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# Delayed dynamic abdominal wall closure following multi-visceral transplantation

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ABSTRACT

*INTRODUCTION:* Primary closure of the abdominal wall following intestinal transplantation or multivisceral transplantation could become a challenging problem in a significant number of patients.
*PRESENTATION OF CASE:* A 38-year-old woman with familial adenomatous polyposis (FAP) underwent a multi-visceral transplantation for short gut syndrome. She subsequently developed acute graft rejection that proved resistant to conventional treatment. She was relisted and underwent re-transplantation along with kidney transplantation. Abdominal wall closure could not be achieved because of the large size of the graft and bowel oedema. The wound was initially managed with laparostomy followed by insertion of the delayed dynamic abdominal closure (DDAC) device (Abdominal Retraction Anchor – ABRA® system). Continuous dynamic traction to the wound edges resulted in gradual approximation and complete closure of the abdominal wound was achieved within 3 weeks.
*DISCUSSION:* Successful abdominal closure after multivisceral transplantation or isolated intestinal transplantation often requires biological mesh, vascularised flaps or abdominal wall transplantation. DDAC eliminated the need for a prosthetic mesh or skin graft and provided an excellent cosmetic result. Adjustment of the dynamic traction at the bedside minimised the need for multiple returns to the operating theatre. It resulted in a well-healed linear scar without a hernia.
*CONCLUSION:* Dynamic traction allows delayed closure of laparotomy resulting in strong and cosmetically sound wound healing with native tissue.


## 1. Introduction

Abdominal wall closure following a multi-visceral/small bowel transplant can be challenging due to loss of abdominal domain from multiple previous operations, donor-recipient size discrepancy and post-reperfusion oedema of the transplanted organs.[1] Abdominal closure achieved under tension could lead to compression of the transplanted organs leading to development of abdominal compartment syndrome [ACS] and graft ischaemia.[2–4] Different strategies have been used to overcome difficulties with abdominal closure such as, use of a prosthetic mesh to close the fascial gap, component separation of abdominal wall and application of vacuum-assisted closure (VAC) system.[1,2,5] We describe a novel technique to achieve closure of a large laparotomy wound using a continuous dynamic tension device (ABRA® system; Canica Design, Almonte, Ontario, Canada).

## 2. Presentation of case

A 38-year-old woman with familial adenomatous polyposis (FAP) and recurrent desmoid tumours underwent a multi-visceral transplant on account of short-bowel syndrome and TPN-induced liver failure. Previously, she had undergone several laparotomies for pan-proctocolectomy, desmoid tumour excisions and multiple intestinal resections. She had desmoid tumours invading the root of the mesentry, both ureters and the iliac vessels. Her left kidney had failed due to longstanding obstructive uropathy. At the time of transplant, she underwent total abdominal exenteration, left nephro-ureterectomy and resection of a part of the right ureter with primary end-to-end anastomosis. A multi-visceral composite graft including liver, stomach, duodenum, pancreas and small bowel was transplanted. A segment of left external iliac artery encased in desmoid was resected and replaced with donor external iliac

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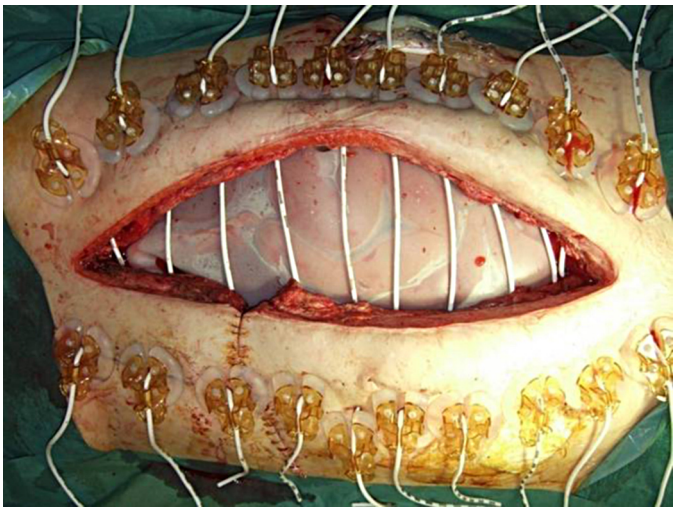

**Fig. 1.** Abdominal Re-approximation Anchor (ABRA) application – Day 5.

artery graft (6 cm segment). She recovered well without any significant complications in the postoperative period. The induction of immunosuppression was with Alemtuzumab and maintenance with tacrolimus and mycophenolate mofetil (MMF). Six months later, the immunosuppression was switched from tacrolimus to sirolimus because of calcineurin-induced renal dysfunction.

A few days after the change of immunosuppressant regimen, she developed acute severe graft dysfunction associated with sloughing of small bowel mucosa. This was treated as acute rejection with Anti-Thymocyte Globulin (ATG) and plasmapheresis. In addition, she developed renal failure requiring haemofiltration. However, the graft function continued to deteriorate despite maximal anti-rejection treatment and therefore, she was listed for "super-urgent" re-transplantation. The second multi-visceral transplant included *en bloc* liver, stomach, duodenum, pancreas, small bowel and an isolated kidney graft. On this occasion, primary abdominal closure could not be achieved due to larger size of the graft that included the kidney and also post-reperfusion oedema of the graft intestine. The abdomen was left open (laparostomy) and delayed primary closure was planned. Histology of the explanted graft showed severe ischaemia secondary to thrombotic thrombocytopaenia in relation to acute rejection. In the first postoperative week, she underwent 3 further laparotomies for control of haemorrhage and resection of an ischaemic jejunal segment. At that stage, it was not possible to achieve abdominal wall closure due to progression of oedema and loss of abdominal domain due to lateral retraction of the abdominal

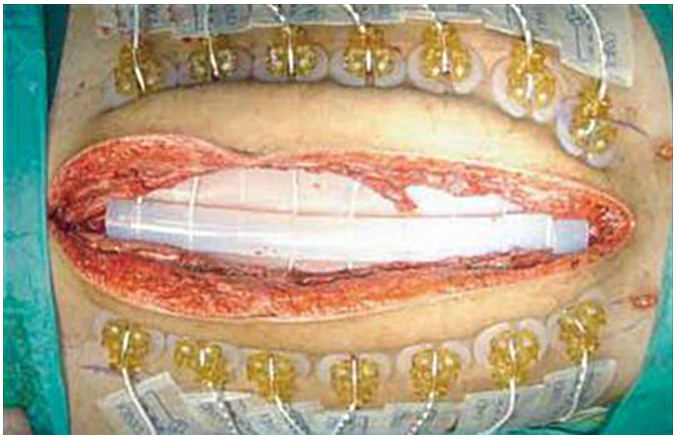

**Fig. 2.** Abdominal Re-approximation Anchor application – Day 11.

**Fig. 3.** Abdominal Re-approximation Anchor application – Day 16.

wall. Therefore, a continuous dynamic traction device that consists of anchor-elastomer system was inserted to achieve delayed abdominal closure.

She had a long midline incision with a right-sided T-shaped extension. The right-sided extension was closed primarily and the DDAC device was inserted on the midline section of the incision. The width of defect in the laparostomy at the middle was 12 cm. The detailed technique of ABRA system application has been described elsewhere (Ref. 4). Briefly, under general anaesthesia, a series of

**Fig. 4.** Laparotomy scar after 6 months of ABRA application.

elastomers were inserted at about 5 cm from the wound edges through full thickness of the abdominal wall and about 5–6 cm apart from each other (Figs. 1 and 2). They were secured with button-pulley units on either side of the wound providing a continuous traction on the fascial and cutaneous tissues. The viscera were protected by placing a porous silastic sheet and a VAC device was applied over it (Fig. 3). The ileostomy in the right iliac fossa was placed outside the elastomer application site. Following the application of the device, the elastomers were tightened initially on alternate days and subsequently daily at the bedside under sterile conditions approximating the fascial edges by 1 cm on each occasion. Complete fascial approximation was achieved in 3 weeks and she was returned to operating theatre for formal delayed primary closure. Subsequently the wound healed up without any infection, dehiscence or herniation with a linear scar (Fig. 4).

## 3. Discussion

Loss of abdominal domain and inability to achieve primary closure of the abdominal wall following intestinal transplantation or multivisceral transplantation is well recognised and remains a significant challenge.[2] Various strategies have been reported to achieve delayed abdominal closure and prevention of abdominal compartment syndrome.[6,7] The goal is to prevent evisceration and protect the underlying viscera with controlled fluid egress whilst allowing easy peritoneal access. The techniques range from temporary abdominal dressings such as Bogota bag, zipper, and Wittmann patch to longer-term closure with prosthetic mesh and VAC device.[8,9] However, these techniques carry potential risks such as fluid collection, sepsis,[5] fascial retraction, visceral adherence[8,9] fistulae, incisional hernia and poor cosmetic result. A review of temporary abdominal closure quoted fistula rates of79% with Bogota bag application and poor delayed primary fascial closure (28%); the use of zipper has been associated with the highest rates for fistula (12.5%) and abscess formation (16%).[9] Enteric fistulae (7%) have also been reported with the use of polypropylene mesh, for which there is the additional potential risk of mesh extrusion and mesh infection.[10] Negative pressure therapy with VAC was associated with lower infective complications and mortality.[9,11] Quyn et al. reviewed the use of the Wittmann patch, which has been reported to have the highest success rate for delayed primary closure (77.8%) with low risk of complications.[9] Some of these techniques however, require frequent trips to theatre for change of dressings under general anaesthetic and often result in wound closure with granulation tissue, and incisional hernia.

Delayed abdominal closure using dynamic continuous traction has been reported in general surgery and trauma. The advantages include maintenance of abdominal domain whilst the abdomen is left open for prevention of ACS, with gradual fascial re-approximation without the need for any prosthetic material.[11] Dynamic traction allows for stretching and relaxation with respiratory excursions while preventing further lateral retraction of the abdominal muscles and fascia.[12] Bedside adjustment of tissue traction with elastomers avoids frequent returns to theatre and general anaesthetic. By preventing visceral adhesions to wound edges this device also allows for easy access to the abdominal cavity, if necessary. The placement of the DDAC device does not interfere with fashioning of the stoma and its management. In the longer term, the fascial and skin re-approximation eliminates the need of skin grafting, minimises the chances of incisional hernia and leads to a linear, cosmetically acceptable scar.[13,14]

In this case, because of the urgent nature of re-transplantation, there was a donor-recipient graft size mismatch. After considering various options for delayed abdominal closure we decided to use the ABRA system because of the reported advantages.

## 4. Conclusion

To the best of our knowledge, this is the first report of the use of this technique for abdominal wall closure following intestinal transplantation. We conclude that the use of dynamic abdominal wall closure is a safe technique for use post transplant and leads to primary fascial and skin closure with excellent long-term outcome.

## Conflicts of interest

None.

## Funding

None.

## Ethical approval

Full written consent from patient to publish the case report and photographs.

## Author contributions

Iype, Satheesh contributed in writing up the manuscript, participated in designing the procedure. Butler, Andrew participated in designing and executing the procedure. Jamieson, Neville participated in writing up and review of manuscript. Middleton, Stephen participated in writing up and review of manuscript. Jah, Asif participated in designing and executing the procedure, and participated in writing up and review of manuscript.

### Key learning points

- Delayed abdominal wall closure prevents ‘Abdominal compartment syndrome’.
- Several methods using prosthetic materials are often required for achieving delayed abdominal closure.
- Higher complications such as sepsis, fistulae and incisional hernia associated with conventional delayed closure techniques.
- Delayed dynamic abdominal wall traction method enables sound closure with native tissue with good cosmetic results.

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