

Original article:

A Comparative Study of Post-Operative Success of Take of Split Skin Graft (SSG) After Application of Isoamyl 2-cyanoacrylate and Conventional Suturing Technique

Jasdeep Singh¹, Amisha Sidhu², Bhupinder Singh³

¹PG Resident, Department of Surgery, SGRDIMSAR, Sri Amritsar, Punjab, India.

²PG Resident, Department of Medicine, SGRDIMSAR, Sri Amritsar, Punjab, India.

³Professor, Department of Surgery, SGRDIMSAR, Sri Amritsar, Punjab, India.

Corresponding Author: Dr. Jasdeep Singh, PG Resident, Department of Surgery, SGRDIMSAR, Sri Amritsar, Punjab, India.

ABSTRACT

Introduction: Some studies have also shown that the therapeutic value of cyanoacrylates in suppressing selective pathogens isolated from corneal infections. Giving thought to all these things and in quest for trying new methods of graft fixation which are more ideal or towards more ideal it was decided to take up this study.

Materials and Methods: The present study was conducted among 50 patients with skin loss and requiring skin grafting. Group A comprised of cases where Split Skin Graft fixation was done using Isoamyl-2-cyanoacrylate, marketed in India by the trade name of NOVOCRYL. Group B comprised of cases where conventional percutaneous interrupted sutures were applied with silk 3-0 cutting body needle (CBN) suture for graft fixation. After 1 and 2 weeks, serous collection or discharge, percentage of Graft take and cosmetic appearance of graft were evaluated. Various observations noted in the patients after placement of graft with isoamyl 2-cyanoacrylate and with silk 3-0 on needle were recorded in the performa and a comparative study was done.

Results: Post-operative pus formation was more in cyanoacrylate group, 1 case as compared to none in percutaneous suture group, but this difference of 1 case was not statistically significant. 3 cases (12%) had hematoma in group A and 2 cases (8%) had haematoma group B. 3 (12%) patients in cyanoacrylate group showed serous collection/discharge as compared to 2(8%) in percutaneous suture group after 1 week of operation. The number of the patients having the complication was in 1(4%) case in group A and none in group B after 2 weeks.

Conclusion: Isoamyl-2-cyanoacrylate is effective material for SSG fixation. There is no need to remove the stitches, as there are no stitches, so the patient is saved of extra burden of coming again for stitch removal and is also saved of pain associated with stitch removal. Application of tissue adhesive material (Isoamyl-2-cyanoacrylate) is convenient, well tolerated. Post-operative complications like erythema, induration, tenderness, serous collection/discharge, stitch sinus, are comparable as compared to percutaneous sutures.

Keywords: Isoamyl 2-cyanoacrylate; Novocryl; Split Skin Graft.

INTRODUCTION

Split thickness skin grafts were first introduced in 1872 by Ollier in France, and later by Thiersch in Germany in 1874. Brown in England developed the electric dermatome in 1944, to harvest thin homogenous grafts.¹

In 1947, Haxthausen transplanted thin split thickness skin grafts from normal to vitiliginous skin in three cases, to study the pathogenesis of the disease.^{2,3} Skin grafts can be classified as split thickness graft for full epidermis and part of dermis, full thickness graft for epidermis and all the layers of dermis, the donor site is either sutured directly or split-thickness skin grafted and composite graft for small grafts containing skin and underlying cartilage or other tissue, donor sites include, for example, ear skin and cartilage to reconstruct nasal alar rim defects.^{4,5}

For Split Thickness graft (SSG), the donor site re-epithelizes spontaneously, due to this healing ability of donor site, SSG are especially valuable to close larger wounds. By examining the skin graft before the 4th postoperative day, a hematoma or seroma can be evacuated, and the mechanical obstruction to revascularization is thus removed.⁴

Some workers have also shown the therapeutic value of cyanoacrylates in suppressing selective pathogens isolated from corneal infections.⁶ Adoni and Anteby used cyanoacrylates in the repair of various episiotomy wounds and found markedly decreased post operative pain as compared to the suture group. The need for the removal of stitches after healing was also obviated.⁷ Zaki I, Scerri and Millard L evaluated the effectiveness of butyl 2-cyanoacrylate tissue adhesive in split-thickness skin grafts in 19 patients with severely damaged skin. They found that split skin grafts were healed successfully in all patients with complete absorption within 6 months without foreign body reaction.⁸ Giving thought to all these things and in quest for trying new methods of graft fixation which are more ideal or towards more ideal it was decided to take up this study.

MATERIALS AND METHODS

The present prospective study was conducted among 50 patients admitted for skin grafting due to skin loss in the Surgery department of Sri Guru Ramdas Hospital attached to Sri Guru Ramdas Institute of Medical Science and Research, Vallah, Sri Amritsar, Punjab (India). Group A and Group B consisted of 25 cases in each group.

Group A comprised of cases where Split Skin Graft fixation was done using Isoamyl-2-cyanoacrylate, marketed in India by the trade name of NOVOCRYL. Group B comprised of cases where conventional percutaneous interrupted sutures were applied with silk 3-0 cutting body needle (CBN) suture for graft fixation. Inclusion criteria was inpatients with ulcer area equal to or $>20\text{cm}^2$. Exclusion criteria was patients with infected wounds, diabetes and immunocompromised or patients suffering from any disease influencing wound healing viz. skin diseases. All the patients had to undergo routine tests before surgery. Isoamyl-2-cyanoacrylate (NOVOCRYL) is a derivative of acrylic acid and is used in closure of external incisions or post-traumatic wounds without the help of external sutures. This material is being considered a major innovation in aid of surgical procedures. The product is liquid in monomer form but polymerises instantly on application to wound edges and forms a thin but strong film that holds the wound edges together. This material is said to have a haemostatic effect by virtue of its quick polymerisation. It is also said to have bacteriostatic properties. On the other hand silk 3-0 is a well-known polyfilament braided non- absorbable suture material. Ulcer preparation was done by following standard surgical practice before application of split skin graft. SSG was dried with dry and sterile gauge to assure direct tissue contact.

In group A, patients undergoing elective procedures were included and split skin graft fixation was done using

Isoamyl-2-cyanoacrylate (Novocryl). One ampoule containing 0.25 ml of Novocryl was used for ulcer area upto 50cm². Area greater than 50 cm² was closed with ampoules containing 0.5ml Novocryl. Prior to applying the tissue adhesives, the area was dried as far as possible. In group B, 25 patients undergoing elective procedures were included and split skin graft fixation was done using conventional interrupted silk 3-0 CBN suture. For both groups proper care was given to obliterate dead spaces and achieve haemostasis, so as to have a dry ulcer when the adhesive was applied. Patients were given routine antibiotics post operatively along with analgesics and anti-inflammatory drugs. The operated site was examined for evaluation of fixation of graft and was evaluated after the 48 hours for the take of graft, haematoma and pus formation. Sutures were removed after 6 days in the control groups.

After 1 week following points were seen:

1. Serous collection or discharge.
2. Percentage of Graft take.
3. Cosmetic appearance of graft.

After 2 week following points were seen:

1. Serous collection or discharge.
2. Percentage of Graft take.
3. Cosmetic appearance of graft.

Various observations noted in the patients after placement of graft with isoamyl 2-cyanoacrylate and with silk 3-0 on needle were recorded in the performa and a comparative study was done.

RESULTS

Hematoma at 48 hours was seen in 3 patients in Group A and in 2 patients in Group B (table 1). Hematoma is expected in the 48 hours after debridement of ulcer bed during surgery, but meticulous attempt was made to achieve haemostasis. Difference was not statistically significantly in group A as compared to group B. Evacuation of haematoma was done by giving a small incision on graft at the site of haematoma. Pus was seen in 1 case in group A and in none in group B. Cyanoacrylates have been shown to have bacteriostatic properties, whereas silk sutures can have bacteria lodged in interstices at time of application but in the study group 1 patient had pus, but in the control group there was no pus. Adequate antibiotic coverage was started to control any infection if present as shown from Table 1. Difference between group A and group B was not statistically significant. This can be attributed to good aseptic preparation and patient selection based on no growth on pus culture sensitivity. Table 2 shows serous collection at 1 and 2 weeks. In group A, 3 cases and 2 cases in group B showed serous collection at 1 week. As much as possible the serous discharge was expressed from the operated site and the site was cleaned and redressed. As shown from table 2 difference between group A and group B was not statistically significant with p value > 0.05. Serous collection was seen in 1 case in group A and none in group B after 2 weeks. Table 3 shows duration of graft closure. Mean time in Group A was 6.84±2.09min and in group B it was 9.45± 3.00 min and the p < 0.001. It is clearly apparent from the p value that the cyanoacrylates saved some time as compared to silk sutures in application of graft but clinically overall difference did not have much bearing on the time spent in the operation. Take of graft was evaluated as percentage graft fixation of total ulcer area. Evaluation was done at 48 hours, 1 week and 2 weeks (table 4). Table 4 shows take of graft (%) at various intervals. Mean percentage of graft take in Group A was 99.40

± 1.65 and in group B it was 99.20 ± 1.87 and $p > 0.05$ at 48 hours. It is clearly apparent from the p value that the cyanoacrylates are comparable as compared to silk sutures for graft fixation. Mean percentage of graft take in Group A was 96.60 ± 5.35 and in group B it was 96.60 ± 3.74 , $p > .05$ at 1 week. It is clearly apparent from the p value that the cyanoacrylates are comparable as compared to silk sutures for graft fixation. Mean percentage of graft take in Group A was 96.20 ± 5.64 and in group B it was 95.60 ± 5.46 , with $p > .05$ at 2 week. Take of graft is statistically not significant in group A compared to group B. No total loss of graft was seen in either group.

DISCUSSION

In all cases conventional percutaneous interrupted suturing took more time (range 5-26 min, mean 9.45 ± 3.00 minutes) as compared to application of tissue adhesive (range 4-14 min, mean 6.84 ± 2.09 minutes) therefore Novocryl saved much of the operation theatre time as compared to conventional skin suturing.

Tamez OA et al concluded that the average time to apply the 2-OCA (2-octylcyanoacrylate) onto a graft was 3 seconds, compared with 8 minutes for Suture and Bolster (S&B) application. 2-OCA provides a quick and reliable means of securing meshed STSGs and would be especially useful in areas where it is difficult to use S&B, such as total maxillectomy defects.⁹

Various workers have also shown that cyanoacrylates took lesser time for skin closure as compared to sutures (table 5).

In a study by David P. Watson reported that the average time required for the closure of skin by adhesive was 5 minutes as compared to 15 minutes by percutaneous sutures. It must be noted that the average time in this study also included the time required to apply sub-cutaneous sutures.¹⁰ Gorozpe CJ et al reported average time for skin closure in the adhesive group to be 14.5 seconds in wounds with a length of 2-6 cms and the average time for the placement of sutures was 3.9 minutes in wounds with a length of 1-4 cm.¹¹ According to Maw JL et al the adhesive provided a faster skin closure than the sub-cuticular sutures for the closure of head and neck incisions. The mean time for skin closure with an adhesive was 29.7 seconds v/s 289.0 seconds required by the sutures ($p < 0.001$).¹² Toriumi et al reported that the time required to close the epidermis with suture (mean 3 minutes and 47 seconds) was about 4 times that of cyanoacrylate (mean 55 seconds).¹³

Post-operative pus formation was more in cyanoacrylate group, 1 case as compared to none in percutaneous suture group, but this difference of 1 case was not statistically significant. Silvestri A et al in his study (Octyl-2-cyanoacrylate adhesive for skin closure and prevention of infection in plastic surgery) evaluated the effectiveness of applying tissue adhesive on surgical wounds in plastic surgery as a protection capable of reducing the onset of infection, and verified the existence of a statistically significant difference between treated and untreated wounds, and determined patients' satisfaction with their cicatricial result.¹⁴ Chambers A et al in 2010 concluded that applying cyanoacrylate glue to a sternal wound had superior outcomes in terms of infection rates, both if applied preoperatively (decreasing from 10.8% to 2.7% or 7.8% to 1.1%, according to two studies) and postoperatively (4.9%-2.1%). This trend was true of both deep surgical site infections (0.6%-0%) and superficial site infections (4.3%-2.1%).¹⁵

In this study, patient selection based on no growth on Pus C/S, proper aseptic precautions, adequate aseptic technique, all contributed to non significant results. 3 cases (12%) had hematoma in group A and 2 cases (8%) had

haematoma group B. This denotes that difference was not statistically significant between silk sutures compared to non-suture closure using cyanoacrylate.

Lumbsden AB et al concluded that immediate hemostasis was achieved in 54.5% of patients receiving cyanoacrylate surgical sealant and in 10% of those receiving the control. The proportion of patients requiring additional adjunctive measures was lower with cyanoacrylate surgical sealant. This study demonstrates that cyanoacrylate surgical sealant is effective at reducing the time to hemostasis.¹⁶ Meticulous attempt was done to achieve haemostasis at ulcer bed. Haematoma was evacuated by giving incision on the graft at the site of haematoma.

As evident from table 2, 3 (12%) patients in cyanoacrylate group showed serous collection/discharge as compared to 2(8%) in percutaneous suture group after 1 week of operation. The number of the patients having the complication was in 1(4%) case in group A and none in group B after 2 weeks.

The serous collection was perhaps due to imperfect haemostasis at the time of closure of the wound. Tissue oedema and ischaemia of the wound edges encountered in suturing technique in interrupted suturing technique leads to serous collection. Comparative incidence of serous collection in studies carried out by other workers is shown in table 6.

In the present study incidence of serous collection was less in group B but the difference was not statistically significant. The reason may be that more meticulous haemostasis was tried in group B. Pitcher D, Quinn et al concluded that incidence of serous collection was less in the non-suture group than in the interrupted suture group.^{17,18} Simon et al in 1997 concluded an equal incidence of serous collection in both the groups.¹⁹

Take of SSG as %age area of ulcer was assessed on 48 hours, 1 week and 2 week. No complete loss of graft was seen in any group. Mean percentage of graft take in Group A was 99.40 ± 1.65 and in group B it was 99.20 ± 1.87 and $p > 0.05$ at 48 hours. Mean percentage of graft take in Group A was 96.60 ± 5.35 and in group B it was 96.60 ± 3.74 , $p > .05$ at 1 week. Mean percentage of graft take in Group A was 96.20 ± 5.64 and in group B it was 95.60 ± 5.46 , with $p > .05$ at 2 week. Deenadayal DS et al studied cyanoacrylate use in myringoplasty, and obtained graft uptake rates of 99% compared with most studies, which report 80% to 90%. This also allows removal of the pack by the seventh day, allowing close follow-up of the graft and less patient discomfort. 552 patients were included in study and were divided into 4 groups based on perforation size.²⁰

We measured only percentage of acceptance of grafts to determine the usefulness of Cyanoacrylate glue to apply skin grafts to granulating wounds and compared this with silk 3-0 CBN sutures.

The inherent elastic property of tissue grafts might pose some difficulty in easy handling and possibly in its immobilization. Immobilization is very important intake of graft. Results in the study show no statistically significant difference as cyanoacrylates and silk sutures achieve adequate immobilization of graft.

CONCLUSION

Isoamyl-2-cyanoacrylate is effective material for SSG fixation. There is no need to remove the stitches, as there are no stitches, so the patient is saved of extra burden of coming again for stitch removal and is also saved of pain associated with stitch removal. Application of tissue adhesive material (Isoamyl-2-cyanoacrylate) is convenient, well tolerated. Time required for the application of tissue adhesive is little less as compared to percutaneous sutures. Post-operative complications like erythema, induration, tenderness, serous collection/discharge, stitch sinus, are

comparable as compared to percutaneous sutures. There is no incidence of tearing of thin SSG as compared to suturing while fixation of graft.

REFERENCES

1. Khunger N, Kathuria SD, Ramesh V. Tissue grafts in vitiligo surgery - past, present, and future. *Indian J Dermatol.* 2009;54(2):150-8.
2. Falabella R. History and chronology of development of surgical therapies for vitiligo. In: Gupta S, Olsson MS, Kanwar AJ, Ortonne JP, editors. *Surgical management of vitiligo.* USA: Blackwell; 2007.p. 41–8.
3. Savant SS. Surgical therapy of vitiligo: current status. *Indian J Dermatol Venereol Leprol.* 2005 Sept;71(5):307–10.
4. Burns JL, Blackwell SJ. *Plastic Surgery.* In: Townsend CM, Beauchamp RD, Evers BM, Mattox KL, editors. *Sabiston Textbook of Surgery. The biological basis of Modern Surgical Practice.* 18thed. Philadelphia: W.B.Saunders; 2008.p.2134-6.
5. Goodcare T. *Plastic and Reconstructive Surgery.* In: Williams NS, Bulstrode CJK, O’Connell PR, editors. *Bailey and Love’s Short Practice of Surgery* 25th ed. London: Hodder Arnold;2008.p. 395.
6. Richard A, Eiferman, James WS. Antibacterial effect of cyanoacrylate glue. *Arch Ophthalmol.* 1983; 101(6): 958-60.
7. Adoni A, Anteby E. The use of N-Butyl 2-cyanoacrylate for episiotomy repair.*Br J Obstet Gynaecol.* 1991 May; 98(5): 476-8.
8. Zaki I, Scerri L, Millard L. Split skin grafting on severely damaged skin. - a technique using absorbable tissue adhesive. *J Dermatol Surg Oncol.* 1994 Dec; 20(12):827-9.
9. Tamez OA, McGuff HS, Prihoda TJ, Otto RA. Securing meshed split-thickness skin grafts with 2-octylcyanoacrylate.*Otolaryngol Head Neck Surg.*1999 Nov;121(5):562-6.
10. Watson DP: Use of cyanoacrylate for closing facial lateration in children. *BMJ.* 1989 Oct; 299(6706): 1014.
11. Gorozpe CJ, Gonzalez VI, Santoyo HS, Castaneda-Vivar JJ. Closure of skin with cyanoacrylate in surgical wounds after tubal sterilization. *Ginecol Obstet Mex.* 1997 Feb; 65:64-7.
12. Maw JL, Quinn JV, Wells GA. Octyl cyanoacrylate tissue adhesive versus suture wound repair in a contaminated wound model. 1997; 122 (1): 69-72.
13. Toriumi DM, O’Grady K, Desai. Use of octyl 2-cyanoacrylate for skin closure in facial plastic surgery. *Plast Reconstr Surg.* 1998 Nov; 102(6): 2209-19.
14. Silvestri A, Brandi C, Grimaldi L, Nisi G, Brafa A, Calabrò M.Octyl-2-cyanoacrylate adhesive for skin closure and prevention of infection in plastic surgery. *Aesthetic Plast Surg.* 2006 Nov30 (6):695-9.
15. Chambers A, Scarci M.Is skin closure with cyanoacrylate glue effective for the prevention of sternal wound infections? *Interact Cardiovasc Thorac Surg.* 2010 May; 10(5): 793-6.
16. Lumsden AB, Heyman ER. Prospective randomized study evaluating an absorbable cyanoacrylate for use in vascular reconstructions. *J Vasc Surg.* 2006 Nov;44(5): 1002-9.

17. Pitcher D. Sutureless skin closure for pacemaker implantation: comparison with subcuticular sutures. Postgrad Med J. 1983 Feb; 59(688): 83-5.
18. Quinn J, Wells G, Sutcliffe T. A randomized trial comparing octyl tissue adhesive and sutures in the management of lacerations. JAMA. 1997 May; 277 (19): 1527-30.
19. Simon HK, Mclario DJ, Bruns TB. Long term appearance of lacerations repaired using a tissue adhesive. Pediatrics. 1997 Jan; 99(2): 193-5.
20. Deenadayal DS, Neeli AK, Patel SH. Graft Uptake Rates with isoamyl-2-cyanoacrylate in myringoplasty procedures- a 10-Year retrospective study. Otolaryngol Head Neck Surg. 2011 Sep; 145(3):442-5.

Table 1: Showing Hematoma and Pus at 48 Hours

Parameters		Group A	Group B	Total
Hematoma at 48 hours	Present	3(12%)	2(8%)	5
	Absent	22(88%)	23(92%)	45
Pus at 48 hours	Present	1(4%)	0(0%)	1
	Absent	24(96%)	25(100%)	49

df=1;p>0.05;not significant

Table 2: Showing Serous Collection at 1 and 2 Weeks

Parameters		Group A	Group B	Total
Serous collection at 1 week	Present	3(12%)	2(8%)	5
	Absent	22(88%)	23(92%)	45
Serous collection at 2 week	Present	1(4%)	0(0%)	1
	Absent	24(96%)	25(100%)	49

df=1;p>0.05;not significant

Table 3: Showing Duration of Graft Closure

	N	Mean±SD
Group A	25	6.84±2.09 min
Group B	25	9.45± 3.00min

df=48;p<0.001;highly significant

Table 4: Showing Take of Graft (%) At Various Intervals

Parameters		N	Mean±SD
Take of graft(%)at 48 hours	Group A	25	99.40 ±1.65
	Group B	25	99.20± 1.87
Take of graft(%)at 1 week	Group A	25	96.60±5.35
	Group B	25	96.60±3.74
Take of graft(%)at 2 week	Group A	25	96.20 ±5.64
	Group B	25	95.60±5.46

df=48;p>0.05;not significant

Table 5: Various Studies That Have Found That Cyanoacrylates Took Lesser Time for Skin Closure as Compared To Sutures

Sr. No.	Author and year of study	Average time taken	
		Cyanoacrylate	Sutures
1.	David P.Watson ¹⁰ (1989)	5 minutes	15 minutes
2.	Gorozepe CJ et al ¹¹ (1997)	14.5 seconds	3.9 minutes
3.	Maw JL et al ¹² (1997)	29.7 seconds	289.0 seconds
4.	Toriumi DM et al ¹³ (1998)	55 seconds	3 min 47 secs
5.	Present study	6.84 minutes	9.45 minutes

Table 6: Comparative Incidence of Serous Collection In Studies Carried Out By Various Workers

Sr. No.	Name of author and year	Total cases		Incidence of serous collection	
		Group A	Group B	Group A	Group B
1.	Pitcher D ¹⁷ (1983)	25	26	3.5%	10.0%
2.	Quinn et al ¹⁸ (1997)	65	65	0	1.5%
3.	Simon et al ¹⁹ (1997)	30	31	3.3%	3.3%
4.	Present study	25	25	4.0%	18.0%