# Canadian Association of General Surgeons
# Association canadienne de chirurgiens généraux

## Symposium on the management of inguinal hernias

## 4. The Shouldice technique: a canon in hernia repair

Robert Bendavid, MD

Controversy exists on the merits of the various approaches to inguinal repair. Evolution of the classic open repair has culminated in the Shouldice repair. Challenges from newcomers, namely, tension-free repair and laparoscopy, are being examined. These two techniques have a number of disadvantages: the presence of foreign bodies (prostheses) and their implication in cases of infection; the cost of prosthetic material, which is no longer negligible (particularly with expanded polytetrafluoroethylene); and problems of safety in that the laparoscopic approach is no longer a dependable asset except in the hands of a highly specialized and dextrous operator. Still, complications occur with laparoscopic repair that should not be associated with a surgical procedure that is considered benign, safe and cost-effective. Surgeons must recognize the pertinent facts and decide according to their conscience which method of repair to use.

Les mérites des diverses méthodes de réparation inguinale suscitent la controverse. L'évolution de la réparation classique a atteint son point culminant avec la méthode Shouldice. On examine à l'heure actuelle les défis posés par de nouvelles méthodes, c'est-à-dire la réparation sans tension et la laparoscopie. Ces deux techniques présentent certains désavantages : la présence de corps étrangers (prothèses) et leurs répercussions en cas d'infection, le coût des prothèses, qui n'est plus négligeable (surtout dans le cas du polytétrafluoréthylène expansé) et les problèmes de sécurité posés par le fait que la laparoscopie n'est plus un moyen fiable, sauf entre les mains d'un chirurgien très spécialisé et habile. La réparation par laparoscopie pose quand même des complications qu'il ne faudrait pas associer à une intervention chirurgicale jugée bénigne, sûre et peu coûteuse. Les chirurgiens doivent reconnaître les faits pertinents et choisir la méthode à utiliser en fonction de leur conscience.

Review of all the available techniques in hernia surgery presents a muddled picture. The contentious issues have revolved around the use of prosthetic materials and more recently the wisdom of laparoscopic herniorrhaphy. Both tension-free and laparoscopic techniques have serious drawbacks.

It is becoming imperative that ethics, safety, economics and results be objectively scrutinized. Furthermore, the influence, precept and manipulation of the manufacturers of surgical instruments must be scrupulously parried since they cannot, or will not, appreciate the nature and implications of invasive technologic legerdemain on the living, human patient.

## The Shouldice technique

Evolution of the Shouldice technique began with that of Bassini, through Halsted, Ferguson, Andrews and to a certain degree, McVay.[1,2] It incorporates steps from all those operations. The only drawback to the Shouldice technique is that it must be done integrally.[3-5] Many surgeons over

the years have made a point of spending 1 to 3 days at the Shouldice Hospital, where they can watch up to 30 operations a day in 5 operating rooms. Too often, surgeons take short cuts, omit steps or improvise so much that the results bear no resemblance to the original technique. I have yet to see a surgeon perform a Bassini repair as described by Bassini or his student, Catterina, whose monograph remains a classic.[6] The 3 crucial components of the Shouldice repair that contribute to its safety, efficacy and cost-effectiveness are local anesthesia, technical aspects of the repair and early ambulation.

## Local anesthesia

The desirability and feasibility of herniorrhaphy under local anesthesia were demonstrated by Halsted, Bloodgood and Cushing as early as 1899[7] in patients for whom ether and chloroform anesthesia represented a clear danger (33 cases). The introduction of local anesthesia on a widespread scale, however, began with Earle Shouldice, as seen in publications from this hospital: 2874 cases reported by Campbell in 1950[8] and 10 000 cases reported by Shouldice in 1953.[9]

Now that elderly patients undergo hernia repair more frequently, the advantages of local anesthesia are even better displayed by the lower incidence, if not elimination, of pulmonary and cardiac complications, urinary retention and deep vein thrombophlebitis. The death rate has consistently been under 1/10 000.[10] Local anesthesia reduces significantly the need for and cost of preoperative consultations and investigations as well as postoperative care. Statistics at the Shouldice Hospital revealed that 52.1% of all patients are older than 50 years (Table I). The incidence of associated cardiac impairment is shown in Table II.

To the majority of patients, local anesthesia is perceived as being associated with minor surgical procedures, so they will proceed more readily with elective repair rather than delay until an emergency, with its attendant complications, will force them to submit to surgery.

The technical aspects of local anesthesia of the inguinal area are simple and do not require unusual dexterity. Procaine hydrochloride (1%) is still used up to a volume of 200 mL. Infiltration of the skin is carried out from the level of the anterior superior iliac spine to the pubic crest — 50 to 80 mL will suffice. Once the skin has been incised and bleeding vessels have been controlled, an additional 20 to 30 mL are injected deep to the external oblique aponeurosis in the general area of the ilioinguinal, iliohypogastric and the genital nerves.

When the external oblique aponeurosis has been divided along the direction of its fibres and the edges freed and retracted, these nerves are visualized and can be individually infiltrated with another 2 or 3 mL of procaine hydrochloride. Other areas that will require anesthetizing during the procedure are the edges of the internal ring (5 mL) and the spermatic cord within its areolar tissue at the level of the internal ring. Another 5 to 10 mL of procaine hydrochloride is allowed to diffuse deep to the transversalis fascia along the edge of the myoaponeurotic arch (falx inguinalis). These additional areas are innervated by sympathetic fibres from the renal and pelvic plexuses. The last site to require infiltration will be a hernial sac, if indirect, with 5 to 10 mL around the base of the sac and directly into the sac. Tension and dissection of the sac may otherwise be painful and bring about a bradycardia.

## Surgical steps

The Shouldice repair applies to direct and indirect inguinal hernias. It does not apply to femoral hernias. The majority of recurrent inguinal hernias can be treated with a Shouldice repair. In a review of our statistics by Obney and Chan,[11] 37% of 1057 patients who presented with a recurrent hernia had

### Table I

Records of Patients at the Shouldice Hospital Over the Age of 50 Years

| Age group, yr | Patients | | Operations, no. |
| | No. | % | |
| --- | --- | --- | --- |
| < 50 | 2917 | 47.9 | 3424 |
| 50–59 | 1116 | 19.1 | 1369 |
| 60–69 | 1330 | 21.4 | 1533 |
| 70–79 | 603 | 9.6 | 689 |
| 80–89 | 124 | 2.0 | 144 |
| Total | 6090 | 100.0 | 7159 |

### Table II

Associated Cardiac Conditions in Patients Over 50 Years of Age, From the Shouldice Hospital Records

| Condition | Patients, % |
| --- | --- |
| Anticoagulation (with acetylsalicylic acid, sulfinpyrazone, warfarin sodium) | 12 |
| History of | |
|   Myocardial infarction | 15 |
|   Angina | 15 |
| Congestive heart failure | 17 |
| Hypertension | 20 |
| Cardiac arrhythmia | 50 |

an indirect inguinal hernia. These recurrences may properly be termed "missed hernias." The majority of recurrent direct hernias can also be treated in the same manner. The need for mesh is 1.3% for all groin hernias[12] (Table III). The essential steps of the repair consist of the following.

### Resection of the cremaster muscle

When the spermatic cord has been exposed, the cremaster muscle is incised longitudinally from the level of the internal ring to the pubic crest, resulting in medial and lateral flaps. The medial flap is essentially avascular and is resected entirely. The lateral flap, containing the external spermatic vessels and the genital branch of the genitofemoral nerve, is divided between 2 clamps. Each resulting stump is doubly ligated with a resorbable suture. In this manner, an indirect inguinal hernia can never be missed. When such a hernia is absent, a peritoneal protrusion can be identified, freed and pushed back into the preperitoneal space of Bogros (Fig. 1).

### Division of the posterior wall of the inguinal canal

This step, already emphasized by Bassini,[13] is perpetuated in the Shouldice repair. It consists of incising the transversalis fascia from the medial aspect of the internal ring to the pubic crest. In exceptional cases in which this fascia is substantial, division may be carried out over 1 or 2 cm only, enough to insert the index finger and palpate the femoral opening. In female patients who rarely have a direct inguinal hernia, the posterior wall need not be incised. The transversalis fascia is then divided from the internal ring to the pubic tubercle. The logic behind this step is that it excludes the weakened transversalis fascia from being used again and, more importantly, provides exposure of the more solid layers needed for the reconstruction, medially and laterally (Fig. 2).

### Incision of the fascia cribriformis

The fascia cribriformis, an exten-

### Table III

**Need for Mesh in Hernia Repairs at the Shouldice Hospital**

| Hernia type | No. of operations | Mesh needed, no. (%) |
|---|---|---|
| Abdominal wall | 7529 | 154 (2.0) |
| Groin | 7085 | 98 (1.3) |
| Direct inguinal | 2890 | 26 (0.9) |
| Indirect inguinal | 4028 | 4 (0.1) |
| Femoral | 144 | 48 (33.3) |
| Inguinofemoral | 23 | 20 (87.0) |
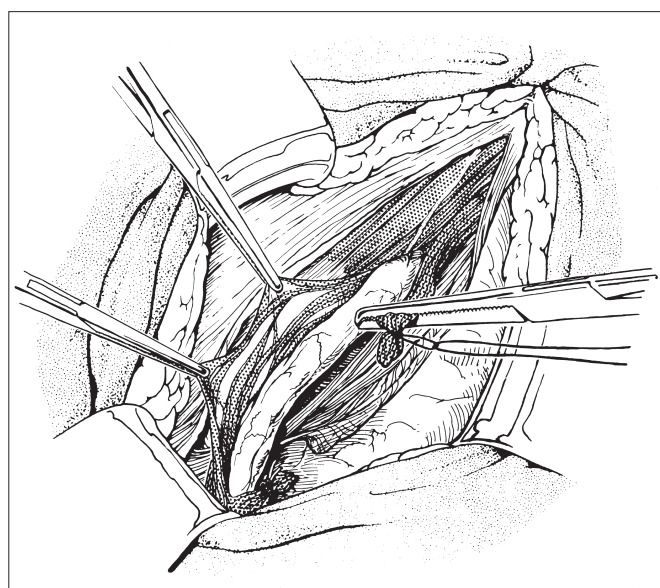


FIG. 1. Longitudinal incision of the cremaster muscle, resulting in two leaves. The medial leaf is entirely resected. The lateral leaf is divided between clamps and doubly ligated, providing 2 stumps. (Reproduced with permission from: Nyhus LM, Baker RJ. *Mastery of surgery*. 2nd ed. Boston: Little, Brown and Company; 1992.)
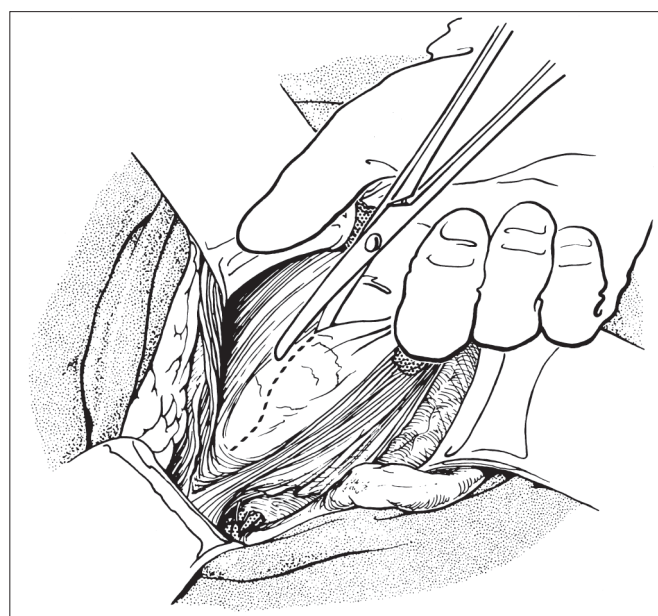


FIG. 2. Incision of the transversalis fascia from the deep inguinal ring to the pubis. Resection of the central elliptical portion is warranted in many cases. (Reproduced with permission from: Nyhus LM, Baker RJ. *Mastery of surgery*. 2nd ed. Boston: Little, Brown and Company; 1992.)

sion of the fascia lata of the thigh, is incised from the level of the femoral vein to the pubic crest. The femoral orifice below the inguinal ligament is demonstrated and with palpation of the femoral ring from the preperitoneal space confirms the presence or absence of a femoral hernia.

### Reconstruction

Reconstruction of the posterior wall is carried out with continuous stainless steel wire (gauge 32 or 34). Steel is an ideal material, being nonreactive and nonallergenic. Furthermore, it never needs to be removed in the presence of infection. The continuous suture is ideal because it eliminates the small defects between interrupted sutures and because it distributes the tension evenly on the suture line. Two continuous sutures are used, each going back and forth, thereby providing 4 lines. The first suture begins near the pubic crest, picking up the iliopubic tract laterally, and crosses over to be inserted through the medial myoaponeurotic arch (transversalis fascia, transversus abdominis and internal oblique muscles) and the lateral border of the rectus muscle, leaving a free border to this arch (Fig. 3). This suture advances toward the internal ring, picking up the lateral stump of the cremaster, inserting it deep to the muscular layer medially. This same suture reverses its course back in the direction of the pubic crest and includes the shelving edge of the ligament of Poupart on its way, to be finally tied near the pubic spine (Fig. 4). The second suture provides lines 3 and 4 and begins laterally, picking up internal oblique and transversus muscles, then crosses over to pick up the inner aspect of the lateral half of the external oblique aponeurosis along a line just superior and parallel to the inguinal ligament, proceeding to the pubic tubercle, then reverses toward the internal ring, picking up again the external oblique aponeurosis on its inner aspect just above and along the previous third line to be knotted finally at the internal ring. Four lines of sutures are thus provided, sealing the posterior wall and absorbing evenly any tension on the repair. The spermatic cord is placed back in its normal anatomic position and the external oblique aponeurosis brought together anterior to the cord with a running absorbable suture.

### RESULTS

Before the introduction of prosthetic mesh in November 1983, the recurrence rate, globally, was less than 1%. With mesh being used in challenging cases (less than 2%, ), the recurrence rate has been 0.7% (Tables III and IV[14-19]).[20]

Complications such as pneumonia, atelectasis, pulmonary embolism, phlebitis and urinary retention are practically nonexistent because of the aggressive encouragement of early ambulation, which begins with the patient walking away from the operating table after surgery. Other complications have been superficial hematomas (0.3%) and infections (0.7%). The incidence of testicular
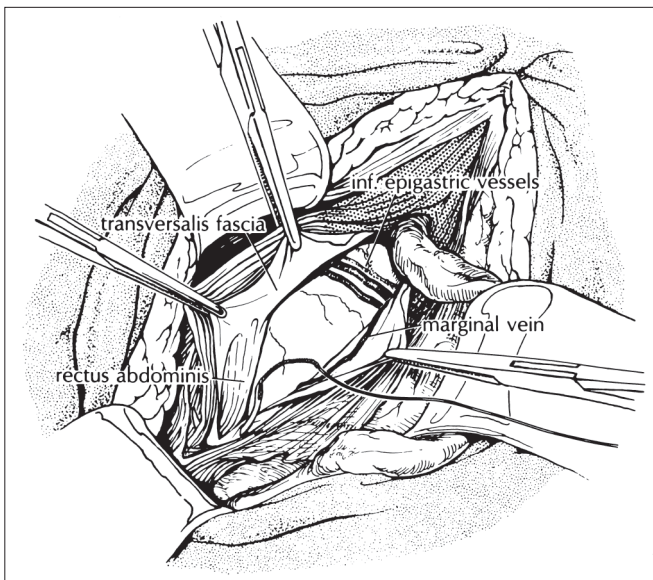


FIG. 3. Exposure of the structures that will contribute to a reliable repair. Note the vessels that must be identified and avoided. (Reproduced with permission from: Nyhus LM, Baker RJ. *Mastery of surgery*. 2nd ed. Boston: Little, Brown and Company; 1992.)
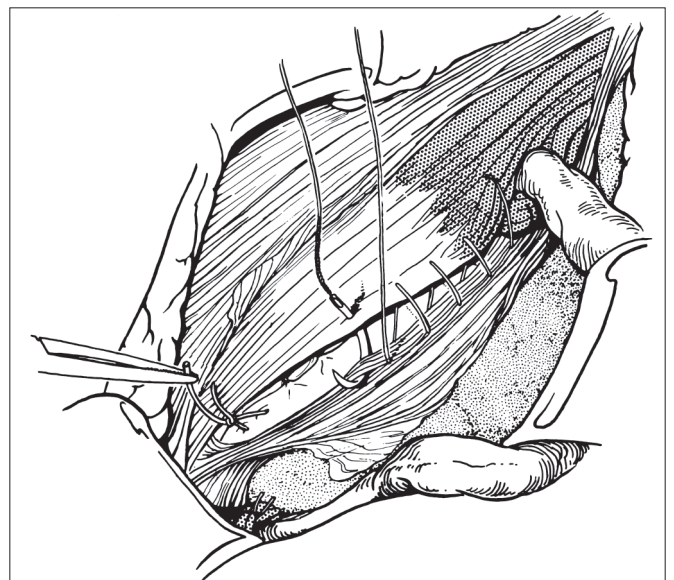


FIG. 4. The second line of the first suture incorporating the inguinal ligament, just before a knot is tied at the pubis. (Reproduced with permission from: Nyhus LM, Baker RJ. *Mastery of surgery*. 2nd ed. Boston: Little, Brown and Company; 1992.)

atrophy after primary repair of an inguinal hernia is 0.036% and after repair of a recurrent hernia, 0.46%.[21] The death rate of 1/10 000 within 30 days of surgery has not been a direct result of surgery (e.g., cerebrovascular accident, perforated gallbladder, duodenal ulcer, mesenteric or coronary thrombosis). The postoperative period (48 to 72 hours) is considered one of rehabilitation during which patients are encouraged to resume normal activities. A study of 1200 patients carried out by Mr. Alan O'Dell, the administrator of Shouldice Hospital, revealed that on average, patients returned to work in 8.2 days.[12]

Increasingly, cost is becoming a major factor in medical economics. In the same study by O'Dell, the cost of all disposable items, per patient, amounted to Can$24.58. These items included: syringes, dressings, swabs, scrub solutions, drugs (midazolam, promethazine, meperidine hydrochloride, morphine, prochlorperazine, diazepam, procaine hydrochloride), caps, masks, gowns, tubings, needles, gloves, blades, sponges, sutures and oxygen.

## Discussion

The simplicity, the excellent results and the cost-effectiveness of the Shouldice repair make it difficult to emulate. What are the objections to the tension-free repair and to laparoscopic herniorrhaphy?

With reference to the first, there is no doubt that it is extremely easy to execute. However, it overlooks basic principles in surgery, namely, the need to know the anatomy of an area that may present other problems than a simple, primary, elective repair. This is particularly applicable to incarcerated or strangulated hernias. A tension-free repair is of no value in inguinofemoral hernias or in the absence of an inguinal ligament, hence potential failures are eliminated, contributing to a success rate that is deceiving. The proper site for a prosthetic mesh is the preperitoneal space, applied as widely as possible, deep to the transversalis fascia as prescribed by Stoppa, Soler and Verhaeghe,[22] Wantz[23] and Flament, Rives and Palot.[24] The weakness of the transversalis fascia is the result of a metabolic etiology that reaches beyond the inguinal floor to the adjacent tissues.[25] Mesh infection always represents a catastrophe, and though the incidence may be low (0.5% to 3.5%),[26] the actual cases provide an indelible experience that should temper their use. I have seen infections present up to 2 years after the original surgery; Stoppa[26] reported 3 to 18 months, Flament and associates[27] 6 and 8 years. Should a recurrent hernia follow a wound infection, subsequent repair must exclude the use of a prosthesis because surviving organisms can be detected years later.[28–31] The cost of prosthetic materials is high, especially in the case of expanded polytetrafluoroethylene. Postoperative comfort and earlier return to work are factors that depend greatly on patient personality, motivation and insurance status rather than the particular herniorrhaphy.

If one remains detached and truly has the patients' interest as an objective, objections to laparoscopic herniorrhaphy appear to be increasing with each published report. There is ample evidence that laparoscopic herniorrhaphy is feasible, but it must be remembered that the average general surgeon performs 50 herniorrhaphies a year (A. O'Dell, Administrator, Shouldice Hospital, Thornhill, Ont.: personal communication, 1995), a number that is not likely to endow anyone with expertise in a challenging technique. Objections therefore beg to be catalogued: exclusions include patients at high anesthetic risk, those with multiple previous abdominal operations, incarcerated or strangulated hernias, peritonitis, coagulopathy, severe obesity, immune deficiency and a history of recent infection, females of childbearing age and those with recurrent hernia after laparoscopy.[32–34] Also "the use of laparoscopic techniques for hernia repair in the pediatric patient has not been well accepted"[35] and "for the simple, nonrecurrent unilateral inguinal hernias, the use of a laparoscopic approach is controversial."[32] Such exclusions make up 90% of the surgery done at the Shouldice Hospital!

### Complications

Long-term complications are not yet known, but some can be predicted, particularly with any technique that leaves prosthetic material within the peritoneal cavity (the intraperitoneal onlay method [IPOM]). This technique "must be considered an experimental operation and patients must be

**Table IV**

**Results of the Shouldice Repair From Various Series**

| Series | No. of cases | Follow-up | | Recurrence rate, % |
|---|---|---|---|---|
| | | % | Length, yr | |
| Shearburn and Myers, 1969[14] | 550 | 100 | 13 | 0.2 |
| Wantz, 1989[15] | 2087 | — | 5 | 0.2 |
| Bocchi, 1995[16] | 2119 | 80 | 7 | 0.75 |
| Devlin et al, 1986[17] | 350 | — | 6 | 0.8 |
| Moran et al, 1968[18] | 104 | — | 6 | 2.0 |
| Berliner, 1983[19] | 591 | — | 2–5 | 2.7 |

so informed,"[32] and "we do not recommend the IPOM procedure outside of a controlled trial."[32] Can the patient really be expected to make the right decision? Complications that may occur at the time of surgery or shortly thereafter are presently well documented and range from 0% to 53.3%.[32,36–57] These complications include the following: perforation of bowel or urinary bladder; major vascular injuries (external iliac, circumflex iliac profunda, obturator and inferior epigastric vessels); nerve injury (the genitofemoral nerve, the femoral nerve and the lateral femorocutaneous nerve of the thigh) (nerves cannot be readily identified with certainty); adhesive, obstructive and erosive events and fistula formation requiring subsequent abdominal surgery; bleeding with or without the need for transfusion; abdominal wall hematomas; trocar site hernias; persistent leg, groin and testicular pain; seromas; hydroceles; orchitis; epididymitis; spermatic cord transection; mesh infection; lost clips or needles; inadequate peritoneal closure leading to bowel slipping into the extraperitoneal space and obstruction ("shower curtain effect"); right lower quadrant pain, Richter's hernia involving a trocar site opening. Control of some of these complications may require immediate conversion to an open procedure[5,52,56] or an urgent laparotomy.

### Recurrence

Recurrence rates vary with the technique, and though earlier reports showed a range from 6% to 22%, those figures have in the best of series, improved to 0% to 0.4% for the totally extraperitoneal repair, 0.7% to 0.8% for the transabdominal preperitoneal repair and 2.2% to 3.2% for the IPOM.[39,41,44,46,50–52,54,55,57] It is interesting to note that the totally extraperitoneal repair, which has the lowest recur-

rence rate, showed the highest incidence of complications.[40,44,57]

### Cost

Exclusive of fixed equipment and set-up expenses, the cost of laparoscopic herniorrhaphy may vary but will always be far more onerous than the open repair. An example may be seen in the figures provided by Arregui: US$1656.00,[58] versus the Shouldice Hospital: US$17.45.[59] Another cost issue raised by laparoscopic surgeons is one of hospital stay, as the patients are discharged on the same day, but this is no longer a particular feat as many institutions also discharge patients on the same day as for an open repair. The issue of earlier return to work after laparoscopic repair has not been convincing. Our own patients return to work on average, 8.2 days after surgery.[59–61]

### CONCLUSIONS

At best, the tension-free and laparoscopic herniorrhaphies may approach the good results of the Shouldice repair in terms of recurrence. With respect to cost, neither of those two techniques may compare, least of all laparoscopy. In terms of actual and potential complications, laparoscopic herniorrhaphy leaves me with a very uneasy feeling. I have no doubt that eventually, common sense and reason will prevail.

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