

## A Prospective Study of the Effect of Prolene Mesh Prosthesis on Testicular Perfusion in Individuals Undergoing Lichtensteins Repair of Inguinal Hernia

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Conflict of interest: Nil

### Abstract:

**Introduction:** The Tension Free Mesh Repair by Lichtenstein is an easy, safe, and efficient operation with very low recurrence rates. It is widely established that perimesh fibrosis and direct mesh contact with inguinal canal vessels may negatively affect testicular flow. The majority of clinical and experimental investigations demonstrate that using mesh during hernioplasty is a risk-free operation for patients. The purpose of the study is to assess how prolene mesh affects individuals having Lichtenstein's mesh repair on their testicles.

**Methodology:** In patients having Lichtenstein's hernia repair, the effect of prolene mesh on testicular volume and perfusion is assessed in this study. 50 patients who had been hospitalised to the general surgery department at IGIMS Patna with inguinal hernias were included in the study, which was done between March 2021 and December 2022.

**Results:** In our study, the majority of patients who received Lichtenstein's hernia surgery recovered postoperatively without any complications. The most frequent complications seen were seroma development and surgical site infection. In our investigation, testicular blood flow parameters and testicular volume measures taken preoperatively and postoperatively showed no statistically significant alterations.

**Conclusion:** The testicular perfusion and size are unaffected by the Lichtenstein hernia repair procedure. If testicular perfusion is negatively impacted, data from clinical and experimental studies may be available. Because of the abundant artery supply and collateral capacity, it would be challenging to affect testicular perfusion following hernia surgery. By minimising dissection, leaving distal indirect hernia sacs, and keeping the cremasteric muscle fibres, the incidence of testicular atrophy was decreased. The greatest outcomes could derive from careful surgical dissection, reconstruction, and use of appropriate prosthetic material.

**Keywords:** Testis, Atrophy, Spermatic cord, Perfusion, Hernioplasty, Mesh.

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### Introduction

One of the treatments that surgeons worldwide conduct the most frequently is the repair of an inguinal hernia<sup>1</sup>. There are around 1,957,850 inguinal hernias among the Indian population each year. Around 1 million of these surgical operations are carried out each year worldwide using prosthetic mesh, the most popular of which is prolene [1,2]. Inguinal hernias were first repaired using an open approach with traditional sutures; however, after the advent of lichtensteins surgery, fewer patients have had a recurrence[3]. Since Lichtenstein first suggested the idea of tension-free hernia repair in 1989, treating inguinal hernias with tension-free mesh has been accepted [4-6]. The internal spermatic artery, also known as the testicular artery, is the major arterial supply for the testis[7]. It is a branch of the abdominal aorta that connects the cord structures immediately within the

deep inguinal ring. The mesh implanted after a hernioplasty hardens shrinks, and fibroses. Additionally, the spermatic cord is in direct touch with the mesh, which might change the blood flow to the testis from the arteries[8]. So, repairing an inguinal hernia can make your testicles less functional. Direct testicular injury or intraoperative or iatrogenic effects on spermatic cord structures can sometimes cause reduced testicular function following hernioplasty. The fibrotic tissue produced as a result of the peri mesh response may disrupt the testicular flow in addition to causing harm to vascular systems [6, 9]. According to some reports, a color Doppler ultrasonography used to check the testicular arteries on the afflicted side of the hernia indicated a higher resistive index (R) than on the unaffected side[10]. In a context with uncomplicated inguinal hernias, it was discovered

in research by Munoz Sanchez et al. that there were no alterations in the artery supply to the afflicted side testis[11]. Currently, inguinal hernias are regularly treated surgically using the tension-free repair technique (Lichtenstein repair), which also involves ligating the sac high up. Despite the popularity of open and laparoscopic hernia surgery procedures, the effects of hernia repair on testicular perfusion are still being studied[12].

According to the literature, one of the most terrifying side effects of inguinal hernia repair is the diminution of the testis' size (testicular atrophy), which leads to its future malfunction as a result of insufficient perfusion.

This condition is rare (occurring in 0-2% of patients following hernia repair), but it is among the most frightening problems[13]. 565 males (6.65%) of the 8500 patients who visited a reproductive clinic for help with infertility, according to Yavetz et al., reported having undergone inguinal hernioplasty, either with or without subsequent testicular atrophy[14]. It is widely known that in testicular diseases and hernias, Color Doppler Ultrasonography (CDUS) is used pre- and post-operatively to assess the spermatic cord and scrotal structure.

When investigating extra-testicular vascularization and testicular perfusion, CDUS is very useful[15]. Its characteristics, such as peak systolic velocity (PSV) and end-diastolic velocity (EDV), are optimised to reflect low-flow velocities. Lefort and colleagues demonstrated that measurement of intratesticular RI should be done during a color Doppler examination of the scrotum since an increased RI may indicate ischemia. However, employing CDUS following TEP or LHR, most of these diseases have not been well studied. In adults, the effects of mesh application on spermatic cord architecture, testicular atrophy, and dysfunction levels are not well understood.

## Materials and Methods

### Source of Data:

Patients diagnosed with inguinal hernia and who underwent Lichtenstein's prolene mesh repair were admitted to the Department of general surgery at Indira Gandhi Institute of Medical Sciences (IGIMS), Patna.

### Study Design:

Prospective study

### Period of Study:

2021 March to 2022 December.

### Place of Study:

The study was carried out in the inguinal hernia patients undergoing Hernioplasty admitted to the Department of General Surgery, IGIMS, Patna.

### Inclusion Criteria

Patients with uncomplicated inguinal hernia with no comorbidities in the age group 15 to 65 years.

### Exclusion Criteria

1. Patients who are having Hydrocele, Epididymo orchitis, Syphilitic Orchitis, TB Orchitis, Varicocele, and Testicular Tumour
2. Previous history of surgeries on the scrotum, testicles or prostate
3. Patients not willing to participate in the study

### Methodology:

Fifty inguinal hernia patients admitted to the Department of General Surgery at IGIMS, Patna, during the study period and met the inclusion and exclusion criteria were included in the study after approval from the Institutional Ethics Committee.

Informed permission was obtained in writing. Patient background, medical history, physical exam findings, and laboratory studies were recorded. The testicular artery's blood flow characteristics were assessed and reported as PSV, EDV, and RI were computed during a pre-operative Colour Doppler Ultrasound of the testes and cord structures with patients in the supine position (Figure 1).

Patients were operated by Lichtenstein's Tension Free Hernia repair technique. Color Doppler Ultrasound of the testes was repeated 3 months after the surgery, and the above parameters were measured again and compared.

### Data Analysis:

The statistical analysis validated the results using GraphPad Prism and Microsoft Excel. The results were percentages, mean  $\pm$  standard deviation, and frequencies wherever applicable. A p-value  $\leq 0.05$  was considered statistically significant.

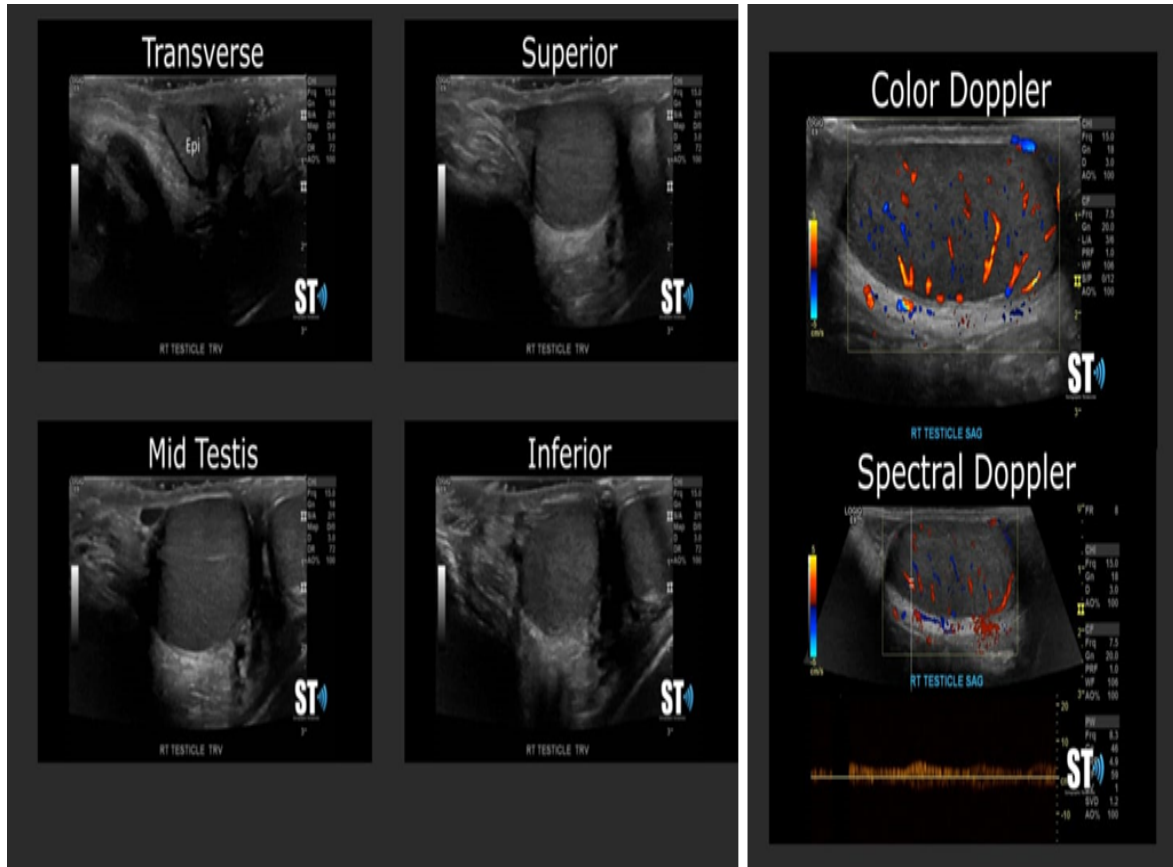


Figure 1: Colour Doppler USG of B/L SCROTUM

**Results**

In all, about 50 inguinal hernia patients who met the inclusion criteria were included in the prospective study. This study looked at potential risk variables such as age, side, inguinal hernia type, triggers, and surgical complications such as post-op discomfort, seroma development, surgical site infection, wound dehiscence, mesh infection, and recurrence. Parameters including peak systolic velocity (PSV), End Diastolic velocity (EDV), testicular volume (TV), and Resistive index – an indicator of ischemia (RI) were measured using Colour Doppler and compared before and after surgery. PSV, EDV, RI, TV, and other characteristics were compared statistically.

**Demographic details of patients**

The patients selected for the study were between 15 and 65 years old. The mean age of the patients was 44.14 ± 9.04 years.

The data revealed that the maximum number of patients admitted with inguinal hernia belonged to the age group 36-45 years (44%), followed by 46-50 years (24%; Table 1 & Figure-2 A).

Cases of inguinal hernia in individuals below 20 years were the least. Based on occupation-wise distribution, a total of 23 (46%) patients had Labourer workers and 8 (16%) patients had farmers, 9 (18%) were employees and 10 (20%) patients were auto drivers (Table 2 & Figure 2B).

**Table 1: Age Distribution of patients**

Age	No. of patients	Percentage
15-25	2	4
26-35	7	14
36-45	18	36
46-55	12	24
56-65	11	22

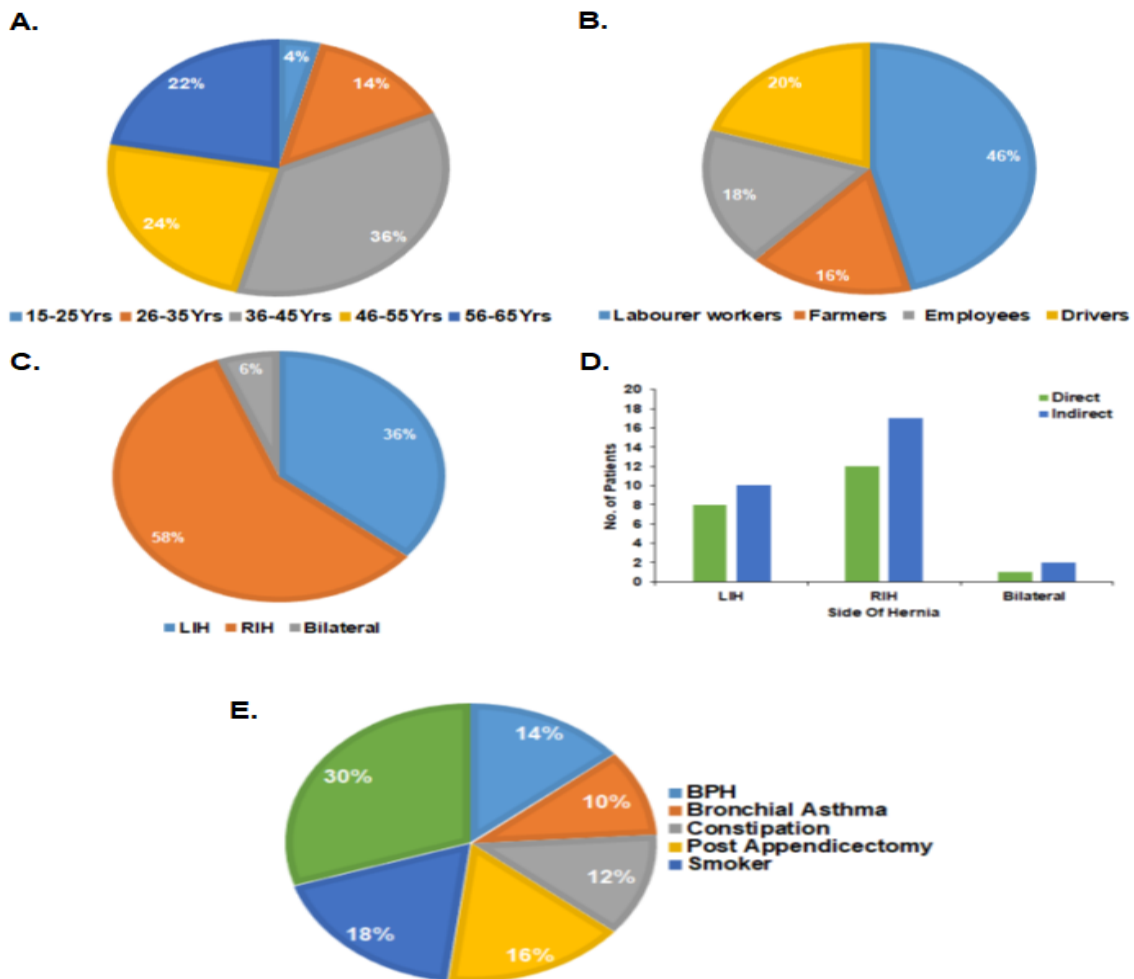


Figure 2: (A) Percentage of Age Distribution; (B) Percentage of Occupational Status; (C) Percentage of hernia laterality side; (D) Laterality Side Diagnosis of hernia; (E) Percentage of Affecting Factors (LIH: Left Inguinal Hernia; RIH: Right Inguinal Hernia; BPH: Benign Prostatic Hyperplasia).

Table 2: Occupational Status of patients

Occupation	Frequency	Percent
Labourer workers	23	46
Farmers	8	16
Employees	9	18
Auto Drivers	10	20

**Type of Inguinal Hernia**

Out of 50 patients, 21 direct inguinal hernia patients and 29 indirect inguinal hernia patients (24%) were involved in the study. Among the patients analyzed, 58% of patients analysed were found to have right sided inguinal hernia preoperatively (Table 3, Table 4 & Figure 2C). Out of 50 patients, duration of symptoms of inguinal

hernia less than one year was higher as compared greater than one year (Table 5). Around 12 and 17 patients had direct and indirect inguinal hernias of the right side.

Here, among the study population, the number of patients having direct and indirect hernias are almost the same even though generally indirect hernias are more common (Table 6 & Figure 2D).

Table 3: Type of hernia

Type of hernia	Frequency
Direct inguinal hernia	21
Indirect inguinal hernia	29

**Table 4: Laterality of Inguinal Hernia**

Laterality	Frequency	Percentage
LIH	18	36
RIH	29	58
Bilateral	3	6

**Table 5: Duration of Symptoms**

Duration	Frequency
>1YR	14
<1YR	36

**Table 6: Diagnosis of Inguinal Hernia**

Side	Type	
	Direct	Indirect
Left	8	10
Right	12	17
Bilateral	1	2

**Affecting Factors:** Among the study population, the common etiologies of inguinal were analyzed. 30% of the study population were found to have no affecting factor. 18% of the patients, i.e. 9 patients were found to be smokers (Table 7 & Figure 2E). In the age group of 56-65 years, the most common

affecting factor was benign prostatic hyperplasia followed by bronchial asthma and constipation. In the age group of 56-65, the most common etiology was smoking, followed by constipation. In the age group of 36-45 years, smoking was the causative factor in 4 patients (Table 8).

**Table 7: Affecting Factors of Inguinal Hernia**

Affecting Factors	Frequency	Percentage
BPH	7	14
Bronchial Asthma	5	10
Constipation	6	12
Post Appendicectomy	8	16
Smoker	9	18
None	15	30

**Table 8: Age Distribution of Affecting Factors of Inguinal Hernia**

Age	BPH	Bronchial Asthma	Constipation	Post Appendicectomy	Smoker	None
15-25	0	0	0	1	1	1
26-35	0	0	0	2	1	2
36-45	0	1	1	3	4	7
46-55	2	1	3	1	1	5
56-65	5	3	2	1	2	0

**Complications of Surgery:** The following problems after surgery were seen among the 7 patients. A total of 4 (8%) patients had Seroma and 3 (6%) patients had surgical site infections, 2 (4%) were urinary retention, and 41 (82%) patients were no complaints (Table 9).

**Table 9: Post-operative Complications**

Complication	Frequency	Percentage
None	41	82
Seroma	4	8
Surgical site infection	3	6
Urinary Retention	2	4
Mesh infection	0	0

#### Comparison of pre-operative and post-operative variables

In a particular group of 50 patients, CDUS assessment of patients prior to surgery, the

velocities assessed, peak systolic and end-diastolic velocities, and resistive index along with the testicular volume were compared with postoperative periods and were expressed as Mean

+/- Standard deviation (Table 10). Resistive index and Testicular volume were compared statistically and were found to be statistically insignificant (p-

value less than 0.05), suggesting non-affected of perfusion to testicular vessels in patients undergoing Lichtenstein hernia repair.

**Table 10: Evaluation of Preoperative and Postoperative variables of testicular perfusion and volume**

Parameters	N	Pre-Operative		Post-Operative		p value
		Mean	SD	Mean	SD	
PSV	50	14.38	2.57	13.79	1.12	0.15
EDV	50	4.69	0.97	5.01	1.13	0.12
RI	50	0.64	0.16	0.63	0.13	0.72
TV	50	14.53	2.24	15.05	2.34	0.25

**Comparison of variables in preoperative and post-operative periods in patients with complications**

In the study population, problems following surgery such as seroma development, surgical site infection, and post-operative urine retention were reported in 9 patients. The four testicular perfusion parameters' sonological values were compared, and the p-value was statistically insignificant (the p-value for all comparisons of the four parameters

was >0.05). The postoperative course of problems showed no statistically significant impact on the sonological measures to assess testicular perfusion.

The commencement of complication may not have any statistically significant effects on post-operative testicular perfusion, according to individual analyses of pre-and post-operative testicular perfusion parameters for each of the observed problems, with the p-value remaining >0.05 (Table 11 & 12).

**Table 11: Evaluation of Preoperative and Postoperative variables of testicular perfusion and volume in Patients with Complications**

Parameters	N	Pre-Operative		Post-Operative		p value
		Mean	SD	Mean	SD	
PSV	9	14.74	2.68	13.74	1.37	0.34
EDV	9	5.09	0.93	5.25	0.62	0.66
RI	9	0.78	0.11	0.7	0.1	0.09
TV	9	15.77	2.12	16.12	2.86	0.68

**Table 12: Individual Evaluation of Preoperative and Postoperative variables of testicular perfusion and volume for every Complication**

Complications	Parameters	N	Pre-Operative		Post-Operative		p value
			Mean	SD	Mean	SD	
Seroma	PSV	4	15.58	3.24	14.97	0.58	0.73
	EDV	4	5.45	0.93	5.61	0.53	0.81
	RI	4	0.79	0.12	0.68	0.13	0.37
	TV	4	15.05	1.38	15.61	3.23	0.78
Surgical infection	PSV	3	14.46	3.01	13.1	1	0.61
	EDV	3	4.86	1.2	4.72	0.55	0.85
	RI	3	0.84	0.12	0.75	0.08	0.09
	TV	3	18.04	1.91	18.35	1.16	0.61
Urinary Retention	PSV	2	13.45	1.29	12.24	0.45	0.51
	EDV	2	4.71	0.75	5.32	0.5	0.61
	RI	2	0.7	0.06	0.67	0.57	0.13
	TV	2	13.79	0.37	13.8	2.18	0.99

**Discussion**

**Age-wise distribution of patients**

50 patients with an uncomplicated unilateral inguinal hernia who underwent open Lichtenstein repair surgery for the condition were compared to other researchers whose studies included samples ranging from 26 to 64. Suculla I et al[16]. had 64 participants, Edgar et al.[17] had 39 patients, Neset

et al[1] had 32, Sinan Hatipoglu et al[18]. had 40, and Dilek et al. had 26.

When compared to the population studied by Ira M. Rutkow[19], where the bulk of the patients were in the 45–64 age range, the majority of patients in our study were between the ages of 36 and 65.

Highest incidence in this study was in the 36-45 years whereas that of Ira M. Rutkow, it was in the

age group 45-64 years (30 cases) followed by 22 cases in 46- 65 years age group.

### Occupation of the Patients

Manual laborers comprise 46% of the study population, whereas constantly/intermittently strenuous work groups in the study by M. Bay Nielson, constitute 47.2% which is comparable. 20% of the study population is auto driver patients compared to 22% of sedentary workers in the study group analyzed by M. Bay Nielson[20]. Employees comprise the maximum number (9 patients) of study subjects, followed by Farmers (8 cases).

### Diagnosis of hernia

The occurrence of different types of hernia shown above reveals that indirect inguinal hernias of the right side are comparable to each other shown in Tables 3 &6, When compared with the population of different types of hernia by Ira M. Rutkow[19], reveals that indirect inguinal hernias of the right side are 36 patients.

### Affecting Factors

According to an analysis by Mike S. L. Liem and colleagues[21], BPH, COPD, and strenuous activity accounted for the majority of etiological variables (5%, 10%, and 24%, respectively). Except for individuals in whom no discernible risk factor was found, smoking (18%) was the most prevalent contributing factor in our analysis, raising the likelihood of a congenital preformed sac. Hernia causes are multifaceted, making it difficult to identify a single element that has an impact. Smokers making up a sizable fraction of the patient population points to aberrant biochemical, metabolic, and connective tissue abnormalities as described in the literature and are a reflection of how common smoking is in society as a whole. The assumption that India is an agricultural nation fits nicely with the large prevalence of farmers and manual laborers.

### Complications of Surgery

In the study, the majority of patients who underwent Lichtensteins hernia repair had an uneventful post-operative period. Some patients faced complications such as seroma formation, surgical site infection, and urinary retention.

### Comparison of pre-operative and post-operative variables

There is no statistically significant difference between the pre-operative and post-operative PSV levels, as indicated by the fact that p value 0.15 is > 0.05. EDV had no statistical significance when compared before and after surgical repair periods because p value 0.12 is > 0.05. As p value 0.72 is > 0.05, it is confirmed that there have been no major ischemia alterations and that the operation has not

dramatically changed the RI. There is no change in the testicular volume that, when compared statistically, is significant since p value 0.25 is > 0.05. The conclusion that the present approach of hernia repair employing mesh prosthesis is less morbid is supported by the fact that testicular atrophy or fluctuation in the size of the testis following surgical repair of an inguinal hernia using a prolene prosthesis is not statistically significant.

Unlike other research academics whose studies included samples ranging from 26 to 64, our study included 50 patients with simple unilateral inguinal hernias who had open Lichtenstein repair surgery. Suculla I et al[16]. had 64 participants, Edgar et al[17]. had 39 patients, Neset et al[1]. had 32, Sinan Hatipoglu et al. had 40, and Dilek et al. had 26. Prior to surgery and 90 days afterward, color Doppler ultrasonography (CDUS) was used to evaluate each patient's ipsilateral testicular perfusion.

### Comparison of variables in preoperative and post-operative periods in patients with complications

Nine patients in our present study experienced mild postoperative morbidity such seroma, SSI, and urine retention. In the current investigation, there was no statistically significant difference between pre- and post-operative Doppler values and post-operative problems.

### Conclusion

In the past, suture material was used to close the aperture during hernia repair. The majority of non-absorbable meshes are used in today's surgical procedures to strengthen the posterior wall. The local tissue shrinks or becomes more indurated as a result of the ensuing tissue reaction to the foreign material. It also affects nerves and other anatomically significant structures, such as testicular arteries, whose perfusion causes testicular atrophy.

The goal of inguinal hernia repair is to complete the procedure with the fewest possible problems and without recurrence. This study provides proof that the volume of the testicles and the perfusion of the testicular arteries are unaffected by Lichtenstein herniorrhaphy. There is current investigation into the possibility that using a prolene prosthesis to treat an inguinal hernia might have unfavourable effects on testicular perfusion. This leads to the conclusion that testicular damage is spared due to the abundant perfusion from the arteries and the support of the collateral vessels, both of which protect the testes from ischemia harm. The above-mentioned difficulties can be reduced in inguinal hernia repairs utilising the Lichtenstein procedure by safeguarding the anastomoses during surgery

with careful dissection, a high index of suspicion, solid anatomical knowledge, good technique, and preservation of the vasculature. By limiting the dissection beyond the pubic tubercle, or when the distal part of an indirect hernial sac is left attached to the cord, and by using posterior preperitoneal repair as is the case in recurrent hernias, damage to the spermatic cord and structures, as well as the occurrence of testicular atrophy, can be avoided. Inflammation around the cord structures can be prevented by preserving the cremasteric muscle fibres and reconstructing the fascia.

The optimum course of action is to prevent simultaneous scrotal operations, testicular delivery into the wound from the scrotal sac, and excessive dissection of indirect sacs distally. Preperitoneal repair attempts provide the extra benefit of minimising further recurrences and avoiding issues with the testes in cases of recurrent hernias. It follows that outstanding results are produced by rigorous surgical technique, suitable reconstruction with the highest respect for surgical anatomy, and use of appropriate prosthetic material.

**Ethical approval:** This study was approved, and Institutional Ethics Committee, IGIMS, Patna, Bihar, India, have recommended the decision [Letter No.: 75/ IEC/IGIMS/2021].

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

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