Comparing the Use of Tissue Adhesive (2-Octyl cyanoacrylate) and Interrupted Sutures for Caesarean Section Wound: a Prospective Randomised Controlled Trial

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Objectives: To compare the efficacy of tissue adhesive (2-octyl cyanoacrylate) plus interrupted nylon sutures versus interrupted nylon sutures alone for wound closure in Caesarean section wound in terms of cosmesis, wound complication rates, pain score by patient, and surgeon satisfaction.
Methods: This was a prospective, non-blinded, randomised controlled study involving 80 subjects undergoing elective Caesarean section having transverse suprapubic skin incisions. The subjects were randomised into two groups for wound closure, namely, with interrupted vertical mattress nylon sutures or the tissue adhesive (2-octyl cyanoacrylate, Dermabond) plus nylon sutures. Results were compared using Chi-square test and *t* test where appropriate. Main outcome measures were cosmesis score and wound complication rates in the two arms.
Results: There was no significant difference between the two groups in the Hollander Wound Evaluation Scale as assessed by plastic surgeons (total mean score, 1.3 vs. 1.0; p=0.31). Wound complication rate, pain and cosmesis scores given by patients using visual analogue scale were comparable between the two groups.
Conclusion: Use of 2-octyl cyanoacrylate in addition to interrupted nylon sutures showed an insignificant favourable trend towards lower cumulative wound complication rate with no significant differences in cosmesis or pain score.
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Introduction

Caesarean section wounds are most commonly closed with suture materials. This method of wound closure carries a risk of needle stick injury, the need for suture removal, and possibility of leaving permanent suture tracks. The lack of tensile strength after suture removal will also put the patients at increased risk of wound dehiscence or widened scar if adequate healing has not occurred before the removal.

Tissue adhesives for closure of surgical wounds are developed to overcome these problems[1]. A Cochrane review[1] shows the presence of significant difference in the surgeons' assessment of cosmetic appearance with higher mean rating for tissue adhesives. Early use of tissue adhesive with butyl cyanoacrylate was limited mainly to areas with low tension because of its physical properties by which it becomes brittle and fractures over longer scars and skin creases[2]. The octyl cyanoacrylate tissue adhesive (Dermabond), on the other hand, is a long-chain cyanoacrylate derivative that is stronger and more pliable than the butyl derivative. In addition to the reduction in needle stick injury[3], it also provides a barrier for the wound against bacterial infection[4]. Featured as monomers in a liquor form, it polymerises on contact with tissue anions and forms a strong bound to hold the edges of the wound together. The application skill can be easily acquired[5]. Removal is not required as it will usually slough off when wound re-epithelialisation occurs within 5 to 10 days.

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The use of Dermabond has been studied in wound closure for laparoscopic surgery, long surgical incisions[6], breast surgery[7], thyroid surgery[8,9], paediatric laceration repair, and hand surgery[10] with satisfactory results[11]. Studies on its use in Caesarean section are limited. A report in Italy showed no substantial differences in the strength of wound closure or cosmetic outcomes between closure with intradermal suture with non-absorbable thread, metallic clips, and 2-octyl cyanoacrylate. However, greater patient compliance was found in the group using the adhesive[12]. Another retrospective study in Virginia comparing methods of skin closure of Pfannenstiel incision included Dermabond, staples, and subcuticular absorbable sutures[13]. Results were not significant when the three groups were compared on wound complications (p=0.65) and surgical site infection (p=0.10).

Therefore, this study aimed to compare the efficacy of using additional tissue adhesive (2-octyl cyanoacrylate) with interrupted nylon sutures versus nylon sutures alone for wound closure in Caesarean section wound in terms of cosmesis, wound complication rates, pain score by patient, and surgeon satisfaction.

Methods

This prospective randomised controlled study was carried out at the Department of Obstetrics and Gynaecology, Queen Mary Hospital, The University of Hong Kong, where vertical mattress sutures using nylon was the standard method of skin closure in Caesarean section. The study was conducted between August 2008 and March 2011. With reference to previous studies[14], patient's preference towards tissue adhesive as the method of choice for wound closure in breast surgery was 73% at 6 weeks postoperation, while it was 20% towards interrupted prolene sutures (p<0.01). With a sample size of 64 patients, this study had a 99% power to detect a statistically significant difference at the 5% level. Eighty patients were recruited in this study to allow for a dropout rate of 20%.

Patients aged 18 years or above undergoing elective Caesarean section at Queen Mary Hospital were eligible for the study. Patients were not eligible if they were allergic to cyanoacrylate, required vertical skin incisions, and had a temperature of >37°C on the day of operation. Patients who were on systemic steroids or had diabetes requiring insulin injections were also excluded.

Patients were invited to participate in the study a day prior to the scheduled elective Caesarean section if the above criteria were met. Written informed consent was obtained from subjects who were willing to participate in the study. After that, a full medical, obstetrical and gynaecological history was undertaken, and physical examination was performed. By computer-generated randomisation, patients were assigned to one of two methods of wound closure: using nylon sutures alone (nylon group) and using Dermabond in addition to nylon sutures (Dermabond group). In the nylon group, five vertical mattress sutures with nylon were applied as a conventional method in our centre. One patient in the nylon group had three vertical mattress sutures and another patient had seven vertical mattress sutures due to individual surgeon's preference. In Dermabond group, Caesarean section wounds were first closed by three stitches of interrupted nylon with application of 2-octyl cyanoacrylate in between the stitches.

The randomisation was performed at the time of Caesarean section in a 1:1 ratio, and the allocation was placed in a sealed envelope, which was only opened at the start of operation. Operating surgeons were instructed to attend a briefing on application of Dermabond to skin wound. All skin wounds were positioned at two fingers above the pubis. For patients with previous Caesarean sections with suprapubic transverse incisions, the same skin incision would be used. The skin edges were closed with either method, depending on randomisation. The length of the incision and the time needed for wound closure were recorded. The surgeons were asked about the ease of application at the end of the operation. This was reflected by the surgeon satisfaction score, with the highest satisfaction score being 10. The nylon sutures were removed on day 5 for patients having first operation and on day 6 for patients having previous laparotomy.

During the hospital stay, patients were examined on postoperative day 1 and day 3. The patients were reviewed again at postoperative 5, 14, and 28 days and any wound complications were documented. Patient's satisfaction on pain and cosmesis using visual analogue scale (VAS) were also recorded. Photos of the wound were taken on day 28, and were shown to a plastic surgeon who was blinded to the method of wound closure for assessment of the wound using the Hollander Wound Evaluation Scale (HWES).

The basic demographics of the patients were compared. The associations between clinical variables and treatment assignments were assessed by Chi-square test or *t* test, as appropriate. Statistical significance was set at p<0.05. The study was approved by the Institutional Review Board of the University of Hong Kong / Hospital Authority Hong Kong West Cluster Committee. The

primary outcome of the study was the cosmesis score using HWES by plastic surgeon, and wound complication rates between the two arms at intervals until postoperative day 28. The secondary outcomes included cosmesis and pain scores using VAS, surgeon's satisfaction on the ease of application, and time of application.

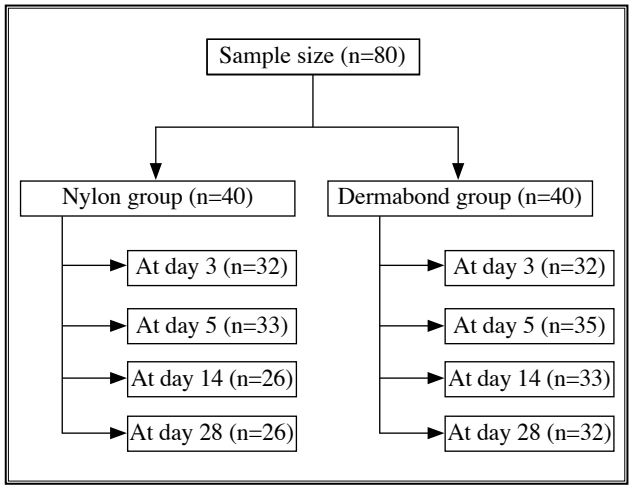

Figure. Number of patients attending follow-up

Results

Recruitment period was initially planned for 8 months only, but with the low recruitment rate and high dropout rate at follow-up, we had to extend our recruitment period. A total of 80 patients were included in this study from August 2008 to March 2011. The randomisation was performed in a 1:1 ratio, with 40 patients randomised to each arm. Informed consent was obtained from all patients and criteria were met in all of them. None of the patients withdrew from the study. Some data were missing because of loss to follow-up and incomplete documentation. The trial profile is shown in the Figure. All patients recruited in our study were Chinese.

As shown in Tables 1 and 2, the basic demographics and indications for Caesarean section were similar among the two groups. In most patients, Caesarean section was performed due to a history of Caesarean delivery. The number of patients with previous wound complications, such as keloid formation, as well as the lengths of Caesarean section skin wound, were similar in the two groups. Acetaminophen-phenyltoloxamine (dologesic) 325 mg/tablet or paracetamol 500 mg/tablet was used as routine

Table 1. Basic demographics in the two groups*

	Nylon group (n=40)	Dermabond group (n=40)	p Value
Age (years)	34.7	34.6	0.19
Body mass index (kg/m^2)	27.6	28.6	0.07
Weeks of gestation	38.8	38.6	0.31
Length of incision (cm)	15.2	15.3	0.14
Experience of surgeon (years)	2.7	2.1	0.08
History of laparotomy	68% (n=27)	68% (n=27)	1.0
History of keloid	23% (n=9)	18% (n=7)	0.62
History of gestational diabetes	20% (n=8)	18% (n=7)	0.73
Use of dologesic / panadol after operation (no. of tablets/patient)	5	4.7	0.63

* Data are shown as mean, unless otherwise specified

Table 2. Indications for Caesarean section

Indication	Nylon group (n=40)	Dermabond group (n=40)
Previous Caesarean section	65% (n=26)	65% (n=26)
Breech presentation	13% (n=5)	13% (n=5)
Multiple pregnancy	3% (n=1)	13% (n=5)
Placenta praevia	10% (n=4)	8% (n=3)
Others	10% (n=4)	3% (n=1)

prescription for postoperative analgesia in our department. There was no significant difference in terms of usage of analgesics between nylon and Dermabond groups.

Photos were taken on day 28 of follow-up, and scores were given by one experienced plastic surgeon who was blinded to the method of wound closure, using HWES. There were 24 photos from the nylon group and 33 photos from Dermabond group as some patients defaulted the follow-up on day 28. Two photos were excluded from analysis as the labelling of patient identity was not clear. The HWES score comprises of six parameters: presence of step-off border, irregular contour, widening of scar of >2 mm, presence of inversion, presence of inflammation, and overall cosmesis. Score 0 was given if none of the above parameters was present. A score of 1 was given for each parameter that was present or when there was suboptimal overall cosmesis, and a total HWES score was calculated (Table 3). Total mean score did not show any statistical difference between the two groups, although it was slightly higher in the nylon group, representing less favourable wound cosmesis (1.3 vs. 1.0; p=0.31).

Complications including wound dehiscence, infection, haematoma, overlapping, and hernia were assessed on postoperative days 3, 5, 14, and 28. Although

Table 3. Wound evaluation by Hollander Wound Evaluation Scale

	No. (%)		p Value
	Nylon group (n=24)	Dermabond group (n=33)	
Step-off borders			0.21
Nil	19 (79%)	30 (91%)	
Present	5 (21%)	3 (9%)	
Irregular contour			0.38
Nil	14 (58%)	23 (70%)	
Present	10 (42%)	10 (30%)	
Widening of scar			0.88
Nil	17 (71%)	24 (73%)	
Present	7 (29%)	9 (27%)	
Presence of inversion			1.0
Nil	24 (100%)	33 (100%)	
Present	0	0	
Presence of inflammation			0.88
Nil	20 (83%)	28 (85%)	
Present	4 (17%)	5 (15%)	
Overall cosmesis			0.64
Optimal	18 (75%)	28 (85%)	
Suboptimal	6 (25%)	5 (15%)	
Total mean score	1.3	1.0	0.31

Table 4. Postoperative cumulative complication rates

No. of days post-surgery	Nylon group (n=40)	Dermabond group (n=40)	p Value
Day 3	2.5% (n=1)	0	1.00
Day 5	30% (n=12)	10% (n=4)	0.05
Day 14	30% (n=12)	13% (n=5)	0.10
Day 28	30% (n=12)	15% (n=6)	0.18

the difference in cumulative complication rates on day 28 between the two groups was not significant, it showed a trend of higher complication rate in the Nylon group (30% vs. 15%; p=0.18). Subgroup analysis also showed that the cumulative complication rate was significantly higher in the Nylon group on postoperative day 5 compared with Dermabond group (30% vs. 10%; p=0.05) [Table 4]. In the nylon group, a total of 12 patients had complications, and one of them had infection, wound dehiscence and overlapping of wound. In Dermabond group, six patients had complications, and one of them had both overlapping of wound and haematoma formation. In subgroup analysis, patients in the nylon group had a trend towards an increased frequency of wound infection (2 vs. 0; p=0.53) and overlapping wounds (7 vs. 2; p=0.64), though the differences were not statistically different (Table 5).

Secondary outcome measures included patient's satisfaction on pain and cosmesis scores using VAS (Table 6). The pain and cosmesis scores showed an insignificant trend of being in favour of Dermabond group, especially on postoperative day 14 (2.6 vs. 1.7; p=0.06 for pain score and 6.2 vs. 6.1; p=0.08 for cosmesis score). Understandably, application of Dermabond added extra time for skin closure and, in general, surgeons preferred to use nylon alone without addition of Dermabond (Table 7).

Discussion

Different methods of wound closure in Caesarean section are used in different centres. Each of them has its benefits and disadvantages. The Cochrane review on techniques and materials for skin closure in Caesarean section[15] included studies on closure with staples versus

Table 5. Frequencies of complications

Complication	Nylon group (n=14)	Dermabond group (n=7)	p Value
Wound dehiscence	3	3	0.35
Haematoma formation	2	2	0.57
Wound infection	2	0	0.53
Overlapping wound	7	2	0.64

Table 6. Mean pain and cosmesis scores using visual analogue scale

Postoperative score	Nylon group	Derbamond group	p Value
Pain score			
At day 1	1.1	1.0	0.92
At day 3	4.9	4.8	0.45
At day 5	3.9	3.5	0.55
At day 14	2.6	1.7	0.06
At day 28	1.3	0.9	0.19
Cosmesis score			
At day 3	5.8	5.5	0.33
At day 5	5.5	5.1	0.74
At day 14	6.2	6.1	0.08
At day 28	7.2	7.5	0.46

Table 7. Time required for wound closure and surgeon satisfaction score

	Nylon group	Dermabond group	p Value
Mean time required for application (mins)	03:51	05:50	0.02
Mean surgeon satisfaction score	8.3	6.8	0.001

subcuticular absorbable sutures, which showed faster operating time but higher pain score in patients using staples. However, there are no (or limited if there is any) studies on the use of interrupted non-absorbable sutures for closure of Caesarean section. Another Cochrane review[16] addressing the use of tissue adhesives versus sutures for closure of surgical wounds showed a lower complication rate including wound dehiscence when sutures were used. Dermabond would, theoretically, decrease wound infection rate as it forms a waterproof layer above the surgical wound and acts as a barrier to bacterial invasion.

To our best knowledge, this is the first randomised controlled trial comparing the use of Dermabond and interrupted nylon sutures versus nylon sutures alone for wound closure in Caesarean sections. An insignificant favourable trend was seen towards Dermabond in terms of overall pain and cosmesis. This was similar to the finding in a previous study[14] comparing interrupted prolene with Dermabond for wound closure in mammoplasty, suggesting an overall preference towards the use of Dermabond, with the panelists noting a significantly better HWES score in patients with Dermabond ($p<0.02$) and a better cosmesis score using VAS by patients ($p<0.05$). A previous study[17] comparing the use of Dermabond, sutures, and staples in laparotomy wounds showed similar infection rate. From our study, though overall complication rates were comparable in the two groups after 4 weeks of operation, there was a favourable trend of fewer overlapping wounds and low rate of infection in Dermabond group, which reached statistical significance on day 5 after operation.

Use of Dermabond could represent a reasonable alternative closure method. We acknowledge the fact that significant results were obtained in previous studies[1,7] using Dermabond over conventional suture methods. One of the postulated reasons is that these studies were mainly on laparoscopic wounds and wounds that were not in the abdominal area where they were subject to movements due to breathing and coughing.

The relatively high dropout rate and missing data could be one of the limitations of this study. This was due to non-compliance of the patients with the relatively frequent and prolonged postoperative evaluations in the postnatal period. It was technically not feasible to blind the patients and surgeons to the method of suture, which could cause bias in developing the pain and cosmesis scores as well as the surgeon satisfaction score. However, the potential bias was minimised by an independent assessment on day 28 by plastic surgeons who were blinded to the method of skin closure. Although the photos were not taken by the same assessors and the distance of the camera from wound was not standardised, results of tele-assessment of wounds have been proven to be similar to those of real-time assessment[18].

We used VAS and HWES in our study as these assessment tools have been proven to be highly reproducible and to minimise inter-observer errors[19,20]. The pain and cosmesis scores ranked by patients showed favourable trends toward the use of Dermabond; by increasing the sample size in future studies, the result may reach statistical significance. In our study, the majority of surgeons applied five stitches of nylon in the nylon group; there was only one case with application of three stitches and one with seven stitches of nylon due to the respective surgeon's personal preference. The use of nylon has been the traditionally advocated method of closure in our unit. Surgeons in this study had a mean of 2 years of experience; thus, they were already accustomed to using nylon for wound closure. It is, therefore, not surprising to note that closure with Dermabond was less popular compared with nylon sutures given that they needed to learn a new method for skin closure. One may expect that if Dermabond is applied without the three Nylon stitches, the surgeons may get more accustomed to using Dermabond for wound closure. The operating time and surgeon satisfaction rate may eventually become comparable between these two methods.

In conclusion, this is the first randomised controlled trial comparing the efficacy of tissue adhesive (Dermabond) in addition to interrupted nylon sutures with interrupted nylon sutures alone for wound closure in Caesarean section. Dermabond in addition to nylon sutures showed a trend, though insignificant, towards lower cumulative wound complication rates with similar cosmesis and pain scores.

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Declarations

The authors declared no conflicts of interest with the information contained in the manuscript. Dermabond was supplied by the Johnson & Johnson Company in Hong Kong.

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