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HERNIA REPAIRS : OPEN TECHNIQUES

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In the surgical treatment of primary inguinal hernias "open" techniques account for 85% of all procedures, while for recurrent hernias, they account for 65 to 70% (1). The predictions made in 1992 by the manufacturers of laparoscopic equipment that all hernias will be "repaired laparoscopically by 1997" did not come to pass.

Open techniques are here to stay, for the simple reasons that they are safe to perform on all patients of all ages, they do not require a general anaesthetic, they do not demand unusual dexterity and they are cost efficient. Also, complications are rare and seldom life threatening. The only imperative is to carry out the technique as established by its author rather than introduce an untested variation of your own. Corruptions of techniques are often so radical that they affect results; the best example of such a corruption is seen with the "imbrication of the transversalis fascia" in the Bassini repair, leading to recurrence rates of up to 25%(2,3). Bassini never "imbricated" the posterior wall of the inguinal canal. He always divided it (3).

An important aspect of hernia surgery today is the incorporation of prosthetic materials in 80% of all hernia repairs²² (4).

Open techniques can be divided into two classes, namely pure tissue repairs and tension free prosthetic repairs:

A) Pure Tissue Repairs

a) Ironically, the operation which Bassini gave us in 1886 has withstood the test of time despite more than 80 eponymic variations (5). The Bassini repair, the Shouldice repair, the Bassini-Shouldice repair, the Canadian repair - all refer to the same technique with the difference that the Shouldice uses a continuous suture where Bassini relied on interrupted sutures. In the hands of those surgeons who respect the letter of the technique, the results are rewarding and recurrences are less than 1-2% (2)

The Bassini-Shouldice technique, when used in the repair of recurrences has been documented to have a re-recurrence rate of 3 to 20% (7).

b) The McVay repair (also known as Lotheissen, Lotheissen-McVay, Narath, Cooper ligament repair). This repair is difficult to perform well, results in excessive tension despite relaxing incisions and therefore, marked post-operative discomfort. This repair has an incidence of femoral vein compression which, while low, is still a constant (2). Experience also shows that a recurrence following a McVay repair can be tedious and difficult to correct because of the extent and depth of the scarring but also because of the proximity of the femoral vessels and the deep inguinal vasculature in the space of Bogros. Recurrence rates vary from 1.5 to 15.5% with the best results seen in the larger series which reflect familiarity with the technique (2).

c) The Nyhus (Annandale, Cheatle, Henry, McEvedy) repair.

The Nyhus repair was based on a good concept but the results did not live up to the promise, particularly in direct inguinal hernias when recurrence rates reached 27% (2). However, when Nyhus added polypropylene mesh to buttress the posterior inguinal wall, the results were dramatic and, along with Stoppa he pre-empted the laparoscopic surgeons (2).

B) The Tension Free Prosthetic Repairs

The concept of tension free repairs was started by Aquaviva of Marseille, France in 1944 when he reported his observations and experience with Nylon mesh to the French Academy (9). Zagdoun and Sordinas of France reported a series of 185 cases of tension free repairs done between 1951 and 1959 ,including a literature review of 200 articles on the subject for the purpose of a doctoral thesis(9). A similar technique was performed in the US by R.Newman of Rahway NJ in 1956. His series of 350 cases was noted

by Lichtenstein who credited him for his contribution (10). Lichtenstein however went on to popularize the technique in his 1970 textbook *Hernia Repair without Disability*(11).

While mesh has been a tremendous addition to the treatment of the hernia diathesis, it must be remembered that we are very likely dealing with a systemic disease which manifests itself over long periods of time and that mesh is not a panacea. Some surgeons, unfortunately, have intimated that with mesh you no longer need to know your anatomy! Nothing can be further from the truth. A plug, for example, may well obliterate and correct a hernia defect in the floor of the canal or at the internal ring but what will happen in 5 or 10 years to the adjacent areas? Should everyone have onlay mesh along with a plug? Time will tell ,for time may be the harshest but the fairest of judges. With so many surgical gadgets appearing so quickly on the market one suspects that perhaps some may not have been adequately or thoroughly investigated or documented. Although single-surgeon series using new hernia gadgets report few if any recurrences, new modifications of the same device appear regularly. If the first version worked so well, why are new versions needed? Still, all tension free repairs are associated with an incidence of recurrence which is less than 2% and often less than 1%.

The Tension Free Repairs can be classified as follows:

- Onlay (superficial)
 - a. Aquaviva ,1944 (9)
 - b. Usher 1959 (12)
 - c. Newman 1956 (10)
 - d. Lichtenstein 1970 (11)
 - e. Valenti 1999 (14)

f. Trabucco 1998 (13)

g. Thovara 1998 (15)

Trans-inguinal pre-peritoneal (TIPP)

a. Copello 1968 (16)

b. Rives 1965(16)

c. Transversalis Fascia Replacement 1983 (5)

d. Moran 1994 (16)

e. Kugel 1997?

f. Willmen -Vicryl pad 1994 (16)

Combined Onlay-Underlay

a. Gilbert (PHS) 1998 ? (17)

b. Rutkow plug 1993 (4)

Supra-Pubic (Supra-Inguinal)

a. Nyhus buttress 1988 (8)

b. Stoppa 1970 (16)

c. Wantz 1994? (16)

d. Ugahary 1999 (19)

Summary:

Pure tissue open repairs are still rewarding procedures for primary hernias, provided that the anatomy is understood and the technique respected in its execution. The same techniques may be successfully used in recurrent hernia repairs, but judgement must be exercised and if any doubt exists ,one must resort to mesh.

Open mesh repairs are presently well established and are compelling because they are easy to perform and are rarely attended by complications. Other significant advantages

are :minimal post-operative pain, particularly when compared to pure tissue repairs, and immediate return to normal activities.

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Laparoscopic Hernia repair: The Best Repair

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Why was the laparoscopic approach developed?

In the late 1980s and early 1990s, most hernia repairs were painful, the recovery was slow, return to work was 6 weeks, and the reported rate of recurrences was up to 15%. Most of the repairs were performed without the use of mesh. Hernia repairs, though commonly performed, were not standardized. Numerous different types of repairs and various modifications of those repairs existed because no one repair was optimal. The laparoscopic approach was developed to reduce the morbidity, recovery and recurrence rate of “standard” open repairs.

The evolution of laparoscopic approaches:

The early laparoscopic approaches included attempts to make the repair simple to perform. These approaches included the plug and patch, simple ring closure and intraperitoneal onlay mesh (IPOM) repairs. The first two had high recurrence rates and the latter did not become widely adopted due to the aversion of most surgeons to place mesh in the peritoneal cavity. The more recent repairs and those that are most commonly performed include the transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) repairs.

TAPP and TEP:

Currently the TAPP is the more widely used technique because of its relative ease to learn and perform. Because it is an intraperitoneal procedure, an incision in the peritoneum must be made to get to the extraperitoneal space. Closure of this incision with either sutures or staples may result in adhesion formation and the potential of small bowel obstruction. Incomplete closure may result in internal herniation, which can result in bowel

obstruction or ischemic injury to bowel. The wide dissection necessary to place a large mesh is also somewhat limited by the TAPP approach. The limitation may contribute to the slightly higher recurrence rate of TAPP vs. TEP. The other possible cause of the slightly higher recurrence rate may be due to the fact that most have undergone the learning curve with the TAPP procedure.

Because of the concerns with the TAPP approach, many have switched to the TEP repair. This approach most closely mimics the open preperitoneal repair of Stoppa in France and Wantz in the United States. This repair which has been performed for over 30 years involves a low midline incision to enter the preperitoneal space. A large mersilene' mesh is placed over the myopectineal orifice of Fruchaud (orifice which includes the femoral, direct and indirect spaces). According to Stoppa, suture fixation is not necessary. Key to his approach is the wide "parietalization" of the cord structures. This involves wide proximal dissection of the peritoneum off the blood supply and cord to the testicle. The TEP is the same repair using the laparoscope.

Advantages of the TEP repair:

There are numerous advantages of the TEP repair. It avoids the peritoneal defect. It allows the widest coverage of the myopectineal orifice, resulting in the lowest recurrence rates. It is anatomically correct because it replaces the weak posterior transversalis fascia. It is also mechanically sound because its success relies on the intraperitoneal pressure evenly distributed over the wide mesh to keep it abutted to the anterior abdominal wall. As Wantz has said about the open Stoppa preperitoneal repair, "...when correctly done, recurrences are inconceivable". In fact, the TEP is the newest repair and in most large series has recurrence rates less than 0.5% in spite of the early learning curve. It took the Shouldice clinic 40 years to get recurrence rates to less than 1%. The TEP repair is an outpatient

procedure, which results in the best patient recovery with a rapid return to work and the least amount of pain.

This is the best repair. Why, then, has it not become the most common repair? Why aren't all surgeons convinced of it and performing it? What are the controversies?

Controversies:

No better than open approaches especially the mesh repairs:

This is a common argument that is not supported by the literature. There have been numerous articles prospectively, retrospectively; randomized and non-randomized comparing the open mesh and non-mesh repairs to the laparoscopic repairs. The majority favor the laparoscopic approach as less painful with a more rapid return to full activity. The more recent meta-analysis of 29 randomized control studies by Cheek found the laparoscopic approach "is superior to open procedures in terms of less postoperative pain and faster return to normal activities." Memon reported an 11-day return to work for laparoscopic repairs vs. 19-day return to work for open repairs in a meta-analysis of 18 clinical trials (13 randomized and 5 non-randomized). Chung reported a significantly quicker return to work with the lap approach vs. the open mesh and a significantly lower amount of pain with the lap vs. tissue repair. In our own review of the literature, we evaluated 18 studies, which compared laparoscopic to open in terms of pain. 13 favored lap, 5 showed no statistical difference and none favored the open approach. 15 papers were evaluated for return to work. 7 favored the laparoscopic approach and 8 found no statistically significant difference. Again, none favored the open approach. In none of the meta-analysis, was there enough statistical power to favor either approach as far as recurrence rates were concerned.

Complications are more numerous and more severe:

In the beginning of the development of the laparoscopic approach, complications such as bowel obstruction, internal herniation, bladder injury, vascular injury and nerve injuries were reported. Many of the injuries were due to the surgeon's relative inexperience with laparoscopy, unfamiliarity with the extraperitoneal anatomy, and lack of standardization of technique. Severe complications are rare and when one again looks at the literature and compares the complications of open vs. laparoscopic repair, there is no statistically significant difference. In our own analysis of 17 comparative studies, 3 favored the laparoscopic approach, one favored the open approach and in 13, there was no significant difference.

Costs:

There is no question that the laparoscopic repair costs more than that of open repairs performed under a local anesthetic with no mesh. Open repairs with mesh using a general anesthetic are probably the most common open approach today. The only difference in cost between this and the laparoscopic approach should be the use of laparoscopic equipment including: light source, camera, insufflation equipment, scopes, disposable and stapling devices. Since all operating rooms today are well equipped for laparoscopic surgery, the only real issue is that of disposable equipment such as trocars, graspers, scissors, suction cannulas, dissecting balloons, and stapling devices. These disposables add \$600 or more to the cost of the procedure and are unnecessary. When all the superfluous equipment is removed, the cost difference should be minimal. Again, when we look at the various meta-analysis, we see that the costs of laparoscopic hernia repairs are higher because of the equipment used and the time it takes to perform the procedure. Even if the costs remain higher, others and we have demonstrated that the more rapid return to work offsets the higher cost of surgery. Heikkinen estimated a five day more rapid return to work with the laparoscopic approach vs. the Lichtenstein approach. The Lichtenstein approach

cost \$517 dollars less than the laparoscopic approach. The cost of sick leave however was \$1,040 less for the laparoscopic repair for an overall \$524 dollar saving to society. In Indiana, for a blue-collar worker to be off work for 30 days, the cost to the employer is \$5,048. The cost for one week off is \$1,262. These amounts more than offset the higher cost of the laparoscopic approach.

It is too hard to do:

True. It is hard to do. The anatomy is less familiar, the technique is more invasive and greater dissection is required. The learning curve is longer for this than the simpler open repairs using mesh. It is technically more demanding and anatomically more challenging to perform and often takes longer to perform than the more simple open repairs. This, perhaps is the greatest deterrent to its widespread use.

Conclusion:

The clinical data support the laparoscopic approach as the best repair. Nonetheless, existing controversies and difficulty in learning this approach has kept this from becoming a popular repair.

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The Role of Watchful Waiting for Inguinal Hernias

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Groin hernia is one of the most common worldwide afflictions of adults, especially men¹. The earliest recordings of medical history include discussions about effective means of treatment. Approximately 500,000-750,000 herniorrhaphies are performed in the United States each year²⁻⁵. It was the most common surgical operation performed by general surgeons in the USA in 1991, according to data from the National Center for Health Statistics⁶. The results are large direct costs for the surgical procedure and significant indirect costs because of time away from normal activities. Pertinent to this presentation is the fact that the overall cost to society for treatment of this condition would be even greater if the estimated 800,000 patients per annum in the USA who choose not to have their inguinal hernias repaired changed their minds⁷.

Natural History

The natural history of an untreated inguinal hernia is poorly understood with almost no modern data available. This is because of the commonly held opinion that all inguinal hernias should be repaired when diagnosed to prevent the complications of intestinal obstruction and/or strangulation of incarcerated contents. In addition, many surgeons recommend routine herniorrhaphy because of the belief that the longer an inguinal hernia goes un-repaired, the more difficult it will be to fix. Koontz in 1963 epitomized the prevailing attitude towards non-operative strategies for inguinal hernia management when he wrote, "There are very few cases in which nonoperative mechanical devices are necessary or desirable. They are for timid people who do not wish to face up to the realities of any situation. Early operation is so simple that it is by all means the method of choice"⁸.

This opinion has been questioned because in fact, the risk of a major complication such as obstruction and/or strangulation (hernia accident) is probably lower than the 2- 6% risk often quoted in older text books. These figures were based more on speculation rather than scientific fact given that hernias are usually repaired when diagnosed making it impossible to do a population based study to determine risk rate. Neuhauser found two diverse groups of patients allowing him to better ascertain the actual risk of a hernia accident. The first group consisted 8,633 patients enrolled in Paul Berger's truss clinic in Paris described in an 1896 publication⁹. This was an important database for looking at natural history because Bassini's method had yet to be widely adopted and therefore elective herniorrhaphy was rarely done. Fortunately, Berger kept records on his truss patients and enumerated untoward events. There were a total of 242 accidents that translated into a yearly risk of 0.0037. Neuhauser's second group came from unpublished data from Cali, Colombia where it just so happens that almost no elective hernia repairs were performed. He found the annual risk of a major complication for this group to be 0.00290. Using such data it can be estimated that an 18-year-old man has a 0.272 lifetime risk of strangulation and a 75-year-olds risk is 0.034.

Not only is the accident risk low but the operative mortality for the treatment of such an accident may have been overstated in the past. The operative mortality for patients undergoing operation for an inguinal hernia complicated by obstruction has traditionally been quoted at between 0.1 and 0.2 % which is at least 10 times greater than the mortality for elective herniorrhaphy. (See Table I)

Table I

Operative Mortality for Patients with Obstructed Inguinal Hernias

<u>Authors</u>	<u>Mortality Rate</u>
<u>Beller & Colp(1926)</u>	<u>.109</u>
<u>Frankau(1931)</u>	<u>.197</u>
<u>Guillen & Aldrete(1970)</u>	<u>.132</u>
<u>Anderson & Ostberg(1972)</u>	<u>.138</u>

Neuhauser looked at Medicare discharge data on 84,995 patients from 1971 specifically examining ICD code 550 (Inguinal hernia without obstruction) and code 552 (Inguinal hernia with obstruction). He found the mortality to be .00519 and .0469, respectively. This confirmed the 10-fold increase in mortality for patients presenting with intestinal obstruction when compared to non obstructed patients but must be interpreted in the light of the extremely low overall mortality compared to the 0.1-0.2 traditionally considered. Based on Neuhauser's incidence, the life expectancy in 1971, and the operative mortality rates for uncomplicated and complicated hernia repair in the Medicare population in 1971, he felt that for patients' 65 years old, elective operation has a higher loss of life than no operation¹⁰.

To summarize, despite popular wisdom to the contrary, it may be that patients with inguinal hernias can safely delay surgical treatment in favor of careful watchful waiting (WW) as the method of management for their hernia. The question is moot in the symptomatic patient

because the indication for surgery is discomfort, not the prevention of complications. But what about the patient with either an asymptomatic or minimally symptomatic hernia?

At the same time that it has become clear that the risk of complications of an untreated hernia as well as the operative mortality for caring for complications of an untreated inguinal hernia has been overstated, it is now realized that inguinal herniorrhaphy results in greater morbidity than has previously been appreciated. A discussion of complications of inguinal hernia is therefore appropriate. The complications of groin hernia repair are divided into three groups: 1) those related to laparoscopy, 2) those related to the patient i.e. general complications and 3) those related to the herniorrhaphy. (See Table II) Complications unique to laparoscopy and the patient are general in nature and not specifically related to herniorrhaphy. For the purposes of this presentation, it is the complications that are directly related to the herniorrhaphy that are of greater concern.

Complications Related to the Herniorrhaphy

The recurrence rate has been brought down to a minimum using modern hernioplasty techniques. Various groin pain syndromes may develop usually from scar tissue, reaction to prosthetic material or incorporation of a nerve in staples or suture material during repair of the hernia. Chronic postoperative groin pain occurs without regard to the type of repair performed. The nerves that are usually involved are the ilioinguinal nerve, the iliohypogastric nerve, and both the genital and femoral branches of the genitofemoral nerve and the lateral cutaneous nerve of the thigh. The former two are especially prone to injury during a conventional herniorrhaphy while the latter are most likely damaged during laparoscopy.

Table II

Complications

Related to the Laparoscopy	Related to the Patient	Related to the Herniorrhaphy
Vascular Injury	Urinary	Recurrence
A) Intra-abdominal	Ileus	Chronic Groin Pain
B) Retroperitoneal	Nausea and vomiting	Neurological
C) Abdominal Wall	Aspiration pneumonia	A) Iliohypogastric
D) Gas Embolism	Cardiovascular &	B) Ilioinguinal
Visceral injury	Respiratory	C) Genitofemoral
A) Bowel perforation	insufficiency	D) Lateral Cutaneous
B) Bladder perforation		Cord & testicular
Trocar Site Complications		A) Hematoma
A) Hematoma		B) Ischemic Orchitis
B) Hernia		C) Testicular Atrophy
C) Wound Infection		D) Dysejaculation
D) Keloid		E) Division of Vas D.
Bowel Obstruction		Wound Infection
A) Trocar or peritoneal closure site hernia		Seroma
B) Adhesions		Hydrocele
Diaphragmatic dysfunction		Hematoma
Hypercapnia		A) Wound
		B) Scrotal
		C) Retroperitoneal
		Osteitis pubis
		Prosthetic Complications
		A) Contraction
		B) Erosion
		C) Infection
		D) Rejection

A femoral nerve injury is extremely rare and is usually the result of a gross technical misadventure. This is fortunate because of the motor component of this structure. As evidenced by a recent prospective, randomized study by Cunningham from Canada, post operative groin pain is probably more common than generally appreciated. In his series,

at one-year post surgery, 62.9% of patients had groin pain and 11.9% of those patients rate the pain as moderate to severe¹¹. At two years the figures were 53.6% and 10.6% respectively. Treatment is difficult with many patients failing all measures. The situation is compounded when workman's compensation issues cloud the picture. The first thing that must be ruled out is a recurrent hernia. This can be difficult. A sonographic examination may be helpful. When operation is the only alternative, scar lysis and neurolysis and/or neurectomy are performed. A recent report suggests that some might be improved by prosthesis removal¹².

Ischemic orchitis and testicular atrophy may be the result if the blood supply of the testicle is compromised during herniorrhaphy. Orchitis is defined as postoperative inflammation of the testicle occurring within one to two days after surgery. Clinically the patient has painful enlargement of the testicle that is hard in consistency and associated with a low-grade fever. The pain is severe and may last several weeks. Ischemic orchitis is most likely due to a thrombosis of the veins draining the testicle due to dissection of the spermatic cord. This condition may progress and result in testicular atrophy that takes several months to develop. Not all patients with ischemic orchitis will develop testicular atrophy because, fortunately, the testicle has a good collateral blood supply. In fact, the occurrence is quite unpredictable, as most patients who develop testicular atrophy do not have a history of any testicular problems associated with the index herniorrhaphy. Vice-versa, the vast majority of patients with testicular problems as an immediate complication of their herniorrhaphy go on to recovery without atrophy. Bendavid studied the incidence of testicular atrophy at the Shouldice Hospital. He found 19 patients out of 52,583 primary inguinal hernia repairs (0.036%) and 33 patients out of 7,169 recurrent inguinal hernia repairs (0.46%)¹³.

Bleeding can occur producing a wound or scrotal hematoma. This is usually the result of delayed bleeding from the cremasteric, internal spermatic or branches of the inferior

epigastric vessels. Injuries to the deep circumflex artery, the corona mortis or the external iliac vessels may result in a large retroperitoneal hematoma.

Osteitis pubis seems to have disappeared as a complication following the elimination of sutures through the periosteum. With a laparoscopic repair, staples are used to attach the mesh to Cooper's ligament, which may sometimes produce osteitis.

The more liberal use of prosthetic material during conventional herniorrhaphy and the routine use with laparoscopy has made the discussion of complications related directly to foreign material more timely. Tissue response, which is variable from person to person, can be so intense that the prosthetic material can be deformed by contraction. Intestinal obstruction or fistulization is possible by erosion especially if there is physical contact between intestine and the prosthesis¹⁴⁻¹⁵. Erosion into the cord structures has also been reported¹⁶.

Infection is rarely seen for prostheses used for groin hernia repair in contradistinction to ventral herniorrhaphy. The reason for this is not clear. When infections do occur, they can occasionally be treated with drainage and prolonged antibiotic therapy but usually the prosthesis must be removed. Rejection because of an allergic response is possible but extremely rare. What patients call rejection in their histories usually is the result of infection.

Randomized Control Trial

This information represents the background for the development of a clinical trial in asymptomatic or minimally symptomatic patients designed to look at watchful waiting non-operative management vs a strategy of routine repair for all inguinal hernias when diagnosed. Such a study is currently accruing patients to document the natural history of an inguinal hernia and to determine if minimally symptomatic hernias need to be repaired. (Inguinal Hernia Management: Watchful Waiting Vs. Operation, RO 1 HS/AG 9860-01A1,

Agency for Healthcare Research and Quality, formerly AHCPH) The study is a randomized, prospective trial with asymptomatic or minimally symptomatic patients being randomized in equal numbers to Watchful Waiting under the careful eye of the investigators, vs. conventional Lichtenstein tension-free hernia repair which is considered the gold standard repair at the present time.

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