Chapter

Incisional Hernia

Anil Kumar and Shiv Shankar Paswan

Abstract

Incisional hernia is one of the most common postoperative complications after abdominal surgery. Several studies have shown that incisional hernias have different etiologies which are related to the patient, the surgical technique, the suture material and experience of the surgeon. Most patients present with abdominal swelling with some level of discomfort, and in emergency the presentation is usually as bowel obstruction or strangulation which requires urgent exploration. The recurrence rate is almost the same for open as well as for laparoscopic approach. The hernia can be repaired either only by closing the defect with nonabsorbable suture or by applying mesh. The recurrence is very minimal with mesh application as compared to repair done only by suture. The mesh can be placed as onlay, inlay and in sublay positions. The intraperitoneal onlay mesh placement (IPOM) is the widely used laparoscopic method for the incisional hernia repair. The incisional hernia with larger defect usually more than 15 cm requires component separation to reconstruct the abdominal wall by releasing the external oblique or transverse abdominal muscle. The outcome of incisional hernia repair is dependent on the associated comorbid conditions like chronic cough, constipation, stricture of the urethra, benign prostate hyperplasia, ascites and obesity.

Keywords: incisional, hernia, mesh, laparotomy, component separation

1. Introduction

It is documented that in the first century A.D., a Roman doctor named Aulus Cornelius described the closure of the abdominal wall and elaborated a detailed description of the pre- and postoperative care of the patient [1]. Later on, another famous Roman-Greek physician, Galen, provided a detailed description of the mass closure of the abdominal wall and described the significance of paramedian incision in order to prevent incisional hernia [2]. The advancement of technology like the advent of modern anesthesia and antiseptic and upgradation of skills in the field of surgery in the present era promotes laparotomy. On the other hand, along with increased number of laparotomy, the incidence of incisional hernia also increased consequently. Incisional hernia is a frequent long-term complication of abdominal surgeries with a reported incidence of 2–20% [3–8]. In the USA alone, approximately 348,000 incisional hernia repairs are performed per year with total estimated procedural costs of $3.2 billion for ventral hernia repair [9–13]. Incisional hernia is more common than primary abdominal wall hernia, and both of these types are included in ventral hernia.

2. Surgical anatomy

The abdominal wall consists of the skin, fascia (Camper's and Scarpa's fascia), muscles (external oblique, internal oblique, transverse abdominis), rectus sheath,

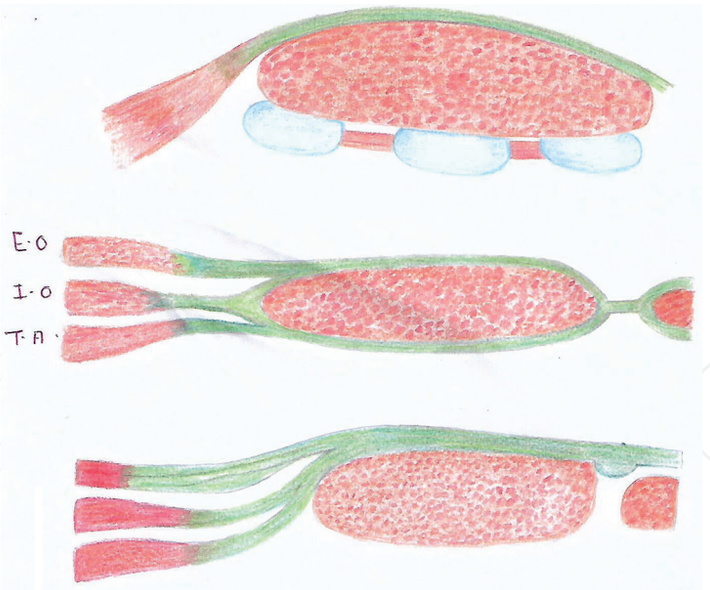

Figure 1.
Rectus sheath formation.

aponeurosis, linea alba, ligaments, openings, rings, blood vessels and nerves. **Figure 1** showed the formation of rectus sheath at three different levels on the abdominal wall. Above the costal margins, only the external oblique muscle with its aponeurosis forms the rectus sheath. In between xiphisternum and umbilicus, the external oblique remains in front, but the internal oblique splits to enclose the rectus muscles. The transverse abdominis is behind the internal oblique (**Figure 1**). All these muscles fuse to form the linea alba in the midline. The rectus abdominis muscles run vertically on either side of the linea alba. This area between the xiphisternum and umbilicus is the strongest area as compared to above the costal margin or below the semilunar line. Below the semilunar line, all the three aponeurosis are anterior to the rectus muscle and fuse in the midline to form the linea alba. So posterior rectus sheath is absent below the semilunar line, and that is why incisional hernias are more common below the umbilicus. On the other hand, the linea alba is the strongest layer of abdominal wall and less likely to develop incisional hernia if it has repaired properly with good bites through the linea alba.

The umbilicus is usually situated in the midline at the level of the superior iliac spine or at the level between the third and fourth lumbar vertebrae. The umbilicus is a strong fibrous ring. Hernia through the umbilicus may occur in children, obese patient and in multiparous women due to childhood umbilical infection, weak muscles and stretching of muscles due to repeated pregnancies, respectively.

3. Risk factors of incisional hernia

The development of incisional hernia is multifactorial. It may be related to the patient, surgical technique and experience of the surgeon, type of disease for which the incision was given or biological factors. **Table 1** summarized the various risk factors for the development of incisional hernia.

3.1 Patient-related factors

The incisional hernias are more common in the elderly age group because of multifactorial reasons including weak abdominal muscles, occurrence of comorbidity

Patient-related factors:
Age more than 60 years
Gender: female after cesarean section
Smoking
Socioeconomic condition: low profile
Occupation: lifting heavy weight
Comorbidities: diabetes mellitus, chronic cough, benign hypertrophy of the prostate, stricture of the urethra, chronic constipation, ascites, obstructive jaundice, chronic renal failure and certain connective tissue diseases (Marfan's syndrome, osteogenesis imperfecta and Ehlers-Danlos syndrome)
Post-organ transplant patient on immunosuppressive agents/corticosteroids
Obesity: (BMI >25 kg/m^2)
Technical factors related to the surgical technique:
Wrongly placed incision: lumbar incision, subcostal incision, lower midline incision and large transverse incision
Wound has not been approximated appropriately
Low surgical skill to close the abdomen
Strength and length of suture used is not appropriate
Disease-related factors:
Emergency operations
Type of surgery: bowel surgery, abdominal aortic aneurism, stoma closure, operations for peritonitis
Re-laparotomy
Wound infection
Long operating time
Increased blood loss
Damaged control surgery in trauma
Open abdomen: in the case of severe septicaemia, chance of abdominal compartment syndrome
Biological factors:
Nutritional deficiencies
Collagen and metalloproteinase synthesis

Table 1.
Risk factors of incisional hernia.

like DM, malignancies and poor immunity. A BMI > 24.5 kg/m^2 is considered as an important risk factor for the development of incisional hernia [14–21]. The patient with low socioeconomic profile is more prone to develop incisional hernia because of malnourishment and being bound to lift heavy weight. Comorbidities like diabetes mellitus, malignancies, chronic lung diseases, benign hypertrophy of the prostate, chronic constipation as well as heavy weight lifting are well-known risk factors for hernia development by increasing the intra-abdominal pressure and delaying the wound healing. The use of immunosuppressant and steroids in organ transplant and other chronic disease patients increases the rate of wound infection, wound dehiscence and incisional hernia [22–27]. Smoking increases the risk of the development of incisional hernia by decreasing the blood flow and tissue oxygenation as well as collagen deposition in the surgical wound, and all these increase the infection rate and synergistically the incisional hernia as well [28, 29]. Abstinence from smoking 30 days preoperatively reduces the adverse effects of smoking on wound healing significantly. This emphasized the contributing role of smoking in causing incisional hernia [30, 31].

3.2 Technical factors related to the surgical technique

Despite advancements in techniques for abdominal wall closure, the incisional hernia rate following laparotomy is as high 15–20% [32]. Poor surgical technique may result in wound dehiscence and delay the wound healing. During closure of fascial edges, if it is not approximated properly, not using the suture with appropriate length and strength, then definitely in the postoperative period, there is a chance of wound dehiscence and development of incisional hernia especially if

other predisposing factors are also present [33–35]. The preferably paramedian, oblique and transverse incisions are better than midline, large transverse, subcostal and lumbar incisions to prevent the occurrence of incisional hernia [36–39].

3.3 Disease-related factors

Wound infection and wound dehiscence are the major risk factors for the development of incisional hernia [18, 29, 35–37, 40–45]. Cases operated for infected intra-abdominal conditions like perforation peritonitis, gangrene of the intestine, severe necrotizing pancreatitis, etc. usually develop incisional hernia. The incidence of infection is less in a diabetic patient if their perioperative glycaemic control is adequate [46]. Furthermore, chance of infection in diabetic patient is higher than nondiabetic patient even after controlling for hyperglycaemia [47]. Re-laparotomy is a strong risk factor for IH [29]. Incidence of incisional hernias in open abdomen for severe septicaemia or for damaged control surgery ranged from 21% at 21 months to 54% after 5 years of follow-up [48–50]. Burst abdomen and open abdomen after the damage control surgery are the most important factors for the occurrence of incisional hernia. In the case of long operative time and where blood loss is more, the chance of IH development is also more. Incisional hernia has been also reported after traumatic abdominal injury [51]. Emergency surgeries are also associated with a higher incidence of incisional hernia development.

3.4 Biological factors

Apart from obesity, malnourishment is also the contributing factor for the development of incisional hernia by causing delayed wound healing and wound dehiscence [52–54]. Defective collagen metabolism with reduced ratio of collagen I-collagen III as well as a reduced ratio of matrix metalloproteinase 1 (MMP1)-MMP2 plays an important role in the development of IH [55]. Micronutrients like copper and zinc are required for the synthesis of the enzyme lysyl oxidase, and this enzyme is very important for the integrity of collagen molecule. So deficiency of these elements may cause the incisional hernia to occur. The plasminogen activator inhibitor, urokinase plasminogen activator inhibitor, in the scar tissue may contribute in the development of IH [56–58].

4. Classification

Various classifications for ventral hernia are available in literature, but unfortunately none of them have been widely accepted. Various classification systems are proposed by Chevrel and Rath, Korenkov et al., Schumpelick et al., Dietz et al., Ammaturo and Bassi and Miserez et al. [59–64]. They all have used variables like size and number of hernia defects, size of hernia sac and its ratio with anterior abdominal wall, primary or incisional hernia, recurrent hernia, location of hernia, and other symptoms and risk factors, in various combinations. To make it standardized, European Hernia Society (EHS) has divided the abdominal wall hernia as "Primary abdominal wall hernia" which is also called as ventral hernia and other "Incisional hernia" rather than either term. Recurrent hernia after treatment for primary abdominal wall hernia would fall in the group of incisional hernia. According to this system, classification of incisional hernias uses localisation and size of hernia as the two variables, as shown in **Table 2**. To avoid confusion with primary abdominal wall hernias (small, medium and large), a coded taxonomy was chosen (W1 < 4 cm; W2 ≥ 4–10 cm; W3 ≥ 10 cm) instead of a nominative one, and yes or no is used for the recurrent incisional hernia in EHS **Table 2**.

EHS Incisional hernia classification				
Midline	Subxiphoidal		M1	
	Epigastric		M2	
	Umbilical		M3	
	Infraumbilical		M4	
	Suprapubic		M 5	
Lateral	Subcostal		L1	
	Flank		L2	
	Iliac		L3	
	Lumbar		L4	
Recurrent	**Incisional Hernia?**		**Yes** ◯	**No** ◯
	Length	Cm	**Width**	Cm
	Width	W1 < 4 cm	W2 ≥ 4–10 cm	W3 ≥ 10 cm
	cm	0	0	0

Table 2.
Showing EHS classification of incisional hernia.

Here the abdomen was divided into a midline zone and a lateral zone.
The borders of the midline area are defined as follows:

1. Cranial: the xiphoid

2. Caudal: the pubic bone

3. Lateral: the lateral margin of the rectal sheath

Thus, all incisional hernias between the lateral margins of both rectus muscle sheaths are classified as midline hernias. A simple and easily memorable classification from M1 to M5 going from the xiphoid to the pubic bone is summarized in **Figure 2a**. Therefore, we define 5 M zones as follows:

1. M1: subxiphoidal (from the xiphoid till 3 cm caudally)

2. M2: epigastric (from 3 cm below the xiphoid till 3 cm above the umbilicus)

3. M3: umbilical (from 3 cm above till 3 cm below the umbilicus)

4. M4: infraumbilical (from 3 cm below the umbilicus till 3 cm above the pubis)

5. M5: suprapubic (from the pubic bone till 3 cm cranially).

Lateral hernias: The borders of the lateral area are defined as in **Figure 2b**:

1. Cranial: the costal margin

2. Caudal: the inguinal region

3. Medially: the lateral margin of the rectal sheath

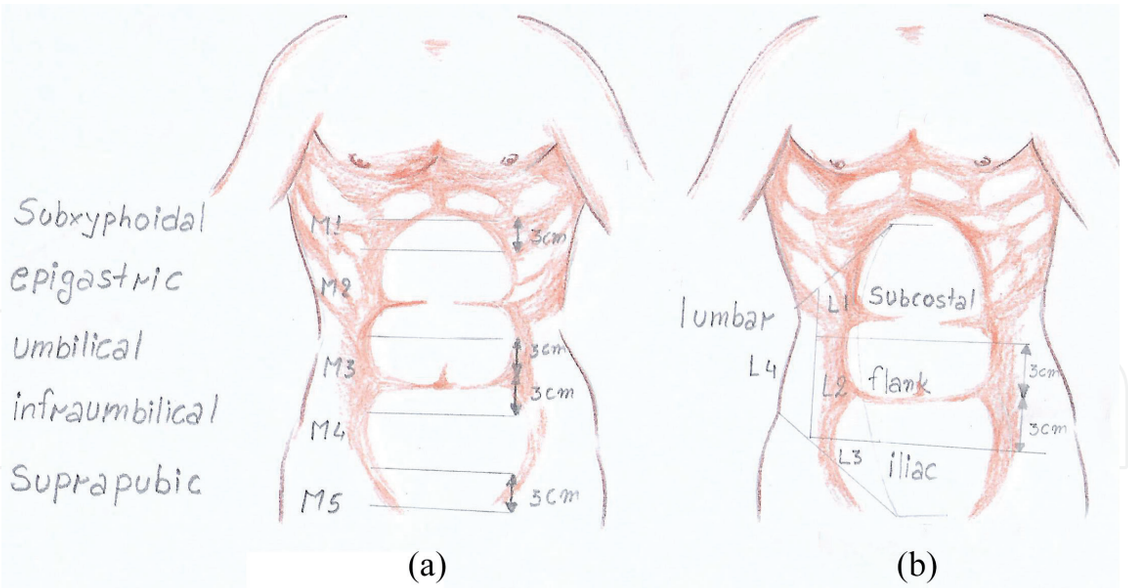

Figure 2.
(a) 5M zone of incisional hernia. (b) 4L zone of incisional hernia.

4. Laterally: the lumbar region

Thus, 4L zones on each side are defined as follows:

1. L1: subcostal (between the costal margin and a horizontal line 3 cm above the umbilicus)

2. L2: flank (lateral to the rectal sheath in the area 3 cm above and below the umbilicus)

3. L3: iliac (between a horizontal line 3 cm below the umbilicus and the inguinal region)

4. L4: lumbar (latero-dorsal of the anterior axillary line)

5. Clinical features

- History of surgery in the past.

- History of infection during the first surgery, postoperative cough, constipation, etc. is usually present.

- Serosanguinous discharge on the fourth postoperative day through the main suture line is a signal of the development of partial or total wound dehiscence. Such cases later develop an incisional hernia.

- Burst abdomen and open abdomen are more likely to develop incisional hernia (**Figure 3**).

- There is bulge or swelling around the scar (**Figure 4**).

Figure 3.
Burst abdomen prone to develop incisional hernia.

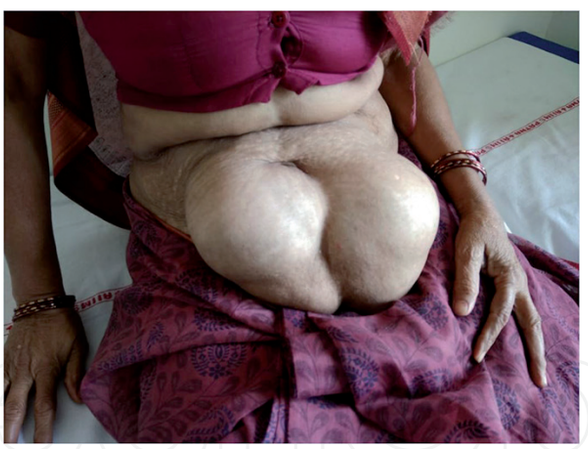

Figure 4.
Complex Hernia with visible bulge.

- The scar is thin and evidence of secondary changes like ulceration or skin color changes may be present (**Figure 5**).

- Expansile impulse on cough and reducibility may be present.

- Intraoperatively during creation of pneumoperitoneum, the bulge/swelling through the scar becomes more obvious (**Figure 6**).

- After reduction of the contents, a defect can be palpated through the scar. Defect depends upon the number of stiches that have given away.

Figure 5.
Lower abdominal wall hernia hanging up to the scrotum with secondary changes.

Figure 6.
Prominent hernial defect after pneumoperitoneum.

- In case of obstructed or impacted content in the defect, the patient may complain of pain in that area.

- Features of bowel obstruction or strangulation may be found in complicated cases.

- In most people, hernias limit patients' physical activities either due to the associated symptoms or as a precaution to avoid worsening.

5.1 Abdominal palpation

In most of the cases, hernial content can be palpated. In few cases even the edges of hernial defect can be appreciated, and the size can be measured. Except in obstructed and strangulated hernia, impulse on coughing and reducibility are present.

5.2 Percussion

Percussion guides us to assess whether the content of the hernia sac is solid, liquid or gas.

5.3 Auscultation

If the content of the sac is bowel loop, a peristaltic bowel sound may be heard and confirm the content of sac as bowel loop.

6. Evaluation

Although most cases of an incisional hernia are diagnosed with a history and physical examination, imaging is sometimes indicated in early stages, obese patients, or complex cases especially to outline the extent of defect and plan the surgical procedure. The first imaging modality in case of incisional hernia is ultrasonography, but the computed tomography scan (CT) is the most commonly used method for the diagnosis as well as for planning of operative management especially for complex cases [65, 66]. CT scan evaluates the incisional hernia by confirming its diagnosis, sizing the defect, identifying the hernia content and assessing the abdominal cavity to plan the surgical treatment. Magnetic resonance imaging (MRI) can also be used to assess abdominal wall hernias but are less commonly used for academic purpose only.

7. Management

The management of incisional hernia includes nonoperative and operative management. Nonoperative management is indicated in patients who are not fit for surgery, those who require preoperative optimization or those who have highly complex hernia like loss of abdominal wall domain, patient with diagnosis of metastatic cancer, advanced cirrhosis, severe cardiopulmonary disease and super obesity (BMI $\geq$ 50 kg/m^2).

7.1 Preoperative management

1. Weight reduction is very important before operating for incisional hernia. It is required to bring the BMI < 30–40 Kg/m^2.

2. Control of COPD, definitive treatment of benign prostatic hyperplasia, stricture of the urethra and all other conditions who may increase the intra-abdominal pressure in postoperative period in view to avoid the recurrence.

3. Cessation of smoking is very helpful for good outcome.

7.2 Indication of surgery in incisional hernia

1. To get the relief from symptoms

2. Prevention of complication like pain, incarceration, bowel obstruction and strangulation

3. To improve the quality of life

There are various operations for the treatment of incisional hernia depending upon the size of the defect, location of the hernia, patient choice as per their economical conditions as laparoscopic repair may be costly and surgeon expertise. **Table 3** summarized the different surgical options for incisional hernia.

7.3 Open hernia repair

Although minimal invasive surgery is widely acceptable and treatment of choice in present era, but open surgery still plays a very important role in incisional hernia repair especially in conditions contraindicated for laparoscopic surgery like very large, non-reducible hernia and strangulated hernia. Besides these contraindicated cases, for small umbilical hernias, open repair is preferred choice. Open repair can be done either by suture repair or by applying mesh. Recurrence rate after suture repair is 42% and after mesh repair only 24%. Ideally if the defect size is more than 4 cm, mesh placement should be the preferred approach, but even for the smaller defect which is less than 2 cm in size, the recurrence rate is 5.6% with suture method as compared to mesh where only 2.2% recurrence rate occurs. Three main positions of the mesh placement for incisional hernia are onlay, inlay and sublay positions (**Figure 3**).

Onlay mesh is placed over the anterior fascia and under the subcutaneous tissue. Inlay mesh is placed to the margin of the aponeurosis. In this case the mesh acts as bridge between the two fascial edges. Sublay mesh is placed retro muscularly and preperitoneally. The sublay mesh placement has been reported to be the best regarding recurrence and skin and soft tissue infection but is associated with higher risk of chronic pain. The main principle to place the mesh is that the mesh should be overlapped at least 5 cm all around the defect. Otherwise, the plane is created between the posterior rectus sheath and rectus muscle, and the mesh is placed in that location, and the anterior rectus sheath is sutured. This is called retro muscular sublay mesh repair. Before placing the mesh, the sac is opened, the greater omentum is excised, and the content is reduced followed by closure of the peritoneum. A mesh is kept in place. In all these repairs, tensionless, nonabsorbable suture repairs are done. Seroma formation is a common complication in open mesh repair which can be overcome by placing drain before closing the wound.

Open hernia repair
Suture repair
Mesh repair
Laparoscopic incisional hernia repair
Primary fascial closure
Different mesh fixation techniques
Abdominal wall reconstruction technique
Bridge repair
Anterior component separation (ACS)
Perforator-sparing ACS
Endoscopic ACS
Posterior component separation
Preoperative tissue expansion
Tissue expanders
Progressive pneumoperitoneum
Flap and tissue transfer

Table 3.
Surgical options for incisional hernia repair.

7.4 Laparoscopic incisional hernia repair

First time in 1993, LeBlanc and Booth introduced the laparoscopic method for incisional hernia repair [67], and since then various studies and approach have been published in literature [68]. Laparoscopic repair of incisional hernia is a very safe procedure and having all the advantages of minimal access surgery like earlier recovery, decreased hospital stay and less wound infections. It has been reported to have a low conversion rate of 2.4%, an enterotomy rate of 1.8% and recurrence rate of 4.2%; however recent randomized trials have shown a similar recurrence in laparoscopic and open hernia repair.

7.5 Contraindications of laparoscopic incisional hernia repair

Contraindications to laparoscopic incisional hernia repair are almost the same as for other laparoscopic surgeries which are summarized in **Table 4**.

7.6 Operative steps of laparoscopic incisional hernia repair

1. Complete all the preanaesthetic checkup and preoperative order like Nil per orally 12 hours prior to surgery and securing IV line for fluid administration, antibiotic test dose and shifting the patient to the operation room.

2. Take the patient on the table in supine position, and after general anesthesia, pneumoperitoneum is created.

3. Three working ports are placed as far as possible from the scar of the previous abdominal surgeries.

4. Start the adhesiolysis if indicated and repose the sac content into the peritoneal cavity.

5. Primary fascial closure may be done to restore the normal anatomy. The technique for this primary fascial closure may be intracorporeal closure, extracorporeal closure or with the help of suture passing needle. This step prevents the postoperative bulge and seroma formation. It also allows wider lateral mesh overlap, thereby preventing recurrence.

6. Overlap of mesh should be ideally 5 cm in all directions because of significant postoperative shrinkage of mesh.

7. Before fixing the mesh, the intra-abdominal pressure should reduce to 5–8 mmHg, so that the abdominal wall is minimally stretched revealing the true size of the hernia defect.

8. Fixation of mesh is usually done by tacker or suture.

The larger defect is usually more than of 10–15 cm
Prior multiple open surgeries
Ascites with child class C cirrhosis
Inability to create a working space

Table 4.
Contraindications of laparoscopic incisional hernia repair.

8. Abdominal wall reconstruction

The open and the laparoscopic techniques are used for small- and medium-sized defects but are not sufficient for very large defects which are too large to allow the fascial to be approximated. In such large size defect, a novel method of abdominal component separation was being developed. According to the EHS, large ventral hernia is defined as a hernia with defect greater than 10 cm and loss of domain defined by more than 50% of visceral contents lying chronically beyond the bounds of the abdomen. In such defect repair by open or laparoscopic method is usually not possible and component separation is required which was first introduced by Ramirez and colleagues in 1990 [69]. Component separation may be anterior, posterior, perforator-sparing ACS or endoscopic ACS.

8.1 Component separation

The component separation technique was first described by Ramirez in 1990. It is very effective for reconstructing large or complex midline abdominal wall defects, and it has the advantage of restoring the innervated dynamic abdominal wall integrity without producing undue tension on the repair. It is a myofascial release that separates the components of the abdominal wall allowing their mobilization into adjacent tissue defects. Classic CST involves releasing the rectus muscle from its posterior sheath and releasing the aponeurosis of the external oblique muscle along the lateral side of the rectus, allowing the rectus muscle to slide towards the midline with its attached internal oblique and anterior rectus fascia. In fact this is called anterior component separation. Fascial defects up to 10 cm wide at the upper abdomen, 20 cm at the waistline and 6 cm at the suprapubic region may be closed using this method.

8.1.1 Steps of anterior component separation

1. Through a laparotomy incision, the posterior rectus sheath is cleared bilaterally of any attachments to the viscera through careful lysis of adhesions.

2. The rectus muscle is loosely attached to its posterior sheath and can be freed from the posterior sheath at this point, as Ramirez did. Freeing the rectus muscle from its posterior sheath allows advancement of this muscle by 3 cm in the upper third, 5 cm in the middle third and 3 cm in the lower third.

3. Separate the skin and subcutaneous tissues from the anterior rectus sheath using electrocautery. Develop this plane until about 2 cm beyond the lateral edge of the rectus sheath. Further lateral dissection in patients with limited subcutaneous tissue may place the resulting skin flaps at risk for ischemia and failure resulting in a large soft tissue defect that will require split-thickness skin grafting.

4. Carefully incise the external oblique aponeurosis 2 cm lateral to the lateral edge of the rectus sheath. Extend this incision parallel to the rectus muscle, superiorly advancing at least 5–7 cm above the costal margin and inferiorly down to the suprapubic region. The plane between the external and internal oblique aponeuroses is relatively avascular and should be bluntly dissected free down to the mid to posterior axillary line.

8.1.2 Complications of ACS

The surgical site infection (SSI), site dehiscence, seroma, hematoma, site necrosis and recurrences have been reported to be highest with ACS compared to other component separation techniques.

8.2 Posterior component separation

In order to gain further mobility of the rectus sheath, Crbonell et al. introduced the concept of posterior component separation (PCS) which involved extending the retro muscular plane laterally between the internal oblique and transverse abdominis. Further modification of the technique was done by Novinsky et al. with the release of transverse abdominis muscle and entry into the retro rectus space, and dissection is carried till lateral of psoas muscle, avoiding skin flap necrosis. A mesh is placed in sublay position after closing the posterior rectus sheath in the midline. PCS is the CS procedure of choice to obtain medial fascial advancement and the creation of huge space for the mesh placement.

8.2.1 Steps of PCS

An incision is made in the posterior rectus sheath within 0.5 cm of its medial border. This incision is extended superiorly and inferiorly along the entire length of the rectus muscle. Dissection is continued medial to lateral as blunt or sharp preventing injury to the epigastric vessels as it lies within the muscles. The lateral limit of this dissection in PCS is the linea semilunaris up to the lateral border of the rectus muscle, the area of fusion of the anterior and posterior rectus sheaths. It is important to identify and preserve intercostal neurovascular structures entering the posterior aspect of the rectus muscle. Superiorly, this plane extends to the retroxiphoid/retrosternal space and inferiorly into the space of Retzius. In many circumstances, dissection in the retrorectus space up to the linea semilunaris is insufficient to permit adequate abdominal wall reconstruction, and there is also insufficient retrorectus space to permit adequate prosthetic reinforcement for hernia. In order to extend the retrorectus dissection lateral to the linea semilunaris, intramuscular dissection is possible by diving the internal oblique muscle; further dissection is performed within the preperitoneal plane or with transverse abdominis release (TAR). Incision is made approximately 0.5 cm medial to the linea semilunaris in the posterior sheath to expose the transverse muscle. It is easy in the upper half of the abdomen where the muscle belly is well developed. With electrocautery, transection of the transverse abdominis muscle is done to prevent injury to the transversalis fascia or peritoneum. This plane may extend superiorly beyond the costal margin to the diaphragm, inferiorly to the myopectineal orifice and laterally to the psoas muscle. Similarly, TAR is completed on the contralateral side. This is followed by reconstruction of the posterior layer with re-approximation of the posterior rectus sheath in midline using running suture. A large mesh is used to cover the space created at the retro muscular space up to the lateral border of dissection. The anterior rectus sheath is approximated in the midline.

9. Preoperative tissue expansion

In situations where fascial closure cannot be achieved even after CS, several other options have been described, each with its own advantages and disadvantages.

Hybrid Operation have been described where fascia is partially closed & reminder is bridge with an absorbable mesh in underlay or sublay position. Addition of vacuum-assisted closure to reduce the SSO and SSI in hybrid procedures has also been described. An alternative to these procedures is preoperative tissue expansion or flap and tissue transfer.

10. Tissue expanders

Tissue expanders are used to provide soft tissue coverage and restore abdominal domain by increasing both the size and the vascularity of the donor tissue by producing a strong, vascularized capsule around the expanders. Various sites of placing tissue expanders have been described like in the subcutaneous space, abdominal wall intramuscular spaces (between the internal oblique and transverse abdominis muscles), intermuscular sites (between the external and internal oblique muscles) and finally intra-abdominally. The expanders can be insufflated over various weeks depending on patient tolerance. Before starting filling of the expander, a period of wound healing is usually awaited for 3 weeks to prevent expander exclusion. Expanded skin retracts after removal of expanders, hence overexpansion is necessary. Complications like expulsion, exposure or infection of implants can occur in about 15% cases.

11. Progressive pneumoperitoneum

Reduction of contents of giant hernias may result in abdominal compartment syndrome. Progressive pneumoperitoneum technique is used to stretch the abdominal wall muscles before repair. Progressive pneumoperitoneum (PPP) increases the capacity of the retracted abdominal cavity, performs a pneumatic lysis of intestinal adhesions, allows the reduction of the hernia contents and improves diaphragmatic function. Air, CO_2 or NO is insufflated over a period of a few weeks every couple of days to about a total of 15–20 L depending on patient tolerability monitored by the development of scapular pain, dyspnoea or subcutaneous emphysema. Once tissue expansion is obtained, hernia repair is attempted.

12. Flap and tissue transfer

An alternative to tissue expansion is the use of plastic surgery procedures of flap and tissue transfer like latissimus dorsi, tensor fascia lata or rectus femoris flaps, but they are more complex and result in donor site defects and functional limitations.

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