Open Access

Annals of Surgical Case Reports & Images

ISSN 2996-7414

Volume 2 | Case Report

Use of the abdominal re-approximation anchor system in a devastating penetrating abdominal injury

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Abstract

The primary fascial closure of the open abdomen after damage control surgery following complex traumatic injury has been an evolving technique. This case report presents a 42-year-old female who sustained a left upper quadrant abdominal gunshot wound, with injuries including splenic hilum avulsion, anterior and posterior gastric body laceration, 2 duodenal lacerations (third and fourth portions), grade 2 pancreatic head laceration, complete transection of the Superior Mesenteric Vein (SMV), and two jejunal enterotomies. The patient underwent damage control laparotomy, thoracotomy with aortic cross-clamping, splenectomy, partial gastrectomy, duodenal and jejunal resections left in discontinuity, and SMV ligation. Surgical reoperations were performed on post-injury day 2 and 3 to establish the continuity of the bowel with Roux-en-Y gastrojejunostomy, primary repair of duodenal injury and jejunal anastomosis. On post-injury day 4, the abdomen was deemed ready for closure, however, there was a very large 31 cm fascial defect. To close this sizeable defect, the Abdominal Re-Approximation Anchor (ABRA) system (Southmedic), in conjunction with a wound Vacuum-Assisted Closure (VAC) device, was employed. Using serial approximations of the ABRA, complete myofascial and skin closure was achieved on day 10 after placement of the ABRA. This case demonstrates that abdominal closures are possible in severely injured trauma patients who undergo multiple laparotomies who develop very large abdominal wall defects from loss of domain.

Received: Dec 17, 2024

Accepted: Jan 23, 2025

Published Online: Jan 30, 2025

Journal: Annals of Surgical Case Reports & Images

Online edition: https://annscri.org

Cite this article: Sugiyama A, Ruff TT, Albini PT, Yala LI, Nguyen AT, et al. Use of the abdominal re-approximation anchor system in a devastating penetrating abdominal injury. Ann Surg Case Rep Images. 2025; 2(1): 1062.

Keywords: Trauma; Open abdomen; Abdominal wall defect; Loss of domain; ABRA; Abdominal Re-Approximation Anchor; Delayed fascial closure; Exploratory laparotomy; Damage control surgery.

Introduction

Since one of its initial descriptions during World War II in 1940, the use of the Open Abdomen (OA) technique after surgery has continued to evolve [1]. Whereas the initial technique involved suturing Vaseline-soaked gauze to the edges of the abdominal fascia, several more advanced techniques are now used to treat a patient with OA and facilitate eventual closure of the abdomen [1,2]. These techniques include, but are not limited to, temporary Vacuum-Assisted Closure (VAC) device, Wittman Patch, skin closure with planned ventral hernia, bridging mesh placement, and the Abdominal Re-Approximation Anchor (ABRA) system [3,4]. Patients with severe abdominal injuries who undergo damage control laparotomy with subsequent temporary abdominal closure require returns to the operating room prior to fascial closure. Prolonged OA after exploratory laparotomy may lead to difficulty in primarily closing the abdomen due to lateral retraction of the abdominal muscles and fascia leading to loss of domain [5]. This predisposes patients to multiple complications, including Entero-Atmospheric Fistula (EAF) and intraabdominal adhesions [6].

The ABRA system is a device used to achieve rapid abdominal closure by utilizing a series of midline-crossing elastomers that have been inserted full thickness through the abdominal wall and are tightened daily to apply dynamic fascial tension.

This system helps to combat the lateral displacement of all the abdominal muscles after midline laparotomy. The device shows rates of primary closure varying from 83 to 100% over a period of 5 to 12 days [4,7]. We report a patient who survived multiple severe intra-abdominal gunshot injuries, resuscitative thoracotomy, and OA with eventual fascial closure of a 31 cm defect with the use of the ABRA system.

Case presentation

A 42-year-old female with Body Mass Index (BMI) of 32 presented to our ACS-verified level-1 trauma center after sustaining a transabdominal gunshot wound. The patient arrived intubated and in hemorrhagic shock and was taken to the operating room for an exploratory laparotomy. Injuries included splenic hilum avulsion, anterior and posterior gastric body laceration, two duodenal injuries (3rd portion and 4th portion), a grade 2 pancreatic head laceration, a complete transection of the superior mesenteric vein, and two jejunal enterotomies. A thoracotomy with aortic cross-clamping, splenectomy, partial gastrectomy, duodenal and jejunal resections left in discontinuity, SMV ligation, and application of temporary abdominal and thoracic closures were performed. After stabilization in the SICU, she was brought back to the operating room on post-injury day 2 and 3 to re-establish bowel continuity with Roux-en-Y gastrojejunostomy, primary repair of duodenal injury and jejunal anastomosis. By post-injury day four, the patient was ready to proceed with closure. However, the width gap between the fascial edges of the abdominal wall was 31 cm. Therefore, an ABRA system was applied via the manufacturer's recommendations to obtain dynamic apposition in the operating room (Figure 1A). On successive wound vac changes, the patient's fascial edges progressed to 21 cm, 9 cm, and finally 5 cm (Figure 1B). We achieved complete primary fascial closure on day 10 after the placement of the ABRA system (Figure 1C).

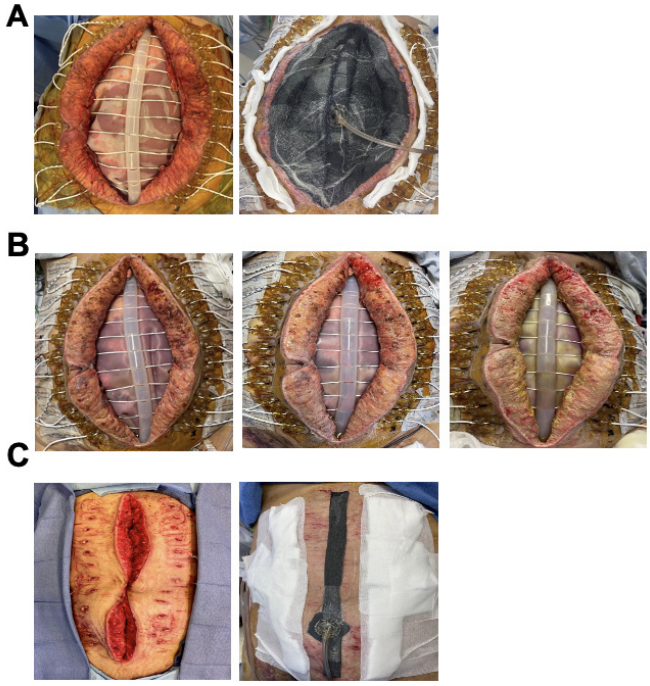

Figure 1: Sequential approximation of a large abdominal wall defect after ABRA placement. **(A)** ABRA Placement Day 1, 31 cm fascial defect. **(B)** *Left Panel* - 1st Wound VAC Change on day 3; 21 cm fascial defect; *Middle Panel* - 2nd Wound VAC change on day 6; 9 cm fascial defect; *Right Panel* - 3rd Wound VAC change on day 9; 5 cm fascial defect. **(C)** *Left and Middle Panels* - Final primary fascial closure on day 10 after placement of the device.

Discussion

Patients with severe intra-abdominal multi-organ injury often require multiple operations, which may lead to loss of domain with difficult fascial closure and may require complex and delayed abdominal wall reconstruction. As previously discussed, there are multiple well-established techniques and newer developing technologies to aid in abdominal closure [3,4]. The Eastern Association for the Surgery of Trauma published in 2022 a guideline for the management of the OA which recommends the conditional use of fascial traction systems [8].

We chose to use the ABRA device in our patient due to its reported ability to close large defects, even in overweight/obese patients. Patients with OA are at high risk for EAF, intraabdominal adhesions, and increased morbidity and mortality, with expeditious tension-free closure of the abdominal being beneficial in decreasing these risks [6,8,9]. While the ABRA system is helpful in efficiently reducing a large abdominal fascial defect, it is not completely without complications. Studies have shown that patients with ABRA applied have developed pressure wounds at the anchor sites, with one patient requiring skin graft after debridement of the pressure-injury site [7,10]. Additionally, varying rates of incisional hernia after fascial closure have been reported, from 16.67% to 50% [4,7]. The ABRA system also appears to have a learning curve with its application, with reported more efficient abdominal closure after repeated exposures to the system by surgical staff and nursing.[4] With consistent usage of ABRA for patients with large abdominal defects at a level 1 trauma center, surgical teams may see an improvement in abdominal closure rates. The patient's serial fascial approximations can be performed at the bedside without the need a return to the operating room; this avoids general anesthesia as well as the interruption of enteral nutrition, and the resources associated with a patient being taken to the operating room.

Conclusion

Here, we present a case of a large fascial gap in a patient who underwent OA for a GSW to the abdomen with multiple injuries, treated successfully with the ABRA traction closure system. The tension on the opposing fascial edges can be adjusted daily at the bedside, avoiding excessive resource utilization and frequent returns to the operating room. This abdominal closure system seems best suited for patients with large defects, secondary to lateral retraction of the muscles of the anterior abdominal wall. Future study of ABRA outcomes and, ultimately, its performance measured against other OA closure technique will strengthen our understanding of device application.

Author statements

Competing interest statement: The authors declare no competing interests.

Data access statement: All relevant data are included in the manuscript.

Patient consent statement: The authors of this manuscript confirm that written informed consent from the patient in this case report was obtained for the publication of their clinical information, including images and case details.

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