

ORIGINAL ARTICLE

The use of cyanoacrylate glue for skin grafts stabilisation: A retrospective multicenter study

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Abstract

Cyanoacrylate (CA) tissue glue is frequently used in various surgical procedures, and it is simple to use and may save time during procedures. We report the use, effectiveness, and postoperative outcomes of patients who have undergone skin graft surgeries in which CA glue was used to stabilise the graft. A retrospective study of patients who underwent skin graft surgeries where CA was used to stabilise the grafts between January 2018 and August 2021 at different medical institutes in Riyadh, Saudi Arabia. The analysis was performed using the Statistical Package for Social Science, version 23.0 (IBM, Armonk, New York). A total of 36 cases were included. Five patients (13.9%) had diabetes. All cases received antibiotics preoperatively. Two types of harvested skin grafts were used: (a) a non-meshed split-thickness skin graft (n = 24, 66.7%), and (b) a meshed split-thickness skin graft (n = 12, 33.3%). The graft uptake outcome was 100% for 32 patients (88.9%). The most common underlying indication of skin grafting was burn 17 (47.2%), in which 5 (13.9%) developed partial graft loss. The percentage of skin grafts taken using CA was high and comparable to other fixation methods. Further studies may be needed to assess the long-term outcomes and cost-effectiveness.

KEYWORDS

cyanoacrylate, skin graft, tissue glue, wound closure, wound healing

Key Messages

- a total of 36 patients who underwent skin graft surgeries were included to assess the use, effectiveness, and outcomes of skin graft stabilisation with cyanoacrylate (CA) glue
- the CA glue is an effective tool for skin graft stabilisation with promising outcomes

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1 | INTRODUCTION

Skin grafting is a surgical procedure that involves the removal of skin from one area of the body and transplanting it to another area of the body. The surgery is performed following injuries to the skin, such as burns, large open wounds, and skin infections. Unlike skin flaps, skin grafts are free pieces of tissue without their own blood supply and are dependent on the wound bed for their nutrients.¹ There are two types of skin grafts: split-thickness grafts, where the epidermis and a portion of the dermis are essentially harvested.² The second is the full-thickness grafts, where the entire epidermis and dermis are harvested.²

There are multiple methods for skin graft stabilisation, which include sutures, staples, and glues.³ In recent years, the use of cyanoacrylate (CA) glue has become widespread.⁴ CAs are liquids that polymerise in the presence of moisture to form adhesives.⁵ They can be utilised in multiple ways ranging from hardware fixation in orthopaedics⁶ to repairing incisions and lacerations and stabilising skin grafts in plastic surgery.⁵ CA demonstrates less toxic effect and tissue inflammation in comparison to the other CAs.⁷ Previous clinical trials showed that CA glue is safe, wound closure took significantly less time than suture repair, and exhibited antimicrobial properties; hence glued wounds were less likely to develop infections.^{7,8} Furthermore, CA glue allows for direct visualisation of skin grafts, permitting early detection of possible complications instead of pressure dressing and bolstering.⁹

Wound healing is an intricate and dynamic biological process that begins immediately after injury to the skin. It consists of three phases: Inflammation, proliferation, and remodelling.¹⁰ Understanding it is crucial in skin grafting, and it plays a significant role in the final outcome of any surgical procedure. In the current study, we aim to assess the use, effectiveness, and post-operative outcomes of patients who have undergone skin graft surgeries in which CA glue was used to stabilise the graft, highlighting its benefits in different indications and applications among plastic surgery patients.

2 | METHODS

2.1 | Ethics statement

The study was approved by the Institutional Review Board and Research Ethics Committee in Riyadh, Saudi Arabia. Patients' medical records were obtained, and data were gathered.

2.2 | The study design and setting

This retrospective cohort study was conducted at three different medical institutes in Riyadh, Saudi Arabia, on patients of both genders who underwent skin graft stabilisation using CA glue by three surgeons' patients between January 2018 and August 2021. Our inclusion criteria were patients who had undergone surgery in which CA glue was used as the sole means of skin graft stabilisation. A list of patients who met the inclusion criteria was obtained.

2.3 | Data collection sheet

After reviewing the literature on previously conducted studies with similar aims and objectives,^{4,5,9} we created a data collection sheet. The intended data were gathered from the medical records, retrospectively using an excel sheet with 24 variables, the patient's demographics, date of surgery, body mass index (BMI), aetiology of the wound, site of surgery, type of harvested skin graft, site of graft harvesting, defect and graft dimensions, number of wounds, if dermal substitutes were applied, type of dressing applied post-operatively, skin graft outcome (take), complications, and preoperative and postoperative images.

2.4 | Surgical technique

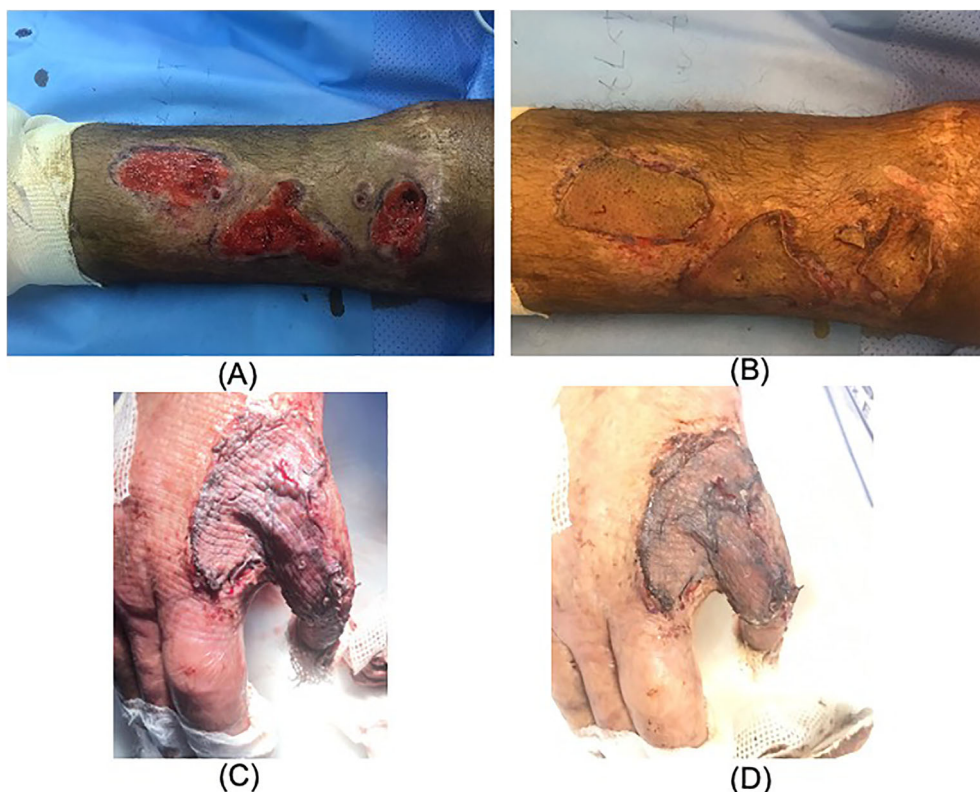
Split-thickness grafts were harvested using a powered dermatome with a thickness ranging from 0.012 to 0.014 in. Two types of skin grafts were used: meshed and unmeshed, depending on the clinical scenario and the judgement of the operating surgeon. After adequate cleaning, debridement, and haemostasis, skin grafts were spread and laid on the wounds. The CA glue was used along the wound's edges to secure the graft. No staples or sutures were used. The dressing was left intact for 5 to 7 days based on the clinical scenario and the clinician's judgement (Figure 1). The graft take was assessed during the first dressing change by measuring the percentage of surface area that did not adhere to the bed compared to the surface area of the graft.

2.5 | Statistical analysis

The data were checked for completeness, and errors were corrected. Categorical variables were presented as frequencies and percentages, and continuous variables were presented as mean and SD. The Chi-square test assessed

FIGURE 1 Images of some of the patients who underwent skin graft surgeries where cyanoacrylate (CA) was used to stabilise the grafts.

(A) Preoperative images of a case of chronic burn wounds over the leg. (B) Seven days postoperative images. (C) Case of dorsal hand contracture released at the time of application of the CA to fix the grafts. (D) Five days postoperative images, first dressing



relationships between the type of skin graft and complication. The relationship between Matriderm application and complication was assessed by the Chi-square test. The Spearman Rank Correlation test established correlations between age, dressing change, and outcome.

3 | RESULTS

A total of 36 cases were included. Only one case was female, and the rest of the cases were male. Comorbidity (diabetes mellitus) was present in 5 (13.9%) cases. All cases received antibiotics preoperatively. Two types of harvested skin grafts were used: non-meshed split-thickness skin graft 24 (66.7%) and meshed split-thickness skin graft 12 (33.3%). The mean size of the graft harvested was $58 \pm 60.6 \text{ cm}^2$ (range between 8 and 270 cm^2). Matriderm was applied in 11 (30.6%) cases. The graft take (survival) outcome was 100% for 32 (88.9%) cases. (Table 1).

The mean age of all cases was 37 years, and the mean time from surgery to the first dressing change was 6 days. (Table 2).

The relationship between harvested skin graft type and complication was not statistically significant; the *P*-value was .302 and .173, respectively. Furthermore, the relationship between dermal substitutes (applied or not-applied) and complication was not statistically significant, *P*-value = .581 (Tables 3 and 4).

There was a mild strength negative correlation between the age of the patient and the first dressing change. Time after operation, correlation coefficient = -0.444 , *P*-value = .038 (Table 5).

4 | DISCUSSION

The use of tissue adhesives with skin grafts is advantageous for many reasons, including saving time during skin graft surgery and decreasing the postoperative pain of staple removal when used. Numerous published studies have shown the effectiveness of CAs in wound closure and healing in various human and animal models, which is in line with our study. Thus, this study highlights the postoperative outcomes of patients who have undergone surgery in which CA glue was used. In a 2013 study on the use of CA glue fixation of split thickness skin grafts on 15 patients, results showed that the graft take was 100% in all patients with no complications.¹¹ Similarly, our study showed the graft uptake outcome was 100% for 32 (88.9%) cases, and 11.1% ($n = 4$) of the grafts had 95% to 99% take, and the complication was not statistically significant. Another study comparing the use of CAs and sutures for full thickness skin graft fixation in 21 showed that no wound dehiscence or graft infection was found, and there was no significant difference in the cosmetic outcome of the adhesive fixation compared to the

TABLE 1 Distribution of categorical variables

Variables	Frequency	Percentage
Gender		
Female	1	2.8
Male	35	97.2
Comorbidities		
Yes	5	13.9
No	31	86.1
Body mass index		
<18.5	4	11.1
18.5-24.9	6	16.7
25-29.9	13	36.1
30-34.9	12	33.3
35-39.9	1	2.8
Underlying cause of undergoing reconstruction with skin grafting		
Skin cancer	3	8.3
Burn	17	47.2
Traumatic	10	27.8
Other	6	16.7
If indication for surgery was burn, what was the total body surface area involved		
2%	1	2.8
3%	2	5.6
5%	4	11.1
10%	2	5.6
15%	2	5.6
30%	3	8.3
40%	3	8.3
Site of surgery		
Arm	2	5.6
Ear	1	2.8
Foot	3	8.3
Forearm	7	19.4
Hand	11	30.6
Leg	8	22.2
Penis—shaft	1	2.8
Scalp	1	2.8
Scrotum	2	5.6
Type of harvested skin graft		
Non-meshed split thickness skin graft	24	66.7
Meshed split thickness skin graft	12	33.3
Matriderm was applied		
Yes	11	30.6

TABLE 1 (Continued)

Variables	Frequency	Percentage
No	25	69.4
Type of dressing applied post-operatively		
Simple without cast (Jellonet, Gauze, no cast)	17	47.2
Simple with cast (Jellonet, gauze splint)	18	50.0
Estimate skin graft outcome uptake		
95.00	1	2.8
96.00	1	2.8
98.00	1	2.8
99.00	1	2.8
100.00	32	88.9
Complications		
None	31	86.1
Partial graft loss	5	13.9

TABLE 2 Distribution of continuous variable

Measurements	Age	First dressing change
Mean	32.4444	5.9091
Median	37.0000	6.0000
SD	18.52326	1.26901

TABLE 3 Relationship between type of skin graft and complication

	Non-meshed split thickness skin graft	Meshed split thickness skin graft	Odds ratio	P-value
Complication			3.667	.173
None	22 (91.7)	9 (75.0)		
Partial graft loss	2 (8.3)	3 (25.0)		

sutures.¹² However, we did not assess cosmetic outcomes. A study comparing the postoperative success of CAs and suturing on split thickness skin grafts with a sample size of 50 patients showed that CAs are more convenient because they are more time-efficient and that there is no pain associated with stitch removal.¹³ A 2017 study done on 118 infants undergoing split thickness skin graft fixation, of which 46 were fixed with CAs and 72 were fixed with skin staples, yielded results that showed strong analgesics were not used in the first

TABLE 4 Relationship between Matriderm applied and complications

	Matriderm = Applied	Matriderm = Not applied	Odds ratio	P-value
Complication			1.905	.581
None	10 (90.9)	21 (84.0)		
Partial graft loss	1 (9.1)	4 (15.0)		

TABLE 5 Correlation between age, first dressing change, and outcome

		Age	First dressing change	Outcome
Age	Correlation coefficient	1.000	−0.444*	−0.167
	Sig. (two-tailed)		0.038	0.330
	N	36	22	36
First dressing change	Correlation coefficient	−0.444*	1.000	0.256
	Sig. (two-tailed)	0.038		0.249
	N	22	22	22

postoperative dressing of the CA group, as opposed to 64% of the skin staples group, in which strong analgesic use was necessary.¹⁴ The study also showed that the CA group's average length of hospital stay was shorter than the skin staples group.¹⁴ Our study did not assess time efficiency, use of analgesics, or average length of hospital stay. The use of CA has been indicated in multiple surgical settings due to its unique molecular makeup. It is a strong, biodegradable tissue adhesive that polymerises upon contact with tissues.⁶ One of the many characteristics that have prompted the widespread use of CA is the glue's ability to reduce time spent on surgical procedures and improve graft fixation.⁴ Hence, the extensive use of CA in orthopaedics for hardware fixation and plastic surgery for blood vessel anastomoses, wound closure, and application of skin grafts.⁶ CA skin adhesives are intended for topical application to hold closed, quickly approximated skin edges of minimum-tension wounds from clean surgical incisions and simple, thoroughly cleansed, trauma-induced lacerations. They may be used in conjunction with deep dermal sutures, but not in place of them. The Food and Drug Administration approved CA for skin adhesion in 2007. Limitations and future recommendations This study was limited by a few factors, including the small sample size and the lack of use of a validated scar assessment tool such as the visual analog scale to assess the cosmetic outcomes of the grafts. To date, there is no standard method of assessment for graft take; thus, our graft takes assessment was done based on the surgeon's clinical judgement and expertise. This study can be used as the basis for further research. However, there is an inherent need

for future clinical studies to implement validated scar assessment tools to assess the cosmetic outcome, in addition to longer follow-up periods to assess any unforeseen complications. Furthermore, we believe there is a need for future prospective studies comparing other skin graft stabilisation techniques among patients with large wound defects with a blinded validator that can be used to determine the wound healing potential.

5 | CONCLUSION

Our study can conclude that CA glue is an effective and safe alternative for graft application, especially over small to moderate size wounds that need graft coverage. Further, we propose it would be used as the standard practice. However, further studies are needed to confirm these findings.

ACKNOWLEDGEMENTS

This work was supported by the College of Medicine Research Center, Deanship of Scientific Research, King Saud University Medical City, King Saud University, Riyadh, Saudi Arabia.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy of the patients.

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How to cite this article: Kattan AE, Mortada H, Alkahtani R, Bin Idris R, Gelidan AG, Alhums T. The use of cyanoacrylate glue for skin grafts stabilisation: A retrospective multicenter study. *Int Wound J*. 2023;20(1):79-84. doi:[10.1111/iwj.13840](https://doi.org/10.1111/iwj.13840)