Component separation technique versus inlay mesh technique in patients with large incisional hernia

Moheb S. Eskandaros, Ahmed A. Darwish

Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Moheb S. Eskandaros, MD, Department of General Surgery, Faculty of Medicine, Ain Shams University, 99 Elmontaza Street, Heliopolis, Cairo, Egypt;
Tel: +20 122 407 5113;
e-mail: moheb_shoraby@yahoo.com

Received 28 November 2016
Accepted 25 December 2016

The Egyptian Journal of Surgery
2017, 36:145–151

Context
In large incisional hernias, fascial reapproximation is difficult, and it may lead to hernia recurrence. Component separation (CS) can reconstruct the abdominal wall by functional advancement. Mesh repair ('inlay' or 'bridging' of the defect) also can be done. But meshes carry risk of infection and visceral erosion. In addition, meshes may separate with time because of the vector forces of the contracting oblique muscles leading to recurrence.
Aim of the study
This study aimed to evaluate the outcomes in patients with large defects undergoing nonperforator-sparing CS versus standard inlay mesh repair.
Settings and design
This is a prospective controlled randomized study.
Patients and materials
A total of 68 patients were included in the study. They were divided into two groups, each including 34 patients. One group was operated with the CS technique and the other with the inlay mesh technique. The patients were observed for postoperative complications and were followed up for 1 year for recurrence.
Statistical analysis used
Continuous variables were expressed as mean and SD. Categorical variables were expressed as frequencies and percentage.
Results
There were no statistically significant differences between the two groups regarding the postoperative complications or recurrence rates. The CS technique had less incidence of recurrence than the inlay mesh technique.
Conclusion
The choice of surgical approach in large incisional hernia is difficult. In the current study, the CS technique was better regarding the shape of the abdominal contour than the inlay mesh technique with less incidence of complications such as adhesions of the bowel to the mesh and hernia recurrence.

Keywords:
component separation technique, hernia recurrence, incisional hernia, inlay mesh

Egyptian J Surgery 36:145–151

1110-1121

Introduction

Incisional hernia repair is a very common operation in general surgery [1]. Repair of incisional hernias has many difficulties, as it is carries high morbidity and high rate of recurrence that reach up to 17% [2,3].

Obesity and infection caused large and complex abdominal defects leading to more difficult fascial closure [4].

With large incisional hernias, reapproximation of the fascia is difficult, and if performed, tension closure may lead to increase in the intra-abdominal pressure that may manifest as abdominal compartment syndrome hindering organ perfusion and impairing venous return. On the long run, excessive fascial tension may predispose to hernia recurrence [5].

Component separation (CS) was first described by Mathes and Bostwick [6] and then popularized by Ramirez *et al*. [7]. They showed that large abdominal wall defects can be reconstructed by functional advancement of abdominal wall components without the need for free-tissue transfer flaps [8–12].

CS alone was found to cause high recurrence rates, with studies demonstrating rates reaching up to 53% [4,13,14].

Mesh repair has become the procedure of choice by many surgeons. In its simplest form ('inlay' or 'bridging' of the defect), the operation is not challenging. Tension is not an issue, and the hernial defect disappears. But meshes carry their own problems, with infection and visceral

 DOI: 10.4103/1110-1121.204528

erosion being the most common. In addition, the bridging mesh may separate with time, and acellular dermis as a replacement for prosthetic material does not seem to have fulfilled its earlier promise [15,16]. The failed bridging repair will enlarge with time because of the vector forces of the contracting oblique muscles, as they have lost their insertion point to the linea alba [17,18].

This study aimed to evaluate the outcomes in patients with large defects undergoing nonperforator-sparing CS versus standard open ventral hernia repair.

Patients and methods

This study was a comparative prospective randomized clinical trial in which 68 patients having incisional hernia after midline incision for laparotomy were included.

Inclusion criteria

(1) BMI up to 40.
(2) Reducible hernia.
(3) Hernia after midline incision.
(4) Primary hernia or recurrent for one time.
(5) Age 24–65 years.
(6) Defect ranges from 100 to 500 cm^2.

Exclusion criteria

(1) BMI more than 40.
(2) Irreducible hernia or loss of domain.
(3) Nonmidline hernia.
(4) Recurrence more than once.
(5) ASA score IV especially chronic pulmonary disease.
(6) Patients with stoma.
(7) Defect more than 500 cm^2.

The study took place from June 2012 till May 2016 with a minimal of 12 months of follow-up for each patient. The patients were randomly allocated by closed envelope into two groups (each containing 34 patients) with standardization of the surgical technique and the team that carried out the procedure for each group. Among these 68 patients, 34 patients were operated with the CS technique (group A), and 34 patients were operated with the inlay mesh technique without closing the defect (group B).

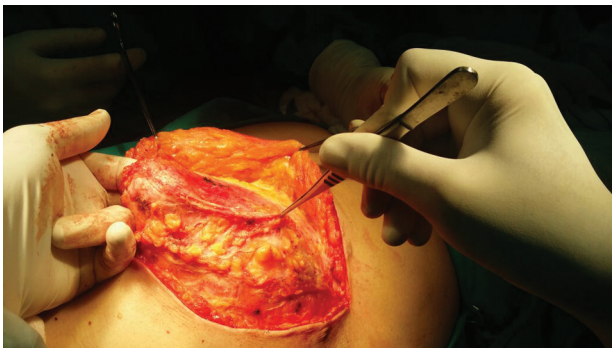
All patients were recruited from the outpatient clinic. Full detailed history was obtained from all patients, and full physical examination was carried out, including abdominal ultrasound and computed tomography of the pelviabdominal region to determine the size of the defect radiologically. An informed consent was obtained from the patients for the participation in the study according to the ethical committee of the Faculty of Medicine, Ain Shams University.

Surgical technique

All patients received general anesthesia. The patients were operated on in the supine position, with prophylactic antibiotics administered and Foley's catheter inserted. The previous scar was excised, and dissection was done till reaching the hernia sac. The sac was dissected all around and opened with reduction of any contents into the abdomen. Adhesiolysis was done to separate any viscera from the defect circumferentially (Figs 1 and 2).

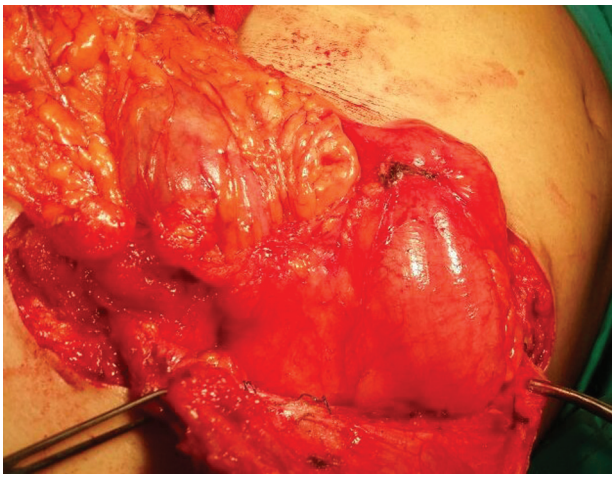
In the CS group (group A), cautery was used to dissect the subcutaneous spacelateral to the rectus sheath and

Figure 1



Opening of skin and subcutaneous tissue with dissection of the sac.

Figure 2



Dissection of the contents from the sac.

then used to cut the external oblique aponeurosis 1 cm lateral to the linea semilunaris. This incision was extended as needed from the fascia, just overlying the ribs, down to the level of the anterior superior iliac spine. Release of the external oblique was then repeated on the opposite side. The posterior rectus sheath was incised from the xiphoid to the arcuate line and repeated on the opposite side. This allows for closure of the mobilized flap in the midline using prolene one sutures. This was then reinforced by application of prolene mesh over the muscles overlapping the lateral cut edges of the external oblique muscle (Figs 3 and 4).

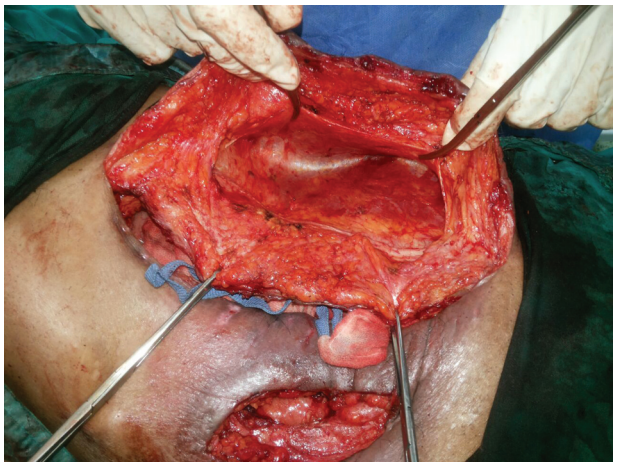
In the inlay mesh group (group B), approximation of the fascial defect was not done. After dissection of the edge of the defect, the sac was opened, and reduction of the contents was done after dissection of adhesions. The excess peritoneum was excised, and the peritoneum was closed by running absorbable sutures. A prolene mesh was applied with fixation to the edges of the defect allowing for a minimum of 5 cm overlap to the defect using the double-crown method (Figs 5 and 6).

Drains were then applied over the mesh, and the closure of the subcutaneous tissue and skin was done.

Results

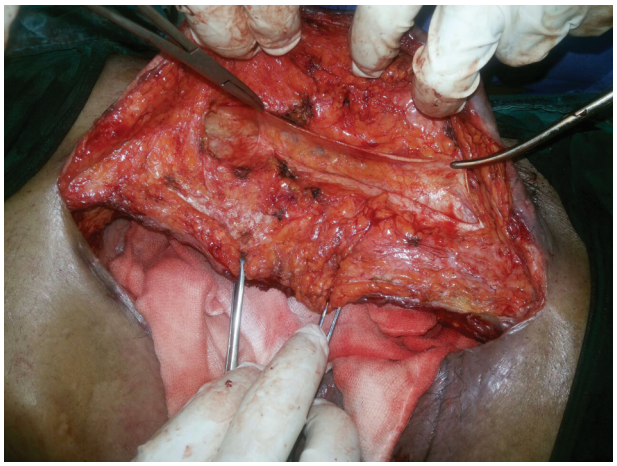
The collected data was revised, coded, tabulated, and introduced to a PC using Statistical Package for Social Science (SPSS 20; SPSS Inc., Chicago, Illinois, USA). Data were, presented, and suitable analysis was done according to the type of data obtained for each parameter.

Figure 3



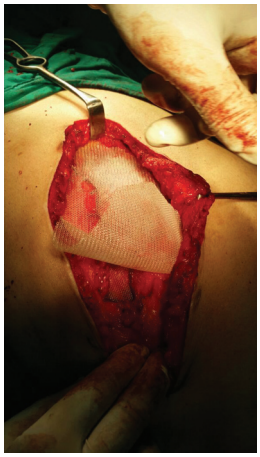
Separation of the external oblique from internal oblique muscle.

Figure 4



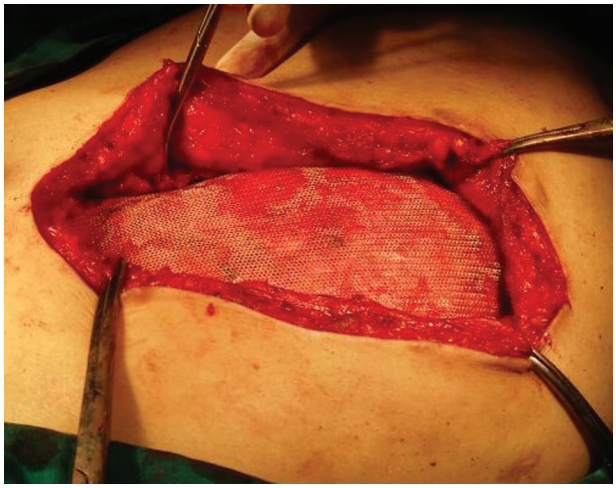
Release incision lateral to the linea semilunaris and advancement of the sheath to the midline.

Figure 5



Applying of inlay mesh.

Figure 6



Mesh after fixation to bridge the defect.

Descriptive statistics

(1) Mean±SD, and range for parametric numerical data, whereas median and interquartile range for nonparametric numerical data were used.
(2) Frequency and percentage for non-numerical data were used.

Analytical statistics

(1) Student *t*-test was used to assess the statistical significance of the difference between two study group means.
(2) χ^2-test was used to examine the relationship between two qualitative variables.
(3) Fisher's exact test was used to examine the relationship between two qualitative variables when the expected count is less than five in more than 20% of cells.

Patients' demographics

In group A, 34 patients were included with mean age (mean±SD) of 47.29±10.97 years, whereas in group B, 34 patients were included with mean age (mean±SD) of 46.38±11.45 years. The *P* value was 0.738, which was statistically nonsignificant.

In group A included were 15 (44.1%) male and 19 (55.9%) female patients, whereas group B included 16 (47.1%) male and 18 (52.9%) female patients. The *P* value was 0.808, which was statistically nonsignificant.

The BMI (mean±SD) in group A was 32.5±4.92 whereas in group B was 31.91±4.94. The *P* value was 0.625, which was statistically nonsignificant.

Patients' comorbidities

There were 11 (32.4%) patients with comorbidities in group A, whereas 12 (35.3%) patients in group B with a *P* value of 0.798, which was statistically nonsignificant.

The individual comorbidities in each group are shown in Table 1. The *P* values were more than 0.01 and were considered statistically nonsignificant.

Size of the defect

The size of the defect (mean±SD) in group A was 264.56±99.65 cm^2 whereas in group B was 264.41 ±100.22 cm^2. The *P* value was 0.995, which was statistically nonsignificant.

Operative time

The operative time (mean±SD) in group A was 131.47± 26.67 min whereas in group B was 107.21±15.43 min. *P* was less than 0.001, which was statistically significant.

Intraoperative complications

The intraoperative complications among the two groups are shown in Table 2.

The *P* value was 1, which was statistically nonsignificant.

Postoperative complications

The postoperative complications among the two groups are shown in Table 3. In all postoperative complications, the *P* value was greater than 0.001, which was considered as statistically nonsignificant.

Hospital stay

The duration of hospital stay (mean±SD) in group A was 8.21±6.4 days, whereas in group B was 7.18±4.36 days. The *P* value was 0.442, which was statistically nonsignificant.

Table 1 Distribution of comorbidities among the two groups

	n (%)		Test of significance	
	Group A	Group B	*P* value	Significance
Arrhythmia				
No	32 (94.1)	32 (94.1)	1	NS
Yes	2 (5.9)	2 (5.9)		
CTD				
No	33 (97.1)	34 (100.0)	1	NS
Yes	1 (2.9)	0 (0.0)		
DM				
No	31 (91.2)	28 (82.4)	0.476	NS
Yes	3 (8.8)	6 (17.6)		
HTN				
No	31 (91.2)	32 (94.1)	1	NS
Yes	3 (8.8)	2 (5.9)		
IHD				
No	32 (94.1)	33 (97.1)	1	NS
Yes	2 (5.9)	1 (2.9)		
Hepatitis				
No	28 (82.4)	28 (82.4)	1	NS
Yes	6 (17.6)	6 (17.6)		

CTD, connective tissue disease, DM, diabetes mellitus, HTN, hypertension, IHD, ischemic heart disease.

Table 2 Intraoperative complications among the two groups

	n (%)		Test of significance	
	Group A	Group B	*P* value	Significance
Intraoperative complications				
No	31 (91.2)	31 (91.2)		NS
Bowel injury	2 (5.9)	2 (5.9)	1	
Blood transfusion	1 (2.9)	1 (2.9)		

Need for analgesia

The need for analgesia/day (mean±SD) in group A was 2.18±0.67 times, whereas in group B was 1.76±0.61 times. The *P* value was 0.01, which was statistically significant.

Return to usual activities

The duration till return to usual activities (mean±SD) in group A was 6.97±3.57 weeks, whereas in group B was 4.79±2.73 weeks. The *P* value was 0.006, which was statistically significant.

Table 3 Postoperative complications among the two groups

	n (%)		Test of significance	
	Group A	Group B	*P* value	Significance
Postoperative ileus				
No	29 (85.3)	30 (88.2)	1	NS
Yes	5 (14.7)	4 (11.8)		
Wound breakdown				
No	32 (94.1)	30 (88.2)	0.673	NS
Yes	2 (5.9)	4 (11.8)		
Wound infection				
No	31 (91.2)	30 (88.2)	1	NS
Yes	3 (8.8)	4 (11.8)		
Seroma that need intervention				
No	30 (88.2)	29 (85.3)	1	NS
Yes	4 (11.8)	5 (14.7)		
Pulmonary embolism				
No	33 (97.1)	32 (94.1)	1	NS
Yes	1 (2.9)	2 (5.9)		
Postoperative bleeding				
No	33 (97.1)	33 (97.1)	1	NS
Yes	1 (2.9)	1 (2.9)		
Skin necrosis				
No	30 (97.1)	33 (88.2)	0.356	NS
Yes	4 (11.8)	1 (2.9)		
Mesh infection				
No	33 (97.1)	32 (94.1)	1	NS
Yes	1 (2.9)	2 (5.9)		

Patients' follow-up after 1 month, 3 months, and 1 year

After 1 month of follow-up, five patients in group A had seroma that required intervention in comparison with four patients in group B. Overall, two patients in each group required readmission for management of seroma. The *P* value was 1, which was statistically nonsignificant (Table 4).

After 3 months of follow-up, three patients had complications in each group. The *P* value was 1, which was statistically nonsignificant. The detailed complications are shown in Table 4.

After 1 year of follow up, in group A, one patient had recurrence and three patients had chronic pain, whereas in group B, four patients had recurrence and one patient had chronic pain. The *P* value was 0.752, which was statistically nonsignificant, yet the rate of recurrence in group B was four times that in group A.

Discussion

CS technique had become a more popular procedure as it was introduced by Ramirez *et al.* [7]. Mesh reinforcement had been well known for significantly reducing recurrence rates [4,19]. Previously, a bridging mesh was used in a large defect or a tension closure, which had shown to have more recurrence and infection rates [20]. Midline reapproximation of the rectus muscles decreased these problems by allowing fascial closure thus strengthening the abdominal wall and restoring its integrity [20].

In this study, 68 patients with incisional hernia at the midline were included and were divided into two

Table 4 Follow-up after 1 month, 3 months, and 1 year

Follow-up	*n* (%)		Test of significance	
	Group A	Group B	*P* value	Significance
1 month				
Seroma that need intervention				
No	29 (85.3)	30 (88.2)	1	NS
Yes	5 (14.7)	4 (11.8)		
Readmission				
No	32 (94.1)	32 (94.1)	1	NS
Yes	2 (5.9)	2 (5.9)		
3 months				
No	31 (91.2)	31 (91.2)	1	NS
Adhesive intestinal obstruction	0 (0.0)	1 (2.9)		
Seroma	3 (8.8)	2 (5.9)		
1 year				
No	30 (88.2)	29 (85.3)	0.752	NS
Chronic pain	3 (8.8)	1 (2.9)		
Recurrent	1 (2.9)	4 (11.8)		

groups each containing 34 patients. The cases were allocated alternatively in each group. There was no statistically significant difference between the two groups regarding age, sex, BMI, patients' comorbidities, or size of the defect. The operative time in the CS group (group A) was longer with mean time of 131.47±26.67 min than in the inlay mesh technique group (group B), which was 107.21 ±15.43 min, with *P* value less than 0.001, which was statistically significant. This was owing to the more time needed for the dissection and repair done in the CS technique. Regarding the intraoperative complications, each group had two cases of small bowel injury that were repaired intraoperatively and one case that required blood transfusion. There was no statistical significance between the two groups, with *P* value of 1. The postoperative complications included postoperative ileus that was reported in five cases in CS group and in four cases in the inlay mesh group, with no statistical difference. Similar results were obtained by the study conducted by Klima *et al.* [5] who reported two patients experienced wound breakdown and dehiscence and three experienced wound infection in CS group whereas four patients experienced wound breakdown and infection in the inlay mesh group, with no statistical difference between the two groups. A total of four patients had seroma that required intervention in the CS group in comparison with five patients in the inlay mesh group; however, in the study done by Klima and colleagues, the CS had a higher incidence. In that study, one patient had pulmonary embolism who was managed with therapeutic dose of low-molecular-weight heparin and ICU admission till stabilization, and one patient had postoperative bleeding who was managed with blood transfusion and reoperation to control the bleeder in the CS group, whereas in the inlay mesh group, one patient had pulmonary embolism who was managed conservatively with therapeutic dose of low-molecular-weight heparin and ICU admission and two patients experienced postoperative bleeding, one of them was managed conservatively by blood transfusion and the other required surgical intervention to control the bleeding. In the CS group, one patient had skin necrosis who required debridement and later closure by secondary sutures, and one patient had mesh infection who was managed with intravenous antibiotics and daily dressing, whereas in the inlay mesh group, four patients had skin necrosis who were managed by debridement and secondary sutures except for one patient who needed advancement flap for coverage and two patients experienced mesh infection who were managed conservatively by intravenous antibiotics and daily dressing. There was no statistically significant difference between the two groups regarding the postoperative complications, yet there was a greater incidence of overall postoperative complications in the inlay mesh group (18 patients) in comparison with the CS group (15 patients) especially in the incidence of postoperative skin necrosis (four patients against one patient). Similar results were achieved by Klima *et al.* [5]. The CS group had slightly longer hospital stay than the inlay mesh technique, yet this was statistically nonsignificant. The CS technique group patients required more analgesia owing to the muscle and the soft tissue dissection than the inlay mesh technique patients, which was statistically significant. Also the duration needed till return to the usual daily activities was longer in the CS group with statistical significance. The follow-up after 1 month period showed significant increase in the inlay mesh group that recorded 28 (82.4%) cases in comparison with the CS group that recorded 11 (32.4%) cases. The complications in the inlay mesh group were 27 (79.4%) cases of abdominal bulging in comparison with 10 (29.4%) cases in the CS group. This was due to absence of the role of the muscle layer that maintained the normal abdominal contour in the inlay mesh technique, where the main factor in the integration of the mesh with the abdominal wall and the formation of a satisfactory fibrous tissue reaction, which was not always successful in all cases, attributing to the high incidence of abdominal bulging in this group in contrary to the CS technique which maintained the physiological muscle role in attaining the abdominal contour and antagonizing the effect of increased intra-abdominal pressure, the function that was considered lacking in the inlay mesh technique. Also, five (14.7%) patients in the CS group and four (11.8%) patients in the inlay mesh group developed seroma that required intervention in the form of repeated aspirations and compression till resolution except for two (5.9%) patients in each group that required readmission and application of drain for drainage of the seroma that rapidly recollects. The results agreed with the data obtained by Klima and colleagues who recorded 14% of patients requiring intervention for seroma as with other studies [21,22]. During the 3 months of follow-up, one (2.9%) patient in the inlay mesh group experienced adhesive intestinal obstruction because of small intestinal adhesions to the mesh that required surgical intervention, whereas no patients experienced such condition in the CS group because of the presence of the muscle barrier between the mesh and the abdominal viscera. Also, three (8.8%) patients in the CS group and two (5.9%) patients in the inlay mesh group still have seroma formation yet to a lesser

degree than those in the first month and were treated conservatively. After 1 year of follow-up, three (8.8%) patients experienced chronic pain in the CS group which may be because of nerve entanglement in the fibrous reaction or because of nerve compression versus one (2.9%) patient in the inlay mesh technique. Also, there was a slight increase in the rate of recurrence after 1 year in the inlay mesh group where three (8.8%) patients developed recurrence versus two (5.9%) patients in the CS group, which was statistically nonsignificant.

Conclusion

The choice of surgical approach in patients with large incisional hernia between the CS technique and the inlay mesh technique is difficult. Very few studies have been conducted comparing both techniques. In the current study, the CS technique was better regarding the shape of the abdominal contour with less incidence of postoperative bulge than the inlay mesh technique, yet there was no statistically significant difference between them concerning other postoperative complications. The CS had less incidence of grave complications such as adhesions of the bowel to the mesh and hernia recurrence than the inlay mesh technique. Further studies on larger scale are required to achieve statistically significant results.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Poulose BK, Shelton J, Phillips S, Moore D, Nealon W, Penson D, *et al.* Epidemiology and cost of ventral hernia repair: making the case for hernia research. Hernia 2012; 16:179–183.

2 Dietz UA, Winkler MS, Hartel RW, Fleischhacker A, Wiegering A, Isbert C, *et al.* Importance of recurrence rating, morphology, hernial gap size, and risk factors in ventral and incisional hernia classification. Hernia 2014; 1:19–30.

3 Albino FP, Patel KM, Nahabedian MY, Sosin M, Attinger CE, Bhanot P. Does mesh location matter in abdominal wall reconstruction? A systematic review of the literature and a summary of recommendations. Plast Reconstr Surg 2013; 132:1295–1304.

4 Joels CS, Vanderveer AS, Newcomb WL, Lincourt AE, Polhill JL, Jacobs DG, *et al.* Abdominal wall reconstruction after temporary abdominal closure: a ten-year review. Surg Innov 2006; 13:223–230.

5 Klima DA, Tsirline VB, Belyansky I, Dacey KT, Lincourt AE, Kercher KW *et al.* Quality of life following component separation versus standard open ventral hernia repair for large hernias. Surg Innov 2014; 2:147–154.

6 Mathes SJ, Bostwick J III. A rectus abdominis myocutaneous flap to reconstruct abdominal wall defects. Br J Plast Surg 1977; 30:282–283.

7 Ramirez OM, Ruas E, Dellon AL. 'Components separation' method for closure of abdominal-wall defects: an anatomic and clinical study. Plast Reconstr Surg 1990; 86:519–526.

8 Shestak KC, Edington HJ, Johnson RR. The separation of anatomic components technique for the reconstruction of massive midline abdominal wall defects: anatomy, surgical technique, applications, and limitations revisited. Plast Reconstr Surg 2000; 105:731–738.

9 Levine JP, Karp NS. Restoration of abdominal wall integrity as a salvage procedure in difficult recurrent abdominal wall hernias using a method of wide myofascial release. Plast Reconstr Surg 2001; 107:707–716.

10 Vargo D. Component separation in the management of the difficult abdominal wall. Am J Surg 2004; 188:633–637.

11 Chang EI, Foster RD, Hansen SL, Jazayeri L, Patti MG. Autologous tissue reconstruction of ventral hernias in morbidly obese patients. Arch Surg 2007; 142:746–749.

12 Ko JH, Wang EC, Salvay DM, Paul BC, Dumanian GA. Abdominal wall reconstruction: lessons learned from 200 'components separation' procedures. Arch Surg 2009; 144:1047–1055.

13 Sailes FC, Walls J, Guelig D, Mirzabeigi M, Long WD, Crawford A, *et al.* Synthetic and biological mesh in component separation: a 10-year single institution review. Ann Plast Surg 2010; 64:696–698.

14 de Vries Reilingh TS, van Goor H, Charbon JA, Rosman C, Hesselink EJ, van der Wilt GJ, *et al.* Repair of giant midline abdominal wall hernias: 'components separation technique' versus prosthetic repair: interim analysis of a randomized controlled trial. World J Surg 2007; 31:756–763.

15 Jin J, Rosen M, Blatnik J, McGee MF, Williams CP, Marks J, *et al.* Use of acellular dermal matrix for complicated ventral hernia repair: does technique affect outcomes? J Am Coll Surg 2007; 205:654–660.

16 Blatnik J, Jin J, Rosen M. Abdominal hernia repair with bridging acellular dermal matrix: an expensive hernia sac. Am J Surg 2008; 196:47–50.

17 Flament J, Avisse C, Palot JP, Delattre JF. Complications in incisional hernia repairs by the placement of retromuscular prostheses. Hernia 2000; 4:24–29.

18 Flament J, Palot J-P, Burde A, Delattre J-F, Avisse C. Treatment of major incisional hernias. In: Bendavid R, Abrahamson J, Arregui ME, Flament JB, Phillips EH, editors. Abdominal wall hernias principles and management. New York, NY: Springer-Verlag; 2001. pp. 508–516.

19 Ko JH, Salvay DM, Paul BC, Wang EC, Dumanian GA. Soft polypropylene mesh, but not cadaveric dermis, significantly improves outcomes in midline hernia repairs using the components separation technique. Plast Reconstr Surg 2009; 124:836–847.

20 Petersen S, Henke G, Zimmermann L, Aumann G, Hellmich G, Ludwig K. Ventral rectus fascia closure on top of mesh hernia repair in the sublay technique. Plast Reconstr Surg 2004; 114:1754–1760.

21 Mazzocchi M, Dessy LA, Ranno R, Carlesimo B, Rubino C. Component separation technique and panniculectomy for repair of incisional hernia. Am J Surg 2011; 201:776–783.

22 Klima DA, Brintzenhoff RA, Tsirline VB, Belyansky I, Lincourt AE, Getz S, *et al.* Application of subcutaneous talc in hernia repair and wide subcutaneous dissection dramatically reduces seroma formation and postoperative wound complications. Am Surg 2011; 77:888–894.