

# Clinical Evaluation of Lateral Pedicle Flap Stabilized with Cyanoacrylate Tissue Adhesive: A Randomized Controlled Clinical Trial

## Abstract

**Context:** Gingival recession is the most common mucogingival defect and is susceptible to tooth hypersensitivity, root caries, and esthetic problems if left untreated. A lateral pedicle flap is used to cover denuded roots that have adequate donor tissue laterally and adequate vestibular depth. A carefully planned surgery needs proper immobilization of the flap at the recipient site and this can be achieved by proper wound closure technique with appropriate material such as sutures or tissue adhesives. **Aim:** The aim of the present study is to evaluate the clinical outcomes of lateral pedicle flap stabilized with cyanoacrylate tissue adhesive and resorbable sutures. **Materials and Methods:** Twenty-two patients with Miller's class I and class II gingival recession were randomly divided into two groups: lateral pedicle flap stabilized with cyanoacrylate tissue adhesive (test) and lateral pedicle flap stabilized with resorbable sutures (control). Plaque index, gingival index, probing pocket depth, clinical attachment level, recession depth and width, height and thickness of keratinized gingiva were evaluated at baseline and 1<sup>st</sup> and 3<sup>rd</sup> month postoperatively. The percentage of root coverage was evaluated at the end of 3<sup>rd</sup> month postoperatively. **Statistical Analysis Used:** Intergroup comparisons for the clinical attachment level, recession depth, recession width, thickness of keratinized gingiva, and height of keratinized gingiva were made by Mann–Whitney test by analyzing the difference of two time periods. Intragroup comparisons were made by the Kruskal–Wallis test. Mann–Whitney test was used to compare the difference between various time periods within the group for all the selected variables. **Results:** The mean plaque index and gingival index at the 1<sup>st</sup> and 3<sup>rd</sup> month were found to be statistically significant and did not present any significant influence over other clinical parameters evaluated. A partial root coverage was observed in both the groups (71.97% for the test group and 61.36% for the control group). **Conclusions:** Cyanoacrylate tissue adhesive is clinically effective in the stabilization of the lateral pedicle flap and can be used as an alternative to resorbable sutures.

**Keywords:** Cyanoacrylate, gingival recession, lateral pedicle flap, mucogingival surgery, tissue adhesive

## Introduction

Gingival recession can be defined as the exposure of root surface by an apical shift in the position of the gingival margin. A denuded root is more vulnerable to root caries, tooth hypersensitivity, and poses esthetic problems.<sup>[1]</sup> The following risk factors play a role in the etiology of gingival recession: tooth shape and malposition, improper oral hygiene methods, path of eruption, iatrogenic restorative treatment, muscle and frenal attachment, periodontal disease and treatment, dehiscence, other self-inflicted injuries (e.g., oral piercing).<sup>[2]</sup> The objective of the treatment of gingival recession is to prevent the disease process and to cover the exposed root surface.

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The mucogingival surgical procedures to improve clinical parameters such as recession depth, width of keratinized gingiva, and clinical attachment level without any residual periodontal pocket can be broadly divided into three main groups: pedicle flaps, free soft-tissue grafts, and regenerative techniques. In patients with esthetic request where there is adequate keratinized tissue lateral to the defect, pedicle flap procedure such as lateral pedicle flap is recommended. Lateral sliding flap as first described by Grupe and Warren reported elevating a full-thickness flap one tooth away from the defect and rotating it to cover the denuded root.<sup>[3]</sup>

Alkyl-2 cyanoacrylates, as an adhesive material, has a wide range of applications,

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and the more recent studies have focused on nontoxic homologs such as the butyl form of cyanoacrylates.<sup>[4]</sup> N-butyl-2-cyanoacrylate tissue adhesive has been reported to offer advantages such as effective and immediate hemostasis, bacteriostatic properties, ease of application, and rapid adhesion to hard and soft tissues.<sup>[5]</sup>

The very important factor that influences the success of the clinical outcome of lateral pedicle flap is the proper stabilization of the flap by which a healthy dentogingival unit is re-established.<sup>[6]</sup> Thus, the stability of the lateral pedicle flap is critical for accomplishing root coverage. The objective of the study is to clinically evaluate the lateral pedicle flap stabilized using either of the two different stabilization methods, cyanoacrylate tissue adhesive, or resorbable sutures.

## Materials and Methods

The study population consisted of 22 patients (16 males and 6 females) of age ranging from 20 to 45 years recruited from the outpatient clinics of the department of Periodontics, Best dental science college and hospital. The study sample size was determined to ensure an alpha error of 0.05% and 80% power. Inclusion criteria were Miller's class I and class II gingival recession with deep narrow defect ( $\geq 3$  mm) in relation to the anterior tooth that has adequate donor tissue laterally and adequate vestibular depth and vital teeth with no history of active periodontal treatment (surgical and nonsurgical) for the past 6 months. Exclusion criteria were the presence of cervical abrasion, erosion, or root caries that would require restoration, pregnant and lactating women, medically compromised patients, taking any medications known to affect the outcomes of periodontal therapy, and using any form of tobacco.

## Study groups

All the patients were subjected to Phase I therapy. Trauma from occlusion if detected was eliminated. At the end, only those patients demonstrating the acceptable oral hygiene standards and gingival health were considered for the study. Finally, a total of 22 participants were randomly allocated into two groups (11 patients in each group) by generating the random number using Statistical Package for the Social Sciences (SPSS) software version 20. In the test group, the lateral pedicle flap was stabilized with cyanoacrylate tissue adhesive and in the control group, the lateral pedicle flap was stabilized with resorbable sutures. All the participants in the study were verbally informed about the treatment design, nature, risks, and benefits of the study, and a written informed consent was obtained. All surgical interventions were performed by the same clinician.

## Clinical parameters

Plaque index<sup>[7]</sup> (PI), gingival index<sup>[8]</sup> (GI), probing pocket depth<sup>[9]</sup> (PPD), clinical attachment level<sup>[9]</sup> (CAL),

recession depth<sup>[9]</sup> (RD), recession width<sup>[9]</sup> (RW), thickness of keratinized gingiva<sup>[10]</sup> (TKG), and height of keratinized gingiva<sup>[9]</sup> (HKG) were recorded at baseline, 1<sup>st</sup> month, and 3<sup>rd</sup> month follow-ups. The percentage of root coverage (%)<sup>[11]</sup> was evaluated at the end of 3 months postoperatively. The measurements were recorded to the nearest millimeter using the University of North Carolina # 15 (UNC-15, Hu-Friedy, Chicago, IL, USA) periodontal probe. PPD was measured at the mid-buccal aspect of the study tooth from the gingival margin to the bottom of the gingival sulcus. CAL was measured at the mid-buccal aspect of the study tooth from the cemento-enamel junction (CEJ) to the bottom of the gingival sulcus. RD was measured at the mid-buccal aspect of the study tooth from the CEJ to the most apical extension of the gingival margin. RW was measured at the CEJ level. TKG was measured 3 mm beneath the gingival margin by piercing the gingival or mucosal surface using the #15 endodontic reamer at 90° angle until hard tissue was reached. Then, the silicone stop on the reamer was slid till it contacts the gingival or mucosal surface. The reamer was removed and the distance between its tip and the inner border of the silicon stop was measured. A digital Vernier caliper was used to measure to the nearest 0.1 mm.

## Recipient site preparation

The surgical area was prepared and adequately anesthetized using 2% lignocaine HCl containing 1:80,000 epinephrine by giving infiltration anesthesia. With a no 15 scalpel blade, V-shaped incision was made about the denuded root to remove the adjacent epithelium and connective tissue. In the case of deep labial pockets and associated frenula, the apex of the V-shaped incision was extended far and wide apically enough to remove them. Furthermore, the V-shaped incision was beveled out on the opposite side to permit overlap and to increase vascularity for the donor site in this area. All these remnants were removed from the area and root planing was done.<sup>[12]</sup> Cotton pellets soaked in tetracycline solution (250 mg/ml) were burnished to the root surface with a light pressure every 30 s for 5 min. The root surface was then rinsed with normal saline solution (NS).<sup>[13]</sup>

## Preparation of the pedicle flap

The pedicle flap was made sure that it was twice as wide as the defect. A full-thickness flap was reflected to the mucogingival junction after which a partial thickness flap was raised. The flap should be free on its underlying side to permit movement to the recipient site without tension. It is sometimes necessary to make a short oblique incision (cutback incision) at the base of the flap to avoid tension that may impair the vascular circulation. The flap was then moved laterally to cover the exposed root, leaving the donor site exposed. Digital pressure was applied with wet gauze to minimize blood clot and to encourage fibrinous adhesion.<sup>[14]</sup>

### Stabilization of the flap

The pedicle flap was then carefully secured with either 5-0 resorbable sutures (control) or n-butyl-2-cyanoacrylate tissue adhesive (test) without tension [Figure 1]. Good adaptation of the flap to the underlying tissues is extremely important for adequate diffusion. Periodontal dressing (Coe Pack Standard, GC America Inc., Alsip, IL, USA) was given thereafter and left in place for 1 week.<sup>[14]</sup>

### Postoperative treatment

The patient was discharged with postoperative instructions and nonsteroidal anti-inflammatory drugs as medications for 3 days to avoid postoperative pain and to reduce inflammation.<sup>[15]</sup> As the surgical site was covered with periodontal dressing, exposure of the surgical site to irritating factors that can cause severe pain and inflammation was prevented. The patient was instructed to avoid toothbrushing in the surgical area. The patient was recalled after 7 days. The periodontal dressing was removed and thoroughly irrigated with NS. The surgical site was examined for uneventful healing. The defect which was created at the donor site healed by secondary intention. The patient was instructed to use a soft toothbrush for mechanical plaque control in the surgical area. Oral hygiene instructions were re-instructed.<sup>[15]</sup>

### Statistical analysis

Data were entered in Microsoft Excel spreadsheet and analyzed using SPSS software (IBM SPSS Statistics, Version 20.0, IBM Corp, Armonk, NY, USA).

- Descriptive statistics – Mean and standard deviation, minimum, and maximum were calculated for all the selected variables separately for the test group and the control group [Table 1]
- Intergroup comparisons for the PI and the GI were made by Mann–Whitney test by analyzing the difference between two groups at various time points [Table 2]

- Intergroup comparisons for the CAL, RD, RW, TKG, and HKG were made by Mann–Whitney test by analyzing the difference of two time periods [Table 3]
- Intragroup comparison of the clinical parameters was made by Kruskal–Wallis test. Mann–Whitney test was used to compare the difference between various time periods within the group for all the selected variables [Table 4].

Data were analyzed using SPSS Software version 20. Differences between the two populations were considered significant when  $P < 0.05$ .

### Results

All measurements were performed by a single calibrated examiner. The mean plaque index and gingival index at the 1<sup>st</sup> and 3<sup>rd</sup> month were found to be statistically significant between the test and the control groups ( $P < 0.05$ ) and did not present any influence over other clinical parameters evaluated [Table 2]. PI and GI were shown to be reduced in the test group than the control group. CAL, RD, RW, TKG, and HKG were statistically similar between both the test and the control groups [Table 2]. Intragroup assessments of CAL, RD, RW, TKG, and HKG values revealed significant differences from baseline to 1<sup>st</sup> month and also between baseline and 3<sup>rd</sup> month [Table 3]. Among all the variables, PPD remained unchanged at all periods of observations. A partial root coverage was observed in both the groups (71.97% for the test group and 61.36% for the control group) at the end of 3 months postoperatively. No postoperative complications were noted in any patient.

### Discussion

The present study was to evaluate the clinical outcomes of lateral pedicle flap stabilized with cyanoacrylate tissue adhesive and resorbable sutures. Twenty-two patients with Miller’s Class I and II recession were randomly

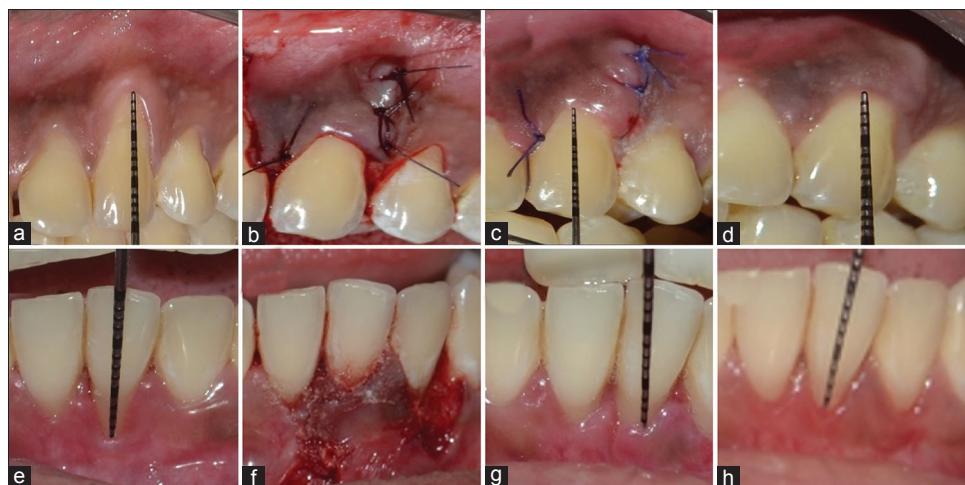


Figure 1: (a) Preoperative view of the control group; (b) Lateral pedicle flap secured with 5-0 resorbable sutures in the control group site (c) 1-month postoperative view of control group (d) 3 months postoperative view of control group (e) Preoperative view of the test group (f) lateral pedicle flap stabilized with cyanoacrylate tissue adhesive in the test group site (g) 1-month postoperative view of test group (h) 3 months postoperative view of the test group



**Table 1: Descriptive statistics with mean and standard deviation of the variables of both the test and the control groups**

	Mean±SD	
	Test	Control
PI		
Baseline	0.269±0.252	0.552±0.441
1 <sup>st</sup> month	0.375±0.219	0.761±0.234
3 <sup>rd</sup> month	0.463±0.347	0.916±0.255
GI		
Baseline	0.276±0.351	0.604±0.402
1 <sup>st</sup> month	0.339±0.139	0.697±0.251
3 <sup>rd</sup> month	0.372±0.214	0.772±0.276
CAL		
Baseline	3.91±1.044	5.27±1.794
1 <sup>st</sup> month	2.18±0.751	2.64±1.502
3 <sup>rd</sup> month	1.91±0.701	2.55±1.128
RD		
Baseline	3.18±0.405	4.18±1.834
1 <sup>st</sup> month	0.82±0.874	1.27±1.489
3 <sup>rd</sup> month	0.91±0.701	1.55±1.128
RW		
Baseline	2.73±0.647	3.09±0.539
1 <sup>st</sup> month	1.45±1.293	1.55±1.508
3 <sup>rd</sup> month	1.64±1.120	2.27±1.191
TKG		
Baseline	0.332±0.22	0.514±0.477
1 <sup>st</sup> month	0.662±0.378	1.063±0.559
3 <sup>rd</sup> month	0.607±0.34	0.936±0.522
HKG		
Baseline	2.00±0.894	1.64±0.924
1 <sup>st</sup> month	4.09±0.539	4.55±1.440
3 <sup>rd</sup> month	4.00±0.632	4.18±1.537

PI: Plaque index; GI: Gingival index; CAL: Clinical attachment level; RD: Recession depth; RW: Recession width; TKG: Thickness of keratinized gingiva; HKG: Height of keratinized gingiva; SD: Standard deviation

divided into two groups and lateral pedicle flap was done according to Grupe and Warren.<sup>[3]</sup> The stabilization of the lateral pedicle flap is often critical because of the tension at the base of the pedicle flap.<sup>[15]</sup> Lateral pedicle flap is a predictable procedure for isolated gingival recession. It has many advantages such as better esthetics, presence of only single surgical site, and better vascularity of the pedicle. The tension of the lateral pedicle flap is a major concern which may lead to failure of stabilization of the pedicle flap in the displaced position in the recipient site. Thus, in the present study, the clinical outcome of lateral pedicle flap was evaluated when stabilized using either resorbable sutures or cyanoacrylate tissue adhesive. In the test group, the lateral pedicle flap was stabilized by using cyanoacrylate tissue adhesive. In the control group, the lateral pedicle flap was stabilized using resorbable suture material. In the present study, except for plaque and gingival index, all the clinical periodontal parameters taken for assessment were

**Table 2: Comparison of plaque index and gingival index scores between test and control groups at baseline, 1<sup>st</sup> month, and 3<sup>rd</sup> month**

	Mean±SD		P*
	Test	Control	
PI			
Baseline	0.269±0.252	0.552±0.441	0.123
1 <sup>st</sup> month	0.375±0.219	0.761±0.234	0.002*
3 <sup>rd</sup> month	0.463±0.347	0.916±0.255	0.009*
GI			
Baseline	0.276±0.351	0.604±0.402	0.178
1 <sup>st</sup> month	0.339±0.139	0.697±0.251	0.002*
3 <sup>rd</sup> month	0.372±0.214	0.772±0.276	0.002*

Mann-Whitney test (\*statistically significant [ $P < 0.05$ ]). PI: Plaque index; GI: Gingival index; SD: Standard deviation

found to be similar for both the test group (cyanoacrylate tissue adhesive) and control group (resorbable sutures) as evidenced by nonsignificant *P* value.

Patients enrolled in the study maintained fairly good oral hygiene as observed by mean plaque index score at various time periods of observation in both control and test groups. The gingival status also was found to be healthy in control and test groups as revealed by the mean gingival index at various time periods of observation.

The mean values of plaque index and gingival index were statistically significant between the two groups at the 1<sup>st</sup> and the 3<sup>rd</sup> month. Thus, in the present study, the increased plaque index scores in the control group (resorbable sutures) may be related to difficulty in oral hygiene maintenance postsurgery. The suture threads may act as sites of plaque accumulation which is in accordance with Binnie and Forest.<sup>[16]</sup>

Suture material present within the tissue might have provoked inflammatory response, according to Macht and Krizek,<sup>[17]</sup> whereas Levin<sup>[18]</sup> related to suture material being treated as a foreign protein by the body and thus, there may be increased inflammatory response. In the present study, n-butyl-2-cyanoacrylate tissue adhesive has shown no postoperative complications with reduced patient discomfort, thus proving an easy and effective way of wound closure compared to sutures.

Saska *et al.*<sup>[19]</sup> analyzed and compared the compatibility of the adhesives ethyl cyanoacrylate (super bonder) and butyl-cyanoacrylate (Histoacryl) and the healing of incisions in the dorsum of rats with suture and concluded that ethyl cyanoacrylate and butyl-cyanoacrylate aid in healing of incised tissues, without promoting inflammatory reaction. Moreover, adhesives facilitated the approximation of incised margins reducing the surgical time compared to the use of suture. These adhesives promoted lower inflammatory reaction in the subcutaneous layer of rats and caused no tissue necrosis. Therefore, cyanoacrylate adhesives can be used for wound synthesis, lacerations, or cutaneous incisions.

**Table 3: Comparison of clinical attachment level, recession depth, recession width, thickness of keratinized gingiva, and height of keratinized gingiva between test and control groups at baseline, 1<sup>st</sup> month, and 3<sup>rd</sup> month**

	Mean±SD		P*
	Test	Control	
<b>CAL</b>			
Baseline-1 <sup>st</sup> month	1.73±0.905	2.64±1.362	0.077
1 <sup>st</sup> month-3 <sup>rd</sup> month	0.27±0.786	0.09±0.831	0.516
Baseline-3 <sup>rd</sup> month	2.00±0.894	2.73±1.737	0.278
<b>RD</b>			
Baseline-1 <sup>st</sup> month	2.36±0.924	2.91±1.514	0.238
1 <sup>st</sup> month-3 <sup>rd</sup> month	-0.09±0.701	-0.27±0.647	0.534
Baseline-3 <sup>rd</sup> month	2.27±0.647	2.64±1.690	0.560
<b>RW</b>			
Baseline-1 <sup>st</sup> month	1.27±1.489	1.55±1.572	0.684
1 <sup>st</sup> month-3 <sup>rd</sup> month	-0.18±1.250	-0.73±1.104	0.139
Baseline-3 <sup>rd</sup> month	1.09±1.375	0.82±1.471	0.553
<b>TKG</b>			
Baseline-1 <sup>st</sup> month	-0.33±0.234	-0.55±0.453	0.324
1 <sup>st</sup> month-3 <sup>rd</sup> month	0.055±0.063	0.127±0.100	0.070
Baseline-3 <sup>rd</sup> month	-0.276±0.195	-0.422±0.435	0.742
<b>HKG</b>			
Baseline-1 <sup>st</sup> month	-2.09±0.701	-2.91±1.446	0.061
1 <sup>st</sup> month-3 <sup>rd</sup> month	0.09±0.302	0.36±0.505	0.136
Baseline-3 <sup>rd</sup> month	-2.00±0.632	-2.55±1.635	0.196

Mann-Whitney test (\*statistically significant [ $P<0.05$ ]).

CAL: Clinical attachment level; RD: Recession depth;

RW: Recession width; TKG: Thickness of keratinized gingiva;

HKG: Height of keratinized gingiva; SD: Standard deviation

Root conditioning by tetracycline selectively removes the smear layer, inhibits collagenase activity and bone resorption, and also exhibits local antimicrobial effect.<sup>[20]</sup> The regenerative effects of root conditioning with tetracycline were also proved in other studies.<sup>[21]</sup> Thus, in the present study, tetracycline HCl was used for conditioning the root surface in both the study groups for better periodontal wound healing.

In the present study, the changes in depth and width of the gingival recession and clinical attachment level were found to show no difference when comparing the two groups between baseline and 1<sup>st</sup> month, 1<sup>st</sup> and 3<sup>rd</sup> month, and baseline and 3<sup>rd</sup> month. The percentage of root coverage was 71.97% for the test group and 61.36% for the control group which is in accordance with various other studies.<sup>[2,22-24]</sup> These findings reveal that cyanoacrylate tissue adhesive is a simple and reliable alternative material to resorbable sutures. The present study has certain limitations such as small sample size, short follow-up period, lack of histological examination of healing processes of tissues, and patient compliance. N-butyl-2-cyanoacrylate tissue adhesive was safe to use, without causing any immunologic or antigenic reactions in any of the patients studied in the present study. The clinical outcome of the lateral pedicle flap stabilized using cyanoacrylate tissue adhesive was comparable to that of resorbable sutures. Thus, it can be

**Table 4: Intragroup comparisons of clinical parameters at baseline, 1<sup>st</sup> month, and 3<sup>rd</sup> month**

	Test (P)	Control (P)
<b>PI</b>		
Baseline versus 1 <sup>st</sup> month	0.309	0.278
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.693	0.107
Baseline versus 3 <sup>rd</sup> month	0.178	0.039*
<b>GI</b>		
Baseline versus 1 <sup>st</sup> month	0.066	0.533
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.921	0.490
Baseline versus 3 <sup>rd</sup> month	0.071	0.490
<b>CAL</b>		
Baseline versus 1 <sup>st</sup> month	0.001*	0.001*
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.372	0.918
Baseline versus 3 <sup>rd</sup> month	0.001*	0.000*
<b>RD</b>		
Baseline versus 1 <sup>st</sup> month	0.000*	0.001*
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.725	0.476
Baseline versus 3 <sup>rd</sup> month	0.000*	0.000*
<b>RW</b>		
Baseline versus 1 <sup>st</sup> month	0.020*	0.009*
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.807	0.272
Baseline versus 3 <sup>rd</sup> month	0.014*	0.051
<b>TKG</b>		
Baseline versus 1 <sup>st</sup> month	0.007*	0.018*
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.511	0.340
Baseline versus 3 <sup>rd</sup> month	0.010*	0.049*
<b>HKG</b>		
Baseline versus 1 <sup>st</sup> month	0.000*	0.001*
1 <sup>st</sup> month versus 3 <sup>rd</sup> month	0.719	0.450
Baseline versus 3 <sup>rd</sup> month	0.000*	0.001*

Mann-Whitney test (\*statistically significant [ $P<0.05$ ]). PI: Plaque

index; GI: Gingival index; CAL: Clinical attachment level;

RD: Recession depth; RW: Recession width; TKG: Thickness of

keratinized gingiva; HKG: Height of keratinized gingiva

used in the stabilization of pedicle flaps as an alternative to resorbable sutures.

## Conclusions

Within the limits of the study, it can be concluded that cyanoacrylate tissue adhesive is clinically effective in the stabilization of the lateral pedicle flap and can be used as an alternative to resorbable sutures. N-butyl-2-cyanoacrylate tissue adhesive was safe to use, without causing any immunologic or antigenic reactions in any of the patients. However, further clinical trials including long-term period of assessment and the use of microsurgical techniques might also be considered to improve the outcome of the study.

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## Conflicts of interest

There are no conflicts of interest.

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