

T-Line Hernia Mesh Background:

Hernia recurrence following ventral hernia repair (VHR) is ~30% or greater over 10 years.¹ A major source of recurrence is thought to be mesh anchor point failure; suture tearing, or “cheese-wiring”, through tissue or mesh at the focal point of attachment (**Figure 1**). Suture cheese-wiring can occur at 6 to 14 N/cm, whereas peak abdominal pressures can exceed 32 N/cm when coughing or lifting.^{2,3} Achieving mesh fixation that withstands these forces will reduce mesh dehiscence and migration, thus decreasing hernia recurrence.



Figure 1. Cheese-wiring from sutures tearing through fascia.

To overcome this problem and facilitate tension-free repair, the T-Line® Hernia Mesh (**Figure 2**) was developed. It is a moderate-weight, super macroporous, polypropylene mesh with unique integrated mesh extensions located at 2-cm intervals along the lateral borders of the prosthetic. The novel mesh extensions serve to significantly reduce focal anchor point stress by spreading these forces over a larger area. While the T-Line Hernia Mesh achieves ~3X stronger anchoring strength than currently available meshes,¹ the anchoring strength of the mesh extensions should increase further over time as they bioincorporate with adjacent host tissue.

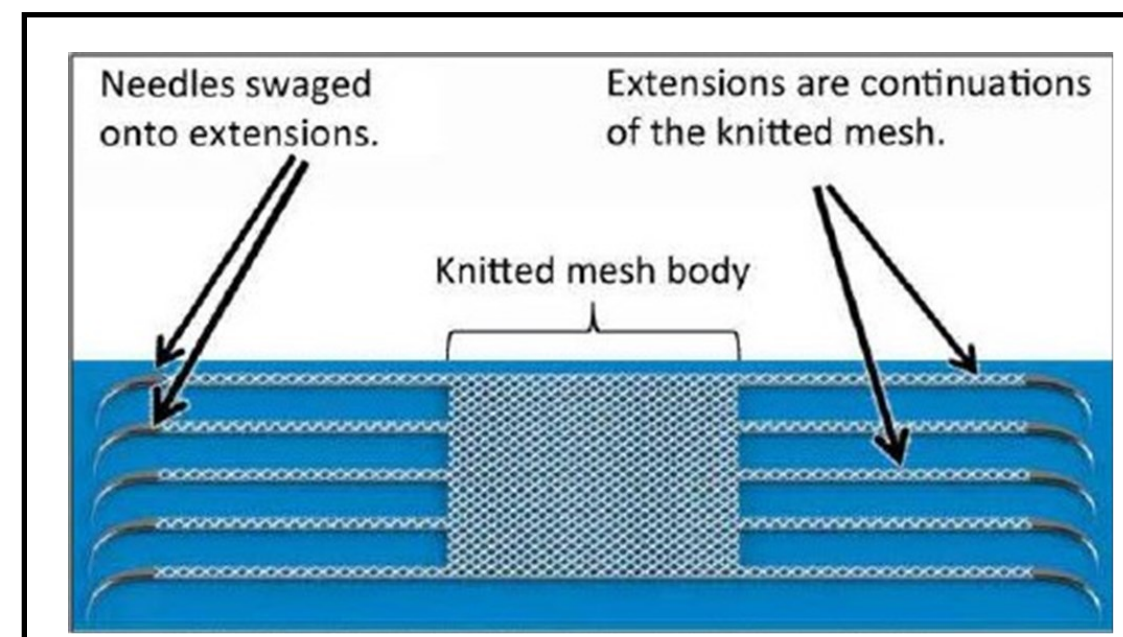


Figure 2. T-line Hernia Mesh. (Photo used with permission from Deep Blue Medical Advances).

During ventral hernia repair, the T-Line Hernia Mesh is placed over the repair with the mesh extensions sewn into the adjacent fascia. A quick self-locking back-stitch secures the extensions and avoids the need for bulky suture knots (**Figure 3**). Mesh tension is set by sewing the contralateral extensions into tissue, thereby allowing the surgeon to control how tightly the mesh is stretched across the tissue.

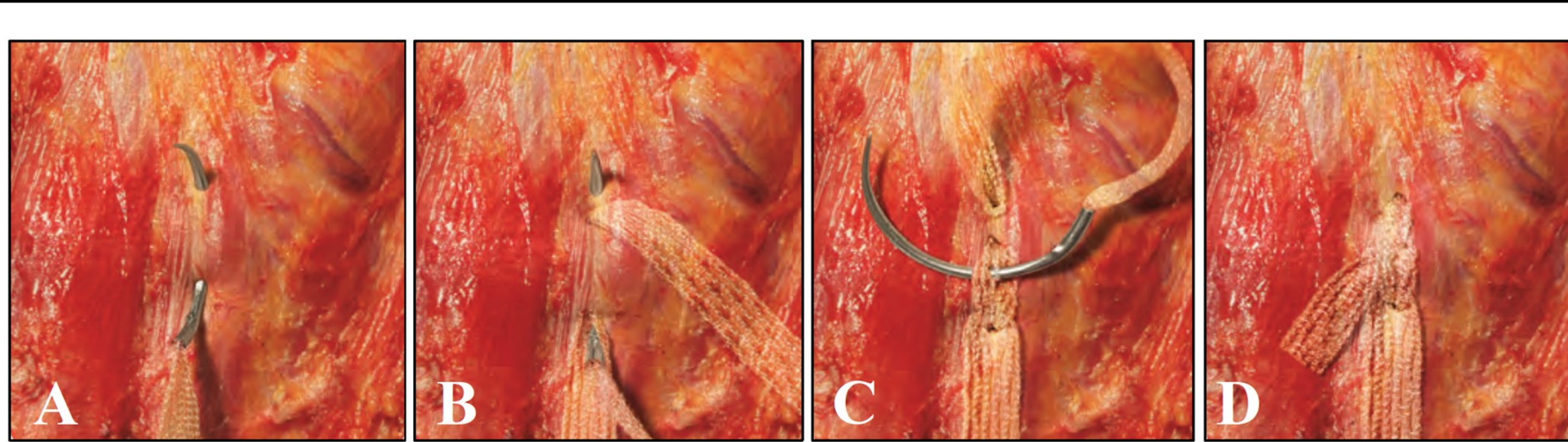


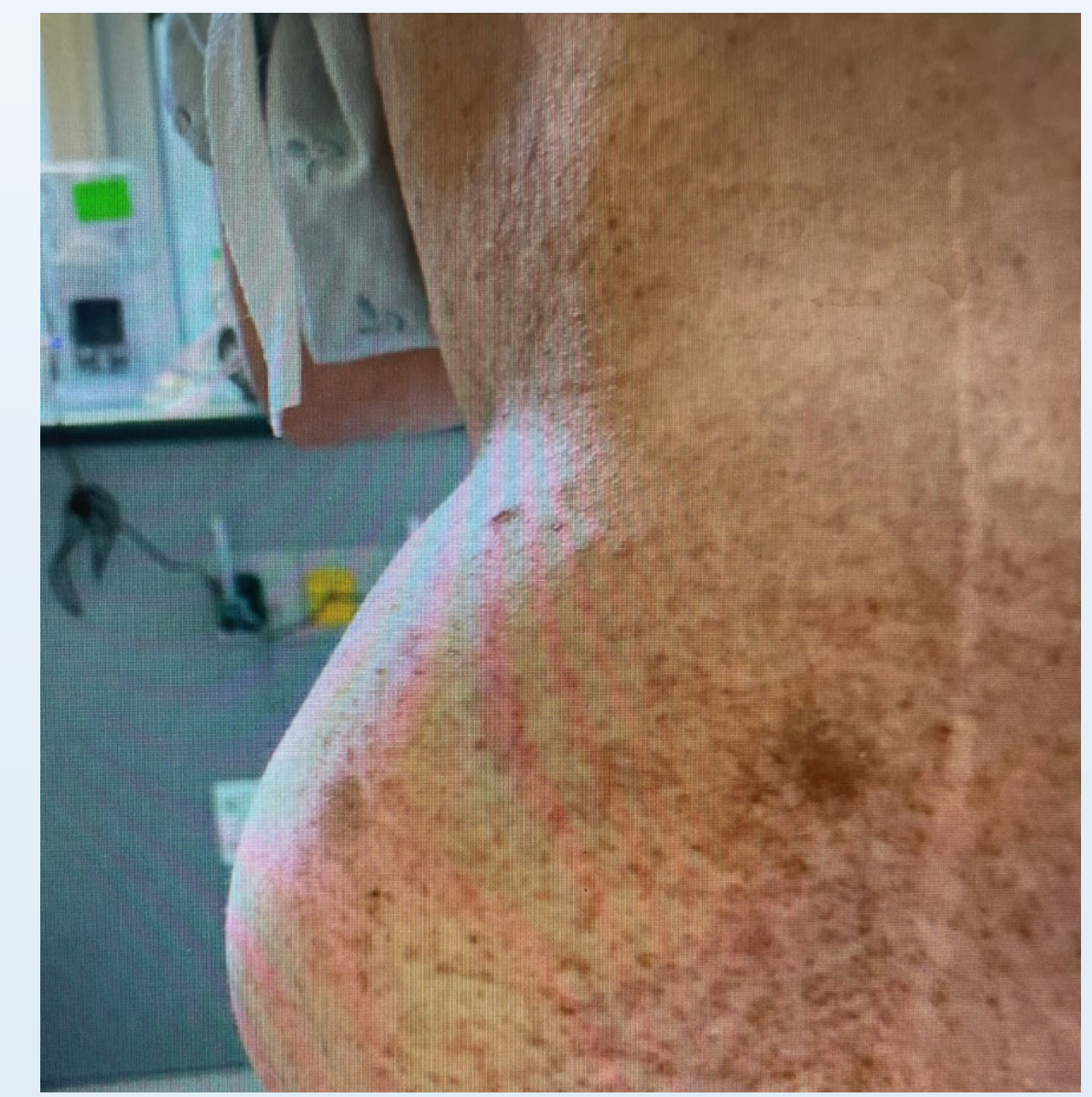
Figure 3. A) shallow 1 - 1.5 cm bite lateral to edge of mesh. B) Pull to create desired tension on mesh and pass needle through center pore of extension where first bite entered fascia and slightly deeper through tissue exiting 1 to 2 mm lateral exit of first bite. C) Pull to create snug loop around fascia and pass needle through center pore of extension where it exits first bite. D) Pull snug to complete self-locking stitch and cut excesses leaving a 1 to 1.5 cm tail.

Cases:

T-Line Hernia Fixation System was used in a series of 18 complex ventral hernia repairs from November 2020 to April 2023, including patients with BMI>35, multiple recurrent hernias, flank hernias, and lumbar hernias. Operative details, age, sex, BMI, OR time, blood loss, follow-up, pain, recurrence rates, and adverse events were recorded (**Table I & II**).

Table I Patients' Characteristics (n=18)		
	Median (range)	n (%)
Age (y)	56.5 (25-83)	
BMI (kg/m ²)	31.7 (23.6-51)	
Sex		
Female		12 (66.7)
Male		6 (33.3)
ASA		
Class II		7 (39)
Class III		11 (61)
Comorbidities		
Hypertension		7 (39)
Diabetes Mellitus		6 (33.3)
COPD		1 (5.6)
Smoking		2 (11.1)
Liver Disease		2 (11.1)
Anticoagulation Medication		1 (5.6)
Antiplatelet Medication		3 (16.7)

Table II Hernia Characteristics (n=18)	
	n (%)
Hernia Type	
Primary Ventral	12 (66.7)
Incisional	6 (33.3)
EHS Classification	
M1	0
M2	6 (33.3)
M3	13 (72.2)
M4	3 (16.7)
M5	0
L1	1 (5.6)
L2	2 (11.1)
L3	0
L4	0
Recurrent Hernias	11 (61.1)
Recurrent Incisional	6 (33.3)
Recurrent Primary Ventral	5 (27.8)
EHS Width Classification	
W1	1 (5.6)
W2	11 (61.1)
W3	4 (22.2)
Unknown	2 (11.1)



Results:

The T-Line Hernia Fixation System has been used in 18 patients over the past 30 months (November 2020 – April 2023). There were 12 women, average age of 62 years (25 – 83), BMI = 35 (24 - 51), OR time = 247 mins, estimated blood loss = 100 ml, with a mean follow up of 16 ± 11 months. All patients did well with 2 seromas reported in the onlay cases (13%) and one superficial SSI (5.6%) reported. There is 1 case of significant pain of undetermined etiology.



Table III Intraoperative Data (n=18)		
	Median (range)	n (%)
Wound Classification		
Clean		17 (94.4)
Clean Contaminated		1 (5.6)
Diastasis		5 (27.8)
Defect Length (cm)	13.5 (2-26)	
Defect Width (cm)	9 (2-15)	
Area of the Defect (cm ²)	117.5 (4-390)	
Mesh Area (cm ²)	449.5 (130-600)	
Mesh Position		
Onlay		16 (88.9)
Sublay		2 (11.1)
Anterior Component Separation		4 (22.2)
Associated Procedure		
Panniculectomy		5 (27.8)
Small Bowel Resection		1 (5.6)
Omentum Resection		1 (5.6)
Intraoperative Complication		
Serosal Tear		2 (11.1)
Drain Use		17 (94.4)
Operative Time	247 (104-395)	
EBL	100 (25-400)	



Table IV Postoperative Outcomes (n=18)		
	Median (range)	n (%)
LOS (days)	6 (0-21)	
ED Presentation within 30 days		2 (11.1)
Readmission		2 (11.1)
Complications		
Seroma		3 (16.7)
SSI		1 (5.6)
Follow-up (months)	16 (4-30)	

Conclusion:

In this study, with 6 patients having more than 2 years of follow-up, T-Line Hernia Fixation System has yielded no **(0%) hernia recurrences** nor increased post-operative pain, far below the reported ~20% recurrence rates with fixation-free mesh and traditional mesh fixation.⁴ These data suggest that enhanced soft tissue fixation may significantly reduce the recurrence rate following complex ventral hernia repair. With rapid clinical uptake, the mesh has been implanted as an onlay and sublay and used in open and robotic cases. Consequently, more than 3,800 mesh sutures have been implanted without reports of pain or significant adverse events. However, further clinical experience and longer follow-up is needed to establish the value of this tool for abdominal wall reconstruction.

- Can be used to repair very complex ventral hernias (onlay & sublay)
- Associated with low rates of early wound complications (SSI & SSO)
- Well-tolerated by patients
- Longer follow-up is needed

Surgeon's Experience:

- “zip lock tie” feel to mesh extensions – a “next-level” barbed suture
- Mesh extensions distribute tension and exhibit enhanced bioincorporation
- Medium weight (90g), ultra-large pore, polypropylene mesh handles like a lightweight, macroporous mesh
- Cut mesh extensions = mesh sutures = empowers increased flexibility & creativity

T-Line Key Benefits:

- Superior anchoring strength
- Mesh and suture are one: the anchor is the mesh
- Enhanced distribution of tension

References:

1. Burger JWA, Luijckijk RW, Hop WCJ, et al. Long-term follow-up of a randomized controlled trial of suture versus mesh repair of incisional hernia. Ann Surg. 2004; 240: 579-583.
2. Ibrahim M, Green J, Everett J, et al. Soft Tissue Anchoring Performance, Biomechanical Properties, and Tissue Reaction of a New Hernia Mesh Engineered to Address Hernia Occurrence and Recurrence. J Med Device. 2019; 13(4): 21-29.
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4. Etemad SA, Huang LC, Phillips S, et al. Advantages of a Fixation-Free Technique for Open Retromuscular Ventral Hernia Repair. Plast Reconstr Surg. 2020; 146(4): 883-890. DOI: 10.1097/PRS.000000000000165