

Effective 3D Mesh (3D Max) Adaptation During Anterior Inguinal Hernia Repair

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Abstract

Even with complex hernial defects, heavyweight 3D painted anatomically fitted polypropylene mesh implants greatly adapt to the geometry of the inguinal region without the need for mesh fixation, reducing the risk of recurrence and chronic post-operative pain. This is because the implant and tissues have multiple points of contact, which generate friction forces. carried out on a 38-year-old man who had an oblique, left-sided, uncomplicated inguinal hernia and an inguinal cord lipoma on the same side. Together with the removal of the spermatic cord lipoma, an anatomically fitted 3D mesh implant was used to reinforce the posterior wall of the inguinal canal without the need for fixation. With less operating time and a trouble-free recovery during the post-operative and short-term follow-up periods, a successful repair was accomplished. Lichtenstein may suggest self-fixed, anatomically fitted 3D mesh implants as a suitable alternative for anterior inguinal hernia repair.

Keywords: Hernia, Polypropylene, Surgical meshes, Three-dimensional.

INTRODUCTION

During Lichtenstein repair, the use of self-fixed mesh implants demonstrated a notable decrease in both postoperative chronic neuralgia^[1] and operating time.^[2] Heavyweight, three-dimensional painted anatomical-shaped polypropylene mesh implants are one type of self-fixed mesh implant that can conform to the extra-peritoneal inguinal region's contours without the need for fixation, reducing the risk of chronic post-operative pain and hernia recurrence.^[3] Furthermore, because of their mechanics and biophysics, anatomically fitted mesh implants have been found to be the best option for preventing recurrence in complex hernial defects. They also provide a better anatomic fit to the geometry of the patient's inguinal region.^[4] Multiple points of contact between the implant and the tissues create friction forces, which ensure mechanical stability and do away with the need for mesh fixation.^[5]

Prior research comparing lightweight mesh (LWM) to heavyweight mesh (HWM) revealed that LWM lowers the incidence of foreign-body sensations and chronic post-operative pain without raising the risk of hernia recurrence.^[6]

This is because LWM has lower concentrations of foreign material, which reduces inflammation.^[7] Recent research has shown that there is no discernible difference between the two mesh types' risk of foreign-body sensation. Furthermore, it was discovered that HWM was better than LWM in laparoscopic inguinal hernia repair.^[8]

CASE REPORT

We received a referral for a 38-year-old male patient at hospital No. 85 of the Federal Medical-Biological Agency (FMBA), Moscow, Russian Federation, reported a painless, gradually growing hernial protrusion in the left inguinal area that had been there for five months without causing any problems.

The patient's overall condition was satisfactory during the physical examination, and their consciousness was evident despite their normosthenic body. There were

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no cyanosis, pallor, or scars, and the skin had a normal moisture content. The temperature of the body was 36°C. Status of lymph nodes: not enlarged. Organs of the respiratory system: free breathing without wheezing. 18 b/min is the respiratory rate. Examining the chest revealed that it was uniformly shaped and contributed equally to breathing. percussion-resonant. Vesicular breath sounds are auscultated. Heart rate: 74 beats per minute, regular. The reading was 120/80 mmHg. The tongue felt moist and clean. There were no palpable organs or scars from prior surgeries, and the abdomen felt calm and painless. Lumbar areas; palpation is painless. The kidneys are painless and not palpable. It was free to urinate.

Local Status

Hernial protrusion up to 5x4 cm in the left inguinal region; painless; positive cough impulse sign; normal skin; freely adjustable into the abdominal cavity. There was a simple left oblique inguinal hernia, and the external inguinal ring extended up to 2 to 5 cm.

Diagnostic Assessment

The patient's laboratory results were within normal limits. Additionally, the measles IgG count is between 0 and 5 IU/ml. Hepatitis B (HBs Ag), Hepatitis C (a-HCV), and Rapid Reaction to Syphilis (RPR): negative. The CXR

and ECG are normal.

Abdominal Ultrasound

A lipoma of the spermatic cord up to 10 x 3 x 3 cm is present, along with a hernial gate up to 2 x 2 cm and a hernial sac with dimensions up to 3 x 2 x 2 cm and hernial content.

Intervention

It was decided to use the Liechtenstein technique to reinforce the posterior wall of the left inguinal canal with a Bard 3D Max™ mesh implant.

Operative Steps

Position of the patient: supine.

Spinal anesthesia is the type.

Sterilizing the surgical field: Two distinct sterile swabs were used to sterilize the surgical field in a single direction after it had been thoroughly moistened with disinfectant solution for two minutes.

Incision is the second step. Above and parallel to the left inguinal fold, a 5-cm inguinal incision was made, following Langer's line. The aponeurosis was dissected, along with the skin and subcutaneous fat. A holder was used to isolate the spermatic cord (Figure 1).



Figure 1: After Being Isolated, the Spermatic Cord was Placed on a Holder.

Lipoma excision is step three. The 10*3*3 cm lipoma of the spermatic cord was separated, dissected, and severed. After the omental content was reduced back into the

abdominal cavity, the hernial sac, which measured up to 3 x 2 x 2 cm, was opened and removed (Figure 2).

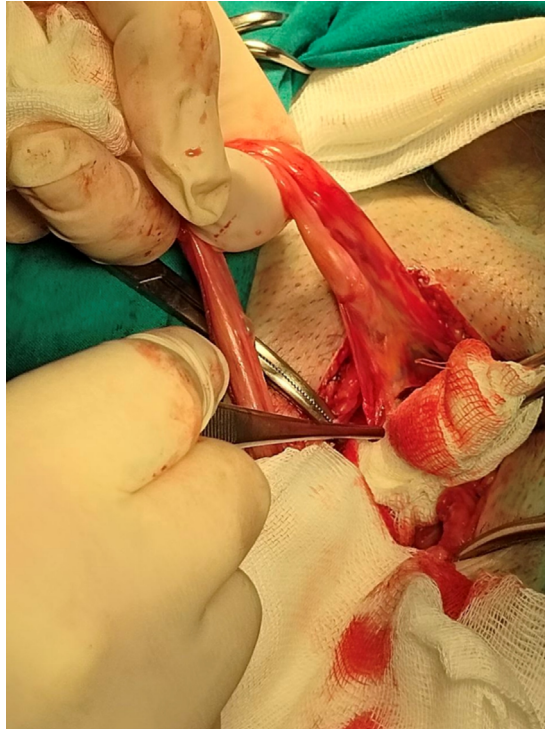


Figure 2: The Hernial Sac is Removed.

Using an 8 x 15 cm Bard 3D Max™ mesh implant (Figure 3), which was fastened to the inguinal ligament from the pubic tubercle up to the level of the deep inguinal ring without fixation, the posterior wall of the inguinal canal was reinforced during the fifth step of the Lichtenstein

on-lay hernioplasty of the left inguinal hernia. Figure 4. The spermatic cord's structural integrity has returned. Reapproximation of the external oblique aponeurosis above the spermatic cord was accomplished with absorbable sutures. There was hemostasis.

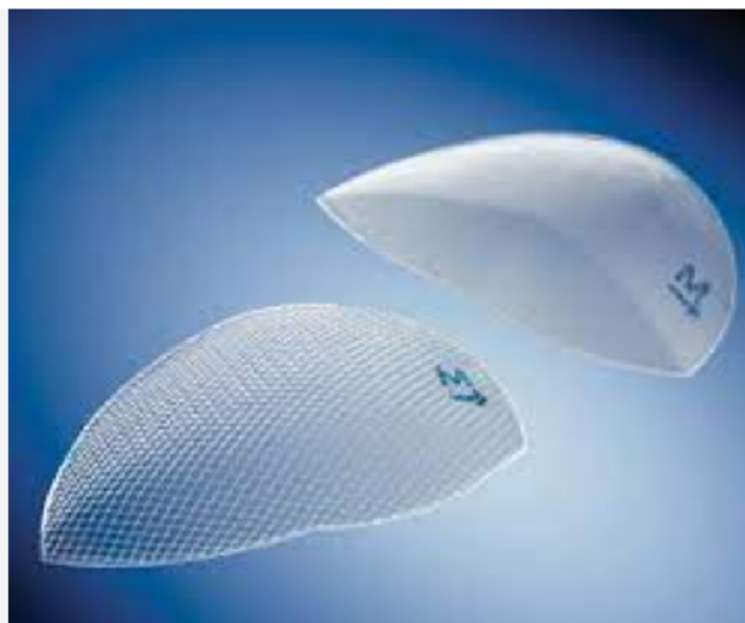


Figure 3: Mesh Implant Bard 3D Max™^[9]

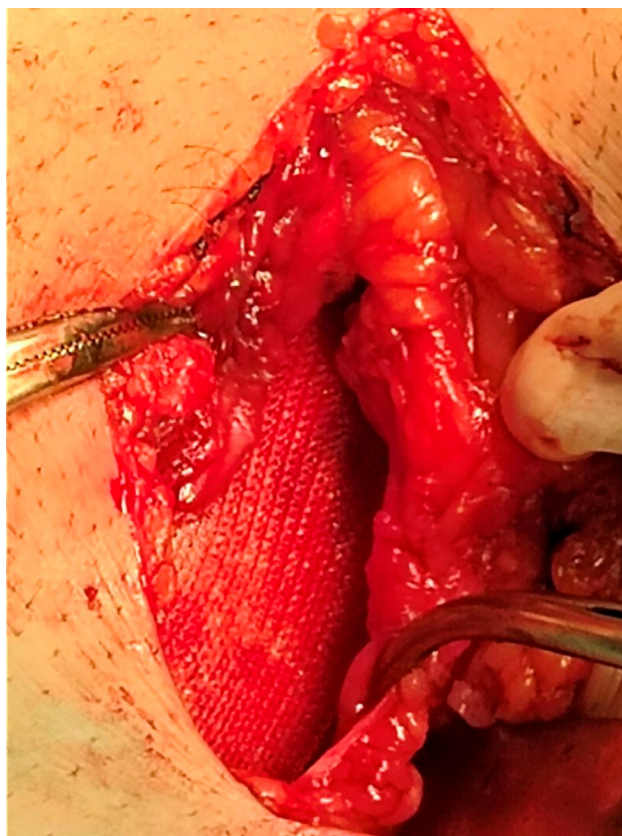


Figure 4: Anatomically, the Bard 3D Max™ Mesh Implant is Tailored to the Anatomy of the Left Inguinal Canal.

Closing the wound is step 6. One layer after another, the wound was sealed.

Operational Time

45 minutes.

The removed spermatic cord lipoma was sent for histopathological analysis. *Results and follow-up*

The patient's condition was very good during the post-operative period. Without any issues, the post-operative pain was improving with NSAIDs. On the third postoperative day, the patient was released. A histopathological analysis of the post-operative specimen showed a spermatic cord lipoma devoid of cancerous cells or changes. There were no complications, including seroma or chronic pain, during the six-month follow-up period. No hernia recurred.

DISCUSSION

In addition to being cost-effective and pocket-friendly because it significantly reduces the cost of fixation and shortens the operative time, the Bard 3D Max™ mesh implant eliminates operative time, post-operative hospitalization, acute and chronic post-operative pain, and complications due to the use of fixation and its formula, which is already created side adaptation either to the right or left side.^[7] Kritharides and others. found that “sandwich” and “hybrid with 3D mesh” appear to offer superior outcomes in terms of recurrences and safety profiles compared to “keyhole” and “Sugarbaker” techniques^[10]

in their systematic literature search of three databases (Medline, Scopus, and Google Scholar) conducted between January 2015 and November 2022, incorporating 1289 total patients with parastomal hernias operated by various minimally invasive surgical techniques for parastomal hernia repair. Furthermore, in the Amato *et al.*^[11] Due to the presence of a pathogenetically coherent treatment for the degenerative damages caused by inguinal hernia disease, they discovered MRI evidence of the regenerative effect of the 3D scaffold for inguinal hernia repair during the short-, mid-, and long-term post-implantation period. They also observed an enhanced regenerative biological response into the 3D inguinal hernia scaffold, which was histologically verified in a porcine experimental model.^[11] Complications may arise with the use of the Bard 3DMax and 3DMax Light meshes for soft tissue reinforcement and hernia repairs. Recurrence of the hernia or defect, seroma, adhesions, hematomas, discomfort, infection, inflammation, extrusion, erosion, migration, fistula formation, and allergic reactions are some of these. Though both have been connected to excruciating pain in certain patients, the 3DMax Light is less powerful than the regular 3DMax.^[12]

Over time, the polypropylene used to make 3DMax and 3DMax Light may shrink and crack. The mesh may break inside the body or fold over as a result of this shrinkage. Some patients have reported experiencing significant, incapacitating pain from both the 3DMax and the 3DMax Light. The future is heading forward to improve such

drawbacks, good porosity and weight, 3D to improve surgical meshes.^[12]
The following table discusses in brief the contrast of 3D

meshes with the most commonly used types of mesh implants in the global markets.

Table 1: Contrasts between Major Types of Polypropylene Surgical Meshes in the Markets.^[1]

	Polypropylene Meshes Fixed By Sutures.	Polypropylene Meshes Fixed By Tacks.	Self-Gripping Polypropylene Meshes.	3D Printed Polypropylene Meshes.
Outcome benefits	Technically easy. Cost-effective.	Reduced operative-time. Reduced post-operative neuralgia and complications. Reduced hospitalization period. Eliminates recurrence.	Reduced operative-time. Reduced post-operative neuralgia and complications. Reduced hospitalization period. Minimal post-operative foreign body sensation. Eliminates recurrence.	Reduced operative-time. Reduced post-operative neuralgia and complications. Reduced hospitalization period. Minimal post-operative foreign body sensation. Eliminates recurrence.
Cost	Inguinal hernia repair procedures typically cost between \$7,500 for straightforward open surgery at an outpatient center to over \$30,000.	The cost of the tack fixation device is added, about \$400.	The cost of the self-gripping mesh is added, starting from about \$400	The cost of the 3D printed mesh is added, starting from about \$ 200
Fixation	Surgical sutures	Surgical tacks using herniostaplers (Tack fixation device)	No fixation is needed	No fixation is needed, however, from our practice we can use single suture fixation.
Incidence of postoperative neuralgia	0.5- 4.6%	About 2.3%*	Less than 2%	Less than 1.5%

* The incidence of foreign body sensation is significantly less with elastic tacks in comparison to metallic ones.

CONCLUSION

Three-dimensional pre-shaped mesh implants were found to be helpful in our clinical practice for lowering the length of time needed for open inguinal hernia repair during Lichtenstein hernioplasty, as well as the need for hospitalization after surgery, acute and chronic post-operative pain, and complications.

FOR TRAINEES

Medical students and surgical trainees should be oriented with the advancement of medical equipment and the advent of novel rapid prototyping processes like melt electro-writing allow for the creation of surgical meshes with geometries that were previously restricted by conventional production procedures. By altering the geometry, surgical meshes made of the same polymers can have their mechanical behavior directly affected. We tried to point out using and adaptation of 3D max mesh in this article step by step aiming to enhance surgical training for trainees.

Conflicts of Interest

The authors of this article declare that they have no conflicts of interest with regard to its publication.

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