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Long-Term Outcomes of Tissue versus Mesh Repair for Inguinal Hernia in India: A 45-Year Single-Surgeon, Single-Center Retrospective Analysis

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ABSTRACT

This study presents a retrospective analysis of surgical interventions performed for inguinal hernia, aiming to elucidate the challenges associated with herniorrhaphy (tissue repair) and compare the overall outcomes with mesh hernioplasty (tension-free repair) in the Indian context. A survey revealed that approximately 80% of inguinal hernia repairs in India are still conducted using tissue approximation techniques, especially in rural and suburban healthcare settings, due to various underlying factors. The analysis evaluates the relative merits and drawbacks of these two surgical approaches, herniorrhaphy and mesh hernioplasty, in the management of inguinal hernias within the Indian healthcare landscape. The findings of this retrospective study provide valuable insights into the selection of appropriate surgical techniques and highlight the potential implications for patient outcomes, particularly in resource-limited settings**.**

Keywords: *Inguinal hernia, Tissue repair, Bassini repair, Mesh repair, Infection, Neuralgia, Recurrence*

1. INTRODUCTION

Inguinal hernia repair is one of the most commonly performed surgical procedures worldwide. The standard approach involves three main steps, as appropriate for each case. Firstly, herniotomy, or the high ligation and excision of the hernia sac, is more applicable for indirect hernias. For direct hernias, many surgeons opt to invert the sac using a purse-string suture at its neck with non-absorbable material, rather than excising it, to avoid potential injury to the urinary bladder that may be sliding into the sac.

The second step is herniorrhaphy, which involves strengthening the posterior inguinal wall using various techniques, adhering to the cardinal principles of using non-absorbable suture material and approximating the edges of the defect without tension. The third optional step is hernioplasty, where extraneous material, such as a mesh prosthesis, is used to reinforce the inguinal canal. The tension-free repair described by Lichtenstein in 1974, involving mesh fixation, is currently the most popular approach, with reported recurrence rates of 0.1%. However, for children below 10 years of age, herniotomy alone is typically sufficient, and the other two steps are rarely employed. Groin hernias are mostly symptomatic and surgery remains the definitive treatment [(5)].

This retrospective study analyzes the outcomes of tissue versus mesh repair for inguinal hernia over a period of 45 years, performed by a single surgeon. The rationale for posterior wall repair in indirect hernias, where the primary issue is the sac, lies in the need to address the laxity at the internal (deep) ring through which the hernia emerges. A single stitch may not be sufficient, as it can cut through, necessitating a row of sutures to optimally reduce the ring size. While the clinical distinction between direct and indirect hernias may seem academically relevant, it holds practical significance during surgery.

Although mesh repair is considered the gold standard in evidence-based medicine, the majority (80%) of hernia repairs in developing countries are still performed using local tissue repair techniques. The primary drawbacks of using mesh include the fear of infection, increased procedural time, higher incidence of neuralgic complications, and additional costs.

The author's policy has been to initially attempt tissue repair and resort to meshplasty, only when comfortable (minimal tension) tissue approximation is not feasible. Malgaigne bulges, considered as phantom hernias, do not constitute an indication for repair nor influence the choice of repair technique.

1.1 Bassini repair : Edoardo Bassini (1844-1924)

The standard Bassini repair involves isolating the spermatic cord, identifying the hernia sac (in indirect hernias), and performing a high herniotomy. This may be facilitated by splitting the cremaster muscle and making a longitudinal incision in the transversalis fascia from the pubic tubercle to the internal ring. The posterior wall is then reinforced by suturing the lower margin of the conjoint tendon (formed by the internal oblique and transversus abdominis muscles) along with the felted margin of the transversalis fascia to the shelving edge of the inguinal ligament using a row of interrupted non-absorbable sutures, starting from the most medial stitch that includes the periosteum of the pubic tubercle. The lateral-most stitch is intended to make the internal ring snug. The cord is then returned to its place, and the external oblique aponeurosis (EOA) is approximated in front of the cord using a continuous non-absorbable suture, starting from the lateral end. The medial most stitch aims to create an optimal external ring size, just allowing the tip of a finger alongside the cord. Although suturing a muscle (conjoint tendon) to a fascia (inguinal ligament) is not considered physiological, the Bassini procedure has stood the test of time and the poor results believed to be more related to the operating surgeon rather than the technique itself.

Several modifications of the Bassini procedure exist, with the most effective and popular one being the use of a continuous monofilament suture, such as polypropylene (Prolene), for the main posterior wall repair, allowing for equal distribution of tension throughout the repair length. The so-called ‘modified Bassini technique’, which involves suturing only the conjoint tendon to the inguinal ligament, leaving the transversalis fascia untouched, is associated with inferior results.

Other commonly employed techniques include the Shouldice repair, which involves splitting the transversalis fascia and double-breasting the upper leaf into the lower leaf, followed by double-breasting the conjoint tendon and internal oblique onto the inguinal ligament, creating four layers of repair to approximate the roof to the floor of the inguinal canal. The Delvin modification also includes double-breasting the redundant EOA after the posterior wall repair.

The Willi Meyer repair involves double-breasting the lax and redundant EOA, with a modification creating a 'neo-inguinal canal' between the overlapping layers of the EOA for placing the cord. The Halsted repair is useful for large direct hernias, where additional posterior wall support is desirable. After dealing with the sac and performing a Bassini-like posterior wall repair, the EOA is also approximated behind the spermatic cord, positioning the cord subcutaneously and aligning the internal and external rings. The loss of obliquity of the inguinal canal is considered its main disadvantage, rendering the normal 'shutter-valve' mechanism ineffective.

Other less common techniques of repair include Ferguson, Henry, Mc Vay, Nyhus, Lotheissen, La Roque's procedures, among others, which the author had no occasion to perform. The myopectineal orifice of Fruchaud, described in endoscopic anatomy, is not relevant in the open anterior approach.

2. MATERIALS AND METHODS

During the course of 45 years, the cumulative number of surgical interventions carried out for inguinal hernia repair totaled 1,144. This figure can be broken down into 1,008 cases where tissue repair techniques were employed and 136 cases involving the use of mesh repair.

The study *excluded* the following cases: children below 10 years of age (for whom canal repair is not required), recurrent hernias, large direct hernias with wide posterior wall defects and cases involving laparoscopic repair (where mesh repair was inevitable). Additionally, patients with hypoproteinemia, collagen disorders, immune deficiencies, and those lost to follow-up were also excluded from the analysis.

The study *included* cases involving patients with diabetes, hypertension, hypothyroidism, obesity, sliding hernias, obstruction, strangulation requiring bowel resection, bilateral hernias, interstitial hernias, as well as those associated with vaginal hydrocele, femoral hernia, lipoma of the spermatic cord or undescended testis.

Figure-1 presents a retrospective analysis of 1,144 inguinal hernia surgical procedures performed on 1,076 patients by a single surgeon over a period of 45 years, spanning from 1975 to 2020.

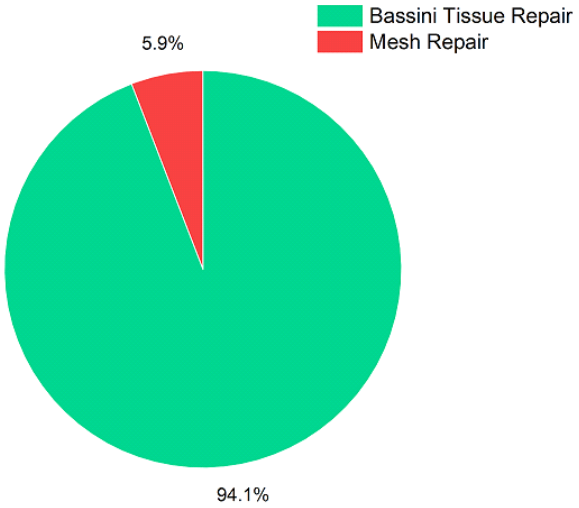

Fig. 1: Inguinal Hernia surgeries by single surgeon (1975-2020)

3. METHODOLOGY

Through the standard inguinal incision (inguinoscrotal for a strangulated hernia), the EOA is divided through the external ring, exposing the spermatic cord (or round ligament). After isolating and looping the spermatic cord, the position of the hernia sac is identified. If it is a direct hernia sac, it would be located medial to the cord, whereas an indirect hernia sac would be within the layers of the cord (requiring incision of the cremasteric and internal spermatic fasciae). After dealing with the hernia sac as indicated, using Alley's clamps placed on the conjoint tendon-transversalis fascia complex, the tension required for apposing to the inguinal ligament is assessed, and a decision is made whether a mesh repair is required.

If a tissue repair is chosen, a Tanner's incision (vertically semilunar) is made on the internal oblique component of the rectus sheath, retracting the EOA medially before proceeding with the repair using a continuous 1-0 or 2-0 Prolene suture, starting from the pubic tubercle. Before Prolene became available, Braided Silk, Mersilene, or Monofilament Polyamide (Nylon) sutures were used. Utmost care is taken not to exert too much traction on the suture, and the tissues are just allowed to come together gently. If the internal ring is found to be unduly lax, an additional stitch may be placed lateral to the cord to reduce it to the desired size. The external iliac vessels lying just behind the inguinal ligament have to be carefully protected by depressing them with a finger while taking a bite on the inguinal ligament, especially as the repair approaches the internal ring.

If any of the nerves, specifically the ilioinguinal or the genital branch of the genitofemoral nerve, come in the way and are likely to be caught in the sutures during the repair, they are excised (cut) in order to avoid troublesome postoperative neuralgia. If some patients experience a transient feeling of numbness over the groin area after the surgery, this only requires reassurance as it has no clinical significance.

While tension-free mesh repair may reduce the local tissue tension during inguinal hernia surgery, it certainly increases the mental stress for a surgeon operating in a primary or secondary care setting. This is because they may have to manage troublesome immediate complications in order to prevent a probable late complication (recurrence). The tension-free mesh repair technique was actually first reported by Usher et al. in 1958, using Marlex mesh, and this method was widely practiced until 1984. Use of mesh is not totally without complications, we had two patients who required a reoperation to remove the previously implanted Prolene mesh (surgery done elsewhere) due to intractable sepsis, nonhealing sinus and local pain. In both cases, after the removal of the mesh, we did tissue repair of the inguinal defect, using synthetic absorbable (Vicryl) sutures, to prevent hernia from reappearing.

Mesh repair of hernias may not be the permanent solution that it was intended to be. Mesh occasionally can get infected and hernias can recur even if permanent mesh is used. In addition, mesh-related complications are increasing in frequency as more patients live longer. Mesh also can grow into the small intestine, colon, or bladder.[17]

Reoperation following a mesh repair can be technically more problematic compared to reoperation after a tissue repair. Proponents of tissue repair strongly argue that they would prefer performing a mesh repair only if the hernia recurs (which occurs in less than 1% of cases), rather than implanting a foreign body (mesh) in all cases as a routine or "blanket" indication, when 99% of patients do not actually require it. We have meticulously documented our cases using the Cardex system and have followed up on over 95% of patients for periods ranging from 4 to 49 years.

In our cases, we did not encounter any instances of injury to the iliac vessels, nor postoperative periosteitis pubis, following

the hernia repair procedures. The demographic characteristics related to inguinal hernia cases are presented in Table 1.

Table -1 : Demographic Characteristics for Inguinal Hernia (1975-2020)

Factors		Number	%age
Age	11-20 yrs	163	14.1%
	21-30 yrs	204	17.9%
	31-40 yrs	167	14.6%
	41-50 yrs	174	15.2%
	51-60 yrs	153	13.4%
	61-70 yrs	175	15.3%
	>70 yrs	108	09.5%
Gender	Male	1108	96.8%
	Female	36	3.2%
Presence of hernia	Unilateral	1008	88.1%
	Bilateral	136 (68X2)	11.9%
Associated with Hydrocele		39	3.4%
Associated with Fem hernia		05	0.4%
Sliding hernia		14	1.2%
Interstitial hernia		04	0.3%
Emergency surgery		56	4.9%
Small bowel resection		08	0.7%

Adjuvant procedures: In many difficult inguinal hernia repairs, especially for large sliding hernias, it becomes necessary to perform additional complementary procedures along with the main repair. The adjuvant step we employed in almost all cases of tissue repair was the Tanner's relaxing incision. We did not feel that repairing the defect created in the internal oblique aponeurosis by using a mesh piece (as described by some authors) was required, and we did not regret for not doing so. Of course, these adjuvant procedures were not performed during mesh repair surgeries. Table 2.2 shows the adjuvant procedures employed during Bassini tissue repair for inguinal hernias**.**

Table 2 : Adjuvant procedures employed during Bassini Tissue Repair

Adjuvant Procedure	Number	%age
Tanner’s (relaxing incision) slide	968	84.6%
Excision of round ligament *	36	3.1%
Orchidectomy *	31	2.7%
Koontz excision of spermatic cord *	21	1.8%
Orchidopexy for undescended testis	25	2.2%
Excision of diffuse lipoma of cord	35	3.0%

In procedures marked * fusion of inguinal canal was performed, for total protection against recurrence

4. SUMMARY OF OUTCOMES

Table 2.3 presents the outcome summary of inguinal hernia surgeries performed by a single surgeon from 1975 to 2020.

Figure 2.2 illustrates the tissue repair procedures for unilateral and bilateral inguinal hernias during the period 1975-2020. Table 2.4 compares the infection rates following Bassini tissue repair and mesh repair surgeries. Table 2.5 compares the rates of neuralgia after Bassini tissue repair and mesh repair. Figure 2.3 shows the recurrence rate following Bassini tissue repair over consecutive 10-year blocks during the study period. Finally, Figure 2.4 illustrates the recurrence rate following Bassini tissue repair for inguinal hernias, with the data presented in blocks of 10 years.

Table 3 : Outcome Summary of Inguinal Hernia Surgery by a single surgeon (1975-2020) 1076 (in 1,008 patients) underwent tissue repair, in blocks of 10 yrs and followed till date

Period	Total No	Bilateral (one side)	Infection		Neuralgia		Recurrence	
1975-84 :	192	15 (207)	05	2.4%	00	0.0%	04	1.9%
1985-94 :	199	18 (217)	03	1.4%	00	0.0%	03	1.4%
1995-04 :	261	13+1*(275)	02	0.7%	01	0.4%	02	0.7%
2005-14 :	253	16 (269)	01	0.4%	00	0.0%	01	0.4%
2015-20 :	103	06 (109)	01	0.9%	00	0.0%	00	0.0%
Total	1008	68+1*(1077)	12	1.1%	01	0.1%	10	0.9%
Consolidated results of mesh (Prolene) repair during the 45 yrs (1975-2020)								
1975-2020	67	67	02	03%	04	6.0%	0.0	0.0%

** signifies one case, bilateral mesh repair was performed for large direct hernia*

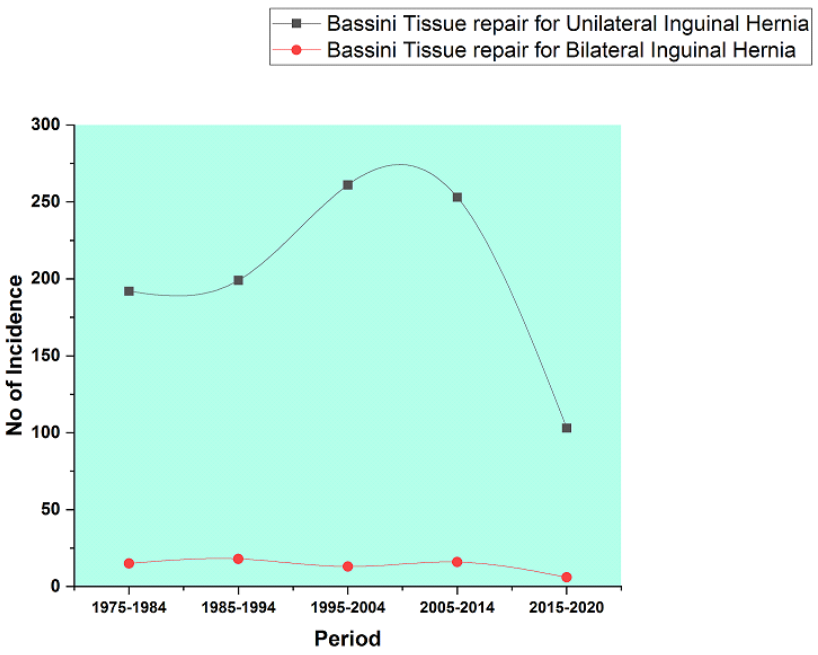

Fig. 2 : Tissue Repair of Unilateral and Bilateral Inguinal Hernia (1975-2020)

Table 4: Infection rate for Bassini tissue repair and Mesh repair

Type of surgery	Period	Number of infection incidence	Infection rate (%)
Bassini Tissue Repair	1975-1984	05	2.4
	1985-1994	03	1.4
	1995-2004	02	0.7
	2005-2014	01	0.4
	2015-2020	01	0.9
	Total	12	1.1
Mesh Repair (Consolidated 1975-2020)		2	3.0

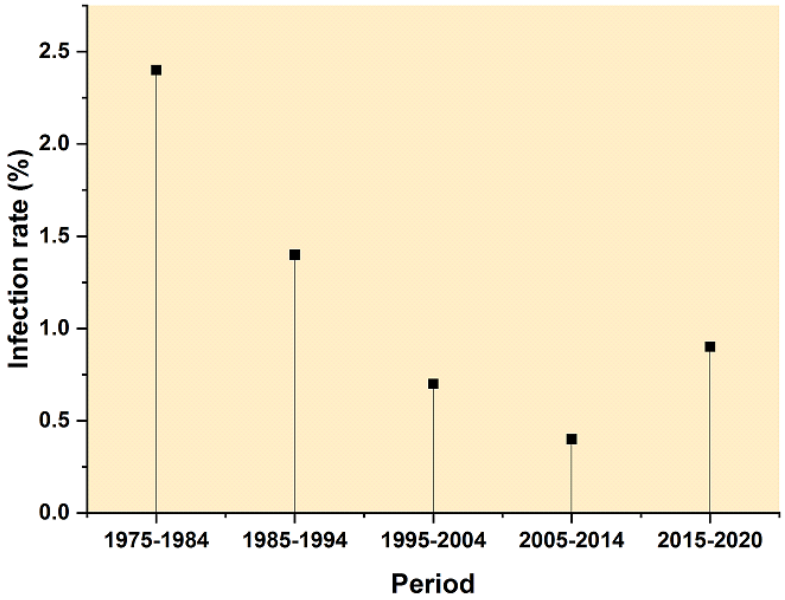

Fig 3 : Incidence of Infection following Bassini tissue repair

Type of surgery	Period	Number	%age
Bassini Tissue Repair	1975-1984	0	0.0
	1985-1994	0	0.0
	1995-2004	01	0.4
	2005-2014	0	0.0
	2015-2020	0	0.0
	Total	01	0.1
Mesh Repair (Consolidated 1975-2020)		04	6.0

Table 5 : Neuralgia following Bassini tissue repair and Mesh repair

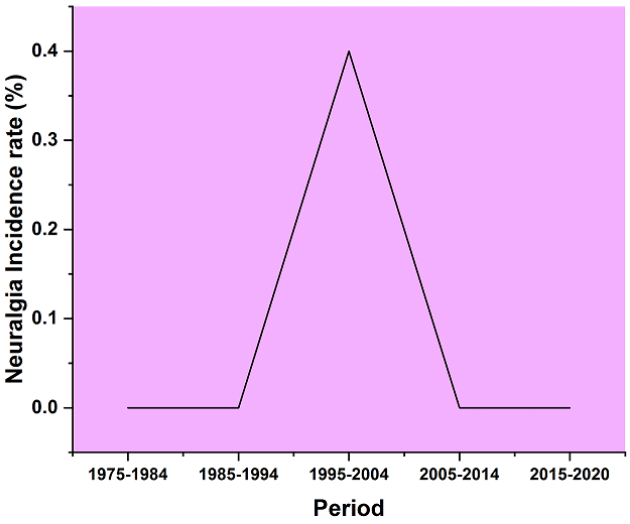

Fig 4 : Neuralgia incidence following Bassini Tissue repair in blocks of 10 years

Type of surgery	Period	Incidence of recurrence	Recurrence rate (%)
Bassini Tissue Repair	1975-1984	04	1.9
	1985-1994	03	1.4
	1995-2004	02	0.7
	2005-2014	01	0.4
	2015-2020	0	0.0
	Total	10	0.9
Mesh Repair (Consolidated 1975-2020)		0	0.0

Table 6 : Recurrence rate for Bassini tissue repair and mesh repair in blocks of 10 years

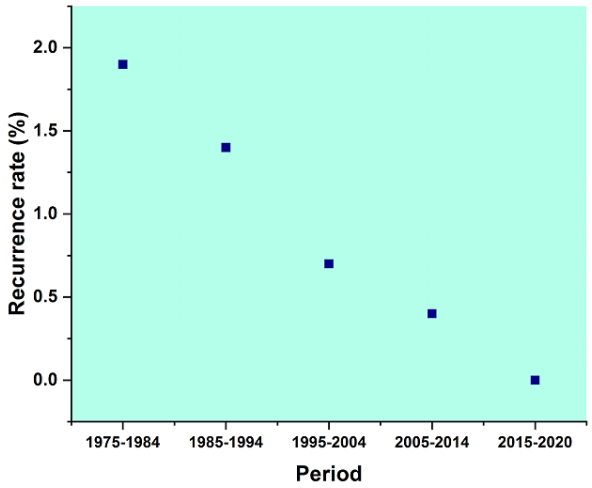

Fig 5 : Recurrence rate following Bassini Tissue repair in blocks of 10 years

There is no recurrence following mesh repair in our series

5. RESULTS AND DISCUSSION:

Despite inguinal hernia repair being one of the most common surgical procedures, efforts to develop new techniques are still ongoing. Groin hernias are mostly symptomatic and surgery remains the definitive treatment[5].The main goal is to decrease recurrence rates, as the lifetime recurrence rate for inguinal hernias in males (1-2%)[3,4] Other factors such as applicability, complication rates, hospital stay, work absenteism, and cost-effectiveness also need to be considered when choosing the repair technique.

Currently, tension-free repair with synthetic mesh is considered the superior 'gold standard' compared to other modalities. A main criticism of standard tissue repair is the tension on the suture line, which can be reduced but not completely avoided by using Tanner's relaxation incision. Tanner's incision mobilizes the lateral and inferior margins of the rectus sheath and conjoint tendons, which has been shown to decrease tension on the suture line[6].

A primary drawback of tissue herniorrhaphy is suturing two sub-optimally opposed tissues - the muscular conjoint tendon and the fibrous inguinal ligament - which is considered unphysiological for sound healing. If undue tension is present, the sutures can tear through the muscular tissue, cause pressure necrosis, and loosen over time.

Proponents of mesh repair argue that it does not cause tension on the suture line, allows repair without altering normal anatomy, results in low recurrence rates, and causes less pain compared to tissue repairs. However, they conveniently ignore the incidence of infection, neuralgic pain, and additional costs in an attempt to reduce recurrence rates from 0.8% to 0.3%, the logistics of which are debatable.

In our study, the infection rate post-tissue repair for inguinal hernia was 1.1%, much lower than the 3% rate following mesh repair. Other studies have reported higher mesh infection rates of 8-9%, 8%, and 5%. Logically, the threat of resistant infection is higher in diabetic, obese, and immune-compromised patients[7-9].

The recurrence rate following tissue repair in our study was 0.9%, well below the 2.2% average recurrence reported after Shouldice repair[10].

Neuralgia and associated chronic groin pain are the most feared complications, affecting 6% of patients after mesh repair in our study. Traditional Lichtenstein and laparoscopic approaches are known to cause significant chronic neuralgia and discomfort. Dedicated hernia institutes have shown a very low incidence of neuralgia (0.1% in our study) with tissue repair for inguinal hernias[11,12].

Both open hernioplasty and laparoscopic mesh repairs are associated with mesh-related complications like infection, rejection, seroma formation, and neuralgia, sometimes requiring mesh removal. On the other hand, several studies showed extremely minimal morbidity and mortality in elective herniorrhaphy[13,14].

Tissue repair is certainly preferred for inguinal hernias with obstruction/strangulation (requiring bowel resection) and localized sepsis, over mesh repairs[15].

Although not a perfect solution, an approach to mitigating problems associated with meshes currently in use, is the use of non-permanent meshes, such as bioresorbable and absorbable mesh. These meshes cause inflammation that strengthens the body's native tissue and builds fibrous tissue to reinforce the repair. These meshes, emerging out of tissue engineering, have a similar recurrence rates to permanent meshes.[17]

6. CONCLUSION

Despite this data, 80% of inguinal hernia surgeries in rural India and 10% in the USA still employ tissue repair, especially by elder surgeons, without regret. This reinforces the significance of the data presented and suggests that the preference for tissue repair among elder surgeons is not merely anecdotal but supported by statistical evidence. We cannot totally rule out the influence of mesh manufacturers on some studies favoring meshes like Plug & Patch prosthesis, Trilaminar Prolene Hernia system etc. Several earlier studies supported our preference for tissue repair and judicious, individualized use of meshplasty. We found that a properly performed, optimal tension tissue repair for inguinal hernia can fulfill every surgeon's desire to operate without the stress of leaving behind a foreign body (mesh) and avoid mesh-related complications, with statistical significance.

7. DISCLAIMER:

1. As this is a retrospective analysis of outcomes, Ethical Committee clearance was not required.
2. There are no conflicts of interest from any external agencies involved in this study.

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