



Components Separation Technique Associated to a “Sandwich” Procedure in the Treatment of Large and Complex Incisional Hernias and Abdominal Wall Defects. A 30-Case Series

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Abstract

Aim: Reconstruction of large, complex abdominal wall hernias is an interesting challenge. Primary closure of those hernias is often not possible. There is little agreement about the most appropriate technique or prosthetic to repair these defects, in spite the fact of the prevalence of ventral hernias.

Sometimes despite being contaminated surgical fields, we are often faced to reinforce with bio-prosthetic meshes.

The components separation technique (CST) is a practical option; however, recurrence rates remain unacceptably high. In an attempt to reduce recurrences, we frequently added a biologic underlay mesh and a lightweight polypropylene only mesh to the traditional components separation technique.

Our objective was to determine biologic mesh practice patterns of reconstructive surgeons with regard to indications, most appropriate technique, election of prosthetics, and experience with complications in order to work those large and complex hernias out.

Methods: 30 consecutive patients who underwent abdominal wall reconstruction by means of components separations associated with non cross-linked porcine dermal scaffolds (NCPDS) or synthetic tissue scaffolds (STS) reinforcement between October 2009 and December 2011 were retrospectively reviewed. Analysis of demographics, indications for NCPDS or STS placement, surgical technique, complications, and follow-up data was performed.

They underwent a “sandwich” procedure with a biologic underlay mesh and a lightweight polypropylene only mesh added to the traditional components separation technique, we chose NCPDS or STC underlay mesh according to the fact of the presence or absence of a contaminated field.

Results: A “sandwich” procedure was used for abdominal wall repair in 30 patients. In all of them, NCPDS or STC was positioned using an intraperitoneal technique associated to a lightweight polypropylene only mesh and the components separation technique. At a mean follow-up time of 30.1 months, most patients had successful outcomes.

Complications included seroma, recurrence, and infection. One of our patients died from multi-organ failure unrelated to hernia repair.

Conclusion: This study shows that complex abdominal wall defects can be successfully reconstructed using a “sandwich” procedure with a low rate of recurrence and complications. Moreover, repair of large, complex abdominal wall hernias by CST augmented with a biologic underlay mesh and a lightweight polypropylene only mesh results in lower recurrence rates compared to historical reports of CST alone.

Keywords: Contaminated hernia repair; Sublay mesh; Biologic mesh; Biologic scaffolds; Non-cross-linked porcine dermis; Components separation technique; “Sandwich” procedure

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Introduction

Abdominal wall defects caused by trauma, tumor resection, and incisional hernias are a commonly encountered and challenging problem for surgeons. Incisional hernias occur in 1% to 11% of patients after midline laparotomy, and their repair is the most common major surgical procedure performed by general surgeons [1]. Operative repair of abdominal wall defects can be complicated by their size and the presence of contamination (Figure 1).

Despite the high prevalence of this problem, there is little agreement as to the most appropriate technique or prosthetic to repair these defects. Reconstruction of large, complex abdominal wall hernias is an interesting challenge for the practicing surgeon. Furthermore, operative repair of abdominal wall defects can be complicated by their size and the presence of contamination.

Unlikely any single technique or mesh will adequately address all patients with incisional hernias because of the broad spectrum of diseases associated with ventral hernias makes it. Additionally, the absence of a clear classification system to standardize all reports makes comparative analysis of publications limited. Several groups have attempted to classify incisional hernias based on different factors and or standards [1,2].

Some years ago, in 2010, were made recommendations as to the most appropriate prosthetic selection (synthetic versus biologic) based on the presence of underlying patient comorbidities and perioperative wound contamination (Figure 2). However, this was only based on expert opinion and was not validated with outcomes data. This group recommended synthetic mesh for otherwise healthy individuals and biologic grafts for those patients with active contamination during abdominal wall reconstruction. There was little consensus as to the ideal prosthetic for high-risk patients (diabetics, obese, COPD, and smokers) without the presence of contamination.

Unfortunately, primary closure of such hernias is often not possible due to the extensive size of the fascial defect encountered, bigger than conventional meshes, and even when possible, the repair often fails due to excessive tension at the suture line. These obstacles



Figure 2: Contaminated surgical fields, including contaminated meshes in association with enterocutaneous fistulas, we had to deal with.

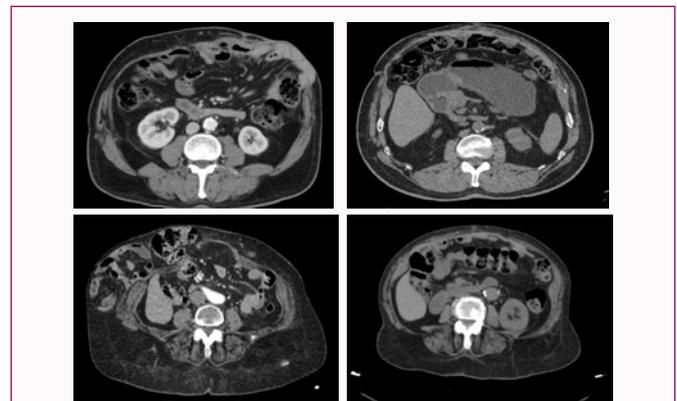


Figure 3: Pre-operative CT scans.

often leave patients with few options as they are commonly refused surgical treatment.

This subset of patients represents a large percentage of incisional hernia patients, as these comorbidities are inherent risk factors to the formation of hernias [3]. The introduction of biologic mesh to the repertoire of the reconstructive surgeon has enabled one-stage repairs of contaminated and infected abdominal wall hernias [4].

The actual utilization of these materials in non-contaminated abdominal wall hernia repair remains unknown. The lack of clear guidelines as to the most appropriate usage of these expensive products has resulted in inconsistent practice patterns among reconstructive surgeons. We hypothesized that practice patterns of reconstructive surgeons with regard to indications, most appropriate technique, choice of prosthetic, and experience with complications vary significantly. We have though up we could combine the CST with the use of prosthetic biomaterials (NCPDS or STS) would allow for a dynamic abdominal wall closure in most of cases as well as keeping the hernia recurrence acceptably low. A biologic underlay has been used to allow for the incorporation of the product into the patient's own collagen to create a neofascia and avoid the complications observed with the permanent prosthetic meshes. Closure of the midline, if possible, adds to the repair while the only mesh reinforces the entire abdominal wall that has been rebuilt.

Material and Methods

From October 2009 until December 2013, 30 consecutive complex abdominal wall defects were repaired by CST using a biologic mesh



Figure 1: Some incisional hernias we included in this series.



Figure 4: Those pictures show how host cells infiltrate NCPDS and so, within a few months, it becomes an integral part of the body.

underlay (Gore BioA Tissue Reinforcement[®]; Gore, Flagstaff, AZ or Permacol[®] Covidien, 15 Hampshire Street, Mansfield, MA) in conjunction with a lightweight polypropylene (Optilene[®] Mesh Elastic, B. Braun, Melsungen, AG, Carl-Braun-Straße 1 Melsungen, Germany) only mesh [5]. Briefly, all patients underwent preoperative imaging including computed tomography of the abdomen and pelvis with no oral contrast (Figure 3). 27 cases in our series suffered from complex incisional hernias; the three others from desmoid tumors.

The construction of porcine dermal collagen is very similar to that of human tissue and because Permacol[®] in sheet form is not a reconstructed form of collagen, its 3-D matrix is maintained. A precisely controlled degree of cross-linking is introduced into the structure, making it resistant to collagenase enzymes responsible for the breakdown and reabsorption of implanted collagen [5]. This unique feature enables surgeons to complete operations and procedures involving tissue reconstruction, re-contouring and repair, with permanent results.

As the finished biomaterial is rendered acellular, it contains no material capable of provoking an immunogenic reaction which is a very important feature in a product designed for implantation into human tissue. Permacol[®] surgical implant is able to support host cell infiltration and revascularisation and within a few months becomes an integral part of the body (Figure 4).

Permacol differs from cheaper synthetic meshes in that it can be used in instances where they cannot be used for example against the bowel. Should infection occur it can be treated while Permacol[®] is in place and need not be removed as would other implants or mesh.

Permacol[®] permanent surgical implant is presented in the form of a flat, off white sheet of acellular porcine collagen. Tough but flexible its constituent elastin fibres are presented moist in sterile saline. Sizes we employed were Gore[®] Bio-A[®] Tissue Reinforcement is a uniquely designed web of biocompatible synthetic polymers that is gradually absorbed by the body, while its 3D matrix of open highly interconnected pores facilitates tissue generation and healing. As a synthetic tissue scaffold, it is not derived from human or animal tissue but engineered for uniformity, consistency and versatility. Clinical evidence demonstrates that the scaffold is replaced with type I collagen.

Optilene[®] Mesh Elastic is a light-weight large pore monofilament polypropylene mesh. Due to the exact elasticity of the abdominal wall it is able to adapt to all movements taking place. The new honeycomb

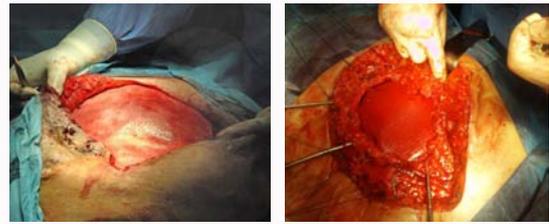


Figure 5: Abdominal wall defects after having been closed with Permacol and Bio-A grafts.

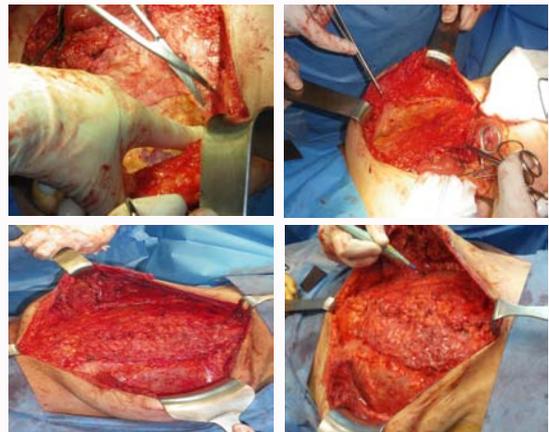


Figure 6: Component separation technique, step by step.

like structure, with one of the largest pores available on the market, permits an ideal healing and the formation of an elastic scar. Optilene[®] Mesh Elastic is ideal for incisional hernia repair. Optilene[®] Mesh Elastic helps to maintain an excellent abdominal wall physiology resulting in a greater convenience and comfort for the patient.

We chose Permacol[®] to be used in contaminated fields and Bio-A[®] if we had to deal with a clean one.

Nasogastric tubes were not routinely employed, only if necessary. Urinary catheters were inserted to drain the bladder, monitor urine output and, if warranted, to measure bladder pressures. The placement and length of the skin incision was determined by prior incisions. So they were specific for each hernia in order to allow an adequate exposure of the fascial defect.

Our patients had undergone from 1 to 11 surgical procedures in order to get their incisional hernias repaired, with an average of 4, 5.

After having made the skin incision, the abdominal cavity was explored, adhesiolysis was performed and the size of the fascial defect was measured. Done that, we started the components separation procedure by elevation of skin and subcutaneous fat off the rectus fascia and external oblique muscle and fascia. Division of the external oblique aponeurosis was performed one cm lateral to the lateral border of the rectus sheath along the defect to be repaired.

The underlay reinforcement (Permacol[®] or Bio-A[®]) sheet were fixed, after having been cut out, using a transparietal technique (Figure 5). Due to the complexity and large extent of their abdominal wall defects, and according to the presence or absence of bacterial contamination, combination of intraperitoneal Permacol[®] (14 patients) insertion and “components separation” technique (Figure 6) while Bio-A[®] was used in 16 cases (53, 33).

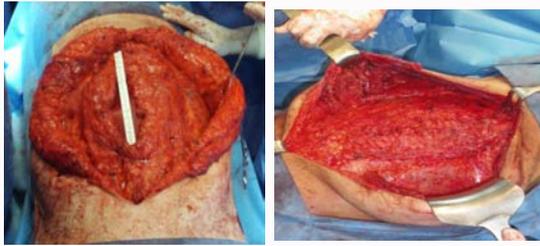


Figure 7: Partial and full closure of the defect; this one was not always achieved.



Figure 8: An achieved “sandwich” procedure with a full closure of the abdominal wall; a biologic underlay mesh and a lightweight polypropylene only mesh are added to the traditional components separation technique.

Full closure of the defect was achieved in 11 (36, 66%) of these cases (Figure 7). In the other 19 cases (63, 33%) combining intraperitoneal mesh with separation of components, medial approximation of the recti muscles was not possible due to the large extent of the initial defect. Permacol® and Bio-A® were sutured under moderate tension in order to distribute the stress of closure evenly between this fixation, and final recti muscle fascial closure when possible. Sizes of Permacol® mesh used in this series varied widely between patients; the most usual were 30 x 20 and 40 x 20 cm, and Bio-A® prostheses were 20 x 30 and 20 x 20cm. However, both, Permacol® and Bio-A® used meshes were always larger than the resulting defect after having performed a CST, so that we could provide a minimum of 3-5 cm overlap with the posterior fascia (Figure 8).

In case the midline fascia could not be re-approximated, we usually closed the redundant hernia sac over the biologic mesh to provide vascularized tissue coverage for mesh in growth. The next step, a large-pore, lightweight polypropylene mesh (Optilene® Mesh Elastic) was fixed to the abdominal fascia in an only position. The most frequent size we used was 30 x 30 cm.

The skin and subcutaneous tissue were then closed over two closed suction drains. At the time of skin closure, generous resection of excessive skin and subcutaneous tissue was performed, leaving only the amount necessary for closure.

Results

Most of patients in our series had successful outcomes at a mean follow-up time of 30.1 months (range, 13–42 months). One patient developed an abdominal compartment syndrome following hernia repair and was returned to the operating room some days later following his hernia repair for decompression. This patient had

significant comorbidities (ASA score of 4), had undergone multiple laparotomies and suffered from a severe chronic respiratory disease. Despite having been thoroughly informed and cautioned regarding his high risk of serious postoperative complications due to significant associated medical comorbidities, he requested to proceed due to the severity of his obstructive symptoms associated with the hernia.

The polypropylene mesh was removed, and the intraperitoneal Permacol® mesh was liberated from its fixations on the patient’s right side and left in place to relieve the intraabdominal pressure. The defect was then patched with Dual Mesh® Plus (W.L. Gore & Associates, Flagstaff, AZ) to allow for normal intra-abdominal pressure. The patient was subsequently returned to the operating room multiple times. Unfortunately, in the end, he passed away.

Thirty patients (17 males and 13 females) underwent a mesh-reinforced CST from October 2009 until December 2011, the average follow-up of 236 ± 2.3 months. The average age of the study population was 59.9 ± 1.8 years, with an average BMI of 37, 96 (23, 12–53) kg/m² and ASA score of 2.92 ± 0.17 . Thirty-nine percent were smokers, 32% were diabetic, and 87% had at least one previous abdominal wall hernia repair.

Operative time for the described CST averaged 176.5, the average blood loss 258 ml and hernia defect size of 21 x 17 cm. Patients were discharged from the hospital on average 9 days following a mesh-reinforced CST.

Surgical site occurrences were identified in 10 patients (33%) most commonly from skin necrosis. Five of these patients were treated with negative pressure dressings for local wound care, and the two other surgical sites improved with antibiotics alone. Seven patients (14%) required re-operation and partial polypropylene mesh excision. This excision involved only the portion of mesh that was grossly infected and unincorporated into surrounding tissues. Two other patients were treated outside our hospital with a Streptokinase cream; it resulted in a local destruction of the Permacol® sheet following new recurrences, so using those creams was strictly forbidden in case of patients after having been placed a biologic mesh.

Wounds were then treated with a negative pressure dressing until resolution of the infection. None of the patients who experienced a surgical site occurrence were found to have a fascial defect during wound exploration, unless those above mentioned patients, other patient suffered from a recurrence, having been re-operated satisfactorily.

Moreover, no bowel complications or leaks were encountered as a consequence of having placed the intraperitoneal biologic mesh.

Seroma formation was the most common postoperative complication, affecting eight of the 30 patients (26, 66%). Average time from surgery to seroma formation was 29 days.

Twelve patients (40%) underwent NCPDS placement to repair a giant ventral hernia complicated with enterocutaneous fistulas. They were taken down at the time of mesh implantation.

The 3 patients with post-ostomal hernias experienced postoperative courses without complications according to the fact we reinforced the whole area by means of a big underlay prostheses.

We have not found association between surgical technique (underlay mesh, the only one, etc) and type of complication.

Discussion

Incisional hernias usually recur because the tensile strength of the healed fascial scar is lower than that of normal fascia.

Repair of these complex hernias has been managed with the insertion of mesh either via an open or laparoscopic technique. The incidence of incisional hernia after abdominal surgery ranges from 9 to 20%, which may also result in large, complex hernias with loss of domain [6]. However, patients with massive hernias that are larger than 12 cm in transverse dimension are difficult to approach either laparoscopically or via an open laparotomy [7].

Our findings suggest that Permacol® or Bio-A® sheets are effective in the reconstruction of complex abdominal wall defects, resulting in satisfactory outcomes at an average follow-up time of 30.1 months and yielding a low rate of surgical complications. Despite the short follow-up time, recurrence rates lower than those reported with mesh repair have been achieved [8].

Furthermore, there was no incidence of small bowel obstruction in this patient population. The most commonly encountered complication was seroma, a benign problem. Our rate of 40% seroma formation is higher than other series we found on medical [9]. The rate of seroma formation in patients with clean wounds, although slightly higher at 25%, is still comparable to the overall percentage.

Reinforcement of tense midline repair with intraperitoneal prostheses has significantly reduced the incidence of this type of hernias in our experience. It is likely that our low recurrence rates are due to the combination of both material and surgical technique. An added benefit of using an intraperitoneal biologic mesh is its ability to resist infection [10,11]. The abdominal cavity can be left open for extended periods of time during the extensive lysis of adhesions that are often required during a CST, thus increasing the risk of wound infection. The surgical undermining that also occurs to release the external oblique adds to the risk of wound infection as well. For these reasons, wound occurrences are frequent and would therefore place a permanent prosthetic mesh at high risk of infection and subsequent need for removal. Removing the permanent underlay mesh would require an extended operation likely requiring the removal of the only mesh as well, resulting in hernia recurrence. The placement of an intraperitoneal biologic mesh obviates the need for future removal, in nearly all cases, and allows for successful treatment of a large majority of wound infections with negative pressure dressings alone, as was the case in our series. In patients with clean wounds, the rate of recurrence is also lower than that of our entire sample population (6, 66 vs. 12, 5%). Although long-term outcomes for primary hernia repair with biologic materials are under investigation, there is strong data supporting its use in infected and contaminated fields [12,13]. For this reason, we initially restricted the use of biologic meshes to patients presenting with difficult, contaminated wounds. However, the evidence-based recommendations of the Ventral Hernia Working Group highlight the growing role of biologic mesh in the reconstruction of a wide variety of abdominal wall defects [14]. As a result of the low incidence of complications observed, we then proceeded to use Bio-A mesh in non-contaminated yet complex abdominal defects, where there was often insufficient omentum, thus precluding use of prosthetic mesh. It is well known that the cost of biologic materials such as NCPDS is higher than synthetic mesh products [15].

We feel that prosthetic mesh plays a significant role in hernia

repair and should be used whenever deemed safe. However, when compared to the foreign body implantation mechanism of synthetic mesh, implanted Permacol or Bio-A did not result in complications like bowel perforation in our series, and may be better suited than mesh whenever an intraperitoneal repair is necessary.

Byrnes explained that a faithful cost-effective analysis of biologic mesh repair is very complex due to the afore-mentioned price variability between institutions [16]. Nonetheless, we believe that this clear reduction in recurrence rates and postoperative complications justifies the use of the more expensive in non-contaminated complex ventral hernias whenever intraperitoneal repair is indicated. The individual rates of seroma (25%), recurrence (10%), and infection (3, 3%) in patients with clean wounds are similar to the rates of these same complications in our entire patient sample. Statistical analysis (Fisher test) determined that no association exists between wound class and type of complication. The trend of complications is however indicating that a larger series may confirm a higher rate of complications in clean cases [17].

In this study, we have reported our increased experience using Permacol® or Bio-A® mesh to rebuild abdominal wall defects in a large patient population over longer follow-up times. We have been able to reproduce the desirable outcomes and minimal complications reported in our initial study. Our work continues to be limited by its single-institution, retrospective nature and its lack of controls. Furthermore, we are a tertiary care hospital dealing with large defects that represent abdominal wall reconstruction rather than routine hernia repairs that are performed by our general surgery colleagues. A prospective, multi-center, randomized trial on abdominal wall reconstruction using Permacol® or Bio-A® should be carried out to compare various products and their efficiency. Despite having been good outcomes, according to the latest articles [17] published on medical literature, we changed our minds about the best way of those patients suffering from enterocutaneous fistulas or infected meshes. So we gave up placing them a second (only) large-pore, lightweight polypropylene mesh (Optilene® Mesh Elastic) in association with an underlay reinforcement (Permacol®) in order to place the lesser amount of foreign bodies on those contaminated fields. In addition it is an evidence of our full confidence in its abilities, such as strength and resistance so that they can reinforce or substitute abdominal wall efficiently. Those new strategies will be the matter of our next work about complex incisional hernias, we hope. To sum up, despite the fact that these materials might be useful in certain conditions, the evidence from latest studies is low. Moreover, although the use of synthetic meshes has really decreased the recurrence rate after the treatment of hernias of the abdominal wall, we know that their use in a contaminated surgical field or in certain locations can lead to specific complications such as mesh infection or erosion. To get over these problems, a completely new generation of so-called remodeling biological scaffolds from human or animal origin or even new synthetic constructs have been promoted in recent years. This study shows that complex abdominal wall defects can be successfully reconstructed using a “sandwich” procedure with a low rate of recurrence and complications. Moreover, repair of large, complex abdominal wall hernias by CST augmented with a biologic underlay mesh and a lightweight polypropylene only mesh results in lower recurrence rates compared to historical reports of CST alone. Although our analysis shows that there was no association between indication for reconstruction and type of complications, a larger patient population studied in a multi-center trial may identify statistically significant

association between indications and complications.

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