Quality of Life after Complex Abdominal Wall Reconstruction

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Keywords

Endoscopic component separation · Ventral hernia repair · Quality of life · Abdominal wall reconstruction · Ramirez

Abstract

Background: Component separation (CS) for tension-free approximation of fascial edges is the established technique for the repair of large ventral hernias mostly regarding mid-line defects. Recent studies suggest lower complication rates following a modified version of this technique using a partially endoscopic-assisted approach, whereas little is known about the quality of life (QoL) in the long-term evaluation of these patients. **Methods:** A retrospective study and analysis of patients undergoing hernia repair using an open CS (OCS) and endoscopically assisted CS (ECS) technique, respectively, from 2011 to 2016 at the Rostock University Medical Center. Patients underwent a mesh-based sublay reinforcement following a distinct CS with closure of the linea alba. Patient characteristics, technical details, and short-term postoperative outcomes were determined by a physician chart review. A health-related QoL survey (EQ-5D) including a pain assessment was evaluated at a median of 19.5 months postoperatively. **Results:** Thirty-five patients had a CS: 25 OCS and 10 ECS. Perioperative variables were comparable except for the median defect size (169 cm² OCS vs. 86 cm² ECS; $p < 0.05$) and maximum width of hernia (25 vs. 13 cm). Hospitalization lasted 16.6 days in the OCS group and 7.9 days in the endoscopic group ($p = 0.04$). Wound complications occurred in 24% of OCS and 10% of ECS patients. **Conclusions:** Patients in the ECS group had a shorter hospital stay and less minor and major wound complications.

These advantages led to a faster recovery directly affecting the QoL in the ECS group. This effect diminishes in the long-term follow-up with a positive trend towards the OCS technique.

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Introduction

Incisional hernias are a common postoperative complication with an incidence of 5–20% following open abdominal procedures [1–3] and 1–3% following minimally invasive abdominal procedures [3–5]. Several risk factors including obesity, smoking habits, genetic disposition, and particularly the type and approach of previous surgical procedures with a focus on postoperative wound healing impairments increase the risk for incisional hernia occurrence up to 55% [6]. Musculofascial component separation (CS), initially described by Ramirez et al. [7], offers theoretically physiological advantages for the repair of abdominal wall defects. Initially described as a mesh-free method of approximation of the rectus muscle and reconstruction of the *linea alba*, it now follows the current standard of mesh reinforcement [8, 9] with the crucial aim of leaving no bridging defect for the mesh by full coverage of the alloplastic material with tissue on both sides.

Open anterior CS (OCS) has considerable consequences for midline skin perfusion and wound healing, particularly in contaminated, irradiated, and/or previously surgically altered abdominal walls. Recently published guidelines have taken this into account and de-

clared OCS a technique with limited recommendation [10].

Prior to this, several groups have described less invasive CS approaches recognizing the above-mentioned limitations [11–13]. This led to the approach that provides direct access to the lateral abdominal wall by using balloon dissectors and endoscopic visualization. The technical feasibility of this procedure has been described recently [14–16]. A disadvantage of the endoscopically assisted CS (ECS) is the reduced gain of abdominal wall advancement [17]. When assessing results of ventral hernia surgery, it is important to consider the full range of outcome parameters that are important to the individual patient: postoperative surgical complications, short-, mid-, and long-term general mortality analogous to visceral surgery, recurrence, patient satisfaction, and functional outcomes affecting quality of life (QoL). Long-term pain, patient satisfaction, and function have been reported in only a few small observational studies [18, 19]. Some authors even imply that there is no significant benefit of mesh utilization in the long term [9, 20].

Methods

After obtaining Institutional Review Board approval, all patients undergoing OCS or ECS for complex abdominal wall reconstruction from January 2012 to October 2016 at the University Medical Center of Rostock were reviewed retrospectively. Patients had to sign a consent form in order to take part in this study and the consecutive follow-up.

When feasible, ECS was offered to patients. The clinical characteristics of the abdominal wall and the defect size were the main parameters for the decision towards ECS. Ultrasound and/or CT were not obligatory and were only primarily done to evaluate hernia sac content and a possible “loss of domain” situation when clinically assumed. According to Harth and Rosen [21], the open approach was selected in patients who required skin advancement or removal, and in patients who were expected to require extensive adhesiolysis, mostly after open abdominal treatment. Medical records were analyzed for patient demographics, including gender, age, comorbidities, body mass index, prior abdominal surgeries, surgical indication, and preoperative pain scores. Perioperative data included the American Society of Anesthesiology (ASA) classification, defect size of the hernia, CS technique used, and mesh type and size required. Outcomes were evaluated for hospital length of stay, postoperative complications including major and minor wound complications, need for reoperation, and hernia recurrence.

Wound complications were classified as major when either a surgical procedure or percutaneous drainage was required, and minor when local bedside debridement, oral/intravenous antibiotics, and/or use of negative pressure therapy were used for treatment. The classification of Dindo et al. [22] was adopted to achieve a comparable grouping.

The follow-up consisted of outpatient visits or mailed surveys. At the time of this report, 32 of 35 patients were available for evaluation. Average length of follow-up was 20.7 months (median 18, IQR 6–28). The validated German version of the EQ-5D Health Questionnaire, which consists of 2 scores: the EQ-5D descriptive

system and the EQ visual analogue scale (EQ-VAS), was used. The EQ-5D descriptive system consisted of 5 dimensions (mobility, self-care, daily activities, pain, or discomfort, and psychological state) in 5 levels (no problems, slight, moderate, severe, and extreme problems). We compared these items with their levels in a reference population that originates from an evaluation of a sample of 3,552 persons [23]. König et al. [23] used time to trade-off techniques to determine valuations (perfect health and death have utilities of 1 and 0, respectively) [24]. The EuroQol also contains an EQ VAS on which persons can rate their overall health state by placing a mark on a vertical scale which ranges from 0 (worst imaginable health state) to 100 (best imaginable health state).

Additionally, we included in our questionnaire the time span from operation to full return to work when applicable (potentially or formerly employed patients).

Hernia recurrence was determined using our follow-up evaluation. All patients had a postoperative physical examination within 3 months after surgery. In case a further surgical or interventional procedure was indicated, indication and type of treatment were noted when required. Statistical analysis was performed using R! software [25]. Percentages were evaluated using either the χ^2 test or the Fisher exact test. Continuous variables were evaluated using the Mann-Whitney test. A *p* value of less than 0.05 was considered significant.

Surgical procedures were performed as follows. Patients were operated in back-spine position. A single-shot of antibiotic (cefazolin 2 g i.v.) was given just before incision; this was repeated when operation time exceeded 3 h. The use of incision foil was not generally adopted.

When performing ECS, we started preparing the dissection plane between the internal and external oblique muscles using a trocar balloon (Spacemaker Dissection Balloon; Covidien Ltd., Dublin, Ireland) and consecutive blunt dissection. An insufflation pressure of 20 mm Hg was used to maintain the space. Trocar positioning started with an 11-mm port above the costal arch in mid-clavicular line, meticulously aiming lateral to the hernia and sparing the rectus sheath and muscle. Another 11-mm port was then introduced under vision through an incision above the inguinal ligament in midclavicular line; an additional 5-mm trocar was used halfway between the first two, entered in the anterior axillary line. This setting allowed the individual switching of the camera and instruments (scissors and hook), with a final incision in the external oblique aponeurosis [26, 27] (Fig. 1–3). The procedure was performed bilaterally and ended with the placement of suction drains (Ch 12). Then the defect was approached using an open midline incision.

The open procedure started by wide excision of the scar tissue intentionally performing a median laparotomy; a panniculectomy was necessary in case of former open abdomen situation with secondary wound healing or skin mesh use. The abdominal cavity was opened stepwise avoiding enterotomy. Meticulous adhesiolysis was done if needed. A systematic interenteric adhesiolysis was not generally performed. The hernia sac in its subcutaneous position stayed primarily untouched. Instead, the rectus muscle was manually identified, and the anterior fascial sheath of the rectus muscle was approached by transecting through the hernia sac approximately 1 cm atop of the hernia ring usually at the level of the maximum width of the defect. Following this plane, the anterior rectus sheath could be dissected beyond the linea semilunaris when performing an anterior CS. When a transverse abdominis release was planned or the CS was already done by the endoscopic technique, the anterior sheath was only defined and followed to the xyphoid and pubic bone for further processing. The anterior CS led to the complete identification of the linea semilunaris sparing perforator vessels if possible and leaving remnants of fatty tissue on the

Fig. 1. **a** Combined balloon-controlled and blunt dissection opens up the space between external oblique fascia and internal oblique muscle. **b** Transection of the external oblique fascia was achieved using the electric hook and the scissors. **c** Complete vertical transection of the external oblique fascia gives access to the subcutaneous fatty tissue that can be bluntly dissected to achieve maximum component separation.

Fig. 2. Postoperative complications according to Clavien-Dindo for open component separation (**a**) and endoscopic anterior component separation (**b**) [22].

fascia if feasible. The following incision of the external oblique fascia 1–2 cm lateral to the linea semilunaris was vertically completed from the costal arch to the inguinal ligament. A blunt dissection achieved a medial advancement of the rectus-fascial muscle complex. This procedure was done bilaterally. The next step was opening of the rectus sheath by incision of the anterior fascia just at the edge of the former hernia ring and completion vertically from the retroxyphoid space (fatty triangle) to the retropubic space (Retzius). The resulting retrorectus space for the mesh augmentation was dissected bluntly sparing the epigastric vessels.

When performing a transversus abdominis muscle release, the posterior fascia was incised 1 cm medially to the linea semilunaris, and the M. transversus abdominis became visible. A combination of transecting the muscle fibers by coagulation and blunt dissection gave the necessary gain to the midline advancement. Whether

an anterior or posterior (transversus abdominis muscle release) procedure was necessary or feasible was mainly decided intraoperatively.

In case of excessive intraoperative abdominal pressure monitored by blood pressure, respiration pressure, or the missed chance to close the posterior and/or anterior fascia, a combination of anterior and posterior CS was inevitable ($n = 2$). In case of ECS, the medial gain was automatically achieved when opening the rectus sheath. The posterior sheath was closed by resorbable continuous suture loops (MonoMax®; B. Braun Melsungen AG) after placement of an intraabdominal drainage.

The placement of the mesh in the sublay (retrorectus) position covered full midline using a Parietex Progrid Mesh (Covidien), alternatively Dynamesh CICAT (Dahlhausen), and in 1 case the biologic mesh Strattice (LifeCell Corp., Branchburg, NJ, USA). As

Fig. 3. Health-related quality of life (a) and self-rated health (b) compared to the reference population.

Table 1. Demographics and perioperative parameters (medians)

	Overall	OCS	ECS	<i>p</i> value
Follow-up, months	19.5	21	13	0.12
Age, years	58	56	59	0.954
Sex, males/females	21/14	15/10	6/4	1
BMI, kg/m ²	29.7	29.7	29.3	0.5
Smokers, <i>n</i>	12	9	3	1
ASA score, I/II/III	0/12/23	0/9/16	0/3/7	1
Length of stay, days	14	16.6	7.9	0.04
Duration of operation, min	187	187	184	0.21
Defect size, cm ²	126	169	86	0.001
Width, cm	12	14.5	10	0.013
Previous incisional hernia repair	5	4	1	1
Impending abdominal compartment	4	3	1	1
C-reactive protein, mg/L				
Preoperatively	3.4	3.51	2.45	0.412
Postoperative day 3	160	179.5	117	0.33
Postoperative day 7	74.8	75.65	69.2	0.8

ASA, American Society of Anesthesiologists; defect size, length × width × $\pi/4$.

above, the mesh suction drains (Ch 16) were placed, and the hernia sac was excised. The anterior rectus sheath was closed analogous to the posterior one. The subcutaneous space was drained and re-constructed by interrupted sutures; skin closure was performed with tacks.

Results

Among the 35 patients operated on during the study period, 32 (91.4%) were successfully contacted for long-term evaluation and represent the study population. Two patients died; the causes of death were not related to the repair but were linked to acute or chronic liver failure;

1 person refused to cooperate due to communication problems.

There were 25 patients who had OCS and 10 who had ECS. No conversion of the minimally invasive approach was necessary. The demographics of the patients were comparable in both groups (Table 1).

Regarding the perioperative parameters, the median hernia size was significantly smaller in the ECS group with 86 cm² compared to 169 cm² in those that had undergone open repair (OCS). Accordingly, the median width of the hernia was more than 30% smaller in the ECS group (OCS 14.5 [IQR: 10–18] vs. ECS 10 [IQR: 8–12]). In contrast, no difference in the median operation time was noted (187 vs. 184 min).

The mean length of hospital stay postoperatively was 7.9 versus 16.6 days in open repair ($p < 0.04$). Overall, there were no statistical differences in complication rates when comparing both groups.

One patient (10%) in the minimally invasive group experienced postoperative wound complications in comparison with 6 patients (24%) in the open group ($p = 0.53$) (Table 2).

Hematoma/seroma was seen in 1 patient (10%) in the endoscopically (assisted) group and required CT-guided drainage (Fig. 1a, b). Three patients (12%) in the open group had a clinically evident hematoma ($p = 1$) but required no further treatment. Four patients in the open group (16%) had prolonged seroma formation that persisted up to 4 months following abdominal wall repair but were managed conservatively.

The only recurrence was detected in the ECS group. However, at the time of the operation, this patient had an epicycstostomy in situ, and the abdominal wall could not be completely reinforced by a mesh.

Three patients in the OCS group suffered severe pulmonary complications requiring tracheotomy and prolonged ICU support (max. 21 days).

The median EuroQol and VAS scores evaluated during the follow-up are summarized in Figure 2. No significant differences between OCS and ECS patients were observed except for a slight tendency towards a better outcome in the OCS group. Both groups showed significant differences ($p < 0.05$ for OCS/ $p < 0.01$ for ECS) compared to the standardized reference population (Fig. 2a). Surprisingly, these differences diminished when measuring the overall health state on VAS basis (Fig. 2b).

Regarding age, 28 patients were <65 years; 12 of these 28 (42%) patients were postoperatively returning to employment. With respect to the duration of return to work, it was only 0.5 weeks shorter (6 vs. 6.5 weeks) for the ECS group.

Discussion

When assessing results of ventral hernia surgery, it is important to consider the full range of outcome parameters that significantly affect the individual patient: postoperative surgical complications, short-, mid-, and long-term general mortality analogous to visceral surgery, recurrence, patient satisfaction, and functional outcome affecting QoL.

Recurrence may always occur but even more so in the course of time. In contrast to other hernia types, the complete recurrence rate will show their full amount rather on a 10-year follow-up [28]. Long-term pain, patient satisfaction, and functional parameters have been reported only in a few, small, observational studies [18, 19]. Even

Table 2. Complications after component separation

	ECS	OCS
Surgical complications		
Superficial	0	2
Subfascial	0	1
Necrosis	0	3
Hematoma	1	3
Seroma	1	4
Others	0	3
Recurrence	1	0
Reoperation	1	6

large comprehensive long-term studies in ventral hernia repair lack dependable elementary statements [9]. The call for multicenter studies with long-term follow-up remains [29].

To our knowledge, this study represents the first study comparing ECS with OCS for abdominal wall defects regarding QoL. While our experience confirms that the endoscopic approach is safe, our data suggest that there may be advantages for the open approach. In our small cohort, clinical outcome and QoL did not significantly differ for each CS method in a systematic follow-up.

The additional focus regarding QoL in our setting of abdominal wall reconstruction as an extraordinary effort to involve endoscopically assisted techniques does not only point to acceptable clinical outcomes but also asks for better QoL for these patients.

We found, as others have, that CS techniques generally improve the QoL in patients with large ventral hernias [30–32]. The use of a global health-related QoL index has been established [30], but the number of patients is still low [31]. There seems to be consensus that the restoration of the linea alba does not only improve abdominal wall function but also QoL [31, 32]. There are no published studies comparing long-term QoL outcomes for different CS techniques.

The difference in wound complications between the 2 techniques reaches statistical significance, which have clinically important implications. Major wound complications can result in prolonged hospital stay, costly reoperations and expensive long-term wound therapy. We give evidence that ECS is associated with a decreased likelihood of requiring subsequent surgical procedures. This is evident in the 8.7-day reduction in hospitalization in the endoscopic group.

There is a negative effect of hernia width and subsequently used mesh size to the occurrence of complications [33].

The decision to perform an ECS in our study led to a selection bias because very large hernias were approached primarily conventionally (OCS). Therefore, the superior-

ity of ECS over OCS might be related to the maximum width of the defect. Taking the differences in the defect size into account by removing patients with the biggest defect size, the OCS results in a postoperative complication rate similar to the ECS.

The low recurrence rate in our cohort of CS is based on the principle of stabilizing the whole abdomen vertically and is therefore not the issue we struggle with when closing smaller defects [34, 35].

Evolution of complex abdominal wall reconstruction shows a trend toward posterior CS techniques, especially transversus abdominis muscle release [36, 37], but ECS still remains an attractive approach [29]. We were able to include defects of up to 122 cm², with a maximum defect width of 13 cm. It seems unfavorable to include patients with the above-mentioned limitations, but if CS is necessary, ECS may be the best indication to prevent wound healing disorders.

We conclude that a precise description of the technique is crucial but will raise even more questions about the use of CS in ventral hernia repair. In our opinion, analysis of postoperative QoL after an appropriate time span is the best option to control the quality of surgery.

Statement of Ethics

The study protocol was approved by the Institutional Review Board.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

M.P. wrote the main parts of the manuscript and made the final structure and corrections of the manuscript.

M.L. developed the structure of the manuscript, reviewed the literature, wrote parts of the manuscript, and created figures; E.K. gave substantial implications for the manuscript and revised the manuscript critically.

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