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Cost-effectiveness of Dermabond versus sutures for lacerated wound closure: a randomised controlled trial

Key Messages

1. For management of simple lacerated wounds, tissue adhesive (Dermabond) achieved more positive outcomes but incurred higher cost, compared with standard sutures.
2. Dermabond may be more cost-effective than standard sutures from a societal viewpoint.
3. Use of sutures required more nursing time and additional costs from subsequent dressing, whereas use of Dermabond incurred higher equipment costs.
4. Dermabond achieved better appearance outcome and patient satisfaction, compared with sutures.
5. Pain levels were not significantly different in patients treated with Dermabond or sutures.

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Introduction

In Hong Kong, nearly 3500 wound closures are handled by each accident and emergency department (AED) each year.[1] Suturing is a painful procedure and requires competent skill and follow-up visits for suture removal.[2,3] Dermabond (2-octyl cyanoacrylate) is a tissue adhesive used as a wound closure alternative.[2-5] Dermabond and sutures achieve equivalent healed wound appearance, but Dermabond entails a shorter procedure time and results in greater patient satisfaction than sutures.[2,3] We aimed to compare Dermabond versus standard wound sutures in terms of cost-effectiveness, outcome appearance, infection rate, pain, and satisfaction.

Methods

This randomised, unblinded, controlled study was conducted from 1 October 2005 to 30 September 2006. Patients from AEDs of two regional hospitals of Hong Kong who were aged ≥18 years, ambulatory, and had simple laceration wound of <8 cm were invited to participate. Patients with complicated wounds, scalp wounds, physical, visual or cognitive impairment were excluded. Patients were randomly assigned to either the control group (wound closure by sutures using standard nylon stitches) or experimental group (wound closure by tissue adhesive—Dermabond). Wound closure was defined as the process of realigning lacerated tissue plane. An intention-to-treat method was used for analysis.

Wounds were disinfected. For the suture group, the wound was anaesthetised with lignocaine 1% and sutured using standard nylon stitiches by AED nurses. After wound closure, simple dressings (plain gauze or band aid) was applied to cover the wound until removal. On discharge, a wound care instruction sheet was provided, and an out-patient follow-up was arranged for suture removal (or dressing as necessary).

For the Dermabond group, no local anaesthetic agent was used. Dermabond was gently 'painted' on the wound sites by AED nurses, and the wound edges were held together for at least 30 seconds to ensure adequate polymerisation. On discharge, a wound care instruction sheet was provided. No wound follow-up was arranged. Clinical data of the patients was recorded by the research assistant at three time points: day 14, month 1, and month 3.

A wound evaluation score (WES) was used to assess six clinical variables: absence of step off, contour irregularities, wound margin separation, edge inversion, excessive distortion, and overall cosmetic appearance. The total WES was derived by the addition of the 'yes' responses to the six variables; a score of six indicates optimal and <6 as sub-optimal wound appearance.[4]

A visual analogue cosmesis scale (VACS) was used to assess each patient's degree of satisfaction with wound appearance outcome after suture removal, with 0 indicating least satisfied and 100 most satisfied. A visual analogue scale (VAS) was used to assess the level of pain during the wound closure process, with 0 indicating least pain and 100 most pain.

A wound infection tool was used to derive a wound score, which was calculated by a reviewer for wound separation, and exudates or erythema from the line of the incision. A score of 0 indicated normal healing and 30 complete dehiscence of the wound.

The patient satisfaction for the overall wound management process was also assessed using a scale of 0 (least satisfied) to 100 (most satisfied). In addition, analgesic consumption at home, rate of wound follow-up, and adverse reactions after wound closure were recorded.

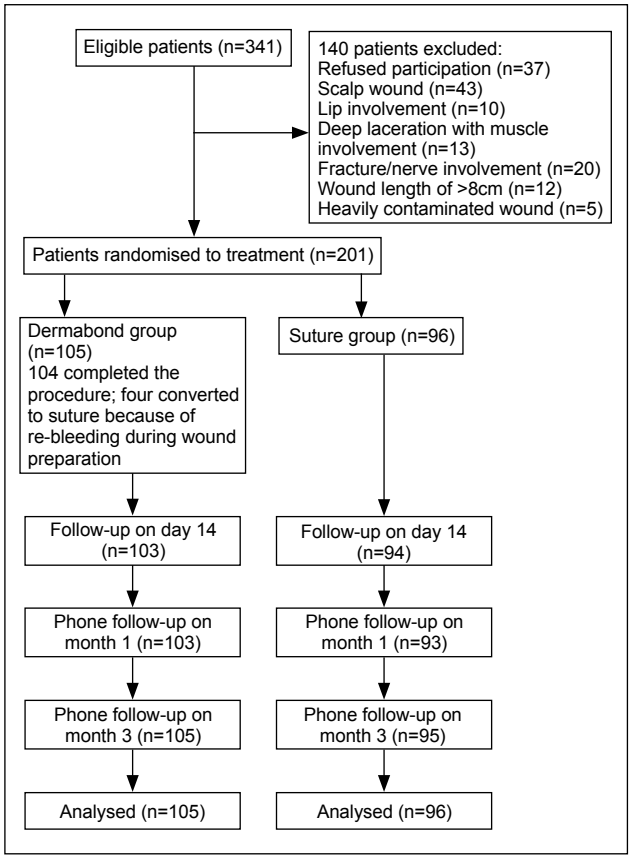

Fig 1. Flow chart of patient randomisation

The total costs of both treatments were compared. All activities related to the treatment or subsequent unexpected outcomes for each patient were recorded. A full cost (total doctor and nursing time of the whole procedure, actual cost of materials, analgesic consumption) for each patient was calculated. The costs for the suture and Dermabond groups were compared for cost-effectiveness analysis. Based on a hospital perspective, incremental cost-effective ratio was used.

Results

Of 201 patients, 105 were treated with Dermabond and 96 with sutures (Fig 1). There was no significant difference between groups in terms of age, gender, co-existing illness, and baseline variables of pain level, mechanism of injury, injury site, wound length, and time from injury to presentation (Table 1).

At day 14, more percentage of patients in the Dermabond group achieved the optimal WES (89.5% vs 86.5%, P=0.29, Table 2). The difference was significant when using VACS perceived by the reviewer (79.1 vs 66.5, P<0.005, t test).

At month 3, using VACS as the dependent variable with potential confounders (such as sex, age, wound length, wound life, and baseline appearance score), multiple regression analysis showed that only wound length had a significant effect on VACS (effect= –2.88, standard error=0.91, P=0.002). Repeated measure ANOVA was used to test the group difference in terms of VACS perceived by the participants at the four time points. There was a significant main effect for intervention (f (1,198)=8.6, P=0.004); the Dermabond group had significantly higher mean score than the suture group (83.3 vs 75 at day 14, 89.3 vs 81 at month 1, and 92.5 vs 85.4 at month 3 (P<0.001, Table 2, Fig 2).

Table 1. Baseline characteristics

Variable	All patients (n=201)	Dermabond group (n=105)	Suture group (n=96)
No. (%) of patients from hospital A	112 (56)	58 (55)	54 (56)
No. (%) of patients from hospital B	89 (44)	47 (45)	42 (44)
Mean±SD patient age (years)	42.7±19.1	43±19.4	42.5±18.9
No. (%) of males	138 (68.7)	71 (67.6)	67 (69.8)
No. (%) of patients with diabetes mellitus	8 (4.0)	4 (3.8)	4 (4.2)
Median (IQR) time from injury to presentation (minutes)	44 (30-61)	43 (30-58)	45 (32.5-64)
Mechanisms of injury (No. [%] of patients)			
Contusion	32 (15.9)	19 (18.1)	13 (13.5)
Cut	115 (57.2)	63 (60)	52 (54.2)
Falls	43 (21.4)	17 (16.2)	26 (27.1)
Motor vehicle accident	2 (1.0)	2 (1.9)	0 (0)
Sports	9 (4.5)	4 (3.8)	5 (5.2)
Site of injury (No. [%] of patients)			
Face	89 (44.3)	51 (48.6)	38 (39.6)
Hand	85 (42.3)	42 (40)	43 (44.8)
Lower limb	12 (6.0)	5 (4.8)	7 (7.3)
Upper limb	13 (6.5)	6 (5.7)	7 (7.3)
Chest	2 (1.0)	1 (1.0)	1 (1.0)
Median (25th-75th quartiles) wound length (cm)	1.7 (1-2)	1.5 (1-2)	2.0 (1-2)

Table 2. Outcome measures between two groups at different time points

Variable	Dermabond group	Suture group	Absolute difference (95% CI)	P value
Visual analogue cosmesis scale score (mean [95% CI])				
Baseline (after wound closure)	60.8 (60.2-61.5)	62.3 (61.3-63.3)	1.5 (0.4-3.5)	-
Day 14	83.3 (79.6-87.0)	75.0 (71.3-78.5)	8.3 (3.7-13.7)	-
Day 14 (assessed by research assistant)	79.1 (75.5-84.4)	66.5 (60.6-70.2)	15.5 (8.3-22.2)	<0.001*
Month 1	89.3 (86.1-92.6)	80.9 (77.6-84.3)	8.4 (4.0-12.7)	-
Month 3	92.5 (89.9-95.1)	85.4 (82.8-88.1)	7.1 (3.4-10.8)	-
Mean difference (baseline vs month 3) [mean±SD]	30.7±14	23.3±14	-	<0.001*
Appearance complication at day 14 using wound evaluation score (WES) [No. (%) of patients]				
Step off	3 (2.9)	1 (1.1)	-	0.34†
Contour irregularities	1 (0.95)	2 (2.1)	-	0.47†
Wound margin separation of >2 mm	2 (1.9)	6 (6.4)	-	0.11†
Edge inversion	1 (1.0)	2 (2.1)	-	0.49†
Excessive distortion	2 (1.9)	2 (2.1)	-	0.66†
Overall sub-optimal cosmetic appearance	8 (7.8)	10 (10.4)	-	0.34†
Suboptimal wound (total WES score of <6)	11 (10.5)	13 (13.5)	-	0.288†
Optimal wound (total WES score of 6)	94 (89.5)	83 (86.5)	-	0.288†
Wound complication at day 14 using WES [No. (%) of patients]				
Erythema/swelling	1 (1.0)	6 (6.4)	-	-
Infection	1 (1.0)	1 (1.1)	-	-
Minor dehiscence	1 (1.0)	1 (1.1)	-	-
Infection (ASEPSIS: 0-30) [mean±SD]	0.09±0.4	0.61±1.9	-	0.011*
Mean (range) visual analogue scale score for pain				
Baseline (before wound closure)	36.9 (32.0-41.8)	33.6 (29.3-38.0)	3.3 (3.5-9.5)	-
Day 14	10.5 (7.3-13.8)	14.9 (12.0-17.9)	4.4 (0.1-8.8)	-
Month 1	3.6 (1.7-5.4)	8.4 (5.8-11.0)	4.8 (1.7-8.0)	-
Month 3	1.1 (0.3-2.4)	4.1 (2.5-5.7)	3.0 (0.9-5.1)	-
Mean±SD nurse time used (minutes)	20.8±9.1	28.1±8.2	-	<0.005*
Mean±SD wound closure time (minutes)	9±2.4	15±30.9	-	<0.005*
Overall patient satisfaction score (0-100)	91.6	85.3	-	<0.0005*

A difference of 15 in the VACS score was defined as the minimum clinically important between optimal and sub-optimal scar.[14,24] The mean VACS scores at baseline were similar between groups, and the absolute differences at day 14 and months 1 and 3 were not clinically significant (<10), despite the Dermabond group having higher scores (Table 2).

The mean VAS scores for pain at baseline were similar between groups (Fig 3). Repeated measure ANOVA of VAS scores for pain as perceived by participants at the four time points showed no significant main effect for intervention (f (1,198)=2.67, P=0.10, Table 2 and Fig 2). The absolute differences at day 14, months 1 and 3 were all <5 (a minimum difference of 13 was regarded as clinically significant).

Infection score (0-30 scale) at day 14 was significantly lower in the Dermabond group (0.09 vs 0.61, P=0.011, *t* test). As the infection rate was low in both groups, sub-scale analysis revealed that there was a higher rate of erythema/swelling in the suture group (Table 2). The overall patient satisfaction score was higher in the Dermabond group (91.6 vs 85.3, P<0.0005).

The mean time to wound closure was longer in the suture group (9 vs 15, P<0.005), and therefore the mean total nurse time used was also longer (20.8 vs 28.1 minutes, P<0.005). The use of Dermabond could reduce the wound closure time and the nurse time.

Respectively in the Dermabond and suture group, the overall mean costs were HK$241.69 and HK$204.02 (Table 3), and the improvements in mean VACS scores were 30.7 and 23.3. To improve the score on wound appearance by one using Dermabond rather than sutures, an additional HK$5.1 (HK$241.69-204.02/30.7-23.3) was incurred.

Dermabond costs about HK$140 per vial, whereas sutures cost HK$9.5 per package. The higher cost in Dermabond use was mainly due to the equipment cost. Sutures entailed suture removal and more frequent follow-ups for dressing. The substantial cost difference stemmed mainly from the follow-up visits and need to remove stitches (HK$68.5 vs HK$8.2). The suture group drained more nurse services, whereas the Dermabond group incurred a higher equipment cost. Nevertheless, there was no significant difference in costs related to doctors.

Discussion

Cost-effectiveness: hospital administration consideration

The high material cost of the Dermabond could not be offset by its low cost in subsequent wound care. Given the similar clinical outcomes, the conventional suture method appeared to be the preferred method for wound closure from the perspective of hospitals, despite lower infection rate, better wound appearance and patient satisfaction for

Table 3. Cost to the Hospital Authority

Variable	Unit cost (HK$)	Dermabond (n=105)			Suture (n=96)		
		No. of patients receiving service	Mean duration of service received (minutes)	Mean cost per person (HK$)	No. of patients receiving service	Mean duration of service received (minutes)	Mean cost per person (HK$)
Costs for wound closure							
Costs for equipment, drugs, and materials							
Normal saline 0.9% for wound dressing	5.2/L	105	-	1.04	96	-	1.04
Local analgesia for sutures (Lignocanie 1%)	2.4/5 mL	4	-	0.13	96	-	2.40
5 ml syringe for infiltration	0.40	4	-	0.02	96	-	0.40
Sterile suture set	3.00	4	-	0.16	96	-	3.00
Simple dressing set	2.70	105	-	2.70	96	-	2.70
Gauze x2 packs	0.36	105	-	0.72	96	-	0.72
Sterile glove	1.70	105	-	1.70	96	-	1.70
Suture material (4'O /5'O) x2 packs	8.25	4	-	0.90	96	-	16.50
Dermabond	140.00	105	-	140.00	0	-	0
Mean±SD subtotal				147.37±5.06			28.46
Absolute difference (95%CI)				118.91 (117.86-119.93)			
Costs for analgesia							
Panadol 500 mg x5 days (20 tabs)	21.0	47	-	10.61	51	-	11.51
Dologesic x5 days (15 tabs)	18.7	9	-	1.81	21	-	4.22
Mean±SD subtotal				12.42±10.17			15.73±8.59
Absolute difference (95%CI)				3.31 (0.59-6.04)			
Costs for human resources*							
Costs for assessment by doctor	5.10	105	5	25.5	96	5	25.50
Costs for wound closure by nurse (procedure)	2.06	105	9	18.41	96	15	30.90
Cost for triage care and advice	2.06	105	12	24.72	96	12	24.72
Costs for reassessment by doctor	5.10	105	1	5.10	96	2	10.20
Mean±SD subtotal				61 ±10.77			78.6 ±12.07
Absolute difference (95%CI)				17.59 (14.75-21.37)			
Mean±SD total costs for wound closure per person				233.52±18.41			135.51±15.54
Absolute difference (95%CI)				98.01 (92.59-102.46)			
Costs for subsequent wound care							
Costs for equipment and materials in suture removal							
Normal saline 0.9% for wound dressing	5.2/L	4	-	0.06	96	-	1.04
Simple dressing set	2.70	4	-	0.15	96	-	2.70
Sterile glove	1.70	4	-	0.09	96	-	1.70
Costs for equipment and materials in wound dressing							
Normal saline 0.9% for wound dressing	5.2/litre	7 (25 visits)	-	0.27	75 (194 visits)	-	2.16
Simple dressing set	2.70	7 (25 visits)	-	0.72	75 (194 visits)	-	5.63
Sterile glove	1.70	7 (25 visits)	-	0.45	75 (194 visits)	-	3.54
Mean±SD subtotal				1.74±7.44			16.77±10.12
Absolute difference (95%CI)				15.03 (12.41-17.55)			
Costs for human resources*							
Costs for suture removal by nurse	2.06	4	8	0.89	93	8	16.48
Costs for wound dressing by nurse	2.06	7 (25 visits)	6	3.32	75 (194 visits)	6	25.65
Costs for subsequent assessment by doctor	5.10	3	5	0.82	3	5	0.82
Costs for subsequent assessment by out-patient doctor	5.10	2	5	0.55	3	5	0.82
Cost for administrative work by clerk	0.87	34 visits	3	0.85	293 visit	3	7.97
Mean±SD subtotal				6.43±22.95			51.74±24.90
Absolute difference (95%CI)				38.19 (31.26-45.12)			
Mean±SD total costs for subsequent wound care per person				8.17±30.20			68.51±34.79
Absolute difference (95%CI)				60.34 (43.74-62.60)			
Mean±SD overall cost to the Hospital Authority per person				241.69±40.92			204.02±39.19
Absolute difference (95%CI)				37.67 (32.76-55.95)			

* Nurse time hourly rate=(mean monthly salary x 12)/(52 x working hours per week)=(HK$23 584 x 12)/(52 x 44); doctor time hourly rate=(mean monthly salary x 12)/(52 x working hours per week)=(HK$58 345 x 12)/(52 x 44); and administrative clerk hourly rate=(mean monthly salary x 12)/(52 x working hours per week)=(HK$10 000x12)/(52 x 44)

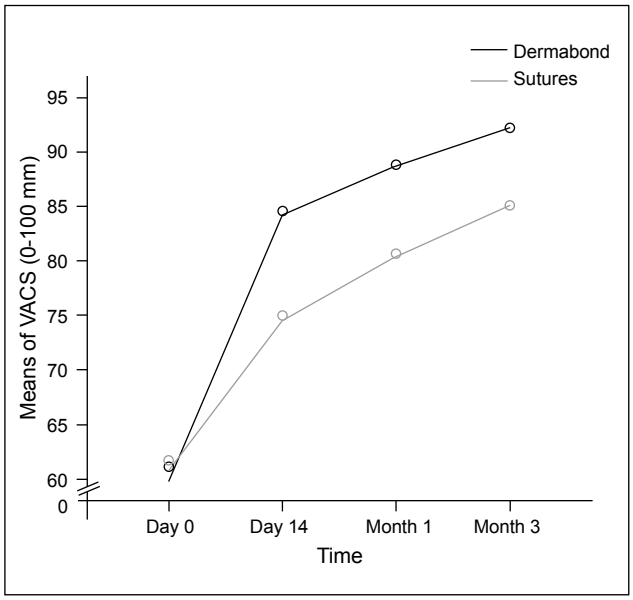

Fig 2. Comparison of visual analogue cosmesis scale (VACS) in Dermabond and suture groups

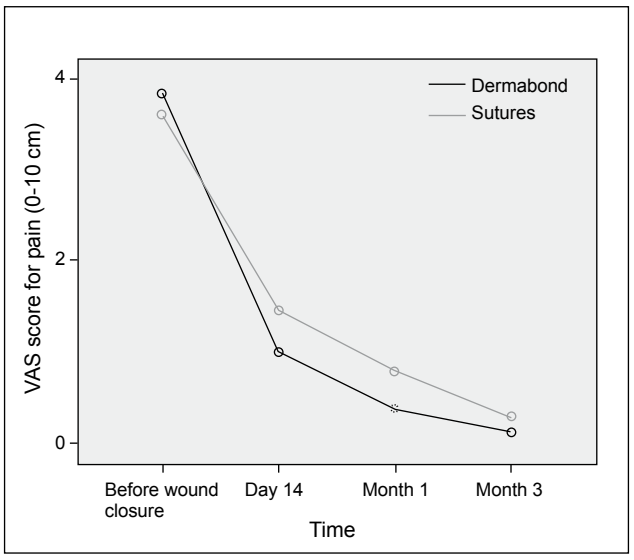

Fig 3. Comparison of visual analogue scale (VAS) score for pain in Dermabond and suture groups

Dermabond.

Cost-effectiveness: patient consideration

The cost-effectiveness analysis did not include charges to patients. Normally each patient needed to pay HK$17 for each dressing, HK$45 for wound reassessment, and HK$100 for each AED attendance. The Dermabond method appeared to be favoured by patients owing to its lower overall charges to them, shorter procedure duration, less frequent follow-up visit, and better patient satisfaction. If a societal viewpoint was taken, which included patient costs and indirect costs such as the value of time taken from work, Dermabond appeared to be more cost-effective and could be adopted more widely and safely in Hong Kong if its supply cost was lower .

Acknowledgement

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