compounds.

Table 1: The Comparative Evaluation of Pain in the sutured group and Cyanoacrylate group at 1st, 2nd, 3rd & 7th Postoperative Days

Grade of pain	1st Post Op Day		2nd Post Op Day		3rd Post Op DAY		7th Post Op Day	
	Sut	Cyn	Sut	Cyn	Sut	Cyn	Sut	Cyn
No. of patients with mild pain	8	10	8	10	1	0	0	0
No. of patients with moderate pain	2	0	2	0	0	0	0	0
No. of patients with severe pain	0	0	0	0	0	0	0	0

evaluate and test these tissue adhesives to find out their effectiveness, advantages and drawbacks over the presently used contemporary methods and materials. The ideal tissue adhesive should demonstrate shelf stability, complete polymerization even in the presence of moisture (blood, saliva or water), it should permit adequate working time, should spread to cover the optimum area, should provide wettability and should not produce excess heat during the process of

The aim of present study is to clinically compare and histologically evaluate cyanoacrylate adhesive (N-BUTYL-2-CYANOACRYLATE) over silk sutures when used for wound closure in human mucosa.

Materials and Methods

The study was conducted in the department of oral and maxillofacial surgery, Meghna Institute of Dental

Sciences, Nizamabad. Patients who need bilateral apicoectomy were elected for the study, 10 patients aged between 15 to 30 years were selected for this clinical study.

Maxillary and mandibular central incisors with periapical pathology and which needed apicoectomy for both central incisors were taken into consideration (Figure 1). Patients with normal general health were selected; patients with diabetes, acute infection and hypertension were excluded.

The procedure was carried on by elevating a mucoperiosteal flap under local anaesthesia, then root resection and removal of apical granulation tissue was done by curettage and haemostasis was achieved the mucoperiosteal flap was positioned in place and sutured on one side with 3-0 black silk suture and on the other side of the frenum, n-butyl-2-cyanoacrylate was used by just delivering a drop of it in the incision line to seal the incision. Clinical examinations were made on the 1st, 2nd, 3rd and 7th post-operative day, each side of the frenum was evaluated for parameters like pain, oedema, bleeding. On the seventh post-operative day sutures were removed and cyanoacrylate remnants were removed by gentle irrigation with normal saline, small biopsy specimen were taken over

was done and silk suture on one side and cyanoacrylate on other side of the frenum was used for the closure of the incision, the evaluation of the treated sites was done and the grading of the swelling was done in maxilla and graded as follows, 1) **Mild**-when there is only local mucosal swelling, 2) **Moderate**-when swelling extending superiorly up to the ala of the nose and crossing the corner of mouth laterally, 3) **Severe**-when swelling extending superiorly up to the infraorbital margin and extending towards the angle of the mandible. In mandible it was graded mild when only local mucosal swelling was there, moderate when swelling was extending up to submental region and severe when the swelling involved submandibular region, accordingly pain was graded 1) **Mild** only when there was dull intermittent pain, 2) **Moderate** when there was throbbing intermittent pain, 3) **Severe** when there was continuous throbbing pain.

Results showed that all the operative areas healed uneventfully by the 7th postoperative day (Figure 2), on the first postoperative day, moderate swelling was observed on both sides in 8 cases and in 2 cases moderate swelling on cyanoacrylate treated side and severe swelling on sutured side, on the 2nd postoperative day the same condition was observed,

Table 2: The Comparative Evaluation of Swelling in the sutured group and Cyanoacrylate group at 1st, 2nd, 3rd & 7th Postoperative Days

Grade of swelling	1st Post Op Day		2nd Post Op Day		3rd Post Op DAY		7th Post Op Day	
	Sut	Cyn	Sut	Cyn	Sut	Cyn	Sut	Cyn
No. of patients with mild swelling	0	0	0	0	8	10	2	0
No. of patients with moderate swelling	8	10	8	10	2	0	0	0
No. of patients with severe swelling	2	0	2	0	0	0	0	0

the incision lines on both the sides, biopsy specimens were fixed in formalin and sent for histologic examination to observe the healing process on both the sutured side and cyanoacrylate treated side.

Results

In this study 10 patients between age group of 15-30 years with satisfactory general health were taken into consideration, in each patient the bilateral apicoectomy

on the 3rd postoperative day, it was mild swelling in 8 cases on both sides and moderate swelling in 2 cases on sutured side and mild swelling on cyanoacrylate side. On the seventh postoperative day there was no swelling in 8 cases but mild swelling was observed in 2 cases on the sutured sides (Table 2), on the 1st postoperative day mild pain was reported in 8 cases on both the sides, in other 2 cases mild pain was reported on the cyanoacrylate side and moderate pain on sutured side, the condition remained unchanged on the

2nd postoperative day, on the 3rd postoperative day there was no pain in all the cases except in one case who reported mild pain on the sutured side, on the 7th post-operative day there was no pain in all the cases (Table 1). There was no evidence of necrosis (Figure 2) in any of the treated cases.

Histologically, the observations revealed that the gap in between the flaps on the sutured side was filled with a dense inflammatory infiltrate along the margins (Figure 4) on the contrary the cyanoacrylate treated side showed no such gap and there was uniform distribution of inflammatory infiltrate (Figure 3) scar tissue formation was slightly more on the sutured side. The inflammatory infiltrate includes lymphocytes, histiocytes and few eosinophils.

Distribution of the results of the clinical examination for post-operative days

Discussion

Healing after closure of wound can be enhanced by proper approximation of the wound edges and proper isolation of the wound. Superficial contamination of the wound occurs postoperatively and often results in delayed epithelialization of the wound surface and the production of excessive granulation tissues, all these factors contribute to failure of the surgery to produce the desired result and lead to greater postoperative pain and discomfort.

Plaque, food debris and excessive manipulation of tissues during surgery retard healing. The incidence of infection can be reduced by careful attention to asepsis and gentle handling of the tissues to prevent the implantation of foreign material into them. Postoperatively the immediate concern is the protection of the tissues and to control the infection while healing. Healing is improved by immobilization of the healing area. Immobilization of healing area can be achieved by suture or tissue adhesive.

Post-operative clinical evaluation of the cases in this study clearly revealed that the sites which were closed with silk sutures showed longer duration and more dense inflammation when compared to the sides treated with the cyanoacrylate, this is possible because of the irritation and trauma from the sutures and collection of food particles on the sutured area, moreover the blood coagulum which fills the defects to

protect the incision from outside influence probably gets effected by the fibrinolytic effect of the saliva during the healing period¹⁸ whereas the adhesion of the two margins of the incision by the cyanoacrylate leaves no space for salivary interference during healing, thus the isolation of the wound margins from the saliva and food debris/plaque appears to be added advantage provided by the use of adhesive materials like cyanoacrylate for closing the incision margins post operatively, it is also observed that cyanoacrylates has antimicrobial activity,¹⁹ bacteriostatic effects against gram positive microorganisms of n-butyl-2-cyanoacrylate have been also reported by Tse³. Schmaisner²⁰ reported that it had bactericidal activity against 10 test bacilli.

This study showed that the amount of inflammation on the sutured and glued incision line was different because the epithelialization on the sutured side was not uniform and there was significant scar formation. Besides the soft tissue applications, cyanoacrylates have also been used for the hard tissues. Mehta¹³ reported that the use of n-butyl-2-cyanoacrylate adhesives in the surgical treatment of fractures seems very promising and he stated that n-butyl-2-cyanoacrylate was nontoxic, non-mutagenic and non-carcinogenic.

In some studies^{21,22} by using agar overlay tissue cultures it has been shown that fibroblast cell death around a disc of n-butyl-2-cyanoacrylate progressed at a slow rate indicating its moderate toxicity on fibroblasts in vitro. Clinical and electron microscopic examination in this study has not revealed any evidence of that sort. Hence this study favours the use of cyanoacrylate as an effective method for closing the incision margins.

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