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Review Article

The Prolene Hernia System Repair for Inguinal Hernia Repair: An Update: Narrative Review Article

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Abstract: Inguinal hernia repair is among the most performed operations worldwide, and mesh-based tension-free techniques have become the standard of care because of their low recurrence rates and favorable postoperative outcomes. The Prolene Hernia System (PHS), introduced by Gilbert, consists of a bilayer polypropylene mesh designed to reinforce both the posterior preperitoneal space and the anterior inguinal floor through a single anterior approach. The theoretical advantages of the PHS include comprehensive coverage of the myopectineal orifice, reduced recurrence risk, minimal tissue tension, and improved biomechanical support. Several randomized controlled trials and observational studies have compared PHS with Lichtenstein repair and other mesh-based techniques. Current evidence demonstrates comparable recurrence rates, chronic pain outcomes, and complication profiles, while some studies suggest shorter operative times and faster convalescence with PHS. Although laparoscopic and robotic approaches have gained popularity, PHS remains a valuable open repair option, particularly in selected patients undergoing primary unilateral inguinal hernia repair. This review examines the Prolene hernia system and compares it with the Lichtenstein and plug mesh repair.

Keywords: Prolene Hernia System, Open Hernia Repair, Tension-Free Repair, PHS, Inguinal Hernia, Chronic Pain, Recurrence.

INTRODUCTION

The Prolene Hernia System is a bilayer patch device developed by Gilbert to treat inguinal hernia. This bilayer polypropylene mesh consists of an in-lay mesh and an over-lay mesh connected in the middle. The underlay patch provides a posterior mesh repair, while the connector functions as a plug repair, and the on-lay patch covers the posterior and lateral wall of the inguinal canal. The on-lay patch is then anchored with a few sutures to stabilize it. Gilbert performed this repair on 759 patients, with 512 patients undergoing local anesthesia and 244 patients under regional anesthesia. There were no reported recurrences, and seroma formation was seen in 4.2% of the cases, and wound infection was seen in 0.7% of the cases(Gilbert *et al*., 1999). The Prolene Hernia System has the advantage of the position of the underlay patch that sits in the preperitoneal space and can be used to treat direct and indirect inguinal hernias and femoral hernias. The underlay patch is not sutured and can contour the shape of the abdominal cavity(Awad & Fagan, 2004).

The European Hernia Society guidelines for the treatment of inguinal hernia in adults have recommended the Prolene Hernia System as an alternative to the Lichtenstein inguinal hernia repair(Simons *et al*., 2009). The Hernia Surge guidelines for the management of inguinal hernia in adults by the Australasian Hernia Society have not recommended the Prolene hernia system for the surgical management of inguinal hernias in adults due to the excessive use of foreign material and the extensive dissection of the anterior and posterior planes of the repair, which can predispose to complications, and the increased cost that is incurred when using this type of mesh(Tran, 2018).

This review article aims to examine the Prolene Hernia System in the surgical management of inguinal hernias in adults. We compare the Prolene Hernia System with other mesh-based repairs like the

Lichtenstein and Plug mesh repair, and laparoscopic inguinal hernia repairs, focusing on complications, chronic pain, and recurrence rates. A comprehensive literature review was conducted using PubMed, Google Scholar, Semantic Scholar, and Cochrane databases to identify original research studies, observational studies, clinical trials, clinical reviews, review articles, systematic reviews, and meta-analyses from 1990 to 2026. The search employed the following keywords: "Prolene Hernia System," "Open hernia repair," "tension-free repair," "PHS," Inguinal hernia", "chronic pain," and "recurrence." All articles were in English, and additional articles were identified through manual cross-checking. Case reports, commentaries, and editorials were excluded, while all articles involving adult patients were included in this review.

DISCUSSION

Prolene Hernia System

Berende *et al*., conducted a retrospective study on the Prolene hernia system for treating inguinal hernia in adults. The study included 217 patients, and postoperative hematoma formation occurred in 1.3% of cases. After a follow-up of 32 months, the recurrence rate was 1.8%, and the incidence of chronic pain was seen in 3.2% of the cases(Berende *et al*., 2007). Yener *et al*., looked at the quality of life following the Prolene hernia system hernioplasty for adult inguinal hernia.30 patients were included in this study, and superficial wound discharge was seen in 10% of the cases; after a follow-up of 8 years, the recurrence rate was 3.3%, and the incidence of chronic pain was 6.6%(Yener *et al*., 2012). A retrospective study on the Prolene hernia system for inguinal hernioplasty was conducted by Mayagoitia *et al*., A total of 125 patients had undergone the Prolene hernia system repair, and after a follow-up of 27.5 months, there were no recurrences, and chronic pain was seen in one patient(Mayagoitia, 2004). Mottin *et al*., conducted a retrospective study on the Prolene hernia system for the management of inguinal hernia. A total of 96 patients were included in this study, and postoperative wound infection was seen in 2.8% of cases, at a follow-up of 49 months; the recurrence rate was 1.04%, and the chronic pain rate was 2.08%(Mottin *et al*., 2011).

Faraj *et al*., conducted a retrospective analysis of the Prolene Hernia System for the treatment of inguinal hernia in adults. There were 150 patients in this study, and after a follow-up of 5.5 years, the recurrence rate was 2.3%, and the chronic pain incidence was 1.8%(Faraj *et al*., 2010). A retrospective study on the long-term outcomes of the Prolene hernia system in inguinal hernia treatment in adults was conducted by Hasegawa *et al*., A total of 367 patients were included in this study; postoperative complications were observed in 5.5% of the cases, the recurrence rate was 1.8%, and chronic pain was seen in 1.9% of the cases(Hasegawa *et al*., 2006). Farrakha *et al*., conducted a study on the feasibility of the Prolene hernia system for treating inguinal hernia in adults. A total of 154 patients were included in this study, and superficial wound infection was seen in 5% of the cases, and scrotal edema was seen in 3.4% of the cases(Farrakha *et al*., 2006). Obaid *et al*., also conducted a retrospective study on the Prolene hernia system in the management of inguinal hernia in adults. A total of 42 patients were included in this study, and the wound infection rate was 4.6%, and there were no recurrences after 2 years of follow-up(Obaid & Quazi, 2017).

Comparison of the Prolene Hernia System and the Mesh Plug and Lichtenstein Hernia Repair for Inguinal Hernia in Adults

The Prolene hernia system was compared with the Lichtenstein repair for inguinal hernia in adults by Badkur *et al*., This randomized prospective study included 67 patients who were randomized to 33patients who underwent the Prolene hernia system and 34 patients who underwent the Lichtenstein repair. The Prolene hernia system was associated with a longer operative time, but the postoperative pain was reduced when compared to the Lichtenstein repair (15.15%vs 41.18%). There were no differences regarding recurrence and chronic pain between the procedures(Badkur & Garg, 2015). A prospective randomized clinical trial comparing the Prolene hernia system and the Lichtenstein repair for inguinal hernia was conducted by Pierides *et al*., A total of 300 patients were randomized to 150 patients who underwent the Prolene hernia system and 150 patients who underwent the Lichtenstein repair. There were no differences regarding chronic pain between the procedures (9.8% vs 12.7%), and the recurrence rates after a follow-up of 5 years were 8% in the Prolene hernia system and 1.7% in the Lichtenstein repair(Pierides & Vironen, 2011).

A meta-analysis comparing the Prolene hernia system and the Lichtenstein repair for inguinal hernia was conducted by Decker *et al*., A total of 7 studies with 1377 patients were included in this study, and there were no differences regarding the recurrence rate (OR=0.86, 95% CI, 0.32-2.88) and chronic pain (OR-1.00,95%CI,0.65-1.55) between the procedures. The Prolene hernia system was associated with a shorter return to normal activity (MD-0.54,95%CI,1.07-0.11). This study showed that both the Prolene hernia system and the Lichtenstein repair were associated with comparable outcomes(Decker *et al*., 2019). A meta-analysis of randomized controlled trials on the open mesh techniques for inguinal hernia repair was conducted by Zhao *et al*., A total of 10 trials with 2708 patients were included in this study, and there were no differences regarding the recurrence rate between the Lichtenstein, Prolene hernia system, and mesh plug repair (RR-0.71,95%CI,0.32-1.56). This study showed that the Prolene hernia system, plug mesh, and Lichtenstein repair were equally effective for the treatment of inguinal hernia in adults(Zhao *et al*., 2009). Another meta-analysis of randomized controlled trials that compared the open tensionless repair techniques for

inguinal hernia in adults was conducted by Ran *et al*., the Prolene hernia system, mesh plug, and the Lichtenstein repair had comparable postoperative complications, recurrence rates, and chronic pain rates(Ran *et al*., 2020).

Hayashi *et al*., retrospectively assessed the outcomes of the Prolene hernia system and the Mesh plug for the treatment of inguinal hernia in adults. A total of 1141 repairs were performed (Prolene hernia system-957, Plug mesh-154), and the wound infection rate (1.3% vs 3.8%) and recurrence rate (1.5% vs1.1%) were similar between the procedures(Hayashi *et al*., 2014). A prospective randomized controlled trial comparing the Prolene hernia system, the plug mesh, and Lichtenstein repair for primary inguinal hernia in adults was conducted by Dalenback *et al*., 472 patients were divided into 155 patients who underwent the Prolene hernia system, 159 patients who underwent the Plug mesh, and 158 patients who underwent the Lichtenstein repair. There were no differences in postoperative complications, recurrence rates, and chronic pain between the procedures. Both the Prolene hernia system and Plug mesh were associated with a shorter operative time(Dalenbäck *et al*., 2009). A randomized controlled trial comparing the Prolene hernia system and the Lichtenstein repair for inguinal hernia repair was conducted by Sanjay *et al*., A total of 64 patients were included in this study, with 31 patients undergoing the Prolene hernia system and 33 patients undergoing the Lichtenstein repair. There were no differences regarding postoperative complications, recurrence rate, and chronic pain(Sanjay *et al*., 2006).

Sanjay *et al*., conducted a meta-analysis comparing the Prolene hernia system with the Lichtenstein repair for open inguinal hernia repair. A total of 6 studies with 1313 patients were included in this study, and the Prolene hernia system had higher postoperative complications compared to the Lichtenstein repair (RR=0.71, 95% CI, 0.55-0.93). There were no differences regarding recurrence rates and chronic pain between the procedures(Sanjay *et al*., 2012). A randomized double-blind study comparing the Prolene hernia system and Lichtenstein repair was conducted by Kingsnorth *et al*., There were 206 patients in this study who were randomized, with 103 patients who underwent the Prolene hernia system and 103 patients who underwent the Lichtenstein repair. The Prolene hernia system was associated with a shorter operative time and reduced postoperative complications when compared to the Lichtenstein repair(Kingsnorth *et al*., 2002). Huang *et al.,* conducted a prospective study comparing the Prolene hernia system with the mesh plug repair in inguinal hernia. There were 393 patients in this study, with 234 patients undergoing the Prolene hernia system and 192 patients undergoing the mesh plug repair. The Prolene hernia system was associated with reduced post-operative pain but longer operative time when compared to the Mesh plug repair. The recurrence rate was similar between the groups(Huang *et al*., 2005).

A randomized clinical trial comparing the Prolene hernia system, mesh plug repair, and the Lichtenstein repair for open inguinal hernia repair was conducted by Nienhuijs *et al*., A total of 344 patients were randomized to 111 patients who underwent the Prolene hernia system,113 patients who underwent the mesh plug repair, and 110 patients who underwent the Lichtenstein repair. There were no significant differences regarding postoperative pain and quality of life between the procedures(Nienhuijs *et al*., 2005). Magnusson *et al*., conducted a prospective randomized controlled trial comparing the Ultrapro Hernia system, the Prolene hernia system, and the Lichtenstein repair for inguinal hernia repair. A total of 309 patients were included in this study, with 99 patients undergoing the Prolene hernia system,108 patients undergoing Lichtenstein repair, and 102 patients undergoing Ultrapro repair. After 3 years of follow-up, there were no differences regarding the postoperative complications and recurrence rates between the procedures(Magnusson *et al*., 2016).

Table I

Study	Study Type	Comparison of repair	Complications	Recurrence	Chronic Pain
Badkur *et al*., 2015	Randomized prospective study	Prolene Hernia System-(PHS) vs Lichtenstein	Early complications: 15.2% PHS vs(41.1%) Lichtenstein	No differences in recurrence rates between the procedures	1/33 (3.0%) PHS vs 2/34 (5.9%) Lichtenstein
Pierides *et al*., 2011	Randomized clinical trial	PHS vs Lichtenstein	Long-term sensory dysfunction: 5% PHS vs 14% Lichtenstein (P=0.022)	0.8% PHS vs 1.7% Lichtenstein at 5 years	Chronic pain at 5 years: 11% overall; no significant difference between groups
Decker *et al*., 2019	Meta-analysis	PHS vs Lichtenstein	No difference in complications	No difference (OR 0.86, 95% CI 0.32-2.28)	No difference (OR 1.00, 95% CI 0.65-1.55)
Sanjay *et al*., 2012	Meta-analysis	PHS vs Lichtenstein	Higher peri-operative complications with PHS; RR favoring	No significant difference	No significant difference

Study	Study Type	Comparison of repair	Complications	Recurrence	Chronic Pain
			Lichtenstein = 0.71 (95% CI 0.55-0.93)		
Zhao *et al*., 2009*	Meta-analysis	PHS vs Lichtenstein vs Mesh Plug	Not readily identifiable from accessible sources	No significant difference reported in pooled analyses	No significant difference reported in pooled analyses
Ran *et al.,* 2020	Meta-analysis	Mesh Plug vs Lichtenstein vs Mesh Plug	No significant difference in seroma, hematoma, infection, or overall postoperative complications	No significant difference (P=0.77)	No significant difference (P=0.90)

Table showing the recurrence rates and chronic pain between the Prolene hernia system, Lichtenstein repair, and Plug mesh repair

Comparison of the Prolene Hernia System and the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal Repair (TEP)

A retrospective study comparing the Prolene hernia system with the transabdominal preperitoneal (TAPP) for primary inguinal hernia repair was conducted by Abdelhamid *et al*., 250 patients were included in this study, with 200 patients undergoing the Transabdominal Preperitoneal (TAPP) and 50 patients undergoing the Prolene hernia system. The recurrence rates between the TAPP and Prolene hernia system were similar (1.5% vs 4.5%), but the Prolene hernia system was associated with a shorter operative time and reduced cost(Salah Abdelhamid, 2017). Susmallian *et al*., conducted an observational study comparing the Total Extraperitoneal (TEP) repair with the Prolene hernia system for inguinal hernia repair. A total of 577 patients were included in this study, with 293 patients undergoing total extraperitoneal repair and 284 patients undergoing the Prolene hernia system. There was reduced postoperative pain with the Prolene hernia system, but the outcomes were similar between the total extraperitoneal repair and the Prolene hernia system(Susmallian *et al*., 2021). Choi *et al*., also compared the Total extraperitoneal repair and the Prolene hernia system for inguinal hernia repair, and the total extraperitoneal repair was associated with a shorter operative time, but it was associated with more postoperative complications like seroma and hematoma formation(Choi *et al.,* 2012).

CONCLUSIONS

The Prolene hernia system is a viable alternative to the Lichtenstein repair for the management of inguinal hernia in adults. The placement of the inlay mesh in the preperitoneal space helps to prevent recurrence, and the procedure can be performed under local or regional anesthesia. The increased complications, like hematoma formation and mesh migration, have led to a decrease in the use of this method of open tension-free inguinal hernia repair. The Prolene hernia system, however, does have a place in the management of inguinal hernia, and general surgeons can benefit from learning how to perform this procedure.

Conflict of Interest: There is no conflict of interest.

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