

*Original articles***Composite mesh (polypropylene - e-PTFE) in the intraperitoneal position.  
A report of 30 cases**

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**Summary:** The treatment of incisional hernias, on occasions, imposes the use of an intraperitoneal prosthesis. Though none of the available biomaterials is entirely satisfactory, the choice often reflects a compromise. Polypropylene and polyester have been associated with bowel obstruction, fistulization and transmigration through a viscus. These problems are almost unknown with e-PTFE. All three however can cause adhesions. On the other hand, the solidity of a repair is a function of the penetration of a prosthesis by fibroblasts and collagen. Polyester and polypropylene manifest such a penetration. e-PTFE less so. The combination of e-PTFE internally and polypropylene externally seems to provide a reasonable composite which has been used in 30 cases in the last six years. During that period no patient presented with an intestinal occlusion or fistula.

**Key words:** Incisional hernia — Composite mesh — Prosthesis

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The introduction of prosthetic materials in hernia surgery has been a mixed blessing. When necessary these materials should be used, mindful however of their complications. These are best illustrated when the peritoneum cannot be reconstituted during an incisional herniorrhaphy thus allowing contact between a viscus and the prosthesis.

The surgical literature has been reporting, albeit sporadically, clinical instances of bowel obstructions secondary to visceral adhesions to prostheses, fistula formation (small, large bowel), transmigration of prosthetic material (esophagus, duodenum, small bowel, large bowel, bladder) [Adloff 1987, Bour-

geon 1972, Cotton 1985, Dufilho 1981, Fitzgibbons 1995, Francioni 1994, Kaufman 1981, Schneider 1979, Slim 1989, Thompson 1984]. In particular, Dufilho in his doctoral thesis (1981) identified 16 cases of intraperitoneal Dacron mesh insertions which resulted in four enterocutaneous fistulas. Of these four cases, three were small intestinal fistulas occurring 8, 9 and 18 months following surgery. The fourth case revealed to be a colic fistula four years after the Dacron insertion. Two of the patients died [Dufilho 1981].

Since the introduction of Polyethylene and Polypropylene by Usher in 1958 [Usher 1958, Usher 1962], the problem of

adhesion and erosion secondary to biomaterials has been examined in the experimental animal as well as the human subject, leading Stoppa (1985) to believe that all prosthetic materials, resorbable and non-resorbable, should be kept out of the peritoneal cavity. Yet, Ellis who has published a great deal on wound healing [Ellis 1962, George and Ellis 1986] leaves no doubt that primary incisional hernia repairs can result in recurrences up to 44% of the time depending on such factors as age, obesity and infection. Those results are mirrored by Stoppa (1995).

The results of prosthetic incisional hernia repairs have, however, dramati-

**Table 1.** Incisional hernias (1991-1996)

	Cases	%
Repaired without prosthesis	85	36.2
Repaired with prosthesis (extra-peritoneal)	120	51
Repaired with prosthesis (intra-peritoneal)	30	12.8
	235	100

cally improved the outcome compared to primary repairs [Bendavid 1989, Wantz 1991]. Ideally, all prosthetic material should be placed in the pre-peritoneal space or the pre-fascial retromuscular plane, hence avoiding juxtaposition with viscera. In certain cases, unfortunately, reperitonealization is not possible and the fascial defect too large to carry out an extraperitoneal repair. Intraperitoneal prosthetic implants are then resorted to with much reticence

### Material and methods

From 1991 to 1996, a personal series of 235 incisional hernia repairs, carried out at the Shouldice Hospital, presented 30 instances where an intraperitoneal prosthesis was dictated by circumstances at the time of surgery (Tables 1 and 2). Sizes of the defects varied widely depending on the original surgery and measured between 10-25 cm longitudinally, and 5-15 cm transversally. There were 30 patients in this series, 23 males and 7 females. Primary incisional hernias were identified in 20 cases (14 males, 6 females) and 10 recurrent incisional hernias (9 males, 1 female) (Table 3). Ages were 32 to 72 for males and 37 to 74 in females. The sites of herniation and the nature of the original operations are seen in Table 2. The composite prosthesis used consists of a sheet of e-PTFE internally and a sheet of Polypropylene externally. The latter is 1 cm shorter (on all sides) than the e-PTFE to avoid any contact between viscus and polypropylene. These two sheets are kept together by a prolene suture at each corner to

**Table 2.** Nature of incision and surgery

Type of incision	Surgical procedure	
Right subcostal	Cholecystectomy	5
Xyphoid-umbilicus (midline)	Cholecystectomy	12
Xyphoid-pubis (midline)	Aortic aneurysm	2
	Diverticulitis	3
McBurney Inc.	Appendix	2
Umbilicus-pubis (midline)	Ca of colon	2
Left low paramedian	Diverticulitis	1
Transverse (infra-umbilical)	Ca of colon	1
Midline	Umb-Epig hernia	2
		30

facilitate handling of the double sheet during insertion. Dissection of the fascial defect about the herniation is carried out with every attempt to preserve peritoneum wherever possible. On occasions, when peritoneum is available, the retraction of the fascial edges overlying the peritoneum is such that closure of the peritoneum itself cannot be carried out. In these cases, the composite Polypropylene - e-PTFE prosthesis is utilized. It is anchored with interrupted Prolene sutures at least 5 cm away from the fascial edges, under direct vision. With the prosthesis in place, a continuous suture is then inserted, circumferentially, approximating a 1 cm width of fascial edge to the Polypropylene mesh only. This mesh can be easily lifted and separated from the underlying e-PTFE layer, thus excluding blind sutures. Wherever feasible, the greater omentum is anchored in such a manner as to separate bowel from the overlying e-PTFE. The reasons behind this composite mesh being: e-PTFE for the lesser incidence of adhesions and transmigrations, while Polypropylene would eliminate the need for blind sutures and provide a framework for an extensive fibroblastic and collagenous infiltration.

### Results

One male patient had a wound infection 7 months after surgery. Conservative treatment, though aggressive (antibiotics, exposure of the mesh, irrigation) was of no avail. The prosthesis was eventually removed. An infection rate of 3.3%.

Two patients had a recurrence 23 and 24 months after surgery. These recurrences were small, less than 2 cm in diameter and will be dealt with subsequently under local anaesthesia. A recurrence rate of 6.6%. The follow-up time ranged from 1 month to 36 months for 16 patients, a follow-up rate of 53.3%. Excluding one patient whose follow up period was only one month, the average follow up was 19.1 months. The incidence of recurrence compares favorably with the results reported by Adloff and Arnaud using Mersilene mesh (4.5%) [Adloff 1987] and Bauer et al. (10.7%) [Bauer 1987].

There were no episodes of bowel obstruction or reoperation to date.

### Discussion

Although the follow-up rate seems low (53.3%), the lack of interest on the part of the patient to be followed-up does not imply dissatisfaction. On the contrary. Given the nature and extent of the surgery, should difficulties develop, either the patient or subsequent surgeon surely would like to know what was done previously. This assurance is derived from a previous study on femoral hernias [Bendavid 1989] when a tenacious follow-up increased the identification of followed-up patients from 63 to 84.7% without adding a single recurrence to the statistics!

The justification for combining e-PTFE (Gore-Tex) and Polypropylene (Marlex, Prolene, Trelex) was borne out of technical observations in the operating room at first. Three patients who

Table 3. Intra-peritoneal mesh insertions (30 cases)

	Males	Females
Primary incisional hernias	14	6
Recurrent incisional hernias	9	1

presented with a recurrence of their previous incisional hernia repair revealed that serosa of small bowel had been incorporated to the Gore-Tex patch. This is not surprising considering that the patch is, macroscopically at least, homogeneous and allows no visibility beyond it. Adhesions between bowel and Gore-Tex patches have commonly been observed and were always fairly easy to separate or lyse, in some instances, up to three years following the original surgery. Another observation is the fact that Gore-Tex patches, once penetrated by a needle, present a small aperture which enlarges with the sawing effect of the suture, thus resulting in "mini-hernias". This "button-hole" complication has already been reported by Monaghan (1991) and Van der Lei (1989).

Polypropylene on the other hand presented a problem of a different nature, as observed on three patients in the operating room. In two instances small bowel, and one instance large bowel, the viscus was so adherent to the mesh that it was impossible to separate safely. The lattice work of the mesh was in fact penetrating the visceral serosa and thus beginning the complication which has been referred to as transmigrating.

Correction of this situation invariably presents a dilemma, that of resecting bowel when mesh must be resorted to for the repair or allowing the transmigrating mesh, freed from the parietes to remain on the bowel wall and eventually extruded (?) into the lumen. Several authors have reported similar situations [Cotton 1985, Francioni 1994, Kaufman 1981, Schneider 1979, Thompson 1984].

While it is true that the ideal prosthesis for intraperitoneal use does not

exist, the published data on available prosthetic materials are difficult to sort out because of individual bias. Manufacturers also seem less than forthright in the promotion of their product. A good example is that while Gore-Tex promotes its patch for hernia repair, the insert which accompanies the product underlines the fact that Gore-Tex is not recommended for peritoneal replacement!

Will it ever be possible to eliminate adhesions following laparotomies? This is not likely since adhesions are consequent upon a fibrin exudate which follows trauma. The fibrin clots form temporary adhesions which last until the fibrinolytic system through a plasminogen activator absorbs the fibrin. This absorption is delayed by infection, ischemia and foreign bodies. This delay allows the fibrin clots to be invaded by fibroblasts, macrophages and new blood vessels thus allowing a maturation of a fibrin clot into tissular adhesions [Amid 1992, 1994, 1995, Bauer 1987, Breland 1989, Brown 1985, Ellis 1962, 1971, Goldberg 1987, Jenkins 1983, Law 1988, Murphy 1989, Raftery 1979].

The prevention of adhesion formation has elicited a great deal of research and though this interesting topic is beyond the scope of this report, good reviews have been offered by Fitzgibbons [Annibali and Fitzgibbons 1994] and Becker (1996). The comparison between e-PTFE and Polypropylene in terms of their ability to elicit adhesion formation has been studied by several groups. Their reports, not surprisingly, give rise to three sets of conclusion: i) e-PTFE provokes the formation of more adhesions than Polypropylene [Goldberg 1987] ii) e-PTFE and Polypropylene elicit the same rate of adhesion formation [Jenkins 1983]. iii) e-PTFE provokes the formation of adhesions far less often than Polypropylene [Bauer 1987, Brown 1985, Murphy 1989, Toy 1994].

Penetration of e-PTFE by fibroblasts and Collagen fibers represents another issue with widely divergent opinions

and observations. Whereas Amid (1995) as well as Law and Ellis (1988) report a 10% penetration of e-PTFE by fibroblasts, Bauer (1987) and Lamb (1983) report complete penetration!

While controversies continue to revolve around which prosthetic material is best suited for intra-peritoneal use, we the surgeons must make the immediate decisions at the time of surgery. From a personal experience, the following factors have led me to use e-PTFE in the intra-peritoneal position, in spite of its illogical cost: a) the filmy nature of the adhesions, b) the easy peeling of viscera from the prosthesis, c) the lack of a weave and lattice in the patch through which a viscus would otherwise transmigrate. The addition of Polypropylene mesh externally is justified by the well established fact that this prosthesis is thoroughly "inhabited" by scar tissue and incorporated within the abdominal wall. To date, the absence of fistulizations, occlusive intestinal episodes and reoperations have proven to be reward enough.

### Conclusion

The choice of prosthetic material for use in the peritoneal cavity presents a dilemma. The three prevalent materials are e-PTFE (Gore-Tex), Polypropylene (Marlex, Prolene, Trelex) and Polyester (Dacron, Mersilene). Each of these presents advantages and drawbacks and while the surgical literature has not satisfactorily settled the issues and controversies surrounding their behavior in the peritoneal cavity, one must lean on one's experience clinically and in the operating room. e-PTFE has provided a relative adhesion free surface for viscera internally, while Polypropylene has provided solidity externally and safety in suturing. This composite mesh, used in 30 cases in the last six years, has not been marred by fistulization or bowel obstruction.

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