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SPECIAL TOPIC
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Retrorectus Ventral Hernia Repair Utilizing T-line Hernia Mesh: Technical Descriptions

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Summary: The T-line hernia mesh is a synthetic, polypropylene mesh with mesh suture extensions designed to prevent anchor point failure by evenly distributing tension across the soft tissue. Previous studies have demonstrated the success of onlay ventral hernia repair with T-line hernia mesh, but retrorectus applications of the mesh have not yet been characterized. This technique article illustrates technical descriptions and clinical applications of the T-line hernia mesh in the retrorectus plane. *(Plast Reconstr Surg Glob Open 2024; 12:e6101; doi: 10.1097/GOX.0000000000006101; Published online 26 August 2024.)*

INTRODUCTION

Surgical techniques for ventral hernia repairs (VHRs) vary with patient demographics, surgeon preferences, and defect characteristics.[1] Large defects exceeding 10-cm diameter pose complex reconstructive challenges, which often require open approaches for durable repairs.[2–5] Generally, mesh reinforcement has become standard of care for abdominal wall hernia defects greater than 1 cm, but thoughtful decision-making is required to determine mesh material, implantation plane, mesh fixation, and utilization of operative adjuncts.[6–9]

Although approaches vary, evidence suggests that synthetic meshes, particularly midweight polypropylene meshes, are preferred to biological or lightweight polypropylene meshes, offering demonstrably lower rates of mesh failure.[10–12] Additionally, retrorectus mesh placement is favored by many due to perceived lower recurrence and infection rates compared with onlay and intraperitoneal placement.[13–16] Mesh fixation is another consideration, with ongoing debate about the best technique.[17] A number of fixation options exist, including tacks, monofilament sutures, and glue, but mesh sutures are also under investigation, as they distribute tension more broadly, withstanding supraphysiologic forces where sutures cheese-wire, aiding the mesh to lay flush with tissue and facilitating bioincorporation through the suture rather than around the suture.[18,19]

The T-line mesh (Deep Blue Medical Advances, Durham, N.C.) is a macroporous polypropylene mesh of moderate weight with unique characteristics. The macroporous prosthetic material has the tensile strength of standard weight prolene mesh, yet the handling characteristics of a lightweight mesh, which render it easy to use and allow it to readily conform to any variations in the topography of the abdominal wall fascia.[1] Its mesh extensions distribute tension across a surface area 15 times that of a conventional monofilament suture.[20,21] compared with the standard suture, the mesh extensions offer 275% greater anchoring strength, which increases as extensions bioincorporate.[20,22,23] The extensions are easily implanted via attached needles and distribute tension across the abdominal fascia, which averts cheese-wiring and accompanying complications, like fascial dehiscence or hernia recurrence.[24] These properties and features allow the T-line hernia mesh to provide durable support for VHRs, as has been shown in numerous onlay studies.[21,25] The applications of the T-line mesh have not been characterized in the retrorectus plane, and in this study we will share technical descriptions and operative details.

METHODS

Study Design

Institutional review board exemptions were obtained for this study. Technical descriptions were elicited from surgeons using in-person interviews and dictated into written form.

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Technical Description: Hope Technique

Following laparotomy, hernia reduction, adhesiolysis, and sac excision, the abdominal wall defect is inspected. The retrorectus plane is identified and circumferentially dissected while preserving skin-perforator vessels supplying the anterior abdominal wall. If needed, a transversus abdominus release is performed to achieve primary fascial closure of the posterior rectus sheath. The posterior rectus sheath is then isolated and closed with running 0-Vicryl suture.

The T-line hernia mesh is brought into the operative field, and mesh size is chosen according to the length and width of the fascial defect. The mesh is selected by measuring the space desired to be covered, ensuring that the mesh extends 5 cm from the perimeter of the defect. The desired mesh extensions are selected with their respective needles loosened from the plastic encasing. Selected extensions are left attached to the mesh, whereas surplus extensions are cut at the perimeter of the mesh rectangle. Typically, at least two extensions are preserved at each lateral mesh edge (usually at the mesh corners and potentially at the midpoint along the mesh edge if the mesh is longer than 10 cm), irrespective of mesh size and based on surgeon preference. The mesh and extensions are introduced into the retrorectus space overlying the closed posterior rectus sheath and contoured superior and inferior to the extensions. Each lateral mesh extension is passed from the lateral retrorectus space through the anterior abdominal wall (anterior rectus fascia, subcutaneous tissue, and skin) at the lateral margins of the mesh at desired fixation point (Fig. 1). For additional security, a strip of mesh suture that was previously cut from the original device is threaded through the cranial and caudal aspect of the implanted sheet of mesh. The needle of the extension is threaded through the edge of the mesh and then through the tail of the extension and cinched down around the edge of the mesh body like a "zip-tie." [**See figure, Supplemental Digital Content 1,** which displays "zip-tie" reattachment of mesh extension: (A) Take a bite of the mesh a few pores in from the edge, (B) pass the needle through a center pore 1–1.5 cm from the bitter end of the free extension, (C) pull the extension through itself similar to a zip-tie until snug on the mesh body, and (D) reattached mesh extension is now ready to sew into fascia using the two-bite lockstitch. **http://links.lww.com/PRSGO/D453.**] The mesh suture is then passed through the anterior abdominal wall superiorly and inferiorly to form fixation points in a similar fashion as performed laterally (Fig. 1). To ensure proper seating of the mesh, radial tension is applied to all fixation points. All fixation strips are cut flush with skin, without anchoring the extensions to tissue, and two flat Jackson-Pratt drains are placed in the retrorectus space exiting through stab incisions in the lower abdomen (Fig. 2). The cavity is irrigated, and

Takeaways

Question: How is the T-line hernia mesh applied in the retrorectus plane for ventral hernia repairs?

Findings: Three surgeons' techniques for retrorectus application are provided with detailed illustrations to characterize nuances in operative technique.

Meaning: After reading this article, surgeons should come away with an understanding of different applications of this unique mesh in the retrorectus plane.

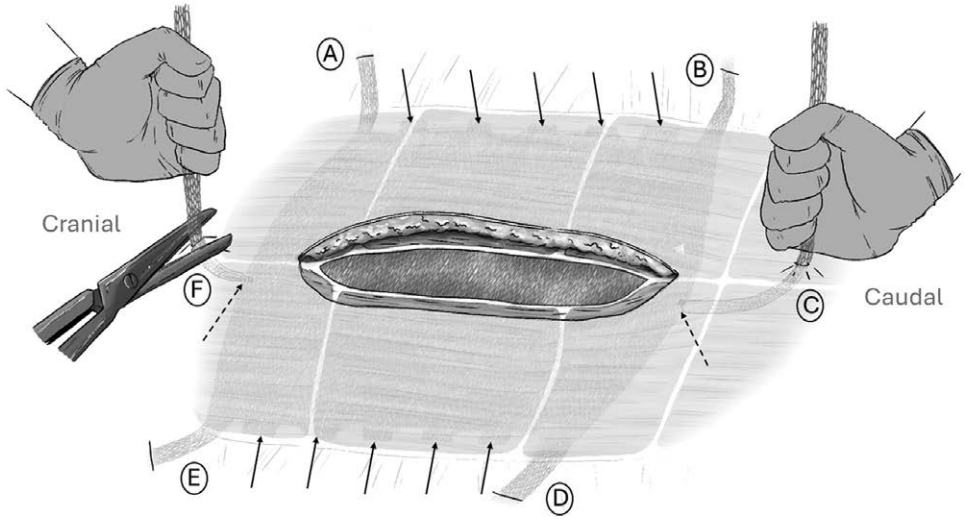

Fig. 1. Positioning of mesh for Hope technique. Mesh is sized to fit in the retrorectus space spanning from left semilunar line to right semilunar line and overlapping the craniocaudal incision by 3–5 cm. Unwanted extensions are removed from the mesh (solid arrows). Two of the removed extensions are reattached at the cranial and caudal midpoints of mesh edge with a zip-tie attachment (dashed arrows). All mesh extensions (eg, C, F) are pulled up through skin knicks to draw mesh taut in retrorectus space. Extensions are cut adjacent to the skin (F) and allowed to withdraw into the subcutaneous space (A, B, D, E).

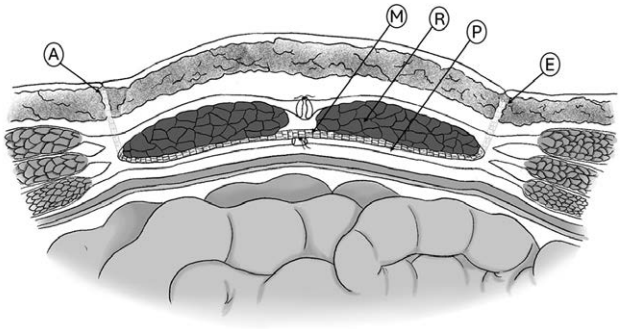

Fig. 2. Final position of Hope technique. Transverse cross-sectional view of implanted mesh (M) in the retrorectus space between the rectus muscles (M) and the posterior rectus sheath (P) with extensions (A & E) pulled to the subcutaneous space through skin knicks to position and stretch flat.

the anterior fascia is closed in a bidirectional running fashion using #1 PDS suture. Loose skin is excised for optimal cosmesis, and the incision is reapproximated in two layers.

Technical Description: Farber Technique

Following laparotomy, hernia reduction, adhesiolysis, and sac excision, the abdominal wall defect is inspected. The posterior rectus sheath is isolated and the retrorectus space is dissected medial to the linea semilunaris. In addition, anterior subcutaneous undermining is performed to the linea semilunaris to allow for complete visualization of the anterior rectus sheath. If needed, an anterior component separation or posterior component separation is performed to facilitate primary fascial closure, but not both. The posterior rectus sheath is then closed primarily with a long-acting 2-0 absorbable barbed suture.

The T-line hernia mesh is chosen based on defect width and brought into the operative field and contoured to fit the retrorectus space. Two to three lateral mesh suture extensions are left in place on each side, whereas the remaining extensions are trimmed from the lateral mesh edges for potential later use. The midline of the mesh is affixed to the midline approximation of the posterior rectus fascia via multiple interrupted long-acting 2-0 absorbable sutures to hold the mesh in place during placement. Trimmed mesh extensions are reattached to the caudal and cephalad mesh edges by threading them through the mesh and performing a zip-tie reattachment (**Supplemental Digital Content 1, http://links.lww.com/PRSGO/D453**). These midline mesh suture extensions are used to anchor the mesh superiorly and inferiorly near the linea alba (Fig. 3). Alternatively, mesh placement and extension attachment may be performed robotically.

For lateral mesh fixation, the mesh extensions are brought out lateral to the rectus muscle through the anterior rectus fascia, medial to the linea semilunaris (Fig. 3). The anterior rectus fascia is reapproximated with long-acting #1 absorbable barbed suture using a short suture technique,[26] with #1 long-acting absorbable internal retention sutures interspersed every 1.5 cm. At this point, radial tension is applied to the mesh extensions to properly seat the mesh, and all mesh extensions are anchored to the

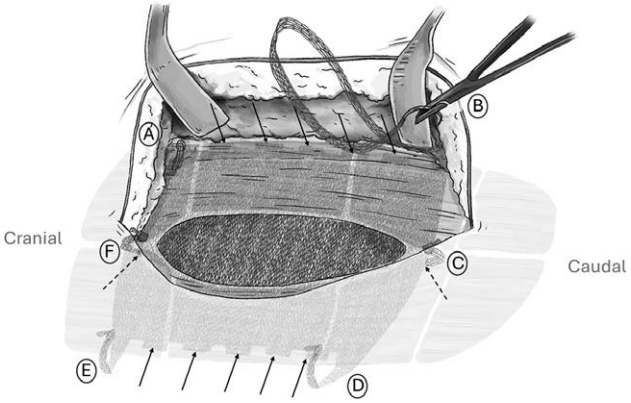

Fig. 3. Positioning of mesh for Farber technique. Mesh is sized to fit in the retrorectus space spanning from the left semilunar line to the right semilunar line and overlapping the craniocaudal incision by 3–5 cm. Unwanted extensions are removed from the mesh (solid arrows). Two of the removed extensions are reattached at the cranial and caudal midpoints of the mesh edge with a zip-tie attachment (dashed arrows). The midline of the mesh is affixed to the midline of the posterior rectus fascia via multiple interrupted absorbable sutures to hold the mesh in place during placement. Two to three mesh extensions per side (A, B, D, E) are passed from the retrorectus space through the anterior sheath. Radial tension is applied to all fixation points (A, B, C, D, E, F) to ensure proper seating, and the extensions are anchored to the anterior rectus fascia with a two-bite lockstitch (B is about to be affixed to the fascia).

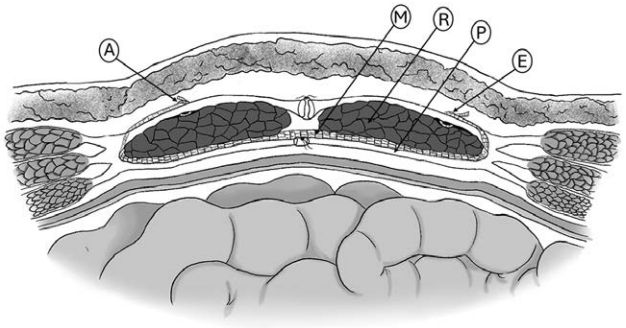

Fig. 4. Final position of Farber technique. Transverse cross-sectional view of implanted mesh (M) in the retrorectus space between the rectus muscles (R) and the posterior rectus sheath (P), with extensions passed anteriorly and anchored in the anterior rectus fascia with a two-bite lockstitch (A & E).

anterior rectus sheath as lockstitches (Fig. 4). A lockstitch technique is performed: the needle is driven through the overlying fascial layer in a bite medially, and then the needle is looped laterally back through the mesh extension and another bite of tissue is taken; then the needle is taken through the extension one last time to complete a two-bite lockstitch, and the extension is cut leaving a short tail ("bite, through, bite, through, cut;" Fig. 5).

Technical Description: Yoo Technique

Following laparotomy, hernia reduction, adhesiolysis, and sac excision, the abdominal wall defect is inspected. The posterior rectus sheath is isolated and the retrorectus

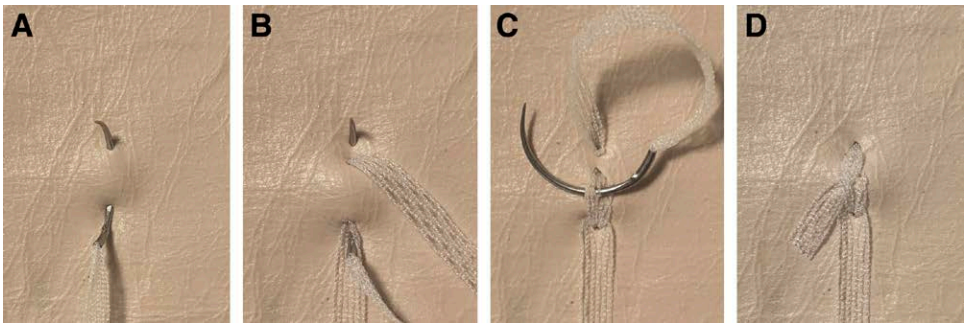

Fig. 5. Anchoring of the mesh extension with a two-bite lockstitch. A, The first bite can be a shallow bite (eg, 1–1.5 cm) through the tissue. The extension is then pulled to create the desired tension on the mesh body. B, The needle is then passed through a center pore of the extension where the first bite entered the fascia and placed slightly deeper through the tissue exiting 1–2 mm lateral to the exit of the first bite. C, The second bite is pulled to create a snug loop around the fascia, and the needle is then passed through a center pore of the extension where it exits on the first bite. D, The extension is drawn snug to complete the self-locking stitch, and the extension is cut with scissors 1–1.5 cm from the last point of pass-through, thus removing the needle and excess extension.

space is dissected medial to the linea semilunaris. The posterior rectus sheath is closed using 2-0 Vicryl suture in a continuous fashion to seal the peritoneal cavity. The T-line hernia mesh is sized to match the entire abdominal wall from the ribs to the pubis and laterally to the mid-axillary line. All but the corner mesh extensions are removed from the mesh body by cutting near the lateral edge. The mesh and remaining extensions are brought into the operative field and placed within this retrorectus space. The mesh is secured to the anterior rectus fascia of the abdominal wall with the attached mesh extensions at the four corners of the mesh. The mesh is pulled flat, taut, and smooth in this space by taking a bite of anterior rectus fascia lateral to the rectus muscles and pulling the extensions medially, stretching out the mesh and achieving the desired, optimal tension (Fig. 6). Fixation can then be accomplished different ways. First, one can use knotless or "traction" fixation by taking a bite of tissue lateral to the rectus muscle and medial to the linea semilunaris, and then the extension is pulled medially until the mesh is stretched out appropriately; the extension is then cut, leaving a tail (Fig. 7). The extensions provide grip in tissue. Alternatively, it can be done with the two-bite lockstitch technique in the area lateral to the edge of the rectus muscle and medial to linea semilunaris per the instructions for use.

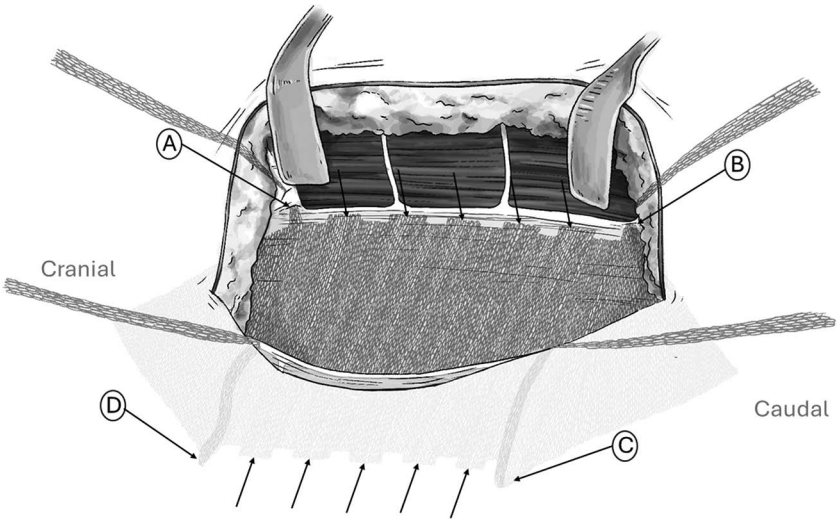

Fig. 6. Positioning of mesh for Yoo technique. The mesh is trimmed to fit the entire space. A bite is taken in the anterior fascia between the lateral edge of the rectus muscle and medial to the linea semilunaris with the extension returning to the retrorectus space at the four corners (A, B, C, & D)—all other extensions are cut off (arrows). After retraction is removed, tension is applied to the four extensions, and the extensions are trimmed at the midline. No lockstitches are used in the traction technique. Anchoring is achieved through traction (friction of the extension in the tissue bite).

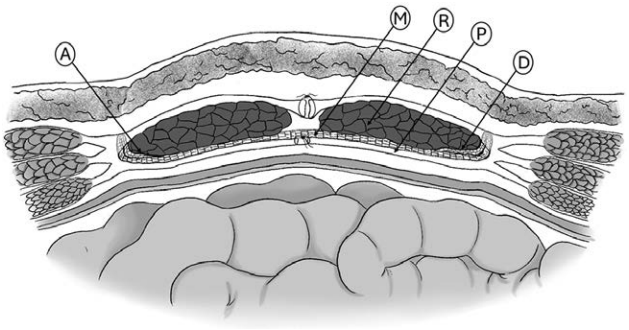

Fig. 7. Final position of Farber traction technique. Transverse cross-sectional view of implanted mesh (M) in the retrorectus space between the rectus muscles (M) and the posterior rectus sheath (P), anchored with traction of bite of extension (A & D) in the anterior fascia lateral to the rectus muscle and medial to the linea semilunaris.

The laparotomy incision is closed with multiple interrupted, 2-0 polypropylene sutures in a figure-of-eight manner. Two #15 blake drains are placed in the subcutaneous space exiting the patient's abdomen from each side and secured to the skin with 2-0 nylon. The deep dermal layer is closed with 2-0 Vicryl sutures in an interrupted fashion. The skin edge is closed using skin staples. Sterile dressings are applied, and an abdominal binder is placed.

Technical Pearls

A comparison of techniques is offered in Table 1 with an additional flowchart (Fig. 8) demonstrating key differences in technique. In addition, prior publications have demonstrated the application of this mesh in a surgical technique video, cited herein.[27]

Contouring the Mesh

Contouring the T-line hernia mesh is dependent on the abdominal wall defect and size of mesh that a surgeon intends to use. If the entire mesh is planned for use, no contouring is required, but the retrorectus space needs to be adequately developed to accommodate the shape of the rectangular mesh. If desired, the surgeon can cut the mesh to fit any defect size by trimming the corners, for example, creating a shield or more oval shape, and then reattaching the extensions with the needle through the tail zip-tie technique. All extensions are then candidates for inclusion, and in Dr. Yoo's technique, the four corner extensions are then used for fixation and to properly seat the mesh. The mesh comes in eight sizes (two length and four width), and the mesh can further be cut to be adjusted to the defect with extensions reattached as needed.

Seating the Mesh

The mesh suture extensions can be passed through the muscular abdominal wall as in Dr. Farber and Yoo's techniques, or they can be passed full thickness through the muscular and cutaneous abdominal wall as in Dr. Hope's technique. Extension fixation is surgeon dependent, as anterior subcutaneous undermining is required for a purely anterior fascia fixation technique. Regardless of fixation technique, all surgeons apply radial tension once the mesh extension is passed through the abdominal wall to seat the mesh. The lockstitch technique is then used by Dr. Farber, whereas Dr. Hope cuts the mesh when flush with the skin and Dr. Yoo, depending on patient condition, either cuts the extension, leaving a small tail in the abdominal wall, or creates a lockstitch on the inferior surface of the anterior rectus sheath between the muscle and linea semilunaris.

DISCUSSION

This article provides multiple technical descriptions of VHR using the T-line hernia mesh in the retrorectus plane. VHR techniques are tailored to each case, but certain principles are gaining favor among experts. Synthetic meshes are gaining popularity for most abdominal wall hernia repairs and offer lower rates of recurrence, readmission, and length of hospital stay when compared with biologic mesh.[28,29] Specifically, synthetic polypropylene midweight meshes in the retrorectus plane provide lower recurrences, mesh failures, pain, and infections compared with lightweight meshes.[11,12,30] These studies support the use of a polypropylene mesh of moderate weight, such as the T-line hernia mesh, in the retrorectus plane, and align with the favorable outcomes observed in this case series.

However, many practices remain highly debated, particularly mesh fixation. Currently, many surgeons use

Table 1. Comparative Summary of Hernia Repair Techniques among Three Surgeons

Technique	Farber	Hope	Yoo
Contouring	Cut 5 cm from perimeter of defect	Cut 5 cm from perimeter of defect	Wide undermining followed by contouring from ribs to pubis and laterally to mid-axillary line
Benefits/challenges	More selective mesh size but requires greater mesh selection for defect specific contouring	More selective mesh size but requires greater mesh selection for defect specific contouring	Uniform mesh selection but greater mesh burden for patients with smaller defects
Seating/fixation	Muscular abdominal wall; lockstitch	Muscular and cutaneous abdominal wall; extensions cut flush with skin	Muscular abdominal wall; lockstitch
Benefits/challenges	Secure fixation of mesh; mesh knots may add bulk to fixation leading to higher postoperative pain	Minimizes internal knots; maximizes radial tension to allow for straightforward mesh seating	Secure fixation of mesh; mesh knots may add bulk to fixation leading to higher postoperative pain

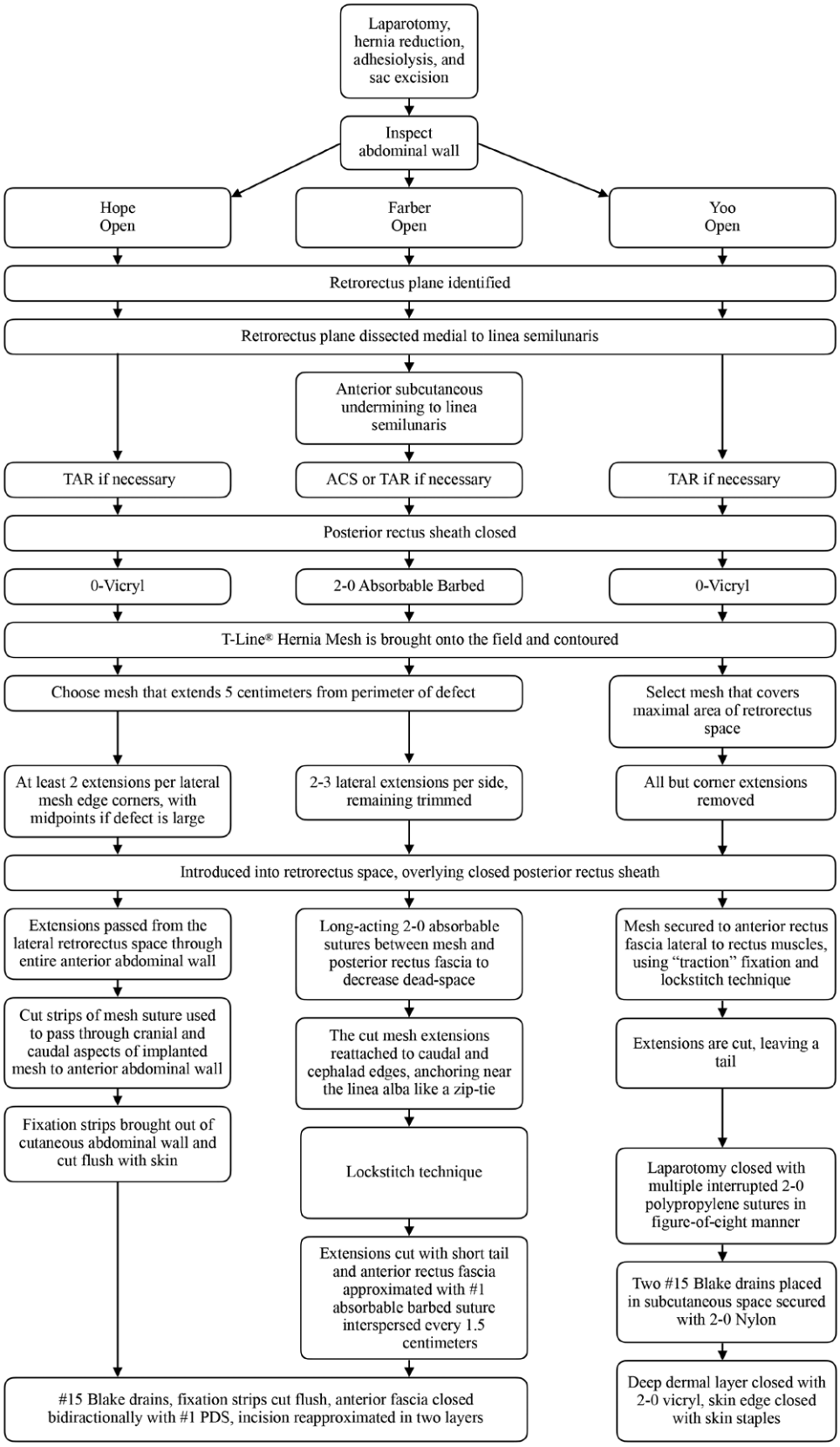

Fig. 8. Side-by-side flowchart of various surgeon techniques.

monofilament suture for fixation due to its ease of use and wide availability. However, monofilament suture fixation is susceptible to cheese-wiring due to its lack of incorporation with surrounding tissues and its small diameter, and it runs the risk of breaking or knot failure. Mesh sutures are also viable options for primary fascial closure, offering superior strength of repair compared with monofilament fixation.[18] Although VHR with mesh suture may improve repair strength, hernia recurrence may still occur, albeit at reduced rates.[18] The T-line hernia mesh improves upon monofilament and mesh suture fixation techniques with integrated extensions that disperse tension over the entire mesh construct as opposed to a singular fixation point, thereby offering greater strength while avoiding the cheese-wiring effect and knot failure potential of other fixation techniques.[22]

The T-line hernia mesh has shown efficacy in multiple realms of abdominal reconstruction, ranging from hernia repair to reinforcement of donor sites after breast reconstruction.[31] An onlay mesh placed for symptomatic incisional hernia or open hernia repair had no surgical site occurrences or recurrence after follow-up.[21,32] Similarly, a retrospective study of 18 patients who underwent incisional and primary VHRs with T-line hernia mesh in the sublay or onlay plane demonstrated no significant in-hospital complications or short-term recurrences.[25] These studies collectively demonstrate successful repair of anterior abdominal defects with T-line hernia mesh reinforcement in multiple planes.

The present study has limitations because it does not offer outcomes or long-term follow-up. The T-line hernia mesh has yet to be characterized in contaminated cases, which are typically associated with higher rates of surgical site infection.[33] Although synthetic meshes are habitually avoided in contaminated cases, newer studies have suggested they may still benefit patients with contaminated surgical fields.[34,35] Specifically, polypropylene meshes in the retrorectus plane showed favorable infection, recurrence, and mesh removal rates in contaminated VHRs as opposed to other abdominal wall planes.[36,37] In addition, although this article provides different perspectives on mesh contouring, this mesh technology is less readily adjustable than alternatives due to the integrated mesh suture extensions, but as such, different sizes are available.

CONCLUSIONS

This article demonstrates the use of T-line hernia mesh in the retrorectus plane for repair of large ventral hernias. Future studies are needed to better characterize how the integrated mesh suture (mesh extension) of the T-line hernia mesh affects hernia recurrence as well as the short and long-term outcomes of these techniques.

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DISCLOSURES

Dr. Yoo serves as a paid consultant to Deep Blue Medical Advances. All the other authors have no financial interest to declare in relation to the content of this article.

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