Mesh Tuck Repair of Ventral Hernias of the Abdomen: A New, Simplified Technique for Sublay Herniorrhaphy

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ABSTRACT

There is biomechanical advantage to placing mesh in the retro-myofascial plane for repair of ventral abdominal hernias. Intra-abdominal pressure applied to the periphery of the mesh increases apposition to the abdominal wall rather than causing distraction and this translates, in general, into lower recurrence rates than after "inlay" and "onlay" mesh placement. Traditionally, retro-myofascial mesh is placed in the pre-peritoneal or retro-muscular space. Both traditional techniques require extensive dissection and placement of large sheets of mesh which can cause symptomatic impairment of abdominal wall compliance. Pre-peritoneal dissection can be particularly tedious due to pathological adherence of peritoneum to the posterior abdominal wall in longstanding primary and incisional hernias. In the technique described, mesh is tucked into the retro-myofascial plane without any dissection into pre-peritoneal, retro-muscular or peritoneal spaces. The operation is less tedious, takes less time to perform, can often be done under local anaesthesia, demands less mesh and achieves similar recurrence rates to traditional retro-myofascial mesh repairs. Sixty-one operations have been performed by the author using this technique, with a recurrence rate of 8.2% after 13 years to 3 months of follow-up (median, 3.75 years) and 9.3% if patients with less than one year of follow-up are excluded. Factors predisposing to recurrence after mesh repair of ventral hernias are numerous and complex. A fair comparison of recurrence rates between this technique and traditional retro-myofascial repairs requires a randomized controlled trial but the crude recurrence rate for this operation falls well within the range reported for traditional repairs from other studies.

Reparación Protésica con Malla, de las Hernias Ventrales del Abdomen: una Técnica Nueva, Simplificada, Para la Herniorrafía de Abordaje Retro-muscular (Sublay)

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RESUMEN

Existe una ventaja biomecánica en colocar una malla en el plano retro-miofascial para reparar las hernias abdominales ventrales. La presión intra-abdominal aplicada a la periferia de la malla, aumenta la aposición en la pared abdominal, en lugar de causar distracción, lo cual se traduce generalmente en tasas de recurrencia más bajas que cuando se colocan mallas "inlay" y "onlay". Tradicionalmente la malla retro-miofascial se coloca en el espacio-pre-peritoneal o retro-muscular. Ambas técnicas tradicionales requieren disección extensa y la colocación de grandes láminas de malla que pueden causar afectación sintomática de la distensibilidad de la pared abdominal. La disección pre-peritoneal puede ser particularmente tediosa debido a la adherencia patológica del peritoneo a la pared abdominal posterior en las hernias primarias de larga duración e incisionales. En la técnica descrita, la malla se instala en el plano retro-miofascial sin disección alguna de los espacios pre-peritoneales, retro-musculares o peritoneales. La operación es menos tediosa, toma menos tiempo, puede a menudo hacerse con anestesia local, requiere menos malla, y logra tasas de recurrencia al menos similares a las tradicionales reparaciones retro-miofasciales con malla. Sesenta y una operaciones han sido realizadas por el autor usando esta técnica, con una tasa de recurrencia de 8.2% luego

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de 13 años a 3 meses de seguimiento (mediana, 3.75 años), y 9.3% si se excluyen los pacientes con menos de un año de seguimiento. Los factores que predisponen a la recurrencia después de una reparación con malla son numerosos y complejos. La comparación justa de las tasas de recurrencia entre esta técnica y las reparaciones retro-miofasciales tradicionales requiere un ensayo controlado randomizado, pero la tasa cruda de recurrencia para esta operación cae sin objeciones dentro del rango de reparaciones tradicionales reportado por otros estudios.

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INTRODUCTION

In repair of ventral hernias of the abdominal wall, there is biomechanical advantage to mesh placement in the retro-myofascial plane (1, 2). Increased intra-abdominal pressure acting anteriorly on the margins tends to appose the mesh to the abdominal wall rather than distracting it. Increased intra-abdominal pressure also tends to push the abdominal wall laterally away from the mesh. The forces opposing this lateral distraction depend on the integrity of fixation of mesh, in turn dependent on the area of contact between mesh and abdominal wall, the density and strength of the incorporation process and the number of layers of anchoring stitches. The balance between these forces favours placement of mesh in the retro-myofascial plane and does result, in general, in a lower recurrence rate than when mesh is placed in the pre-myofascial plain (onlay) or sutured to the edge of the defect (inlay) (2, 3).

Traditionally, retro-myofascial mesh is placed either in the pre-peritoneal or retro-muscular (retro-rectus) space (1) or in the peritoneal cavity. The dissection required in the first two methods is quite extensive and tedious, often made more difficult by pathological adhesion of peritoneum to the posterior abdominal wall at the margin of the defect in long-standing primary and incisional hernias. Large sheets of mesh are advocated and this can result in significant, symptomatic reduction in the compliance of the abdominal wall (4). Mesh placed in the peritoneal cavity carries a significant risk of development of obstructing adhesions and bowel fistulae (5).

A technique is presented whereby mesh is tucked into the retro-myofascial plane after dissection of the sac to just beyond the margins of the hernia defect. The pre-peritoneal and retro-muscular spaces are not entered. The sac is not opened and the peritoneal cavity is not entered. Large sheets of mesh are not required, minimizing the effect on abdominal wall compliance.

SUBJECTS AND METHODS

Informed consent was obtained in all cases. A single dose of prophylactic anti-staphylococcal antibiotic is administered just prior to incision. Deep vein thrombosis prophylaxis is administered as indicated. The hernia sac is dissected completely to a point just posterior to the true muscular aponeurotic edge of the defect. No deliberate attempt is made to dissect into the pre-peritoneal space beyond the nexus of the sac and peritoneum lining the posterior abdominal wall. Any defects created in the sac are closed with absorbable suture. The sac is then inverted.

A piece of polypropylene or polyester mesh is selected which should be larger than the defect by about 4 or 5 cm in all directions (except for smaller defects where the overlap should be proportionately less). Polypropylene suture (0 or 1) on a round bodied or tapered needle is used to fix the mesh in all cases. Suturing is started along a line concentric to the defect and about 3 to 4 cm external to the margin of the defect (Fig. 1). The needle is placed through this imaginary line into the myofascial layer and is guided in an oblique direction to exit the myofascial layer at a point just posterior to the muscular aponeurotic defect and immediately anterior to the junction of the sac and peritoneum lining the posterior abdominal wall. When the defect is in the midline and abuts the *recti abdominis*, the needle will have traversed the anterior rectus sheath at about its middle (about 3.5 cm lateral to the medial border) and exited the posterior rectus sheath at the posterior edge of the medial border of the rectus, at the junction of the inverted sac and peritoneum lining the posterior rectus sheath (Fig. 1), care being exercised to prevent the needle entering the peritoneal cavity at this cul-de-sac.

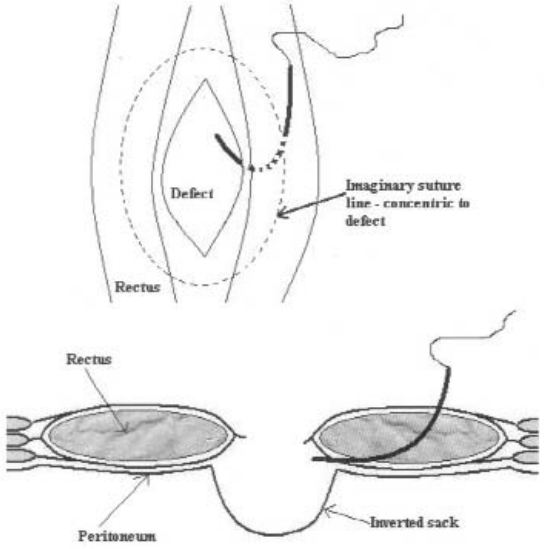

Fig. 1: The first pass of the needle through the imaginary ellipse concentric to the defect, exiting posterior rectus sheath or muscle just anterior to the nexus of sack and peritoneum.

A 1 to 1.5 cm bite is then taken at 2.5 cm from the edge of the mesh, parallel to the circumferential line of the

elliptical or circular defect (bites should not exceed 1.5 cm as this would result in a large gap between suture points and may predispose to recurrence). The needle is then passed back underneath the edge of the defect obliquely through the myofascial layer along a path retrograde to the first pass of the needle to exit at a point 1 to 1.5 cm from the first entry point of the needle (Fig. 2). The stitch is drawn and tied, resulting in the mesh being invaginated or tucked into the cul-de-sac between the margin of the inverted sac and the posterior myofascial wall and pulled underneath it to overlap the myofascial layer by the distance between the margin of the defect and the plane of entry of the fixing stitch (about 2.5 cm) (Fig. 2). The free edge of the mesh will either spread

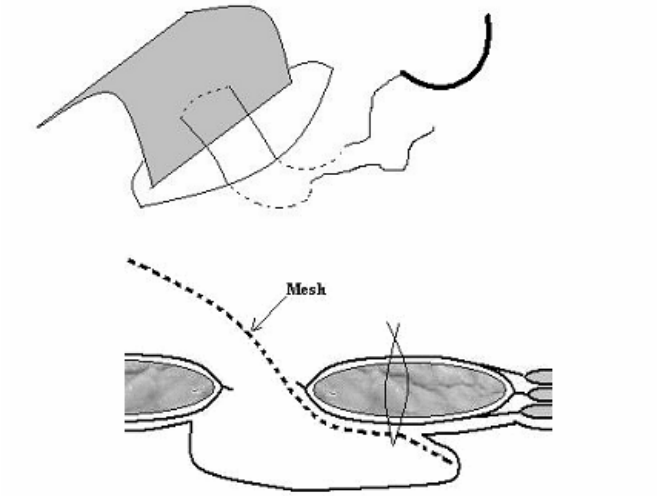

Fig. 2: A 1 to 1.5 cm tangential bite of mesh is taken about 2.5 cm from its margin and the needle is then passed back along a path retrograde to the first pass of the needle and about 1 to 1.5 cm from it. When the suture is drawn and tied, mesh is tucked into the retro-myofascial position.

itself along the wall of the sac or be curled up against itself, depending to some extent on how much slack exists in the inverted sac.

This procedure is continued until the entire piece of mesh has been tucked and sutured into position posterior to the defect and the myofascial layer (Fig. 3), care being exercised to take each bite of mesh from the point where the suture last passed through it (so that the gaps between suture points on the mesh are minimized). A continuous stitch is used but interrupted stitches are theoretically preferable as the integrity of the repair would then not depend entirely on the integrity of one continuous stitch. The body of the mesh should be relatively loose, allowing for shrinkage and the consequent tendency for increased tension to occur over time.

There will now be a section of myofascial tissue overhanging the mesh. This overhanging tissue is sutured with 00 or 0 polypropylene to the mesh with stitches which begin within the ellipse of the previous suture line and take a radial bite (rather than tangential) out of the mesh (Fig. 4). This

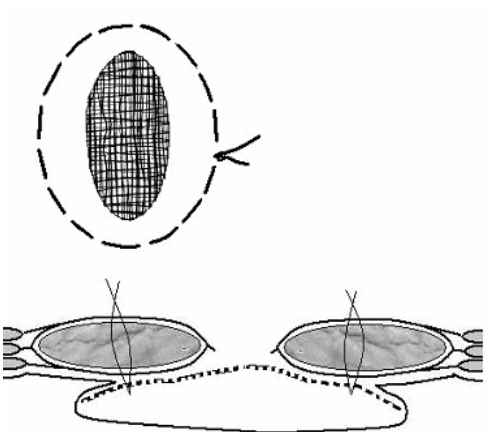

Fig. 3: Suturing in like fashion is continued until the entire piece of mesh has been tucked into position posterior to the defect and myofascial layer.

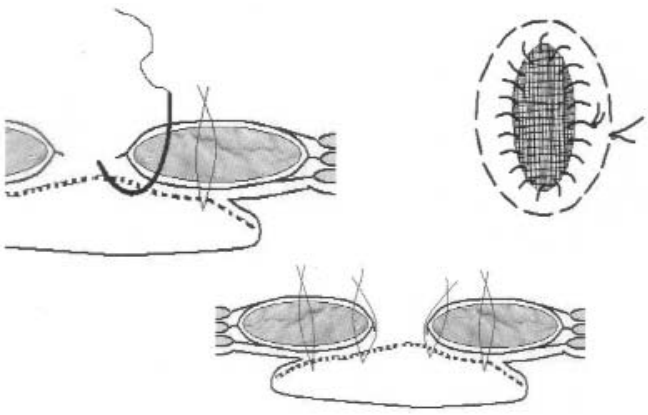

Fig. 4: The overhang is sutured to the mesh with continuous radial stitches, completing the repair.

layer of suture is also continuous. This second layer of stitches may be omitted with very small hernia defects (say 2.5 cm and less). Multiple defects in the *linea alba* may be connected and treated as one large defect or may be repaired individually, depending on how far they are from each other. The subcutaneous tissue and skin are then closed. A recent modification of the technique for closing the subcutaneous layer involves attaching it to the exposed mesh *en passant* in the hope of decreasing seroma volume. This modification, if it does indeed reduce seroma formation, should influence interpretation of any statistical association between seroma and Mersilene™ mesh which was only used in the early part of the study. No drain is placed in any case.

Cases are routinely followed for 3 to 6 months. For the purposes of this review, case notes were retrieved from three private and the two public hospitals serving the population from which the cases came and perused for evidence of recurrence. Follow-up time is the time from the date of surgery to the date the notes were reviewed.

Stata (version 8) was used for analysis. The primary analysis sought associations with recurrence using classical

bivariate techniques and logistic regression. Some secondary analyses were performed for associations between other variables.

RESULTS

The operation was performed by the author on 61 cases (60 patients) with mean age 46 years (range 26 to 75 years) and was initially restricted to incisional, recurrent incisional and large primary ventral hernias but was later (after 18 cases) used to repair all ventral hernias with a defect larger than 2 cm. Table 1 summarizes the main characteristics of the group.

Table 1: Characteristics of the 61 patients undergoing mesh tuck repair.

	Type of hernia		
	Primary	**Incisional**	**Recurrent Incisional**
Sex			
Male	10	3	0
Female	18	16	14
Body mass index*			
Normal	7	5	0
Obese/Overweight	18	5	4
Morbidly obese	3	9	10
Anaesthesia			
General	9	16	13
Local/Sedation	19	3	1
Site of hernia			
Epigastric	13	5	2
Umbilical	15	1	6
Subumbilical	0	13	5
Non-midline	0	0	1
Type of mesh			
Prolene	27	14	7
Mersilene	1	5	7
Recurrence	1	1	3

* Normal: BMI # 25; Obese/overweight: 25 < BMI < 40; Morbidly obese: BMI $ 40.

Fifteen patients had other significant disease including diabetes mellitus (6 females), hypertension (9 patients) and asthma (2 females). Of the 19 incisional hernias, 12 followed operations for obstetrical/gynaecological problems, two followed open cholecystectomy through midline incisions, two followed laparotomy for perforated duodenal ulcer and the operation preceding the remaining three was not recorded. Of the 14 recurrent incisional hernias, three had two previous failed repairs and the remaining 11 had 1 previous repair. Two of the 14 had prior repairs done with mesh – one is the only non-midline hernia (lumbar incisional) in the group, which had been repaired with an inlay technique and the other is one of the 5 failed mesh tuck repairs (did not recur after second mesh tuck repair). Mersilene™ mesh was used in the first 13 cases because that is what was available, and Prolene™ in all others. Seroma requiring aspiration occurred in 26.2% (16/61; CI 15.8%, 39.1%) of cases. Seromas recurred for one week (4 cases), two weeks (eight cases), three weeks (1 case), six weeks (1 case), 8 weeks (1 case) and 8 months (1 case).

Superficial wound infection occurred in 9.8% (6/61; CI 3.7%, 20.2%) of cases. All settled with antibiotic treatment alone and in none did the hernia recur. Only one was diabetic. Two patients in this group suffered mild chronic pain, felt to be caused by reduced abdominal wall compliance and not by infection. Deep wound infections occurred in 8.2% (5/61; CI 2.7%, 18.1%) of cases, requiring open drainage with exposure of mesh. All healed without mesh being removed and in none did the hernia recur. One of the two diabetics (also morbidly obese) with deep wound infection developed multiple sinuses (but no recurrence) eight years after repair with Mersilene™ mesh.

The crude recurrence rate is 8.2% (5/61; CI 2.7%, 18.1%) after a median follow-up time of 3.75 years (range 3 months to 13 years – first operation done August, 1992). All known recurrences occurred within the first year after surgery. If patients with less than one year follow-up were excluded, the recurrence rate would be 9.3% (5/54, CI 3.1%, 20.3%). Table 2 shows recurrence rates by type of hernia.

Table 2: Recurrence rates by type of hernia.

Type of Hernia	**Recurrence rate (number; 95% confidence interval)**
Primary ventral	3.6% (1/28; 0.1%–18.3%)
Incisional	5.3% (1/19; 0.1%–26%)
Incisional + recurrent incisional	12.1% (4/33; 3.4%–28.2%)
Recurrent incisional	21.4% (3/14; 4.7%–50.8%)

Recurrence rate is linearly related to type of hernia at the 10% level (p = 0.068, score test of trend for odds)

There is a significant linear relationship between recurrence rate and type of hernia at the 10% level (p = 0.068, score test of trend for odds), with 3 of the 5 recurrences occurring in recurrent incisional hernias. This is confirmed in the crude logistic regression model (p = 0.069, likelihood ratio test). All five recurrences occurred in females, with four being morbidly obese and one obese. The recurrence in the obese patient was the only one following repair of a primary (epigastric) hernia and features identified at the subsequent repair suggest a missed *linea alba* defect rather than a true recurrence. There is also a linear relationship between recurrence rate and body mass index, significant at the 5% level (p = 0.043, score test of trend for odds). This is also confirmed in the crude logistic regression model (p = 0.025, likelihood ratio test). There was no association between recurrence and age, other significant disease, seroma formation, superficial wound infection, deep wound infection, chronic pain, site of hernia and type of mesh, neither after bivariate analysis nor inclusion in the logistic regression model.

Given that caution is to be exercised in drawing firm conclusions from the analytical statistical output from this data (since the operation was selectively applied to the first 18 cases, type of mesh used was not randomly applied and the numbers of some variables are small), some additional observations are nevertheless noteworthy. Type of hernia was associated with site (excluding the only non-midline hernia, $p < 0.001$, Fisher's exact test) with all primary hernias being epigastric or umbilical and most (25/32) incisional and recurrent incisional being umbilical or subumbilical. Seroma was only associated with use of Mersilene™ mesh ($p = 0.009$; Wald test), and other significant disease ($p = 0.049$; Wald test) at the 5% level of significance after adjustment for other variables in a stepwise logistic regression model in which all variables which were not associated with the dependent variable at $p < 0.15$ are dropped. Superficial wound infection was only associated with site of hernia (all occurred in sub-umbilical hernias) and gender (all occurred in females) after stepwise logistic regression and deep wound infection was only associated with gender (all occurred in females). Note that no wound infection, neither superficial nor deep, occurred after repair of primary hernias.

DISCUSSION

This study reports the evolution of an operation for mesh repair of ventral hernias born out of frustration with the traditional approaches of Rives and Flament (retro-muscular) and Stoppa (pre-peritoneal), both of which require extensive dissection and placement of large sheets of mesh (1). As such, it does not reflect a consistently systematic application of the technique. Mersilene™ mesh was used in the first thirteen cases and Prolene™ in the remainder, a decision based on availability rather than choice. The first 18 cases were selected, consisting only of large primary and incisional or multiply recurrent hernias. The technique was only subsequently applied to all ventral hernias, including those with defects as small as 2 cm, as the author became convinced that even at these smaller sizes, simple suture repairs had a prohibitively high recurrence rate, an impression supported by others (6). Attachment of the subcutaneous layer to mesh in the hope of limiting seroma formation was only applied to the latter repairs. Statistical associations derived from this data, although consistent with the findings of others (2) and useful for hypothesis generation should therefore not be taken as scientifically robust.

The follow-up strategy is less than satisfactory (even prospective follow-up strategies for hernia repairs pose challenges) but there are reasons to believe that the recurrence rate identified is reasonably accurate. No random encounter with patients after review of the medical records revealed any previously unidentified recurrences and, conversely, all recurrences encountered after the review had been previously identified as such.

There are several advantages of the mesh tuck technique. Extensive dissection is not required, there is shorter operating time and decreased seroma volume. Local anaesthesia is adequate for most small hernia repairs and the size of the mesh required for a given hernia is smaller, thereby limiting the effect on abdominal wall compliance. Reduced abdominal wall compliance may cause chronic discomfort (4). The recent introduction of lightweight, composite meshes with thin filament size, large pore construction and absorbable components, such as Ultrapro ™, holds the promise of reduced effect on abdominal wall compliance from repairs with large sheets. The lateral border of the rectus muscle is avoided, thereby reducing the risk of direct entrapment of the lateral cutaneous nerves as they enter the rectus sheath, a phenomenon believed to contribute to chronic pain after traditional retro-myofascial mesh repairs in which mesh fixation is performed at or lateral to the lateral border of the rectus sheath (7). The overall recurrence rate of 9.3% (CI 3.1%, 20.3%) after 1 to 13 years follow-up is well within the range of 0% (8) to 24% (9) reported for the traditional pre-peritoneal and retro-muscular techniques. It is not unreasonable to assume that the crude recurrence rate would have been even lower if the technique had been applied to treatment of all ventral hernias from the start, rather than only after the first 18 cases, since recurrence was less common after repair of primary hernias (3.6%; CI 0.1%, 18.3%).

Disadvantages are theoretical and include an overlap between mesh and abdominal wall of less than the minimum 5cm recommended by Klinge for incisional hernia repair (10) as well as weak points at the apex and nadir of the repair where mesh is tucked under the *linea alba*. The success of the mesh tuck repair implies that the minimum overlap between mesh and abdominal wall is unknown. The second layer of stitches undoubtedly plays a significant part in maintaining the overlap achieved after tucking the mesh as well as contributing its own resistance to the lateral distracting component of the force from increased intra-abdominal pressure.

On the face of it, the technique described by Guzman-Valdivia, Medina and Martinez (11) seems similar to the mesh tuck technique described herein but the operations are fundamentally quite different. In their technique, the anchoring stitches for the mesh are deliberately passed through the posterior abdominal wall into the peritoneal cavity then through the sac and back. This intra-peritoneal course requires prior opening of the sac and dissection of any adherent bowel off the sac and adjacent peritoneum. The mesh tuck technique requires no such procedure as the stitches do not pass through the peritoneal cavity.

The ultimate test of any hernia operation is the recurrence rate. Other desirable features are ease of performance and minimal complications. The major problems with comparing recurrence rates are that ventral hernias are such a heterogeneous group and recurrence is impacted by such a large number of variables (2) that crude recurrence rates in published series are not comparable. In the words of

Korenkov *et al* (12), repairs "*…have been performed by different surgeons* on *different patients in different countries*". Attempts have been made to classify ventral hernias (12) and it is clear that future studies on ventral hernia repair should include some kind of classification which will allow investigators to compare outcomes fairly. All that can be reasonably said is that the mesh tuck operation achieves a crude recurrence rate within the range reported in the literature for the traditional techniques and that this implies that an overlap of 5 cm or more is not necessary for successful repair of most ventral hernias. Indeed, a consensus seems to be emerging that ventral hernia repair needs to be more individually oriented (12). There may well be a subset of large, multiply recurrent hernias for which the traditional techniques with large sheets of mesh and extensive overlap are superior, but the mesh tuck technique should be considered an acceptable first option for open repair of primary, incisional and recurrent incisional ventral hernias of usual size and is certainly deserving of a prospective, randomized, controlled comparison to the traditional retro-myofascial mesh repairs. It may be possible, from such a trial, to work out a threshold index beyond which the overlap should be more extensive than that achieved by the mesh tuck repair.

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