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DELAYED ABDOMINAL WALL RECONSTRUCTION USING THE TOPCLOSURE® TENSION-RELIEF SYSTEM: CASE SERIES

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## DELAYED ABDOMINAL WALL RECONSTRUCTION USING THE TOPCLOSURE® TENSION-RELIEF SYSTEM: CASE SERIES

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### SUMMARY

Complex abdominal wall defects resulting from trauma or severe intra-abdominal sepsis complicated by abdominal compartment syndrome present a significant challenge to reconstructive surgeons. Delayed abdominal wall reconstruction remains a well-established strategy in the management of such patients. This case series describes the TopClosure® tension-relief system as a viable alternative for functional restoration of the abdominal wall.

We report a case series on delayed abdominal wall reconstruction using the TopClosure® Tension-Relief System. The series included three consecutive patients ( $\geq 18$  years) who were admitted to our surgical unit with intra-abdominal sepsis between 2019 and 2021 at a private tertiary care centre. Emergent laparotomies and peritoneal washouts were performed as part of sepsis control, followed by management in the critical care unit for physiological stabilization and optimization. Thereafter, the TopClosure® system was applied in combination with negative-pressure wound therapy (NPWT) with instillation using normal saline and oxygen. This approach reduced bowel and anterior abdominal wall oedema while facilitating continuous irrigation to remove effluent and infectious material and prevent loss of abdominal wall domain.

Definitive closure was achieved in all patients within 5 to 10 days of the TopClosure® system application, with a mean hospital stay of 32 days. The only complication observed was a superficial surgical site infection in one patient, which was managed conservatively; all patients were followed up for six months after discharge.

In conclusion, our experience suggests that the combined use of the TopClosure® system and NPWT with instillation is a feasible option for delayed abdominal wall reconstruction in resource-limited health systems, with favorable short-term outcomes. It reduces the need for grafts or microsurgical techniques and facilitates early functional recovery.

**Keywords:** Abdominal wall reconstruction, TopClosure® Tension Relief System

### INTRODUCTION

Complex abdominal wall defects resulting from trauma or severe intra-abdominal sepsis complicated by abdominal compartment syndrome present a significant challenge to reconstructive surgeons. Delayed abdominal wall reconstruction remains a well-established strategy in the management of such patients [1].

The principles underlying this approach are based on a comprehensive understanding of the anatomy and biomechanics of the anterior abdominal wall. This multilayered musculo-fascial complex preserves the abdominal domain and protects the intra-abdominal viscera from external injury, herniation, and fluid or electrolyte loss [2]. In addition, coordinated muscular activity supports respiration and maintains intra-abdominal pressure. Temporary abdominal wall reconstruction techniques aim to safeguard

intra-abdominal organs while preserving the wall's integrity during recovery [3]. This strategy aligns with the principles of the reconstructive ladder, emphasising staged, function-preserving restoration through the simplest effective intervention [4].

Several reconstructive techniques have been established for the management of large and complex abdominal wall defects, including the use of grafts, flaps, and tissue expanders. The TopClosure® Tension-Relief System, developed in 2012 by Professor Topaz in Israel, represents an alternative method that, when combined with negative-pressure wound therapy (NPWT) with instillation, enhances infection control and promotes definitive abdominal wall reconstruction [5]. We report a single-centre experience of three patients who underwent delayed abdominal wall reconstruction using the TopClosure® system in combination with NPWT with instillation.

**CASE SERIES PRESENTATION**

This case series was reported in accordance with the 2025 SCARE guidelines [6]. We present a single-centre case series of delayed abdominal wall reconstruction using the TopClosure® Tension-Relief System involving 3 consecutive patients admitted to the general surgery units of The Mater Misericordiae Hospital between 2019 and 2021. Eligible patients were adults aged ≥18 years with intra-abdominal sepsis undergoing open abdomen management in whom immediate primary closure was not possible. Delayed abdominal wall reconstruction was performed using the TopClosure® Tension-Relief System, with at least 6-month follow-up after discharge. The cohort comprised 2 male and 1 female patients. (Table 1)

**Table 1:** Patient demographics and clinical characteristics

Patient	Sex	Age (years)	Comorbidities	Aetiology	Indication
1	Male	42	Sickle cell disease	Vaso-occlusive pain crisis	Small bowel obstruction
2	Female	76	Acute cholelithiasis	acute cholelithiasis	Necrotising fasciitis post-laparoscopic cholecystectomy
3	Female	23	None	complicated appendicitis	Generalized peritonitis

Broad-spectrum intravenous antibiotics were initiated upon diagnosis and later tailored according to culture and sensitivity results. Written informed consent was obtained from all patients before each procedure, including consent for photo documentation and for future publication of clinical findings. All surgeries were performed under general anaesthesia by an attending consultant surgeon.

Emergent laparotomies and peritoneal washouts were performed for sepsis control at 24–48-hour intervals until the effluent was clear and free of purulent material, marking the endpoint of lavage. Following this, patients were managed in the critical care unit for physiological stabilisation and optimisation. Initial temporary abdominal closure was achieved

using either a Bogotá bag or open wound packing. The Bogotá bag, a sterile plastic sheet (adapted from a urine drainage bag), was sutured to the skin edges using non-absorbable suture material to allow re-entry for planned relook procedures. Open wound packing involved the use of moist, sterile gauze to facilitate drainage.

Subsequently, the TopClosure® system, comprising two flexible attachment plates secured to the skin on either side of the wound and connected by adjustable tension straps, was applied to allow gradual approximation of wound edges at the bedside, as tolerated by the patient. This was combined with negative-pressure wound therapy (NPWT) with instillation using normal saline and oxygen. NPWT

with intermittent instillation of 50 ml of normal saline was applied daily, while supplemental oxygen was delivered at 0.5 L/min via the instillation system to enhance tissue oxygenation. Dressings were changed every 48–72 hours or earlier if soiled.

### Case 1

A 42-year-old male with a known history of sickle cell disease (SCD) presented with features of generalised peritonitis following a vaso-occlusive pain crisis. He had no prior history of abdominal surgery. Intraoperative findings revealed a distended small bowel with multiple inter-loop abscesses, a segment of small bowel herniating through a mesenteric rent, marked bowel oedema, and purulent collections within the paracolic gutters and pelvis. Initial management involved thorough peritoneal lavage and temporary abdominal closure using a Bogotá bag (Figure 1a). Despite two relook laparotomies and additional washouts, intra-abdominal sepsis persisted (Figure 1b).

Given the patient's poor tolerance for repeated surgical interventions, a multidisciplinary team decision was made to apply the TopClosure® Tension-Relief System in combination with negative-pressure wound therapy (NPWT). Instillation consisted of 50 mL of normal saline daily, supplemented with oxygen at 0.5 L/min (Figure 1c). By postoperative day 10, sepsis had resolved, and functional closure of the abdominal wound was achieved within five days of device application (Figure 1d). The postoperative course was complicated by a superficial surgical site infection, which was managed conservatively on an outpatient basis.

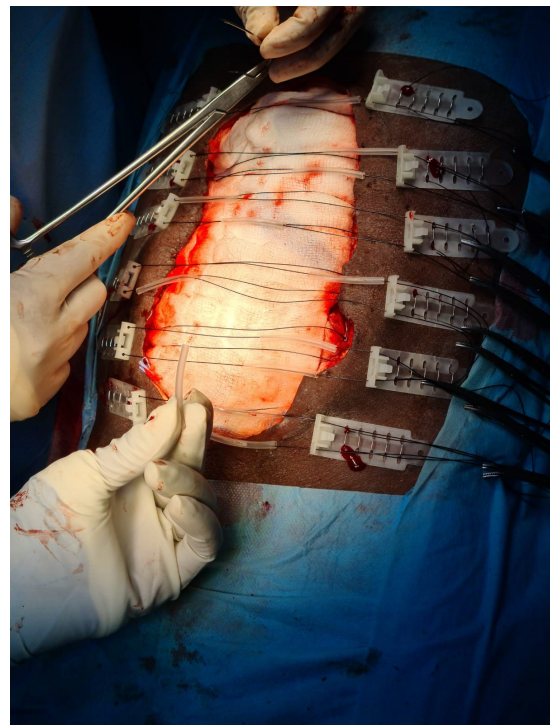
**Figure 1a:** Bogotá bag placement after abdominal washout



**Figure 1b:** Abdominal wound after removal of Bogotá bag



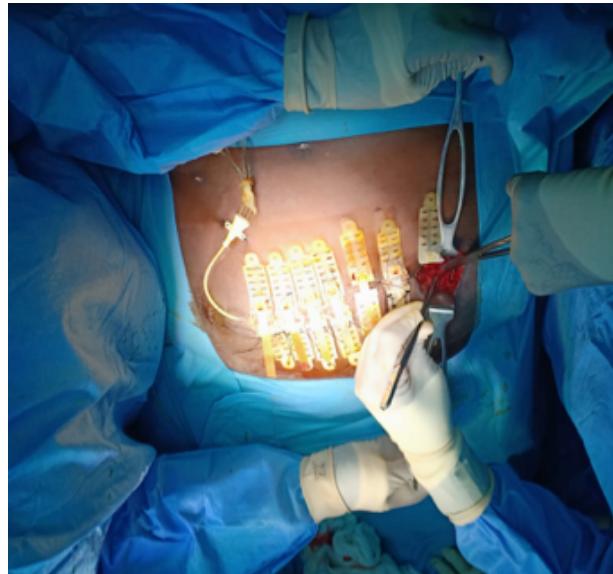
**Figure 1c:** Intraoperative Day 10: Topclosure® placement



**Figure 1d:** Day 15 postoperative, functional closure of the abdominal wall



**Figure 2b and 2c:** TopClosure® system application



**Case 2**

A 76-year-old female was readmitted one week following laparoscopic cholecystectomy with a painful, foul-smelling discharge from the umbilical port-site wound. Examination and imaging confirmed anterior abdominal wall necrotising fasciitis. She underwent emergency laparotomy, and the wound was initially managed with wound packing (Figure 2a). At re-look surgery, the TopClosure® tension-relief system was applied in combination with negative pressure wound therapy (NPWT) (Figure 2b and 2c). Complete wound closure was achieved after 5 days, and the patient recovered without further complications (Figure 2d).

**Figure 2d:** Wound closure after TopClosure® system application.

**Figure 2a:** Abdominal wound post debridement



**Case 3**

A 23-year-old female presented with acute abdominal pain and peritonitis two weeks after an open appendectomy performed at another facility. Emergent laparotomy was done, findings revealed a perforated appendiceal stump with purulent collections in the pouch of Douglas, right subphrenic space, right iliac fossa, and inter-loop regions. Peritoneal lavage was performed, and temporary abdominal closure was achieved using a Bogotá bag (Figure 3a and 3b). Following eight days of intensive care and two re-look laparotomies, the Bogotá bag was replaced with the TopClosure® tension-relief system combined with negative pressure wound therapy with instillation (NPWTi) (Figure 3c). Sepsis was successfully controlled, and functional wound closure was achieved within 10 days (Figure 3d). The patient was discharged with the device in situ, and the attachment plates and straps were subsequently removed in the outpatient clinic.

**Figure 3a and Figure 3b:** Open abdomen secondary to ruptured appendix with Bogotá bag placement



**Figure 3c:** Delayed wound closure after 10 days



**Figure 3d:** Abdominal wall closure after 10 days of TopClosure® system application



**RESULTS**

Definitive abdominal wall reconstruction was achieved in all patients within 5–10 days of TopClosure® system application, with a mean hospital stay of 32 days (Table 2).

During the six-month follow-up period, one patient developed a superficial surgical site infection, which was managed conservatively with local wound care alone. No cases of deep surgical site infection, enterocutaneous fistula, wound dehiscence, or incisional hernia were observed. At final follow-up, all patients demonstrated stable linear scars without hypertrophic or keloid scarring. Residual punctate skin marks corresponding to the attachment plate fixation sites were still visible; however, these were mild, non-hypertrophic, and did not result in functional impairment or patient-reported dissatisfaction.

**Table 2:** Timing of abdominal closure and operative burden

Patient	Length of hospital stay (days)	Duration of open abdomen (days)	Time to closure after Top Closure® application (days)	Number of operating room sessions
1	42	15	5	4
2	24	8	5	3
3	30	18	10	4
Mean	32	13.8	6.7	3.7

## DISCUSSION

Management of the open abdomen remains one of the most challenging aspects of surgery, particularly in patients with sepsis or large abdominal wall defects [7]. Achieving a balance between effective source control and prevention of complications such as entero-atmospheric fistula formation, infection, and loss of abdominal domain remains difficult. Additional factors, including physiological instability, timing of definitive closure, and limited access to advanced care, further compound these challenges, especially in resource-limited settings [8].

Functional restoration of the abdominal wall seeks to re-establish both anatomical integrity and physiological competence, in keeping with the reconstructive principle of restoring “like with like” [4]. In the literature, reconstructive strategies exist along a continuum, ranging from skin grafting and tissue expanders to component separation techniques, prosthetic materials, and complex microvascular free tissue transfer [9].

The TopClosure® Tension-Relief System represents an intermediate modality within this spectrum, enabling controlled, incremental approximation of native tissues under regulated tension. This dynamic approach facilitates delayed primary closure without recourse to prosthetic materials or extensive flap mobilisation [10]. Compared with conventional techniques, the system offers the advantages of sustained mechanical traction, reduced tissue ischaemia, preservation of fascial continuity, and a shorter time to definitive closure [11]. However, the comprehensive application of advanced abdominal wall reconstruction techniques remains constrained in many low- and middle-income settings owing to the scarcity of microsurgical expertise, prohibitive costs, and limited institutional resources [12]. Furthermore, most patients need help affording health insurance premiums (public/private) to access value-based care. The cost of TopClosure® Tension-Relief System is KSh. 65,000 compared to micro-vascular free tissue transfer costs KSh. 1,500,000 in our setting [13]. Within these contextual limitations, the TopClosure® system demonstrated a feasible and efficacious alternative, achieving delayed abdominal closure with low morbidity and favourable functional outcomes.

Despite these advantages, the TopClosure® Tension-Relief System is not without limitations. The requirement for multiple dermal fixation points results in punctate skin scars that may persist at medium-term follow-up and represent a cosmetic trade-off compared with primary linear closure. In addition, the technique relies on sustained mechanical tension and repeated dermal insult, which may increase the risk of pathological scarring in

predisposed individuals. Although no hypertrophic or keloid scarring was observed in this series, none of the patients had a known predisposition to keloid formation. Consequently, use of the system in keloid-prone patients should be guided by an individualised risk–benefit assessment, with appropriate patient counselling and close postoperative scar surveillance [14].

Successful application of the system also requires careful patient selection, meticulous tension adjustment, and close postoperative surveillance to minimise the risk of skin-edge ischaemia or device-related complications. While less costly than complex flap-based reconstruction, the financial burden of the system may still limit accessibility in resource-constrained environments, and robust cost-effectiveness data remain limited [12].

Despite achieving successful delayed abdominal wall closure in all cases, postoperative morbidity was minimal, limited to a single superficial surgical site infection. While short-term outcomes were favourable, the six-month follow-up duration limits the assessment of long-term outcomes, including late ventral hernia formation and scar maturation. These findings underscore the need for structured postoperative surveillance and extended longitudinal follow-up after delayed abdominal wall reconstruction.

## CONCLUSION

The combined use of the TopClosure® system and NPWT is a feasible and effective approach for delayed abdominal wall reconstruction, particularly in resource-limited settings. This approach minimises reliance on grafts and microsurgical reconstruction while facilitating timely closure and early functional recovery.

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