Title Page

Abdominal Bulge After Retroperitoneal Dissection: The Definitive Management Using Bone Anchored Mesh

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Financial Disclosure and Products Page

Hyuma Leland, M.D. does not have any financial interests, commercial associations, or disclosures to report related to this study.

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Structured Abstract

Background

Abdominal bulge after retroperitoneal dissection occurs at a rate of 1-56%. Injury to the T11 and T12 nerves is thought to result in abdominal musculature denervation, laxity, and symptomatic abdominal bulge. This complication has become more prevalent as the retroperitoneal approach for spinal surgery has become the preferred approach in specific lumbar and thoracic cases. Current repair techniques fail to address the etiology of abdominal wall laxity and outcomes are poorly reported. Recurrence rates in complex abdominal hernia repair exceed 20%, and the complication rate is nearly 25%. We present a method of bone anchored fixation of mesh for abdominal wall reinforcement after the imbrication of the atrophied musculature, resulting in the definitive treatment of abdominal bulge after retroperitoneal dissection.

Methods

A retrospective review of consecutive patients who underwent bony fixation of mesh using Mitek suture anchors (De Puy, Raynham, MA) for abdominal bulge after retroperitoneal dissection between February 2013 and September 2014 was performed. The preoperative, intra operative, and postoperative records of four patients were reviewed and compared.

Results

There were no reported early recurrences and no peri-operative morbidity or mortality related to the operation. Average follow up was 9 months (range 6-18 months), operative time 157 minutes, postoperative length of stay 3.5 days, and EBL was 50mL.

Conclusions

Reinforcement of the myofascial repair using bone anchored fixation of mesh represents a novel approach for the treatment of abdominal bulge after retroperitoneal dissection. Results demonstrate safety and no early recurrence.

Level of Evidence: VI, Therapeutic

Author Roles and Participation

Hyuma Leland reviewed patient records, created figures, analyzed data, and authored the manuscript.

David Kulber created the study design, contributed to data analysis, and reviewed and edited the manuscript.

Statement of Institutional Review Board Approval

This study was reviewed and approved by the Cedars-Sinai Medical Center Institutional Review Board in adherence with the guidelines established by the Declaration of Helsinki.

Introduction

Abdominal bulge and flank bulge are the clinical manifestations of weakness of the intrinsic abdominal wall tone resulting from disruption of T11 and T12 nerve innervation. Since abdominal bulge represents abdominal wall laxity without fascial defect and no true hernia sac, there is no risk of herniation or incarceration. However, abdominal cramping, pain, bloating, nausea, early satiety, and poor cosmesis are all frequently reported symptoms.

The true incidence of abdominal bulge is currently unknown, as most occurrences are likely to go unreported. In published case series, incidence of flank bulge has ranged from 1-8%[1,2] for anterior or paramedian incision approaches to the retroperitoneum compared to 19 - 56% in anterolateral flank incisions[3–6]. However, with 488,000 spinal fusions performed in 2011, constituting a 70% increase over the previous 10 years, the incidence of abdominal bulge after anterior lumbar interbody fusion (ALIF) is expected to continue to rise[7,8].

No consensus on indications for repair of abdominal or flank bulge exist at this time. Multiple repair techniques have been described including midline and flank abdominal wall plication, polypropylene mesh onlay onto the anterior rectus sheath[9], mesh sublay onto the posterior rectus sheath and extending superficial to the transversus abdominus muscle[10], and preperitoneal mesh underlay[11,12]. Repair techniques report a wide variety of outcomes, and with one exception, recurrence rates in mesh based repair with fascial fixation range from 33 – 100% (Table 1).

It is proposed that abdominal wall denervation resulting in muscle laxity and atrophy contributes to the failure of fascial fixation techniques. For this reason, we are investigating the use of bone-anchored sutures to achieve stable mesh fixation in an effort to reduce bulge recurrence. In this study we report early outcomes in four patients who underwent abdominal wall oblique plication and bone-anchored mesh overlay for definitive repair of abdominal wall bulge after retroperitoneal dissection.

Patients and Methods

The study was reviewed and approved by the Cedars-Sinai Medical Center Institutional Review Board. A retrospective chart review of consecutive patients who presented between January 2013 and January 2015 with an abdominal bulge and history of a retroperitoneal dissection were included in this study. Patients were excluded if physical examination or computed tomography (CT) imaging demonstrated facial defect consistent with hernia, age less than 18 years old, active abdominal wall infection or neoplasm, or if medical comorbidities caused the patient to be unstable for surgery. A total of 6 patients presented with unilateral abdominal wall bulge and two patients were excluded from the study after work up demonstrated concomitant hernia.

Preoperative Evaluation

After history and physical examination, patients were evaluated by CT of the abdomen and pelvis to evaluate the integrity of the abdominal wall layers.

Preoperatively, patients were marked demonstrating underlying bony landmarks including the iliac crest, pubic tubercle, xyphoid, and costal margin. The borders of the abdominal bulge were marked (Fig. 1).

Operative Details

Patients were intubated under general anesthesia and placed in the supine position. An oblique incision was made overlying the abdominal bulge oriented from anteroinferomedial to superiolateral. Dissection was carried superficial to the external oblique fascia and anterior rectus sheath (Fig. 2A). The borders of the dissection were the ipsilateral costal margin, xyphoid, contralateral costal margin to the aponeurosis of the external oblique fascia, and pubic tubercle. The umbilical stalk was left intact.

Following completion of the dissection, the redundant external oblique fascia and rectus abdominus anterior sheath were imbricated obliquely using a series of (…deep buried “0” PDS and a second layer of running 0-PDS suture (Fig. 2B). Polypropylene mesh (Prolene, Ethicon Inc, Cincinnati, OH) was then sized to overly the plication line by a minimum of 5 cm in all directions. The tissue overlying the ipsilateral iliac crest was dissected down to the level of the periosteum, which was also dissected free from the underlying bone. A surgical drill was then used to bore the cortex and the anchor (Mitek GII/GIV, DePuy Synthes, Raynham, MA) was deployed into the iliac crest (Fig. 3A). Use of the GII or GIV was dictated based on bone stock quantity and quality. Between 2 and 4 bone anchors were inserted into the ipsilateral

iliac crest. In one patient two anchors were deployed into the contralateral iliac crest. In one patient, two Mitek GII suture anchors were deployed into the pubic tubercle (Fig. 3B). The integrated suture was used to affix the stretched polypropylene mesh to the abdominal wall. Interrupted “0” PDS was then used to affix the mesh circumferentially to the costal periosteum, xyphoid, anterior rectus sheath, and pubic tubercle periosteum (Fig. 4). Two surgical drains were left in place and the wound was irrigated and closed in three layers using 2-0 PDS, 3-0 vicryl, and 4-0 PDS.

A compressive dressing and abdominal binder was placed prior to waking the patient.

Postoperative Care

Patients were managed postoperatively with oral pain medication. Diet was advanced as tolerated and ambulation was initiated postoperative day 1. An abdominal binder was kept in place during all activities out of bed. Patients were discharged to home once tolerating a regular diet, pain controlled on oral medication and ambulating.

Data Analysis

Preoperative, intraoperative, and postoperative outcomes were recorded for each patient included in the study. Mean and standard deviation values were calculated for numerical data.

Results

Preoperative Characteristics

The mean age for patients included in this study was 63 years with average BMI of 25 (Table 2). Three of four patients were men. Patient 1 had undergone previous right abdominal retroperitoneal dissection for renal transplantation. Patients 2, 3, and 4 had previous history of retroperitoneal dissection during anterior lumbar interbody fusion (ALIF) surgery. All patients presented with left sided abdominal bulge and symptoms included poor cosmesis, pain, anorexia, and weight loss.

Perioperative Outcomes

Mean operative time for bone-anchored mesh abdominal reconstruction was 156 ± 29 minutes with mean EBL 50mL (Table 3). In all cases a polypropylene mesh was used in the

reconstruction. Between 2 and 4 Mitek G2 or G4 suture anchors were placed in the ipsilateral ASIS. In one case 2 Mitek anchores were placed in the pubic tubercle. Postoperatively patients stayed for a mean of 4 ± 2 days (Table 4). There was no related morbidity and one mortality due to metastatic tumor recurrence, a complication unrelated to this study. Patient follow up ranged between 6 and 17 months with mean follow up of 9 months. Figure 5 portrays a representative outcome ___weeks after surgery.

Discussion

As an iatrogenic injury, multiple studies have investigated the etiology of abdominal bulge. Cadaveric studies have elucidated the course of thoracic nerve innervation to the anterolateral abdominal wall. After exiting the costal groove, thoracic nerves T7-T12 extend in an inferomedial direction to innervate the anterior abdominal wall, lying in the neurovascular plain between the internal oblique and transversus abdominus muscles[13]. In cadaveric dissections and intraoperative EMG studies, T11 and T12 were found to be responsible for abdominal wall innervation in 81-97% of patients[14].

Clinical reports have given support to anatomical studies, as preservation of T11 and T12 through EMG monitoring resulted in preservation of the abdominal musculature postoperatively[14]. Furthermore, reports of flank bulge following infiltration of local anesthetic into the transversus abdominus plane (TAP block)[15,16] and flank bulge following postherpetic neuralgia occurring in the T11 and T12 dermatomal distributions further support the importance of the T11 and T12 nerves in anterolateral abdominal wall innervation[17]. Standard flank incisions have postoperative bulge rates up to 57%[5], and demonstrate greater volumetric bulge, paresthesia and numbness[18].

Risk factors for abdominal bulge include comorbid renal disease or cancer, incision length > 15cm or body mass index > 23 mg/kg^2.[5]

While limited data to support the following recommendations is available, surgeons have reported the following surgical techniques to reduce iatrogenic flank bulge after retroperitoneal dissection: minimize incision length[5], direct identification and preservation of intercostal nerves, careful suture placement to avoid nerve strangulation[14], incision placement superior to the line between the tip of the 12th rib and umbilicus[13,19], anterior paramedian incision[2], and limit incisions from entering the intercostal space[6].

Current techniques of abdominal wall reconstruction using fascial fixation of mesh demonstrates high recurrence rates, up to 100%[10,12], due to failure to address attenuation of the denervated abdominal wall. While this is the first study to specifically investigate the use of abdominal wall plication and bone-anchored mesh overlay for the repair of flank bulge after retroperitoneal dissection, previous reports have investigated the use of bone anchored mesh in abdominal bulge after TRAM flap and ventral hernia repair. In 1994, Francis, et al. published a case report using Mitek suture anchors for TRAM donor site defect repair[20]. In 2004, a case series of 10 patients reported the use of bone anchored mesh for the repair of lumbar hernias with no recurrence after 40 months of follow up[21]. Finally, in a series of 7 patients with average history of 3 failed ventral hernia repairs, 6 patients demonstrated no hernia recurrence at 24 months follow up. One patient with unremitting lateral cutaneous nerve of the thigh paresthesia, mesh removal was performed with resulting flank bulge recurrence[22].

Early follow up on a limited series of patients with flank bulge after retroperitoneal dissection suggests the technique of bone anchor fixation is safe and effective for abdominal wall reconstruction. As ALIF continues to evolve into the approach of choice for lumbar interbody fixation, the incidence of flank bulge after retroperitoneal dissection is expected to continue rising.

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Figures

Figure 1.

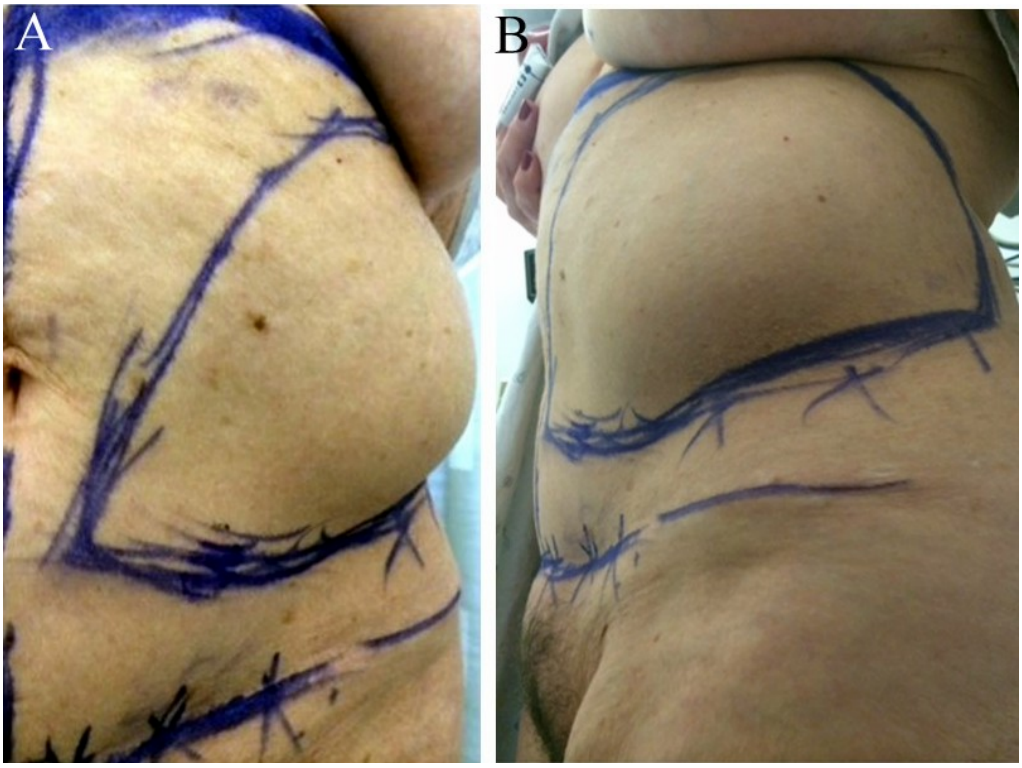
A
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Figure 2.

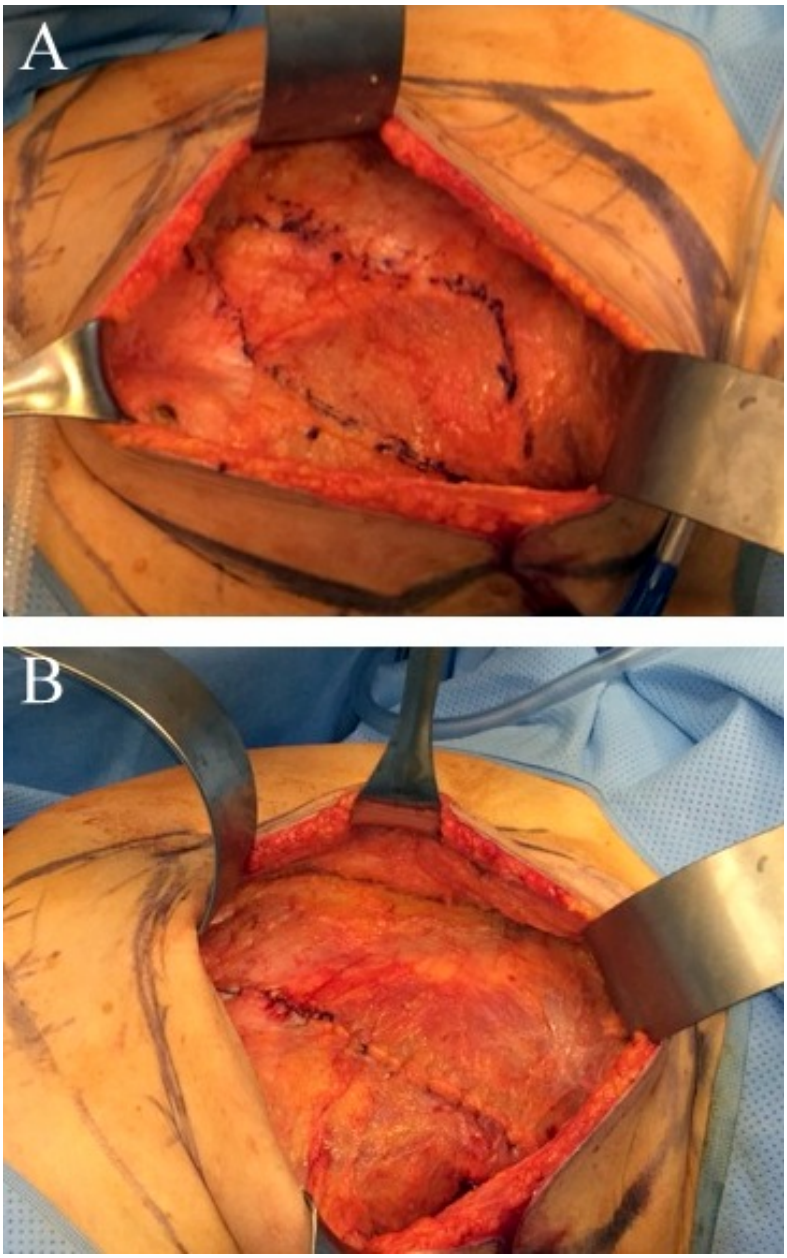


Figure 3.

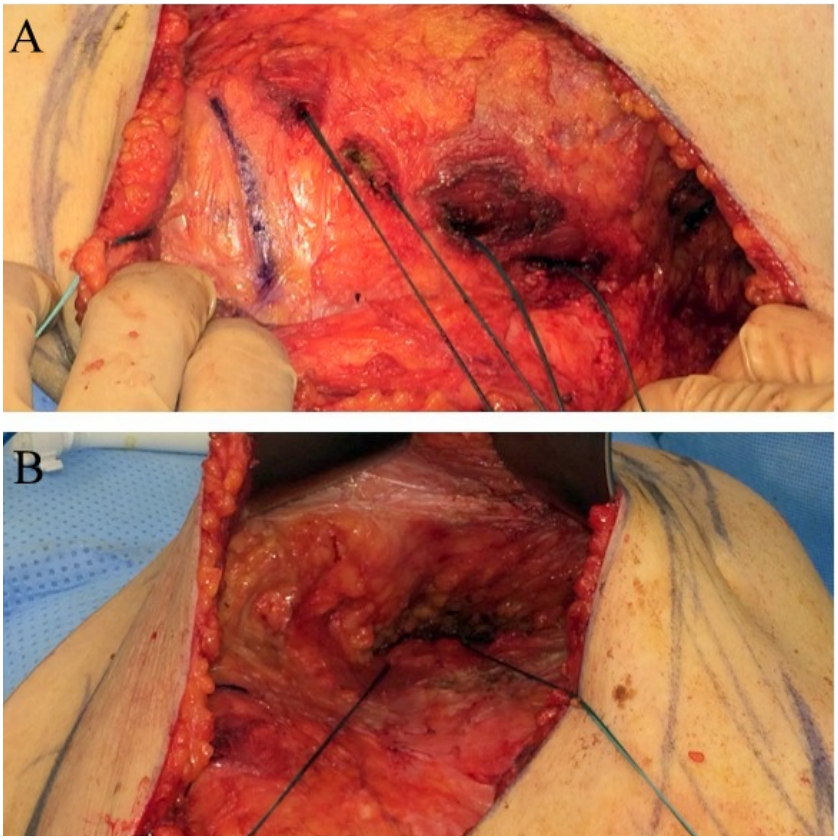


Figure 4.

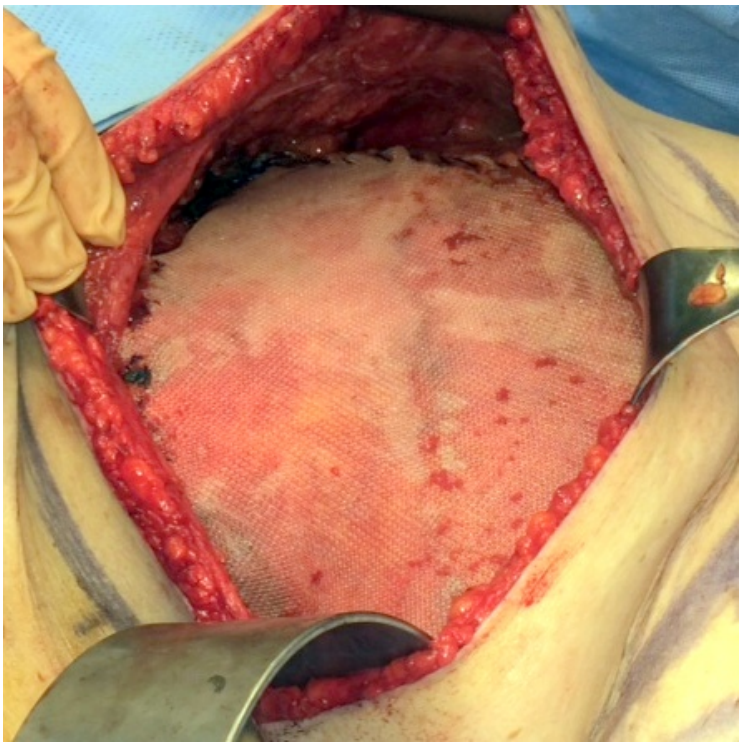
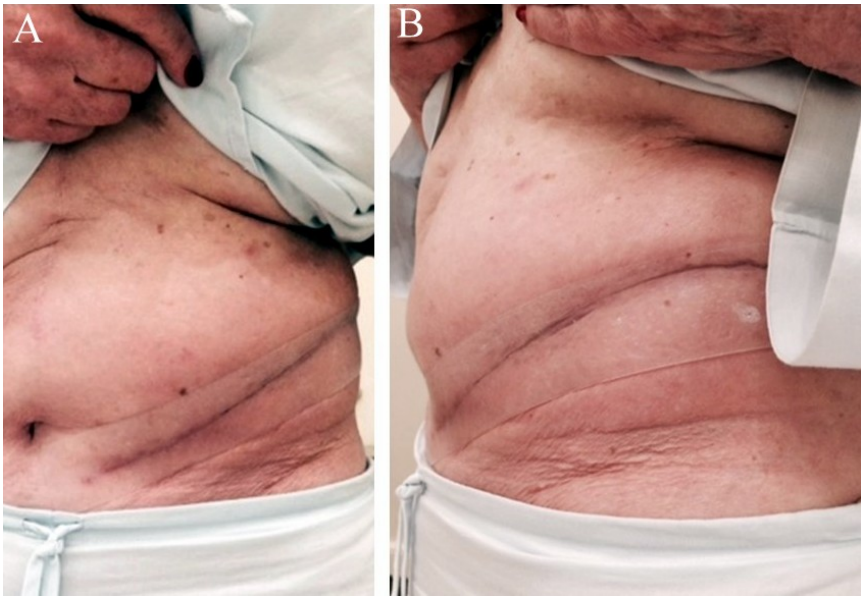


Figure 5.



Tables

Table 1. Abdominal Bulge Repair with Mesh and Fascial Fixation

Study	Year	Repair Technique	n	Bulge Recurrence (%)
Petersen[10]	2002	flank incision with sublay of ePTFE or polypropylene mesh	4	4 (100%)
Hoffman[9]	2004	abdominoplasty incision, midline and flank plications, polypropylene mesh onlay	3	1 (33%)
Zieren[12]	2007	flank incision with polypropylene preperitoneal underlay	7	7 (100%)
Liu[11]	2011	previous flank incision, polypropylene mesh preperitoneal underlay*	14	0 (0%)
Pineda[23]	2013	previous incision, internal oblique myofascial flap closure with mesh onlay over internal oblique	8	2 (25%)

Table 2. Preoperative Characteristics

Patient	Age	Gender	BMI (kg/m^2)	Comorbidities	Indication	Previous surgery	Location of Defect
1	48	M	22.8	SLE with nephritis s/p renal transplant, HCV, HTN, GERD, diverticulosis	severe abdominal bulging	9/19/1998 - renal transplant, 9/14/2012 right extraperitoneal renal transplant, h/o laparoscopic cholecystectomy	Left abdomen between rectus and external oblique
2	74	M	31.1	HTN, HLD, hypercoagulable state, history of DVT/PE, history of inguinal hernia repair	recurrent abdominal bulge	h/o L2-S1 fusion c/b nonunion, 6/17/2009 ALIF L4-S1, 6/28/2013 lateral interbody fusion DLIF L2-S1	Left flank
3	60	M	22.3	Osler-weber-rendu, Asthma, Afib s/p Maze procedure, hereditary hemorrhagic telangiectasia	Recurrent Abdominal bulge with pain, anorexia, weight loss	2007 abdominoplasty, 5/8/2013 L4-S1 ALIF; 9/15/2014 Laparoscopic incisional hernia repair	Left lower quadrant
4	71	F	24.4	Depression	severe abdominal bulge, pain	8/1/2012 - anterior approach for L1-L2 ALIF	Left abdomen
Mean	63.3		25.1				
SD	11.8		4.1				

Table 3. Intraoperative Data

Patient	Duration (min)	EBL (mL)	Mesh	Mitek size	Sites of Mitek	Suture fixation
1	115	50	polypropylene	G4	2 Left ASIS	Left subcostal periosteum, surrounding healthy fascia
2	156	50	crystalline polypropylene and high density polyethylene	not noted	3 Left ASIS	Left subcostal periosteum, surrounding healthy fascia
3	177	50	polypropylene	All G2	2 Right ASIS, 2 Left ASIS	Left subcostal periosteum, suprapubic scar tissue/ fascia, healthy surrounding fascia
4	178	50	polypropylene	G2 - 2 in pubis, two in ASIS; G4 - two in ASIS	4 Left ASIS, 2 pubis	Left subcostal periosteum, surrounding healthy fascia
Mean	156.5	50.0				
SD	29.5	0.0				

Table 4. Postoperative Course

Patient	LOS (POD)	Morbidity	Mortality	Recurrence	Follow up time (mo)
1	3	None	9/16/14 cardiopulmonary arrest, metastatic renal cancer to lungs	None	5.4
2	2	None	No	None	17.8
3	7	None	No	None	6.7
4	2	none	No	None	6.0
Mean	3.5				9.0
SD	2.4				5.9

Figure Legend

Figure 1. Preoperative markings outlining left sided flank bulge with head oriented superiorly in patient 4 in anterior (A) and lateral views (B).

Figure 2. Suprafascial dissection with marking demonstrating the margins of the attenuated tissue to be approximated by plication (A). Obliquely oriented plication of the attenuated left flank and abdominal wall (B).

Figure 3. Suture anchors *in situ* following dissection, cortical drilling, and deployment into the anterior superior iliac spine (A). Dissection and suture anchors for fixation to the pubic tubercles (B).

Figure 4. Polypropylene mesh following bone anchor fixation and fascial onlay.

Figure 5. Postoperative photographs ___weeks after surgery in anterior (A) and lateral views (B).

Table 1. * Composix Kugel mesh recalls issued 2005, 2006, and 2007, overlapping the recruitment period of this study from 2006-2010.

Table 2. Systemic lupus erythematosus (SLE), hepatitis C viral infection (HCV), hypertension (HTN), gastroesophagel reflux disease (GERD), hyperlipidemia (HLD), deep venous thrombosis (DVT), pulmonary embolus (PE), direct lateral interbody fusion (DLIF), atrial fibrillation (afib), standard deviation (SD)

Table 3. Anterior superior iliac spine (ASIS), standard deviation (SD)

Table 4. Standard deviation (SD)