The European Research Journal 2021;7(3):297-303 Original Article

DOI: 10.18621/eurj.710303 *General Surgery*

Comparison of the outcomes of 'component separation with mesh', 'component separation without mesh' and 'primary prosthetic repair' methods in complex abdominal wall reconstruction

Ufuk Arslan, Umut Eren Erdoğdu

Department of General Surgery, University of Health Sciences, Bursa Yüksek Ihtisas Training and Research Hospital, Bursa, Turkey

ABSTRACT

Objectives: The aim of this study is to compare the results of different surgical methods used in giant midline incision hernias.

Methods: The records of 90 patients operated on for a midline abdominal incisional hernia were reviewed retrospectively. The patients were divided into three groups based on the surgical method used primary prosthetic repair (PPR), component separation with mesh (CSM) and component separation without mesh (CS). Two-year follow-up results were compared.

Results: A statistically significant difference was noted between the groups in the transverse diameter measurement of the defect ($p = 0.003$). Subgroup analyses revealed that the median transverse diameter was higher in the CSM group than in the CS group ($p = 0.003$). There was also a statistically significant difference in the duration of surgery ($p < 0.001$), with a subgroup analysis revealing that the duration of surgery was longer in the CSM group than in the PPR and CS groups (PPR-CSM; $p = 0.008$, CSM-CS; $p < 0.001$). Recurrent incisional hernia, smoking and postoperative morbidity development were found to be statistically and significantly associated with recurrence ($p = 0.005$, $p = 0.002$, $p < 0.001$; respectively).

Conclusions: The use of the CSM method for the repair of giant incisional hernias may reduce recurrence.

Keywords: Component separation, incisional hernia, mesh, recurrence

Patients undergoing abdominal surgery are likely to develop incisional hernias at a rate of 9-20% [1]. The primary treatment approach to incisional hernias is surgery, with an increased likelihood of morbidity and mortality due to hernia complications in untreated patients [2, 3]. The reconstruction approach in the presence of giant midline abdominal wall incisional hernias is challenging in terms of the selection and implementation of the optimum method, and the high morbidity and relatively high recurrence rates in the postoperative period [4].

One of the most common surgical approaches to incisional hernias is reconstruction with prosthetic materials [5]. The component separation technique was first described as "tension relieving" in epigastric hernias, and is today used to repair incisional hernias [6, 7]. The component separation technique has been reported to result in a lower tension at the repair site,

Received: *March 27, 2020;* ***Accepted:*** *May 6, 2020;* ***Published Online:*** *January 31, 2021*

How to cite this article: *Arslan U, Erdoğdu UE. Comparison of the outcomes of 'component separation with mesh', 'component separation without mesh' and 'primary prosthetic repair' methods in complex abdominal wall reconstruction. Eur Res J 2021;7(3):297-303. DOI: 10.18621/eurj.710303*

Address for correspondence: *Ufuk Arslan, MD., University of Health Sciences, Bursa Yüksek Ihtisas Training and Research Hospital, Department of General Surgery, Mimar Sinan mah., Emniyet Caddesi, Yıldırım, 16310, Bursa, Turkey. E-mail: drufuk33@hotmail.com, Mobile phone: +90 530 1321658*

e-ISSN: 2149-3189

and lower postoperative morbidity and recurrence rates [8-10].

The present study aimed to compare the outcomes of the primary prosthetic repair (PPR), component separation with mesh (CSM) and component separation without mesh (CS) techniques in giant midline incisional hernias.

METHODS

In the present study, the data of 90 patients who were operated on for a midline abdominal incisional hernia, and who completed two years of follow up between January 2016 and 2018, were reviewed retrospectively. The patients were divided into three groups based on the surgical method used (PPR, CSM and CS), with each group including 30 patients. Prior to surgery, detailed information of the surgical method was provided to the patients, and their written informed consent was obtained. The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki.

The study included patients over the age of 18 that completed two years of follow up. Patients operated on using different methods, those with a hernia with a transverse diameter < 6 cm, those undergoing emergency surgery and those with a stoma were excluded from the study.

Demographic information, Body Mass Index (BMI), American Society of Anesthesiologists (ASA) scores, transverse diameter of hernia defect, status of being primary or recurrent hernia, duration of surgery, morbidity, length of stay in hospital and recurrence rates after two-year follow up of all patients were recorded and compared. Patients that had undergone previous incisional hernia surgery were assessed as "recurrent incisional hernia".

Operative Technique

Primary Prosthetic Repair (PPR) Technique

After intraabdominal adhesions were removed and the intact fascia rims were exposed, the abdomen was closed using absorbable continuous sutures. The skin and subcutaneous tissue were mobilized laterally through the anterior rectus sheath to create space for the mesh placement. A non-absorbable polypropylene synthetic mesh (Prolene mesh, Ethicon) was then placed into this space.

Component Separation with Mesh [CSM] or without Mesh [CS] Technique

After intraabdominal adhesions were removed and intact fascia rims were exposed, the skin and subcutaneous adipose tissue were dissected bilaterally around 3-4 cm lateral to the linea semilunaris. The aponeurosis of the external oblique muscle was exposed around 1-2 cm laterally from the end of the rectus sheath (Fig.

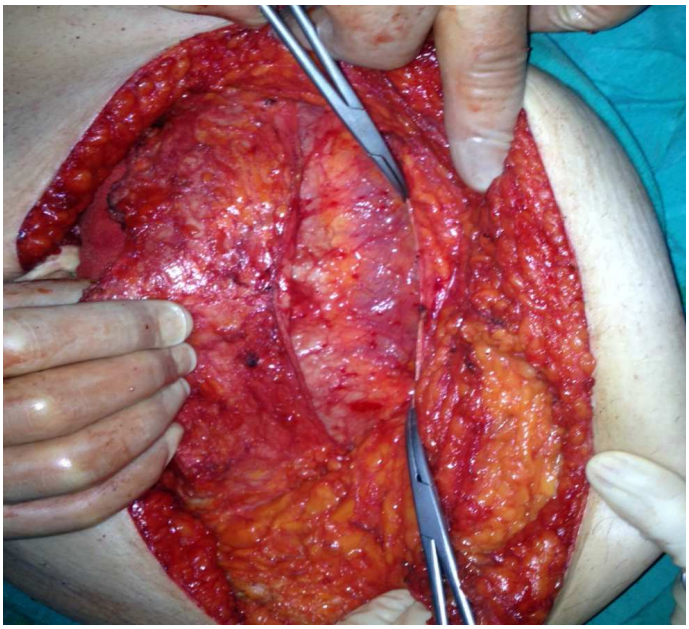

Fig. 1. Unilateral component separation.

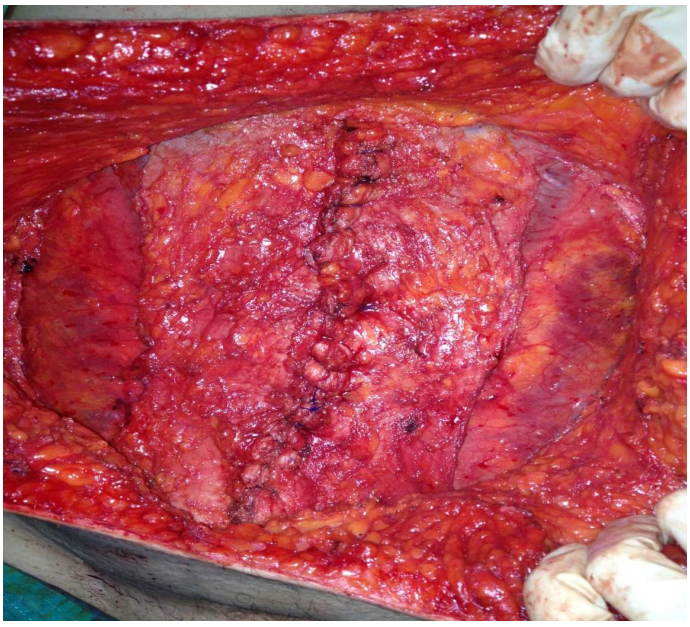

Fig. 2. Final component separation.

1). The myoaponeurosis of the external oblique muscle was transected longitudinally as far as the costa at the superior and the inguinal ligament at the inferior. The avascular area between the external oblique muscle and the internal oblique muscle was dissected. In this technique, the abdominal wall was unilaterally advanced to the midline by about 3-5 cm at the upper edge of the rectus muscle, 7-10 cm at the waistline and 1-3 cm at lower abdomen (Fig. 2). In the CSM group, a prolene mesh was placed on this area after closing the abdomen, while in the CS group, no mesh was used.

Perioperative Care

All surgeries were performed under general anesthesia. A urinary catheter was inserted into each patient and removed at the postoperative 2nd hour. Anti-embolism stockings were applied to every patient, and enoxaparin (Clexane, Sanofi Aventis) was administered to those with a BMI > 30 for embolism prophylaxis. All patients received prophylactic antibiotherapy prior to surgery. Wounds were monitored daily for hematoma, seroma and skin necrosis. Patients with wound site infections were administered antibiotic treatment based on culture results. Two aspirative drains were placed subcutaneously into the patients from all groups as routine. When the drainage amount decreased below 50 cc, the drains were removed. Patients were called for controls at 3, 6, 12 and 24 months, and checked with a physical examination. Cases suspected of recurrence during the physical examination were examined further with ultrasonography or computerized tomography.

Statistical Analysis

A Shapiro-Wilk test was used to assess whether the variables followed a normal distribution. Variables were reported as mean±standard deviation or median (minimum: maximum). Based on the results of the normality test, ANOVA or Kruskal Wallis tests were used for the comparison of the groups. A Dunn test was also performed after the Kruskal Wallis test for a pairwise comparison. Categorical variables were compared with Chi-square, Fisher's exact or Fisher-Freeman-Halton tests. To determine the independent risk factors affecting recurrence development, a binary lo-

Table 1. Patient's demographic data

	PPR (n = 30)	CSM (n = 30)	CS (n = 30)	*p*-value	Pairwise Comparisons		
					p_{1-2}	p_{1-3}	p_{2-3}
Age (year)	55.73 ± 12.06	57 ± 11.58	54.80 ± 12.20	0.775[a]	-	-	-
Gender (F/M)	17/13	16/14	17/13	0.956[b]	-	-	-
Weight (kg)	74.83 ± 8.22	75.63 ± 10.47	74.93 ± 12.73	0.951[a]	-	-	-
BMI	26.47 ± 2.46	26.34 ± 2.62	26.88 ± 2.82	0.712[a]	-	-	-
Defect (cm) (transverse diameter)	10 (7:17)	11.50 (7:24)	8 (7:23)	**0.003[c]**	0.942[e]	0.063[e]	**0.003[e]**
ASA, n (%)							
I	7 (23.30)	9 (30)	12 (40)	0.355[d]	-	-	-
II	12 (40)	11 (36.70)	14 (46.70)				
III	10 (33.30)	9 (30)	3 (10)				
IV	1 (3.30)	1 (3.30)	1 (3.30)				
Smoking, n (%)	6 (20)	5 (16.70)	7 (23.30)	0.812[b]	-	-	-
Recurrence/Primary, n (%)							
Recurrence	4 (13.30)	5 (16.70)	8 (26.70)	0.390[b]	-	-	-
Primary	26 (86.70)	25 (83.30)	22 (73.30)				

Data are shown as mean ± standard deviation or n (%) or median (minimum: maximum). PPR = Prosthetic repair, CSM = Component separation technique with mesh, CS = Component separation technique without mesh

[a]ANOVA test, [b]Chi-square test, [c]Kruskal Wallis Test, [d]Fisher-Freeman-Halton Test, [e]Dunn Test

gistic regression analysis was performed. SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) software was used for the statistical analyses. A p - value of ≤ 0.05 was considered statistically significant.

RESULTS

Demographic data of the patients from all groups were evaluated (Table 1). There was no difference in age, gender, weight and BMI between the groups. There was a statistically significant difference in transverse diameter of the defect between the groups (p = 0.003). Subgroup analyses revealed that the median transverse diameter was higher in CSM group compared to CS group (p = 0.003). No statistically significant difference was found in ASA score, smoking status and primary or recurrent nature of hernia between the groups ($p > 0.005$).

For the patients in all groups, the duration of surgery, postoperative morbidity, need for reoperation after morbidity, and recurrence rates on the day of hospitalization and during the two-year follow-up period were evaluated (Table 2). Other than wound site complications, no morbidities were detected in the patients. A statistical difference was noted in the duration of surgery ($p < 0.001$), with a subgroup analysis revealing that the duration of surgery was longer in the CSM group than in the PPR and CS groups (PPR-CSM; p = 0.008, CSM-CS; $p < 0.001$). There was no statistical difference in morbidity, length of hospital stay or recurrence in the two-year follow up between the groups. Yet, the recurrence rate was 20% in the CS group and 10% in CSM group (Fig. 3).

A logistic regression analysis was used to examine

Table 2. Follow up data

	PPR (n = 30)	CSM (n = 30)	CS (n = 30)	*p*-value	Pairwise Comparisons		
					p_{1-2}	p_{1-3}	p_{2-3}
Duration of surgery	122.50 (100:195)	140 (105:200)	120 (85:150)	**< 0.001**[c]	**0.008**[e]	0.431[e]	**< 0.001**[e]
Morbidity							
Yes	6 (20)	7 (23.70)	6 (20)	0.935[b]	-	-	-
No	24 (80)	23 (76.70)	24 (80)				
Morbidity							
Hematoma	1 (3.30)	0	0	< 0.99[d]	-	-	-
Seroma	5 (16.70)	6 (20)	6 (20)				
Skin Necrosis	0	1 (3.30)	0				
No	24 (80)	23 (76.70)	24 (80)				
Reoperation for wound complication							
Yes	-	2 (7.10)	0	-	-	-	0.229[f]
No	-	26 (92.90)	30 (100)				
Day of hospitalization	5 (3:13)	5 (3:18)	4 (3:12)	0.078[c]	-	-	-
Recurrence							
Yes	4 (13.30)	3 (10)	6 (20)	0.654[d]	-	-	-
No	26 (86.70)	27 (90)	24 (80)				

Data are shown as mean ± standard deviation or n (%) or median (minimum: maximum). Group 1 = Prosthetic repair, Group 2 = Component separation technique with mesh, Group 3 = Component separation technique without mesh
[b]Chi-square test, [c]Kruskal Wallis Test, [d]Fisher-Freeman-Halton Test, [e]Dunn Test, [f]Fisher's Exact Test

Table 3. Risk factors affecting recurrence

Factor	Wald	*p*-value	OR	95% CI for OR	
				Lower	Upper
Recurrent/Primary					
Primary (ref. cat.)	-	-	1	-	-
Recurrent	7.97	**0.005**	29.91	2.83	316.25
Smoking					
No (ref.cat)	-	-	1	-	-
Yes	9.48	**0.002**	39.73	3.81	413.94
Morbidity					
No (ref.cat)	-	-	1	-	-
Yes	13.10	**< 0.001**	147.58	9.88	220.54
Model χ^2= 98.01; ***p* < 0.001**					
Pseudo R^2= 89%					
N = 90					

OR = Odds ratio, Ref.cat = Reference category, CI = Confidence Interval

such potential risk factors as duration of surgery, BMI, transverse diameter of the hernia, wound complications, smoking status, ASA scoring, primary or recurrent nature of the hernia, age, gender and length of hospital stay, which were likely to affect recurrence development (Table 3). Recurrent incisional hernia, smoking and postoperative morbidity development were found to be statistically associated with recurrence ($p = 0.005$, $p = 0.002$, $p < 0.001$;respectively).

DISCUSSION

The use of tension-free techniques with prosthetic materials for incisional hernia repairs has decreased recurrence rates from 50% to 24% [11]. The risk factors for recurrence following incisional hernia reconstruction have been identified as hernia diameter (> 10 cm), BMI (> 30 kg/m2), history of previous repair, chronic obstructive pulmonary disease and diabetes,

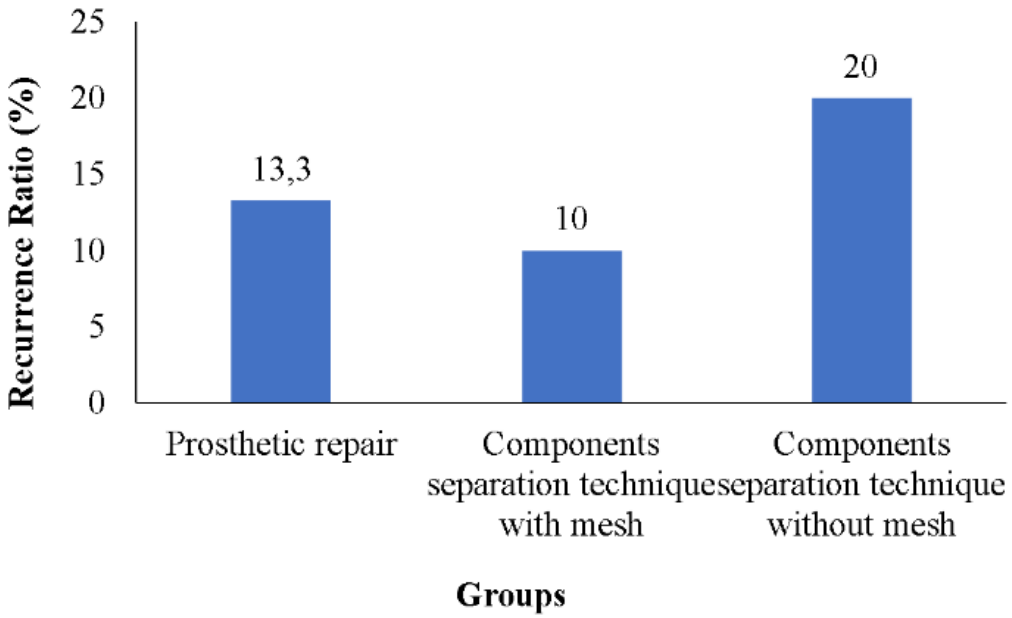

Fig. 3. Recurrence rates between groups during follow-up.

smoking and postoperative wound site complications (surgical site infection, hematoma and seroma) [12, 13] The present study also found that a history of previous repair, smoking and surgical site infection were statistically associated with recurrence development. The use of mesh is recommended as standard in incisional hernia reconstructions [14]. Repairs with mesh have been reported to significantly reduce recurrence rates in CS, as in the standard open ventral hernia repair technique [15, 16]. The goal of tension-free and anatomic repair is to create a neo-linea alba by approximating the rectus muscles again to the midline [17], which enables a tension-free closure of the fascia and its reinforcement with mesh, minimizing the risk of recurrence [18, 19]. In the present study, the recurrence rate during the postoperative two-year follow-up was 13.3% in PPR, 20% in CS and 10% in CSM, meaning no statistical difference in recurrence development between the surgical methods. That said, the recurrence rate was lower in patients with mesh, and lowest in the CSM group. We believe that the failure to identify a statistical difference was due to the low volume of patients, and that a statistical difference may be established in future studies with a larger patient groups.

Wound site complications (hematoma, seroma, skin necrosis and surgical site infection) following the repair of giant incisional hernias may occur in 12-67 % and 12-27 % of patients treated with CS and PPR, respectively [20, 21]. It is believed that wound complications increase with wide dissections, prolonged durations of surgery and ligation of the epigastric perforating arteries at the dissection site [20]. After ligating the epigastric perforating arteries, the supply of skin can only be provided through intercostal arteries and the branches of the pudental artery, leading to wound site perfusion and supply disorders. Although attention was paid to preserving the perforating arteries in the present study, the wound site complication rates were 20%, 23.7% and 20% in the PPR, CSM and CS groups, respectively. A direct association has been identified between wound complications and recurrence risk [12, 13]. The present study also identified a more frequent development of recurrence in patients with wound complications. We believe that termination of smoking, especially in the preoperative period, and taking care to preserve the perforating arteries in patients with recurrent incisional hernia may be helpful.

This study is the first in literature to compare three surgical methods (CS with mesh and without mesh, and primary prosthetic repair) in incisional hernias. Our study is limited by the relatively low number of cases included in the groups and the single-center retrospective design.

In addition, a statistically significant difference was found in the transverse diameter of the hernia defect between the groups (groups 2 and 3, $p = 0.003$). Accordingly, the CSM procedure was applied to hernias with larger diameters, which may be attributed to the non-randomized design of the study. Prospective randomized controlled studies with a larger number of patients are needed for the acquisition of better data.

CONCLUSION

In conclusion, in giant midline incisional hernias, the CS technique is an effective and safe method involving careful dissection and the preservation of perforating vascular structures as far as possible. Nevertheless, we believe that such procedures should be reinforced with a mesh in order to minimize the recurrence rates as the defect size increases. We also believe that there is a need for randomized studies involving larger numbers of patients and evaluating short-term and long-term outcomes in order to determine the place of CS in incisional hernia reconstructions.

Authors' Contribution

Study Conception: UA, UEE; Study Design: UA, UEE; Supervision: UA, UEE; Funding: UA, UEE; Materials: UA, UEE; Data Collection and/or Processing: UA, UEE; Statistical Analysis and/or Data Interpretation: UA, UEE; Literature Review: UEE; Manuscript Preparation: UA and Critical Review: UA, UEE.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The authors disclosed that they did not receive any grant during the conduction or writing of this study.

REFERENCES

1. Hoer J, Lawong G, Klinge U, Schumpelick V. Factors influencing the development of incisional hernia. A retrospective study of 2,983 laparotomy patients over a period of 10 years. Chirurg 2002;73:474-80.
2. Greenawalt KE, Butler TJ, Rowe EA, Finneral AC, Garlick DS, Burns JW. Evaluation of sepramesh biosurgical composite in a rabbit hernia repair model. J Surg Res 2000;94:.92-8.
3. Felemovicius I, Bonsack ME, Hagerman G, Delaney JP. Prevention of adhesions to polypropylene mesh. J Am Coll Surg 2004;198:543-8.
4. 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. World J Surg 2007;31;756-63.
5. Luijendijk RW, Hop WJC, van den Tol MP, de Lange DC, Braaksma MM, Jzermans JN, et al. A comparison of suture repair with mesh repair for incisional hernia. N Eng J Med 2000;343:392-98.
6. Young D. Repair of epigastric incisional hernia. Br J Surg 1961;48:514-6.
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;86:519-26.
8. Lowe JB, Garza JR, Bowman JL, Rohrich RJ, Strodel WE. Endoscopically assisted "components separation" for closure of abdominal wall defects. Plast Reconstr Surg 2000;105:720-30.
9. Maas SM, de Vries RS, van Goor H, de Jong D, Bleichrodt RP. Endoscopically assisted "components separation technique" for the repair of complicated ventral hernias. J Am Coll Surg 2002;194:388-90.
10. Rosen MJ, Jin J, McGee MF, Williams C, Marks J, Ponsky JL. Laparoscopic component separation in the single-stage treatment of infected abdominal wall prosthetic removal. Hernia 2007;11:435-40.
11. Van't Riet M, de Vos van Steenwijk PJ, Bonthuis F, Marquet RL, Steyerberg EW, Jeekel J, et al. Prevention of adhesion to prostetic mesh: comparison of barriers using an incisional hernia model. Ann Surg 2003;237:123-8.
12. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS]) - Part III. Surg Endosc 2014;28:380-404.
13. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS]) - Part II. Surg Endosc 2014;28:353-79.
14. Yoo A, Corso K, Chung G, Sheng R, Schmitz ND. The impact of surgical approach on late recurrence in incisional hernia repair. JSLS 2018;22:e2018.00053.
15. Joels CS, Vanderveer AS, Newcomb WL, Lincourt AE, Polhill JL, Jacobs DF, et al. Abdominal wall reconstruction after temporary abdominal closure: a ten-year review. Surg Innov 2006;13:223-30.
16. 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;124:836-47.
17. Buchwald H. Three helpful techniques for facilitating abdominal procedures, in particular for surgery in the obese. Am J Surg 1998;175: 63-4.
18. Petersen S, Henke G, Zimmermann L, Aumann G, Hellmich G, Ludwig K, et al. Ventral rectus fascia closure on top of mesh hernia repair in the sublay technique. Plast Reconstr Surg 2004;114:1754-60.
19. Kulhánek J, Mestak O. [Reconstruction of complex abdominal wall defects using the component separation technique]. Rozhl Chir 2013;92:640-3. [Article in Czech]
20. Ennis LS, Young JS, Gampper TJ, Drake DB. The ''open-book'' variation of component separation for repair of massive midline abdominal wall hernia. Am Surg 2003;69:733-42.
21. Maloney SR, Schlosser KA, Prasad T, Colavita PD, Kercher KW, Augenstein VA, et al. The impact of component separation technique versus no component separation technique on complications and quality of life in the repair of large ventral hernias. Surg Endosc 2020;34:981-7.