



## Review Article

# Large Incisional Hernia Repair: Abdominal Wall Component Separation & Transversus Abdominis Release

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### Background:

Ever since the birth of modern surgery in mid-nineteenth century, abdominal incisions added an iatrogenic group of hernias, labeled as incisional hernia (IH). European prevalence of IHs following midline incision was shown at 12.8% (0-35.6%)<sup>1</sup> and that of transverse caesarian sections at 5.8%<sup>2</sup>. Weakness in abdominal wall from a healed surgical wound largely entails modifiable factors like patient's co-morbidities, wound events and surgeons' technical failures<sup>3</sup>. However, it is assumed that genetically linked defect of collagen synthesis has a significant role in this predicament<sup>4</sup>.

Repair of incisional hernias has always been a surgical challenge. Before the introduction of synthetic mesh, anatomical suture repair used to end up with 30-50% recurrences<sup>5</sup>. Although synthetic mesh has drastically cut down the recurrences, it is still between 5 to 20%. In addition, implanted meshes are blamed for the significant discomfort to many patients<sup>6</sup>.

### Anatomy:

Understanding anatomical details of abdominal wall is key to effective IH repair, as contemporary techniques focuses more on its structural and functional components. Rectus muscles, principal support of anterior abdominal wall, is enclosed within

rectus sheath which is formed by the anterior and posterior laminae of internal oblique aponeurosis blending with corresponding sheaths of external and transversus oblique muscles. Intercostal nerves passe between the transversus and internal oblique muscles, pierce the posterior lamina of internal oblique to supply the rectus muscle. These nerves need to be identified and preserved, as rectus muscles in conjunction of the three lateral abdominal muscles forms the contractile abdominal support (Figure-1).

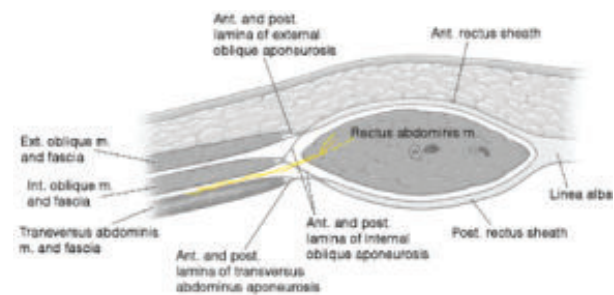


Figure 1. Anatomy of rectus sheath

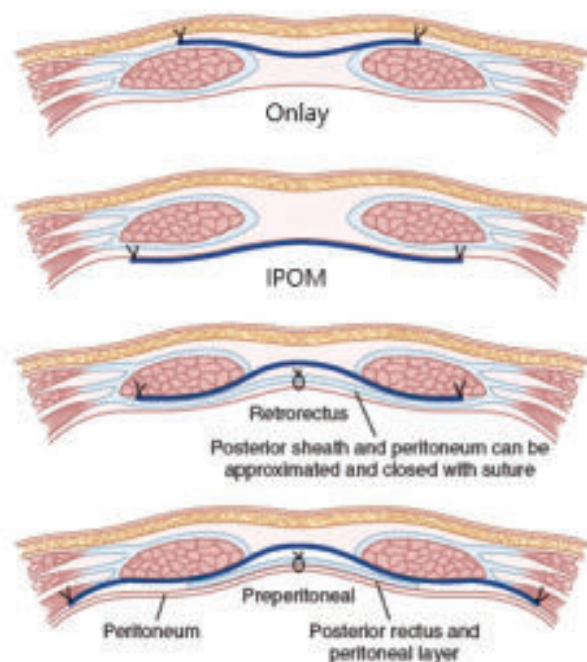
### In search of right place for mesh:

There is no gold standard for placing mesh so far. In general, mesh is deployed over the hernial defect with at least 5cm beyond its margin, either over the Musculo-fascial surface (Onlay) or intraperitoneally over the peritoneal surface (IPOM). Meshes placed on these surfaces eventually creates a rigid collagen-mesh complex. This rigidity, in the long run, interferes with the contraction and relaxation of abdominal wall during breathing and straining maneuvers like coughing, defecation etc. Furthermore, surface meshes require good number of fixations in order to

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prevent its migration. Fixations and fibrosis are implicated to the acute and chronic post-repair pain. On the contrary, when mesh is placed between the layers of abdominal wall with minimal fixations (Retro-muscular or pre-peritoneal), there is greater tissue integration of synthetic meshes with minimal interference with functions. Thus, sources of pain and discomfort can largely be avoided<sup>7</sup> (Figure-2).

It has also been observed that, chances of recurrence after Onlay and IPOM repair for larger than 5cm defect is higher. There is a general agreement that hernias with larger defect or “complex hernias” emerging from several repair attempts, retro-muscular pre-peritoneal plane appears to be the ideal place for the synthetic meshes<sup>8</sup>.

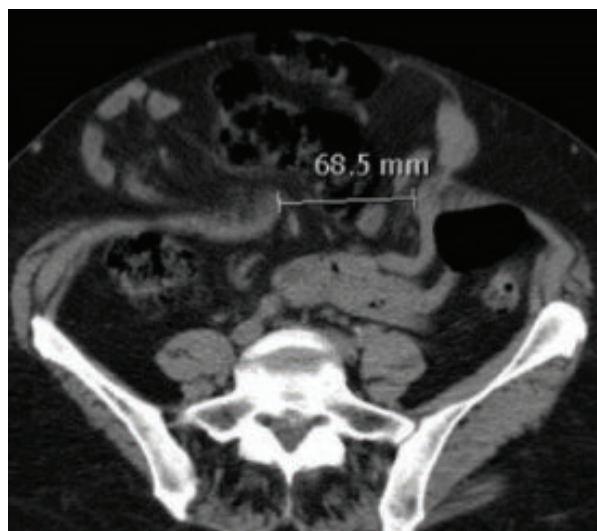


**Figure 2** Levels of mesh deployment on or between abdominal wall components

### Principles of repair:

Contemporary techniques for repairing the larger IHs are essentially based on two principles. Firstly, closing the defect of abdominal wall by midline suture in an absolute tension free manner. Secondly, putting mesh between the abdominal wall components with widest coverage. In order to achieve these goals, one or more of abdominal wall components need to be separated from each other for having some degree of ‘release’ for midline closure and ‘space’ for mesh deployment. Hence, the ‘Abdominal wall component separation’ (ACS) has become the basic step for large IHs<sup>9-11</sup>.

**Evaluation and optimization:** Gold standard for evaluating IHs is CT scan of the abdomen (Figure-3). CT measurements (Herniometry) help determine accurate defect size, comparative volumes of hernia and abdominal cavity, visceral contents of hernial sac, location of previous mesh and status of abdominal muscles particularly width of rectus abdominis<sup>12</sup>. Abdominal domain loss (hernial sac volume > 20- 30% of abdominal volume) is the cause of respiratory distress from high intra-abdominal pressure after a closure without necessary release or relaxation of muscles<sup>13</sup>.



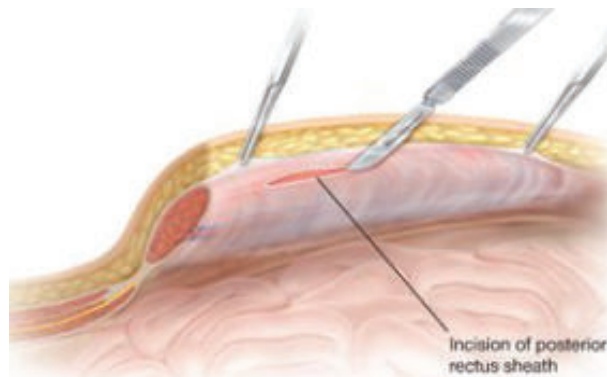
**Figure 3** CT scan “Herniometry”

Moreover, overweight/obesity (BMI > 30), diabetes, pulmonary and cardiac issues greatly influence the outcome of the IH repairs<sup>14,15</sup>. Going through a pre-operative checklist is a good idea in order to ensure the complete evaluation and optimization of patients (Table-1).

**Table-I.** Pre-operative check list for incisional hernia

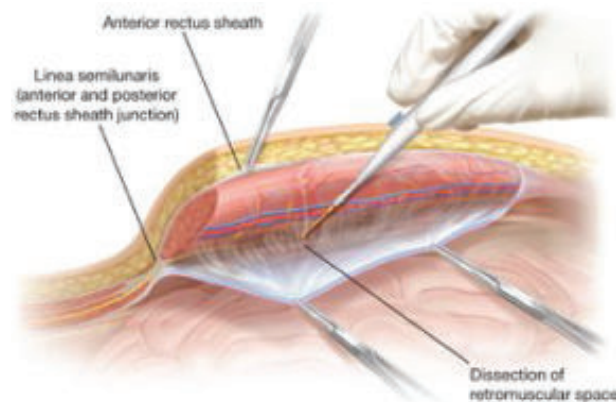
Parameters	Remarks
Diabetes mellitus	Full control
COPD	Full control
BMI	<30
CT Scan	
Sac : abdomen vol ratio	<30% to prevent respiratory distress
Defect size	Margin to margin
Rectus: defect ratio	>1 is better
Unrecognized hernia	Presence note
Previous mesh	Position, size

**Technique of abdominal component separation (ACS):** Following brief description may help understanding ACS technique. After isolating hernial sac and taking care of the adhesions, rectus sheath is opened incising posterior sheath 1cm from midline (figure-4). Then posterior sheath is separated from rectus muscle up to linea semilunaris where internal oblique aponeurosis splits and intercostal nerves are seen piercing the posterior lamina. If dissection up to this level on both sides is enough for a tension-free closure of posterior sheath, mesh is placed



**Figure 4.** Posterior sheath is being incised 1 cm medial to linea

posterior to the rectus muscles - the “Rives-Stoppa” (RS) space (Figure-5). If further release is needed, incision is made on posterior lamina 1 cm medial to nerves to expose and divide the transversus abdominis muscle fibers up to central tendon of

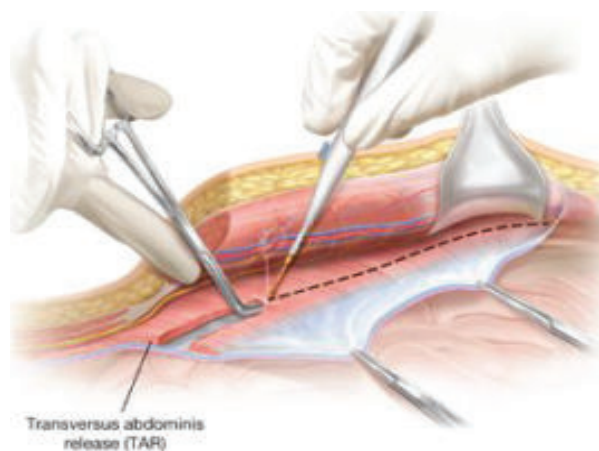


**Figure 5.** Posterior sheath is being separated from, rectus muscle creating ‘Rives-stoppa’ space,

diaphragm cranially and transversus aponeurosis up to arcuate line caudally (Figure-6). Further dissection of peritoneum up to retro-pubic spaces downward and then laterally up to psoas muscle mobilizes the rectus sheath-peritoneum complex medially to a

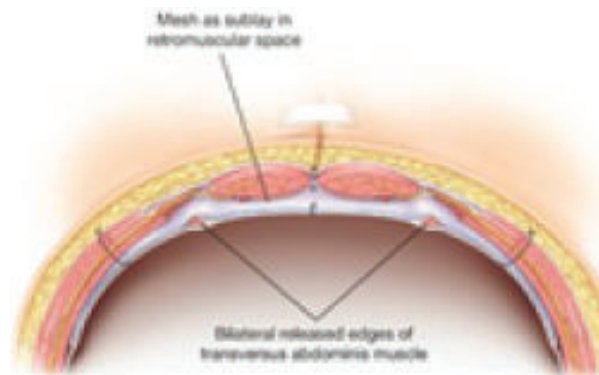
greater extent. Depending on the size of the hernial defect transversus abdominis release (TAR) is done either unilaterally or bilaterally. Closure of posterior sheath in the midline creates a space for deployment of 30x30 cm or larger polypropylene mesh superficial to peritoneum-rectus complex. Linea alba is closed after minimum or no fixation mesh and placing a drain if considered necessary.

ACS + RS and ACS + TAR techniques either done by open or minimal access Laparoscopic/Robotic approach, principles and dissections of the procedures remain same. However, laparoscopic/robotic approaches offer better post-operative comfort and less wound related complications<sup>16</sup>.



**Figure 6.** Division of transversus abdominis fibers medial to the emerging intercostal nerves

What has been described so far is also known as ‘posterior abdominal component separation’. ‘Anterior component separation’ which is rarely done for smaller defects is, essentially, the division of external oblique aponeurosis lateral to the linea semilunaris for a medial sliding of rectus sheath.



**Figure 7.** Retro-muscular and pre-peritoneal wide mesh placed



**Table 2.** Guidelines for IH repairs according to defect size

Defect size	Closure of defect	Release of abdominal Wall component	Mesh type & Deployment
1 cm	Suture	No	No
1-4 cm	Suture	No	IPOM, composite mesh
4-10 cm	Suture	ACS + Rives-Stoppa (RS) /Unilateral TAR	Polypropylene mesh, Retro-muscular Pre-peritoneal
> 10 cm	Suture	ACS + Bilateral TAR	Polypropylene mesh, Retro-muscular Pre-peritoneal

Choice of technique for IH repair is made according to following guidelines (Table-2).

#### Post-Operative events of ACS:

Post operative pain is usually milder than other procedures that require generous fixations of Onlay or IPOM meshes. Commonest post-operative complication of ACS-TAR are occasional respiratory distress due to raised intra-abdominal pressure from distended bowels. Avoidance of nitrous oxide and a NG tube during anaesthesia could be helpful. More serious event is posterior sheath disruption which causes abdominal pain and distension. Immediate exploration and a tension free closure is to be done for salvation. Incidences of seroma, haematoma and mesh infections are much infrequent than onlay repairs. Mesh infections in this situation may respond to conservative management without explantation<sup>17</sup>.

#### Outcome:

Long term outcome data is awaited. However, 2-3-year observational reports are highly satisfactory with recurrence rate less than 5%. Patient satisfaction rates were high as there were fewer instances of chronic pain in addition to satisfactory abdominal wall flexibility and strength (Table-3)<sup>18-20</sup>.

**Table 3.** Characteristics of techniques for IH repair

Parameters	ACS techniques	Onlay open	IPOM
Effective for defect Size>4cm	Yes	Yes	No
Effective for Complex hernias	Yes	No	No
Tensionless defect closure	Yes	No	No
Widest Prolene mesh cover	Yes	Some	No
Less Seroma/Infection	Yes	No	Yes
Recurrences Rate <5%	Yes	No	Yes
Less pain and discomfort	Yes	No	No

#### Prevention:

Optimization of patients and methodical abdominal fascial closure after each laparotomy is the key to prevention of incisional hernias. Consensus has been reached as to the laparotomy fascial closure technique. Guidelines are summarized Below (Table-4)<sup>21,22</sup>. Prophylactic use of mesh in selected cases of primary abdominal closure appears to have reduced incidences of incisional hernia significantly<sup>23</sup>.

**Table 4.** Guidelines for laparotomy closure for IH prevention

Wound:Suture length	1:4
Suture material	Unabsorbable, delayed absorbable
Suture type/strength	Monofilament/1-0 or 1
Suture bites	1cm from the margin
Suture spacing	1cm apart, non-locking

#### Conclusion:

Outcome of incisional hernia repairs greatly improved after the advent of synthetic meshes. However, larger, recurrent and complex hernias exist as formidable surgical challenge. Understanding the anatomical and functional details of abdominal wall, detailed CT scan evaluation of Incisional hernias and optimization of patients before undertaking a repair technique can not be overemphasized. 1-5 cm hernial defects are better managed by Intra-Peritoneal-Onlay-Mesh repair. Whereas, for larger defects abdominal wall component separation up to required extent is necessary before transversus abdominis muscle release in order to achieve tension free midline closure and retro-muscular pre-peritoneal mesh deployment. Thus, strength and flexibility of abdominal wall is preserved by midline closure and incorporations of wider mesh within abdominal

components. This novel approach seems to have lessened recurrences and improved patient satisfaction as revealed in mid-term observations.

## References

1. Bosanquet DC, Ansell J, Abdelrahman T, Cornish J, Harries R, Stimpson A, et al. Systematic Review and Meta-Regression of Factors Affecting Midline Incisional Hernia Rates: Analysis of 14,618 Patients. *PLoS One*. 2015;10(9):e0138745.
2. Paulsen CB, Zetner D, Rosenberg J. Incisional hernia after cesarean section: A systematic review. *Eur J Obstet Gynecol Reprod Biol*. 2020;244: 128-33.
3. Tarasova NK, Dynkov SM, Pozdeev VN, Teterin AY, Osmanova GS. [Analysis of the causes of recurrent postoperative ventral hernias]. *Khirurgiia (Mosk)*. 2019(10):36-42
4. Antoniou GA, Georgiadis GS, Antoniou SA, Granderath FA, Giannoukas AD, Lazarides MK. Abdominal aortic aneurysm and abdominal wall hernia as manifestations of a connective tissue disorder. *J Vasc Surg*. 2011;54(4):1175-81
5. Farthmann EH, Mappes HJ. [Tension-free suture of incisional hernia]. *Chirurg*. 1997;68(4):310-6.
6. Sasse KC, Lim DC, Brandt J. Long-term durability and comfort of laparoscopic ventral hernia repair. *JLS*. 2012;16(3):380-6.
7. Köckerling F, Lammers, B Weyhe, D, Reinpold, W et al. What is the outcome of the open IPOM versus sublay technique in the treatment of larger incisional hernias? A propensity score-matched comparison of 9091 patients from the Herniated Registry *Hernia*. 2020
8. Cano-Valderrama O, Porrero JL, Quirós E, Bonachia O, Castillo MJ, Cervantes N, et al. Is Onlay Polypropylene Mesh Repair an Available Option for Incisional Hernia Repair? A Retrospective Cohort Study. *Am Surg*. 2019;85(2):183-7.
9. Fafaj A, Petro CC, Tastaldi L, Alkhatib H, AlMarzooqi R, Olson MA, et al. Intraperitoneal versus retromuscular mesh placement for open incisional hernias: an analysis of the Americas Hernia Society Quality Collaborative. *Br J Surg*. 2020.
10. Blair LJ, Cox TC, Huntington CR, Groene SA, Prasad T, Lincourt AE, et al. The effect of component separation technique on quality of life (QOL) and surgical outcomes in complex open ventral hernia repair (OVHR). *Surg Endosc*. 2017;31(9):3539-46.
11. Tastaldi L, Blatnik JA, Krpata DM, Petro CC, Fafaj A, et al. Posterior component separation with transversus abdominis release (TAR) for repair of complex incisional hernias after orthotopic liver transplantation. *Hernia*. 2019;23(2):363-73.
12. Grolleau JL, Otal P, Micheau P, Chavoïn JP, Costagliola M. [Imaging of abdominal wall eventration: role and value of x-ray computed tomography]. *Ann Chir*. 1997;51(4):327-32
13. Tanaka EY, Yoo JH, Rodrigues AJ, Utiyama EM, Birolini D, Rasslan S. A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain. *Hernia*. 2010;14(1):63-9.
14. Alkhatib H, Tastaldi L, Krpata DM, Petro CC, Huang LC, Phillips S, et al. Impact of modifiable comorbidities on 30-day wound morbidity after open incisional hernia repair. *Surgery*. 2019;166(1):94-101
15. Hajibandeh S, Deering R, McEleney D, Guirguis J, Dix S, Sreh A, et al. Accuracy of co-morbidity data in patients undergoing abdominal wall hernia repair: a retrospective study. *Hernia*. 2018;22(2):243-8.
16. Fox M, Cannon RM, Egger M, Spate K, Kehdy FJ. Laparoscopic component separation reduces postoperative wound complications but does not alter recurrence rates in complex hernia repairs. *Am J Surg*. 2013;206(6):869-74; discussion 74-5.
17. Radu VG. Retromuscular Approach in Ventral Hernia Repair - Endoscopic Rives-Stopppa Procedure. *Chirurgia (Bucur)*. 2019;114(1): 109-14.
18. Punjani R, Arora E, Mankeshwar R, Gala J. An early experience with transversus abdominis release for complex ventral hernias: a retrospective review of 100 cases. *Hernia*. 2020.

19. Oprea V, Radu VG, Moga D, -. Transversus Abdominis Muscle Release (TAR) for Large Incisional Hernia Repair. *Chirurgia (Bucur)*. 2016; 111(6):535-40.
20. Munoz-Rodriguez JM, Lopez-Monclus J, San Miguel Mendez C, Perez-Flecha Gonzalez M, Robin-Valle de Lersundi A, Blázquez Hernando LA, et al. Outcomes of abdominal wall reconstruction in patients with the combination of complex midline and lateral incisional hernias. *Surgery*. 2020.
21. Williams ZF, Tenzel P, Hooks WB, Hope WW. Suture to wound length ratio in abdominal wall closure: how well are we doing? *Hernia*. 2017;21(6):869-72.
22. Deerenberg EB, Harlaar JJ, Steyerberg EW, Lont HE, van Doorn HC, Heisterkamp J, et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. *Lancet*. 2015;386(10000):1254-60.
23. Blázquez Hernando LA, García-Ureña M, López-Monclús J, Hernández SG, Valle de Lersundi Á, Cidoncha AC, et al. Prophylactic mesh can be used safely in the prevention of incisional hernia after bilateral subcostal laparotomies. *Surgery*. 2016;160(5):1358-66.