

# ONLAY VERSUS SUBLAY REPAIR AFTER INCISIONAL HERNIA: WHICH TECHNIQUE TO PREFER?

Mezjda Ismail Rashaan <sup>a</sup>



Submitted: 15/5/2020; Accepted: 30/6/2020; Published: 21/3/2021

## ABSTRACT

### *Background*

Incisional hernia (IH) is one of the most common complications worldwide after abdominal surgery. For repair of IH, a wide spectrum of surgical techniques is advocated. However, there is no consensus on the ideal technique for mesh location and it remains controversial.

### *Objectives*

This clinical study aimed to compare the postoperative results of onlay mesh repair with sublay (retromuscular) mesh repair.

### *Methods*

This retrospective study was conducted in the surgical department of Sulaimani Teaching hospital from January 2010 to February 2014. Follow up period was for 2 years conducted via telephone or at outpatient clinics. All patients underwent preoperative evaluation and postoperative follow-up with regards to postoperative pain, wound infection, seroma, recurrence rates, and hospital stay.

### *Results*

A total of 186 patients underwent open mesh repair for incisional hernia of whom 96 cases were operated on by onlay technique and 90 cases by sublay mesh repair. Patients who underwent onlay repair had statistically significant more post-operative complications compared to the sublay group 33 patients (34.4%) vs. 13 patients (14.4%),  $p < 0.001$ . In the onlay group, the incidence of recurrence was 13 (13.5%) compared with 3 (3.3%,  $p = 0.01$ ) in the sublay group. 3 patients (3.3%) in the sublay group had wound infection compared with 10 patients (10.4%,  $p = 0.05$ ) in the onlay group. Patients in the onlay group had statistically significant more moderate pain (VAS 4-6) during hospital admission compared with the sublay group (82 (85.4%) vs. 62 (68.9%),  $p = 0.01$ ). However, patients in the sublay group had statistically more severe pain (VAS 7-10) during hospital admission compared to the onlay (28 (31.1%) vs. 14 (14.6%),  $p = 0.01$ ).

### *Conclusion*

Sublay mesh repair is to be preferred to the onlay mesh repair technique because of the statistically significant less postoperative complications such as recurrence and wound infection.

**Keywords:** *Onlay Repair; Sublay Repair; Incisional Hernia.*

---

<sup>a</sup> Department of Surgery, College of Medicine, University of Sulaimani, Kurdistan Region, Iraq.  
Correspondence: [mezjda.mohammad@univsul.edu.iq](mailto:mezjda.mohammad@univsul.edu.iq)

## INTRODUCTION

Incisional hernia (IH) is one of the most common complications after abdominal surgery, which can occur in 15- 25% of the patients who underwent abdominal operations<sup>(1-6)</sup>. Incisional hernia is associated with a high rate of morbidity (abdominal discomfort and pain, dragging sensation, intestinal obstruction, cosmetic) that affects the quality of life negatively with a significant effects and burden on socioeconomic costs and health care<sup>(7, 8)</sup>. In the past decades a wide range of surgical procedures have been developed to repair incisional hernias. Nowadays, mesh repair is the standard treatment of IH.

Nevertheless, there is no consensus on the ideal anatomic position of the mesh placement<sup>(9)</sup>. Studies showed favorable results of sublay repair compared to onlay repair in terms of low recurrence rates and low rates of postoperative complications<sup>(10)</sup>.

However, most of the available evidence is based on retrospective studies based on patient population in the Western world. Extrapolation of these results to the Kurdish patient's population should be done with caution because of the demographic differences and the organization of the health care compared with the Western population. Therefore, this study aimed to compare the clinical outcomes of only technique with sublay mesh repair in the management of incisional hernia.

## PATIENTS AND METHODS

Patients who underwent onlay or sublay mesh repair after primary incisional hernia were retrospectively reviewed from January 2010 to February 2014. The study was conducted at the surgical department of Sulaimani Teaching Hospital (Sulaimani, Iraqi Kurdistan). Inclusion criteria were incisional hernia requiring onlay or sublay hernioplasty. The exclusion criteria were if onlay or sublay mesh repair did not meet the pre-defined definition of both operative techniques in our study, patients were younger than 18 years, or whenever data was incomplete.

### Operative technique

All the operations were performed under general anesthesia or spinal anesthesia. Before the operation, the patient received an antibiotic prophylaxis single dose of Amoxiclav.

In onlay repair, dissection of the subcutaneous fat

was performed for more than 7 centimeters laterally from the hernia defect. Thereafter, the hernia sac was excised. The fascial defect was closed primarily by a non-absorbable suture. Following this, the mesh was cut to the appropriate size with a 5 cm overlap in all directions to cover the hernia defect and fixed to the anterior rectus fascia or external oblique fascia with a non-absorbable suture.

In sublay mesh repair (retro-rectus muscle), a similar way was implemented by dissecting subcutaneous fat and hernia sac. The rectus muscle was uncovered by incising the edges of the hernia scar. By blunt dissection between the rectus muscle and along the length of the posterior rectus fascia, open space is created. In the midline, the peritoneum was closed by non-absorbable sutures. An appropriate size of mesh was prepared and fixed by non-absorbable sutures with 5 centimeters overlap of the defect in all directions between the rectus muscle and posterior rectus sheath. The anterior rectus sheath was closed by non-absorbable sutures over the mesh.

Patients were included only if they met the above criteria of onlay or sublay repair. According to surgeon preference at our hospital, the patient who underwent uncomplicated onlay repair stayed one or two days at the hospital, and patients who underwent sublay repair stayed two to three days at the hospital.

Baseline characteristics including operative notes, clinical notes, laboratory data, and discharge summary were included.

### Statistical analysis

Data entry was performed using an excel spreadsheet then the statistical analysis was performed by the SPSS program, version 24 (IBM SPSS Statistical Package for the Social Sciences). The data presented in tabular forms showing the frequency and relative frequency distribution of different variables among both groups of patients. The statistical difference in mean between the two groups was assessed using an independent sample t-test, while the difference in the mean rank between 2 groups (for non-normally distributed variables) was assessed by a non-parametric test (Mann-Whitney).

Chi-square tests and Fisher exact tests were used to compare the categorical data between these two groups of patients (the two methods of surgery) in respect to different variables as presenting features, the state of each group, and the course and follow

## *Onlay versus Sublay Repair after Incisional Hernia: which Technique to Prefer?*

up of each group postoperatively, the side effects and the outcome variables. P values of 0.05 were used as a cut-off point for the significance of statistical tests.

### **RESULTS**

#### **Patient Characteristics**

Between January 2010 and February 2014, a total of 186 patients met the inclusion criteria. Table 1 shows the patient characteristics. 96 patients underwent onlay mesh repair and 90 patients sublay mesh repair. There was a statistically significant difference between both treatment groups regarding gender, residence and work occupation, time to hernia recurrence from the previous operation, and cause of incisional hernia based on the history of the patient.

Patients in the onlay group had significantly more dragging sensation compared with the sublay group before incisional hernia repair 48 (50.0%) vs. 22 (24.4%),  $p < 0.001$ . There were no statistically significant differences between both groups for the chief complaint, abdominal pain, intestinal obstruction, or other symptoms. (Table 2).

#### **Incisional hernia characteristics**

Patients in the sublay group underwent significantly more ultrasonographic evaluation of the incisional hernia pre-operatively compared with the onlay group (88 (97.8%) vs. 5 (5.2%),  $p < 0.001$ ). No significant differences were found between both treatment groups about the size and number of defects found on the ultrasonography (US). Nevertheless, as seen in Table 3, a higher number of defects were found in the sublay group that underwent US evaluation compared to the onlay group (1-4 vs. 1,  $p = 0.85$ ).

#### **Operation outcomes**

Patients who underwent onlay repair had statistically significant more post-operative complications compared to the sublay group 33 (34.4%) vs. 13 (14.4%),  $p < 0.001$ . Thirteen (13.5%) patients had a recurrence in the onlay group compared with 3 (3.3%,  $p = 0.01$ ) patients in the sublay group. Postoperative wound infection was statistically significantly different between the onlay group of 10 (10.4%) patients compared to 3 (3.3%) patients in the sublay group,  $p = 0.05$ . Post-operative seroma was observed more in the onlay group than the sublay group with no statistical significance. Moreover, the length of hospital stay in the sublay group was

longer compared with the onlay group 2.9 days (0.7) vs. 2.2 days (0.4),  $p < 0.001$ . Patients in the onlay group had statistically significant more moderate pain (VAS 4-6) during hospital admission compared with the sublay group (82 (85.4%) vs. 62 (68.9%),  $p = 0.01$ ). However, patients in the sublay group had statistically more severe pain (VAS 7-10) during hospital admission compared to the onlay (28 (31.1%) vs. 14 (14.6%),  $p = 0.01$ ). (Table 4).

Table 1. Patient's characteristics.

	Onlay N= 96	Sublay N= 90	p-value
<b>Age means (SD)</b>	45.9(14)	44.4(11)	0.42 <sup>(4)</sup>
<b>Gender</b>			
Male	27 (28.1%)	9 (10.0%)	0.002 <sup>(2)</sup>
Female	69 (71.9%)	81 (90.0%)	
<b>Female</b>			
Married	62 (89.9%)	78 (96.3%)	0.11 <sup>(1)</sup>
Unmarried	7 (10.1%)	3 (3.7%)	
<b>Number of children (Female)</b>			
Mean (SD)	3.9 (2.2)	3.8 (1.7)	0.09 <sup>(4)</sup>
<b>Parity among female cases</b>			
Nulli-parus	7 (10.1%)	5 (6.2%)	0.14 <sup>(2)</sup>
1-2 children	11 (15.9%)	9 (11.1%)	
3-5 children	34 (49.3%)	55 (67.9%)	
>5 children	17 (24.6%)	12 (14.8%)	
<b>Residence</b>			
Urban	34 (35.4%)	51 (56.7%)	0.004 <sup>(2)</sup>
Rural	62 (64.6%)	39 (43.3%)	
<b>Occupation</b>			
Employed	26 (27.1%)	13 (14.4%)	0.03 <sup>(2)</sup>
Unemployed	70 (72.9%)	77 (85.6%)	
<b>Reason for previous operation</b>			
Appendectomy	11 (11.5%)	9 (10.0%)	0.53 <sup>(1)</sup>
Kidney operation	1 (1.0%)	2 (2.2%)	
Cholecystectomy (Kocher)	4 (4.2%)	3 (3.3%)	
Laparotomy	21 (21.9%)	18 (20.0%)	
Caesarean section	11 (11.5%)	19 (21.1%)	
Para umbilical hernia	4 (4.2%)	1 (1.1%)	
Umbilical hernia	44 (45.8%)	38 (42.2%)	
Previous operations done for same purpose	18 (18.8%)	13 (14.4%)	0.43 <sup>(2)</sup>
Time to incisional hernia, month median (range)	46 (14-180)	36 (1-250)	0.001 <sup>(3)</sup>
<b>Mesh applied at primary operation, number (%)</b>			
Yes	2 (2.1%)	3 (3.3%)	0.60 <sup>(2)</sup>
No	94 (97.9%)	87 (96.7%)	
<b>Cause of recurrence</b>			
Closure technique	31 (31.3%)	43 (47.8%)	0.03 <sup>(1)</sup>
Infection	22 (22.9%)	17 (18.9%)	
Constipation	2 (2.1%)	2 (2.2%)	
Pregnancy	0 (0.0%)	2 (2.2%)	
Lifting heavy objects	0 (0.0%)	3 (3.3%)	
Others	0 (0.0%)	2 (2.2%)	
Closure technique & other reasons	23 (24.0%)	14 (15.6%)	
Infection with other reasons	16 (16.7%)	5 (5.6%)	
Constipation & other reasons	2 (2.1%)	2 (2.2%)	

<sup>(1)</sup> Fisher exact test; <sup>(2)</sup> Chi-square test; <sup>(3)</sup> Mann-Whitney test, <sup>(4)</sup> Independent t-test

Onlay versus Sublay Repair after Incisional Hernia: which Technique to Prefer?

Table 2. Symptoms before incisional hernia repair.

	Onlay N= 96	Sublay N= 90	p-value
<b>Chief complain</b>			
Asymptomatic	7 (7.3%)	5 (5.6%)	0.55 <sup>(1)</sup>
Cosmetic	1 (1.0%)	0	
Symptomatic	88 (91.7%)	85 (94.4%)	
<b>Pain</b>	87 (90.6%)	80 (88.9%)	0.70 <sup>(2)</sup>
<b>Dragging sensation</b>	48 (50.0%)	22 (24.4%)	< 0.001 <sup>(2)</sup>
<b>Intestinal obstruction</b>	0	3 (3.3%)	0.07 <sup>(1)</sup>
<b>Others*</b>	37 (38.5)	28 (31.1%)	0.29 <sup>(2)</sup>

\*Other symptoms were numbness, weakness in the abdominal wall, borborygmic movement in the abdomen.

<sup>1</sup>Fisher exact test; <sup>2</sup>Chi-square test; <sup>3</sup>Mann-Whitney tests

Table 3. Radiological findings of incisional hernia.

	Onlay N= 96	Sublay N= 90	p-value
<b>Ultra sound performed</b>	5 (5.2%)	88 (97.8%)	< 0.001 <sup>(1)</sup>
<b>US size (cm)</b>	3 – 4 cm	2 – 10 cm	0.36 <sup>(1)</sup>
<b>US no of defect</b>	One	One – four	0.85 <sup>(1)</sup>

RUQ=Right Upper Quadrant, RLQ=Right Lower Quadrant, LUQ=Left Upper Quadrant, LLQ=Left Lower Quadrant. <sup>1</sup>Fisher exact test; <sup>2</sup>Chi-square test; <sup>3</sup>Mann-Whitney tests

Table 4. Post-operative outcomes.

	Onlay N= 96	Sublay N= 90	p-value
<b>The operation, n (%)</b>			
Transverse	95 (99%)	60 (66.7%)	< 0.001 <sup>(1)</sup>
Longitudinal	1 (1%)	22 (24.4%)	
Oblique	0	8 (8.9%)	
<b>Hospital stay, mean (SD)</b>	2.2 (0.4)	2.9 (0.7)	< 0.001 <sup>(4)</sup>
<b>Complications, n (%)</b>	33 (34.4%)	13 (14.4%)	< 0.001 <sup>(2)</sup>
<b>Type of complication, n (%)</b>			
None	63 (65.6%)	77 (85.6%)	0.002 <sup>(2)</sup>
Recurrence	13 (13.5%)	3 (3.3%)	0.01 <sup>(1)</sup>
Seroma	9 (9.4%)	7 (7.8%)	0.70 <sup>(1)</sup>
Wound infection	10 (10.4%)	3 (3.3%)	0.05 <sup>(1)</sup>
Death	1 (1.0)	0 (0.0%)	0.33 <sup>(1)</sup>
<b>Pain score* (categories), n (%)</b>			
None (0)	0 (0%)	0 (0%)	0.01 <sup>(2)</sup>
Mild (1-3)	0 (0%)	0 (0%)	
Moderate (4-6)	82 (85.4%)	62 (68.9%)	
Severe (7-10)	14 (14.6%)	28 (31.1%)	

<sup>1</sup>Fisher exact test; <sup>2</sup>Chi-square test; <sup>3</sup>Mann-Whitney test <sup>(4)</sup> Independent t-test

\* pain score measured during hospital admission

## DISCUSSION

To the best of our knowledge, this study is the first comparative study that compared the surgical outcomes of onlay mesh repair to sublay mesh repair in a Kurdish patient population in Iraq with a follow-up period of two years. This study showed that patients who underwent sublay mesh repair had statistically significantly fewer postoperative complications in terms of recurrence and wound infection. No conclusion can be made regarding which operation technique to prefer based solely on post-operative pain.

One of the most frequent complications after abdominal surgery, despite advances in surgical technique, is an incisional hernia. A wide spectrum of surgical techniques has developed but still, no optimal procedure has been established and this remains controversial<sup>(9,10,11)</sup>. But nowadays the use of prosthetic material for repair has become standard goal practice<sup>(12)</sup>. A less post-operative complication in the sublay group is the most significant finding in this study. In terms of operative technique, an onlay mesh repair is a well-known approach that is less complex to learn and requires less operative time when compared to the sublay mesh repair. Sublay mesh repair is more challenging due to the dissection of the posterior rectus fascia from the hernia scar and rectus muscle.

Our study found a lower recurrence rate in the sublay group. A systematic review and meta-analysis by Timmermans et al. confirm our findings (recurrence rate: Onlay versus Sublay repair, Odds Ratio 2.4 (0.99-5.88)<sup>(5)</sup>. Our data shows that the postoperative early recurrence rate was lower in the sublay repair (3 patients, 3,3%) comparing to 13 patients (13,5%,  $p=0.01$ ) in the onlay group<sup>(13-17)</sup>. Mesh tissue ingrowth and integration may reduce the recurrence rates. In sublay mesh repair, intra-abdominal pressure is distributed uniformly to the mesh and abdominal wall muscles which may cause fixation of the mesh<sup>(4,17)</sup>. Also, in sublay mesh repair from two loads bearing tissues from both sides (posterior rectus sheath and anterior rectus sheath with rectus muscles) produce strong mesh tissue fixation to the lateral abdominal muscles and integration<sup>(17-19)</sup>. Moreover, in sublay mesh repair by closing the anterior rectus sheath over the mesh at its cranial and caudal edges of repair, it supports these two well-known weak points to prevent a recurrence<sup>(20-22)</sup>.

One of the major complications after hernia repair is wound infection. In this study, the rate of wound infection was higher in patients treated with onlay hernioplasty 13 patients (13,5%) vs 3 patients (3,3%,

$p=0.01$ )<sup>(9, 11, 22)</sup>. Due to the deep anatomic position of the sublay mesh, transmission of infection from the superficial wound is prevented from potentially spreading into deep intraperitoneal contents<sup>(18)</sup>. In onlay mesh repair, dissection of a substantial area of subcutaneous tissue for harvesting skin flaps may increase the risk of flap devascularization<sup>(9, 18)</sup>.

Patients in the onlay group had statically significant more pain (VAS 4-6) than the sublay group, whereas the sublay group had statistically significant more severe pain (VAS 7-10) during hospital admission. A possible explanation for this finding is that patients from the sublay group had larger and more than one hernia defect which required more extensive dissection and thus operative time<sup>(23, 25, 26)</sup>. This may have resulted in more post-operative pain and a longer hospital stay compared with the onlay group.

The incidence of occurrence of seroma formation according to current literature is more frequent in onlay hernioplasty than in sublay hernioplasty<sup>(9,11)</sup>. This study showed more seroma formation in the onlay group (9 patients, 9,4%) compared to the sublay group (7 patients (7,8%). However, this difference was not statistically significant ( $p=0.70$ ). The incidence of developing more seroma in onlay repair compared to sublay repair can be explained by the wide subcutaneous tissue dissection which can cause transection of many blood vessels. The onlay mesh act as a temporary barrier between the subcutaneous tissue and the deep fascia thereby compromising the circulation between the two layers (accumulating in seroma)<sup>(18)</sup>. In sub lay repair, the dissection of subcutaneous tissue is less extensive therefore resulting in less fluid accumulation and seroma.

In conclusion, this study showed that the sublay mesh repair technique is to be preferred above the onlay mesh repair technique because of the statistically significant less recurrence and wound infection in the sublay group. Prospective studies including a larger number of patients and a longer postoperative follow-up are advised to confirm our findings in the Kurdish population.

## REFERENCES

- 1-Israelsson LA, Smedberg S, Montgomery A, Nordin P, Spangen L. Incisional hernia repair in Sweden 2002. *Hernia* 2006 Jun;10 (3):258-61.
- 2-Berger D, Lux A. Operative therapy of secondary ventral hernia: technical principles. *Chirurg*, 2013 Nov;84(11):1001-12

## Onlay versus Sublay Repair after Incisional Hernia: which Technique to Prefer?

- 3-Venclauskas I, Maleckas A, Kiudelis M. One-year follow up after Incisional hernia treatment: results of a prospective randomized study. *Hernia*. 2010 Dec;14(6):575-82).
- 4-Iker Murat Arer, Hakan Yabanoglu, Huseyin Ozgur Aylac, Ali Fzer, Kenan Caliskan. Long term results of retromuscular hernia repair: a single-center experience. *Pan Afr Med J*. 2017; 27:132.
- 5-Timmermans L, de Goede B, van Dijk SM, Kleinrensink GJ, Jeekel J, Lange JF. Meta -analysis of sublay versus onlay mesh repair in Incisional hernia surgery. *Am J surg*.2014 Jun; 207(6): 980 - 988.
- 6-Venclauskas L, Silanskatie J, KanisauskatieJ, Kiudelis M. Long-term results of Incisional hernia treatment. *Medicina (Kaunas)*. 2007;43(11):855-60
- 7-Winkler MS, Gerharz E, Dietz UA. Overview and evolving strategies of ventral hernia repair. *Urolog A*. 2008 Jun;47(6):740-7.
- 8-R. Godara, P. Garg, H. Raj, S. Singla. Comparative Evaluation of Sublay Versus Onlay Meshplasty in Ventral Hernias. *The Internet Journal of Surgery*. Jul-Aug 2006;25(4):222-3.
- 9-Demetrashvili Z, Pipia I, Loladze D, Metreveli T, Ekaladze E, Kenchadze G, Khutsishvili K: Open retromuscular mesh repair versus onlay technique of Incisional hernia : A randomized trial. *Int J.Surgery* 2017 Jan; 37:65-70.
- 10-Bender JS. Open retrofascial Incisional hernia repair is a safe and effective operation. *Am J Surg*.2016 Mar;211(3):589-92.
- 11-Kundan Kharde, Bharat Bhushan Dogra, Sunil Panchabhai, Karan V.S. Rana, Srihari Sridharan, Sai Kalyan : A comparative study of onlay and retrorectus mesh placement in incisional hernia repair. Original article. *Med J DY Patil UniV* Year: 2013 volume: 6 / Issue : 3 /page :258-262
- 12-Vichova B, Oravsky M, Schnorrer M. (Scar hernia repairs using a mesh- the sublay technique ). *Rozhl Chir*. 2008 Mar;87(3):138-40.
- 13-Hawn MT, Snyder CW, Graham LA, Gray SH, Finan KR, Vick CC. Long-term follow- up of technical outcomes for incisional hernia repair. *J Am Coll Surg*. 2010 May; 210(5):648-55
- 14-Helgstrand F, Rosenberg J, Kehlet H, Jorgensen LN, Bisgaard T. Nationwide prospective study of outcomes after elective incisional hernia repair. *J Am Coll Surg*.2013 Feb;216(2):217-228.
- 15-Demetrashvili ZM, Kerkadze VN, Pipia IN, Topchishvili GG. Comparative evaluate of methods of placement of polypropylene meshes in alloplastic of incisional hernias. *Georgian Med News*.2009 Oct;(175):7-9.
- 16-Furat Shani Aoda and Alaa Sharief Ibrahim. Sublay versus onlay mesh repair of ventral hernia. *QMJ vol 9 No.16*.
- 17-Bantu Rajsiddharth, Madipeddi Venkanna, Gandia Anil Kumar, Sridhar Reddy Patlolla, Sridhar Sriramoju, Bachannagari Srinivas Reddy. Comparative study of onlay and pre-peritoneal mesh repair in the management of ventral hernias. *International Journal of Scientific Study / October 2015/ vol 3/ Issu 7*.
- 18-Holihan JL, Nguyen DH, Nguyen MT, Mo J, KAO LS, Liang MK. Mesh Location in Open Ventral Hernia Repair: A Systemic Review and Network Meta-analysis. *World J Surg*.2016 Jan;40(1):89-99.
- 19-David R. PLUM, Karen Horvath, Thomas Koepsell. Have Outcomes of Incisional Hernia Repair Improved With Time? *Annals of Surgery*. 2003,Jan; 237(!): 129-135.
- 20-de Vries Reilingh TS, van Gelder D, Langenhorst B. , de Jong D.van der Wilt GJ, van GOOR H, Bleichrodt RP. Repair of large midline Incisional hernia with polypropylene mesh: comparison of three operative techniques. *Hernia*. 2004 Feb; 8(1):56-9.
- 21-Den Hartog D, Dur AH, Tuinebreijer WE, Kries RW. Open surgical procedures for incisional hernias. *Cochrane Database Systemic Rev*. 2008 Jul 16; (3) CD006438. experience in incisional hernia surgery, A comparative retrospective study of 432 incisional
- 22-Gleysteen JJ. Mesh -Reinforced Ventral Hernia Repair: Preference for 2 Techniques. *Arch Surg* 2009;144:740-745.
- 23-Akinci M, Ergul Z, Kaya O, Kulah B, Kulacoglu H. Predictors for the duration of hospital stay after abdominal wall hernia repairs. *Chirurgia (Bucur)*.2010 Jan-Feb;107(1):47-51.
- 24-Linas Venclauskas, Jolita Silanskaite, Jurga Kanisauskaite, Mindaugas Kiudelis. Long-term results of incisional hernia treatment. *Medicine (Kaunas)* 2007; 43(11).
- 25-Langer C, Liersch T, Kley C, Flosman M. Suss M, Siemer A, Becker H. Twenty-five years of hernia repair. *Chirurg*. 2003 Jul; 74(7):638-45.
- 26-Pourk KE, Farrow N, Azar F, Burce KK, Hicks CW, Azoury SC, Comell P, Cooney CM, Eckhouser FF. Effect of hernia size on operative repair and postoperative outcomes after open ventral hernia repair. *Hernia*. 2016 Dec;20(6):805-8