

Outcomes of Open Transinguinal Preperitoneal Hernioplasty in Unilateral Inguinal Hernia

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Abstract: Inguinal hernia repair is the second most commonly performed operation for General Surgeons. Several operative techniques have been described. Tension - free mesh repair has been described as the gold standard in open inguinal hernia repair. In today's scenario, the Lichtenstein Technique is the procedure of choice for open repairs. It is a tensionless repair, easy to learn and perform, with very low recurrence rates. Nowadays chronic pain is the main problem associated with the Lichtenstein procedure for inguinal hernia repair, with reported incidents of 15 - 40%. These problems can be avoided by placing a mesh in the preperitoneal plane by the transinguinal preperitoneal technique [TIPP]. Preperitoneal repairs are usually performed by the laparoscopic approach but are generally associated with a higher learning curve and cost. The preperitoneal tension - free technique [TIPP] combines the utility of the open operation technique with the advantages of minimal access procedures (small incision, preperitoneal mesh placement, avoidance of neuropathic pain). In our study, we found that transinguinal preperitoneal hernioplasty had similar results to Lichtenstein Mesh Repair in terms of operative time, duration of hospital stays, recovery time, and return to daily activities when compared with literature and published studies of Lichtenstein mesh repair.

Keywords: Transinguinal Preperitoneal Hernioplasty, inguinal hernia, TAPP, TEP

1. Introduction

The Transinguinal preperitoneal mesh repair is a simple technique which gives an approach to inguinal, femoral and obturator hernias and bears the same anatomical relationship in TEP and TAPP approaches which gives a better understanding of the TEP and TAPP procedures. **Transinguinal preperitoneal (TIPP) hernia repair (using prolene mesh) resulted in greater patient comfort with reduced post - operative pain and also decreases the number of complications and also decreases hospital stay and recurrence rates and it can be recommended for all primary unilateral inguinal hernias.**

Inguinal hernia repair is the second most commonly performed operation for General Surgeons.¹ Several operative techniques have been described. The traditional techniques are tissue - based repair and tension - free repair using an open approach. In recent times, the laparoscopic repair of inguinal hernia has been described using either a totally extraperitoneal or trans - abdominal preperitoneal (TAPP) approach. Several studies have established tension - free mesh repair as the gold standard in open inguinal hernia repair. In today's scenario, the Lichtenstein Technique is the procedure of choice for open repairs. It is a tensionless repair, easy to learn and perform, with very low recurrence rates.² However, patients undergoing hernioplasty by Lichtenstein Procedure can have wound complaints and

chronic groin pain which is often underreported.³ Nowadays chronic pain is the main problem associated with the Lichtenstein procedure for inguinal hernia repair, with reported incidents of 15 - 40%.⁴ These problems can be avoided by placing a mesh in the preperitoneal plane by the transinguinal preperitoneal technique [TIPP]. Preperitoneal repairs are usually performed by the laparoscopic approach but are generally associated with a higher learning curve and cost. Laparoscopic repair is safe and efficient. It offers the patient the advantages of minimally invasive surgery and the associated recurrence rate does not differ from that of the classic open tension - free mesh technique. It can be used as the first - line option even for the repair of inguinal hernia but is generally associated with a higher learning curve and cost.^{6, 7, 8} Lichtenstein herniorrhaphy, the open procedure used in most trials, applies a mesh on the pre - muscular layer and not in the preperitoneal space, unlike the totally extraperitoneal or TAPP laparoscopic technique. This difference in mesh location causes some discrepancies in the comparison between the two approaches, as a result of which the results may not give an exact distinction between the two. Preperitoneal tension - free technique [TIPP] combines the utility of the open operation technique with the advantages of minimal access procedures (small incision, preperitoneal mesh placement, avoidance of neuropathic pain). Transinguinal preperitoneal [TIPP] repair is a classic open anterior preperitoneal technique for tension - free herniorrhaphy, preperitoneal space by means of internal ring

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for indirect hernias or Hesselbach's triangle for direct and femoral hernias. The layer where the mesh is placed in the preperitoneal space and the regions covered by the mesh in the TIPP procedure are completely identical to those in the TAPP laparoscopic techniques. The only difference is their approach, open vs laparoscopic.⁹ In addition, the laparoscopic approach is hampered by a long learning curve¹⁰, increased cost, and higher recurrence and complication rates. TIPP avoids all these problems while retaining the benefits of preperitoneal mesh replacement. Tension-free mesh inguinal hernia repair has reduced the incidence of recurrence to 2 to 5%¹¹. The transinguinal preperitoneal (TIPP) technique seems to be associated with less chronic pain, comparable to the total extraperitoneal (TEP) technique.^{12, 13, 14} Chronic pain has significant effects on all day activities, including walking, work, sleep, relationships with other people, mood and general enjoyment of life. Thus, much effort has been put into strategies to reduce chronic pain. TIPP avoids all these problems while retaining the benefits of preperitoneal mesh placement.

Just like in TEP in the mesh is entrapped between the peritoneum and the posterior surface of the abdominal wall by intra-abdominal pressure. There is no contact with the nerves in the inguinal canal. In this study, we will study the efficacy, pain, complications and recurrence in the open transinguinal preperitoneal hernia repair.

2. Review of Literature

Sir Astley Cooper (19th century Surgeon)

"No disease of the human body, belonging to the province of the surgeon, requires in its treatment a greater combination of accurate and anatomic knowledge, with surgical skill, than hernia in all its varieties." One of the most beautiful chapters in the track rhymes of anatomy and surgery, In the history of hernia, is teemed with transmutation and shadows, ideas and realities, myths and facts. Its history is as old as human race. Since 1500 BC, Inguinal hernias have been recorded by the ancient Greeks. Hernia refers to the Greek word meaning "Offshore, a budding or bulge."

In Latin, Hernia means to tear or to rupture. **History [15, 16, 17, 18, 19]**

Hernia was first stated in Egyptian Papyrus of Ebers. 3500 years ago, abdominal binders were first used by Egyptian physicians for the conservative management of inguinal hernia. In Alexandria during the Hellenistic era, for the first time, surgery was considered for hernia repair. Cauterization was used during the hernia repair for the first time by Indian surgeons.¹⁵ The cause of herniation i.e., rupture of peritoneum and stretching of overlying fascia was first concluded by Galen in 2000 AD. Taxis and transillumination were first used by the Greek surgeons, Aulus Cornelius Celsus in 5 AD to differentiate Hydrocele. Paul of Aegina in 700 AD was the first to state the difference between complete and incomplete hernia. Surgery was forbidden in many religions such as Islam, Christianity and Buddhism. With the arrival of the Era of Renaissance, the treatment and care of the sick or the ill was dominated and monopolised by monks and priests. Due to the

widespread of Ayurveda in India, it was believed that those who come in contact with blood and pus are impure, making surgeons were considered equal to executioners, brick makers, shoe makers, Barbers. Thus, due to this misbelief, the art of surgery was passed on as family secret. This led to temporary inactivity in the development of surgery in India. The difference between femoral and inguinal hernia was given by Guy Chauliac in 1362 AD in France.

Pierre Franco, a Swiss barber surgeon was the first one to successfully treat strangulated hernia in 1556 AD. The Trendelenburg position for the conservative treatment of hernia was mentioned by Ronald of Perma in 1383 AD. The Royal Operation i.e., tying a gold thread around the sac and cord while protecting the viscera and testis was first described by Gerald of Metz. In 1412 AD.^{16, 17} The Reappearance of practice in surgery along with anatomic dissection and autopsy was seen after the Renaissance era.

Litre in 1700 AD was the first to mention the possibility of Meckel's Diverticulum as one of the hernial sac contents.

Ronsil in 1724 described obturator hernia for the first time.

Congenital hernia was mentioned by Hunter and Percival Port of London in 1778.¹⁸

Antonio Scarpa described sliding hernia for the first time in 1814.¹⁸

Frenz Casper Hasselbach (1759 - 1860) For his anatomic studies relative to groin hernia eponyms include Triangle (an anatomic space bounded by inguinal ligament, the medial margin of rectus muscle and deep or inferior epigastric artery).¹⁸

Astley Patson Cooper (1768 - 1841) the study Pupil of John Hunter whose great interest was in the study of hernia, breast and arterial surgery. In this treatise on hernia published in London in 1804 and 1807. In 1844, Anatomy and surgical treatment of abdominal hernia was published. Cooper for the first time, described the superior pubic ligament, which shares its name and transversalis fascia with full recognition of its role in the pathogenesis of hernias.¹⁸ Jules German Cloquet (1770 - 1883) allegedly dissected and sketched 345 cases of hernia. He also pointed out that the peritoneum is actually displaced and not ruptured in the formation of hernia sac. Describe the processus vaginalis is rarely closed at birth. In the early 19th century, severe sepsis and recurrence of hernia was followed after any attempt to open the inguinal Canal, despite the introduction of Anaesthesia (1846) advances made by Cloquet.¹⁸

A man with a 69 years history of inguinal hernia. The patient, Frank Lamb, was a slave in North Carolina and since he was 9 years old suffered from left inguinal hernia. Nevertheless, he was forced to hard, daily labor. As a result, an important inguino-scrotal herniary sac developed. From: Otis Historical Archives of "National Museum of Health and Medicine".¹⁹

Surgical Techniques

Darn Repairs:

Mc Arthur (1901), made pedicled strips using external oblique aponeurosis to weave the inguinal ligament and conjoint tendon.

Gallie and Le - Mesurier (1921) mentioned the use of Fascia Lata strips for suturing the muscles, inguinal ligament and the tissues of the posterior wall of inguinal ligament.

Ogilvie (1936), use floss silk lattice repair using non – absorbable material. He was followed by **Maingot (1941)**

Pratt (1948) used steel wire and Tantalum gauze by **Koontz (1950)**.

Moloney (1948), introduced the use of modern darn technique.

In the late 19th century, the basic principle of hernia repair was continued and modifications were done in Bassini's procedure.

Patch Graft Repair

The thought of exogenous or endogenous prosthesis of good tensile strength came into light when surgeons understood that the sutures didn't hold and the hernia recurred if the local tissues were weak and attenuated approximation of tissue is under tension.

Initially, natural tissues and biological materials or synthetic sheets were used as patches to fill in the gap of the posterior wall of the canal. In most of the cases where silver wire mesh was used, it either got corroded or fragmented and was rejected through chronic sinuses and led to recurrence of the hernia. **Burke (1940)**, introduced Tantalum metal sheets, which also led to recurrence of hernia due to fragmentation. As a result, surgeons started using fascia of the thigh as a natural tissue flap. Aponeurosis of external, internal oblique or rectus sheath were turned down and sutured to inguinal ligament.

Usher (1958), introduced the technique of strengthening and supporting the previously sutured repair with the help of synthetic polythene mesh prosthesis.

Lichtenstein (1947), proved that mesh could be successfully used for femoral and recurrent hernia repair. He also introduced that the only mesh patch can be used for primary hernia repair. Since then, a variety of mesh designs and placements have flourished.

Gilbert (1991), introduced **the suture less repair** of inguinal hernia. It included three factors: **i)** the internal ring is a convenient passageway to the retromuscular preperitoneal space; **ii)** prosthetic mesh provides an effective and safe barrier; and **iii)** the inherent forces of the body are sufficient to secure the mesh repair. In this technique two 'Swatches' of prosthetic mesh are required, each placed in its appropriate tissue plane. One Swatch is positioned immediately posterior to the internal ring between the peritoneum and the transversalis fascia. This instantly cures the indirect hernia by preventing the protrusion of the

peritoneal sac. The second Swatch is positioned immediately anterior to the intact posterior wall of the canal to prevent formation of an incipient direct hernia. Sutures are unnecessary as the hydrostatic and intra - abdominal pressures of the body secure both pieces of mesh in place (Pascal's law). [A]

In recent years, extensive use of woven monofilament polyamide or knitted monofilament polypropylene has been seen. Recently a bilayer patch{B} device for inguinal hernia was introduced. The polypropylene mesh device has distinctive special feature that has three components

- 1) Posterior mesh repair is provided by its underlay patch
- 2) Plug repair is done by its connector
- 3) The posterior wall upto inguinal ring is covered by its only patch.

Pre - Peritoneal Repairs

Thomas Annandale (1876) of Edinburg, was the first to present the concept of preperitoneal approach.

Lawson Tait (1883) of Birmingham, England, was the first to mention the advantage of using the median abdominal section for the treatment of hernia. **Bate (1913)**, used transversalis fascia for repairing the defect from posterior approach.

Cheatle (1920), renewed interest in the preperitoneal approach. **Henry (1936)**, advised that the technical handling of inguinal and femoral hernias can be made easier by using the preperitoneal approach. **Nyhus (1960)**, strongly recommended this technique.

Stoppa especially recommends recent preperitoneal approach for problematic cases in which repeated repairs of multiple recurrent hernia have caused the weakening and scarring of the tissue, destroying the normal anatomy of it.

Laparoscopic Inguinal Hernia Repair

The ideal way of providing durable low morbidity repair of inguinal hernia is still an argument.

Arregui (1991), mentioned the transabdominal preperitoneal approach with full exposure of the inguinal floor and placement of large preperitoneal prosthesis.

Mc Kernal and Laws (1992), mentioned a technique which avoids peritoneal cavity known as Totally Extra - Peritoneal technique.

3. Aims and Objectives

Aim

To study the transinguinal preperitoneal mesh placement for inguinal hernia

Objectives

- To determine whether open preperitoneal repair (TIPP) is a better alternative than the Lichtenstein technique for hernia repair, especially with regards to operating conditions, operative time, patients and surgeon's satisfaction, duration of hospital stay, faster recovery, and decreased postoperative pain, postoperative pain

relief, complications (chronic postoperative pain, sensory loss, spermatic cord edema) and avoiding the long recovery time, early return to work and economic benefits.

- To evaluate 2 years of TIPP experience.

4. Methods

Inclusion Criteria:

- 1) Patients willing to give written informed consent.
- 2) Presence of unilateral inguinal hernia.
- 3) Prothrombin time of less than 15 seconds.
- 4) Platelet count greater than 50, 000/ mm³ to limit the risk of bleeding.
- 5) No infection at time of surgery.

Exclusion Criteria:

- 1) Patients aged below 18 years.
- 2) Bilateral or recurrent hernias.
- 3) Undergoing emergency hernia repairs.
- 4) Medically unfit for the operation such as renal failure or immunosuppression.
- 5) Patients' follow - up during the study period will be maintained.
- 6) The types of hernias will be indirect, direct and combined variety.

Sample Size:

Sample size of 50 will be selected for this study.

Study Duration: 2 Years

Source of data

All the patients admitted with the diagnosis of inguinal hernia in MGM medical college, Aurangabad and those who will fulfill the inclusion and exclusion criteria will be selected for the study.

Statistical Analysis

The collected data will be compiled in EXCEL sheet and master sheet will be prepared. For analysis of this data spss software version 20 will be used. Data will be presented by visual impression like bar - diagram, pie - diagram etc. qualitative variables will be represented in form of frequencies and percentages, also chi - square will be applied to check significance of association between different attributes. P - value will be checked at 5% level of significance

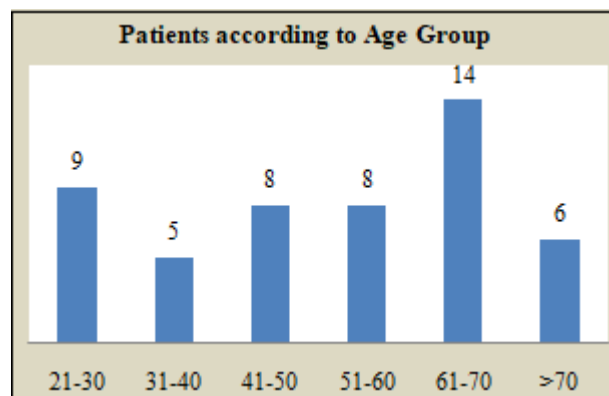
Technique

Incision of TPT is same as that of Lichtenstein technique. After dissection of the sac, the transversalis fascia is incised to enter the preperitoneal space. The preperitoneal space is developed by dissection with index finger. The space extends from rectus muscle medially, arcuate line cranially, a little beyond the anterior superior iliac spine over the psoas muscle laterally and the iliopubic tract caudally. Adequate size polypropylene mesh will be used, the inferior medial angle of the mesh is trimmed in a semicircular fashion to prevent trauma to the bladder neck. The mesh is placed in the preperitoneal space and anchored to the cooper's ligament with a single 2 - 0 interrupted prolene suture.

5. Observation and Results

Table 1: Distribution of patients according to Age Group

Age - Group	No. of patients	Percentage
21 - 30	09	18.0
31 - 40	05	10.0
41 - 50	08	16.0
51 - 60	08	16.0
61 - 70	14	28.0
>70	06	12.0
Total	50	100.0
Mean±SD	50.97±16.76 years	

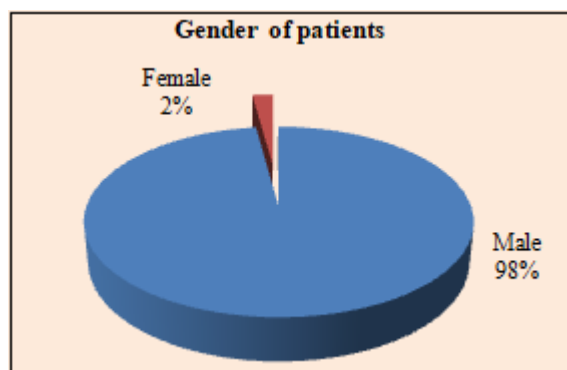


Graph 1: Patients according to Age Group

In our study, out of the 50 participants, the maximum number of patients (n=14) belonged to the 61–70 - year age group while least number of patients belonged to the more than 70 year age group (n=6). The mean age of participants in our study was 50.97 years with a standard deviation of 16.76 years.

Table 2: Distribution of patients according to Gender

Gender	No. of patients	Percentage
Male	49	98.0
Female	01	2.0
Total	50	100.0

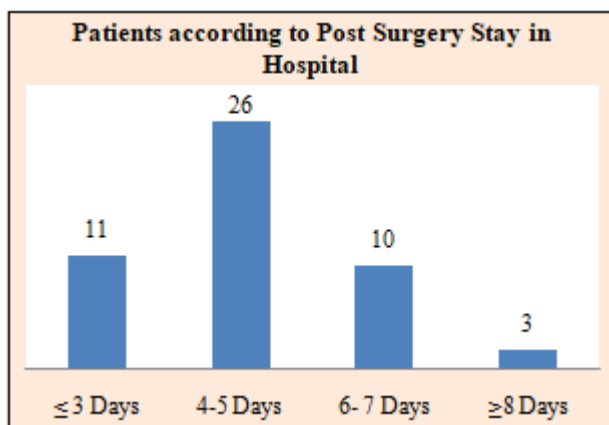


Graph 2: Gender of patients

In our study, 49 patients belonged to the male sex with only 1 patient belonging to the female sex. This was consistent with the higher incidence of inguinal hernia in males.

Table 3: Distribution of patients according to Post Surgery Stay in Hospital

Post - Surgery Stay in Hospital	No. of patients	Percentage
≤ 3 Days	11	22.0
4 - 5 Days	26	52.0
6 - 7 Days	10	20.0
≥8 Days	03	6.0
Total	50	100
Mean±SD	4.69 ±1.56 Days	

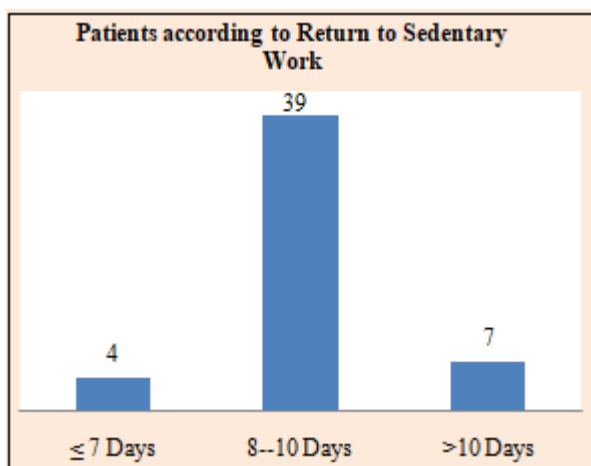


Graph 3: Post surgery stay in hospital

In the study, among the 50 participants, maximum number (n=26) were discharged between 4th to 5th post - operative day, whereas minimum number of patients (n=3) were discharged after on 8th post - operative day after. The mean post - operative day of discharge was 4.69 day with standard deviation of 1.56 days. Of the 3 patients who were discharged on 8th post - operative day or after, 2 patients had post - operative seroma formation and were started on extended iv antibiotic therapy. 1 patient had prolonged post - operative pain and hence was discharged on later date after conservative management of oral analgesics.

Table 4: Distribution of patients according to Return to Sedentary Work

Return to Sedentary Work	No. of patients	Percentage
≤ 7 Days	04	08.0
8–10 Days	39	78.0
>10 Days	07	14.0
Total	50	100%
Mean±SD	9.22±1.43 Days	

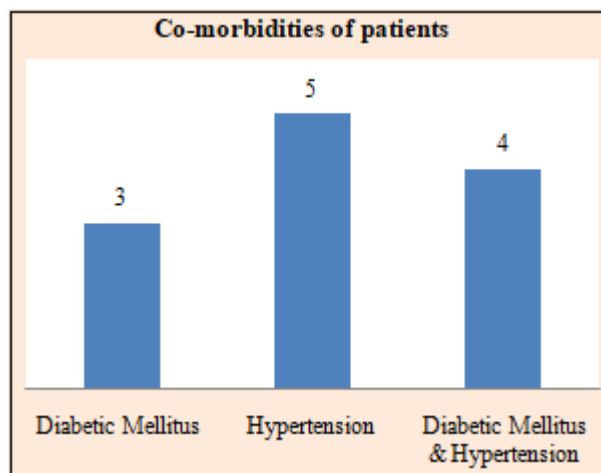


Graph 4: Return to sedentary work

In our study, of the 50 participants, maximum number of patients (n=39) returned to sedentary work between 8th to 10th post operative day whereas least number of patients (n=4) returned to sedentary work on 7th post operative day or before. The mean duration to return to sedentary work was 9.22 days with standard deviation of 1.43 days.

Table 5: Distribution of patients according to Co - morbidities

Co - morbidities	No. of patients	Percentage
Diabetic Mellitus	03	6.0
Hypertension	05	10.0
Diabetic Mellitus & Hypertension	04	8.0

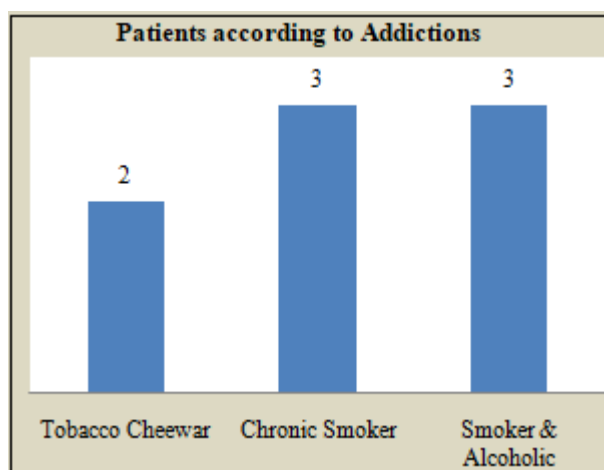


Graph 5: Co - morbidities of patients

Of the 50 participants, 3 patients suffered with Diabetes Mellitus, 4 patients had hypertension and 4 patients had both diabetes mellitus and hypertension.

Table 6: Distribution of patients according to Addictions

Addictions	No. of patients	Percentage
Tobacco Chewer	02	4.0
Chronic Smoker	03	6.0
Smoker & Alcoholic	03	6.0

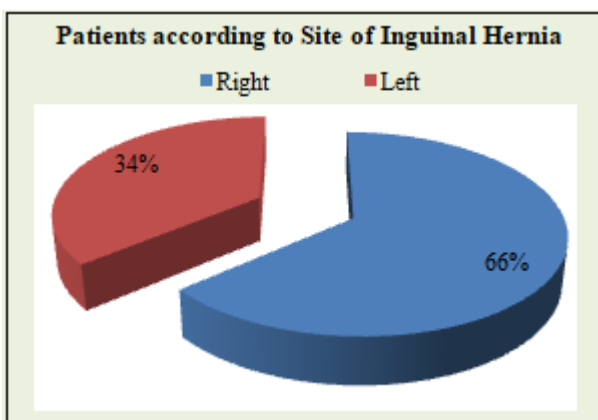


Graph 6: Addictions

Among the 50 participants enrolled in our study, a total of 8 patients had addiction history. 2 patients had history of tobacco chewing, 3 patients had history of smoking, and 3 patients had history of both tobacco smoking and routine alcohol intake.

Table 7: Distribution of patients according to Site of Inguinal Hernia

Site	No. of patients	Percentage
Right	33	66.0
Left	17	34.0
Total	50	100.0

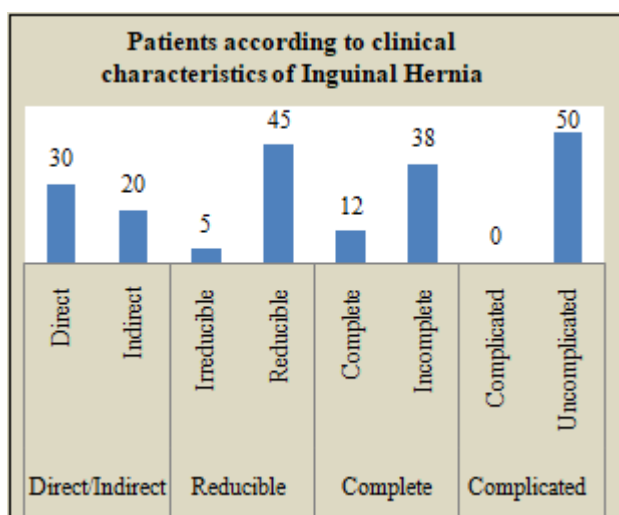


Graph 7: Site of Inguinal Hernia

In the study, among the 50 participants 33 patients had right sided inguinal hernia and 17 patients with left sided hernia.

Table 8: Distribution of patients according to Characteristics of inguinal hernia

Inguinal Hernia		No. of patients [n=47]	Percentage
Direct/Indirect	Direct	30	60.0
	Indirect	20	40.0
Reducible	Irreducible	5	10.0
	Reducible	45	90.0
Complete	Complete	12	24.0
	Incomplete	38	76.0
Complicated	Complicated	00	00
	Uncomplicated	50	100.0

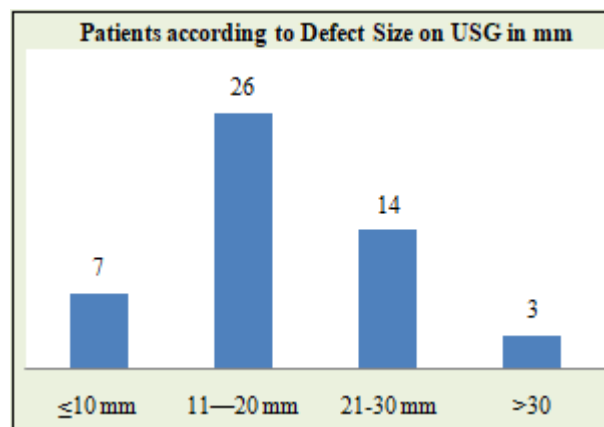


Graph 8: Clinical Characteristics of inguinal hernia

Of the 50 participants, 30 patients had direct inguinal hernia and 20 patients had indirect inguinal hernia, 5 patients had irreducible hernia and 45 patients had reducible hernia, 12 patients had complete inguinal hernia and 38 patients had indirect inguinal hernia whereas no patient in our study had complicated hernia (incarcerated/ strangulated/ obstructed hernia).

Table 9: Distribution of patients according to Defect Size on USG in mm

Defect Size on USG in mm	No. of patients	Percentage
≤10 mm	07	14.0
11—20 mm	26	52.0
21 - 30 mm	14	28.0
>30	03	6.0
Total	50	100
Mean±SD	18.49±7.84 mm	

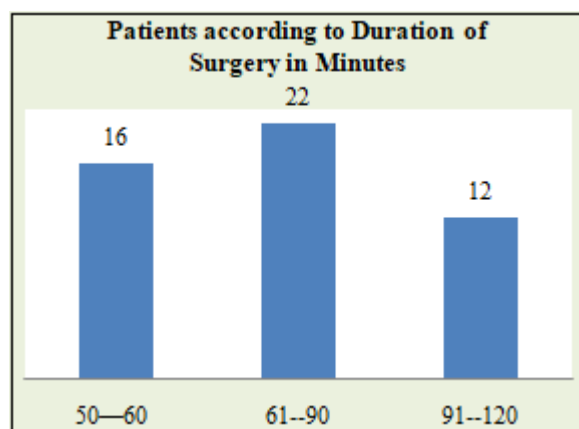


Graph 9: Defect size on USG in mm

In our study, among the 50 participants maximum number of patients (n=26) had a defect of size in between 11 - 20mm as per the ultrasonographic findings, whereas minimum number of patients (n=3) had a defect of size in 30mm or more as per the ultrasonographic findings. The mean size of defect as per the ultrasonographic findings was 18.49 mm with a standard deviation of 7.84mm.

Table 10: Distribution of patients according to Duration of Surgery in Minutes

Duration of Surgery in Minutes	No. of patients	Percentage
50—60	16	32.0
61—90	22	44.0
91—120	12	24.0
Total	50	100.0
Mean±SD	84.1±21.43 minutes	



Graph 10: Duration of Surgery in Minutes

Of the 50 participants in our study who underwent the surgical procedure, the mean intraoperative time was 84.1 minutes with a standard deviation of 21.43 min. The

maximum number of patients (n=12) had the mean intraoperative time between 91 to 120 min.

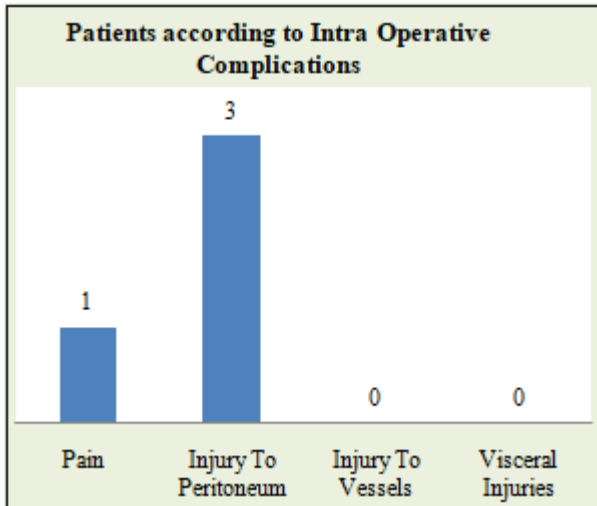
Table 11: Distribution of patients according to Intra Operative Complications

Intra Operative Complications	No. of patients	Percentage
Pain	01	2.0
Injury To Peritoneum	03	6.0
Injury To Vessels	00	00
Visceral Injuries	00	00

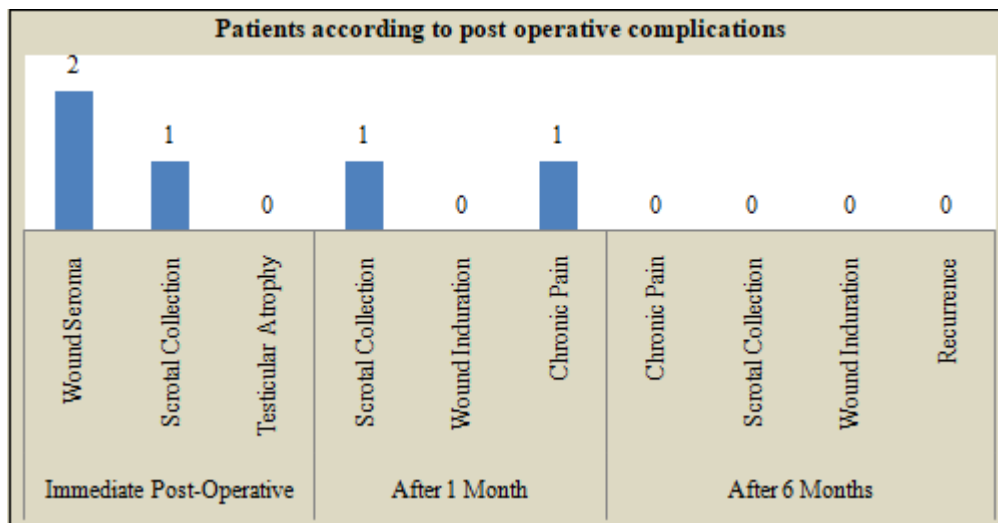
In our study, 1 patient had intraoperative pain during the procedure, 3 patients had injury to peritoneum as intraoperative complications. There was no incidence of injury to vessels or visceral injury in our study.

Table 12: Distribution of patients according to post operative complications

Complications		No. of patients	Percentage
Immediate Post - Operative	Wound Seroma	02	4.0
	Scrotal Collection	01	2.0
	Testicular Atrophy	00	00
After 1 Month	Scrotal Collection	01	2.0
	Wound Induration	00	00
After 6 Months	Chronic Pain	01	2.0
	Chronic Pain	00	00
	Scrotal Collection	00	00
	Wound Induration	00	00
	Recurrence	00	00



Graph 11: Intra operative complications



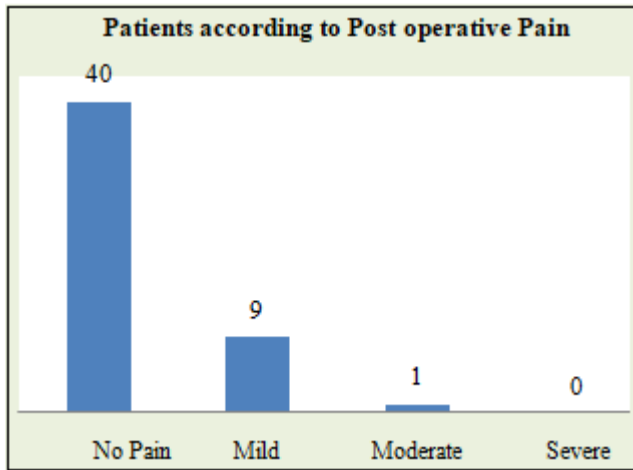
Graph 12: Post operative complications

In our study, of the 50 participants 2 patients developed seroma post operatively whereas 1 patient had scrotal collection in the immediate postoperative patient. After 1 month of the procedure 1 patient had persistent scrotal collection whereas 1 patient had persistent inguinaldynia. On 6 - month follow - up no incidence of any long term postoperative complication where encountered.

Severe	00	00
Total	50	100

Table 13: Distribution of patients according to Post operative Pain

Pain	No. of patients	Percentage
No Pain	40	80.0
Mild	09	18.0
Moderate	01	2.0



Graph 13: Post operative Pain

In our study of the 50 participants, 40 patients reported no postoperative pain whereas 9 and 1 patient reported mild and moderate pain respectively in the immediate postoperative period.

There was no incidence of severe postoperative pain in the immediate postoperative period in our study.

6. Discussion

In our prospective, single arm, observational study, titled “Open trans - inguinal pre - peritoneal mesh repair of inguinal hernia” we demonstrated that TIPP repair resulted in greater patient comfort with reduced post - operative pain and also decreases the number of complications and decreases the hospital stay and recurrence rate and that it can be recommended for all primary unilateral inguinal hernias.

In comparison with the established method of Lichtenstein mesh hernioplasty for inguinal hernia, as per published literature, our study encountered that the risk of developing complications both intraoperatively and post operatively and the post operative pain was similar following TIPP repair and LR. Although being a single arm study, on comparison with the available literature, it is seen that duration of operation was statistically similar in both groups, in concordance with previously published systematic reviews.

The prolene (polypropylene mesh) used for hernioplasty causes light microscopic changes in the myelin sheath covering the peripheral nerve further causing endoneurial and perineurial edema. This leads to fibrosis and axonal loss which results in chronic groin pain or inguinodynia due to entrapment of nerve in the associated fibrosis.²⁵ The mesh used also induces a foreign body reaction which can incite seroma formation and induration.²⁶

The wound complications associated with inguinal hernia mesh repair and the complication of chronic pain, delays recovery significantly affecting a patient’s lifestyle and activities of daily living.²⁷ These complications are secondary to anatomic location and plane of mesh placement and hence can be avoided by the pre - peritoneal placement of mesh by the transinguinal preperitoneal approach. The plane of placement of mesh in our study, guaranteed complete coverage of the myopectineal orifice unlike the

Lichtenstein mesh repair and is an optimal treatment for indirect, direct, femoral and obturator hernias and prevents their recurrence.

The published literature, well demonstrates the advantages associated with preperitoneal mesh placement in the totally extraperitoneal (TEP) or by the Transabdominal preperitoneal (TAPP) methods of inguinal hernia repair by minimal invasive techniques.²⁸ However, laparoscopic methods have their unique set of complications as well as a steep learning curve and the need for general anaesthesia.²⁹ In our study, a transinguinal preperitoneal approach was used, which can be considered analogous to the Totally extraperitoneal approach used in laparoscopic hernia repair, albeit, is less expensive, has a shorter learning curve, easier to perform and can be done under regional anaesthesia.

The duration of surgery in the transinguinal preperitoneal mesh placement for the repair of inguinal hernia is theoretically higher than the Lichtenstein procedure and can be attributed the added dissection required in the preperitoneal plane and the proper placement of mesh in the said plane. This dissection may be associated with complications like injury to peritoneum and consequent peritoneal breach but can be avoided by meticulous surgical technique. In cases where large peritoneal tears are encountered, this can be easily tackled with a few stitches of absorbable sutures owing the healing potential of peritoneum. Also, the procedure involves blind placement of mesh in the established preperitoneal plane which could pose some difficulty since the total dissected area cannot be visualised directly and can only be felt with the fingertips.

In our study, 50 patients were enrolled by simple randomization. Out of the 50 participants, the maximum number of patients (n=14) belonged to the 61–70 - year age group while least number of patients belonged to the more than 70 - year age group (n=6). The mean age of participants in our study was 50.97 years with a standard deviation of 16.76 years. This is in concordance with the fact that there is a linear relationship between the increasing age and increased incidence of inguinal hernia. The increased incidence of inguinal hernia can be attributed to the fact that muscle weakness which is the inherent pathophysiological factor in the formation of a hernia, increases with age. The incidence of hernia also increases due to the fact that associated comorbidities leading to increased intraabdominal pressure such as prostatic hypertrophy, chronic cough associated with chronic obstructive pulmonary disorder show increased incidence in this age group. In our study patients belonging to more than 70 yrs of age group where least in number because many patients were excluded to associated comorbidities and hence watchful waiting approach was preferred as they lacked fitness for surgery. In the study titled, “Comparison of Kugel and Lichtenstein Operations for Inguinal Hernia Repair: Results of a Prospective Randomized Study” by Dogru et. Al.³⁰ the mean age was 51.1 years with the standard deviation 16.2 years similar to our study.

In our study, 49 patients belonged to the male sex with only 1 patient belonging to the female sex. This was consistent with the higher incidence of inguinal hernia in males. The

incidence of inguinal hernia is higher in males, due to the reproductive anatomy associated with descent of testes, causing inherent weakness in the region of inguinal canal. This is in concordance with published literature in regards to incidence of hernia in males and females.

In the study, among the 50 participants, maximum number (n=26) were discharged between 4th to 5th post - operative day, whereas minimum number of patients (n=3) were discharged after on 8th post - operative day after. The mean post - operative day of discharge was 4.69 day with standard deviation of 1.56 days. Of the 3 patients who were discharged on 8th post - operative day or after, 2 patients had post - operative seroma formation and were started on extended iv antibiotic therapy. 1 patient had prolonged post - operative pain and hence was discharged on later date after conservative management of oral analgesics. Most of the discharges were seen on the 4th - 5th postoperative day because of patient factors, such as lack of transportation facilities to and from the hospital to village areas, apprehension towards early discharge due to preformed notions associated among the general populace regarding surgeries in general, financial constraints, and lack of health care facility in remote areas. The patients who were discharged on 6th - 7th postoperative day had similar patient related factors as well as some complained of foreign body sensation which is a norm, in the early postoperative period following prosthetic mesh placement.

In our study, of the 50 participants, maximum number of patients (n=39) returned to sedentary work between 8th to 10th post operative day whereas least number of patients (n=4) returned to sedentary work on 7th post operative day or before. The mean duration to return to sedentary work was 9.22 days with standard deviation of 1.43 days. The sedentary work included activities of daily living such as going to the bathroom, moving about at home, lifting simple household objects, doing simple day to day chores which did not require physical exertion and lifting heavy objects etc. this statistical configuration seen in our study depends largely on subjective factors such as the patients tolerance and sensitivity to pain, psycho - social factors such as apprehension associated with injury to the surgical incision site, predetermined notions and beliefs rampant among the patient and immediate family members regarding postoperative bed rest.

Of the 50 participants, 3 patients suffered with Diabetes Mellitus, 4 patients had hypertension and 4 patients had both diabetes mellitus and hypertension. Comorbidities such as diabetes mellitus, increase the rate of surgical site infection, mesh infections etc. Fortunately, no patients had any major infective complication in the post operative period due to meticulous technique followed, minimal tissue handling and strict and religious maintenance of sterile surgical and post - surgical techniques followed in our study.

Among the 50 participants enrolled in our study, a total of 8 patients had addiction history. 2 patients had history of tobacco chewing, 3 patients had history of smoking, and 3 patients had history of both tobacco smoking and routine alcohol intake. History of addiction has a bearing on fitness for surgery as well post - operative outcomes in patient

undergoing hernia surgeries. This is because of increased incidence of post operative cough and increased incidence of muscle weakness associated with intake of tobacco in all its forms. The increased post operative cough and muscle weakness may lead to early recurrence of hernia which may not necessarily be due to technical failure of the procedure used for hernia repair.

In the study, among the 50 participants 33 patients had right sided inguinal hernia and 17 patients with left sided hernia. This statistical configuration is consistent with literature which shows higher incidence of right sided inguinal hernia over the left sided inguinal hernia. The side of inguinal hernia has no bearing on intraoperative and post operative outcomes as well as the procedure used in our study.

Of the 50 participants, 30 patients had direct inguinal hernia and 20 patients had indirect inguinal hernia, 5 patients had irreducible hernia and 45 patients had reducible hernia, 12 patients had complete inguinal hernia and 38 patients had indirect inguinal hernia whereas no patient in our study had complicated hernia (incarcerated/ strangulated/ obstructed hernia). The presence of increased incidence of direct inguinal hernia over indirect hernia was consistent with the literature, stating that posterior wall weakness and thereby development of direct inguinal hernia is more common with increasing age. Clinically irreducible hernias were repaired in the same fashion as the procedure used for reducible inguinal hernia repair. Complicated hernia encompassing incarcerated/ obstructed or strangulated hernias were not included in this study as placement of prosthetic mesh is contraindicated in such cases due to significantly higher incidences of mesh failure and mesh infection thereby increasing the morbidity and mortality in such patients.

In our study, among the 50 participants maximum number of patients (n=26) had a defect of size in between 11 - 20mm as per the ultrasonographic findings, whereas minimum number of patients (n=3) had a defect of size in 30mm or more as per the ultrasonographic findings. The mean size of defect as per the ultrasonographic findings was 18.49 mm with a standard deviation of 7.84mm. This is in concordance with the fact that the size of defect has no bearing on the size of mesh used, technique of mesh placement and recurrence rates, as the mesh size used in our technique (12x15cm) completely covers the myopectineal orifice of Fruchaud. A larger defect size although was associated with larger contents in the hernia sac and increased incidence of adhesions of sac with the surrounding tissue thereby increasing the operative time in such cases.

Of the 50 participants in our study who underwent the surgical procedure, the mean intraoperative time was 84.1 minutes with a standard deviation of 21.43 min. The maximum number of patients (n=12) had the mean intraoperative time between 91 to 120 min.

The operative time was higher in cases where the patient was obese, or had a chronic hernial sac which had more adhesions to the surrounding resulting in increased time required for its separation from surrounding structures. The patients who had adhesions, some also had injury to peritoneum and consequent peritoneal breach which was

repaired intraoperatively taking more time than in other cases in our study. The rate limiting as per our study was creation of pre - peritoneal plane and placement of mesh in said plane. This goes to show that, technical aspects with regards to preperitoneal placement of mesh remained largely unchanged despite the variation in the intraoperative time of different cases.

In our study, 1 patient had intraoperative pain during the procedure due to pull over the mesentery during handling of hernia sac and its contents, 3 patients had injury to peritoneum. In patient with the peritoneal breach, primary repair with absorbable suture was done. There was no incidence of any major complications such as vascular or visceral injury in our study.

Since there was no cord or bowel mobilization required in this procedure there was no incidence of any visceral injury. Since mesh was not fixed by sutures to underlying structures, there was no incidence of any vascular and visceral injury seen during other methods of hernia repair, thereby vouching for the superiority of transinguinal preperitoneal inguinal hernia repair over other methods of hernia repair in terms of intraoperative complications.

In our study, of the 50 participants 2 patients developed seroma post operatively whereas 1 patient had scrotal collection in the immediate postoperative patient. After 1 month of the procedure 1 patient had persistent scrotal collection whereas 1 patient had persistent inguinodynia. On 6 - month follow - up no incidence of any long - term postoperative complication where encountered. A seroma is a collection of liquefied fat, serum and lymphatic fluid under the incision. The fluid is usually clear, yellow and viscous and is found in the subcutaneous layer of the skin. Seromas represent the most benign complication after an operative procedure and are particularly likely to occur when large skin flaps are developed in the course of operation as is often seen in cases of groin dissection or when a prosthetic mesh is used. A seroma usually manifests as a localized and well circumscribed swelling, pressure or discomfort and occasional drainage of clear liquid from the immature surgical wound. Of the 2 patients who developed seroma, one patient had persistent wound discharge for more than 10 days. In this case, aspiration was done under sterile conditions and there was no reaccumulation. In another patient with seroma there was no aspiration done as there was no wound discharge and as such the complication was managed conservatively, although extended antibiotic therapy was given in both cases to avoid secondary infection and mesh infection. Scrotal collection or collection along the spermatic cord may result from leaving portion of distal hernia sac in situ. In our case, there was a small swelling with no associated pain or skin changes signifying secondary infection and as such was managed conservatively using extended antibiotic therapy. Persistent post - operative pain was seen in 1 patient and was managed conservatively. Persistent post - operative pain most likely occurs secondary to nerve entrapment, excessive spermatic cord handling, etc. In our study the patient who had persistent postoperative pain was obese with a chronic hernia sac with multiple adhesions and required extensive dissection to separate the sac and create a preperitoneal plane, which most likely was

the cause of inguinodynia.

In our study of the 50 participants, 40 patients reported no postoperative pain whereas 9 and 1 patient reported mild and moderate pain respectively in the immediate postoperative period. There was no incidence of severe postoperative pain in the immediate postoperative period in our study. Post - operative pain was assessed using the Visual Analog score. The perception of pain and its intensity is a subjective finding in most of the cases and as such is difficult to assess in an absence of any clinic - pathological findings at the surgical site. In all cases of post - operative pain, analgesia using NSAIDS was given and there no requirement of any long - term analgesia or opioid analgesia.

7. Conclusion

To summarize, we conducted a prospective, single arm, observational study, titled "Open trans - inguinal pre - peritoneal mesh repair of inguinal hernia" at the department of general surgery, MGM medical college and hospital, Aurangabad where 50 patients were enrolled for this study. The variables that were studied in our study were, operative time, patients and surgeons' satisfaction with the procedure, and duration of hospital stay, recovery time and return to daily sedentary activities, postoperative pain and complication rate of this procedure.

All patients selected for the study were subjected to transinguinal preperitoneal mesh repair of inguinal hernia using standardized technique. We found in our study that, this procedure, was non - inferior to the gold standard of Lichtenstein Mesh Repair in terms of operative time, duration of hospital stays, recovery time and return to daily activities when compared with literature and published studies of Lichtenstein mesh repair.

Post - operative complications and complication rate were similar to Lichtenstein mesh repair as per published literature and has steeper learning curve when compared to Lichtenstein mesh repair, as development of pre - peritoneal plane and blind placement of mesh in this plane is demanding and requires meticulous surgical skill to avoid peritoneal breach and its consequent complications. There was no recurrence of hernia in our study comparable to Lichtenstein repair of inguinal hernia.

In summary we conclude that the procedure can be used as an alternative to Lichtenstein mesh repair but has no practical advantage over it although more randomized controlled trials are required to conclude definitively the added advantages or disadvantages of one method over the other.

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