

On-lay versus sub-lay placement of proline mesh in patients with mutilated abdomen through abdominoplasty approach

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Abstract

Introduction: Abdominoplasty in patients with mutilated abdomen is still a challenging procedure. These patients need anterior wall reconstruction with prosthetic mesh placed either superficial to the primary repair (on-lay), or deep to the musculo-aponeurotic layer (sub-lay). Both techniques have their advantages and disadvantages.

Objective: To compare the on-lay and sub-lay prosthetic mesh application to propose the best technique as standard in cases of mutilated abdomen abdominoplasty.

Patients and methods: 140 patients were subjected to this clinical controlled randomized study conducted in Plastic Surgery Unit in Suez Canal University Hospital, Ismailia, Egypt from March 2003 to March 2011. Each group was formed of 70 patients.

Results: Seroma, hematoma, wound complications, mesh removal, days before drain removal, days of post-operative pain, hospital stay, and time before return to work were significantly higher in the on-lay group than in sub-lay group. In addition, the higher rates of DVT, chest complications and hernia recurrence observed in the on-lay group were not statistically significant. Similarly longer operative time in sub-lay group was without statistical significance.

Conclusion: Sub-lay mesh herniorrhaphy with concomitant abdominoplasty offers significant better functional and cosmetic results. Significant reduction of post operative complications in sublay technique than in the onlay technique was proved.

Introduction:

Abdominoplasty has become a popular procedure since its first description in 1899 by Kelly. It is indicated for abdominal wall laxity, excess skin, striae, and diastases of the rectus muscles.¹⁻⁵

Before 1960, most of abdominal defects were repaired by tissue approximation, which was accompanied by a recurrence rate ranging from 30% to 40%. This was noticed in particular with large defects causing the fascia to be under additional tension after closure. The use of a prosthetic mesh for ventral hernia repair started in the early 1960s, when Usher described the usefulness of a knitted polypropylene mesh for repair of complex inguinal and anterior abdominal wall hernias. Although prosthetic mesh improved the

recurrence rate (5% to 20%), yet it was associated with a higher risk of seroma, hematoma, and tissue necrosis from extensive dissection.⁶⁻⁹

Polypropylene mesh can be used as a “bridge” or “inlay” attached to the margins of the aponeurotic defect, or as “onlay” reinforcement over a primary repair. The placement of prosthetic material in a pocket beneath the rectus muscles and outside the peritoneum was devised in Europe by J. Rives and Rene Stoppa in the 1970.^{10,11}

The abdominoplasty approach to recurrent hernias is extremely helpful. It provides the best exposure obtainable. It allows access to all components of the abdominal wall permitting a number of techniques for hernia repair. Other hernias, which otherwise may

not have been detected, can be found. Finally, it may help to reduce the incidence of recurrence by enabling removal of a large pannus and the resultant weight on the anterior abdominal wall.¹²

The onlay technique requires less dissection because the prosthesis is placed anterior to the abdominal wall fascia; however, in theory the intra abdominal pressure is transferred to the edges of the mesh at the lateral aspect of the defect, and recurrences tend to occur in these regions laterally. The sublay technique is an attractive alternative because it offers many theoretical advantages. First, by preserving the hernia sac, a layer of viable autogenous tissue persists to serve as a barrier between the prosthesis patching the defect and the intraperitoneal contents. Second, intraparietal placement of the prosthesis allows well vascularized anterior soft tissue coverage of all aspects of the prosthesis. Third, fixation of the prosthesis within the abdominal wall. Fourth, the intraabdominal pressure tends to hold the mesh in place opposed to the posterior rectus muscle over a wide surface area. Finally, this is a tension-free repair.^{2,13-15}

Patients and methods:

This study was carried out as a clinical controlled randomized study. It was conducted in Plastic Surgery Unit in Suez Canal University Hospital, Ismailia, Egypt from March 2003 to March 2011.

During this period, 140 patients with huge mutilated, deformed abdomen were operated on for abdominoplasty with mesh repair.

The inclusion criteria were those of Matarso III (Moderate skin laxity, variable fat and moderate abdominal flaccidity) and IV (Severe skin laxity, variable fat and significant

abdominal flaccidity).¹⁶ Patients with mild to moderate redundant abdomen, upper abdominal scars, recent pregnancy, and severe chronic illness were excluded.

All patients were operated on by the same surgical team and technique. All included patients completed at least 6 months follow up period.

Patients were randomly assigned to one of the two groups:

- Group 1: Abdominoplasty with on-lay mesh repair (70 patients).
- Group 2: Abdominoplasty with sub-lay mesh repair (70 patients).

Preoperative preparations:

Patients were subjected to detailed history taking and clinical examination. Routine preoperative investigations were done. Prophylactic antibiotics (cephalosporin 3rd generation) and anticoagulants were introduced.

Surgical techniques:

Lower abdominal skin crease incision, extended laterally to both anterior superior iliac spines, was done. The incision was deepened to reach the anterior rectus sheath medially and external oblique muscles laterally. Dissection was then completed cephalically to reach the xiphisternum in the mid-line and the costal margins laterally. During this dissection any old meshes were removed. Hernial sacs were opened and adhesolysis was done when indicated. Any anterior wall defect was located.

In group 1, primary repair of the defects in two layers was done then the polypropylene mesh was placed over the repair (on-lay). The edges of the mesh were sutured to the abdominal wall under tension with polypropylene 0 **Figure(1)**.



Figure (1)

In group 2, bilateral anterior fasciotomy through the anterior rectus sheath was done, thus exposing the medial edge of the rectus muscle, and developing the space laterally was done bluntly to the midclavicular line (lateral edge of the rectus muscle). The mesh was placed between the rectus muscles superiorly

and posterior rectus sheath and fascia transversalis or peritoneum inferiorly. If the peritoneum was deficient, the omentum was mobilized to cover the defect. Multiple polypropylene 0 sutures were taken to secure the position of the mesh without tension **Figure(2)**.

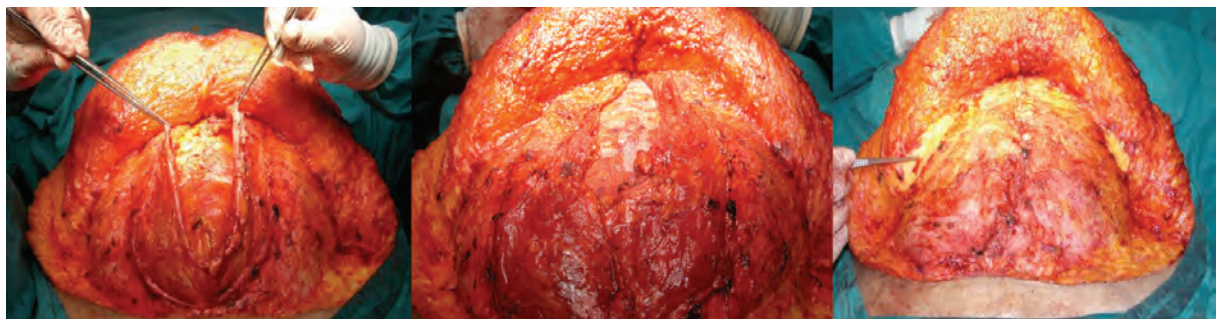


Figure (2)

Two closed suction drains were left in the subcutaneous space. Drains were removed

when the accumulation of fluid in the container was less than 50 ml/day.

Results:

The mean age of the study population was 36.34 ± 9.04 years, ranging from 20-57 years, with group (1) patients had having slightly higher age, but no statistically significant

difference was found between both groups ($p < 0.05$) **Table(1)**. Moreover, 70.7% of the patients were females with slightly higher percentage among group (1), ($p > 0.05$) **Table(2)**.

Table (1): Distribution of both groups according to age & Body Mass Index "BMI".

| | Group (1) On-lay repair | Group (2) Sub-lay repair | Student t-test | p-value |
|--------------------------|----------------------------|-----------------------------|----------------|---------|
| | Mean \pm SD | Mean \pm SD | | |
| Age (years) | 38.2 ± 8.98 | 35.36 ± 9.25 | 1.85 | 0.067 |
| BMI (kg/m ²) | 31.95 ± 5.36 | 31.3 ± 4.4 | 0.79 | 0.429 |

Regarding the preoperative risk factors, diabetes mellitus was slightly higher among group (2) patients (27.1% compared to 24.3% in group (2); $p > 0.05$), while body mass index, hypertension, smoking and chest diseases were slightly higher among group (1) patients ($p > 0.05$) **Table(1&2)**. The majority of patients in

both groups was of grade 3 Mattarsso (58.6% of group 1 compared to 51.4% in group 2); however, no statistically significant difference was found between them ($p > 0.05$). On the other hand, 64.3% of patients in both groups had previous hernia repair **Table(2)**.

Table (2): Comparison of common pre-operative risk factors between both groups.

| | | Group (1) | | Group (2) | | Unadjusted odds ratio and 95% CI | Chi-square | p-value |
|------------------------|---------|---------------|------|----------------|------|----------------------------------|------------|---------|
| | | On-lay repair | | Sub-lay repair | | | | |
| | | No. | % | No. | % | | | |
| Sex | Male | 19 | 27.1 | 22 | 31.4 | 1.23 (0.59, 2.55) | 0.31 | 0.577 |
| | female | 51 | 72.9 | 48 | 68.6 | | | |
| Diabetes Mellitus | | 17 | 24.3 | 19 | 27.1 | 1.16 (0.54, 2.48) | 0.15 | 0.699 |
| Hypertension | | 17 | 24.3 | 12 | 17.1 | 0.65 (0.28, 1.48) | 1.09 | 0.297 |
| Smoking | | 16 | 22.9 | 15 | 21.4 | 0.92 (0.41, 2.05) | 0.04 | 0.839 |
| Chest diseases | | 11 | 15.7 | 8 | 11.4 | 0.63 (0.26, 1.84) | 0.55 | 0.459 |
| Mattarsso | Grade 3 | 41 | 58.6 | 36 | 51.4 | 1.34 (0.69, 2.6) | 0.72 | 0.396 |
| Classification | Grade 4 | 29 | 41.4 | 34 | 48.6 | | | |
| Previous hernia repair | | 45 | 64.3 | 45 | 64.3 | 1.00 (0.5, 2.00) | 0.00 | 1.000 |

* Statistically significant at $p < 0.05$ and 95% confidence level

On-lay repair operation took a slightly shorter time than sub-lay repair operation (p -value > 0.05). However, drains were removed earlier, and postoperative pain disappeared faster in patients who underwent sub-lay repair (p -value < 0.05) **Table(4)**.

Complications were more common in the on-lay repair group (1) when compared to patients with sub-lay repair group (2). Seroma developed early in 15.7% of patients in group 1 compared to 1.4% in group 2. No patient in group 2 developed late seroma while it was detected in 27.1% of patients in group 1 (p -value < 0.05). Similarly, hematoma, wound complications and mesh removal were significantly higher among group 1 patients when compared to group 2. Although deep venous thrombosis (DVT), chest complications and hernia recurrence were higher in group 1 than in group 2, the difference was not statistically significant (p -value > 0.05) **Table(3) & Figure(2)**. On the other hand, sub-lay repair operation was found to be

significantly associated with less hospital stay and earlier return to work compared to on-lay repair (p -value < 0.05) **Table(4)**.

Logistic regression analysis of independent predictors of common postoperative complications in both groups was done. Covariates in the model were surgical technique, sex, age, body mass index, Mattarsso grade, diabetes mellitus, hypertension, previous hernia repair, chest diseases and smoking. Surgical technique (On-lay versus sub-lay repair) was found to be a predictor for seroma, hematoma, wound complications and recurrence; on-lay repair was associated with those complications more than sub-lay repair **Table(5)**. Mattarsso grade was also a predictor for hematoma, wound complications, recurrence and deep venous thrombosis with more representation among on-lay repair patients **Table(5&3)**. However, previous hernia repair was a predictor for seroma and hematoma only **Table(5&3)**.

Table (3): Comparison of post-operative complications between both groups.

| | | Group (1) On-lay repair | | Group (2) Sub-lay repair | | Unadjusted odds ratio and 95% CI | Chi-square | p-value |
|----------------------------|-------|----------------------------|------|-----------------------------|------|-------------------------------------|------------|----------|
| | | No. | % | No. | % | | | |
| Seroma | No | 40 | 57.1 | 69 | 98.6 | | 35.05 | < 0.001* |
| | Early | 11 | 15.7 | 1 | 1.4 | | | |
| | Late | 19 | 27.1 | 0 | 0.0 | | | |
| Hematoma | | 22 | 31.4 | 3 | 4.3 | 0.1 (0.03, 0.35) | 17.58 | < 0.001* |
| Wound complications | | 15 | 21.4 | 3 | 4.3 | 0.16 (0.05, 0.6) | 9.18 | 0.002* |
| Mesh removal | | 4 | 5.7 | 0 | 0.0 | 0.49 (0.41, 0.58) | 4.12 | 0.042* |
| DVT | | 4 | 5.7 | 2 | 2.9 | 0.49 (0.09, 2.74) | 0.7 | 0.404 |
| Chest complications | | 14 | 20.0 | 8 | 11.4 | 0.52 (0.2, 1.32) | 1.94 | 0.164 |
| Recurrence | | 6 | 8.6 | 1 | 1.4 | 0.16 (0.02, 1.32) | 3.76 | 0.053 |

* Statistically significant at $p < 0.05$ and 95% confidence level

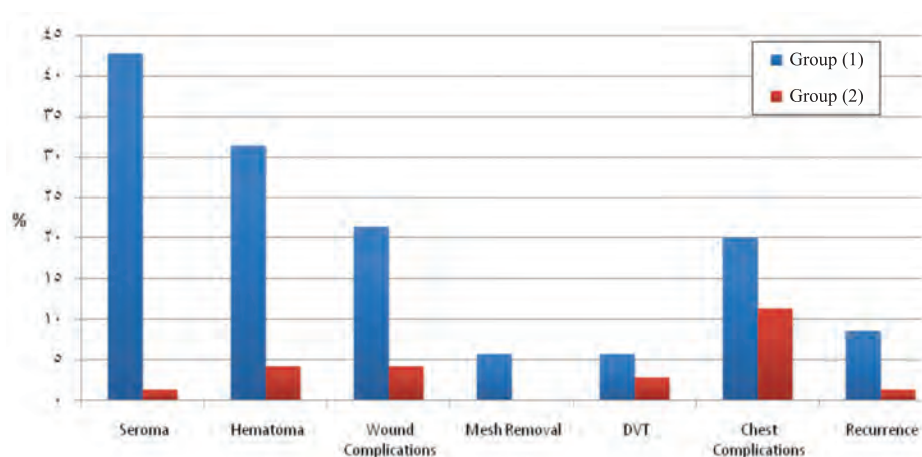


Figure (3)

Table (4): Comparison of postoperative prognostic factors for on-lay & sub-lay repair operations.

| | Group (1) On-lay repair Mean \pm SD | Group (2) Sub-lay repair Mean \pm SD | Student t-test | p-value |
|---------------------------------------|---|--|----------------|----------|
| Operative Time (hours) | 3.17 \pm 0.52 | 3.29 \pm 0.59 | 1.22 | 0.224 |
| Follow-up Period (months) | 11.53 \pm 4.82 | 9.98 \pm 3.78 | 2.12 | 0.037 * |
| Days before Drain Removal | 6.47 \pm 2.14 | 5.11 \pm 1.21 | 4.62 | < 0.001* |
| Days before Pain Disappearance | 8.78 \pm 2.38 | 5.91 \pm 1.6 | 8.38 | < 0.001* |
| Hospital Stay (days) | 9.46 \pm 2.55 | 7.61 \pm 1.25 | 5.42 | < 0.001* |
| Return to Work (months) | 4.67 \pm 1.40 | 2.90 \pm 1.30 | 7.76 | < 0.001* |

* Statistically significant at $p < 0.05$ and 95% confidence level

Table (5): Predictors of common postoperative complications in both groups.

| Predictors | β | P- value | Adjusted OR (95% CI) |
|----------------------------|---------|----------|------------------------|
| Seroma | | | |
| Surgical technique | -4.343 | < 0.001 | 0.013 (0.002, 0.106) |
| Age | -0.055 | 0.056 | 0.946 (0.894, 1.001) |
| DM | -1.070 | 0.091 | 0.343 (0.099, 1.186) |
| Previous hernia repair | 0.997 | 0.071 | 2.711 (0.919, 7.995) |
| Hematoma | | | |
| Surgical technique | -2.380 | < 0.001 | 0.093 (0.026, 0.335) |
| Mattarso Grade | -0.979 | 0.062 | 0.376 (0.134, 1.052) |
| Previous hernia repair | 0.904 | 0.102 | 2.468 (0.836, 7.291) |
| Wound complications | | | |
| Surgical technique | -1.865 | 0.006 | 0.155 (0.041, 0.589) |
| Sex | 1.621 | 0.046 | 5.059 (1.031, 24.831) |
| Mattarso grade | -1.768 | 0.010 | 0.171 (0.044, .657) |
| Recurrence | | | |
| Surgical technique | -1.804 | 0.101 | 0.165 (0.019, 1.421) |
| Mattarso grade | -1.582 | 0.151 | 0.206 (0.024, 1.781) |
| DVT | | | |
| Mattarso grade | -2.013 | 0.088 | 0.134 (0.013, 1.348) |
| Chest diseases | 2.475 | 0.008 | 11.882 (1.930, 73.148) |
| Chest complications | | | |
| DM | 1.001 | 0.063 | 2.721(0.946, 7.829) |
| Chest diseases | 1.394 | 0.022 | 4.030 (1.222, 13.293) |
| Smoking | 1.604 | 0.003 | 4.973 (1.705, 14.500) |

Variable(s) entered on the 1st step of logistic regression: Surgical technique, sex, age, BMI, Mattarso classification, DM, HTN, previous hernia repair, chest diseases and smoking.

Discussion:

All mesh repair techniques have high complication rates with classical abdominoplasty. Modifications in surgical procedures and techniques for incisional hernia repair and the availability of newer prosthetic materials have allowed improvement of surgical results with reduced complication rates.¹⁷

In our study, wound complications were 21.4% in onlay repair while it was only 4.3% in the sublay group. Also; 30 patients of 70 of onlay group developed seroma (early and late) while only one patient of 70 of the sublay group developed early seroma.

Infections of the implanted mesh prosthetics

can be especially difficult to treat and can lead to mesh resection and hernia recurrence. The use of mesh is not necessarily related to a higher incidence of wound infection (5.5% with mesh versus 6% without mesh).¹⁸ A similar study had an infection rate of 9.6%.¹⁹ The few observed minor wound complications of small cutaneous dehiscence without infection are consistent with previous reports of abdominoplasty combined with hernia repair.²⁰ Postoperative wound infections occurred in 0-18% of the patients of many previous studies.^{11,21-23}

Postoperative seromas are a common finding after ventral hernia repairs. Some surgeons

have categorized these as postoperative findings, rather than as true complications, due to the fact that they represent a nearly universal finding. Seroma is the most common complication of these procedures, occurring in 1-23% of cases.²⁴ Bauer and his colleagues' rate of seroma formation (12.3%) was similar to those in previous series of incisional hernia repairs using prostheses.¹⁶

Our data revealed significant correlations between smoking history and any of postoperative chest complications. Krueger et al, found that the complication rates for abdominoplasty are significantly higher in smokers.²⁵

Regarding co-morbidities in our patients; we found that diabetes mellitus, chest diseases and previous hernia repair were significant predictors for post-operative complications. Hensel et al. and van Uchelen et al. found the same observation that patients suffering from co-morbid conditions like diabetes mellitus and hypertension had significantly higher complication rates after abdominoplasty.^{26,27}

Obesity is a major contributing factor in the initial development of a hernia. When the morbidly obese patients are considered, both the recurrence rates and the complication rates tend to increase regardless of the technique.²⁸⁻³¹

Mean body mass index of our patients was 31.95 in onlay group and 31.3 in the sublay group. There was no significant difference between the two groups regarding BMI. We could not find that BMI was a predictor of post operative complications in our work. We can explain these findings by that our patients were not having a high BMI.

The development of tension-free incisional hernia repairs employing prosthesis has decreased recurrence rates markedly, to about 6-10%.²¹ Bauer et al. series had no recurrences (except in one patient whose prosthesis was removed) and an infection rate of 3.5%. These results are superior to those generally achieved with onlay repairs, for which the recurrence rate is about 4-6% and the infection rate approximately 7-10%.¹⁶ Recurrence rates in previous studies of Stoppa repairs range from zero to approximately 4%.^{11,21,22,32,33} Recurrence in our patients was 8.6% in onlay group and 1.4% in sublay group.

Since its introduction in 1989, the Rives-Stoppa technique has been popularized by many surgeons and recently was proclaimed to be the gold standard for open mesh hernia repairs by the American Hernia Society. The advantages of a large mesh with significant overlap placed under the muscular abdominal wall can possibly be explained by Pascal's Principles of Hydrostatics. The intraabdominal cavity functions as a cylinder, so pressures are distributed uniformly to all aspects of the system. The same forces that are attempting to push the mesh through hernia defects are also holding it in place against the adjacent intact abdominal wall.^{10,15}

In our series DVT was 5.7% in onlay group and 2.9% in sublay group. In Mark F. Berry, and his colleagues series; the most common postoperative complications were thromboembolic events (13%).³³

Avoidance of onlay methods has been recommended because of minimal tissue incorporation of the prosthesis,³⁴ excessive tension on the repair,³⁵ and a possible increase in the risk of seroma and infection.^{11,24,36,37}

Conclusion:

For patients with complex recurrent hernias and deformed abdomen, sub-lay mesh herniorrhaphy with concomitant abdominoplasty offers significant functional and esthetic results. Sub-lay placement of prosthetic mesh in the repair of abdominal wall is effective and superior to other methods. Approaching the recurrent abdominal wall hernia and certain primary hernias through an abdominoplasty incision; provides access to all components of the abdominal wall and identifies previously undetected hernias. Significant complications are low and patient satisfaction is high.

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