

## Prosthetic Mesh Repair for Incarcerated Inguinal Hernia

Cihad Tatar<sup>1</sup>, İshak Sefa Tüzün<sup>2</sup>, Tamer Karşıdağ<sup>3</sup>, Mehmet Celal Kızılkaya<sup>4</sup>, Erdem Yılmaz<sup>5</sup>

<sup>1</sup>Department of General Surgery, Besni State Hospital, Adiyaman, Turkey

<sup>2</sup>Department of General Surgery, Haseki Training and Research Hospital, İstanbul, Turkey

<sup>3</sup>Department of General Surgery, Ataşehir Memorial Hospital, İstanbul, Turkey

<sup>4</sup>Department of General Surgery, Bulanık State Hospital, Muş, Turkey

<sup>5</sup>Department of General Surgery, Çekirge State Hospital, Bursa, Turkey

**Background:** Incarcerated inguinal hernia is a commonly encountered urgent surgical condition, and tension-free repair is a well-established method for the treatment of non-complicated cases. However, due to the risk of prosthetic material-related infections, the use of mesh in the repair of strangulated or incarcerated hernia has often been subject to debate. Recent studies have demonstrated that biomaterials represent suitable materials for performing urgent hernia repair. Certain studies recommend mesh repair only for cases where no bowel resection is required; other studies, however, recommend mesh repair for patients requiring bowel resection as well.

**Aim:** The aim of this study was to compare the outcomes of different surgical techniques performed for strangulated hernia, and to evaluate the effect of mesh use on postoperative complications.

**Study Design:** Retrospective cross-sectional study.

**Methods:** This retrospective study was performed with 151 patients who had been admitted to our hospital's emergency department to undergo surgery for a diagnosis of incarcerated inguinal hernia. The patients were divided into two groups based on the applied surgical technique. Group 1 consisted of 112 patients treated with mesh-based repair techniques, while Group 2 consisted of 39 patients treated with tissue repair techniques. Patients in Group 1 were further divided

into two sub-groups: one consisting of patients undergoing bowel resection (Group 3), and the other consisting of patients not undergoing bowel resection (Group 4).

**Results:** In Group 1, it was observed that eight (7.14%) of the patients had wound infections, while two (1.78%) had hematomas, four (3.57%) had seromas, and one (0.89%) had relapse. In Group 2, one (2.56%) of the patients had a wound infection, while three (7.69%) had hematomas, one (2.56%) had seroma, and none had relapses. There were no statistically significant differences between the two groups with respect to wound infection, seroma, hematoma, or relapse ( $p>0.05$ ).

In Group 3, it was observed that one (6.7%) of the patients had wound infections, while one (6.7%) had a hematoma, one patient (6.7%) had seroma, and none had relapses. In Group 4, seven (7.2%) of the patients had wound infections, while one (1%) had a hematoma, three (3%) had seromas, and one (1%) had a relapse. There were no significant differences between the two groups with respect to wound infection, seroma, hematoma, or relapse ( $p>0.05$ ).

**Conclusion:** In urgent groin hernia repair surgeries, polypropylene mesh can be safely used even in the patients undergoing bowel resection.

**Keywords:** Incarcerated, inguinal hernia, prosthetic mesh

Inguinal hernia is a commonly encountered urgent condition in surgical clinics. An abdominal wall hernia is a protrusion of the abdominal tissues or organs through a weakness in the muscular structure of the wall of the abdomen. Inguinal and femoral hernias are usually classified together as groin hernias. It is believed that the prevalence of groin hernias in a population

varies between 3% and 8%. Between 75% and 85% of all hernias are observed in men. Inguinal hernias account for 80-83% of all hernias (59% indirect inguinal hernias, 25% direct inguinal hernias, 5% femoral hernias). The most common hernias in both genders is inguinal hernia; however, femoral hernias are reported to be more common in women than in men (1-3).

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Address for Correspondence: Dr. Cihad Tatar, Department of General Surgery, Besni State Hospital, Adiyaman, Turkey

Phone: +90 533 659 98 89

e-mail: tatarcihad@gmail.com

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Incarcerated inguinal hernia is a commonly encountered urgent surgical condition, and tension-free repair is a well-established method for the treatment of non-complicated cases. However, due to the risk of prosthetic material-related infections, the use of mesh in the repair of strangulated or incarcerated hernia has often been the subject of debate. Recent studies have demonstrated that biomaterials represent suitable materials for performing urgent hernia repair. Certain studies recommend mesh repair only for cases where no bowel resection is required; other studies, however, recommend mesh repair for patients requiring bowel resection as well.

The aim of this study was to compare the outcomes of different surgical techniques performed for strangulated hernia, and to evaluate the effect of mesh use on postoperative complications.

## MATERIALS AND METHODS

This retrospective study was performed with 151 patients who had been admitted to our hospital's emergency department between 2007 and 2013 to undergo surgery for a diagnosis of incarcerated inguinal hernia. Patients who died in the postoperative period due to systemic complications, as well as those who were lost during the follow-up period, were excluded from the study. The patients were divided into two groups based on the applied surgical technique. Group 1 consisted of 112 patients treated with mesh-based repair techniques, while Group 2 consisted of 39 patients treated with tissue repair techniques. The surgical technique to be applied was selected by the surgeons. The Lichtenstein procedure was used for inguinal hernia patients where mesh-based repair was preferred, while the Bassini procedure was used for inguinal hernia patients where the tissue repair technique was preferred. The mesh plug repair procedure was used for femoral hernia patients where the mesh repair was preferred, while the McVay procedure was used for femoral hernia patients where tissue repair was preferred. Patients in Group 1 were further divided into two sub-groups: one consisting of patients undergoing bowel resection (Group 3), and the other consisting of patients not undergoing bowel resection (Group 4). Thus, Group 3 antibiotic therapy included patients who underwent mesh repair in addition to bowel resection, while Group 4 consisted of patients not assigned for bowel resection who underwent mesh repair.

All the patients were administered a single prophylactic dose of antibiotics; patients who underwent bowel resection received antibiotic therapy for an additional two to four days.

Ethics committee approval was received for this study.

The Statistical Package for the Social Sciences (SPSS Inc.; Chicago, IL, USA) version 16.0 for Windows software package was used in data collection and statistical analysis.

The Chi-square test and Mann-Whitney U test were used for statistical analysis. P values <0.05 were considered to be statistically significant.

## RESULTS

Mesh-based repair techniques were performed on the 112 patients comprising Group 1, while tissue repair techniques were performed on the 39 patients comprising Group 2 (Table 1). In this study, 81.5% (23) of the patients were male, while 18.5% (28) were female. Female patients had a significantly higher ratio of femoral hernia than male patients, while male patients had a significantly higher ratio of inguinal hernia than female patients ( $p<0.05$ ).

In Group 1, 83% (93) of the patients were male, while 17% (19) were female. In Group 2, 77% (30) of the patients were male, while 23% (9) were female. In Group 1, 87.5% (98) of the patients had inguinal hernias, while 12.5% (14) had femoral hernias. In Group 2, 77% (30) of the patients had inguinal hernias, while 23% (9) had femoral hernias. In Group 1, 51.7% (58) of the patients had hernias on the right side, while 48.3% (54) had hernias on the left side. In Group 2, 61.5% (24) of the patients had hernias on the right side, and 38.5% (15) had their hernias on the left side. There were no statistically significant differences between the two groups with respect to gender, hernia type, or hernia localization ( $p>0.05$ ) (Table 2).

In Group 1, it was observed that eight (7.14%) of the patients had wound infections, while two (1.78%) had hematomas, four (3.57%) had seromas, and one (0.89%) had a relapse. In Group 2, one (2.56%) of the patients had a wound infection, while three (7.69%) had hematomas, one (2.56%) had seroma, and none had relapses. There were no statistically significant differences between the two groups with respect to the ratio of wound infection, seroma, hematoma, or relapse ( $p>0.05$ ) (Table 3).

TABLE 1. Groups

Group 1 (Mesh-based repair)	Group 2 (Tissue repair)
112	
<b>Group 3</b> (Mesh-based repair with bowel resection)	<b>Group 4</b> (Mesh-based repair without bowel resection)
15	39
97	

**TABLE 2.** Gender, hernia type, and hernia localization for 151 patients who underwent surgical treatment for incarcerated hernias

	Group 1 (Mesh-based repair) (n=112)	Group 2 (Tissue repair) (n=39)	p*
Male	93 (83%)	30 (77%)	0.3976
Female	19 (17%)	9 (23%)	
Inguinal	98 (87.5%)	30 (77%)	0.1134
Femoral	14 (12.5%)	9 (23%)	
Right	58 (51.7%)	24 (61.5%)	0.2923
Left	54 (48.3%)	15 (38.5%)	

\*Chi-square test was used.

**TABLE 3.** Statistical analyses of complications for 151 patients who underwent surgical treatment for incarcerated hernias

	Group 1 (Mesh-based repair) (n=112)	Group 2 (Tissue repair) (n=39)	p*
Wound infection	8 (7.14%)	1 (2.56%)	0.3023
Hematoma	2 (1.78%)	3 (7.69%)	0.0780
Seroma	4 (3.57%)	1 (2.56%)	0.7681
Relapse	1 (0.89%)	0	

\*Mann-Whitney U-test was used.

It was determined that 8.92% (10) of the patients in Group 1, and 20.51% (8) of the patients in Group 2 had comorbidities. In Group 1, the mean age of the patients was 53.54 years (range: 16-94 years), the mean hospitalization time was 2.27 days (range: 1-8 days), and the mean follow-up period was 37.3 months (range: 6-67 months). In Group 2, the mean age of the patients was 49.41 years (range: 9-85 years), the mean hospitalization time was 2.12 months (range: 1-17 months), and the mean follow-up period was 40.1 months (range: 2-62 months). There were no statistically significant differences between the two groups in terms of mean age, hospitalization time, and follow-up period ( $p>0.05$ ) (Table 4).

In Group 3, 40% (6) of the patients were male, while 60% (9) were female. In Group 4, 89.7% (87) of the patients were male, while 10.3% (10) were female. In Group 1, 26.7% (4) of the patients had inguinal hernias, while 73.3% (11) had femoral hernias. In Group 4, 89.7% (87) of the patients had inguinal hernias, while 10.3% (10) had femoral hernias. The ratio of bowel resection requirement was significantly higher among female patients, as well as in patients with femoral hernias ( $p<0.05$ ).

In Group 3, 40% (6) of the patients had hernias on the right side and 60% (9) had hernias on the left side. In Group 4, 53.6% (52) of the patients had their hernias on the right side, 46.4% (45) had hernias on the left side. There were no statistically significant differences between the two groups in terms of hernia localization ( $p>0.05$ ) (Table 5).

**TABLE 4.** Comorbidities, mean age, hospitalization time and follow-up period for 151 patients who underwent surgical treatment for incarcerated hernias

	Group 1 (Mesh-based repair) (n=112)	Group 2 (Tissue repair) (n=39)	p*
Comorbidities	10 (8.92%)	8 (20.51%)	0.0558
Mean age	53.54 (16-94) (SD: 19.01)	49.41 (9-85) (SD: 21.63)	0.3640
Hospitalization time	2.27 (1-8) (SD: 1.85)	2.12 (1-17) (SD: 2.78)	0.2344
Follow-up period	37.30 (6-67) (SD: 16.34)	40.10 (2-62) (SD: 16.20)	0.3176

\*Mann-Whitney U-test was used.

**TABLE 5.** Gender, hernia type, and hernia localization for 112 patients who underwent surgical treatment with mesh-based repair

	Group 3 (Mesh-based repair with bowel resection) (n=15)	Group 4 (Mesh-based repair without bowel resection) (n=97)	p*
Male	6 (40%) 87 (89.7%)	8 (20.51%)	<0.0001
Female	9 (60%)	10 (10.3%)	
Inguinal	4 (26.7%)	87 (89.7%)	<0.0001
Femoral	11 (73.3%)	10 (10.3%)	
Right	6 (40%)	52 (53.6%)	0.3263
Left	9 (60%)	45 (46.4%)	

\*Chi-square test was used.

In Group 3, 6.7% (1) of the patients had wound infections, while 6.7% (1) had hematomas, 6.7% (1) had seromas, and none had relapses. In Group 4, 7.2% (7) of the patients had wound infections, while 1% (1) had hematomas, 3% (3) had seromas, and 1% (1) had relapses. There were no statistically significant differences between the two groups in terms of wound infection, seroma, hematoma, or relapse ( $p>0.05$ ) (Table 6).

In Group 3 and Group 4, 26% (4) and 8.2% (8) of the patients had comorbidities, respectively. In Group 3, the mean age of the patients was 62.6 years (range: 32-82 years), the mean hospitalization time was 5.73 months (range: 5-7 months), and the mean follow-up period was 37.8 months (range: 6-67 months). In Group 4, the mean age of the patients was 52.1 years (range: 16-94 years), the mean hospitalization time was 1.7 months (range: 1-8 months), and the mean follow-up period was 33.7 months (range: 7-62 months). Patients belonging to Group 3 had significantly higher comorbidity rates, higher mean age, and longer hospitalization times ( $p<0.05$ ). There were no statistically significant differences between the two groups in terms of the mean follow-up period ( $p>0.05$ ) (Table 7).

**TABLE 6.** Statistical analyses of complications for 112 patients who underwent surgical treatment with mesh-based repair

	Group 3 (Mesh-based repair with bowel resection) (n=15)	Group 4 (Mesh-based repair without bowel resection) (n=97)	p*
Wound infection	1 (6.7%)	7 (7.2%)	0.9466
Hematoma	1 (6.7%)	1 (1%)	0.1315
Seroma	1 (6.7%)	3 (3%)	0.4979
Relapse	0	1 (1%)	

\*Mann-Whitney U-test was used.

**TABLE 7.** Comorbidities, mean age, hospitalization time and follow-up period for 112 patients who underwent surgical treatment with mesh-based repair

	Group 3 Mesh-based repair with bowel resection (n=15)	Group 4 Mesh-based repair without bowel resection (n=97)	p*
Comorbidities	4 (26.6%)	8 (8.2%)	0.0102
Mean age	62.67 (32-82) (SD: 17.09)	52.13 (16-94) (SD: 18.98)	0.0438
Hospitalization time	5.73 (5-7) (SD: 0.70)	1.78 (1-8) (SD: 1.36)	<0.0001
Follow-up period	37.86 (6-67) (SD: 16.24)	33.73 (7-62) (SD: 17.07)	0.4343

\*Mann-Whitney U-test was used.

## DISCUSSION

Incarcerated inguinal hernia is one of the most common urgent surgical conditions. Ten percent of patients with inguinal hernia present with incarceration, and require urgent surgical procedures. For inguinal hernias, the risk of strangulation varies between 0.29% and 2.9% (4).

Nearly 15% of all inguinal hernia repairs are associated with relapses, and most of them occur following old surgical techniques that do not include a mesh-repair (5,6).

Although modern inguinal hernioplasty techniques do not affect mortality rates following incarceration, they are highly effective in reducing the relapse rate (7).

### Mesh

The most commonly used prosthetic materials in tension-free mesh repair are polymers, polypropylene, and polyester. Polypropylene is the most preferred of these, since it is provides the best prosthesis leading to fibroblast activation. The

pore size of the mesh is also important. With pore sizes larger than 75 µm, it is easier for macrophages to penetrate the tissue, which helps to minimize the risk of infection (8).

In the current study, large pore monofilament polypropylene prostheses were used.

### Wound infection-recurrence

Although tension-free mesh repair is considered to be the gold standard surgical procedure in inguinal hernia repair under elective conditions, it is not recommended for strangulated hernia repair since it may increase the risk of wound infection. However, recent studies have reported that strangulation is no longer a contraindication for tension-free mesh repair (9-19).

However, other studies report mesh as a potential cause of wound infection, describing that it may be necessary to perform mesh removal to limit the risk of infection (20,21).

Papaziogas et al. (4) conducted a study of 75 patients with incarcerated hernia who underwent surgery in their study, where 33 patients were assigned to the tension-free mesh repair group (Group A), while 42 patients underwent hernioplasty with the Bassini procedure (Group B); the outcomes in both group were then compared. Two patients in Group A and four patients in Group B had wound infections; however, no statistically significant difference was identified between the groups. In Group B, hospitalization time was significantly longer. The mean follow-up period was nine years. One patient in Group A and two patients in Group B experienced relapse. This study reported that the use of polypropylene mesh in strangulated hernias can be considered safe.

Wysocki et al. (15) previously performed a study of 77 patients who underwent the Lichtenstein procedure. In this study, two of the patients had seromas, while two patients had limited wound infections. The study reported that the use of monofilament polypropylene mesh implantation in strangulated hernias is safe, with a low risk of local infection risk.

A study by Elsebae et al. (22) included fifty-four patients with incarcerated hernia who underwent surgery. Twenty-seven of these patients were assigned to the Lichtenstein procedure, while 27 patients underwent the Bassini procedure. Among the patients who underwent the Lichtenstein procedure, one had seroma, one had wound infection, and none had relapses. Among the patients who were assigned the Bassini procedure, three had wound infections, while three had relapses. There were no statistically significant differences between the groups in terms of complications.

In a study by Pans et al. (23), no statistically significant difference was identified between mesh-repair and non-mesh repair in terms of wound infection. It was also reported that none of the nine patients who underwent bowel resection as well as mesh-repair had wound infections.

In the current study, only one patient exhibited relapse. In this case, the mesh was removed after the patient developed a wound-infection in the postoperative period, and the relapse occurred approximately one year later. There were no statistically significant differences between the groups with respect to hematoma, seroma, or relapse.

### Bowel resection

In a retrospective study previously performed by Dahlstrand et al. (24) on 8208 patients in Sweden between 1992 and 2006, it was reported that femoral hernias were significantly more common among women than men. The study revealed that being female and having femoral hernias increased the risks of incarceration, bowel resection, complications, and mortality. In the same study, it was also reported that older age had a noticeable impact on bowel resection and mortality rates.

Certain studies report femoral hernia and delaying visits to physicians can increase the risk of bowel resection (25-27).

In 2010, Ge et al. (26) reported that femoral hernia was a risk factor for bowel resection.

The study by Azari et al. (28) compared patients above and below 80 years old diagnosed with strangulated hernia, and reported that elderly age played a role in morbidity and mortality.

In a similar study, Compagna et al. (29) compared inguinal hernia patients above and below 80 years of age, and also reported that elderly age played a role in mortality and morbidity. The current study revealed that femoral hernias are significantly more common among women than men, and that the requirement for bowel resection was significantly higher in female patients, as well as in patients with femoral hernias.

A number of studies have reported that performing bowel resection increases the complication rates in incarcerated inguinal hernias, while the type of mesh used is not directly associated with postoperative complications (16).

In this study, patients who underwent bowel resection had significantly higher comorbidity rates, higher mean age, and longer hospitalization times.

In a study performed by Sawayama et al. (30), 2 of the 10 patients who received mesh repair in addition to bowel resection developed wound infection afterwards; on the other hand, none of the 64 patients who received mesh-repair only, without being assigned to bowel resection, developed any wound infection. The current study revealed that as long as a wound is kept clean and contamination-free, the use of mesh does not constitute a contraindication, even for cases where bowel resection is performed.

Certain authors claim that even when bowel resection is performed, the use of polypropylene mesh for implantation does not increase the risk of wound infection in strangulated hernia repair (23,31). The current study similarly reported no statistically significant differences in terms of hematoma, seroma and relapse occurrence between patients who received mesh repair in addition to bowel resection, and patients who only had mesh repair. There were also no statistically significant differences between Group 3 and Group 4 with respect to the mean follow-up period.

### Antibiotherapy

The administration of antibiotics for two to four days to patients with incarcerated inguinal hernia repair is reported to decrease the risk of wound infection associated with mesh implants (32).

Most surgeons prefer to use antibiotic prophylaxis to prevent infection (33-36).

Yerdel et al. (35) claimed that the use of prophylactic single dose intravenous antibiotic would reduce the risk of wound infection.

In the current study, all patients were administered a single prophylactic dose of antibiotic; additionally, patients assigned to bowel resection received additional antibiotherapy for two to four days.

The current study revealed that the use of polypropylene mesh in incarcerated inguinal hernia repair has no negative effect on wound infection or complications. Considering the fact that traditional tissue repair techniques can increase the risk of relapse, the current study results revealed that polypropylene mesh can be used safely in urgent groin hernia repair, even in cases where bowel resection is required.

Limitations of our study include the fact that the surgeries were performed by the same surgeon; the fact that the study was retrospective, and the lack of standardization between the groups. As this study is a clinical trial, there was only a weak correlation in parameters such as gender and age, while performing comparisons between different groups was inevitably necessary.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Haseki Training and Research Hospital.

**Informed Consent:** N/A.

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