Section: General Surgery

Case Series

POSTERIOR COMPONENT SEPARATION WITH TRANSVERSUS ABDOMINIS RELEASE FOR GIANT AND COMPLEX INCISIONAL HERNIAS: A SINGLE-CENTRE CASE SERIES OF FIVE PATIENTS

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ABSTRACT

Background: Giant and complex incisional hernias represent one of the most formidable challenges in abdominal wall surgery. Conventional retromuscular techniques often fail to achieve tension-free fascial closure in large defects and are associated with high recurrence rates. Posterior component separation with transversus abdominis release (PCS-TAR) has emerged as an effective reconstructive strategy that enables wide retromuscular prosthetic reinforcement while restoring midline anatomy.

Materials and Methods: A prospective observational case series was conducted at a tertiary-care teaching hospital in Uttarakhand, India, from January 2023 to July 25. Five consecutive patients with giant or complex incisional hernias (fascial defect width >8 cm) with a preoperative Component Separation Index (CSI) >0.21 underwent open PCS-TAR with retromuscular polypropylene mesh reinforcement. All hernias were classified using the European Hernia Society (EHS) classification. Postoperative complications were graded according to the Clavien–Dindo system. Demographic characteristics, operative details, complications, drain duration, length of hospital stay and six-month recurrence outcomes were recorded and analysed descriptively.

Results: Three males and two females with a mean age of 57 years (range 48–66 years) and mean BMI of 34.8 kg/m² were included. All hernias were classified EHS W2-3. Mean fascial defect area was 108.4 cm² (range 80–144 cm²). Primary fascial closure was achieved in all five patients without bridging. Mean operative time was 3.85 hours. One patient (20%) developed a deep surgical site infection (Clavien–Dindo Grade IIIa), managed successfully with culture-directed antibiotics and serial wound debridement, without mesh explantation. Mean hospital stay was 16.4 days (range 12–21 days). No seroma requiring intervention, enterocutaneous fistula, abdominal compartment syndrome, or mortality was observed. No clinical recurrence was identified at six months of follow-up.

Conclusion: PCS-TAR provides a safe, reproducible, and effective method for reconstruction of giant and complex incisional hernias in a resource-limited tertiary-care setting. The technique permits tension-free midline closure, wide retromuscular mesh placement, and acceptable perioperative morbidity. Successful mesh preservation despite surgical site infection and the absence of early recurrence support its broader adoption.

Keywords: Incisional hernia; abdominal wall reconstruction; posterior component separation; transversus abdominis release; giant ventral hernia; retromuscular mesh; Component Separation Index.

INTRODUCTION

Incisional hernia is one of the most frequent long-term complications following abdominal surgery, occurring in approximately 10–20% of patients after midline laparotomy.[1,2] Itatsu et al. reported estimated incidence rates of 5.2% at 12 months and 10.3% at 24 months in a large prospective series of 3,927 patients.[3] Risk factors include obesity, wound infection, diabetes mellitus, smoking, malnutrition, the use of corticosteroids, and a history of repeated abdominal operations.[1,4] The Rives–Stoppa retromuscular repair revolutionised ventral hernia surgery by introducing prosthetic reinforcement within the retrorectus space, thereby reducing recurrence compared with primary suture repair.[2,5] However, in patients with giant incisional hernias exceeding 8–10 cm in width, significant lateral rectus muscle retraction, or loss of domain, conventional retromuscular repair often fails to provide adequate medial myofascial advancement for tension-free closure.[5,6]

Anterior component separation (ACS), as described by Ramirez et al. in 1990, significantly improved fascial mobilisation through external oblique aponeurosis release.[7] However, extensive subcutaneous undermining in ACS was associated with significant wound morbidity, including skin flap necrosis, seroma formation, and increased surgical site infection rates.[7,8] The introduction of intraperitoneal mesh techniques (IPOM and IPOM-PLUS) requires appropriate sized dual meshes which are very costly and not affordable for a resource limited population These limitations prompted the development of posterior component separation techniques that preserve the overlying skin vascularity and utilises affordable and universally available polypropylene meshes. Transversus abdominis release (TAR), first described by Novitsky et al. in 2012, represents a paradigm shift in complex abdominal wall reconstruction.[9] By incising the posterior rectus sheath medial to the linea semilunaris and releasing the transversus abdominis muscle, the retromuscular dissection plane is extended far beyond the lateral border of the rectus sheath, enabling robust posterior layer reconstruction and wide mesh placement in the pre-transversalis or pre-peritoneal plane, while preserving neurovascular bundles to the rectus muscles.[9,10] Subsequent large series by Novitsky et al. demonstrated durable outcomes with recurrence rates below 4% and acceptable morbidity even in comorbid patients with large defects.[11] Preoperative planning with contrast-enhanced computed tomography (CECT) of the abdomen, including calculation of the Component Separation Index (CSI), has emerged as a standardised objective tool to predict the likelihood of requiring component separation and to anticipate the need for bridging mesh.[12] A CSI value exceeding 0.21 is associated with a significantly greater probability of requiring component separation and interpositional repair.[12] Despite its well-established efficacy in high-volume specialised centres in the Western world, PCS-TAR has limited representation in the published literature from the Indian subcontinent and other resource-limited settings. The present study reports our prospective experience with PCS-TAR in five patients with giant and complex incisional hernias at a tertiary-care teaching institution in Uttarakhand, India, and evaluates short-term clinical outcomes, postoperative complications, drain management, and six-month recurrence.

MATERIALS AND METHODS

Study Design: This was a prospective observational case series conducted in accordance with the PROCESS (Preferred Reporting Of Case Series in Surgery) guidelines.

Study Setting and Period: All procedures were performed at the Department of General Surgery, in a tertiary care hospital cum medical college of Uttarakhand between January 2023 and July 2025.

Ethical Approval and Informed Consent: Institutional ethical clearance was obtained from the Institutional Ethics Committee of the University prior to commencement of the study. Written informed consent was obtained from each patient prior to surgery, including consent for publication of anonymised clinical data. Patient's identity has been protected throughout.

Inclusion Criteria

- Age ≥18 years.
- Giant or complex incisional hernia with fascial defect width >8 cm(EHS W2/W3)
- Preoperative CSI >0.21 on CECT abdomen, indicating requirement for component separation.
- Elective abdominal wall reconstruction setting.
- Capacity and willingness to provide written informed consent.
- Minimum postoperative follow-up of six months.

Exclusion Criteria

- Strangulated or acutely incarcerated hernia.
- Active surgical site infection or contaminated operative field at the time of surgery.
- Morbid obesity (BMI >40 kg/m²).
- Uncontrolled cardiopulmonary, renal, or hepatic disease precluding elective major surgery.
- Patients who declined surgery or were lost to follow-up prior to the six-month assessment.

Preoperative Assessment and Optimisation: All patients underwent standardised preoperative workup including complete blood count, hepatic and renal biochemistry, coagulation profile, chest radiography, and electrocardiography. Nutritional status was assessed; patients with serum albumin <3.0 g/dL received 2–4 weeks of preoperative nutritional supplementation. Glycemic control was optimised in diabetic patients to achieve a preoperative HbA1c <7.5%. Smoking cessation was strongly encouraged for at least four weeks prior to surgery.

Contrast-enhanced computed tomography (CECT) of the abdomen was performed in all patients to evaluate defect dimensions, hernia contents, degree of rectus muscle retraction, and feasibility of closure. The Component Separation Index (CSI) was calculated from axial CECT images according to the method described by Christy et al,[12] a fixed reference point (aorta) and the medial leading edges of the bilateral rectus abdominis muscles were used to measure the angle of diastasis, which was then divided by 360° to yield the CSI. All patients in this series had a CSI >0.21, indicating high complexity and likelihood of requiring component separation.

Hernias were classified according to the European Hernia Society (EHS) classification system described by Muysoms et al., incorporating anatomical location (M-zones) and defect width (W1: <4 cm; W2: 4–10 cm; W3: >10 cm).[13]

Anaesthesia: All procedures were performed under combined general anaesthesia with endotracheal intubation and epidural analgesia, the latter being continued for 48–72 hours postoperatively as part of a standardised multimodal analgesia protocol to facilitate early ambulation.

Operative Technique: The operative technique employed was based on the method described by Novitsky et al,[9,10] and Carbonell et al,[10] with standardised modifications as follows:

The previous midline scar was excised via an elliptical incision. A midline laparotomy was performed, dense intraperitoneal adhesions were systematically lysed, and the hernia contents were reduced. Bilateral retrorectus dissection was developed medially to laterally, reaching the linea semilunaris on each side, exposing the posterior rectus sheath.

Posterior component separation was then performed bilaterally: a longitudinal incision was made in the posterior rectus sheath, approximately 0.5–1.0 cm medial to the linea semilunaris, exposing the medial edge of the transversus abdominis muscle preserving the neuromuscular bundles and deep inferior epigastric vessels. The transversus abdominis muscle was divided along its entire length, entering the pre-transversalis fascial plane above the arcuate line and the pre-peritoneal plane below it. This dissection was extended cranially to the costal margin, caudally to Cooper's ligament and laterally toward the psoas fascia, communicating with the space of Bogros laterally and the retropubic space of Retzius medially. The posterior layer — comprising the posterior rectus sheath cranially and the transversalis fascia/pre-peritoneal flap caudally — was closed in the midline under minimal tension using a continuous Prolene 2-0 suture on a round-body needle. Primary fascial closure was assessed prior to mesh placement; bridging was not required in any case. A 30 × 30 cm intermediate-weight macroporous polypropylene mesh (pore size >1 mm) was positioned in the retromuscular sublay plane in a diamond orientation. The mesh was fixed at Cooper's ligament bilaterally at the caudal extent, near the xiphoid process cranially, and at the level of the anterior superior iliac spine laterally. Two closed-suction retromuscular drains were placed in the TAR plane after mesh positioning. The anterior fascia (anterior rectus sheath) was closed with a running Prolene no.1 suture on round body needle. One subcutaneous closed-suction drain was placed prior to skin closure.

Component Separation Index (CSI)

The Component Separation Index is a CT-based radiological parameter developed by Christy et al. to standardise preoperative assessment of ventral hernia defect complexity.[12] Using the aorta as a fixed reference point and the medial leading edges of the bilateral rectus abdominis muscles on the axial CECT image at the level of maximum defect width, the subtended angle is measured and divided by 360° to give the CSI. As the CSI approaches and exceeds 0.21, the likelihood of requiring component separation and interpositional mesh reinforcement increases significantly.[12] All five patients in the present series had a CSI >0.21, ranging from 0.22 to 0.27, confirming the appropriateness of component separation as the planned reconstructive strategy.

Postoperative Care: A standardised enhanced recovery protocol was followed. Patients were mobilised on postoperative day (POD) one with abdominal binder support. Oral fluids were commenced on POD one and a soft diet on POD two. Epidural analgesia was maintained for 48–72 hours and supplemented with intravenous paracetamol and ketorolac. Subcutaneous drains were removed when output was <30 mL/24 hours on two consecutive days. Retromuscular drains were maintained until drain output was <30 mL/24 hours. Antibiotic prophylaxis was administered as a single intravenous dose of cefoperazone-sulbactum 1.5 gram at induction, continued for 5 days post operatively and extended in case the patient developed SSI, guided by wound culture sensitivity.

Outcome Measures: The primary outcome was achievement of tension-free primary fascial closure. Secondary outcomes included postoperative complications (graded according to the Clavien–Dindo classification),[14] surgical site infection (SSI), seroma requiring intervention, mesh infection, enterocutaneous fistula, abdominal compartment syndrome, duration of drain placement, length of hospital stay, and hernia recurrence at six months of follow-up.

Follow-up: All patients were reviewed in outpatient clinic at 2 weeks, 6 weeks, 3 months, and 6 months postoperatively. Clinical examination was performed at each visit. Recurrence was defined as any clinically palpable fascial defect or imaging-confirmed hernia at the operative site.

Statistical Analysis: Data are presented as frequencies and percentages for categorical variables, and as mean with range for continuous variables. No inferential statistical testing was performed, consistent with the descriptive design of this case series.

RESULTS

Five patients underwent open PCS-TAR during the study period. All patients completed the minimum six-month follow-up.

Demographic and Baseline Characteristics

The cohort comprised three males and two females. Mean age was 57 years (range 48–66 years). Mean BMI was 34.8 kg/m² (range 33–36 kg/m²). All patients were classified ASA II–III. The most common comorbidities were hypertension (4/5), type 2 diabetes mellitus (3/5), and a history of prior abdominal hernia repair (3/5). Patient-specific demographic, comorbidity, and surgical history data are presented in [Table 1 and 2].

Table 1: Baseline Demographic Characteristics

Patient	Sex	Age (years)	BMI (kg/m²)	ASA Grade	Previous Abdominal Operations (n)
1	Male	56	33	III	2
2	Male	60	36	III	3
3	Male	66	35	III	2
4	Female	55	36	II	1
5	Female	48	34	II	1
Mean	3M : 2F	57 years	34.8 kg/m²	—	—

Table 2: Comorbidities and Prior Surgical History

Patient	Type 2 DM	Hypertension	Hypothyroidis m	Smoking	Prior Hernia Repair
1	Yes	Yes	No	Yes	Yes (mesh repair)
2	Yes	Yes	No	No	Yes (two prior repairs)
3	No	Yes	Yes	No	Yes (suture repair)
4	Yes	No	No	No	None
5	No	Yes	No	No	None

Hernia Characteristics: All hernias were midline incisional hernias arising from previous laparotomy wounds. According to EHS classification, all five defects were classified as W2(4-10 CM),W3 (>10 CM maximum width), however the minimum defect width in our case series was 8cm. Defect locations spanned M2–M5 zones. Mean defect area was 108.4 cm² (range 80–144 cm²). All patients demonstrated preoperative CSI >0.21, consistent with a requirement for component separation. Loss of domain was calculated by TANAKA's index and was found to be present only in one of the five patients. Hernia characteristics are detailed in [Table 3].

Table 3: Hernia Characteristics (EHS Classification, Defect Dimensions, and CSI)

Patient	Defect Size (cm)	Area (cm²)	CSI Value	EHS Classification	Loss of Domain
1	10 × 10	100	0.24	M3, W3	Absent
2	8 × 10	80	0.22	M3, W3	Absent
3	9 × 12	108	0.23	M2–M4, W3	Absent
4	11 × 10	110	0.25	M2–M4, W3	Absent
5	12 × 12	144	0.27	M2–M5, W3	Present
Mean	—	108.4 cm²	0.242	—	—

EHS: European Hernia Society; CSI: Component Separation Index; W3: defect width >10 cm; M: midline zone (M2–M5 per EHS grid).

Operative Details: All procedures were performed electively under combined general and epidural anaesthesia. Bilateral PCS-TAR with retromuscular polypropylene mesh sublay was performed in all patients. A 30 × 30 cm intermediate-weight macroporous polypropylene mesh was used in every case. Mean operative time was 3.85 hours (range 3.25–4.5 hours). Primary fascial closure was achieved in all patients without the need for bridging mesh. Operative data are summarised in [Table 4].

Table 4: Operative Details

Patient	Anaesthesia	Procedure	Operative Time (h)	Mesh Size (cm)
1	GA + Epidural	PCS-TAR + Retromuscular Mesh	3.5	30 × 30
2	GA + Epidural	PCS-TAR + Retromuscular Mesh	4.0	30 × 30
3	GA + Epidural	PCS-TAR + Retromuscular Mesh	3.25	30 × 30
4	GA + Epidural	PCS-TAR + Retromuscular Mesh	4.0	30 × 30
5	GA + Epidural	PCS-TAR + Retromuscular Mesh	4.5	30 × 30
Mean	—	—	3.85 h	—

Postoperative Outcomes and Complications: One patient (Patient 1; 20%) developed a deep surgical site infection on postoperative day 8. The SSI was classified as Clavien–Dindo Grade IIIa (requiring interventional management without general anaesthesia). Wound cultures grew Staphylococcus aureus; the isolate was methicillin-sensitive (MSSA). The patient received culture-directed intravenous

antibiotics (Linezolid 600 mg twice daily for 14 days) and underwent serial wound debridement with negative-pressure wound therapy. Complete wound healing was achieved without mesh explantation. This patient also had the longest hospital stay (21 days) and the longest drain removal (POD 45). No seroma requiring aspiration or intervention was observed in any patient. No mesh infection, enterocutaneous fistula, abdominal compartment syndrome, or mortality occurred. Postoperative outcome data are detailed in [Table 5].

Table 5: Postoperative Outcomes and Clavien–Dindo Complication Grading

Pt.	Hospital Stay (days)	Complication	Clavien–Dindo Grade	Mesh Removal	Seroma	Recurrence (6 months)
1	21	SSI (deep)	Grade IIIa	No	No	No
2	14	None	—	No	No	No
3	12	None	—	No	No	No
4	18	None	—	No	No	No
5	17	None	—	No	No	No
Mean	16.4 days	SSI rate: 20%	—	0%	0%	0%

SSI: surgical site infection; POD: postoperative day; Clavien–Dindo Grade IIIa: complication requiring interventional management without general anaesthesia.

Table 6: Drain Removal (Postoperative Day)

Patient	Retromuscular Drain Removal (POD)	Subcutaneous Drain Removal (POD)	Remarks
1	45	45	Prolonged — SSI; wound debridement performed
2	13	10	Uneventful
3	11	9	Uneventful
4	16	13	Uneventful
5	17	14	Uneventful

Figure 1: pre-operative picture showing large incisional hernia

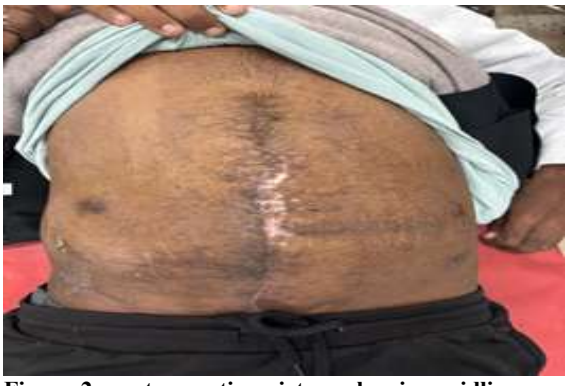

Figure 2: post-operative picture showing midline scar and no bulge

Figure 3: Intra-operative pic showing posterior layer, comprising the posterior rectus sheath cranially and the transversalis fascia/pre-peritoneal flap caudally — was closed in the midline under minimal tension using a continuous Prolene 2-0 suture on a round-body needle

Drain Management: Retromuscular and subcutaneous drains were managed as described. The significantly prolonged drain duration in Patient 1 (POD 45 for both retromuscular and subcutaneous drains) was attributable to the deep SSI and ongoing wound management. In the four remaining patients, retromuscular drains were removed between POD 11 and POD 17, and subcutaneous drains between POD 9 and POD 14. Drain removal details are presented in [Table 6].

Recurrence: No clinical hernia recurrence was observed in any patient during the six-month follow-up period. All patients were reviewed at their

scheduled outpatient appointments and underwent clinical examination of the abdominal wall.

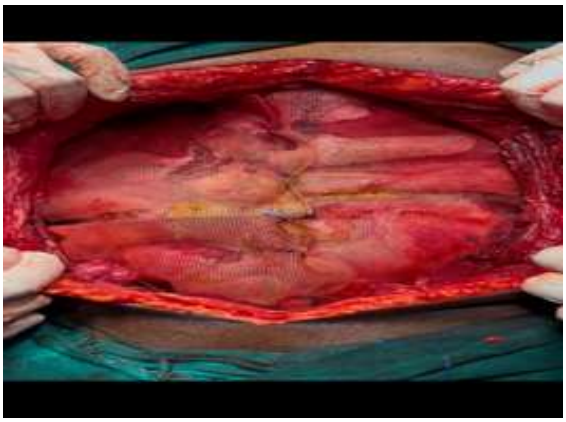

Figure 4: A30×30cm intermediate-weight macroporous polypropylene mesh (pore size >1 mm) was positioned in the retromuscular sublay plane in a diamond orientation.

DISCUSSION

Complex abdominal wall reconstruction remains one of the most technically demanding domains of modern general surgery. Giant incisional hernias, defined by defect widths exceeding 10 cm or areas exceeding 100 cm², are frequently associated with obesity, loss of domain, and multiple prior repair attempts, all of which substantially increase operative complexity and the risk of recurrence.[1,4,6] The landmark description of TAR by Novitsky et al. in 2012 transformed the surgical management of these hernias.[9] The TAR approach extends the classical Rives–Stoppa retromuscular plane beyond the linea semilunaris by releasing the transversus abdominis muscle, thereby creating a large, well-vascularised retromuscular space for mesh placement while avoiding the extensive skin undermining inherent to anterior component separation.[7,9] In the pivotal 2016 series by Novitsky et al. comprising 428 patients, posterior component separation with TAR and synthetic mesh sublay achieved primary fascial closure in 99% of patients, with a wound morbidity rate of 18.7% and a recurrence rate of 3.7% at a mean follow-up of 27 months— outcomes that remain the benchmark against which subsequent series are compared.[11]

In the present series, all five patients achieved primary fascial closure without bridging, despite mean defect areas exceeding 100 cm² and the presence of loss of domain only in one of the five cases. This reflects the powerful myofascial advancement facilitated by bilateral TAR and is consistent with results reported in the literature.[9,11,15] The preoperative use of CECT-derived CSI for patient selection ensured that only patients with objectively documented complexity (CSI >0.21) were scheduled for PCS-TAR, lending rigour to our case selection.[12]

Surgical site infection occurred in one patient (20%). Although this rate is higher than the <10% SSI rate reported in the large series by Novitsky et al,[11] and the 4.5–6.2% rates described from high-volume specialised centres,[6] it is consistent with rates observed in studies from resource-limited settings with higher baseline comorbidity burden, where rates of 10–28% have been documented.[15,18] Critically, the mesh was salvaged in this patient, affirming the importance of the retromuscular plane in providing a biologically favourable environment for prosthesis preservation. The retromuscular location places the mesh beneath multiple layers of well-vascularised tissue with intact blood supply from the superior and inferior epigastric systems, conferring resistance to infection compared with the onlay or IPOM positions.[9,11]

The classification of complications using the Clavien–Dindo system,[14] provides objective, internationally standardised grading of surgical morbidity, facilitating meaningful comparison across institutions and series. Grading the SSI in Patient 1 as Grade IIIa (requiring bedside interventional management under local anaesthesia) places our complication profile in appropriate context and highlights the absence of Grade IV or V events in this series.

The mean hospital stay of 16.4 days in our series is longer than the 5.9-day median reported by Novitsky et al,[11] and the 7–10-day stays described in other specialised TAR centres. This difference likely reflects the index SSI case (21 days), the resource-limited infrastructure of our setting, and the absence of a fully established enhanced recovery after surgery (ERAS) protocol at the time of this series. The four patients without SSI had a mean stay of 15.25 days, which still exceeds Western benchmarks, underscoring the importance of formalising ERAS pathways at our institution.

No recurrence was observed at six-month follow-up. Published TAR series report recurrence rates ranging from 2–8% at one to two years, with recurrence predominantly occurring beyond six months.[9,11,15,16] Our short follow-up period is a recognised limitation and prevents definitive conclusions regarding long-term durability. Continued surveillance is essential to characterise the long-term recurrence profile of this cohort.

This study holds particular contextual significance. The overwhelming majority of published TAR literature originates from highly specialised abdominal wall reconstruction programmes in high-income countries with dedicated infrastructure, resources, and teams. Our series demonstrates that PCS-TAR can be performed safely and effectively using standard affordable polypropylene mesh in a general surgical department at a teaching institution in northern India, thereby establishing feasibility of this technique in resource-limited settings. This resonates with the observations of Punjani et al., who similarly reported acceptable outcomes with TAR in a resource-constrained Indian centre.[18]

Limitations: The principal limitations of this study are the small sample size (n = 5), single-centre design, absence of a comparative control group, and a follow-up period restricted to six months, which precludes assessment of long-term recurrence. Selection bias cannot be excluded given the prospective observational design without randomisation. Additionally, detailed quality-of-life outcomes and functional abdominal wall assessments were not formally captured. Despite these limitations, this series provides valuable real-world data on PCS-TAR from a resource-limited Indian tertiary-care setting, contributing to the growing body of evidence supporting global applicability of this technique.

CONCLUSION

Posterior component separation with transversus abdominis release is a safe, reproducible, and effective technique for the reconstruction of giant and complex incisional hernias. By enabling tension-free midline closure and wide retromuscular mesh reinforcement without sacrificing abdominal wall vascularity, PCS-TAR addresses the principal determinants of hernia recurrence and wound morbidity. In this series, primary fascial closure was achieved in all patients, mesh was preserved despite a surgical site infection, and no recurrence was observed at six months. PCS-TAR is feasible and effective in a tertiary-care teaching hospital in a resource-limited setting and should be incorporated into the reconstructive armamentarium of trained general surgeons managing complex incisional hernias.

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