



## Indirect Inguinal Hernia Repair using the Ultrapro Plug™ and the “Double Slit” Technique, Our Initial Experience

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### Abstract

There are many proprietary mesh products on the market for open inguinal hernia repair that offer low recurrence rates. However, there is growing concern about scar tissue, shrinkage and chronic pain associated with “heavy mesh”. Therefore, we began using a light weight, macroporous, and partially absorbable mesh plug with a flat pre-peritoneal portion. We place this mesh using a “double slit” technique where the onlay portion of the plug is slit and placed around the spermatic cord and sewn to the inguinal ligament. The patch is also slit and sewn around the spermatic cord to the inguinal ligament lateral to the internal ring. This is a retrospective study to validate this technique.

**Methods:** Retrospective data was collected between June 1, 2007 and December 30, 2012. Follow-up data was collected by office visit and examination by the attending surgeon.

**Results:** A total of 125 patients qualified for the study and 24 consented to participate. Over an average follow-up of 21 months, there were no recurrent hernias. Eighteen (79.3%) patients had no pain, 4 (16.6%) had very mild (1 of 10) groin pain and one (4.1%) had moderate (4 of 10) groin pain. No patients had testicular pain.

**Conclusion:** Indirect inguinal hernia repair using the Ultrapro Plug and the “double slit” technique is an effective method of inguinal hernia repair with low rates of recurrence and significant chronic pain.

**Keywords:** Inguinal hernia; Mesh plug; Open repair; Lightweight mesh; Recurrence; Chronic pain

### OPEN ACCESS Introduction

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There are many proprietary mesh products on the market for open inguinal hernia repair. The Lichtenstein repair with flat mesh, the Perfix™ plug and patch, the Kugal™ patch repair and the Prolene Hernia System™ all offer low recurrence rates [1-4]. However, there are growing concerns about scar tissue and sensation of mesh [5], shrinkage [6] and chronic pain [7,8] associated with these “heavy meshes” [9]. In addition, there have been reports of mesh plug migration with injury to surrounding structures including the scrotum and bowel obstruction [10-12]. In an attempt to avoid these issues, in 2007 we began using the Ultrapro Plug and Patch from Ethicon®. This is a light weight, macroporous, partially absorbable mesh plug with an additional flat pre-peritoneal portion. Ultrapro has been studied in animals and humans with excellent results [13-15]. It has become a commonly used mesh product with 17, 704 units being sold in the U.S in 2013.

After performing several cases with the Ultrapro plug, we began slitting the anterior onlay portion of the plug and suturing it around the spermatic cord just medial to the internal ring. This secured the mesh around the spermatic cord and maintained the plug in the internal inguinal ring. The mesh patch was also slit in the usual manner. The tails of the patch were then sewn together, to the plug and to the inguinal ligament just lateral to the spermatic cord. We call this the “double slit” technique. This technique has not been reported in the literature. We hypothesize that this mesh repair can be done with similar recovery and equal or better recurrence and complication rates when compared to other mesh repairs. Therefore, we performed a retrospective review of patients who underwent indirect inguinal hernia repair using the Ultrapro™ plug and patch mesh and a “double slit” technique to confirm the feasibility of this technique as well as a prospective analysis of long term outcomes including recurrence and quality of life measures.

### Methods

Upon Institutional Review Board approval, all patients who had undergone open repair of an

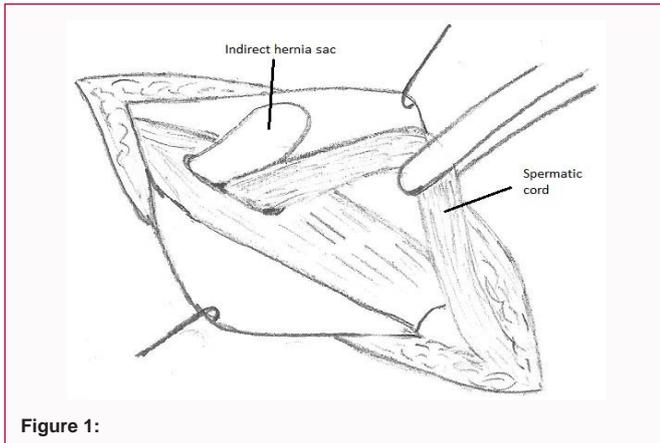


Figure 1:

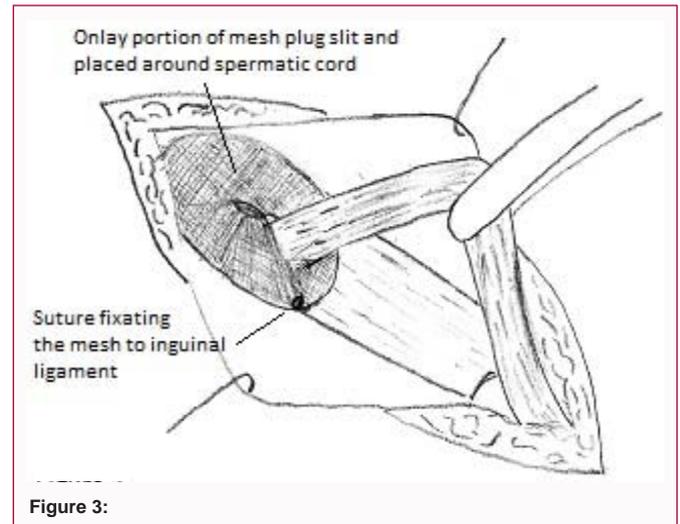


Figure 3:

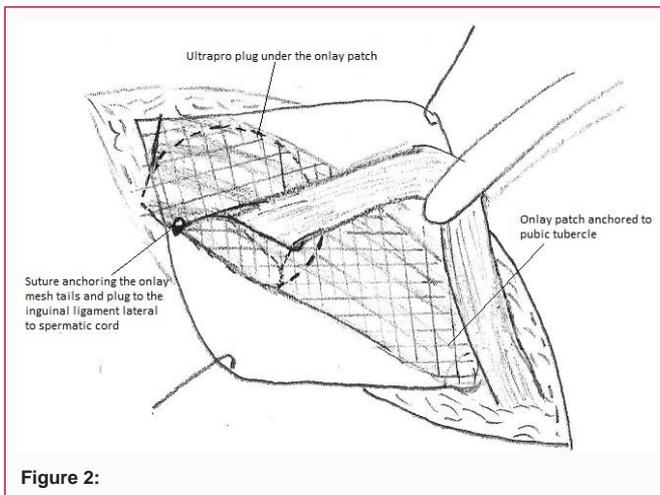


Figure 2:

indirect inguinal hernia using the Ultrapro mesh and the “double slit” technique between June 1, 2007 and November 1, 2012 at a single institution by one surgeon were contacted. Written consent was obtained for retrospective analysis of operative data as well as an additional office visit for prospective collection of long term follow up data. Inclusion criteria included males who were at least 18 years of age and at least 6 months out from the operation. Chart review was conducted to obtain retrospective perioperative and short term follow-up data. Long term outcome data was obtained prospectively at the additional office visit by having the patient complete a Carolina Comfort Scale and be examined by the operating surgeon. This data was then analyzed with particular attention to chronic pain and incidence of recurrence.

## Surgical Technique

The patient was placed supine. The affected groin was prepped and draped in standard sterile fashion. Lidocaine 2% mixed equally with Marcaine 0.5% with epinephrine was used to anesthetize the skin and deep tissues over the inguinal ligament. A barrier drape was then placed. An oblique incision was created and dissection was carried down through the soft tissues to expose the aponeurosis of the external oblique which was then opened through the external inguinal ring. The ilioinguinal nerve was identified, dissected free from the cord and fascia, and either allowed to run along the spermatic cord or divided if it was going to be compromised by the mesh patch. The spermatic cord was mobilized anteriorly and cephalad and encircled with a Penrose drain. The indirect hernia sac was mobilized from the

surrounding cord structures using careful cautery, dissected high into the internal ring and dunked into the pre-peritoneal space (Figure 1). The Large Ultrapro plug was inserted into the defect and the blue underlay ring was spread out in the pre-peritoneal space. The plug was secured superiorly and superolaterally with two interrupted 2-0 Ethibond sutures through the overlay ring of the plug and the muscle. The medial portion of the overlay ring was slit and brought around the spermatic cord. The ends were sutured together around the cord and to the inguinal ligament, medial to the internal ring (Figure 2). The patch was cut and laid over the floor of the inguinal canal and the medial end was anchored to the pubic tubercle. The tails were placed around the spermatic cord and sewn together with a bite through the plug and the inguinal ligament lateral to the inguinal ring (Figure 3). The external oblique aponeurosis was closed along with Scarpa's fascia the dermis and epidermis.

## Results

A total of 125 patients qualified for the study and 24 consented to participate in the follow-up exam. The average hernia size was 1.9 cm and the Large Ultrapro plug was used in all patients. The average operative time was 43.9 min. One patient was admitted due to transient leg numbness and weakness due to local anesthesia injection. There were no early complications. Over an average follow-up of 21 months, there were no recurrent hernias. On exam no patients had palpable mesh, 17 (70%) had no palpable scar tissue, 4 (17%) had very minor (1/5) scar tissue palpable, and 3 (13%) had moderate (2 or 3/5) palpable scar tissue (Table 1). At follow up, 18 (79.3%) reported no groin pain (0/10) while 4 (16.6%) had mild groin pain (1/10), and one had (4.1%) moderate groin pain (4/10), none of the patients experienced testicular pain (Table 2). Carolinas Comfort Scale was given to all patients and revealed very minimal pain, mesh sensation and movement limitations (Table 3).

## Discussion

Inguinal hernia repair is one of the most common procedures performed in the world and the majority is done using an open approach. Tension free mesh repair became the gold standard in the late 1980's when the Lichtenstein repair brought the recurrence rate to near 1% [1]. This was re-affirmed in 2007 when Van Veen published results of a randomized clinical trial of non-mesh versus mesh after a ten year follow-up showing recurrence rates of 17% and 1% respectively [16]. Since then, many proprietary mesh products have

**Table 1:** Palpable mesh or scar on exam.

Palpable mesh
100% had no palpable mesh
Palpable scar tissue
70% had very minor (1/5) palpable scar tissue
3% had moderate (2 or 3/5) palpable scar tissue

**Table 2:** Chronic groin or testicular pain.

18 (79.3%) no groin pain (0/10)
4 (16.6%) mild groin pain (1/10)
1 (4.1%) moderate groin pain (4/10)
No patients experienced testicular pain

**Table 3:** Carolinas Comfort Scale.

Table 1 - Summary of CCS scores (N=24)						
Domain	Sensation of mesh		Pain		Movement limitations	
	Mean	SD	Mean	SD	Mean	SD
Laying down	0.13	0.34	0.13	0.34	-	-
Bending over	0.17	0.38	0.13	0.34	0.08	0.28
Sitting up	0.17	0.38	0.21	0.51	0.04	0.20
ADL	0.25	0.44	0.29	0.55	0.04	0.20
Coughing or deep breathing	0.13	0.34	0.13	0.34	0.08	0.28
Walking	0.04	0.20	0.33	0.76	0.08	0.28
Stairs	0.17	0.38	0.25	0.53	0.08	0.28
Exercise	0.29	0.55	0.58	0.88	0.13	0.45
<b>Global</b>	<b>1.33</b>	<b>2.51</b>	<b>2.04</b>	<b>3.26</b>	<b>0.54</b>	<b>1.69</b>

Total CCS Score Mean=2.92±6.60

The best possible score for each domain is 0 and the worst possible score is 5  
 The best possible score for global sensation of mesh is 0 and the worst possible score is 40

The best possible score for global pain is 0 and the worst possible score is 40

The best possible score for global movement limitation is 0, the worst possible score is 35

The best possible total CCS score is 0 and the worst possible score is 115

been developed to facilitate open inguinal hernia repair, including: Perfix™ plug and patch (C.R. Bard, Inc. Murray Hill, NJ), Kugal™ patch repair (C.R. Bard, Inc. Murray Hill, NJ), Prolene Hernia System™ (Ethicon, Inc. Somerville, NJ), Pro-loop™ mesh (Atrium Medical Corp. Hudson, NH), Progrid™ (Covidienns, Dublin, Ireland) and Bio A™ (W.L. Gore and Associates, Inc. Newark, DE). However, these are all considered heavy weight mesh 85-110 gm/m<sup>2</sup> and have small pores. Since recurrence rates with these repairs are similar, the surgical community began looking at other outcome measures, most notably chronic pain and mesh foreign body sensation. Multiple randomized controlled trials have been done comparing lightweight and heavyweight mesh in inguinal herniorrhaphy. In a systematic review and meta-analysis of these trials Sajid found that there was no difference in recurrence or complications, but the use of LWM was associated with a reduced risk of developing chronic groin pain and foreign body sensations [17]. Due to the increased risk of chronic groin pain and other complications related to heavyweight mesh plug repair, we began using the Ultrapro Plug™ (Ethicon, Inc. Somerville, NJ) and patch which is a lightweight macroporous partially absorbable mesh. To facilitate the fixation of the plug in the setting of an indirect inguinal hernia repair, the onlay portion of the plug is cut and placed around the spermatic cord and sewn to the inguinal ligament. This

makes the plug lay flat on the muscle and holds the pre-peritoneal portion near the cord, theoretically reducing the chance of the plug becoming displaced anteriorly or migrating. We placed the onlay portion in a similar manner to the Perfix plug repair with 1 cm overlap of the pubic tubercle and usually an anchoring stitch in the fascia. We slit the mesh and re-approximated the tails lateral to the spermatic cord, forming a new internal ring. The lateral stitch was through the onlay and the plug, with the intent of preventing plug migration and inferolateral recurrence of the indirect hernia sac.

Our average operating time was 44 minutes, indicating that the double slit technique is easy to perform. Despite sewing two pieces of mesh around the spermatic cord, there were no cases of spermatic cord edema or testicle pain after this repair. In addition, it is a very secure repair as indicated by the zero recurrence rate in our study. The partially absorbable nature of the mesh may be beneficial as well. Scar tissue could not be palpated in 70% of patients on follow-up exam and was minimal in 17%. The mesh was not palpable in any patient at follow up exam. Using the Carolina Comfort Scale, patients had very little sensation of the mesh, pain or limitation in movement. Finally we report a rate of significant chronic pain (pain >2/10) of 4.5%, where the literature reports up to 30%. The major limitation of this study is the low number of follow-up patients. However, based on these results, we are planning a prospective randomized trial to further study this mesh and technique.

**Conclusion**

Indirect inguinal hernia repair using the Ultrapro Plug™ and the “double slit” technique is an effective method of inguinal hernia repair offering: ease of use, no recurrences, no testicular pain or injury, less than 5% incidence of significant chronic pain, and no cases of mesh migration or significant sensation of the mesh. A prospective randomized controlled trial comparing this to other open mesh repairs is indicated.

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