Original Research Article

An observational study to compare the outcomes of onlay technique with combined onlay-plug technique of mesh hernioplasty in inguinal hernia

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ABSTRACT

Background: Inguinal Hernia is a common entity in general surgical practices across the world. Its management though appears to be straightforward, could still be a nightmare for a surgeon if not dealt with proper attention and care. Lichtenstein’s mesh hernioplasty is still one of the most popular surgeries performed for inguinal hernia repair across the world. At our institute, we commonly perform this surgery with either Onlay mesh hernioplasty technique or combined Onlay-Plug mesh technique. The double mesh placement had always kept us engaged in regards to its post-operative outcomes and its advantage over single onlay mesh. We were also keen to take the subject due to the scarce availability of the recent literature.

Methods: This prospective observational study was conducted in the Department of Surgery, Dr. Hedgewar Hospital, Aurangabad, Maharashtra, India on 200 patients who were randomly and equally divided into two groups. Patients in Group A underwent Onlay mesh hernioplasty surgery, while patients in Group B underwent combined Onlay-Plug mesh hernioplasty surgery. Post-operative outcomes were assessed in both groups for a period of six months.

Results: There was a significant difference between the two groups in terms of post-operative pain, scrotal edema, cord tenderness, and wound infection as patients in Group 2 who underwent combined Onlay-Plug mesh repair were found to have more incidences of the above-mentioned post-operative outcomes.

Conclusions: Single Onlay mesh placement is sufficient. There is no significant benefit of keeping an additional Plug/Inlay mesh in patients undergoing tension-free mesh inguinal hernioplasty as per our findings.

Keywords: Mesh inguinal hernioplasty, Onlay mesh repair, Plug mesh repair, Inlay mesh repair, Chronic inguinodynia, Mesh hernioplasty complications

INTRODUCTION

Hernia term is of Latin origin meaning rupture. A hernia is defined as an abnormal protrusion of an organ or tissue through a defect in its surrounding walls. These defects most commonly involve the inguinal region of abdominal wall. The site of abdominal wall hernias is usually the one where the aponeurosis and fascia are not covered by striated muscle. The neck of a hernia lies at musculoaponeurotic layer, whereas the hernia sac is lined by peritoneum and protrudes out of the neck. Inguinal hernias are classified as direct or indirect. An indirect inguinal hernia begins from the internal inguinal ring, traverses through external inguinal ring and thereby leads into the scrotum. However direct inguinal hernia protrudes outward and forward and lies medial to the internal inguinal ring and inferior epigastric vessels. About 75% of all hernias occur in the inguinal region two
thirds of which are indirect types. In men, indirect hernias predominate over direct hernias at the ratio of 2:1.

The tension-free repair using a synthetic mesh prosthesis is the most commonly employed method of inguinal hernia repair, a concept popularized by Lichtenstein. In the Lichtenstein repair, a prosthetic nonabsorbable mesh piece is used to cover the defect. Monofilament nonabsorbable suture is used to fix the mesh, from pubic tubercle to superior aspect above the internal inguinal ring. On the medial aspect, the mesh is sutured to the aponeurotic tissue which overlies the pubic tubercle, continuing along the transversus abdominis or conjoined tendon superiorly. The inferolateral edge of the mesh is sutured to the iliopubic tract. A slit is made and the tails created are fixed together around the spermatic cord forming a new internal inguinal ring. This technique is referred to as Onlay technique in this study.

Gilbert introduced use of cone-shaped plug of polypropylene mesh which when inserted into the internal inguinal ring would occlude the hernia. This plug is sewn to the surrounding tissues and held in place by an additional overlying mesh patch. It is this plug repair that we are referring here in Inlay technique. Later Rutkow and Robbins popularized plug and patch technique of hernia repair (Onlay + plug).

**Objective**

To compare the post operative outcomes (recurrence, pain, wound infection, seroma, scrotal edema, cord tenderness) of Onlay technique with combined Onlay-Plug technique of mesh inguinal hernioplasty and find if there exists any additional benefit of putting a plug/inlay mesh.

**METHODS**

A prospective study was carried out on a sample size of 200 patients who visited surgery OPD of Dr. Hedgewar Hospital within the study time period of eighteen months and were posted for an elective mesh inguinal hernioplasty surgery. All the cases were thoroughly examined and investigated to be considered appropriate to be a part of this study. The patients were randomly divided into two equal groups of 100 each (groups A and B). All patients underwent preoperative anesthesia evaluation and post-operative follow-up under similar clinical standards. Similar mesh and suture materials were used across both groups.

Outpatient clinical notes, discharge summary, operative notes, and laboratory data were reviewed. All patients were discharged on Day 3 post-operatively.

Patients in both the groups were followed up for a period of 6 months to assess the outcomes and a comparison was established.

**Inclusion criteria**

All patients within the age group of 18-59 years, patients with unilateral indirect inguinal hernias of bubonocele and funicular variety and unilateral direct inguinal hernias, primary cases with no previous history of hernia, patients undergoing elective Lichtenstein’s tension-free open repair surgery and male sex only.

**Exclusion criteria**

Complete inguinoscrotal variety of inguinal hernias, bilateral inguinal hernia and all other types of hernias which do not fall into the defined case criteria, patients with previous history of hernia at the same site or any other site, Immunocompromised status or patients with any other significant co-morbidities which may have altered the interpretations of this study, any case with emergency component and laparoscopic procedures.

**Sample size formula**

The sample size was derived after the statistician’s opinion and calculations based on the previously available studies such as the one conducted by Singh et al in 2016. The collected data was entered in microsoft excel and analyzed using Statistical package social sciences (SPSS) version 24.0th. Mean and SD was calculated for quantitative variables and proportions were calculated for categorical variables. For Comparison of two group outcomes paired test was applied. P-value was checked at a 5% level of significance.

**Interventions**

Patients in Group A were subjected to Onlay technique of Lichtenstein tension free hernia repair procedure wherein instead of suturing anatomical structures that are not in apposition, the entire exposed length of inguinal floor is reinforced by a sheet of prolene mesh placed between the layers of transversalis fascia and external oblique aponeurosis (Figure 1).

Patients in Group B were subjected to a Plug/Inlay technique wherein a piece of prolene mesh was placed between the edges of the defect and sutured through thereby serving as a bridge to the gap, popularly known as Plug mesh repair (Figure 2). An onlay mesh was also kept over the inguinal floor thereby achieving a double mesh repair.

**RESULTS**

There was a significant difference between the two groups in terms of post operative pain as measured on Visual analogue scale (VAS) at post-operative day one, day seven, one month, three months, and six months respectively with the median VAS being highest in Group B at each time point (Figure 3).
None of the participants in Group A had surgical site infection while 2.0% of the participants in Group B had developed surgical site infection. However, no significant difference between the groups in terms of distribution of SSI ($\chi^2=2.020$, $p=0.497$) could be established.

Figure 1: Onlay mesh repair.

There was a significant difference between the two groups in terms of distribution of Scrotal Edema ($\chi^2=10.009$, $p=0.002$). 9.0% of the participants in Group A had scrotal edema while 26.0% of the participants in Group B had scrotal edema. Hence participants in Group B had a larger proportion of scrotal edema than Group A (Figure 4).

Figure 4: Scrotal edema association with study groups.

None of the participants in our study had post operative seroma or recurrence. A summary of cross-sectional analysis between the two groups and various parameters is shown in Table 1.

Figure 3: Post-operative pain as VAS between two groups.

There was a significant difference between the two groups in terms of distribution of post-operative Cord Tenderness ($\chi^2=7.254$, $p=0.014$). 7.0% of the participants in Group 2 had Cord Tenderness (Figure 5).

Figure 5: Post operative cord tenderness across study groups.
DISCUSSION

Different types of repairs have been described for inguinal hernia but due to conflicting opinions the efforts to find new techniques are still going on. The main factor underlying these searches is to decrease the recurrence rates and common post-operative complications. Other factors to consider are applicability, hospital stay, and overall cost-effectiveness of the techniques. All the failures in surgical reconstruction techniques were ascribed to the basic principle, the tension on the suture line. With the use of modern prosthetic materials, it has now become feasible to perform all hernia repairs with minimal alteration in the normal anatomy and without tension.

Chronic (post-operative) groin pain or Mesh inguinodynia is defined as the pain lasting for more than 3 months after surgery and interfering with the patient’s activities of daily living. It is estimated that around 8%-16% of the patients getting operated for hernia continue having chronic pain to an intensity that impairs their routine activities for six months post-surgery. The cause of chronic pain following inguinal hernia surgery can be multifactorial and often it is not possible to identify a particular reason in these patients. Somatic or nociceptive pain is usually the most frequent. Causes include ligament injury or muscle injury due to the surgery, aggressive scarification reaction, osteitis pubis, or a vigorous inflammation of the pubic tubercle.

Rare causes may include reactions to the prosthetic mesh/material. Neuropathic pain is due to direct nerve damage or injury caused intraoperatively. Technical issues may be there, including the incorporation of nerves with staples, sutures, or mesh. The nerves commonly involved are ilioinguinal, iliohypogastric, genital branch of the genito-femoral nerve, and lateral femoral cutaneous nerve. Classic symptoms include hypoesthesia or hyperesthesia, allodynia, and paresthesia along the sensory distribution of the affected nerve. Visceral pain may have an intestinal origin. Preperitoneal tissue compromise may take place from mesh placement. Apart from these, dysuria and other genitourinary problems like dysejaculation syndrome and erectile dysfunction may contribute to visceral pain. Use of lightweight meshes has been linked to an overall lower risk of chronic pain following the Lichtenstein repair technique. A wide range of interventions can be tried for chronic pain following inguinal hernia surgery including watchful waiting, pharmacological treatments, local anesthetic blocks, sensory stimulation or ablation of nerves, and surgery (mesh removal, reoperation for recurrence, and neurectomy). Thus, chronic pain is a frequent and equally important aspect as it affects walking, work, sleep, interpersonal relationships, and mood, and therefore must thoroughly be investigated and managed.

In our study, a comparison of pain in terms of VAS on day 1 and day 7 post-operatively revealed a significant difference between the two groups. The mean of VAS on day 1 was 4.46 in Group A and 5.12 in Group B whereas the mean of VAS on day 7 was 3.11 in Group A and 3.90 in Group B. Similarly, a comparison of pain in Terms of VAS on 1 month, 3 months, and 6 months post-operatively revealed a significant difference between the two groups. As per our findings, patients in Group B who underwent combined Onlay with Inlay mesh repair had a longer duration of post-operative pain/chronic inguinodynia. However, Rana et al in 2016, reported post-operative pain complaints in 8% of the patients in Lichtenstein’s group and 4% of patients in the plug and patch group. Similarly Gupta et al in 2019, compared three different techniques of hernia surgery- Rutkow-Robbins repair, Gilbert double repair, and Lichtenstein operation and found no statistically significant difference between the three groups at days 1, 7, and 30 with regard to post-operative pain.

Seroma is collection of fluid at the site of inguinal hernia surgery usually seen after 7-10 days of surgery and presenting as a fluctuating mass which can be attributed to local inflammatory response against mechanical injury incurred by tissue dissection during surgery, presence of foreign body like mesh prosthesis and sutures and wide dissection causing a larger dead space. Spontaneous

Table 1: Summary of cross-sectional analysis between group and parameters.

| Parameters                  | Group   | P value |
|-----------------------------|---------|---------|
|                            | A (n=100) | B (n=100) |       |
| VAS (day 1)***              | 4.46±0.80 | 5.12±0.81 | <0.001^ |
| VAS (day 7)***              | 3.11±0.63 | 3.90±0.76 | <0.001^ |
| VAS (1 month)***            | 0.13±0.34 | 0.38±0.65 | 0.002^  |
| VAS (3 months)***           | 0.01±0.10 | 0.18±0.52 | 0.001^  |
| VAS (6 months)***           | 0.01±0.10 | 0.11±0.42 | 0.030^  |
| Seroma (yes)                | 0 (0.0%)  | 0 (0.0%)  | 1.000^  |
| SSI (yes)                   | 0 (0.0%)  | 2 (2.0%)  | 0.497^  |
| Scrotal Edema (yes)***      | 9 (9.0%)  | 26 (26.0%)| 0.002^  |
| Cord tenderness (yes)***    | 0 (0.0%)  | 7 (7.0%)  | 0.014^  |
| Recurrence (yes)            | 0 (0.0%)  | 0 (0.0%)  | 1.000^  |
resolution of seroma within a few weeks is a rule in general however larger seromas may require aspiration. Minimizing tissue dissection and avoiding dead space formation may prevent post-operative seroma formation. It is suggested that a seroma should be considered a complication only if it persists for more than six weeks, presents continuous growth, or becomes symptomatic. In our study none of the patients had seroma. According to the study by Sriramaju et al in 2018, 1 (3.33%) case had seroma which was managed by aspiration and evacuation followed by compression dressing. As per the study by Singh et al in 2016, twelve (12%) patients in Lichtenstein and eight (8%) patients in plug and patch study group developed wound seroma in post-operative period. All these patients were reassured and seroma resolved spontaneously with time.

Surgical site infection after open inguinal repair is a rare. The reported incidence of mesh-related infections varies between 1 and 8% in different series. It is often difficult but crucial to determine whether the infection is limited to the superficial incisional layer or has involved mesh prosthesis. Most early post-operative groin hernia infections can be treated with aggressive use of antibiotics after the incision is opened and drained expeditiously. A remarkable feature of post-operative groin hernia infection involving mesh prosthesis is that it tends to present after a delayed period of 2 weeks to 3 years following surgery. The common pathogens involved in mesh infections are Staphylococcus species, streptococcus spp, gram-negative bacteria (mainly Enterobacteriaceae), and anaerobic bacteria. In our study 2.0% of the participants in Group B had SSI. Both the participants presented in our OPD after six months of surgery with complaints of persistent groin pain. We performed an ultrasonographical examination and confirmed the presence of a sinus tract in both cases originating deep from the inlay mesh site. In 2000, Hatada et al reported a case of late onset prosthetic infection after mesh-plug inguinal hernioplasty after three months of surgery which eventually required sinus tract excision and infected mesh removal. While in the study by Rana et al in 2016, wound infection was encountered in four (4%) patients of Lichtenstein and four (4%) patients of plug and patch hernia repair. It was corrected with antiseptic dressing along with oral antibiotics and anti-inflammatory drugs.

Post operative scrotal edema is one of the most common complications in open hernioplasty surgery. It usually responds to a conservative approach in the form of rest, scrotal support and oral medications. Previous studies have attributed various causes such as traumatic disruption of blood vessels, removal of inguinoscrotal variety of hernia causing empty cavity in the scrotum which gets filled by exudative fluids. Extensive dissection of the spermatic cord can lead to injury to the testicular artery and the delicate veins of the pampiniform plexus. A larger hernia sac would mean more dissection for skeletonization of the spermatic cord leading to more scrotal edema. Incidence of scrotal hematoma and oedema are very high in case of complete sac (Inguinoscrotal) hernia cases because sac has to separate from whole of spermatic cord starting from the base of scrotum up to the internal ring. In our study 9.0% of the participants in Group A had scrotal edema, while 26.0% of the participants in Group B had scrotal edema. This could be attributed to more tissue handling and more chances of trauma around the spermatic cord and cremasteric muscle while placing inlay mesh either in cases of indirect hernia or direct hernia. The scrotal edema in either group however settled mostly by day 7 post-surgery.

Injury to the inguinal segment of the genital branch of genitofemoral nerve may occur during removal of the cremasteric muscle layer, cord mobilization, dissection or ligation of the hernia sac, suturing of the inguinal floor, or specifically during placement of an inlay mesh (plug) ultimately contributing to significant post-operative cord tenderness. 7% participants in Group B complained of pain along the spermatic cord radiating till testes and occasionally tight aching feeling in lower abdomen and groin. On physical examination, spermatic cord tenderness was elicited. Compression of structures around spermatic cord by scar tissue or prosthetic material may explain this type of groin pain.

Causes of recurrence of inguinal hernia after surgery can be due to surgery-related, general, or local factors. Surgery-related factors include surgeon’s experience, tension-free repair technique, type of suture material, and infected surgical wound. General factors include family history, general condition and nutritional status of the patient, history of smoking and chronic cough, insufficient amount of growth factors, and other immunomodulators which halts the physiological process of granulation tissue formation and fibroblasts production resulting in decreased breaking strength of wounds. Local factors include the size of hernia, cremaster muscle and hernia sac dissection, missed hernias, mesh type, and its characteristics, suboptimal mesh placement, inappropriate mesh fixation, etc. In our study, no recurrence was observed. Our finding was consistent with that of the studies conducted by Rana et al and Destek et al.

**Limitations of the study**

The data collection was confined to a small area of the country which may not be an accurate presentation of the general population. The follow-up period of this study was relatively shorter for complications like mesh infection and recurrence which often have a delayed presentation.

**CONCLUSION**

There is a significant difference between the Onlay technique and combined Onlay- Plug technique of Mesh...
inguinal hernioplasty in terms of post-operative pain, scrotal edema, cord tenderness, and wound infection. Overall patients who underwent Onlay mesh repair had better post-operative recovery than those who underwent combined Onlay-Plug repair. Both the techniques appear to be similar in terms of post-operative seroma formation and post-operative recurrence chances since none of the patients in our study developed seroma or recurrence. It can be said that there is no additional benefit of keeping a Plug/inlay mesh in patients undergoing tension-free mesh inguinal hernioplasty, single onlay mesh placement should be enough as standard procedure.

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**Conflict of interest:** None declared

**Ethical approval:** The study was approved by the Institutional Ethics Committee

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