

Methods literature review

[Technology](#), [Development](#)



Discussion and Comparison of Laparoscopic and Open Surgical Inguinal Hernia Repair in Adults.

Abstract

There is an ever increasing number of hernia repair surgeries required likely due to decreasing levels of physical activity amongst young adults and concurrent muscle wastage in the abdomen. Time off from work, staffing issues at hospitals, and cost of hospital bed space are some of the issues associated with the high cost of open surgical methods. Wound infection, decreased mobility, and recurrence of the hernia are problems associated with all surgeries. The last thirty years has seen the advent of laparoscopy and minimally invasive techniques of surgical repair. These methods offer the promises of decreased surgical morbidity, less pain, and faster mobilization post-operatively, as well as smaller scars. This study seeks to conduct a literature review to determine whether or not the outcomes of open and laparoscopic methods are identical and what benefits exist to one method over another.

Introduction

Hernias are defined as the abnormal protrusions of tissues or organs through a hole in the surrounding walls. Although they can occur anywhere throughout the body, hernias of the abdominal wall are the most common site. Hernias are more prone to occur where muscular tissues do not cover the underlying fascia. Common sites of herniation are the inguinal (both direct and indirect), femoral, and umbilical areas. Additionally, sites of prior surgical incisions may become prone to hernias (Sabiston, 2012).

Approximately 5% of the population will develop a hernia of the abdominal

wall. The most common site of herniation is the inguinal region where approximately seventy-five percent of them occur. Men are significantly more likely to develop a hernia in the inguinal area with a 25: 1 ration of occurrence. Women are more likely than men to develop hernias in the femoral and umbilical areas with rations of 10: 1 and 2: 1, respectively. Even though the epidemiology of the femoral and umbilical hernias favors females, the most likely type of hernia a woman will develop remains, as with men, the inguinal hernia (Sabiston, 2012). Hernia repair is, thus, one of the most common surgeries that occur. Over six hundred thousand hernia repairs are performed every year, however, the procedures used are far from perfected and complications ranging from infection to recurrence and more life threatening difficulties are common (Sabiston, 2012).

Diagnosis occurs with the initial finding of a bulge in the affected region. The bulge may be reducible or irreducible, meaning that the contents being spilled through the opening can be pushed back into the cavity of origin.

There may be pain or some discomfort, but a painless presentation is very common unless the hernia is irreducible and becomes strangulated by the surrounding tissues, causing ischemia and necrosis. Paresthesias may also occur in relation to a hernia depending on the involvement of any nerves in the area of the hernia. When diagnosing a hernia, other masses must be differentiated and alternative pathologies eliminated (Sabiston, 2012).

Many classifications of hernias exist, the most widely used being the Nyhus classification. According the Nyhus classification system, four types exist.

Type I hernias are indirect inguinal hernias with a normal inguinal ring (pediatric), type II are indirect inguinal hernias with a dilated internal inguinal

ring, type III are posterior wall defects, and type IV are recurrent hernias (Sabiston, 2012).

In normal adults the inguinal canals normally contain, the spermatic cord in males and the round ligament in females. The canal can be best visualized as a cylinder, traveling obliquely from the posterior abdominal wall through the anterior abdominal wall into the scrotum. In the developing fetus the inguinal canals form the pathway that the testes will follow into the scrotum, although in females there are no testes, the inguinal canals develop in both sexes because of the gonads are undifferentiated at this stage of development. Anatomically, the canal is bordered anteriorly by the aponeurosis of the external oblique muscle, and posteriorly by the transversus abdominis muscle and the transversalis fascia. The gubernaculum, is undifferentiated mesenchyme that is attached to the caudal end of the testes or ovaries on one end, and to the labiosacral swellings (future scrotum or labia majora) on the other end; it aids in the descent of the gonads. In males the upper portion degenerates while the lower portion persists as the “ gubernaculum testis”, which limits movement of the testis within the scrotum. In females the gubernaculum becomes the ovarian ligament and the round ligament, which serve as support for the ovaries and uterus. These form the borders of the inguinal canal, and also serves as the coverings of the spermatic cord and the testis. As the testis enter the scrotum, they push the processus vaginalis forward and into its cavity. Once the process has completed, usually by two years of age, the processus vaginalis undergoes apoptosis, and the only remnant is the serous covering of the testis, now known as the tunica vaginalis. As the testes

descend, there is an invagination of the abdominal wall known as the processus vaginalis, which begins to develop around the third month of gestation. It carries with it, all the layers of the abdominal wall, which include from most superficial to the most deep:

- skin
- subcutaneous fat
- external oblique muscle
- internal oblique muscle
- transversus abdominis muscle
- transversalis fascia
- subperitoneal fat
- peritoneum

Surgical management of a hernia is recommended due to the progressive nature of the pathology, with enlargement and further weakening of the surrounding musculature, and the potential for strangulation. In patients with minimal symptoms however, recent research has shown that a watchful waiting approach did not lead to worse outcomes in those patients. In Europe, a common non-surgical approach is the use of a truss that must be properly fitted. The use of a truss is not without complications though and testicular atrophy and neuritis may occur (Sabiston, 2012).

Anterior repair is the most common approach for inguinal hernias, and tension-free repair is considered the prime standard of current treatment. There are several types of tension-free repairs. Open hernia repair is begun with a 2-3 cm incision above and parallel to the inguinal ligament. Careful dissection and identification of the anatomy is performed eventually leading

to the hernia sac. If the sac is large it is dissected to visualize the contents. The sac is then mobilized and placed into the preperitoneal space from whence it came. In certain cases tissue repair is undertaken, however, this is no longer the first method due to unacceptable recurrence rates. Thus, in most cases a synthetic mesh prostheses is used to repair the defect in order to create a tension free repair, since tension is the main cause of hernia recurrence. Mesh is the dominant repair method used today with the Lichtenstein repair, the plug-and-patch repair, the Prolene hernia system, and a self-expanding polypropylene patches being some common methods (Sabiston, 2012).

Aside from the open methods, today minimally invasive approaches are also often used. Advocates of laparoscopic repair believe that quicker recovery times, less pain, better visualization of anatomy, decreased site infections, and decreased cost to both institute and patient, are some of the advantages over open hernia repairs. Two techniques are widely used laparoscopically, the total extraperitoneal approach and the transabdominal preperitoneal approach which, apart from the laparoscope, are similar in physical outcome to the above described path of repair. (Sabiston, 2012).

There are several options that may be used by the surgeon when considering the laparoscopic hernia repair. The basic repair involves putting a mesh in position, similar to a ventral hernia repair. Due to a large rate of recurrence and the downsides of having an intraperitoneal mesh, this approach has been abandoned in favor of the total extraperitoneal (TEP) and the transabdominal peritoneal (TAPP) approach. The difference between these two techniques is the order in which access is to the peritoneal space is

achieved. In the TEP method, a balloon dissector in the peritoneal space allows for access to the cavity. In TAPP, access is gained by going through the peritoneal cavity. TEP is a faster approach and there is less risk of damaging the viscera, despite these advantages, it is costly, the surgeons working space is small, and if there has been prior surgical attempts on the patient, creating the space might be impossible. Furthermore, if the peritoneal flap may tear, and if the tear is large enough, than the working space may be completely destroyed. If any of the drawbacks occur, conversion to a transabdominal approach will become necessary (Sabiston, 2012).

When performing the procedure using TEP an incision is made infraumbilically. The anterior rectus sheath is opened, and the ipsilateral abdomis musculature is retracted to the side. Blunt dissection is used to create space underneath the musculature. A balloon is then placed deep to the posterior rectus sheath and pulled towards the pubic symphysis, whereby it is inflated while being observed by the laparoscopic cameras. Once the space is opened and the space insufflated, additional trocars are placed. The best visualization of the region is made with a 30-degree laparoscope. The vessels of the inferior epigastrium are recognized and the bottom portion of the rectus muscles are retracted towards the anterior plane. Cooper's ligament is then cleared from the pubic symphysis towards the external iliac veins. Injury to the femoral branch of the genitofemoral nerve must be avoided, as well as injury to the lateral femoral cutaneous nerve. Dissection is performed laterally to the anterior superior iliac spine, and at the end the spermatic cord is skeletonized (Sabiston, 2012).

TAPP allows for more immediate identification of the relevant anatomy before dissection occurs. TAPP also allows for a much wider working space and thus, if the surgeon has less experience, the operation will pass more smoothly (Sabiston, 2012). The only absolute contraindication to a laparoscopic hernia repair is an inability to tolerate anesthesia. In patients that have had extensive prior abdominal surgeries, the adhesions may become a problem, and significant time and effort will be spent removing the adhesions. In patients that have had significant pelvic surgeries that altered the underlying anatomy, accurate and safe dissection can become more challenging (Sabiston, 2012).

The surgical approach in TAPP uses an infraumbilical incision to gain access to the peritoneal cavity. Two ports are made to the side of the inferior vessels of the epigastrium at the level of the umbilicus. A flap is created on the abdominal wall which extends from the median umbilical fold to the anterior superior iliac spine. Following the initial incisions, the repair is identical to the TEP procedure (Sabiston, 2012).

The hernia sac and any associated peritoneal fat that has not been reduced by the expansion of the balloon, is reduced by traction. A small hernia sac is mobilized from the structures of the cord and reduced into the peritoneum. A larger sac may complicate reduction, in which case the sac is cauterized towards the internal inguinal ring, leaving a distal sac in place. The proximal sac is ligated and closed in order to prevent air from entering the peritoneum. After reduction of all the hernias, a polypropylene mesh measuring 12x14 cm is placed through the trocar and unfolded, covering the direct, indirect, and femoral spaces, resting above the structures of the cord. It is

necessary to dissect the peritoneum no less than 4cm from the cord structures to preclude the peritoneum from invading beneath the mesh, which is associated with a recurrence of the hernia. The mesh is secured to Cooper's ligament using staples from the pubic tubercle to the external iliac vein, just in front of the posterior rectus muscles and the transversus abdominis aponeurosis at least 2 cm above the hernia, and lateral to the iliopubic tract (Sabiston, 2012).

The mesh that is placed should extend from the pubic symphysis and the spermatic cord and peritoneum. Tacks are not used inferior to the iliopubic tract further than the external iliac artery, and the mesh is not fixed to this region. Staples that are used can cause injury to the genitofemoral nerve or the cutaneous nerves, and should be avoided. Furthermore staples must be avoided in the "triangle of doom" region, formed by the ductus deferens and the spermatic vessels, in order to avoid injuring the iliac vessels and femoral nerves. If the tip of the tacking tool can be palpated, then the delicate structures are most likely avoided (Sabiston, 2012).

The continued overall decrease in fitness levels in the young is leading to less confining muscle walls in the body. This progression has dramatically increased the number of inguinal hernia repairs being required and performed. With the many repairs, it is not economically or medically viable to continue doing traditional open repairs. Increased time-off from work and increased personnel involved can be viewed as downsides of the traditional repair, while the increased resources required and training needed by the surgeon to become proficient will also be viewed as downsides to smaller, more general, or underserved hospital surgical areas. Thus, it is

hypothesized that the use of laparoscopic uncomplicated inguinal hernia repair surgery will decrease recovery time, with decreased operative complications and improve post-operative mobility of patients when compared with traditional (open) hernia repair for the majority of patients.

In order to determine whether or not laparoscopic techniques indeed improve surgical outcomes for patients a search of literature was performed using pubmed. gov. The search term “ hernia repair” returned over fourteen thousand articles.

Articles were excluded that were older than eight years old. Furthermore, only studies that discussed a comparison between open and laparoscopic methods were utilized, thus, articles examining the differences between different open or different laparoscopic methods were excluded from the analysis.

A full profile of the entire perioperative and surgical outcomes were considered acceptable. Some articles discuss the differences in recurrence rates for the two procedure types, while others discuss the differences in intraoperative complications such as bleeding and perioperative infections, still others discuss the differences in quality of life outcomes between the procedures. Furthermore, whereas the immediate interest was in the treatment of adult abdominal hernias, studies of childhood hernias were not excluded due to the belief and discovery that the surgical outcomes and risks were largely similar – namely, perioperative infections, post-surgical pain, poor healing, and recurrence were just as likely to occur.

A significant number of meta-analyses were returned in the pubmed search. There was no specific intention of excluding them from the analysis because

it was believed that they would provide an invaluable aggregation of information from case studies and well formed syntheses of the outcomes of the procedures. However, the vast majority of meta-analyses incorporated studies that were much older than the exclusion criteria permitted and thus, unless fitting criteria, they were excluded.

Finally, Direct or head-to-head comparisons between open repair and laparoscopic repair were preferred in order to limit confounders and analytical bias as much as possible. This provided the extra advantage of reducing statistical modeling which may lead to error and inaccurate reporting of data.

In total, ten studies of various design were selected to evaluate the benefits and outcomes of the methods under review.

Results

Ten studies were found that matched the chosen inclusion criteria defined above. The studies evaluated several differing variant types of hernias to be repaired including incisional, inguinal, pediatric, and adult hernia types. All included studies were head-to-head comparisons of open repair and laparoscopic repair. The dependent variables evaluated by the studies included: infection rates, pain levels, in-theatre operative time, post operative mobilization time, testicular volume and blood flow, and quality of life. The varying designs of the studies reviewed are presented below in table 1.

All but one study compared adult outcomes following surgeries. The significance in this, is that the etiological factors of pediatric and adult

hernias are different. Adult hernias usually occur as a result of straining a weak muscle whereas pediatric hernias are more likely a result of incomplete closure of the deep and superficial inguinal ring in embryologic development. Post-operative pediatric outcomes though, were similar.

The results are rather mixed. Most studies showed that hospital stays were lower, infection rates were lower, and that there was less pain with laparoscopic techniques (7/10 studies). 3/10 studies concluded that there was no significant difference in the outcomes of the two operational approaches. A differing 3/10 studies noted that operating room time was increased in laparoscopic procedures. Two studies stated that there was less recurrence with open procedures, however, most indicated that recurrence rates between open and laparoscopic methodologies were similar. Two of the studies also stated that quality of life measurements were better following laparoscopic repair. Quality of life was assessed using a questionnaire, the Quality of Life assessment form (SF-36) (Singh, N. A., et al, 2011; Abbas, A. E., et al, 2011).

One study, which happened to be the most recent and a controlled clinical trial, stated that the perioperative complication rate was higher with the laparoscopic procedure. The perioperative complications cited were: enterotomy, serosal bowel injury, and bladder perforation (Eker, H. H., et al., 2013). Finally, of note was that most studies indicated that anesthetic-operative time, not just time in-theatre, was significantly longer with laparoscopic surgery. Though it was noted this did differ between physicians depending on number of operations performed (Eklund, A. 2009)

Two of the studies reviewed testicular complications following hernia

surgery. In the case of pediatric hernia repair there was no difference reported in the vascularization of the testes by the two methods. In the case of adult hernia repair though, open surgeries were associated with restricted blood flow that can lead to a decrease in testicular volume, a decrease in testicular size, and a concurrent increase in FSH and LH.

A review of the literature regarding pediatric hernia repair is most informative regarding complications and complication rates. Whereas the cause of herniation is different (embryological development vs. strictly muscular weakness), the repair is ultimately nearly identical. However, the lack of comorbidities present in childhood give a better indication of the actual differences in outcome between the repair methods. Older patients are much more likely to have hypertension leading to bleeding, diabetes leading to poor wound closure, more exposure to potential bacterial contamination leading to infections, and ultimately can not be restrained and isolated in the same way that a pediatric patient may be. Thus, a child can more easily be controlled and extraneous factors effecting outcome of the repair can be more effectively eliminated.

In a study designed by Bharathi Ramanathan et al, there were a total of 85 patients (M: F= 77: 7) that were assigned to the study; 51 patients receives laparoscopic surgery, while thirty four underwent open repair (2008). Within the group of patients receiving laparoscopic surgery, 35 patients had a strictly unilateral hernia repair, while the rest underwent bilateral repair, but were excluded from the collected data. The data is demonstrated in the table below:

While their study did not include patients with a contralateral hernia, the

number of patients that presented with a unilateral hernia and subsequently had a contralateral patent processus vaginalis (CPPV) was significant, > 20%. The options to detect a bilateral hernia are many, namely routine bilateral explorations, ultrasonography, laparoscopy, and the wait and watch policy. Because the rate of CPPV has been reported to be in the range of 38-100 %, with a narrower range calculated somewhere in between 31-48% the use of laparoscopy is advantageous in that, it can prevent a second operation. However, because the operation in itself carries risks, such as the risk of a recurrent hernia, which is around 3.4-4.1%, and because having a CPPV does not necessarily mean that it will become a hernia, it generally occurs in about 10-15% of patients, many doctors consider the need to explore the contralateral side unnecessary. However, Lau et al proposed that a CPPV becomes significant in 25-50% of the time.

While post-operative pain is subjective, the larger incision created by the open approach did not equate to a greater amount of pain following the operation. Parietal pain is pain associated with the outer coverings of organs, but not the organ itself. Parietal pain is severe and can be pinpointed to an exact location. Pain following an open operation caused parietal pain, and it was able to be relieved in their patients. Visceral pain is pain that originates within an organ. It is slow in onset and increase in severity over time. With the use of the laparoscopic approach, there was parietal pain, but the increase in pressure of the peritoneum also caused visceral pain, due to stretching. Therefore the difference in pain was not considered to be significant between the two processes.

Patients undergoing laparoscopic repair had a postoperative recovery of <3

hours in 74.3%, and patients undergoing open surgery has a postoperative recovery of <3 hours in 94.12%, showing significance ($P=.02$). However the overall duration of patients undergoing both procedures showed no significance in the data. Showing that in overall post-operative recovery the results are comparable.

Endo et al, published results comparing their experience using laparoscopic assisted extracorporeal repair with the open procedure at Saitama City Hospital and at Kyorin University Hospital (2009). Their results are presented below. Characteristics of patients who underwent chosen procedure:

Operative Findings:

In this study, parents were given the choice of a laparoscopic procedure or an open procedure. The open procedure group was further divided into a group of parents who chose a simple open procedure vs. parents who chose an open procedure with diagnostic laparoscopy. “ Parents favored the laparoscopic for several reasons: a) postoperative cosmetic superiority, b) inspection for CPPV, and simultaneous repair if it was present, c) the ability for a second look at the previous operation site in cases of recurrence or contralateral occurrence, d) availability of simultaneous umbilicoplasty for umbilical hernia, or an ugly umbilicus.” It is no surprise that a significant percentage of girls received the laparoscopic procedure due to the cosmetic superiority. Parents who chose to have the open procedure favored this method because of personal feelings such as, a previous bad experience with a laparoscopic procedure.

In this study the operative time shows, that while unilateral procedures between the LPC and CD groups showed no significant difference, however

there was a difference in time when these procedures were done in patients that had bilateral hernias (35.8 ± 11.6 vs. 46.7 ± 17.7). In these cases the laparoscopic approach is clearly superior. Another significant time difference was seen in patients that received CDL (open procedure with a diagnostic laparoscopy) vs. CDA. CDL took an average 6 minutes longer for a unilateral hernia and about 8.6 minutes longer for a bilateral hernia than CDA with a $p < 0.001$. I assume that CDL group took longer because of the need to create access routes for the ports.

In their postoperative findings, they had 2 patients out of 1,257 (0.16%) with a postoperative recurrence in the laparoscopic group, while in the open group, 2 out of 308 patients had a hernia that recurred. A metachronous hernia (MH) develops in a previously asymptomatic side of a patient that previously underwent surgical repair of a unilateral hernia. MH developed in 0.79% of the LPC patients and in 1.67% of the CD patients, with 1.59% in the CDL group and 1.89% in the CDA group. The findings show that the incidence of both a recurrent hernia and a metachronous hernia development occurred in fewer patients that underwent the laparoscopic repair.

Rafik Shalaby et al, carried out a prospective randomized control study comparing the procedures (2012). Out of a total of 250 patients the 179 were male and 71 female. Patients were divided into two groups; A and B. Group A totaled at 125 patients (M= 38, F= 87) and they received laparoscopic repair. Group B consisted of 125 (M= 92, F= 33) patients receiving open repair. Presentation of the patients were as follows:

The patients that underwent LS they were able to resume normal activities

within six hours after the operation, while the patients that underwent OS resumed normal activity in approximately 10 hours. Operative time showed a significant difference in their study. Laparoscopy proved to be much quicker for them than previously reported.

Results of postoperative complications were grouped as; hydrocele, recurrence, iatrogenic ascent of the testis, testicular atrophy, and the presence of an ugly scar (cosmesis). Differences between the two procedures showed no significant difference except in regards to iatrogenic ascent of the testis and cosmesis. Group A patients had zero reported cases (0/87), while in group B 4/92 patients (4.35%) ($P=0.049$) developed this complication. An ugly scar was reported in 5/125 (4.0%) of patients' in-group B, while zero reported an ugly scar in-group A ($P=0.024$).

Discussion

There is, unfortunately, no clear cut answer to the hypothesis that the use of laparoscopic uncomplicated inguinal hernia repair surgery will decrease recovery time, with decreased operative complications and improve post-operative mobility of patients when compared with traditional open hernia repair. The hypothesis was partially supported by a slight majority of the studies reviewed, insofar as 6/10 of the studies believed that there were fewer complications and improved post-operative mobility. The several studies that reviewed longer term outcomes seemed to indicate that there was no difference between the two methods. In fact in those few studies that looked at long-term results, they found that open hernia repair had fewer recurrence rates by a slight margin. Thus, a narrow majority of studies seemed to support a conclusion that the hypothesis was strictly correct and

that operative complications were reduced and the mobility of patients was faster following a laparoscopic repair. However, one study noted that the complication rates of laparoscopic repair are lower, but the complications that do occur tend to be more immediately severe and in later post-operative presentation. Bowel injury was the most common complication during laparoscopic surgery and was not recorded during open surgical repair of the hernia. When there was a bowel injury, the operation immediately converted to open and was controlled thus (Itani, K. M. F., et al, 2010). Surgical time seemed to be significantly longer when the operation was performed laparoscopically – with some studies suggesting that laparoscopic operating time was up to 30% longer (avg. 100 minutes vs. 76 minutes)(Eker, H. H., et al, 2013). On the other hand, other studies had a much smaller time difference (avg. 46 minutes vs. 45 minutes)(Abbas, A. E., et al, 2011).

There are many factors that may contribute to the different outcomes in the surgical results. The most commonly cited factor is physician experience with the techniques that are being used to perform the repair. In the cases where physicians are able to perform a high volume of laparoscopic repairs the complications are diminished and recurrence rates are low. However, in the hands of inexperienced surgeons laparoscopic techniques seem to provide no benefit and actually cause an increase in the rates of severe complications. There was little mention, and no direct information was found, regarding whether the skill and experience of the other members of the surgical team (such as nurses and anesthesiologists) made a significant difference in outcome.

Another repeatedly cited factor regarding the outcomes of hernia repair is the size of the herniated sac. A large hernia was associated with higher recurrence rates in the majority of the studies reviewed.

The limitations of this research study include the search terms used and the reliance on reported studies. None of the studies provide a reference regarding physician training and furthermore none of the reviewed studies discussed other independent risk factors and their relationship to complications and results.

In sum, the choice of surgical method is dependent on several factors; namely the type of hernia present, and the skills of the surgeon performing the operation.

Laparoscopic techniques provide several advantages related to scar size, however, the benefits regarding surgical complications and risk of recurrence have not been proven in any appreciable manner. However multiple articles did distinctly show a correlation with increased training and experience (number of operations performed) and decreased complications which leads to a separate conclusion, and possible basis of future study,

References:

- Abbas, A. E., et al. (2012). Patient-perspective quality of life after laparoscopic and open hernia repair: a controlled randomized trial. *Surgical Endoscopy*, 26, 2465-2470. DOI 10. 1007/s00464-012-2212-9
- Ballem, N., et al. (2008). Laparoscopic versus open ventral hernia repairs: 5 year recurrence rates. *Surgical Endoscopy*, 22, 1935-1940. DOI 10. 1007/s00464-
<https://assignbuster.com/methods-literature-review/>

008-9981-1

Bharathi R, Arora M, Vasudevan B. (2008) Pediatric Inguinal Hernia:

Laparoscopic

versus Open Surgery. *JLS* 12. 277–281

Celebi, S., et al. (2012). Do open repair and different laparoscopic techniques in pediatric

inguinal hernia repairs affect the vascularization of the testes? *Journal of Pediatric Surgery*, 47, 1706-1710. [http://dx. doi. org/10. 1016/j. jpedsurg.](http://dx.doi.org/10.1016/j.jpedsurg.2012.03.044)

2012. 03. 044

Choi, Y. Y., et al. (2012). Comparison of the outcomes between laparoscopic totally

extraperitoneal repair and prolene hernia system for inguinal hernia; review of one surgeon's experience. *Journal of the Korean Surgical Society*, 82, 40-44. [http://dx. doi. org/10. 4174/jkss. 2012. 82. 1. 40](http://dx.doi.org/10.4174/jkss.2012.82.1.40)

Eker, H. H., et al. (2013). Laparoscopic vs Open Incisional Hernia Repair.

JAMA Surgery,

148(3), 259-263.

Eklund, A., et al. (2009). Low Recurrence Rate after Laparoscopic (TEP) and Open

(Lichtenstein) Inguinal Hernia repair: A Randomized, Multicenter Trial with 5-

Endo, M. et al (2009). Laparoscopic completely extraperitoneal repair of inguinal hernia in children: a single institute experience with 1257 repairs compared with cut-down herniorrhaphy. *Surgical Endoscopy* 23(8), 1706-1712. DOI: 10.1007/s00464-008-0300-7

Itani, K. M. F., et al. (2010). Comparison of Laparoscopic and Open Repair

With Mesh for

the Treatment of Ventral Incisional Hernia. *Archives of Surgery*, 145(4), 322-328.

Lomanto, D., et al. (2006). Laparoscopic versus open ventral hernia mesh repair: a

prospective study. *Surgical Endoscopy*, 20, 1030-1035. DOI: 10.

1007/s00464-005-0554-2

Malangona, M. A., Rosen, M. J. (2012). Hernias. In C. M. Townsend, R. D. Beauchamp,

B. M. Evers & K. L. Mattox (Eds.), *Sabiston Textbook of Surgery* (19th ed.) (pp. 1114-1140). Philadelphia: Elsevier

McGreevy, J. M., et al. (2003). A prospective study comparing the complication rates

between laparoscopic and open ventral hernia repairs. *Surgical Endoscopy*, 17, 1778-1780. DOI: 10. 1007/s00464-002-8851-5

Rogmark, P., et al. (2013). Short-term Outcomes for Open and Laparoscopic Midline

Incisional Hernia Repair. *Annals of Surgery*, 0(0). 1-9. DOI: 10. 1097/SLA. 0b013e31828fe1b2

Shalaby, R. et al. (2012). Laparoscopic Hernia repair vs. open herniotomy in children: A controlled randomized study. *Minimally Invasive Surgery*, Article ID 484135, 8 pages doi: 10. 1155/2012/484135

Shalaby, R. et al (2010). Laparoscopic hernia repair in infancy and childhood: evaluation

of 2 different techniques. *Journal of Pediatric Surgery* 45(11) 2210-2216

Singh, A. N., et al. (2012). Testicular functions, chronic groin pain, and quality of life after laparoscopic and open mesh repair of inguinal hernia: a prospective randomized controlled trial. *Surgical Endoscopy*, 26, 1304-1317. DOI 10.1007/s00464-011-2029-y

Townsend, C. M., et al (2012). *Sabiston Textbook of Surgery: The Biological basis of Modern Surgical Practice* 19th ed. Philadelphia, PA: Elsevier Saunders