

Original Article

Laparoscopic Retro-rectus Onlay Mesh Repair (RROM) for Ventral Abdominal Wall Hernias – Is It the New Gold Standard ?

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In this paper, we describe the evolution of the radical new surgery for ventral abdominal hernias, developed by us, known as laparoscopic Retro-Rectus Onlay Mesh Repair (RROM). This represents a retrospective review of the cumulative data for the surgical procedure since it was initially conceptualized in 2007 upto March 2021.

A total of 244 patients underwent laparoscopic repair by this technique, consisting of 140 umbilical hernias, 78 incisional hernias and 26 divarication of recti. Females predominated, comprising 61% of our patients. Of the total, 196 patients underwent laparoscopic RROM repair alone while in 48 cases, either unilateral or bilateral Transversus Abdominis Release (TAR) was added. In 9.2% cases, an additional concomitant surgery was performed, majority being unilateral Total Extra-Peritoneal (TEP) for groin hernias. Other concomitant surgeries included bilateral TEP repair for groin hernias, cholecystectomy and tubal division, all performed laparoscopically.

Nearly 64% patients completed 2 years of follow-up. Clinical seroma detection rate was 11%, none requiring intervention. Two patients developed divarication of recti in the postoperative period and none developed mesh infection or had recurrence.

[J Indian Med Assoc 2021; 119(9): 22-6]

Key words : Retro-rectus onlay mesh (RROM), hernia, laparoscopy, extraperitoneal repair.

Midline ventral hernias constitute approximately 20% of all abdominal wall hernias; they may be primary or secondary¹.

Most, if not all, ventral hernias require surgery as they tend to enlarge over time and may develop complications such as incarceration, obstruction or strangulation resulting in considerable morbidity and mortality².

Introduction of prosthetic repairs have substantially reduced recurrence rates when compared to primary tissue approximation and are indicated in all but the smallest of ventral hernias^{3,4}.

Since the first case of laparoscopic incisional hernia repair with synthetic mesh was reported in 1993⁵, based on the open technique pioneered by the Rives-Stoppa operation^{6,7}, it has evolved globally in recent years and offers numerous advantages over the conventional open approach, including decreased postoperative pain, length of hospital stay, and recurrences⁸. The Intra-peritoneal Onlay Mesh (s-IPOM) or its modification IPOM-Plus have come to be considered as the 'gold standard' for laparoscopic management of ventral abdominal hernia⁹. However, there are two major drawbacks to this technique, viz, cost and intraperitoneal placement of mesh. We have

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Received on : 18/05/2021

Accepted on : 25/08/2021

Editor's Comment :

- The RROM approach safely combines the advantages of the laparoscopic intra-peritoneal repair (IPOM) and the extra-peritoneal repair (e-TEP) for ventral abdominal hernias.
- It allows intraperitoneal dissection and reduction of hernia contents under vision. At the same time, the mesh is placed in the extra-peritoneal space, circumventing any complications that can arise from the placement of a large foreign object in the peritoneal cavity.
- Moreover, due to the lack of requirement of any special type of mesh or fixation apparatus, the cost of the surgery is drastically reduced.

developed and reported on a new laparoscopic approach to ventral abdominal hernia, circumventing both these disadvantages¹⁰. In this paper, we trace the evolution of our new technique of laparoscopic Retro-Rectus Onlay Mesh Repair (RROM) and present a retrospective analysis of our cumulative data.

MATERIAL AND METHODS

The procedure was initially conceptualized in 2007 and gradually adopted into practice. This is a retrospective analysis of all the cases of midline ventral abdominal wall hernias operated using the RROM approach from 2007 to 2020.

Though the technique was conceptualized in 2007, initially it was only offered to highly selected patients as it was a radically new approach to laparoscopic repair of ventral abdominal wall hernias. It was only by the end of 2016 that RROM replaced IPOM as our procedure of choice and was offered to all patients. Initially, the RROM was done only for small, reducible

umbilical hernias. As our experience and confidence grew, it was offered to all ventral midline abdominal wall hernias, including incisional hernias, upto a maximum transverse defect size of 8 cms. Upto a maximum transverse defect size of 4 cms., RROM repair is done alone. For defects 4-8 cms in size, intraoperative assessment is done whether the posterior rectus sheath can be closed without tension and Transversus Abdominis Release (TAR) is added either on one or both sides as needed. Beyond 8cms defect size, usually open repair is offered. In addition to this, RROM repair was also done in patients with divarication of recti.

The main steps of the procedure are already described elsewhere¹⁰. To briefly recap the same:

(1) The patient is placed in a supine position with nasogastric tube in situ. The surgical team stands near the head of the patient on either side while the monitor is placed at the foot end of the patient.

(2) Pneumoperitoneum is created by Veres needle insertion at Palmer's point. Trocars are inserted as depicted in Fig 1.

(3) Reduction of hernia contents and adhesiolysis, if needed.

(4) Transverse incision on the posterior rectus sheaths, extending from one linea semilunaris to the other, 7 cm cranial to the cranial edge of hernia defect.

(5) Dissection of space between recti muscles and posterior rectus sheaths.

(6) Division of the posterior rectus sheath on both sides, about 2 mm from midline.

(7) Reduction or division of the hernia sac.

(8) The extent of dissection is: The median limit of the dissection is the where the posterior rectus sheath turns ventrally to form the linea alba. The lateral limit of the dissection is the point where one sees the lateral neurovascular bundles, which have to be preserved. The caudal limit of dissection is 7 cms caudal to the caudal border of the defect or the pubic symphysis, whichever is more cranial.

(9) Measurement of defect and selecting appropriately sized mesh to allow 5 cms overlap over the edges of the defect in all directions.

(10) Closure of any ventral defect, if larger than 1 cm. using 1-0 polydioxanone barbed suture running stitch.

(11) Deploying the mesh. We prefer self-fixating

polypropylene mesh (the mesh has a fine layer of barbs on one surface, which is placed facing the recti muscles). Three midline tranfixating polydioxanone sutures are placed and tied. The mesh is spread out and gently compressed against the posterior aspect of the recti muscles to enable self-fixation. There is no need for additional tackers/sutures to fix the mesh (Fig 2).

(12) The divided edges of the posterior rectus sheath are repaired using 1-0 polydioxanone barbed suture running stitch.

(13) Finally, the transverse incision in the posterior aspect of the rectus sheath is sutured using 1-0 polydioxanone barbed suture running stitch.

The nasogastric tube is removed before extubation. All patients are mobilised in four hours and liquids are started. Soft diet is commence on the next day. The patient is discharged by 24-48 hours after surgery, depending on his or her comfort level.

Patients are also given an abdominal support belt to wear.

Typically, patients are called for follow-up 7 days after surgery, and subsequently after one month and three months. Thereafter, they are advised to visit yearly or if fresh complaints develop.

For epigastric hernia, the technique is slightly different. The patient is placed in a modified lithotomy position, the surgeon stands between the legs of the patient and the camera assistant is on the right side of the patient with the monitor at the head end. Under guidance of a 5 mm laparoscope initially placed at the Palmer's point, four trocars are put in the lower quadrants as mirror image of Fig 1.

RESULTS

The laparoscopic RROM repair was done in a total of 244 patients. For the purposes of simplicity, 14 cases of epigastric hernias are included along with umbilical hernias as the technique and outcomes are identical. Between 2007 to 2016, it was done very selectively in 30 patients as the technique was

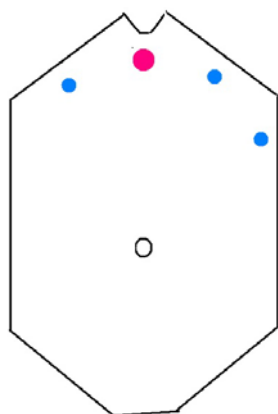


Fig 1 — Port positions



Fig 2 — Retrorectus space has been created, fascial defect closed, self-fixating mesh deployed and left half of it has been opened

finessed. The remaining 214 patients were operated between 2016 to March 2021. The distribution of cases is summarized in Table 1. Out of the 78 cases that underwent the laparoscopic RROM repair, unilateral or bilateral Transversus Aponeurosis Release (TAR) was done in 26 cases, as it was also done in 22 cases operated for divarication. The distribution of type of surgeries performed is summarized in Table 2.

Females predominated in our data, comprising 61% of our sample. While we were selective in the initial years (upto 2016) in offering this surgery to patients with BMI less than 25 kg/m², subsequently it was offered to all patients considered fit for laparoscopic repair and the data reflects this. Same holds true for other factors like Diabetes Mellitus (DM), smoking and Chronic Obstructive Pulmonary Disease (COPD). The demographic details of the sample are given in Table 3.

Concomitant surgery was performed in 23 patients (9.2%). The commonest surgery was unilateral groin hernia repair (TEP) in 12 (4.9%), followed by cholecystectomy in 8 (3.3%), bilateral groin hernia repair (TEP) in 3 (1.2%) and tubal division for family planning in 1 (0.4%) patients.

The operating time varied depending on the type of surgery as well as whether any additional surgery was performed at the same time. The data for ventral abdominal hernia repair alone is detailed in Table 4. Additional procedures increased the mean operative time by 12 minutes, 18 minutes, 22 minutes and 38 minutes for tubal division, cholecystectomy, unilateral groin hernia repair and bilateral groin hernia repairs respectively.

Out of the 244 patients, 156 patients (63.9%)

	Indication			Total
	Umbilical hernia (%)	Incisional hernia (%)	Divarication (%)	
Total	140 (57.3%)	78 (32.0%)	26 (10.7%)	244

Type of surgery	Indication			Total
	Umbilical Hernia (%)	Incisional hernia (%)	Divarication of recti (%)	
Laparoscopic RROM	140(57.4%)	52(21.3%)	4(1.6%)	196 (80.3%)
Laparoscopic RROM + TAR	0	26 (10.7%)	22 (9%)	48 (19.7%)

Parameter	Number
Total number of patients	244
Male : Female	95 : 149
Mean BMI (Range) kg/m ²	26.1 (23-42)
DM	45 (18.9%)
Smokers	19 (7.8%)
COPD	7 (2.9%)

Surgery	Operative timings in minutes (Range)
Laparoscopic RROM	74 (62-145)
Laparoscopic RROM	106 (75-176)
Laparoscopic RROM + TAR	125 (86-210)

completed at least two years follow-up. Clinical seroma was detected in 27 patients (11.1%). All the patients responded to conservative management and reassurance. Two cases developed divarication of recti in the postoperative period, one of which required surgical correction, which was done by the open conventional technique. None of the patients had chronic postoperative surgical site pain or developed recurrence or mesh infection.

DISCUSSION

Incisional hernia is the most common complication following laparotomy and is still representing a challenge to surgeons due to high recurrence rate and morbidity¹¹.

Over the last two decades, LIHR has steadily gained recognition as an alternative to open procedures because of several purported advantages, including the lower incidence of surgical-site infection¹². While the s-IPOM technique is simpler to perform, the IPOM-Plus modification, in which the fascial defect is sutured closed, is advocated by many as it seems to reduce the incidence of adverse hernia-related events including recurrence, seroma formation, and mesh bulging¹³. However, in both s-IPOM and IPOM-Plus, since the mesh is to be placed intraperitoneally, a specialized composite mesh has been used to minimize adhesions between the mesh and the intraperitoneal contents. Composite meshes are expensive. While a 15 X 15 cm composite mesh costs between 25000-32000 INR, the self-fixating polypropylene mesh that we used in most of our cases costs approximately 4500 INR.¹⁴ Additionally, the mesh is usually fixed in s-IPOM/IPOM-Plus with absorbable tackers, which cost almost as much as the mesh itself. This is not required in the RROM approach since the mesh is sandwiched between the posterior rectus sheath and the recti muscles, not requiring any additional fixation apart from the barbs built on its surface. Moreover, intraperitoneal placement of mesh leaves a foreign body inside which may have long-term consequences including delayed presentation with adhesions, bowel obstruction, fistulization and increased morbidity during subsequent explorations¹⁵. Finally, it has been found that when the mesh is placed in the retro-rectus plane (sub-lay) position, as in the RROM approach, the outcomes are superior than when the mesh is in the inlay or bridging position (s-IPOM) or underlay

position (IPOM-Plus)¹⁶.

During our initial experience, we performed only RROM approach for selective small umbilical hernias. As our experience grew, we included patients with incisional hernias without domain loss and then, with domain loss upto 8 cms. In the latter cases, we perform unilateral or bilateral Transversus Abdominis Release (TAR) as described by Novitsky *et al*¹⁷. Similar approach has also been supported for IPOM-Plus¹⁸.

Females outnumbered males in our data since almost all the incisional hernias, except two, were in female patients following either lower abdominal caesarean section or open hysterectomy. Our risk-averse selection bias was also evident in the early part of our series as far as BMI and co-morbidities like chronic obstructive pulmonary disease (COPD) were concerned. However, after 2018, we have included patients with BMI upto 42 kg/m² and those with controlled COPD as well as smokers and diabetics.

The RROM approach is also well-suited in patients developing recurrence after open repair, as is evident from the 14 (5.7%) cases in our series. Twenty-three patients (9.2%) in our series underwent concurrent surgery, with safe outcomes. This has been demonstrated to be safe by others as well in the case of s-IPOM/IPOM-Plus^{19,20}.

Seroma formation impacts negatively on patients' aesthetic outcomes and causes discomfort, pain, and/or infection. The incidence rate of seroma formation following IHR is unknown, as its presence varies significantly between series of studies²¹. The reason behind the differences in the reported incidence of seroma in various studies is the methodology of the diagnostic criteria used by different authors. In one comparative study of IPOM-Plus and sIPOM, the incidence of seroma was 5.6% vs 27.8%, but in another study, it was 11.4% versus 4.3%^{22,23}, this could indicate that the effectiveness of IPOM-Plus is questionable in terms of reducing seroma formation. We have logged in clinically detectable seroma, on examination of the patients, as recordable entity and found this to be the case in 11.1% of our cases. However, all the patients responded to conservative management and, in all the cases, complete resorption of the seroma occurred, latest by 12 weeks. Two patients in our series developed divarication of the recti in the post-operative period. This was due to iatrogenic damage to the linea alba while dividing the medial end of the posterior rectus sheath. An immediate course correction by leaving at least 2 mm of the posterior rectus sheath medially ensured that there was no recurrence of this complication.

Various other researchers have described other

endoscopic approaches to the same space and placement of the mesh in the retro-rectus plane like the e-TEP, MILOS, EMILOS, TARM²⁴⁻²⁷. However, we feel that the RROM approach is superior as it is technically easier, allows intraperitoneal adhesiolysis under vision as it is a transperitoneal approach, does not require any specialized equipment and same approach can be used for adding unilateral or bilateral TAR.

Mesh bulging, believed to be the out-pouching of the bridging portion of the mesh in s-IPOM protruding into the hernial sac as a result of intra-abdominal pressure is classified as pseudo-recurrence, but may contribute to significant patient dissatisfaction. The incidence of mesh bulging after sIPOM has been reported to be as high as 17.4%²⁸. Since both the anterior and posterior fascial defects are sutured close in the RROM approach, we did not encounter any incidence of mesh bulging in our series.

Chronic pain after hernia repair is always a significant issue after ventral hernia repair, seen in upto 39% of patients, purportedly due to the transfascial fixating sutures or tackers^{29,30}. In the RROM approach, the mesh is not fixed by any devices except by the three orienting sutures in the midline, which is essentially devoid of any nerves. It is held in place initially by the barbs on its outer surface due to its unique design. As the pneumoperitoneum is evacuated, the space collapses and the mesh is held in place between the posterior rectus sheaths and the recti muscles. Avoidance of any transfascial sutures laterally may have contributed to the absence of chronic post-operative pain in our series. Apart from the 3 in the midline. Also there is no need for fixation of the mesh with the tacker because the mesh itself is self fixating.

Our study had several limitations, including the fact that it is a retrospective review. Also, since it documents the evolution of a new technique, there was a significant learning curve involved for us as well. The operative time as well as certain complications like post-operative divarication of recti because of iatrogenic damage to the linea alba reflect this progression. Moreover, the patients were highly selective, especially in the early part of the evolution. But as we gained more experience and confidence in the technique, our case selection became much more liberal, including cases with higher BMIs, co-morbidities like diabetes mellitus and COPD, Smokers and Incisional Hernias with domain loss upto 8 cms., with comparable results.

We feel that the RROM approach truly reflects the philosophy of MAS (minimal access surgery) for the masses as it is a safe approach, giving equivalent outcomes as compared to the IPOM techniques at significantly lower costs. In our opinion, this technique

of RROM is suitable to become the gold standard in the management of ventral abdominal wall hernias. Further research in the form of direct comparison with s-IPOM/IPOM-Plus through a randomized clinical trial or a cohort study may help to establish its true worth.

Limitations of the study : This is the result from a single center, the surgeries being performed by an expert surgeon who was also the innovator of this technique. There may be a significant learning curve associated with the technique as it requires extensive intra-corporeal suturing. Moreover, lack of familiarity with the new perspective may lead the novice surgeon to damage the linea alba, resulting in postoperative dehiscence of the recti (recti diastases). Randomised controlled trials may be helpful in establishing the true worth of the technique. At the same time, cost-effectiveness studies would help to determine whether this technique is economically beneficial.

Conflict of Interest : Both the authors declare that there is no conflict of interest whatsoever.

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