

Comparative Study of Dynamic versus Static Reconstruction for Midline Anterior Abdominal Wall Weakness

Ahmed Z.Gharib¹, Mohamed H.Zedan¹ and Ahmed Maarouf Mohamed Gaddaf Addam A. Masoud^{1*}

¹Department of General Surgery, Faculty of Medicine, October 6 University, Egypt

*Corresponding Author: Mohammed Gaddaf Addam Ahmed Masoud; Affiliation: Department of General Surgery, Faculty of Medicine, October 6 University, Egypt; Phone No.: 0 11 25780509
Email: Mmgag57@gmail.com

Received: 28th Feb, 2026; Revised: 6th March 2026; Accepted: 7th April, 2026; Available Online: 20th April, 2026

ABSTRACT

Reconstruction of midline anterior abdominal wall defects remains a challenging surgical problem. Several surgical techniques have been developed to restore abdominal wall integrity and function while minimizing postoperative complications and recurrence. The current study aim to compare the clinical outcomes of open component separation (OCS) and static mesh repair in the management of moderate midline anterior abdominal wall defects measuring 6–10 cm. This prospective randomized comparative study was conducted on 100 patients with midline anterior abdominal wall defects measuring 6–10 cm. Patients were randomly allocated into two groups: Group A underwent open component separation repair, while Group B underwent static mesh repair. Operative time, hospital stay, postoperative pain, complications, intra-abdominal pressure (IAP), recurrence, and quality of life (EQ-5D) were evaluated. Operative time was significantly longer in the OCS group compared with the static repair group. Patients in the OCS group also experienced longer hospital stay and higher early postoperative pain scores. In contrast, seroma formation was more frequently observed in the static repair group. Intra-abdominal pressure measured before fascial closure was higher in the static repair group compared with the OCS group. No significant differences were observed between the two groups regarding surgical site infection, hematoma, skin necrosis, recurrence, or postoperative quality of life. Both open component separation and static mesh repair represent effective surgical options for the management of moderate abdominal wall defects. OCS facilitates tension-free fascial closure with lower intra-abdominal pressure, whereas static repair provides shorter operative time and faster early recovery. The choice of technique should therefore be individualized according to defect characteristics and patient factors.

Keywords: Dynamic Reconstruction, Open Component Separation, Static Reconstruction, Midline Anterior, Abdominal Wall

How to cite this article: Gharib AZ, Zedan MH, Masoud AAMGA, Comparative Study of Dynamic versus Static Reconstruction for Midline Anterior Abdominal Wall Weakness. *Int J Drug Deliv Technol.* 2026;16(5): 341-347. DOI: 10.25258/ijddt.16.5.36

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Reconstruction of anterior abdominal wall defects remains a challenging problem in general surgery. These defects may result from ventral hernias, previous abdominal operations, trauma, or congenital conditions, and they can significantly affect abdominal wall function, patient mobility, and overall quality of life. Successful reconstruction aims to restore abdominal wall integrity, maintain physiological function, and minimize postoperative complications and recurrence.^{1,2} Various surgical techniques have been developed for abdominal wall reconstruction. Static repair using prosthetic mesh reinforcement has become widely accepted because it provides structural support and reduces recurrence rates. However, mesh-based repair, particularly when performed using the onlay technique, may be associated with complications such as seroma formation, surgical site infection, and foreign body reaction.^{3,4} To overcome these

limitations, dynamic reconstructive techniques such as the component separation technique have been introduced. This technique allows medial advancement of the abdominal wall musculature through release of the external oblique aponeurosis, thereby facilitating tension-free fascial closure and restoring the functional anatomy of the abdominal wall. Previous studies have demonstrated that component separation may improve abdominal wall function and enable closure of moderate to large defects without excessive tension.^{5,6} Although both techniques are widely used in abdominal wall reconstruction, the optimal surgical approach for moderate abdominal wall defects remains controversial, particularly regarding operative outcomes and postoperative complications. Therefore, the present study aimed to compare the clinical outcomes of open component separation and static mesh repair in the management of moderate midline anterior abdominal wall defects measuring 6–10 cm.

*Author for Correspondence: Mmgag57@gmail.com

MATERIALS AND METHODS

This prospective randomized controlled clinical study was conducted at the General Surgery Department of October 6 University Hospital between March 2023 and March 2025. Patients were enrolled consecutively during the study period. A total of 100 patients aged 30–60 years diagnosed with midline anterior abdominal wall weakness, presenting with either primary or recurrent hernia with or without previously applied mesh, were included in the study. After confirmation of eligibility criteria, patients were randomly allocated into two equal groups (n = 50 each) using simple randomization through computer-generated random numbers. Group (A) included 50 patients who were managed by dynamic reconstruction using the open component separation technique, while Group (B) included 50 patients who were managed by static reconstruction technique. All included patients were followed postoperatively at 3, 6, and 9 months. The study was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants. Patients with anterior abdominal wall weakness presenting with midline fascial defects measuring 6–10 cm, including cases with severe rectus muscle dehiscence at the umbilical level. Patients with controlled chronic illness as hypertension, diabetes mellitus and any cardiac disease. Body Mass Index ranging between 25 to 39 Kg/m².

Patients with severe comorbidities that may significantly impact surgical outcomes such as Chronic obstructive pulmonary disease, severe restrictive lung disease and diagnosed with intercostal muscles and diaphragmatic muscle weakness. and BMI > 40 Kg/m² were excluded.

Baseline assessment included demographics, comorbidities, surgical history, abdominal wall

examination, laboratory investigations, and measurement of abdominal bulge using a standardized ruler at the umbilical level. Defect size, intra-abdominal pressure (IAP) were recorded intraoperatively. Hernia reduction or diastasis plication was performed as indicated. IAP was measured using intravesical saline manometer immediately before fascial closure, with <12 mmHg considered physiologic. When intra-abdominal pressure exceeded physiologic limits, tension-releasing maneuvers—primarily component separation—were performed to allow safe fascial closure. Static mesh reinforcement was applied only after achieving acceptable closure tension and physiologic IAP values.

In **Group A** patients underwent the open component separation technique, a dynamic repair method without the use of mesh. After limited subcutaneous flap elevation to the linea semilunaris while preserving perforators, the lateral edge of the rectus abdominis was identified and mobilized toward the midline. The external oblique aponeurosis was then incised longitudinally approximately 1.5–2 cm lateral to the linea semilunaris, extending from the costal margin to the inguinal region. The plane between the external and internal oblique muscles was developed under direct vision, with ligation or cauterization of perforators as needed. Lateral extension was performed only as required to achieve 3–5 cm of medial advancement per side at the umbilical level. Primary fascial closure of the linea alba was performed using heavy non-absorbable (prolene 1-0) or slowly absorbable running sutures (PDS), ensuring even tension across the repair. Hemostasis was confirmed, closed-suction drains were placed when indicated, subcutaneous tissue was approximated in layers, and the skin was closed.

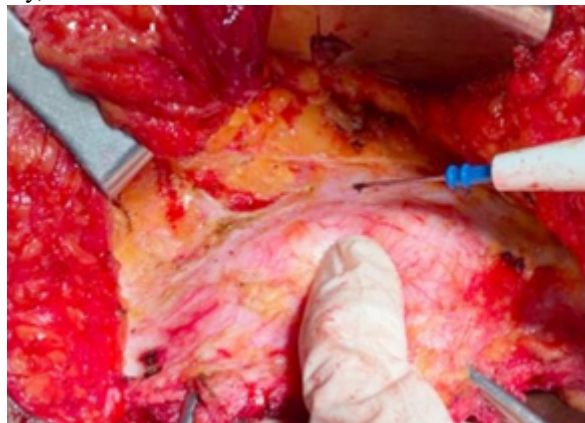




Figure (1) - (A) grasp the rectus sheath between thumb and index finger, feel the lateral edge, and gently pull towards the midline. (B) Under direct visualization, with proper retraction, separate the external oblique aponeurosis from the internal oblique muscle



Figure (2) - the rectus sheath from each side meet at the midline.

Patients in Group B underwent static repair with primary midline closure reinforced by onlay mesh. an onlay mesh was then positioned over the repaired fascia and fixed to the anterior rectus sheath using interrupted and running non-absorbable (prolene 1-0) sutures placed at 2–3 cm intervals, with corner stitches placed first and care taken to

avoid injury to the epigastric vessels. Two closed-suction drains were inserted to prevent fluid accumulation. The subcutaneous tissue and skin were closed according to institutional protocols, and drains were removed once the output was less than 30 mL per 24 hours.





Figure (3) - (A) closing the defect with sutures, **(B)** mesh in placed over the defect and suturing with (prolene 2-0)

For patients presenting with hernia, the sac was reduced or excised, and any peritoneal defects were repaired prior to the application of the assigned surgical technique. In cases of rectus diastasis without a true fascial defect, midline plication was performed. Additional medial advancement with OCS was performed if required, whereas mesh reinforcement was applied for static repair according to group allocation. Patients were monitored for wound healing, complications (seroma, SSI, hematoma, skin necrosis, bulge, recurrence), and quality of life. General health was assessed using the EQ-5D questionnaire (mobility, self-care, usual activities, pain/discomfort, anxiety/depression), and hernia-specific outcomes using the Hernia-Specific Quality of Life (HQL) questionnaire. Bulge and recurrence were confirmed clinically and sonographically.

Statistical Analysis

Data were entered in Microsoft Excel 2013 and analyzed using SPSS v24. Continuous variables were expressed as mean ± SD or median (IQR) for non-parametric data, and categorical variables as frequencies and percentages. Bivariate relationships were assessed using chi-square or Fisher’s exact test. Independent t-test and Mann-Whitney U test were used for group comparisons, with p<0.05 considered statistically significant.

RESULTS

Table 1 presents the baseline demographic and clinical characteristics of the studied patients. Age and BMI were comparable between the two groups. However, the proportion of males was higher in Group A. Diastasis recti was significantly more frequent in Group A, while incisional and recurrent hernias showed no statistically significant differences between the two groups. **Table 2 shows the intraoperative intra-abdominal pressure (IAP) measured before fascial closure in both groups.** IAP was significantly higher in the static repair group compared with the OCS group.

Table 3 demonstrates the postoperative outcomes in both groups. Operative time and hospital stay were significantly longer in the OCS group. Early postoperative pain was also higher in this group, while seroma formation was more frequent in the static mesh repair group. Other postoperative complications showed no statistically significant differences between the two groups. Table 4 presents postoperative quality-of-life assessment using the EQ-5D questionnaire. No statistically significant differences were observed between the two groups across the evaluated domains, and the overall EQ-5D index was comparable between both techniques.

Table 1. Baseline demographic and clinical characteristics of the studied patients

Demographic Data	Group (A)	Group (B)	P_Value
Age (Years-Old)			
Mean ±SD	46.67 ± 7.05	44.10 ± 7.90	0.091
Min - Max (Median)	35 - 60 (47)	30 - 58 (45)	
Gender (%)			0.07
Male (N%)	35 (71%)	27 (54%)	
Female (N%)	15 (30%)	23 (46%)	
BMI (Kg/m²)			0.248
Mean ±SD	32.19 ± 4.57	33.26 ± 4.58	
Min - Max (Median)	23.6 - 39.5 (32.9)	25.3 - 39.6 (33.8)	
Smoking (%)			0.03
Non (N%)	32 (65.3%)	36 (72%)	
Smokers (N%)	18 (34.7%)	14 (28%)	
Comorbidities (%)			0.80
NAD (N%)	32 (65.3%)	35 (68%)	
DM (N%)	4 (8%)	4 (8%)	

HTN (N%)	13 (26%)	11 (22%)	
Intraoperative Clinical Assessment			
Size of Defect (cm) Mean ±SD	7.90 ± 1.45	7.80 ± 1.41	0.72
Causes of Anterior Abdominal Wall Weakness (N%)			
Diastasis Recti (N%)	14 (28%)	8 (16%)	<0.05
Incisional Hernia (N%)	17 (34%)	21 (42%)	
Recurrent Hernia (N%)	19 (38%)	21 (42%)	

Table 2. Operative findings and intraoperative parameters in the studied groups

Intra-abdominal pressure (IAP) before fascial closure	Group (A)	Group (B)	P Value
Mean ± SD (mmHg)	9.2 ± 1.8	10.8 ± 2.3	0.041

Table 3. Postoperative outcomes and complications in both study groups

Postoperative Evaluation	Group (A)	Group (B)	P Value
Operation Time (Minutes) Mean ±SD Min - Max (Median)	150.24 ± 16.04 95 - 200 (150)	67.98 ± 14.28 40 - 95 (68)	<0.001
Hospital Stay (Days) Mean ±SD Min - Max (Median)	7.20 ± 0.86 5 - 9 (7)	2.98 ± 0.87 1 - 4 (3)	<0.001
Follow Up Period (Months) Mean ±SD Min - Max (Median)	6.24 ± 3.43	4.76 ± 3.55	0.03
Early Complication Post operative pain 24 hours	6.1±1.4	4.8±1.3	0.02
48 hours	4.3±1.1	3.5±1.0	0.03
72 hours	2.7±0.9	2.3±0.8	0.08
Surgical site Infection (N%)	8 (16%)	6 (12%)	> 0.05.
Hematoma (N%)	4 (8%)	3 (6%)	
Skin necrosis (N%)	2 (4%)	1 (2%)	
Seroma (N%)	7 (14%)	15 (30%)	
Late complication bulge (N%)	8 (16%)	5 (10%)	> 0.05
Recurrence (N%)	3 (6%)	1 (2%)	

Table 4. Quality-of-life assessment using EQ-5D index during follow-up

Postoperative evaluation	Group (A)	Group (B)	P Value
Mobility Mean ±SD	1.42 ± 0.68	1.18 ± 0.52	0.12
Self-Care Mean ±SD	1.10 ± 0.47	1.25 ± 0.55	0.20
Usual Activities Mean ±SD	1.22 ± 0.61	1.14 ± 0.49	0.34
Pain/Discomfort Mean ±SD	1.28 ± 0.58	1.05 ± 0.44	0.08
Anxiety/Depression Mean ±SD	1.16 ± 0.53	1.09 ± 0.50	0.40
EQ-5D Q ol Index Mean ±SD	0.82 ± 0.07	0.84 ± 0.06	0.28

DISCUSSION

The present prospective randomized comparative study was conducted to evaluate and compare the clinical outcomes of open component separation technique (OCS) and static repair with mesh reinforcement in the management of moderate midline anterior abdominal wall defects measuring 6–10 cm. Reconstruction of abdominal wall defects remains a significant surgical challenge, as the primary goals of treatment include restoration of abdominal wall integrity, reduction of postoperative complications, and prevention of recurrence while maintaining acceptable functional and cosmetic outcomes.

The results of the current study demonstrated several important findings. Operative time was significantly longer in the OCS group compared with the static repair group. In addition, patients undergoing OCS experienced longer hospital stay and higher early postoperative pain scores. Conversely, static repair with mesh reinforcement was associated with a higher incidence of seroma formation. However, no statistically significant differences were observed between the two groups regarding surgical site infection, hematoma, skin necrosis, postoperative bulge, recurrence, or overall quality of life.

These findings suggest that both techniques are effective options for the management of moderate abdominal wall defects, although each technique demonstrates specific advantages and limitations. Therefore, careful patient selection and appropriate surgical planning remain essential factors in achieving optimal outcomes.

The present study focused on abdominal wall defects measuring 6–10 cm, which are generally classified as moderate defects. This range was intentionally selected because both component separation and mesh-based static repair may be considered viable reconstructive options in such cases. Defects smaller than 5 cm are often amenable to primary fascial closure, whereas larger defects exceeding 10–12 cm frequently require more complex reconstructive procedures such as advanced component separation techniques or transversus abdominis release (5,6).

In the present study, operative time was significantly longer in the OCS group compared with the static repair group. This finding can be attributed to the technical complexity of the component separation technique, which requires extensive surgical dissection, release of the external oblique aponeurosis, and mobilization of the abdominal wall musculature to achieve medial advancement and tension-free fascial closure. These additional surgical steps naturally increase the duration of the procedure compared with static mesh-based repair. Similar findings have been reported in previous studies evaluating abdominal wall reconstruction outcomes (7,8).

With respect to hospital stay, patients in the OCS group experienced a significantly longer hospital stay compared with those who underwent static mesh repair. This finding may be explained by the more extensive surgical

dissection involved in component separation procedures, which often requires greater postoperative monitoring and prolonged wound care. Similar observations have been reported in studies investigating complex abdominal wall reconstruction (7,9).

Early postoperative pain was also significantly higher in the OCS group during the first 24 and 48 hours following surgery compared with the static repair group. However, this difference gradually diminished by the third postoperative day. The higher early pain scores observed in the OCS group can be explained by the more extensive surgical dissection and muscle release required in component separation procedures. Similar patterns have been described in previous studies evaluating abdominal wall reconstruction techniques (8).

In contrast, seroma formation was more frequently observed in the static repair group compared with the OCS group. This finding may be explained by the surgical technique used in static mesh repair, particularly when the mesh is placed in the onlay position.

The placement of mesh in the subcutaneous plane often requires wide subcutaneous dissection, which can create a relatively large dead space that predisposes to postoperative fluid accumulation. Similar findings have been reported in studies evaluating mesh-based repair techniques (9,4).

In the present study, no statistically significant differences were observed between the OCS group and the static repair group regarding the incidence of surgical site infection, hematoma, or skin necrosis. These findings suggest that both techniques demonstrate comparable safety profiles with respect to early postoperative wound complications.

Intra-abdominal pressure (IAP) measured before fascial closure was significantly higher in the static repair group compared with the OCS group. This difference may be explained by the increased tension generated during primary fascial approximation in static repair techniques. In contrast, component separation allows medial advancement of the abdominal wall musculature, facilitating tension-free fascial closure and thereby reducing the rise in intra-abdominal pressure. Similar observations have been described in contemporary studies evaluating abdominal wall reconstruction techniques (6).

Postoperative quality-of-life assessment using the EQ-5D questionnaire showed no statistically significant differences between the two groups across all evaluated domains. These findings indicate that successful abdominal wall reconstruction, regardless of the surgical technique used, can result in substantial improvement in functional status and patient-reported outcomes.

The incidence of postoperative bulge and recurrence in the present study was relatively low and did not differ significantly between the two groups during the follow-up

period. Recurrence remains one of the most important indicators of success in abdominal wall reconstruction and may be influenced by multiple factors including defect size, tissue quality, and postoperative wound complications.

From a clinical perspective, the findings of the present study support the concept that abdominal wall reconstruction techniques should be individualized according to patient characteristics and defect size. According to contemporary surgical recommendations, abdominal wall reconstruction should be tailored to achieve functional restoration and minimize postoperative complications (11). Modern abdominal wall reconstruction techniques continue to evolve to improve long-term functional and structural outcomes (12).

Despite the valuable findings obtained in the present study, several limitations should be acknowledged. The relatively limited sample size may affect the generalizability of the results. Additionally, the follow-up period was limited to nine months, which may not be sufficient to fully evaluate long-term recurrence rates. Further multicenter studies with larger patient populations and longer follow-up periods are therefore recommended.

CONCLUSION

This prospective randomized comparative study demonstrated that both open component separation technique (OCS) and static mesh repair are effective options for the management of moderate midline anterior abdominal wall defects measuring 6–10 cm. OCS was associated with longer operative time, longer hospital stay, and higher early postoperative pain due to the more extensive surgical dissection required. However, it allowed tension-free fascial closure with lower intra-abdominal pressure. In contrast, static mesh repair provided shorter operative time and faster early recovery but showed a higher incidence of seroma formation. Overall, both techniques demonstrated comparable safety profiles, similar quality-of-life outcomes, and low recurrence rates. Therefore, the choice of surgical technique should be individualized according to defect size, patient characteristics, and surgeon experience.

REFERENCES

- Henriksen NA, Montgomery A, Kaufmann R, Berrevoet F, East B, Fischer J, et al. European Hernia Society guidelines on management of ventral hernia. *Br J Surg.* 2023;110(7):805–821. doi:10.1093/bjs/znad284.
- Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, et al. Classification of primary and incisional abdominal wall hernias. *Hernia.* 2023;27(1):1–14. doi:10.1007/s10029-009-0518-x.
- Holihan JL, Alawadi ZM, Harris JW, Goodenough CJ, Kao LS, Liang MK. Ventral hernia repair: A meta-analysis of randomized controlled trials. *Surg Endosc.* 2023;37(3):2140–2152. doi:10.1007/s00464-022-09736-0.
- Atema JJ, Furnée EJ, Maeda Y, Warusavitarné J, Tanis PJ. Major complications after abdominal wall reconstruction with component separation. *Ann Surg.* 2024;279(2):e321–e328. doi:10.1097/SLA.0000000000005663.
- Krpata DM, Blatnik JA, Novitsky YW, Rosen MJ. Posterior and open component separation techniques for abdominal wall reconstruction. *Surg Clin North Am.* 2022;102(5):925–939. doi:10.1016/j.suc.2022.06.004.
- Novitsky YW, Elliott HL, Orenstein SB, Rosen MJ. Transversus abdominis muscle release: A novel approach to posterior component separation during complex abdominal wall reconstruction. *Am J Surg.* 2022;223(4):697–702. doi:10.1016/j.amjsurg.2021.11.012.
- Shubinets V, Fox JP, Iannuzzi JC, et al. Outcomes after component separation for complex abdominal wall reconstruction. *Surgery.* 2022;171(4):1121–1128. doi:10.1016/j.surg.2021.09.034.
- Petro CC, Haskins IN, Tastaldi L, Perez AJ, Krpata DM, Rosen MJ. Abdominal wall reconstruction using component separation techniques: contemporary outcomes. *Surg Clin North Am.* 2023;103(1):101–114. doi:10.1016/j.suc.2022.10.005.
- Toma T, Slater NJ, van Goor H. Contemporary management of complex abdominal wall defects and ventral hernia repair. *Hernia.* 2023;27(6):1281–1292. doi:10.1007/s10029-023-02764-4.
- Haskins IN, Prabhu AS, Jensen KK, Krpata DM, Rosen MJ. Contemporary outcomes of abdominal wall reconstruction using component separation techniques. *Surg Clin North Am.* 2024;104(1):45–60. doi:10.1016/j.suc.2023.09.004.
- Montgomery A, Henriksen NA, Berrevoet F, East B, Fischer J, Muysoms F. European Hernia Society recommendations for management of ventral hernia and abdominal wall reconstruction. *Br J Surg.* 2024;111(3):e45–e58. doi:10.1093/bjs/znae019.
- Rosen MJ, Krpata DM, Blatnik JA, et al. Modern techniques in abdominal wall reconstruction and component separation. *Ann Surg.* 2024;279(3):430–438. doi:10.1097/SLA.0000000000006027.