

## Abrahamson's Repair in the Management of Ventral Hernia

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**Abstract: Background:** Abdominal wall hernias are among the most common of all surgical problems. Ventral hernia is one of the common hernias in middle-aged females, incisional hernia results from failure of line of closure of abdominal incision. No incision in the abdomen is immune to the development of incisional hernias. Jack Abrahamson the modifier and the developer of the shoelace darn repair started using this technique on 1973. The Shoelace operation is a simple but effective darn technique for the repair of ventral hernias. **Objectives:** The aim of this study is to evaluate shoelace darn in the repair of ventral hernias and to compare it to open mesh repair. **Patients and methods:** A prospective observational study of 100 cases of ventral hernia was carried out in Kafr Al-Sheikh General Hospital to find the place of shoelace darn in the repair of ventral hernias and to compare it to open mesh repair from where recurrence and complications 2 years after surgery. All the patients in the study were subjected to demographic data, complaints and history of present illness, laboratory investigations, electrocardiography and Management of 100 cases of ventral hernia by analyzing 2 operative methods: a shoelace darn repair and non-absorbable open mesh repair; 50 cases were managed by shoelace darn repair (group A) and 50 cases were managed by mesh repair (group B). **Results:** Statistical analysis revealed that there were no statistical significant differences between both groups as regards age, sex, clinical presentation, the site of previous incision, sites of incisional hernia and widths of the defects preoperatively according to SWR classification, size and number and reducibility of hernias, pulmonary complications, wound complications, intestinal complications, retention of urine, chronic pain and recurrence. But, there was a statistical significant difference between both groups as regards operative time. Blood loss was more obvious during surgical procedure for group B than for group A. Statistical analysis revealed that there were statistical high significant differences between both groups as regards post-operative hospital stay and drain removal and total amount of fluid drained. **Conclusion:** The shoelace darn repair is quick, easy, extra-peritoneal method that simply returns the unopened hernial sac and its content to the abdominal cavity, and thus avoids the tedious and perhaps risky dissection of the adherent loops of the bowel on the inner surface of the sac required in the re-suture and in the mesh repair. So, shoelace darn repair have got a good place in managing abdominal ventral hernias.

[Mohamed A. Radwan; Yaser A. Amer and Tarek M. Abd Alsamed. **Abrahamson's Repair in the Management of Ventral Hernia.** *Nat Sci* 2018;16(1):41-51]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). <http://www.sciencepub.net/nature>. 6. doi:[10.7537/marsnsj160118.06](https://doi.org/10.7537/marsnsj160118.06).

**Key Words:** Anterior abdominal wall, ventral hernia, mesh repair hernioplasty, Shoelace Darn repair, Abrahamson's repair

### 1. Introduction

Ventral hernias refer to fascial defects of the anterolateral abdominal wall through which intermittent or continuous protrusion of abdominal tissue or organs may occur. They have been reported to occur after 0-26% of abdominal procedures. Although these hernias mostly become clinically manifest between 2 to 5 years after surgery, studies have shown that, the process starts within the first postoperative month. They are said to occur as a result of a biomechanical failure of the acute fascial wound coupled with clinically relevant impediments to acute tissue repair and normal support function of the abdominal wall, during post-operative period<sup>(1)</sup>.

The shoelace darn repair is a quick, easy, extra-peritoneal method that simply returns the unopened hernial sac and its contents to the abdominal cavity, and thus avoids the tedious and perhaps risky

dissection of the adherent loops of the bowel on the inner surface of the sac required in the re-suture and in the mesh repair. The repair restores the functional anatomy of the abdominal wall. It reconstruct a strong new linea alba and allows the rectus muscles to straighten and lie along side each other at the midline. It also reconstruct the anterior rectus sheaths and fixes them to the new linea alba<sup>(2)</sup>.

The shoelace repair is entirely extraperitoneal and involves only two simple suture lines placed in normal healthy tissue, consequently the postoperative recovery is smooth and rapid<sup>(3)</sup>.

Majid et al. found the place of shoelace darn in the repair of incisional hernias and concluded that shoelace darn repair have got a good place in managing abdominal incisional hernias<sup>(4)</sup>.

The aim of this study is to evaluate shoelace darn in the repair of ventral hernias and to compare it to open mesh repair.

## 2. Patients and Methods

A prospective observational study of 100 cases of ventral hernia was carried out in Kafr Al-Sheikh General Hospital to find the place of shoelace darn in the repair of ventral hernias and to compare it to open mesh repair from where recurrence and complications 2 years after surgery.

### **Inclusion criteria:**

- Only those patients who are willing to participate in study were included.
- Incisional hernias located in upper, lower midline, and paramedian incision or resulting from Pfannensteil's incision in shoelace darn repair.
- Recurrent para-umbilical hernia.

### **Exclusion criteria:**

- Patients with size of hernia larger than 15 cm in its largest dimension in shoelace repair.
- Patients with obstructive or strangulated ventral hernia were excluded from this study.
- Patients with severe comorbid conditions (severe cardiopulmonary disease and uncontrolled ascites).
- Pregnancy or planning to become pregnant.



**Figure (1):** Incisional hernia after Medline sub umbilical exploration

### **Methods:**

All the patients in the study were subjected to:

- Demographic data.
- Complaints and history of present illness:
  - Socioeconomic status.
  - Comorbid conditions and risk factors.
  - Review of other systems.
  - Past history.
  - Family history.

- Laboratory investigations (complete blood count, blood urea, creatinine, fasting blood sugar, ALT and AST).
- Electrocardiography (ECG).
- Management of 100 cases of ventral hernia by analyzing 2 operative methods: a shoelace darn repair and non-absorbable open mesh repair; 50 cases were managed by shoelace darn repair (group A) and 50 cases were managed by mesh repair (group B).



**Figure (2):** Huge Para umbilical hernia

### **Operative technique:**

#### **1. Anesthesia:**

The patients were given a general endotracheal anesthesia with full muscle relaxation.

#### **2. Preoperative examination:**

The abdomen was thoroughly examined before the start of operation, and the defect, the scar, and the skin incision and flaps were marked with an indelible skin marking pen.

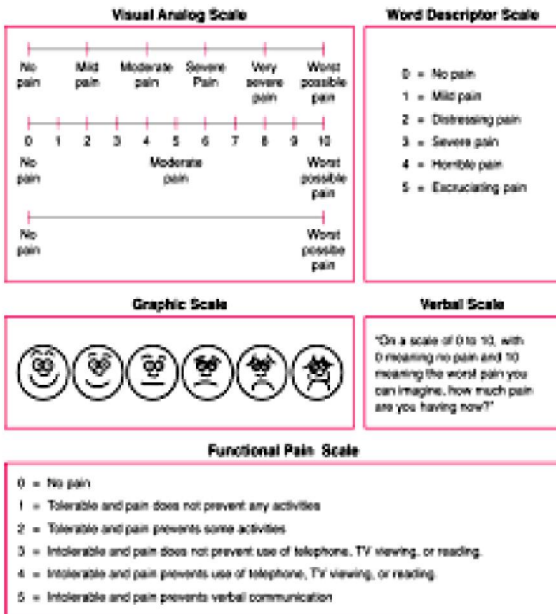
#### **3. Operative procedure:**

The operation starts after a wide abdominal painting (10% povidone iodine) and toweeling by making an elliptical skin scar excision. Skin and subcutaneous tissue were dissected off the hernial sac, as well as off the anterior rectus sheath on both sides. An incision is made in each anterior rectus sheath 1-2 cm. from its medial edge. The incision is extended up and down the entire length of the hernial defect. The two medial strips are sutured together by a continuous No.1 monofilament nylon (polyamide) loop. This will create a new linea alba and will returns the hernial sac and its content to the abdominal cavity. The gap remaining between the lateral cut edges of the anterior rectus sheaths is then sutured using 2-3 No.1 nylon loop beginning at the top end taking good bites of the anterior rectus sheath in a vertical manner 2 cm away from the lateral cut edges and incorporating the newly created linea alba thus restoring the rectus sheaths and rectus muscles to their normal position. This nylon suture pass to and fro in front the rectus muscles and through the new linea alba for the whole length of the

hernial defect in a manner of a shoelace tightening a boot. Excess skin and subcutaneous tissue excised if any. Wound closed with two vacuum drains.

**4. Postoperative care:**

Postoperative patient admitted to the ward supplied with adequate analgesia, antibiotic, abdominal truss and follow up of the amount and colour of vacuum drain. All patients assisted according visual pain score.



**Figure (3):** Visual pain scores



**Figure (4):** Post-surgical incisional hernia

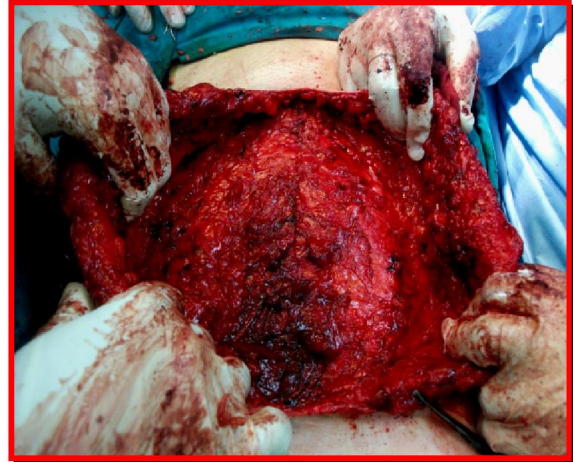
**Follow up:**

Follow up of patients were done as follows:

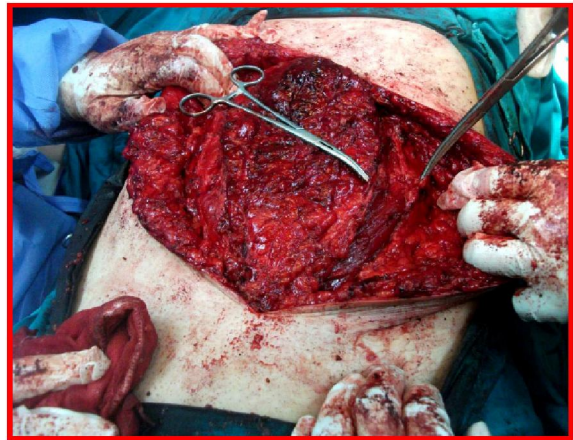
1. Operative technique (difficulties, time of operation).

2. Immediate postoperative findings (till stitch removal) for early post operative complications as infection or disruption.

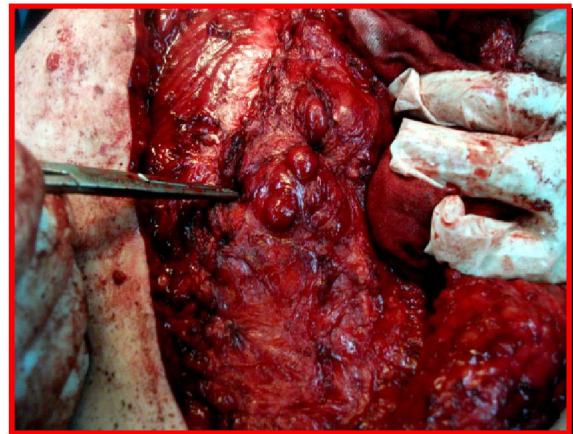
3. Postoperative follow up for 24 months for complications as recurrence, sinus....etc.



**Figure (5):** Elevation of skin flaps

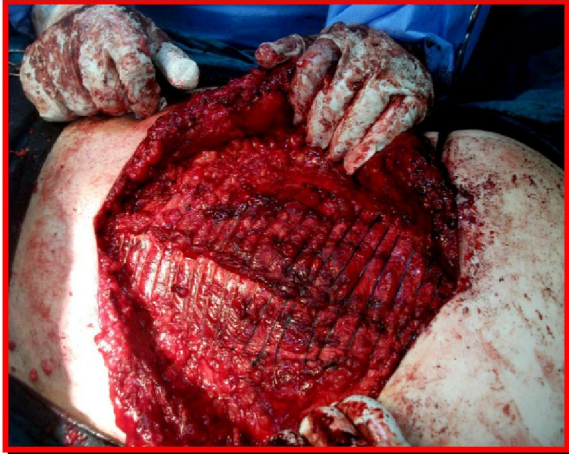


**Figure (6):** Incision of the anterior rectus sheath



**Figure (7):** Elevation of the edges of the rectus sheath





**Figure (8):** Completion of the Shoelace repair

(Armonk, NY: IBM Corp) <sup>(2)</sup> Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level <sup>(5)</sup>.

- Chi-square test for categorical variables, to compare between different groups.
- Fisher’s exact or Monte Carlo correction. Correction for chi-square when more than 20% of the cells have expected count less than 5.
- Student t-test for normally distributed quantitative variables, to compare between two studied groups.

**Statistical analysis:**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0

**3. Results**

**Table (1):** Sex of the patients in both groups

	Group A Shoelace darn repair n=50		Group B Prolene mesh repair n=50		total n=100		P Value
	N	%	N	%	N	%	
<b>Sex:</b>							
<b>Male</b>	36	72%	30	60%	66	66%	0.205
<b>Female</b>	14	28%	20	40%	34	34%	
<b>M: F ratio</b>	2.57:1		1.5:1				
<b>Total</b>	50	100%	50	100%	100	100%	

**Table (2):** Age of the patients in both groups

	Group A Shoelace darn repair n=50		Group B Prolene mesh repair n=50		P Value
	N	%	N	%	
<b>Sex:</b>					
Age (year) Mean +SD Range	37.2 ± 7.9 21-60		41.0 ± 11.0 23-65		0.070
<b>21- 30y</b>	8		7		
<b>31- 40y</b>	20		18		
<b>41 – 50y</b>	17		19		
<b>51 – 60y</b>	5		3		
<b>61 – 70y</b>	-		3		

Thirty six of the group A were males (72%) and fourteen were females (28%) with a male to female ratio of 2.57:1. While in group B, there were thirty males (60%) and twenty females (40%) with a male to female ratio of 1.5:1. Statistical analysis revealed that there was no statistical significant difference between both groups as regards sex (P = 0.205) (table 1).

The age of group A ranged between 21-60 years with a mean of 37.2 ± 7.9 years, while the age of group B ranged between 23-65 years with a mean of

41.0 ± 11.0. Statistical analysis revealed that there was no statistical significant difference between both groups as regards age (P = 0.07) (table 2).

The previous incision was a midline, paramedian or transverse incision above or below the umbilicus (100%). Twenty two of these incisions were above the umbilicus (22%), nine were in group A (18%) and thirteen (26%) in group B. Incision below the umbilicus present in fourteen patients (14%); eight were in group A (16%) and six were in group B (12%),

while an incision extended above and below umbilicus was present in fifty one patients (51%), twenty eight of them in group A (56%) and twenty three were in group B (46%). Statistical analysis

revealed that there was no statistical significant difference between both groups as regards the site of previous incision (table 3).

**Table (3):** Type of previous incision in both groups

Type of previous incision:	Group A Shoelace n=50		Group B Prolene mesh n=50		total n=100		P Value
	N	%	N	%	N	%	
<b>* Midline:</b>							MC <sub>p</sub> = 0.711
1- upper midline (above the umbilicus) Supraumbilical M1	9	18%	13	26%	22	22%	
2- Low midline (below the umbilicus) Subumbilical M3	8	16%	6	12%	14	14%	
3- Complete (combined) Xipho- pubic M4	28	56%	23	46%	51	51%	
<b>* Paramedian:</b>							
Juxta umbilical M2							
1- Rt. Upper	1	2%	2	4%	3	3%	
2- Rt. Lower	2	4%	2	4%	4	4%	
3- Lt. Upper	2	4%	1	2%	3	3%	
<b>* Transverse:</b>							
1- above the umbilicus Subcostal (Kocher's Incision) L1	-	-	2	4%	2	2%	
2- below the umbilicus: Lumbar (Mcbumy's) L4	-	-	1	2%	1	1%	

**Table (4):** SWR classification of incisional hernia as regard sites of incisional hernia

*Sites of the hemi a:	Group A Shoelace n=50		Group B Prolene mesh n=50		In both group (all Cases) total		p
	N	%	N	%	N	%	
Supra umbilical M1	9	18%	13	26%	22	22%	MC <sub>p</sub> = 0.558
Juxta umbilical M2	5	10%	5	10%	10	10%	
Subumbilical M3	8	16%	6	12%	14	14%	
Xipho – Pubic M4	28	56%	23	46%	51	51%	
After Kocher's incision L1	-	-	2	4%	2	2%	
After Lambar incision L4	-	-	1	2%	1	1%	
<b>Total</b>	50	100%	50	100%	100	100%	

Statistical analysis revealed that there were no statistical significant differences between both groups as regards sites of incisional hernia according to SWR classification (table 4), causes of previous surgery (table 5), abdominal muscle tone, site of incisional hernia and contents of the hernia (table 6), associated medical diseases (table 7) (p = 0.94), widths of the defects preoperatively according to SWR classification (table 8) and length of the defect (table 9).

Operative time for group A (Shoelace repair) ranged between 70-120 minute with a mean of 90 ± 6.5 minutes; while for group B (prolene mesh repair),

it ranged between 80-140 minutes with a mean of 130 ± 75.2 min. Statistical analysis revealed that there was no statistical significant difference between both groups as regards incision (p = 0.544), but there was a statistical significant difference as regards operative time (table 10).

Statistical analysis revealed that there were statistical high significant differences between both groups as regards post-operative pain score and post-operative hospital stay (p < 0.001). There was no statistical significant difference between both groups as regards duration of using post-operative analgesia (p = 0.367) (table 11).

Statistical analysis revealed that there were statistical high significant differences between both groups as regard drain removal and total amount of fluid drained ( $p < 0.001$ ) (table 12).

In group A, patients needed a time ranged between 20-35 days with a mean of 25+10.9 days to return to full daily activity while patients of group II

needed time ranged between 20-30 days with a mean of 25+5 days to return to full activities post-operatively and statistical analysis revealed there was no significant difference between both groups as regards the time needed for regaining full daily activities postoperatively ( $p = 1$ ) (table 13).

**Table (5):** Causes of previous surgery in both groups

	Group A Shoelace n=50		Group B Prolene mesh n=50		total		P Value
	N	%	N	%	N	%	
<b>*Type of Abdominal injury (cause of previous surgery)</b>							
<b>- exploratory laparotomy (acute Abdamen):</b>							
1-Penetrating injury (Stab abdomen and gun shot)	15	30%	13	26%	28	28%	
2-Blunt injury (ex car accident)	10	20%	8	16%	18	18%	
3- Perforated peptic ulcer	6	12%	6	12%	12	12%	
4- necrotizing pancreatitis	2	4%	5	10%	7	7%	
5- Perforated appendicitis	2	4%	3	6%	5	5%	
<b>- Post Surgical:</b>							
1- Splenectomy	2	4%	1	2%	3	3%	MC p= 0.878
2- Du & Stomach Surgery (ex. Peptic ulcer, cancer stomach)	1	2%	3	6%	4	4%	
3- Hiatal hernia	2	4%	1	2%	3	3%	
4- Cholecystectomy	1	2%	4	8%	5	5%	
5- Para- umbilical hernia repair	1	2%	-	-	1	1%	
6- anterior resection	1	2%	-	-	1	1%	
7- Gynecological operation:							
- Midline Cesarean Section	3	6%	2	4%	5	5%	
- Lower midline hysterectomy	3	6%	4	8%	7	7%	
- oophorectomy	1	2%	-	-	1	1%	
Total	50	100%	50	100%	100	100%	

**Table (6):** Abdominal muscle tone, site of incisional hernia and contents of the hernia

		Group A Shoelace n=50		Group B Prolene mesh n=50		Total n=100		p
		N	%	N	%	N	%	
<b>Abdominal musch Tone:</b>	<b>Good</b>	16	32%	21	42%			0.300
	<b>Poor</b>	34	68%	29	58%			
<b>Site of incisiml hernia</b>	<b>M1</b>	9	18%	13	26%	22	22%	
	<b>M2</b>	5	10%	5	10%	10	10%	
	<b>M3</b>	8	16%	6	12%	14	14%	
	<b>M4</b>	28	56%	23	46%	51	51%	
	<b>L1</b>	-	-	2	4%	2	2%	
	<b>L4</b>	-	-	1	2%	1	1%	
<b>Content of the hernia</b>	<b>Intestine</b>	12	24%	20	40%	32	32%	MC p= 0.355
	<b>Intestine &amp; omentum</b>	18	36%	13	26%	31	31%	
	<b>Omentum</b>	17	34%	15	30%	32	32%	
	<b>Sac Was empty</b>	3	6%	2	4%	5	5%	

**Table (7):** Associated medical diseases

	Group A Shoelace n=50		Group B Prolene mesh n=50		Total N= 100		P Value
*associated medical disease:	N	%	N	%			
<b>HTN (Hypertension)</b>	4	8%	6	12%	10	10%	MC p= 0.940
<b>D.M (Diabetic mellitus)</b>	3	6%	2	4%	5	5%	
<b>Obesity:</b>	20	40%	17	34%	37	37%	
<b>-Body built:</b>							
- underweight	zero	Zero%	zero	Zero%	-	-	
- Normal	13	26%	12	24%	-	-	
- Over weight	17	34%	21	42%	-	-	
- Obese	19	38%	17	34%			
- Grossly obese	1	2%	Zero	Zero%			
<b>Anaemia</b>	3	6%	4	8%	7	7%	
<b>other</b>	-	-	-	-	-	-	
<b>Tota</b>	30	60%	29	58%	59	59%	

**Table (8):** SWR classification of Incisional hernia as regard widths of the defects preoperatively

	Group A Shoelace n=50		Group B Prolene mesh n=50		In both group (all Cases) total		p
*width of the defect (cm):	N	%	N	%	N	%	
<b>&lt;5cm (W1)</b>	1	2%	2	4%	3	3%	MC p= 0.059
<b>5-10 cm (W2)</b>	25	50%	17	34%	42	42%	
<b>10-15 cm (W3)</b>	24	48%	26	52%	50	50%	
<b>&gt; 15 cm (W4)</b>	-	-	5	10%	5	5%	
<b>Mean</b>	11.31		12.8				t p= 0.051
<b>S.D</b>	3.17		4.24				
<b>Range</b>	4-15cm		3-18cm				

**Table (9):** Length of the defect in both groups

*Length of the defect (cm)	Group A Shoelace n=50	Group B Prolene mesh n=50	t <sub>p</sub>
<b>Mean</b>	16.8	17.32	0.491
<b>S.D</b>	3.26	4.21	
<b>Range</b>	12-21	11-23	

**Table (10):** Operative incision and time

	Group A Shoelace n=50		Group B Prolene mesh n=50		total		P Value
*Operative data:	N	%	N	%	N	%	
<b>- Incision:</b>							MC p= 0.544
<b>Midline</b>	46	92%	42	84%	88	88%	
. above the umbilicus	9	18%	13	26%			
. below the umbilicus	8	16%	6	12%			
. Combined	29	58%	23	46%			
<b>Para median</b>	2	4%	5	10%	7	7%	
<b>Transverse</b>	2	4%	3	6%	5	5%	
. above Or							
. below the umbilicus							
<b>- Operative time: (min)</b>					<b>P Value</b>		
Mean + SD	90+60.5		130+75.2		t <sub>p</sub> = 0.004*		
Range	70-120		80-140				

**Table (11):** Postoperative pain and duration of hospital stay (days) in both groups

*Operative data:	Group A Shoelace n=50	Group B Prolene mesh n=50	t <sub>p</sub> Value
<b>- Pain:</b>			
<b>. Visual pain score (mm)</b>			
Mean + SD	18+1.72	22+2.44	<0.001*
Range	15-22	18-26	
<b>- Duration of analgesics (days)</b>			
Mean + SD	2+5	3+6	0.367
Range	3-7	4-9	
<b>- Hospital stay (days)</b>			
Mean + SD	4+1.54	6.4+1.65	<0.001*
Range	3-6	4-8	

**Table (12):** Drain removal and total amount of fluid drained in both groups

	Group A Shoelace n=50		Group B Prolene mesh n=50		P Value
*Post operative data:	N	%	N	%	
<b>- Drain removal (days)</b>					
. Day of removal:					
5 <sup>th</sup> day	13	26%	-	-	<0.001*
6 <sup>th</sup> day	10	20%	5	10%	
7 <sup>th</sup> day	9	18%	10	20%	
8 <sup>th</sup> day	18	36%	11	22%	
9 <sup>th</sup> day	-		7	14%	
10 <sup>th</sup> day – 15 <sup>th</sup> day	-		17	34%	
. Mean + SD	7.01+2.09		9.29+3.11		t <sub>p</sub>
. Range	5-8 days		6-15days		<0.001*
<b>- Total amount of fluid Drained: (cc)</b>					
. Mean + SD	1160.3+601.7		1905.8+725.3		t <sub>p</sub> <0.001*
. Median	1350 cc		2375 cc		
. Range	450-2420cc		600-5460cc		
. Distribution of cases					
< 500cc	4	8%	-		<0.001*
500-1000cc	18	36%	12	24%	
1000-1500cc	17	34%	7	14%	
1500-2000cc	9	18%	18	36%	
>2000cc	2	4%	13	26%	

**Table (13):** Return to full daily activity in patients with recurrent hernia

*Other data	Group A Shoelace n=50	Group B Prolene mesh n=50	t <sub>p</sub> Value
<b>- Return to full daily activity (days):</b>			
Mean + SD	25+10.9	25+5	1.000
Range	20-35days	20-30days	

p: and p values for **Chi square test** for comparing between the two groups

<sup>MC</sup>p: p value for **Monte Carlo for Chi square test** for comparing between the two groups

<sup>FE</sup>p: p value for **Fisher Exact for Chi square test** for comparing between the two groups

t, p: t and p values for **Student t-test** for comparing between the two groups

\*: Statistically significant at  $p \leq 0.05$

#### 4. Discussion

Ventral hernias are commonly encountered in surgical practice. The estimated incidence of ventral

hernia is 15-20%. An abdominal incisional hernia represents a failure of primary laparotomy wound healing or a failure of a previous hernia repair, due to



many local and general factors. The repair of ventral hernias has evolved from simple suture approximation to the use of prosthetic mesh and, recently, laparoscopic procedures <sup>(6)</sup>.

Three basic methods have emerged for the repair of these hernias (Resuture, darn repair and Synthetic nonabsorbable mesh repair). The use of synthetic non-absorbable mesh repair is well established. The method involves the excision of the hernial sac, and the dissection of the adherent loops of bowel, with the risk of fistula formation. It is a time consuming procedure, often improperly performed by surgeons <sup>(7)</sup>.

Hernias that are less likely to incarcerate include upper abdominal hernias, hernias less than 1 cm in diameter, and hernias larger than 7 to 8 cm (where loops of bowel can move in and out of the hernia sac without restriction, and are therefore less likely to become incarcerated) <sup>(8)</sup>.

Paraumbilical hernia is a protrusion through the linea alba just above or below the umbilicus, if the hernia is untreated it increase in size and more and more of its contents become irreducible eventually strangulation may occur thus operation should be advised in nearly all cases <sup>(8)</sup>.

As a result of high recurrence rate in the repair of ventral hernia, various types of repairs have been used both anatomical and prosthetic. But the results have been disappointing with a high incidence of recurrence of about 30-50% after anatomical repair and 1.5-10% following prosthetic mesh repairs <sup>(8)</sup>.

Jack Abrahamson the modifier and the developer of the shoelace darn repair started using this technique in 1973. He reported the results in 1984, 1985, 1987, and finally the operative technique was detailed in a paper published in 1988<sup>(2)</sup>.

In our study, a total of 100 patients were enrolled to find the place of shoelace darn in the repair of ventral hernias and to compare it to open mesh repair from where recurrence and complications 2 years after surgery. Fifty underwent Shoelace darn repair (group A), while the other fifty underwent prolene mesh hernioplasty (onlay mesh repair) (group B).

In this study, the age of group A ranged between 21-60 years with a mean of  $37.2 \pm 7.9$  years, while the age of group B ranged between 23-65 years with a mean of  $41.0 \pm 11.0$ . Statistical analysis revealed that there was no statistical significant difference between both groups as regards age.

These results were in agreement with **Majid et al.** <sup>(4)</sup> who found a mean age of 36.9 years in patients of his group. **Bhattaria and Bhandari** <sup>(9)</sup> found a mean age of over 50 years in their study which is some what more than the detected age in our group of patients.

Our study revealed that thirty six of the group A were males (72%) and fourteen were females (28%) with a male to female ratio of 2.57:1. While in group B, there were thirty males (60%) and twenty females (40%) with a male to female ratio of 1.5:1. Statistical analysis revealed that there was no statistical significant difference between both groups as regards sex.

**Majid et al.** <sup>(4)</sup> found that there were 66 males and 34 females. **Hameed et al.** <sup>(10)</sup> and **Memon et al.** <sup>(11)</sup> indicated that the female to male sex ratio was 1.4:1. The incidence of ventral hernia is higher in females rather than males but this difference was non significant.

Our results were in agreement with **Clarke** <sup>(12)</sup> who found no significance difference in both groups of his study as regards sex incidence. **Bhattaria and Bhandari** <sup>(9)</sup> found a increased incidence of incisional hernia in females (72.3%) than males (27.7%) in their study which is in contradiction with our results.

In our study, patients represented with a bulge in the anterior abdominal wall. Fifty eight of them represented with bulge alone (58%). It is also associated with abdominal pain in twenty three patients (23%). Back pain was associated with hernia in 5 patients (5%). Hernia was associated with heaviness in three patients (3%). It was associated with vomiting in one patient belonged to group A and with abdominal distention in seven patients (7%). Lastly, hernia was associated with ulcerating scar in three patients (3%). Statistical analysis revealed that there was no statistical significant difference between both groups as regards clinical presentation.

These results were in agreement with **Majid et al.** <sup>(4)</sup> who found that all patients complaining of bulge in the anterior abdominal wall, 23% bulge with abdominal pain, 18% associated with back pain and 3% having ulcerated skin over in patients.

In our study, the previous incision was a midline, paramedian or transverse incision above or below the umbilicus (100%). Twenty two of these incisions were above the umbilicus (22%). Incision below the umbilicus present in fourteen patients (14%), while an incision extended above and below umbilicus was present in fifty one patients (51%). Statistical analysis revealed that there was no statistical significant difference between both groups as regards the site of previous incision.

**Majid et al.** <sup>(4)</sup> found midline or paramedian incision in 91% of their cases and a transverse incision above or below the umbilicus in 9%. In contrast, **Bhattaria and Bhandari** <sup>(9)</sup>, found that the lower midline incision has been the most common in their group of patients (72.3%).

Statistical analysis revealed that there were no statistical significant differences between both groups

as regards sites of incisional hernia and widths of the defects preoperatively according to SWR classification. This is similar distribution with **Jat et al.**<sup>(13)</sup>.

Our sixty four patients had hernia of wide neck (64%). Narrow neck of the hernia was present in 27 patients (27%). Hernia of multiple narrow neck was present in nine patients (9%). Statistical analysis revealed that there was no statistical significant difference between both groups as regards size and number and reducibility of hernias.

**Majid et al.**<sup>(4)</sup> found 66% of their cases with wide neck, 21% narrow single neck and 13% with multiple narrow neck, also, they found 14% of their cases complicated (irreducible). **Orenstein et al.**<sup>(14)</sup> found hernia complications (encarcination) in 77% of patients in their study which disagree with our results.

In our study, time for group A (Shoelace repair) ranged between 70-120 minute with a mean of  $90 \pm 6.5$  minutes; while for group B (prolene mesh repair), it ranged between 80-140 minutes with a mean of  $130 \pm 75.2$  min. Statistical analysis revealed that there was a statistical significant difference between both groups as regards operative time.

Our results was in agreement with **Majid et al.**<sup>(4)</sup> who found an operative time of about 1.5 hours (for Shoelace repair) in patients of his group. **Canziani et al.**<sup>(15)</sup> recorded an operative time of 120-240 min for the surgical procedure of hernioplasty which is so longer than the recorded our operative time. In addition, **Orenstein et al.**<sup>(14)</sup> found in their study that the average length of operative time was 134 min ranged between 40-280 days.

Blood loss during operative procedure in group B (Shoelace repair) ranged between 110-140 ml with a mean of  $230+115.37$  ml; while during surgical procedure for group B (Proplene mesh repair), it ranged between 130-450 ml with a mean of  $410.5+154.83$  ml. Statistical analysis revealed that blood loss was more obvious during surgical procedure for group B than for group A. **Lord et al.**<sup>(16)</sup> found that intra-operative blood loss of 700 cc affects wound healing and predispose to wound complications and when intra-operative blood loss exceeds 1000 ml it increase the risk of recurrence.

In our study, post-operative visual pain score for group A ranged between 15-22 with a mean of  $18+1.72$ ; while for group B, it ranged between 18-26 with a mean of  $22+2.44$  and the statistical analysis revealed that there was statistical high significant difference between both groups as regards post-operative pain score. Duration of post-operative analgesia usage for group A ranged between 3-7 days with a mean of  $2+5$  days; while for group B, it ranged between 4-9 days with a mean of  $3+6$  days and the statistical analysis revealed that there was no

statistical significant difference between both groups as regards duration of using post-operative analgesia. Post-operative hospital stay for group A ranged between 3-6 days with a mean of  $4+1.54$  days; while for group B, it ranged between 4-8 days with a mean of  $6.4+1.65$  days and the statistical analysis revealed that there was statistical high significant difference between both groups as regards post-operative hospital stay.

Patients were having mild to moderate postoperative pain in the first day requiring an injection or two of analgesic. All patients recovered easily and they were ambulant and on oral fluid diet next day. **Majid et al.**<sup>(4)</sup> stated that patients with co-morbid illnesses were managed during and after the operation. Mean hospital stay was 4.6 days with a range of 3 to 7 days.

**Canziani et al.**<sup>(15)</sup> recorded a post-operative hospital stay of 2-8 days with a mean of 3 days which is in contradiction with our study which reported hospital stay of 5-6 days for both groups. Also, **Bhattaria and Bhandari**<sup>(9)</sup> found post-operative hospital stay of about 3 days mean in their study group. In addition, **Orenstein et al.**<sup>(14)</sup> found in their study that the average length of hospitalization was 2.9 day ranged between 1-10 days.

Statistical analysis revealed that there were statistical high significant differences between both groups as regard drain removal and total amount of fluid drained.

During the follow up period, pulmonary complications were found in three patients (6%) of group A and two patients of group B (4%). Wound complications were found in seven patients (14%) of group A and another fourteen patients of group B (28%). Intestinal complications were found in one patient (2%) of group B, retention of urine was found in one patient (2%) of group A and chronic pain was found in two patients (4%). Recurrence was found in two patients (4%) of group A and one patient (2%) of group B. Statistical analysis proved that there were no significant differences between both groups as regard pulmonary complications, wound complications, intestinal complications, retention of urine, chronic pain and recurrence.

In spite of that, overall complications occurred in 13 patients (26%) of group A and 20 patients (40%) of group B but statistical analysis proved that there was no significant difference between both groups as regard overall complication occurrence. There was no mortality in this study.

Our results were in contradict with **Majid et al.**<sup>(4)</sup> who wound infection in only 3% of his group and recurrence rate in only 4% of his patient group. There was no mortality in this study. As well, **Canziani et al.**<sup>(15)</sup> recorded post-operative wound infection in 10%

and wound hematoma in 7.5% which is in agreement of our study but did not record seroma formation which is in contradiction of our results.

Also, potential complications of incisional hernia surgery include hernia recurrence, infection, seromas, hematomas, adhesions, bowel obstruction and erosion of mesh into the bowel or urinary bladder<sup>(17)</sup>.

In addition, **Clarke**<sup>(12)</sup> found no significance difference between the two groups of his study as regards post-operative complications (chronic pain, recurrence and wound infection). **Orenstein et al.**<sup>(14)</sup> found no wound related complications (infection, hematoma) or significant seroma formation in their study.

The shoelace darn repair restores the functional anatomy of the abdominal wall. It reconstruct a strong new linea alba and allows the rectus muscles to straighten and lie along side each other at the midline. It also reconstruct the anterior rectus sheaths and fixes them to the new linea alba<sup>(2)</sup>.

**Majid et al.**<sup>(4)</sup> found the place of shoelace darn in the repair of incisional hernias concluding that shoelace darn repair have got a good place in managing abdominal incisional hernias. **El-Fayoumi**<sup>(18)</sup> compared and followed two different modalities of repair in ventral incisional hernia for detection of complications and recurrence. Shoelace repair is a safe method to repair ventral incisional hernias, as it requires a shorter time for drain removal than mesh repair. The foreign body effect and infectious complications are more with mesh repair and so collection of seroma is more frequent in mesh than in shoelace repair. On the other hand, the shoelace repair decreases the cost of the operation as it does not require prolene mesh. Also, it reconstructs and restores the functional anatomy of the abdominal wall, resulting in a normal looking, soft, pliable and expandable abdomen with avoidance of the so called corsage feeling which usually occurs as a result of mesh repair where there is a sensation of tightness and restriction of abdominal wall mobility.

### Conclusion

The shoelace darn repair is quick, easy, extra-peritoneal method that simply returns the unopened hernial sac and its contents to the abdominal cavity, and thus avoids the tedious and perhaps risky dissection of the adherent loops of the bowel on the inner surface of the sac required in the re-suture and in the mesh repair.

From the study, we concluded that Shoelace darn repair have got a good place in managing abdominal ventral hernias.

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