

A Case of Pediatric Abdominal Wall Reconstruction: Components Separation within the Austere War Environment

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Summary: Reconstructive surgeons supporting military operations are required to definitively treat severe pediatric abdominal injuries in austere environments. The safety and efficacy of using a components separation technique to treat large ventral hernias in pediatric patients in this setting remains understudied. Components separation technique was required to achieve definitive closure in a 12-month-old pediatric patient in Kandahar, Afghanistan. Her course was complicated by an anastomotic leak after small bowel resection. Her abdominal wall was successfully reopened, the leak repaired, and closed primarily without incident on postinjury day 9. Abdominal trauma with a large ventral hernia requiring components separation is extremely rare. A pediatric patient treated with components separation demonstrated minimal complications, avoidance of abdominal compartment syndrome, and no mortality. (*Plast Reconstr Surg Glob Open* 2014;2:e180; doi: 10.1097/GOX.000000000000120; Published online 9 July 2014.)

Military operations in Iraq and Afghanistan have presented many unique challenges to in-theater military treatment facilities. Advances in forward surgical care have resulted in improved survivability of military and civilian per-

sonnel after warfare-related injury despite greater injury severity. Damage control abdominal surgery techniques often delay definitive midline abdominal closure to facilitate second-look operations. The open abdominal space is managed with serial washouts and eventual closure by reconstructive mesh, primary fascial closure, external tissue expansion sutures or device techniques, or planned delayed ventral hernia repair with early skin grafting.¹ Of these options, primary fascial closure has been shown to be associated with the lowest patient morbidity, and thus when possible, techniques that provide early primary fascial closure are the preferred method of treatment within the war theater.¹

Although the majority of open abdomens typically present secondary to exploratory laparotomy for penetrating or blunt abdominal trauma, a small

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number of patients present with large abdominal wall defects due to a combined blunt and penetrating mechanism. This scenario is commonly seen in the current war trauma casualties who suffer from blast injury. However, the principles of stabilization and resuscitation remain the same. Thus, the important concepts in addressing posttraumatic abdominal reconstruction include the restoration of abdominal wall continuity, the restoration of torso muscle stability, the reestablishment of the abdominal domain space, and recreating an aesthetic appearance.²

The components separation technique (CST), also known as separation of parts, utilizes bilateral, innervated, bipediced rectus abdominis/internal oblique/transverses abdominis muscle flaps to reconstruct large central abdominal defects.^{2,3} The complete release of the external oblique muscle and fascia from the underlying rectus abdominis/internal oblique/transverses abdominis muscle complex facilitates closure of large midline abdominal defects with minimal tension. Treatment of traumatic pediatric ventral hernia using CST has not been well described. Furthermore, pediatric patients account for approximately 10% of military combat support hospitals admissions in Iraq and Afghanistan, of which one fifth involve penetrating or blast injury to the torso.⁴ This case report describes employment of the CST technique to address a large pediatric traumatic ventral hernia encountered within an austere combat setting.

CASE REPORT

A 12-month-old female Afghani infant was presented to US-led in-theater combat care unit after suffering improvised explosive device trauma consisting of severe abdominal fragmentary wounds, multiple small bowel perforations, a right open globe eye injury, and a partial traumatic amputation of her left foot (Fig. 1). At laparotomy, she was found to have multiple enterotomies requiring enterectomies, and the patient was left in discontinuity for transfer to a higher level of care facility. After placing a temporary abdominal negative pressure dressing, her left foot was debrided, and she was transferred via air to the NATO Role 3 Multinational Medical Unit in Kandahar, Afghanistan.

She was re-explored in the operating room (OR) on postinjury day (PID) 1 as a second-look procedure where she underwent small bowel re-anastomoses (Fig. 2). Her abdominal wall could not be closed primarily due to bowel edema coupled with segmental rectus abdominis loss. An abdominal negative pressure dressing was placed for temporary closure, and she underwent a below-knee amputation at that time. She returned to the OR on PID 3 for possible abdominal closure. The abdominal wall could not be



Fig. 1. A 12-month-old female Afghani pediatric trauma patient after blast-related injuries including severe penetrating abdominal wound.



Fig. 2. Same 12-month-old female patient after multiple enterotomy repairs.

closed primarily due to significant tension; thus, a CST was used to definitely close her open abdominal wound (Figs. 3–6). During the closure, neither the bladder pressure nor peak inspiratory pressures deviated more than 2 mm Hg.

The patient returned to the OR on PID 5 for revision of below-knee amputation wound. She remained in the intensive care unit until PID 9 where she acutely decompensated hemodynamically. A chest x-ray revealed intra-abdominal free air. She returned to the OR where an exploratory laparotomy demonstrated an anastomotic breakdown. The leak was repaired and the midline closed at the conclusion of the procedure without revision to her prior separation. The patient was transferred to a local Afghan facility on PID 13 without further complica-

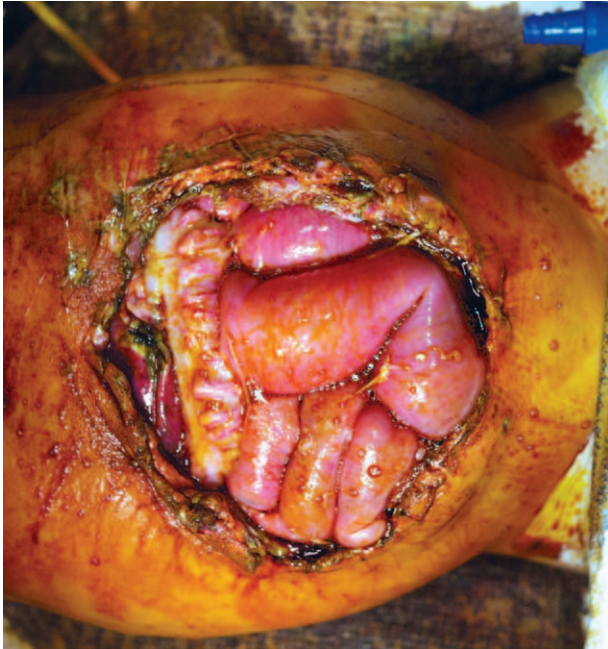


Fig. 3. Resulting large abdominal wall defect before definitive abdominal wall closure.



Fig. 4. Initial CST releases before definitive abdominal wall closure. Note significant excursion of left rectus and internal oblique/transversalis muscle flap after release of the external oblique muscle unit.

tion. Nine-month follow-up from the in-theater hospital has revealed that the patient has been meeting developmental milestones despite her significant prior traumatic event, has not developed a midline hernia or abdominal wall defect, has no significant abdominal wall weakness or disability, and has tolerated full return to a traditional Afghan diet.

DISCUSSION

Operating in the austere environment can have resource limitations, yet the primary goals of all of the



Fig. 5. Abdominal wall myofascial closure after bilateral CST releases.



Fig. 6. Final appearance of abdominal area after CST and definitive skin closure.

patients, including pediatric cases, are triaged in the following priority: life preservation, sight preservation, limb preservation, and final, optimal functional outcome. Using damage control abdominal surgery techniques, the open abdomen after laparotomy for trauma has increased in prevalence. Advantages of the open abdomen include the prevention of abdominal compartment syndrome, improved accessibility for second-look procedures, and expeditious conclusion of the operation to allow adequate correction of coagulopathy secondary to hypothermia, abnormal acid-base balance, and depletion of coagulation factors. Disadvantages of this technique include increased risk of enterocutaneous fistula, increased rates of ventral hernia, and increased use of synthetic mesh or biological grafts to assist in definitive abdominal closure.

The CST technique permits abdominal fascial advancement for abdominal closure and can provide an early closure abdominal technique for certain pediatric trauma cases. This technique provides restoration of the function and integrity of the musculofascial abdominal wall, prevention of visceral

eventration, and provision of dynamic muscle support.⁵ This technique has been described for closure of difficult pediatric organ transplant, omphalocele repair, and certain trauma cases, but it has not been reported within the war theater setting—a setting in which it may have great utilities.^{6–8}

CONCLUSIONS

The potential benefits of a well-timed separation of components closure in addressing early open abdomen repair may ultimately reduce the risk of enterocutaneous fistula and multiple abdominal operations without greatly increasing the risk of respiratory compromise, compartment syndrome, or infection related to mesh. Furthermore, in the austere war environment or in settings having limited resources, the potential benefits of CST may be magnified, allowing for an autologous early closure technique with acceptably low associated risks.

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