

Study of outcome of Shoelace Meshplasty in large midline Incisional Hernias

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Abstract :

Introduction: An incisional hernia happens when a weakness in the muscles of the abdomen allows the tissues of the abdomen to protrude through the abdominal wall muscles. In the case of an incisional hernia, the weakness in the muscle is caused by the incision made in a prior abdominal surgery and it starts as symptomless partial disruption of deeper layers of laparotomy wound during early postoperative period. **Aim:** To study efficacy and outcome of shoelace meshplasty for midline incisional Hernias. **Methods:** A prospective non-randomized study of 20 cases of midline incisional hernia at Civil hospital, Ahmedabad over a period of 3 years was done. Patients underwent shoelace meshplasty comprising of reconstruction of linea alba, with the use of polypropylene mesh to reinforce the fascial layer. Proforma was maintained for each patient documenting details, nature of previous surgery, complications if any, postoperative course, and complications post incisional hernia repair. **Results:** 20 patients underwent this repair with no complications and no recurrence for a minimum follow-up period of 6 months and maximum of 24 months. **Discussion:** The principle is, during straining, the recti shorten by tonic contraction and approximate towards the midline. An incisional hernia weakens the midline and causes the recti to move laterally with contraction as medial pull is lost. By reforming a strong new linea alba, there is restoration of medial pull on recti. This is further buttressed by the mesh, hence the tension free repair. **Conclusion:** Shoelace meshplasty is a simple & safe procedure with no extensive tissue dissection, and avoids the potential complications of bowel injury and adhesions with the mesh and can be used when gap in anterior sheath is large and its closure is primarily difficult.

Key Words: Incisional hernia, Shoelace meshplasty

Introduction :

An incisional hernia happens when a weakness in the muscle of the abdomen allows the tissues of the abdomen to protrude through the abdominal wall muscles. Due to various local (e.g. surgical site infection) and general factors (e.g. Poor nutrition) there is a failure of healing of primary laparotomy wound which results in incisional hernia formation. It usually starts as symptomless partial disruption of deeper layers of laparotomy wound during early postoperative period. The only sign could be the local serosanguinous discharge in the early post-op period. In the best centres, incidence of abdominal incisional hernia has been found to be between 3-11%, with majority occurring between initial 3 years after laparotomy.

Recurrence is seen in up to 44 % of patients, which has decreased to 10–20 % with mesh repair.⁽¹⁾ These hold the second position in incidence second only to inguinal hernias with defect size varying considerably. With the development of modern synthetic non-absorbable suture material, three basic methods have emerged for the repair of these hernias: ⁽¹⁾ Primary suturing (anatomic repair), open meshplasty (includes onlay, inlay, preperitoneal and intraperitoneal, shoelace), and laparoscopic repair.

Jack Abrahamson is the developer of the shoelace darn repair and started using this technique in 1973 and the operative technique was detailed in a paper published in 1988.⁽¹⁾ Abrahamson described shoelace repair for large incisional hernias, which is basically based on restoring the functional anatomy of the anterior abdominal wall.

Functional anatomy of the anterior abdominal wall

The flat muscles of the abdominal wall are normally in a

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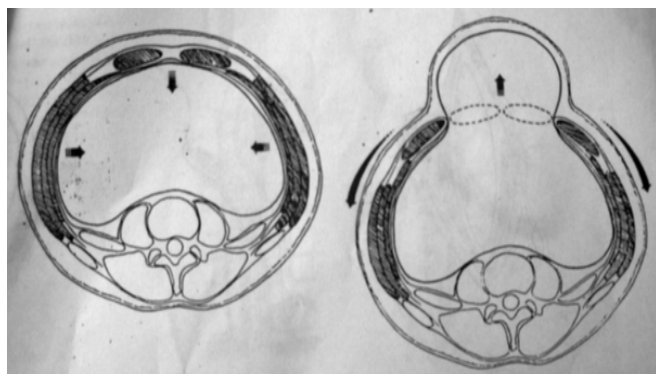
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state of tonic contraction, which tends to shorten them. However, since they are fixed to each other in the midline at the linea alba, they are not able to shorten but pull against each other in a balanced fashion so that they act as a dynamic girdle, flattening the abdominal wall and holding back the contents of the abdomen.

Mechanism of development of incisional hernia

With the vertical splitting of the midline at operation and separation of the two halves postoperatively as the hernia develops, the flat muscles lose their midline anchor and therefore can no longer pull against each other. Their tonic contraction now causes them to shorten so that the gap between the recti is widened. Each rectus abdominis muscle is pulled laterally and becomes curved with the concave side facing medially. With increase in intra-abdominal pressure centrifugal forces created causes the gap between the recti to widen.

Figure 1: Cross section of the abdomen showing the tonic contraction of the flat muscles shortening them and holding back the abdominal contents. With separation of the midline, the tonic contractions cause the sheet muscles to shorten so that the hernia widens.



Abrahamson's Shoelace Darn Technique

1. After putting incision over the anterior rectus sheath, reconstructing a new linea alba by suturing together the medial edge of each anterior rectus sheath. 2. To restore the recti to their normal position and to draw the flat muscles of the abdominal wall back to their former length so that the abdominal wall takes up its normal anatomic state and function by drawing together the lateral cut edges of the anterior rectus sheaths by a

continuous suture of heavy monofilament nylon, which passes to and fro between these cut edges and also substitutes functionally and anatomically for the missing anterior rectus sheath.

Methods:

A prospective, non-randomized study was done enrolling 20 patients with large midline incisional hernias in Surgery department of Civil Hospital, Ahmedabad, over a period of 3 years from May 2015 to April 2018. The age preponderance of the study group was 15 to 70 years.

Patients underwent shoelace meshplasty comprising of reconstruction of linea alba using PDS loop no. 1 suture in continuous non locking manner, and then the use of polypropylene mesh to reinforce the fascial layer which is spread beyond the lateral incision and fixed using vicryl 1-0 sutures. Two negative suction drains no. 16 were placed in subcutaneous plane in each case, and subcutaneous tissue was closed with vicryl 2-0 simple interrupted sutures. Skin was closed with polyamide 2-0 or skin staplers as per availability.

Inclusion Criteria:

- Male or female, with midline reducible incisional hernias with single defect
- Age between 15 and 70 years.

Exclusion Criteria:

- Large hernias where recti are far apart (>10cm)
- Hernias with features of Obstruction and Strangulation.
- Age less than 15 years and more than 70 years.
- Defects other than midline
- Multiple defects
- Presence of ascites.
- Irreducible or partially reducible hernias, where on palpation adherence of sac to the contents is suspected.

Every patient underwent detailed history taking, clinical examination, and investigations. A day prior to surgery, shaving of the abdomen and genitalia was done, and patients were kept nil by mouth overnight. Broad-

spectrum antibiotic was given preoperatively, and patients were catheterized. Ryle's tube insertion was not done. The procedure was done under general anaesthesia or spinal anaesthesia according to patient's fitness, in supine position. General anaesthesia was preferred as suggested originally by Abrahamson, which facilitates returning of flat muscles to their original length.

Postoperative course was monitored in terms of the following:

- Operative time
- Significant pain beyond postoperative day 1
- Fever
- Wound infection
- Wound gap
- Seroma
- Drain removal
- No. of days of postoperative stay
- Suture removal
- Recurrence

Highlights of the technique instituted are:(i) Creation of appropriate thickness flaps, which should have adequate subcutaneous tissue.(ii) Reconstruction of new linea alba.(iii) Reinforcement by mesh placement.(iv) Placement of mesh beyond the lateral cut edge of anterior rectus sheath.

Steps employed were:

An elliptical scar cutting was kept, and a plane was made between subcutaneous tissue and sac, taking care not to open the peritoneum; and of appropriate thickness so that it was not too thin or not making a button hole in the skin. Adequate thickness of subcutaneous tissue was left on the flap. Peritoneum, if inadvertently opened, was closed with vicryl 2-0. Then the edge of rectus muscle was identified and palpated, and incision was kept over the anterior rectus sheath, leaving the 1 cm strip medially. This was done on both the sides. Then a new linea alba was reconstructed by suturing together a strip of fascia from the medial edge of each anterior rectus sheath using loop PDS 1 no. in continuous non-locking fashion.

The fascial defect formed between the lateral cut edges

of the rectus sheath was repaired using a polypropylene mesh sutured to the edges of the defect with continuous non locking vicryl 1-0. and the edges of the mesh were sutured with anterior rectus sheath present beyond the lateral end with interrupted sutures using vicryl 1 no. which provided a strong framework to prevent herniation from the lateral edges and reinforced the abdominal wall. Then two negative suction drains No. 16 were placed in subcutaneous plane. Subcutaneous tissue was then closed with vicryl 2-0 interrupted sutures and then skin was closed.

Results:

Of the 20 cases, the average age was 35 years with commonest age group being 27 to 45 years. History of previous surgery followed by wound infection was present in all cases. Of the 20 cases studied, in 60 % (n=12) defects were extending both above and below the umbilicus; while in 40% (n=8) defects were only below umbilicus but in midline. In all the cases, the defects were at least more than 3 cms with lateral retraction of the rectus muscle. Average operative time was 2 hours, calculated from time of incision till closure of skin.

Post operative complications:

Of the 20 cases studied, there were no undue postoperative complications. Immediate post-operative pain was present in 15%(n=3) of patients. Only one patient had pain beyond four days, which actually ended up being chronic in nature for a period of 1 year, patient is still in follow up. Seroma formation was seen only in two patients; of the 2 patients who developed seroma, one patient developed wound gaping which was managed conservatively with dressing, and none developed wound infection.

The duration of postoperative hospital stays ranged from 6 days to 10 days with a mean hospital stay of 8 days. Post operatively tablet serratiopeptidase enzyme was started in all the patients at a dose of 10mg twice a day, for a period of 1 week. Drain was removed on post-op. day 5 & 7 on an average, and suture removed on post-operative day 14 on an average. Regular follow ups were done at 15 days, 1 month, 3 months, 6 months, one year and 2 years postoperatively from the time of discharge and it revealed no recurrence in any case.

Discussion:

Figure 2: Pre-operative standing image (as seen from front)



Figure 3: Lying down image of the same patient (supine view, pre -op)



Figure 4: Pre-op standing image of same patient (As seen from side, showing midline incisional hernia of a male patient)



Figure 5: Creation of subcutaneous flap taking care not to open peritoneum



Figure 6: Creation of new linea alba in midline



Figure 7: Lateral relaxing incision kept after palpating muscles. (Arrow)

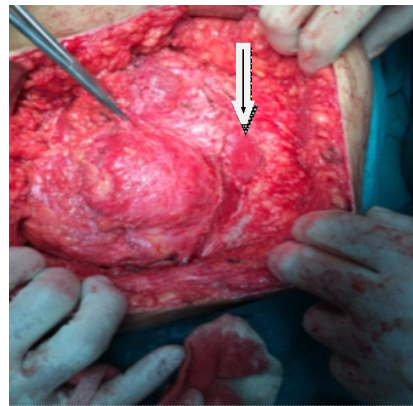


Figure 8: Onlay prolene mesh placed after creation of linea alba. Mesh fixed with vicryl 1-0 sutures to lateral margin of sheath.



Figure 9 : Post -op image of the same patient showing abdominal contour (negative suction drains seen were placed in subcutaneous plane)



Figure 10 : Pie Chart Showing Number of patients with extension of defect

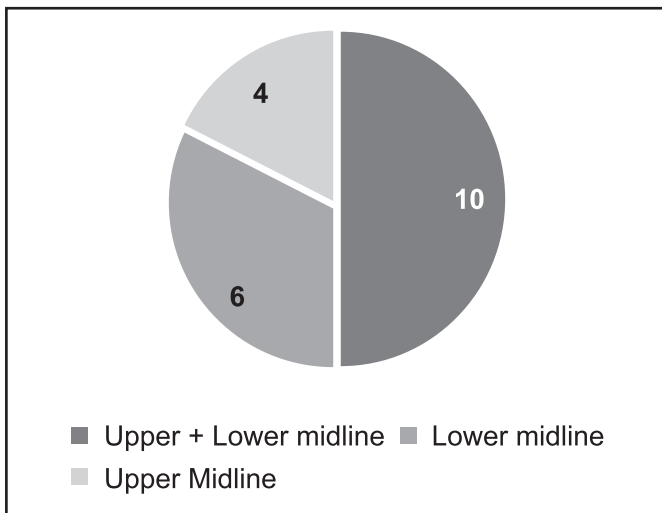


Figure 11 : Pie Chart Showing Vertical Size of defect in midline

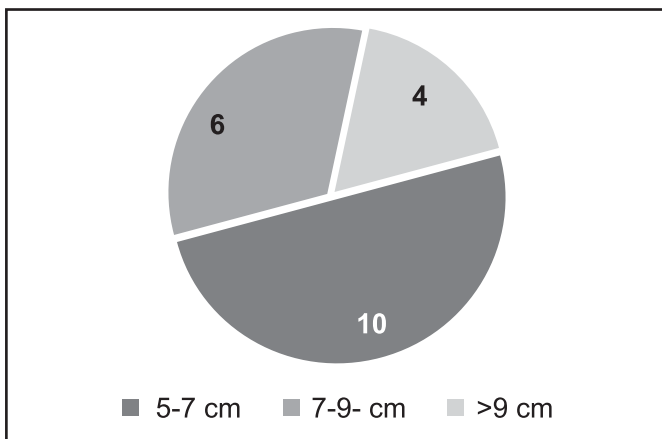
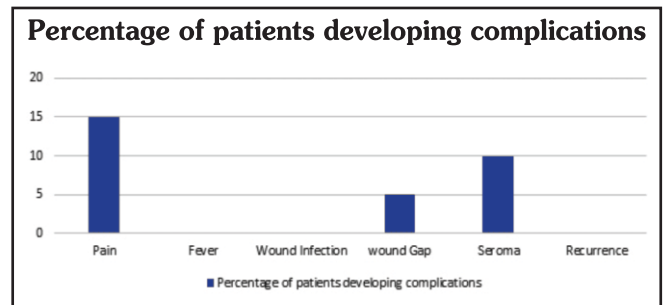


Table 1: Incidence of post-operative complications following shoelace meshplasty



The concept of shoelace came after the anatomical repair and keel repair. Abrahamson first introduced a new concept of restoring the functional anatomy of the anterior abdomen by creating a new linea alba with anterior rectus sheath and using the Shoelace technique to strengthen the anterior abdominal wall. The disadvantage of this technique was because of the fact that in patients suffering from incisional hernia, the abdominal musculature tone was very poor and so when attempting to approximate the recti, the muscles were further weakened due to the tension created.⁽²⁾ So, came the concept of reinforcement by mesh, a modified shoelace, in which mesh is closely sutured to the cut lateral edges of the rectus sheath to prevent herniation through the gaps that exist at the lateral edges at the same time reinforcing the anterior abdominal wall⁽³⁾ but the mesh is just fixed to the edges of the rectus sheath but doesn't overlap, hence these gaps still persist. Moreover, there is enormous fibrous tissue reaction with mesh contracture, and also the chance of mesh infection is high. So, came the woven darning technique (two layered darning) that gives a tension free repair of the hernia and defects in lateral cut edges of the rectus sheath are well addressed.⁽⁴⁾ But Langer and Christiansen⁽⁵⁾ compared their results using primary repair with historical data using a mesh and suggested that the use of mesh gave a better repair with less recurrence.

In our study of shoelace meshplasty for midline incisional hernias, we employed the technique of modified shoelace repair with extension and fixation of mesh beyond the lateral cut edge also and hence, is basically a combination of inlay with onlay meshplasty, but with minimum recurrence (because of reconstruction of linea alba and placement of adequate sized large mesh) and seroma formation (because of absorption of fluid by

Table 2 : Comparison of our study from other previous studies (similar concept but different technique)

Parameter	Our study	Joshi, Singh and Gadhire ⁽³⁾	Prof.N. Tamilselvan, Dr. M. Rajaseka, Dr. S.S.Meera ⁽⁴⁾	Dr. Shah Bhavin K., Dr. GurjarVipul ⁽⁶⁾
Technique	Shoelace repair with meshplasty beyond lateral edges	Modified shoelace repair with mesh placement	Woven darning without mesh	Woven darning without mesh
Number of patients	20	30	20	50
Mesh placement	Yes	Yes	No	In 1 case only
Wound gap	5%(n=1)	6.67%(n=2)	5%(n=1)	Nil
Wound infection	Nil			4%(n=2)
Seroma	10%(n=2)	3.3%(n=1)	5%(n=1)	6%(n=3)
Post- operative pain beyond day 1	15%(n=3)	26.67%(n=8)	25%(n=5)	(Not included in study)
Fever	Nil	Nil	Nil	Nil
Hospital stay (Average-max)	Avg 8days Max-10 days	Avg-7 days Max-17 days	Avg 12.5 days Max-15 days	Avg 11 days
Recurrence at 1 year followup (minimum)	Nil	Nil	Nil	Nil
Operative time (average)	2 hours	(Not included in study)	(Not included in study)	3 hours

exposed rectus muscle). No recurrence was seen in the 20 cases studied at a minimum follow-up period of 6 months, with maximum follow up of 2 years, and only 10% (n=2) cases reported seroma formation.

Similar technique has also been mentioned in some of the cases of incisional hernia managed in the study of 50 Cases of Shoelace Repair for Midline Incisional Hernia carried out in 2015 by Dr Shah Bhavin and Dr Gurjar Vipul.⁽⁶⁾ In that study they used mesh only in 1 case and rest other were darn repair as proposed in modified shoelace technique. Although other results were comparable, they have not clearly mentioned about the contour of the abdomen which is better with the mesh as in our study. The lateral weakening and laxity of abdominal wall is vanished and patient satisfaction is

excellent. Keel's repair and Mayo's double breasting repair etc. have been studied extensively but most are followed by high percentage of recurrence and post op complications.

The drawback of our study was small sample size. However the study is ongoing and soon will have ample sample size.

Conclusion:

The shoelace meshplasty has been found to be an anatomically sound, easy operative procedure, for midline incisional hernias of the abdomen. It maintains the abdominal domain, is technically simpler to perform with no extensive tissue dissection, extraperitoneal and thus prevents chances of injury to the bowel during

dissection, or postoperatively due to adhesions with the mesh. It restores functional anatomy by creating a new linea alba, which is, further, buttressed by the mesh in a tension-free manner. And it carries minimum recurrence rate as well as minimum postoperative complication like seroma and wound infections. It carried zero recurrence rate and 10% seroma formation rate in our study of 20 cases in average follow up period of 18 months. The main advantage of not opening of peritoneum with creation of new linea alba to provide strength to repair, makes it an excellent approach for large midline incisional hernias; where otherwise complicated component separation would have been required. Since there is no opening of peritoneum, there are no chances of post op obstruction or fistula formation making this procedure even more suitable, apart from being easy to learn and easy to reproduce. It is faster to perform preventing additive morbidity of the long anaesthesia.

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