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Original Research Article

Comparative Study between Use of Sutures Versus Cyanoacrylate Tissue Adhesive for Split Thickness Skin Graft Fixation

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Abstract

Introduction: Split-thickness grafts, in which the epidermis and a part of the dermis are virtually taken, are one of two forms of skin transplants. The second type of graft involves harvesting the complete dermis and epidermis for full-thickness grafts. Cyanoacrylate (CA) adhesive usage has grown significantly in recent years. In the presence of moisture, liquids called CAs polymerase create adhesives. Split skin graft fixation has been accomplished using a variety of methods and supplies. Each has advantages and disadvantages. An investigation compared the efficacy of Cyanoacrylate tissue glue versus sutures for fixing skin grafts.

Aims and Objectives: To compare the outcomes between Sutures Versus Cyanoacrylate Tissue Adhesive in Split Thickness Skin Graft Fixation.

Methods: A sample of 212 patients who were admitted and treated with STSG in the departments of surgery and plastic surgery were separated into two groups, with 105 patients in group A and 107 patients in group B. The envelope approach was used to randomize the patients. Tokens identifying the tokens' groups, i.e. Group-A or Group-B, were placed inside unmarked identical envelopes holding the numbers 1 and 2. The split-thickness skin grafts were harvested in the usual manner with humby's knife or mechanical dermatome and meshed and spread over gauze on a moist wooden board.

Results: It was found that all patients' VAS scores varied between 3 and 5 (moderate discomfort). On the third day, individuals reported mild to moderate pain. Patients in Groups A and B experienced different levels of pain, however, this difference was not thought to be statistically significant ($p>0.05$).

Conclusion: It is to be concluded that cyanoacrylate is a better-emerging option for recipient graft fixation than alternate methods.

Keywords: Dermatome, Cyanoacrylate, Split Thickness Skin Graft Fixation.

Introduction

A medical procedure called skin grafting involves removing skin from one place of the body and transplanting it to another. Following skin injuries such as burns, significant open wounds, and skin infections, the procedure is carried out. Skin grafts, as opposed to skin flaps, are unattached patches of tissue without their blood supply and rely on the wound bed for nutrition [1]. Split-thickness grafts, in which the epidermis and a part of the dermis are virtually taken, are one of two forms of skin transplants [2]. The second type of graft involves harvesting the complete dermis and epidermis for full-thickness grafts.

Sutures, staples, and glues are only a few of the techniques used to stabilize skin grafts [3]. CA adhesive usage has grown significantly in recent years [4]. In the presence of moisture, liquids called CAs polymerase create adhesives [5]. They can be used in a variety of methods, from orthopaedic hardware fixation [6] to incision and laceration repair and stabilizing skin grafts in plastic surgery [5]. Comparatively to the other CAs, CA exhibits reduced tissue inflammation and toxic impact [7]. Previous clinical studies have shown that CA glue is secure, heals wounds quickly compared to suture repair, and has antibacterial qualities, which reduces the risk of infection [7, 8]. Additionally, CA glue enables direct skin graft visibility, enabling early diagnosis of potential problems in place of pressure dressing and bolstering [9]. Tissue glue made of CA is often utilized in a variety of surgical procedures because it is quick and easy to apply. We discuss the application, efficacy, and postoperative results of patients who had skin transplant procedures where CA glue was used to support the graft.

A sophisticated and dynamic biological process known as wound healing starts as soon as the skin is injured. Inflammation, proliferation, and remodelling are its three stages [10]. Understanding it is essential for skin grafting, and it has a big impact on how a surgical surgery turns out in the end. Burns, trauma, surgical excision, and reconstructive surgery for post-burn contracture or congenital abnormality are common causes of skin loss. Today, there are various options for covering wounds caused by skin loss, including collagen sheath dressing, amniotic membrane application, honey application, and skin grafting (such as split skin grafts, full-thickness grafts, and composite grafts). Split Skin Graft (SSG) is still among the most practical and effective treatment options, but [11]. Split skin grafts must be properly fixed to prevent graft mobilization; failing to do so may result in poor graft survival and reduced revascularization [12, 13]. The best coverage for the human body is thought to be the skin. It has a significant immune function in defending the body against viruses because of how it interacts with the environment [14].

Because skin serves so many vital and fundamental roles for the body, losing skin has several negative effects. Therefore, it is essential to address skin loss as soon as possible. There are several ways to replace missing skin, but split skin grafting is one of the most effective and practical solutions (SSG). SSG fails, though, if it is not repaired. If the problem is not resolved, the graft may become mobilized, which could result in unsuccessful revascularization and graft necrosis. For the split skin graft to survive, the donor site must be fixed. Split skin graft fixation has been accomplished using a variety of methods and supplies. Each has advantages and disadvantages. An investigation compared the efficacy of Cyanoacrylate tissue glue versus sutures for fixing skin grafts.

Materials and Methods

Study design

A single-centre, prospective comparative study titled "Comparative Study between Use of Sutures Versus Cyanoacrylate Tissue Adhesive for Split Thickness Skin Graft Fixation" was carried out on patients admitted to the general surgery and plastic surgery departments at Sir Sayajirao General Hospital in Vadodara between March 2020 and August 2021.

A sample of 212 patients, who were admitted and treated with STSG in the departments of surgery and plastic surgery were separated into two groups, with 105 patients in group A and 107 patients in group B.

105 patients were in Group A (Cyanoacrylate glue).

Patients in Group B (sutures): 107

The envelope approach was used to randomize the patients. Tokens identifying the tokens' groups, i.e. Group-A or Group-B, were placed inside unmarked identical envelopes holding the numbers 1 and 2. The researcher was not the one who made the allocations. Before surgery, randomization was conducted. Pain assessment was done using Visual Analogue Score (VAS) score which is assessed on the 24th hour, 3rd day, 5th day and 7th day. VAS of > 5 was significant. The detailed history of all the enrolled patients including associated co-morbidities and past medicinal history was taken. All investigations- hemogram, random blood sugar (RBS), HbA1c, renal function tests, liver function tests, any immunocompromised status- HIV, HBsAg and HCV status, Blood group cross match had been done. In both groups, patients were subdivided into 3 groups according to the size of ulcers of <10cm^2, 11-25cm^2 and 26-36cm^2. Measurements for the ulcer area were taken by putting a piece of gauze over the raw area and measuring the area stained over the gauze piece in cm^2. In all the patients, the following data was collected from local examination of the ulcer and involved limb: size and site of ulcer, ulcer's characteristics- edge, margin, floor, base and its relations with deeper structures, examination of the surrounding area. Examination of lymph nodes, nerve lesions and vascular insufficiency if present were noted. All the patients were treated for ulcers by daily dressing, antibiotics according to culture sensitivity report and frequent blood investigations. Patients with low haemoglobin values (<8mg/dl) were transfused blood products. Once after the formation of healthy granulation tissue with culture sensitivity report of ulcer s/o no organism and haemoglobin report of >=10mg/dl, patients were posted for split-thickness skin grafting. The size of the ulcer was measured before grafting. The split-thickness skin grafts were harvested in the usual manner with humby's knife or mechanical dermatome and meshed and spread over gauze on a moist wooden board.

Inclusion criteria

In the study, split-thickness skin grafting patients above the age of 15 were included. The study covered patients with haemoglobin levels of more than 10 gm% and culture reports indicating no organism.

Exclusion criteria

The following patients were cut off from the investigation

1. A patient who left SSG Hospital before finishing their treatment.
2. A patient under the age of 15.
3. A person suffering from a mental illness.
4. A patient, who is immunosuppressed due to HIV, receiving chemotherapy, has chronic renal failure, and has uncontrolled diabetes.

Statistical analysis

The frequency and percentage forms of qualitative data were used. By using the Chi-Square test, associations between qualitative variables were evaluated. When

comparing quantitative data from the two groups, an unpaired t-test was used if the data passed the "Normality test" and a Mann-Whitney test if it failed. The level of significance was set at a p-value of 0.05 or lower. If it was thought necessary, results were illustrated graphically. For most of the analysis, SPSS Version 21.0 and Microsoft Excel 2010 were utilized, respectively.

Ethical approval

The Institutional Ethics Committee for Human Research (IECHR) of Medical College Baroda gave its approval to the project. All patients provided written, voluntarily informed consent. The patients received thorough explanations of the study's goal and the recommended course of treatment. The envelope approach was used for randomization.

Results

Age and sex distribution are included in this study in tabular form. In this study, there were a total of 16 male patients and 7 female patients in the 16-to-20-year age range. There were 37 male and 9 female patients in the 21 to 30 age range. 31 men and 9 women in the age range of 31 to 40 were male. 35 men and 5 women in the age bracket of 41 to 50 were present. In the age category of 51 to 60, 29 men and 6 women were present. There were 10 girls and 18 guys that were older than 60.

A total of 166 male patients and 46 female patients were enrolled in this study.

In the study, group A had 27 patients with diabetes melitus out of 212 patients, while group B had 31 patients with the condition. Of 212 patients in this study, 105 patients were in Group A and 107 patients were in Group B. Clinically, patients were split into these groups based on the size of the ulcer (cm^2). 28 individuals in group A had ulcers that were smaller than 10 cm^2 in size. There were 65 patients with ulcers that were 11 to 25 cm^2 in size, and 12 patients with ulcers that were 26 to 36 cm^2. Thirty patients in group B had ulcers that were smaller than 10 cm^2 in size. Twenty patients had ulcers measuring 26 to 36 cm^2, and 57 individuals had ulcers measuring 11 to 25 cm^2.

Table 1: Distribution of age, sex, diabetes mellitus (DM), and size of the ulcer.

Age (in Years)	Gender of the Patient		Total
	Male	Female	
16 - 20	16	7	23
21 - 30	37	9	46
31 - 40	31	9	40
41 - 50	35	5	40
51 - 60	29	6	35
> 60	18	10	28
Total	166	46	212
	Group A	Group B	
DM	27	31	58
Non-DM	78	76	154
Total	105	107	212
Ulcer size			
<= 10 cm^2	28	30	58
11 - 25 cm^2	65	57	122
26 - 36 cm^2	12	20	32

In this study, the mean graft absorption in Group A after the first dressing was 96.73%. Mean graft absorption in the second dressing was 95.31%. The mean graft absorption in the third dressing was 94.14%.

In group B, the mean graft uptake in the initial dressing was 96.67%. Mean graft absorption in the second dressing was 95.22%. The mean graft absorption in the third dressing was 94.06%.

It was shown that there was no significant difference in the mean graft uptake between Group A (Cyanoacrylate Glue) and Group B (Suture) (p>0.05).

Regardless of the skin graft fixation method, the average difference in graft absorption between diabetes and non-diabetic patients is statistically insignificant (P value >0.05). Hence, both approaches are equally effective in terms of graft uptake on the first, second, and third dressings in patients with and without diabetes. Nonetheless, it is important to point out that the present study only included patients with managed DM. Both groups were evaluated with respect to the extent of the ulcer and the length of the operation. Patients in group A who had ulcers less than 10 cm^2 in size experienced a mean duration of 35.3 seconds. The mean duration for patients with sizes between 11 and 25 cm^2 was 95.5 sec. The mean duration for patients with areas between 26 and 36 cm^2 was 168.4 seconds.

In comparison to group A, group B's mean graft attachment length is much longer. (p> 0.05). It was discovered that when the ulcer area grew, it took an average longer time to fixate the skin graft. This conclusion holds for both skin graft fixation techniques employed in this investigation.

Table 2: Comparison of graft uptake and meantime of fixation

Graft uptake on first dressing	**Group A**	**Group B**	**Total**
<93%	3	5	8
93-95%	53	47	100
95-97%	35	42	77
>97%	14	13	27
Graft uptake on 2nd dressing			
<93%	10	13	23
93-95%	57	50	107
95-97%	31	39	70
>97%	7	5	12
Graft uptake on 3rd dressing			
<93%	12	17	29
93-95%	75	74	149
95-97%	14	13	27
>97%	4	3	7
Mean graft uptake			p-value
1st dressing	96.73	96.67	0.723
2nd dressing	95.31	95.22	0.668
3rd dressing	94.14	94.06	0.758
Mean graft uptake	**Diabetic**	**Non- diabetic**	
1st dressing	96.74	96.68	0.782
2nd dressing	95.17	95.3	0.572
3rd dressing	94.24	94.05	0.498
Ulcer size (mean duration)	**Group A**	**Group B**	0.001
</= 10 cm^2	35.3 sec	92.5	
11-25 cm^2	95.5 sec	182.9	
26-36 cm^2	168.4 sec	302.1	
Mean	87.80 sec	179.88 sec	0.001

The VAS score was used to calculate the patients' 24-hour perception of pain. Whether the graft was fixed with CA glue or sutures, it was found that all patients' VAS scores varied between 3 and 5 (moderate discomfort). On the third day, individuals reported mild to moderate pain. Patients in Groups A and B experienced different levels of pain, however, this difference was not thought to be statistically significant (p>0.05). About 20% of the patients experienced moderate to severe discomfort by the fifth day of dressing. On the fifth day, there is a significant difference in the VAS score of pain between Group A and Group B (P value 0.05). On the seventh day after dressing, the pain was seen to be significantly more in the mild to moderate range. Nonetheless, it was shown that there was a statistically significant difference in the level of discomfort between patients in Group A and Group B. The length of the patient's hospital stays following surgery (measured as the time between the surgery date and the date of release) varied from 8 days to 24 days. The average length of stay was determined to be 9.10 days in Group A while it was 10.64 days for the patients in Group B. It was determined that the mean difference was statistically significant (P value 0.05).

The study compares post-operative problems using both techniques. Four patients in group A had seroma in their initial dressing. One patient had a seroma in the second dressing. No patient had seroma after the third dressing. Five patients in group B's first dressing had seroma. Three patients had seroma after the second dressing. One patient got seroma in the third dressing.

Just 5% of the patients had seroma development after they received their first dressing. When the third dressing was applied, this steadily decreased to less than 1%. Also, it was discovered that Group A and Group B did not generate seromas in significantly different ways.

Hematoma was discovered in postoperative complications in 7 patients in group A and 12 patients in group B. In this study, a significant portion of patients had no hematoma formation. Just 10% of the participants in this study who had hematoma development were noted.

Table 3: Comparison of post-op pain, duration of hospital stay, post-op complications

VAS score	Group A	Group B	p-value
Comparison at 24 hour			
0-2	0	0	
03-May	105	107	
06-Oct	0	0	
Total	105	107	
Comparison at 3rd day			0.449
0-2	33	28	
03-May	72	79	
06-Oct	0	0	
Total	105	107	
Comparison at 5th day			0.001
0-2	84	1	
03-May	20	67	
06-Oct	1	39	
Total	105	107	
Comparison at 7 day			0.001
0-2	69	35	

03-May	35	70	
06-Oct	1	2	
Total	105	107	
Mean VAS score			
24 hours	3.8	4	
3rd day	3.2	3	
5th day	2.1	5	
7th day	1.6	3	
Mean duration of hospital stay (days)			0.001
08-Oct	88	55	
Nov-13	16	43	
>14	1	9	
Mean	9.1	10.64	
Comparison of seroma formation			
First dressing			
Present	4	5	
Absent	101	102	
2nd dressing			
Present	1	3	
Absent	104	4	
3rd dressing			
Present	0	1	
Absent	105	106	
Hematoma			
Present	7	12	
Absent	98	95	

Discussion

In a retrospective multicenter study, Kattan et al. (2023) investigated and reported on the usage of cyanoacrylate adhesive for stabilizing skin transplants. There were 36 cases altogether. 13.9%, or 5 patients, had diabetes. Preoperative antibiotics were given in all cases. A non-meshed split-thickness skin transplant (n=24, 66.7%) and a meshed split-thickness skin graft (n=12, 33.3%) were the two types of harvested skin grafts used. 32 patients (88.9%) had a 100% transplant uptake outcome. Burns were the most frequent underlying reason for skin grafting, accounting for 47.2% of cases, of which 5 (13.9%) resulted in partial graft loss. A high proportion of skin grafts were harvested with CA, which was comparable to other fixation techniques. To evaluate the cost-effectiveness and long-term results, additional research may be required. According to the findings of the study, CA glue is a reliable and secure alternative for applying skin grafts, particularly over small to moderate-sized wounds. Furthermore, we suggest that it be adopted as the norm. To corroborate these results, however, additional research is required [15].

In their 2018 study, Pithwa et al. compared the fixing of split skin grafts using sutures and cyanoacrylate tissue adhesive. From 15 December 2015 to 31 March 2018, a prospective study was conducted on patients who attended Unit-I of the Department of Surgery in our tertiary medical care facility. 48 patients were included in the trial, and they were split into two groups. N-Butyle-2-Cyanoacrylate ester was employed to repair the split skin graft in Group-I of 25

patients. While 2, 3, and 4 patients in Group II had three prolene sutures to fixate split skin grafts. One examiner handled all of the parameters. According to the study, 19 women and 29 men underwent SSG, which was fixed using either sutures or N-butyl-2-Cyanoacrylate ester. They were between the ages of 3 and 70. The most frequent reason patients received SSG was surgery for post-burn contracture followed by burn. In comparison to Group II, Group I required substantially less time to fixate on the split skin transplant. The two most frequent side effects that were seen in both groups were infection and hematoma/seroma development. However, only 8.6% of individuals in Group I experienced complications, compared to 30.4% of cases in Group II. The grafts take-up rate in Group I was 100% and in Group II it was 91.3%. Age Distribution, Wound Type, Graft Fixation Time, Post-Operative Complications, and Graft Take Up Rate. Our research demonstrated successful SSG fixation and Graft take-up using both techniques. N-Butyle-2-Cyanoacrylate was employed in group I rather than group II to repair the split skin graft, and the outcome was much better in group I [16].

The topmost layer of skin is treated topically using cyanoacrylate adhesives. For the attachment of metal plates, cartilage, and bone, it is also widely utilized. N-Butyle-2-Cyanoacrylate was used in a study [13] to successfully fix full-thickness grafts, with good results [14]. The cyanoacrylate is provided as liquid monomers. It polymerizes to create a solid link between the tissue and the graft that retains the graft in place. There is no need to remove the cyanoacrylate adhesive because it often falls off with epithelialization after 5 to 10 days. Because of the unique combination of chemical and physical qualities found in cyanoacrylate namely, that it cures quickly at room temperature, its application has expanded recently. [17] It binds firmly to a wide range of materials. It may be manually applied to a raw surface with ease and safety.

Conclusion

It is to be concluded that cyanoacrylate is a better-emerging option for recipient graft fixation than alternate methods. The findings of this study were aimed at comparing the use of cyanoacrylate versus sutures for the fixation of split-thickness skin graft showing results are in favour of the use of cyanoacrylate glue for the fixation of skin graft. A significant difference was seen in the duration of graft fixation. The mean duration was less in the cyanoacrylate group compared to the suture group. There was also a comparatively lower side of visual analogue scoring in the cyanoacrylate group than in the suture group, suggesting more patient comfort and ease. Though the difference in graft uptake results of the cyanoacrylate group and the sutures group was not statistically significant, it does encourage the usage of cyanoacrylate for the fixation of skin graft.

Though the difference was not found to be statistically significant, it does influence the patients' satisfaction positively. Skin grafting usually requires a relatively shorter operation, yet skin graft procedures are time-consuming. The present study has revealed that the use of cyanoacrylate significantly reduces the time required for graft fixation. Thus, while considering the time taken in the operating procedure, cyanoacrylate scores better in comparison with sutures.

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