

Glue versus Staples versus Sutures in Elective Wound Closures: A 3 years Comparative Study

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Abstract

Introduction: Sutures and staples remain the mainstay of wound closure techniques. In the modern era, the use of tissue glue is increasing in clinical practice. Octyl-2-cyanoacrylate, a more stable and reliable compound than its successors, has several advantages such as rapid application, reduced operating time, and less post-operative pain with antimicrobial properties.

Materials and Methods: A 3 year prospective randomized controlled study was conducted on 180 patients comparing tissue glue (octyl-2-cyanoacrylate) with staplers and sutures in primary wound closures following elective groin surgeries in the Department of General Surgery in SRM Medical College and Research Centre from May 2013 to May 2016. 180 patients in good general health undergoing open inguinal hernioplasty were selected for the study.

Results: Out of 180 patients, in any group, no irritation to skin or hypersensitivity reaction was observed. No generalized reaction or toxicity was noted either. The patients were randomly included in either of the three groups and analyzed using Chi-square test, Pearson's correlation test, NPAR, and Kruskal-Wallis test, and the results were formulated.

Conclusion: Tissue glue (octyl-2-cyanoacrylate) application is easier, simple to perform and consumes significantly less time than staples and sutures. Octyl-2-cyanoacrylate gives the best results in terms of less post-operative pain, wound asepsis, and cosmetic results. The concept of tissue glue is a safe, attractive, and effective alternate over other conventional methods of wound closures following elective surgical situations with a trend to decreased incidence of surgical wound infections.

Key words: Octyl-2-cyanoacrylate, Staplers, Sutures, Tissue glue, Wound closures

INTRODUCTION

Open surgical technique both in elective and emergency setting involves some modality of wound closure. Wound closure techniques have evolved from the earliest development of suturing materials to resources that include synthetic absorbable sutures, staples, tapes, and adhesive compounds. Wound closure materials are divided into three major categories: Suture materials, staples, and tissue glue. Suturing has been the most widely used method for wound closure because of the high reliability of suture materials.

However, in the modern era alternative techniques of staples and glue are increasingly used as they are easy to perform, consuming less time and most importantly no additional bandaging/removal required.^{1,2}

The most widely used tissue adhesives nowadays come from homologs of alkyl cyanoacrylates. Initial attempts at cyanoacrylate-based tissue adhesive development have been associated with handling problems and histotoxicity.^{3,4} Octyl-2-cyanoacrylate (Dermabond, Ethicon, Inc.) is a recent cyanoacrylate derivative with eight alkyl constituents of the carboxyl group, which slows down degradation and by product release into the surrounding tissues. In addition, plasticizers have been added which make the adhesive bond stronger, durable, and allows full flexion of the skin.⁵ Its usage as a skin adhesive was first described by Quinn *et al.*⁶ and Toriumi *et al.*⁷ Cyanoacrylates have a number of advantages over conventional sutures such as their fast

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and painless application, rapid setting which reduces the total operating time and their antibacterial properties. Cyanoacrylate itself acts as a waterproof dressing and helps in reduction in the number of follow-up visits. As they do not require any needles, accidental needle stick injuries are prevented. The cyanoacrylate adhesive has suitable features for wound closure such as proper strength, tissue barrier capability, and binding ability in moist environment.⁸ However, there are certain disadvantages of cyanoacrylates such as their less tensile strength and chances of adhesive seepage if edges are not properly approximated. Multiple studies have shown equivalence of octyl cyanoacrylate to 5-0 skin sutures in esthetic facial surgery and repair of traumatic facial wounds.⁹ As the flexibility of octyl cyanoacrylate is better than conventional cyanoacrylate, it can also be used on irregular surfaces.¹⁰ Octyl-2-cyanoacrylate (Dermabond[®]) use has been associated with a reduction in wound infection and it has been thought to act as a physical barrier to bacteria accessing the wound especially the Gram-positive bacteria.¹¹

MATERIALS AND METHODS

A 3 year prospective randomized controlled study was conducted on 180 patients comparing tissue glue (octyl-2-cyanoacrylate) with staplers and sutures in primary wound closures following elective groin surgeries in the Department of General Surgery in SRM Medical College AND Research Centre from May 2013 to May 2016. 180 patients in good general health undergoing open inguinal hernioplasty were selected for the study. Following these surgeries, after subcutaneous approximation patients were randomly selected to three groups, Group A, B, and C. In Group A, incisions were closed with octyl-2-cyanoacrylate using propen. Octyl-2-cyanoacrylate was applied in a thin layer over the entire wound, extending 5-10 mm beyond wound edge using propen as shown in Figure 1. The wound was allowed to dry for 20-30 s and the second layer and third layer was applied. No additional bandaging was done. In Group B, incisions were closed with nonabsorbable skin staples. In Group C, incisions were closed with nonabsorbable nylon subcuticular sutures (ethilon 3-0).

In all 3 groups, once the procedure is finished, the wound was dried and the time of start and finish of skin closure was noted using a stopwatch timer. The time taken for skin closure was noted. The post-operative pain was assessed at 12 h, 24 h, 48 h, and 7th day using visual analog scale of 0-100. 0 being no pain and 100 is worst pain possible as rated by patient themselves. The outcome of wound was assessed at 3rd, 5th, 7th post-operative day (OPD) using the standard wound asepsis scoring system from 0 to 10. The

wound was assessed for cosmesis on the 7th OPD using modified Hollander cosmesis scale of 1-6. A score of 6 was considered as optimal while 5 or less as suboptimal. Any complications/infections, if the present were also observed in both the groups. On the follow-up, 1st and 3rd month, wound cosmesis is assessed by independent blinded observer and wound scoring done using visual analog scale of 0-100.

RESULTS AND DISCUSSION

Out of 180 patients, in any group, no irritation to skin or hypersensitivity reaction was observed. No generalized reaction or toxicity was noted either. The patients were randomly included in either of the three groups and analyzed using Chi-square test, Pearson's correlation test, NPAR, and Kruskal-Wallis test, and the results were formulated.

Time Taken for Skin Closure

Quinn *et al.*, in a series of 130 patients (220 s vs. 744 s; $P < 0.001$) and Matin (150 s vs. 360 s) found cyanoacrylate closures faster to perform than suture closures.¹²⁻¹⁵ Similarly, in this study, in Figure 2, mean time taken for skin closure in tissue glue group was 112.33 s when compared



Figure 1: Adhesive glue application

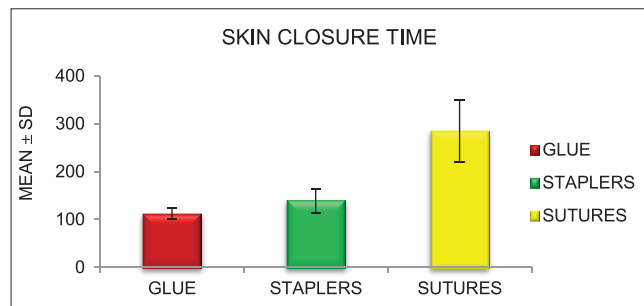


Figure 2: Time taken for skin closure in seconds

to 139.33 s with staples and 284.50 s in the skin suturing group with a significant $P = 0.000^{***}$ proving tissue glue to consume less time for skin closure over staples and sutures. In addition, the incision length and skin closure time were correlated using Pearson's correlation test. In the tissue glue group, there was no correlation between incision length and the time taken for skin closure, Pearson's correlation being 0.062 - insignificant when compared to 0.462* - significant in skin stapler group and 0.751** - highly significant in skin suturing group concluding that there is no correlation with incision length and skin closure time following closures with 2-cyanoacrylate. However, in the skin stapler and skin suturing group, as the incision length increases the time taken for skin closure also increases.

Post-operative Pain

Earlier studies by Zempsky *et al.*, Arunachalam *et al.*, and Quinn *et al.* have compared the post-operative pain using a visual analog scale and shown less post-operative pain following adhesive glue closures but had failed statistical significance.^{12,16,17} In our study, the mean postoperatively pain score as in Table 1, was less in tissue glue group with a highly significant $P = 0.000^{***}$ compared to staplers and sutures at all specified time intervals.

Table 1: Post-operative pain score using VAS at specific time interval in each study group

VAS	Glue		Staplers		Sutures		P value
	Mean	SD	Mean	SD	Mean	SD	
12 h	63.83	10.75	67.50	09.50	78.50	08.19	0.000 ^{***}
24 h	41.67	13.04	43.33	12.17	55.50	09.46	0.000 ^{***}
48 h	22.17	09.58	26.33	12.48	33.67	11.19	0.000 ^{***}
POD-7	06.67	08.77	10.00	09.21	14.17	07.67	0.000 ^{***}

VAS: Visual analog scale, POD: Postoperative day, SD: Standard deviation

Table 2: Post-operative wound asepsis score at specific time interval in each study group

WAS	Glue		Staplers		Sutures		P value using NPAR tests
	Mean	SD	Mean	SD	Mean	SD	
POD-3	0.17	0.76	0.80	1.92	1.10	2.66	0.026*
POD-5	0.20	0.88	1.02	2.05	1.13	2.21	0.008**
POD-7	0.60	1.70	1.15	2.26	1.20	2.25	0.107

WAs: Wound asepsis score, POD: Post-operative day, SD: Standard deviation

Table 3: Post-operative wound cosmesis score at specific time interval in each study group

WCs	Glue		Staplers		Sutures		P value
	Mean	SD	Mean	SD	Mean	SD	
POD-7	5.85	0.44	5.45	0.87	5.13	0.81	0.000 ^{***}
1 month	80.00	12.76	72.33	10.95	66.33	9.91	0.000 ^{***}
3 months	95.83	8.69	91.50	9.17	84.83	7.92	0.000 ^{***}

WAs: Wound asepsis score, POD: Post-operative day, SD: Standard deviation

Wound Asepsis and Complications

Data from five well-known trials contributed to the meta-analysis (Cheng and Saing, 1997; Dowson *et al.*, 2006; Shamiyeh *et al.*, 2001; Sinha *et al.*, 2001; Switzer *et al.*, 2003) found that there was an overall significant difference detected between the proportion of wounds with dehiscence, relative risk 4.29 95% confidence interval 1.45-12.73, favoring closure by suture with no evidence of heterogeneity ($I^2 = 0$).¹⁸⁻²² However, Blondeel *et al.*, in 2007, in a series of 209 patients treated with octyl-2-cyanoacrylate and commercially available devices following closure of long surgical incisions concluded that the new tissue adhesive formulation provides epidermal wound closure equivalent to commercially available devices with a trend to decreased incidence of wound infection.²³ In our study series, the results were in favor of tissue adhesives over staplers and sutures with a significant $P = 0.026^*$ on POD-3, highly significant $P = 0.008^{**}$ on POD-5 and an insignificant $P = 0.107$ on POD-7 as shown in Table 2. The overall wound complication rate (WCR) following tissue glue closures was 13.3% (8/60 cases), stapler closures were 23.3% (14/60 cases), and suture closures was 35% (21/60 cases) proving 2-octylcyanoacrylate closures less infective than staplers and sutures and with least WCRs.

Wound Cosmesis

Keng and Bucknall, in 1989, in a randomized series of 43 patients (46 wounds) whose operations involved a groin incision found that the glued wounds had consistently better cosmetic scores (mean score 4.71 at 4 weeks) compared to subcuticular wounds (mean score 4.00 at 4 weeks) with a $P < 0.05$.²⁴ Although, Maartense *et al.*, in 2002, and Dowson *et al.*, in 2006, found no statistical difference on the use of tissue adhesives for laparoscopic port site closure incisions.^{19,25} In our study, the mean post-operative WCs as shown in Table 3, at POD-7 was 5.85 for glue, 5.45 for staplers, and 5.13 for sutures, at 1st month of follow-up, WCs was 80.00 for glue, 72.33 for staplers, and 66.33 for sutures and during 3rd month of follow-up, WCs was 95.83 for glue, 91.50 for staplers, and 84.83 for sutures with a highly significant $P = 0.000^{***}$ favoring tissue glue closures with the best cosmetic results over staplers and sutures.

CONCLUSION

Tissue glue (octyl-2-cyanoacrylate) application is easier, simple to perform and consumes significantly less time than staplers and sutures. Octyl-2-cyanoacrylate gives, the best results in terms of less post-operative pain, wound asepsis, and cosmetic results. The concept of tissue glue is a safe, attractive, and effective alternate over other conventional methods of wound closures following elective surgical

situations with a trend to decreased incidence of surgical wound infections.

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