**Science Journal of Clinical Medicine**
2012;1(1):10-14
Published online December 30, 2012 (http://www.sciencepublishinggroup.com/j/sjcm)
doi: 10.11648/j.sjcm.20120101.13

# Laparoscopic intraperitoneal onlay repair of abdominal incisional and ventral hernias with polyvinylidene fluoride-coated polypropylene mesh; A retrospective study with short to medium term results

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**To cite this article:**
D. G. Roberts, S. Anwar. Laparoscopic Intraperitoneal Onlay Repair of Abdominal Incisional and Ventral Hernias wth Polyvinylidene Fluoride-Coated Polypropylene Mesh; A Retrospective Study with Short to Medium Term Results. *Science Journal of Clinical Medicine.* Vol. 1, No. 1, 2012, pp. 10-14. doi: 10.11648/j.sjcm.20120101.13

**Abstract:** Laparoscopic repair of incisional and ventral hernias has increased in popularity due to reduced pain, shorter length of stay and earlier return to work. Dynamesh® Intraperitoneal onlay mesh (IPOM), a composite of polyvinylidene fluoride (PVDF) coated polypropylene (PP) was designed to utilize the properties of both materials. This retrospective study reports a single surgeon experience with laparoscopic IPOM using Dynamesh ®, to ascertain any short to medium term complications. Forty consecutive patients underwent intraperitoneal onlay mesh repair with Dynamesh® in a District General hospital (DGH) over a 33 month period. Data was collected retrospectively from medical notes, clinical assessment and telephone interviews. Short term complications include development of seromas post operatively in three patients which were successfully drained. One patient was readmitted with small bowel obstruction that was successfully managed conservatively. Medium term results showed two further seromas. Our recurrence rate is 13% after a mean follow up of 15 months. On submission of this manuscript, none of the patients have had to undergo surgical re-intervention for Dynamesh® related complications. We have not noticed any significant short to medium term complications with Dynamesh® in our experience. The debate about the best composite mesh continues; only a randomised control trial between the different meshes, with long term follow up can determine the true incidence of complications.

**Keywords:** Laparoscopic, Dynamesh, Incisional Hernia, Ventral Hernia

## 1. Introduction

Despite advances in technology, the optimal repair of abdominal wall hernias particularly, incisional hernias, still remains technically challenging and somewhat controversial. Laparoscopic Intraperitoneal onlay mesh repair (IPOM) has been popularized as an alternative to open repair and shown to be at least as effective if not superior to open approach 1. IPOM was first reported in 1993 by Karl LeBlanc; since then, there have been significant developments in the types of meshes available to use2. Broadly speaking synthetic meshes are most often categorised as marcoporous, microporous and composite3.

Dynamesh® (FEG Textiltechnik mbH, Aachen, Germany) is a 100% synthetic two component textile mesh. It has an open pore monofilament structure. The two components comprise of polypropylene (PP) for the abdominal wall and polyvinylidene fluoride (PVDF) for the visceral surface. The PVDF on the visceral side is supposed to retains its low adhesive properties and the PP on the parietal side provides effective incorporation into the abdominal wall. When compared to the previously common mesh material polypropylene PP), polyvinylidene fluoride (PVDF) was shown to have improved biostability, lowered bending stiffness and a minimum tissue response 4. Berger et al 5 reported a large series of 297 patients with incisional hernias. Dynamesh was used to repair these with a laparoscopic IPOM technique. An overall complication rate of less than 1% was reported in this study. More recently Fortelny et al6 have reported adverse effects requiring explantation of mesh from three out of their 29 patients who had an IPOM with Dynamesh® for incisional hernia repair.

The present study reports a single surgeon experience with laparoscopic intraperitoneal onlay mesh repair using the PVDF coated PP Dynamesh®.

# 2. Methods

Between the periods of March 2008 and Nov. 2010 we have performed 40 laparoscopic incisional and ventral abdominal wall hernia using Dynamesh® IPOM.

### *2.1. Operative Technique*

All patients were given a single shot of preoperative and two doses of postoperative intravenous antibiotics; cefuroxime 750 mg (flynnpharma, Dublin) and 500 mg Flagyl (Baxters, UK) . Intraperitoneal onlay mesh repair was performed by a single surgeon using Dynamesh. The operation was performed using a three-port technique, with placement of the trocars taking into account the size and the location of the hernia. Our preferred site of entry was mostly on the left mid axillary line. One 10-mm trocar was first inserted with a visiport (Ethicon, UK) with a zero0 camera. After successful insuffulation camera was changed to 300 and a further 10-mm and one 5mm trocars were inserted under direct vision. For large mesh placements (30*20cm) two further trocars were inserted on the R mid axillary line exactly opposite the left sided trocars.

When necessary adhenolysis was performed using scissors without any diathermy or energy source. The hernia was identified and any contents were reduced. The hernia sac was reduced and dissected with electrocautry. The surrounding area was prepared for mesh placement with no closure of the defect. Under laparoscopic vision the defect was palpated and marked with a sterile pen on the external abdominal wall. The mesh size was chosen with a minimum overlap of 5 cm around the defect. Prior to intra-abdominal placement, four Prolene sutures (Ethicon UK) were placed at the midpoints of the mesh superiorly, inferiorly, the left lateral and the right lateral margins, to assist placement of the mesh and with a sterile pen corresponding markings for the sutures were made on the external abdominal wall.

The mesh was then inserted via the 10 mm trocar and placed over the defect. Meticulous care was taken to make sure that the mesh is faced the right way up. A suture passer device was used to pull and tie in the subcutaneous layer. The mesh was fixed circumferentially with spiral tacks using a standard double crowning technique. The operative field was inspected and the trocars were removed under direct vision. The fascial layer was closed in the 10 mm incisions with no drains being placed.

### *2.2. Data Collection*

Patients identified as having a laparoscopic incisional and/or ventral hernia repair using Dynamesh were deemed eligible for the study. The medical notes for all patients were reviewed and data on demographics, indication, and operative procedure, length of hospital stay, readmission rates and outpatient clinic appointments were collection. A single follow up appointment was offered to all patients at a mean follow up (FU) of 12 weeks. Any problems identified during the first follow up visit were recorded and the patient was given subsequent appointments. Patients were discharged when they reported no symptoms. In an ideal world patients should be called back every year at least for 5 years to look for recurrence, unfortunately in a the current NHS, due to financial constraints, it is impossible to follow benign diseases after they have recovered from their surgery. A telephonic interview was carried out at a mean FU period of 15 months of months and all patients who reported any problems were re invited to a clinic set up for hernia review.

# 3. Results

Forty patients underwent intraperitoneal onlay mesh repair using Dynamesh® (Table 1, II and III). 4 operations (10%) had to be converted to an open procedure. Three were converted because the adhesions were found to be very dense and it was thought to be unsafe to proceed with laparoscopic adhenolysis. In one patient an inadvertent tear was made in the bladder wall while taking the adhesions down. This patient had previous multiple pelvis operations and the bladder was stuck on the posterior abdominal wall. There were no other intra operative complications. Our inpatient stay was a median of 2 days. The patient with a bladder laceration was kept in for observation and had a normal cystogram. Two patients had delayed discharge due to social reasons.

***Table 1***. *Patients, Hernia characteristics.*

| | **No. of Patients^** | **Range** |
|---|---|---|
| Age (years)* | 51 | 27 -86 |
| BMI (kg/m$^2$)* | 34 | 20 - 41 |
| ASA | | |
| I | 14 | |
| II | 23 | |
| III | 3 | |
| Sex (Female/Male) | 22/18 | Sex ratio (F/M) : 1.2 |
| Indication | | |
| Incisional hernia | 17 | |
| Umbilical/Paraumbilical | | |
| *Primary* | 14 | |
| *First Recurrence* | 1 | |
| Epigastric | 1 | |
| Ventral | 3 | |
| Spigelian | 1 | |
| Combination | | |
| Incisional/ Umbilical | 1 | |
| Umbilical/ Ventral | 2 | |

*^Unless indicated otherwise; *values are median; BMI, Body Mass Index; ASA, American Society of Anesthesiologists.*

***Table 2.*** *Surgical data.*

| | Number^ | Range |
|---|---|---|
| Duration of operation (min)* | 90 | 40 - 190 |
| Mesh Size (cm2)* | 600 | 225 - 900 |
| Conversion | 4 | |
| Intra-operative complications | 1 | |
| Inpatient stay post operatively (days)* | 2 | 0 - 14 |

*^Unless indicated otherwise; *values are median.*

***Table 3.*** *Sizes and Number of meshes used.*

| | Number | Percentage (%) |
|---|---|---|
| 15 x 15 | 16 | 40 |
| 20 x 20 | 2 | 5 |
| 20 x 30 | 13 | 32.5 |
| 30 x 30 | 8 | 20 |
| 2 meshes - 15 x 15 and 30 x20 | 1 | 2.5 |

### *3.1. Postoperative Complications (Table IV, V)*

***Table 4.*** *Short-term post operative data.*

| | Number^ | Percentage (%) |
|---|---|---|
| Recurrences | 0 | 0 |
| Readmission | 1 | 2.5 |
| Seroma | 3 | 7.5 |
| Reoperation | 0 | 0 |
| Length of follow-up (weeks)+ | 12 | |

*^Unless indicated otherwise; +values are mean.*

***Table 5.*** *Medium-term post operative data.*

| | Number^ | Percentage (%) |
|---|---|---|
| Recurrences | 4 | 13 |
| Readmission | 0 | 0 |
| Seroma | 2 | 5 |
| Reoperation | 0 | 0 |
| Length of follow-up (weeks)+ | 64 | |

*^Unless indicated otherwise; +values are mean.*

On clinical assessment at the post operative outpatient clinic follow up, three patients had developed a seroma, all three were drained. Although the seromas were small and asymptomatic the patients were concerned about the recurrence of their hernias. The seromas were drained in full aseptic conditions to reassure the patients. The patients who were well and had no concerns were discharged and no further follow up was arranged. One patient returned as an emergency within a week of their operation with symptoms suggestive of small bowel obstruction; he had a CT scan which suggested ileus. This was successfully managed with conservative treatment. The patient was discharged home without the need for any subsequent surgery.

Four patients were invited for a second outpatient clinic appointment. One for a follow up after a large seroma aspiration and three for abdominal discomfort. Currently, only one patient is under follow up with continual abdominal discomfort although clinical examination is unremarkable.

Of the 40 patients, successful telephonic interview was carried out with 28 patients. One patient died of a cerebro–vascular event in the interim period. The rest of eleven patients who could not be contacted via telephone, were sent questionnaires via mail. Two questionnaires were returned. In total we were able to get in touch with 30 out of 40 patients.

Seven patients raised concerns about possible recurrences therefore were invited back to an additional clinic to undergo clinical assessment. Out of the seven, three had clinical and one had radiological (CT) evidence of recurrence of hernia with no additional complaints relating to mesh complications. All the 4 recurrences were in the incisional hernia group where large meshes were used (20-30 cm and 30-30cm). One patient had a small seroma along with a palpable subcutaneous port site stitch which was causing her discomfort. This was removed under local anaesthesia.

## 4. Discussion

Currently there are more than 80 different types of meshes available on the market for IPOM repair of abdominal wall hernias. Synthetic meshes can be broadly classified into macroporous, microporous and composite meshes. Macroporous meshes such as polyp-propylene (PP) allows for ingrowth of scar tissue. However if these are put in contact with the bowel surface they cause formation of adhesions and enterocutaneous fistulas (7). Microporous meshes such as expanded Polytetraflouroethylene (ePTFE) does not allow for tissue ingrowth but may lead to encapsulation and subsequent infection. ePTFE has been shown to cause infection requiring explanation of meshes in several cases (8) . To deal with these problems synthetic meshes with anti adhesive coatings have also been developed. Most of the coating material comprises of an absorbable layer such as collagen hydrogel, omega 3 fatty acids and oxygenated cellulose. There are some experimental trials claiming reduced risk of adhesions to composite and coated synthetic meshes when compared to traditional synthetics (9-10). Biological meshes are expensive and are normally reserved for repair of hernias in potentially infected fields. In the absence of randomised controlled trials there is no data to suggest the superiority of the various meshes available, one over the other.

Dynamesh® is made of PVDF with a small amount of PP on the parietal surface (4). It has been generally in use since 2004. Junge et al (11) in an experimental model compared Dynamesh with 3 other meshes including PP as a control. Dynamesh was found to be better in terms of adhesion formation and shrinkage when compared to a coated synthetic PP mesh and an ePTFE mesh . The biggest experience so far for Dynamesh has come from Berger's series of 297 patients with incisional hernia repair (5). After a median follow up of 24 months they reported a recurrence

rate of 0.6%; more importantly the complication rate was less than 1% with no mesh explantation required. Contrary to this Fortenly et al (6) reported problems with ileus and small bowel adhesions requiring explantation of 3 out of six patients with adhesive complications. Our own experience is quite contrary to this. Only one patient was readmitted with ileus and was managed successfully conservatively.

Majority of the earlier observational cohort studies showed a clear benefit in laparoscopic abdominal wall hernia repairs in terms of recurrence rates, less pain, earlier return to work and shortened hospital stay (12-13). A meta analysis of five randomised controlled trail (14) by Sajid et al showed similar postoperative pain and recurrence in both laparoscopic and open groups. The length of hospital stay and complication rates was lower in the laparoscopic group. A recent meta analysis of eight RCT's (1) has again demonstrated no difference between the recurrence rates for lap vs. open incisional hernia repairs. Length of hospital stay, incidence of wound infections and infections requiring mesh removal was smaller in the lap group. Interestingly enough in this review the pooled hernia recurrence rates for open and lap incisional hernia repairs were 3.4 and 3.6% respectively. This is not in keeping with the previously reported rates of up to 32% risk of recurrence after an open incisional hernia repair with a 10 year follow up period (15). The authors on the Forbes review (1) admitted that the low recurrence rates for both the lap and open group in their review might be because of the shorter length of follow up, small size of hernias included in the trials and lack of definition of hernia recurrence. Recurrence rates after laparoscopic ventral hernias range from 1-17% (16). This wide variations is not only because of the afore mentioned factors but also due to patient related factors such as co morbidities, BMI, steroid use, and surgeon experience. The recurrence rate in our study is 13%. We realise that our follow up data is not complete; 10 out of 40 patients could not be contacted. However our recurrence rate is n keeping with the other studies in the literature.

Seroma formation is the most common complication reported in the lap repair group for ventral abdominal hernias. Berger et al (17) reported a 92.6% incidence of seromas in the laparoscopic group. This is mainly attributed to the hernia sac left behind in the laparoscopic IPOM repair. Our seroma rate of 12.5% was lower than many other reported series. We attribute this to the deliberate effort of reducing and diathermizing the sac in almost all cases. Others have also shown a similar technique in a RCT (18).

Dynamesh is transparent which helps with the correct positioning of the mesh. However the PP surface is differentiated from the PVDF by the presence of a stitch placed by manufacturer on the PP side. It is very important that the mesh should be placed the right way round as it is not difficult to be disorientated especially when placing larger IPOMS.

The ventral hernia working group guidelines (19) acknowledges the role of laparoscopic IPOM repairs in incisional hernia surgery and recommends its use in non infected repairs.

An ideal mesh should be resistant to adhesion formation, bowel erosion, shrinkage, and seroma formation. It should promote tissue ingrowth be non carcinogenic and cause minimal pain. The quest for the ideal mesh continues.

Ours is a small retrospective study with medium term FU period. The recurrence rates are largely dependent on survey questionnaire which is also a limitation of our study. However in our experience the Dynamesh® is safe to use with minimal short term complications.

**"Drs. Anwar and Roberts have no conflicts of interest or financial ties to disclose."**

"DGR carried out the data collection, helped in design of the study, participated in patient follow up (FU) via phone calls and drafted the manuscript. SA conceived the study, helped in the data collection, designed the study, conducted the final FU clinic and drafted plus finalised the manuscript. Both authors read and approved the final manuscript".

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