Guidelines of the Brazilian Hernia Society (BHS) for the management of inguinocrural hernias in adults.

Orientações da Sociedade Brasileira de Hérnia (SBH) para o manejo das hérnias inguinocrurais em adultos.

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A B S T R A C T

Inguinal hernias are a frequent problem and their repair is the most commonly performed procedure by general surgeons. In the last years, new principles, products and techniques have changed the routine of surgeons, who need to recycle knowledge and perfect new skills. In addition, old concepts regarding surgical indication and risk of complications have been reevaluated. In order to create a guideline for the management of inguinal hernias in adult patients, the Brazilian Hernia Society assembled a group of *experts* to review various topics, such as surgical indication, perioperative management, surgical techniques, complications and postoperative guidance.

Keywords: Hernia. Hernia. Inguinal. Abdominal Wall.

INTRODUCTION

The Brazilian Hernia Society has brought together a group of national hernia surgery *experts* to unify the most important information for the appropriate treatment of inguinocrural hernias in adults and to add clinical experience to produce guidance on their treatment. The most relevant topics were defined by the working group. Each subject was reviewed by one surgeon. The preliminary text was sent to the other surgeons, who made their observations and questions. After updating by the reviewer, the content was presented topic by topic in a face-to-face surgeon meeting. The text has been approved and we selected the most relevant information.

The model adopted follows that of recent publications, having as main examples the guidelines of the European and International hernia societies[1,2]. The idea of producing this work was to summarize and to concisely and practically transmit the conducts that should not be lacking in the daily practice of the surgeon who deals with inguinocrural hernias, serving as a guide for decision making. It is worth remembering that it is the responsibility of the surgeon involved with a specific patient's case to make the most appropriate final decision for each situation, always individualizing and prioritizing the best treatment.

This publication is structured by chapters of different subjects in the management of

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inguinocrural hernias in adults. Each chapter begins with the final guidelines, follows with brief explanations of each orientation, and ends with a list of additional recommended reading on the subject.

1. Conservative *versus* operative management.

- Surgical treatment is indicated for symptomatic men with inguinocrural hernia.
- Surgical treatment is indicated for women with inguinocrural hernia, whether symptomatic or asymptomatic.
- Observation may be a safe alternative for male patients with comorbidities that increase surgical risk and those with poorly symptomatic or asymptomatic hernia, but it is noteworthy that the latter subgroup has a 70% chance of developing symptoms throughout observation and ultimately requiring surgical treatment.

Many patients can be securely observed, with a very low probability of developing complications, such as incarceration and requiring urgency operation, with increased morbidity[3,4]. On the other hand, there are subgroups of patients who will benefit from early surgery at the time of diagnosis due to the presence of some risk factors that indicate early onset of symptoms and consequent need for surgery[5]. Patients who have pain while performing strenuous activities, chronic constipation, prostatism, married patients and individuals classified as ASA 1 or 2 (American Society of Anesthesiology) comprise this group. It is important to note that about 70% of patients will develop symptoms during observation and request surgery within two years of observation[6].

The increased occurrence of emergency repairs with the observation strategy reinforces the indication for surgery for most patients if clinical conditions allow it. Long-term quality of life is better in operated patients than in just-observed patients, although some cost-effectiveness studies have shown that observation may be a cost-effective alternative in asymptomatic or low-symptom male patients[4-6].

The reason for defining the timing of the surgery is not the risk of incarceration or strangulation, but the impairment in the patient's quality of life that caused by the presence of the hernia.

2. Diagnostic imaging methods.

- The diagnosis of inguinocrural hernia should be made by clinical examination. Imaging methods should only be requested when there is diagnostic doubt.
- Ultrasound should be the initial examination in cases where the clinical history is consistent with hernia and its physical examination is vague, or suspected differential diagnosis. In the persistence of diagnostic doubt, magnetic resonance is superior to computed tomography.
- Although sensitive and specific for the diagnosis of hernia, physical examination and imaging cannot reliably distinguish inguinal from crural hernias.

The diagnosis of inguinal hernia is mostly clinical, with the association between clinical history and physical examination having a sensitivity of 74.5% and a specificity of 96%, requiring no other investigative method[7,8].

Although there is still no consensus on which method is the best, imaging should be requested with a diagnostic doubt or in the presence of differential diagnoses, such as lymph node enlargement, incisional hernia, hydrocele, pubitis, osteitis, among others.

Ultrasound is considered a cheap, effective and easily accessible exam. When used in conjunction with a clinical history of inguinal hernia and an indefinite physical examination, it has a sensitivity between 33% and 77% and specificity between 81% and 100%, in accordance with intraoperative findings[7-10].

Magnetic resonance imaging (MRI) allows the analysis of the inguinal region by multiple planes, as well as static and dynamic evaluation. It has a specificity of 96.3% and a sensitivity of 94.5%, and the great advantage is that it can identify differential diagnoses, especially sports hernia and osteitis[11].

3. The use or not of a mesh in surgical repair.

- The use of a mesh in the repair of inguinocrural hernias in adults is recommended.
- Meshes should be used to reduce hernia recurrence.
- The incidence of postoperative chronic pain with mesh use is similar to or lower than without its use.
- Endoscopic techniques should always include mesh implantation.
- Meshes should be used in incarcerated or strangulated hernia surgeries when the surgical wound is considered clean.
- In case of strangulated hernias with contamination of the operative field (intestinal loop perforation, peritonitis or abscess), the use of meshes should be avoided.

- The use of mesh is strongly recommended in relapsed hernias.
- Meshless techniques should be reserved for experienced surgeons or services, the Shouldice procedure being the most recommended.

The choice of a technique for hernia correction aims at low complication rates (pain, recurrence, etc.), rapid learning curve, rapid recovery, reproducible results, and a good cost-benefit ratio[2]. A universal technique does not exist, but most surgeons agree that the use of a mesh in hernia surgery achieves these goals.

The laparoscopic correction, which necessarily uses a mesh, brings results equal to or better than open techniques[1,12]. Regarding open surgery, the best comparison of results is made between the two best techniques, with and without a mesh, Lichteinstein and Shouldice, respectively[13]. Some studies show better results with the Shouldice technique considering recurrence and chronic postoperative pain. However, such publications give rise to many questions. A more faithful comparison would involve experienced surgeons in both techniques with randomized case distribution. The use of meshless techniques outside specialized centers for Shouldice surgery is restricted to patient refusal, material unavailability and in selected urgent cases.

The main publications endorsed by the most important hernia societies in the world bring the best level of evidence[1], with the strongest recommendation (A) in favor of mesh use for surgical correction of inguinal hernias[1,2,12]. Such publications have been updated and there is a consensus regarding the use of mesh in inguinal hernia repair.

4. Peroperatory considerations.

- There is no way to establish the indication of prophylactic antibiotics use in elective inguinal hernia repair, by either open or laparoscopic surgery.
- There is no difference in the infection rate between preoperative and non-preoperative trichotomy, but when necessary, it should be done just before surgery, with hair clippers.
- The best anesthesia for operating the patient with inguinal hernia is local anesthesia, provided that the surgeon mastered the anesthetic and surgical techniques.
- The patient should always be asked to empty the bladder before entering the operating room, especially in laparoscopic repairs.

Studies show no significant data on the routine use or not of prophylactic antibiotics[14,15]. There are special conditions, however, such as high-risk patients (ASA 3 or 4), that increase the risk of developing surgical site infection. In such cases, prophylactic antibiotic therapy with first generation cephalosporin should be used[12]. So far, due to the uncertainty found in the literature, with many studies indicating and others contraindicating, there is no way to establish or not the use of prophylactic antibiotics to repair open inguinal hernias.

Trichotomy, when required, can be done up to one day before surgery using a hair clipping machine. Ideally, however, it should be done immediately before the procedure begins.

Local anesthesia is the technique that has the lowest rates of immediate complications. It allows the patient to walk immediately after the procedure and is the one that provides the longest analgesia time, besides having very low urinary retention rates[16,17]. Relative contraindications are very obese patients and reoperations in the same anterior access site. The second best technique is general anesthesia because it has less urinary retention than blockages (epidural or spinal anesthesia) and, if accompanied by local infiltration, will give long-term analgesia.

A full bladder can substantially increase the technical difficulty in total extraperitoneal repair (TEP). Thus, to reduce the risk of bladder injury, the bladder should be voided before surgery in these cases[18]. If the patient cannot or is already anesthetized, a bladder relief catheterization should be provided or even a Foley catheter may be inserted, as long as it is removed at the end of the procedure.

5. Critical points of open techniques without mesh.

- Complete groin dissection (surgical, non-anatomical): deep inguinal ring, spermatic funicular, nerves, inguinal ligament and arch of the internal oblique muscle and transverse muscle.
- Delicate manipulation of tissues and nerves (thin, non-blunt dissection).
- Reinforcement of the posterior wall, following the principles of the Shouldice technique.

The tissue or anatomical repair of the inguinal hernia is confused with that of the groin itself, because it is the groin that will be repaired or reconstituted.

Perhaps it would be better to say "inguinorrhaphy" or "inguinoplasty", but the terms "herniorrhaphy" and "hernioplasty" (inguinal in this case) were consecrated by use and time.

Delicate maneuvers, fine scissors dissection or with electric scalpel prevent seromas and hematomas. Reduced surgical trauma and minimal nerve management reduce the inflammatory reaction and, consequently, the intensity of acute postoperative pain. The cross section of the cremaster muscle, about 2cm to 3cm from its origin, may facilitate inspection of the funiculus or resection of pre-hernial lipomas (its proximal and distal stumps will be used for inguinal reconstruction). The inguinal floor should be opened near the inferior border of the internal oblique and transverse muscles, from the deep annulus to near the pubic tubercle, respecting the reflex ligament, when present. This opening of the inguinal floor creates two flaps of fascia transversalis: one latero-inferior, basically constituted by the iliopubic tract, and another medio-superior, which joins the free edge of the transverse and internal oblique muscles, constituting the triple stratum, thus named by Bassini. This favors the dissection of the inguinal hernial sac (direct and/or indirect) and of an eventual femoral hernia, from its origin. Caution is required when opening and closing the fascia transversalis because of the risk of inadvertent injury to the epigastric vessels. In addition, every section stimulates fibroplasia, which consolidates the suture lines.

The inguinal canal recomposition may follow the Shouldice technique principles in three suture planes, which has been the most recommended among groin tissue repairs[19,20]:

- The first plane comprises the apposition of the iliopubic tract with the posterior face of the triple stratum (fascia transversalis), starting near the reflex ligament and proceeding laterally. At the end, the deep annulus is calibrated near to the spermatic funiculum and reinforced by the proximal stump of the cremaster muscle, which is fixed under that same stratum after inferiorly and medially circumventing the emergence of the funiculum. In women, as the Round ligament is sectioned and returned to the preperitoneal groin space, this annulus will be closed completely.

- In the second plane, the entire posterior wall of the inguinal canal is reinforced, especially the middle pit, by lowering and fixing the triple stratum, now definitively, whose free edge is sutured to the inguinal and lacunar ligaments. This plane runs in the opposite direction, using the same suture thread, without interruptions (knots), and should not involve equal portions of the ligament due to the risk of tearing it (indented suture).

- The third and last plane follows the path of the first and comprises suturing the free edge of the inferior sheath of the external oblique aponeurosis over the internal oblique (3 to 4 passes). Then, a fold of the same sheath is seized, parallel to the inguinal ligament, and sutured to that muscle, until the newly formed inguinal annulus.

The recommended suture should be a 3-0 or 2-0 caliber monofilament (polypropylene or nylon), mounted on a 2.5cm length, ½ circle cylindrical needle, compatible in gauge with the suture.

Synthesis should be performed so as not to cause the tissue ischemia, through simple continuous (running) suture, to favor the influx and subsequent activation of fibroblasts and myofibroblasts[21]. Closure of the inguinal canal will be done by planes, remembering to fix the cremaster's distal stump by retracing the superficial inguinal annulus to try to avoid testicular ptosis, although the dartos tunic plays its role most of the time. The skin should be preferably sutured with synthetic, absorbable, monofilament suture.

6. Type of mesh.

- The type of mesh may impact the final outcome of inguinal hernia repair surgeries.
- Flat monofilament polymer meshes, weighing between 30 and 140 g/m^2 and having a pore size greater than 1mm, are recommended.

There is scientific evidence that the mesh type may impact the outcome of inguinal hernia repair surgeries[22]. The meshes sold in Brazil, registered by the National Sanitary Agency (ANVISA), are almost entirely manufactured using polypropylene (PP), polyester (PET) and polyvinylidene (PVDF), classified as thermoplastics or simply polymers. As for the filament structure, the meshes can be made of single (monofilament) or multiple (multifilament) threads. These materials exhibit similar behaviors regarding mesh erosion/migration. The degradation of these implants occurs over time, the PVDF being more resistant than the PP and PET, but without evidence of clinical repercussion. There is no evidence of immune-mediated rejection or increased risk of carcinogenesis[22,23]. There is evidence that monofilament threads are at lower risk for mesh-related complications[1,12].

The mesh's weight depends directly on the polymer's specific weight (PP: 0.91g/cm^3; PTE: 1.38g/cm^3; PVDF: 1.77g/cm^3) used and the pore size (see description below). The unit of measure is gram/m^2, also known as grammage. There is no fully accepted rating for mesh weight. They are usually divided into categories: ultra-low, low, medium, and heavy weight[24]. Weight ranges for each category may vary greatly depending on the publication. So-called low-grammage or lightweight meshes have been introduced to the market more recently, and have been erroneously related to large-pore or effective-pore meshes, which are not always true (see description below). Perhaps most important in relation to mesh weight is that very low-weight meshes (less than 30g/m^2) may have inadequate physical characteristics, such as low tensile strength (significantly less than 16N/cm), high elasticity and high anisotropy (very large difference between vertical and horizontal elasticity). Similarly, thicker meshes (greater than 140g/m^2) may have inadequate physical characteristics, such as poor elasticity, no anisotropy and often small pores (see description below).

In summary, the best performing meshes are probably within the weight range of 30 to 140 g/m^2. As a final guideline, the use of weight as an isolated parameter for mesh choice does not seem to be appropriate. Another feature that affects the biological behavior of meshes is pore size. This seems to interfere with the resistance to infection and the three-dimensional conformation of the fibrotic scar tissue (formation of fibrotic bridges). Micro and macropore nomenclature should be avoided, giving preference to large-pore or small-pore terms. Large-pore meshes are the ones with pores greater than or equal to 1.0 to 1.5 mm.

There is evidence that large-pore meshes display less fibrotic tissue formation, with impact on decreased mesh surface and foreign body sensation[2,12]. Regarding resistance to infection, pores smaller than 0.1mm have a higher risk of infection, and pores greater than 0.75mm, lower risk[12,24]. That is, even small-pore meshes may have greater resistance to infection, but no lower risk of fibrotic bridging. In summary, it seems like a large pore mesh (greater than or equal to 1mm) presents superior biological behavior, with less chance of mesh-related complications. These characteristics may have repercussions on the results regarding acute and chronic pain, foreign body sensation, resistance to infection and scar tissue contracture, with consequent decrease in implant size, which may vary greatly depending on each mesh and its interaction with the tissues of each patient. With regard to scar tissue contracture, it is likely that at least 20% reduction in the mesh surface will occur after the implant incorporation[24]. It is noteworthy that this whole discussion refers only to flat meshes, three-dimensional ones or plugs not being considered in this chapter.

7. Critical points in open mesh techniques.

- The Lichtenstein technique is the procedure of choice.
- In order to decrease recurrence, the mesh should have a minimum size of 6x14cm and surpass the pubic tubercle medially by 2cm. The lateral and medial loops, created after opening the upper portion of the mesh for the passage of the spermatic funicular, should be sutured together with polypropylene thread to properly calibrate the spermatic funicular content and form a new deep inguinal ring. In addition, the medial loop should cross and anteriorly cover the lateral loop, and be fixed to the inguinal ligament.

The Lichtenstein technique is the simplest to learn and reproduce and its clinical results are excellent. Hence, it is the gold standard of open techniques[1,2,25,26].

This technique rarely presents relapses, less than 4% in surgeons with smaller annual hernioplasty volumes, and less than 2% in surgeons with large hernia surgeries. The two most frequent relapse sites are the anatomical extremes of the region, namely: 1) near the pubis (direct hernia); and 2) near the deep inguinal ring (indirect hernia)[12,26]. Therefore, concerning direct recurrence, it is necessary that the mesh reaches and surpasses the pubic tubercle region by about 2cm. With the healing process, the mesh will decrease in size with the shrinking of the scar tissue, thus exposing the site to possible posterior wall failure if this safety margin is not adopted. Regarding indirect recurrence, it is important that, after the proximal opening of the mesh and the encirclement of the spermatic cord in the region of the inner ring, both loops of the mesh are sutured proximally, closing the ring formed by the prosthesis. Then the medial loop should cross over the lateral loop and be fixed to the inguinal ligament proximal to the inner ring with polypropylene thread.

Failure to close the proximal mesh with non-absorbable thread and suturing the proximal mesh loops in parallel without crossing are known causes of recurrence in the inner ring region.

8. Critical points in endoscopic techniques.

- Endoscopic repair of inguinocrural hernia is associated with lower postoperative pain in the early period when compared with inguinotomy techniques.

- The transperitoneal technique (TAPP) is a more reproducible technique than the totally extraperitoneal technique (TEP), and both are equivalently safe and effective in treating inguinocrural hernia.

- In TEP, the access to preperitoneal space can be done safely with direct dissection with the optics, with insufflation by suprapubic puncture with a Veress needle or with the use of a dissector balloon, the latter being easier and facilitating the learning curve.

- In TAPP, the peritoneum opening should be high, at least 4cm above the hernial defect, and extend from the medial umbilical ligament to the anterior superior iliac crest.

- The preperitoneal region should be extensively dissected to correctly identify the anatomical landmarks of all hernial defects. The limits of this dissection are, inferiorly, the point where the vas deferens is insinuated over the iliac vessels; laterally, the visualization of the iliopsoas muscle; and medially, about 2cm beyond the contralateral pubic symphysis.

- In direct hernias, it is necessary to reduce the hernial content, usually preperitoneal fat. The flaccid fascia transversalis (pseudo-hernial sac) can be plicated and fixed to the rectus abdominis muscle or to the Cooper's ligament to decrease the incidence of postoperative seromas.

- Indirect hernial sacs should be carefully separated from the vas deferens and spermatic vessels to avoid injury to these structures. A circumferential incision in the sac can be made in large inguinoscrotal sacs to minimize the risk of testicular pain and postoperative orchitis. In these cases, the distal sac is abandoned after section.

- The deep inguinal ring should be systematically explored for hernial "lipomas", and these, if present, are reduced.

- The meshes used must be at least 15x10cm in size and have no slits.

- Fixing or not fixing the MESH will be covered in the next chapter.

- In TAPP, the peritoneum should be closed with suture or stapling to avoid contact of the mesh with the intestinal loops. In addition, peritoneal "holes" that may cause intestinal obstruction should be avoided.

The endoscopic approaches have less postoperative discomfort that the open ones in certain patients[1,2,12,27]. Young and active patients benefit more from endoscopic surgery because they gain more from a short recovery period[28]. In elderly patients, there is no advantage in endoscopic procedures regarding early postoperative pain[12].

The success of endoscopic repair of the inguinocrural hernia consists of technical details related to the anatomy of the Fruchaud myopectineal orifice[29]. As with any laparoscopic surgery, the first critical point is the correct positioning of the portals and the surgical team, followed by a technical standardization, where the dissection of a large preperitoneal area is critical to the insertion of a large mesh, correctly fixed or not, following the anatomical landmarks related to the posterior innervation of the inguinal region.

No study compared different positions of the patient, the operating table or the surgeon. However, there is a consensus that the patient is set in supine position and in lateral decubitus directed towards the surgeon. The surgeon may adopt various positions, but in most cases, he stands in the side opposite to the defect to be treated.

TEP also requires three portals, of which the optic trocar is either subumbilical or on the rectus abdominis muscle (10/12mm). The other two working portals (usually 5mm) are variable and depend on whether the hernia is unilateral or bilateral. Both may be in the midline or slightly away from it in the direction opposite to the hernia defect. One option is to place one trocar on the midline and another laterally on the side of the hernia. There are several options for accessing the preperitoneal space. Direct access with a regular or Hasson's trocar and creation of the initial preperitoneal space with the optics are feasible and satisfactory. Another option is the suprapubic puncture technique with a Veress needle and insufflation of the preperitoneal space before direct optic dissection[18]. The creation of the preperitoneal space using the balloon is the most used method and helps in the surgeon's learning curve.

In TAPP, three working portals are positioned, the first of which is a 10mm, located in the umbilical scar, for the passage of the 30-degree optics. This allows the treatment of an eventually associated umbilical hernia. The working portals, right and left hands of the surgeon, should be introduced under direct vision and positioned at the same height as the optic portal, 2cm to 3cm parallel to the lateral margin of the rectus abdominis muscle. This allows excellent instrument triangulation.

The secret about the peritoneal flap closure lies in its proper opening. An opening extending from the medial umbilical ligament to the anterosuperior iliac crest is important. This opening should be elliptical toward the iliac crest. Good peritoneum traction allows adequate linear opening of the peritoneum.

The upper limit of the peritoneal flap should be performed 4cm above the hernial defect, either direct or indirect. The boundaries of dissection and creation of the preperitoneal space are the same in either technique. The inferior limit should be the point where the vas deferens crosses the iliac vessels, becoming nearly vertical, and 2cm below the pubis or the pectineal ligament over the bladder. It is important to dissect laterally until visualization of the iliopsoas muscle, and medially, about 2cm beyond the pubic symphysis towards the contralateral side, especially in direct hernias, since transposition of the mesh beyond the medial Linea Alba is of paramount importance. Wide exposure of the preperitoneal space is the key to good endoscopic repair. At the end of dissection, the following structures must be clearly exposed: pubic tubercle, iliopubic tract, Cooper's ligament, inferior epigastric vessels, vas deferens, spermatic vessels and the topography of the anterior superior iliac spine[27,30].

During TEP, peritoneum perforation is the most common reason for conversion to the TAPP technique. To minimize the difficulty at this time, we should perform a Veress needle puncture in the left hypochondrium and increase the CO_2 insufflation flow. Closure of the defect is preferred by most surgeons.

Direct hernia is the weakness of the posterior inguinal canal aponeurosis and therefore does not have a true hernial sac. A critical point is the release of preperitoneal fat adhered to the flaccid fascia transversalis in its portion medial to the epigastric vessels. The inversion and subsequent fixation of this fascia in the pubis bone or rectus abdominis is an important tactic in preventing postoperative seroma.

Perhaps the treatment of an indirect hernial sac is in the most critical point in the laparoscopic correction of inguinal hernias by either of two techniques[27]. The hernial sac that enters the inguinal canal is usually adhered to the elements of the spermatic funiculus and to the vaginal tunic in the scrotum in the inguinoscrotal hernias. The release of this peritoneum requires surgical skill and parsimony on the part of the surgeon, as he/she should be pull the hernial sac, bluntly dissecting the vascular elements and the vas deferens. In large inguinoscrotal hernias, a tactical option is a circumferential cut in the peritoneum at the level of the internal inguinal ring, abandoning the sac in the inguinal canal. This minimizes postoperative testicular pain by preventing injuries to the genital branch of the genitofemoral nerve, to the spermatic or testicular vessels, and to the vas deferens[2,12]. In TEP, the peritoneal stump should be sutured to prevent cavity opening.

The deep inguinal ring should be explored lateral to the elements of the spermatic funiculus, in search of preperitoneal fat (lipoma) that enters the inguinal canal, which should totally resected[29].

Large meshes should be used to cover the entire Fruchaud myopectineal orifice, i.e., a minimum size of 15cm in its longitudinal (lateromedial) axis and 10cm to 12cm in its vertical (anteroposterior) axis. They should not contain any kind of opening.

The mesh fixation must respect the anatomy of the nerves in the posterior region of the inguinal canal, lateral to the spermatic cord and inferior to inguinal ligament, the region of the pain triangle, formed by the femorocutaneous nerve (or lateral cutaneous nerve of the thigh), the genitofemoral nerve and its genital and femoral branches, and the femoral nerve. This lateral fixation must be carried out about 3cm above the iliopubic tract. In the medial portion of the mesh, its fixation should be performed close to the Cooper's ligament, pubic symphysis and the Linea Alba. Six staples are sufficient to secure a 15x12cm mesh[30].

In bilateral hernias, rather than using a single large mesh, it is easier to implant two meshes, which overlap 1-2cm in the midline above the pubic symphysis.

The synthesis of the peritoneal flap in TAPP should preferably be done with absorbable thread, always from right to left, as it allows continuous stitching in the most ergonomic direction of the suture line. Clamp closure is also possible by transposing the lower flap over the upper one and lowering the pneumoperitoneum to 8mmHg to 10mmHg. Whatever the surgeon's choice, it is of paramount importance that there is no spacing between the suture or the tacks, thus avoiding entrapment of an intestinal loop and consequent obstructive acute abdomen.

At the end of a TEP, to prevent the mesh from rolling over itself during cavity emptying, a large preperitoneal space needs to be created and the gas outlet must be observed directly[18]. Another possible maneuver is the use of glue in the posterior region.

The technical proposal, defined by us, is to dissect the preperitoneal space in three areas, namely: 1) lateral (over the iliopsoas muscle); 2) medial (over the bladder and beyond the pubic symphysis); and 3) central (over the Doom triangle). This allows a standardization that comprises the critical points previously discussed, facilitating the laparoscopic treatment of inguinal hernias by the posterior access of the inguinal canal[30].

Both techniques are similar in operative time, risk of complications, incidence of acute and chronic postoperative pain, and recurrence rates. Therefore, it is recommended that the choice of technique be based on the surgeon's skills, formation and experience.

9. Mesh fixing.

- It is not necessary to fix the mesh in TAPP for small hernias, type LI, II and MI and II, i.e., indirect or direct defects of up to 2-3cm*.
- It is not necessary to fix the mesh in TEP in most cases except major direct defects - MIII (larger than 3-4cm)*.
- Among the fixation methods, one should prefer the atraumatic ones (glues or sealants and self-adhesive), as when compared to those of traumatic fixation (staples or tacks), the former are associated with lower risk of postoperative pain.
- When used, four to six staples/tacks are sufficient (unilateral hernia), as there is a positive correlation between the number of staples/tacks and the risk of postoperative pain.
- The fixation of the mesh should not replace the principles of wide

dissection, reduction of hernia sacs and placement of a large mesh to prevent recurrence in open surgery. The atraumatic fixation of the mesh, may reduce the risk of postoperative pain.

* European Hernia Society (EHS) classification for inguinal hernias.

The need to fixate the mesh during laparoscopic inguinal hernia repair is controversial. Currently, most authors recommend mesh fixation to prevent relapse, with the use of staples or tacks, the latter being the most used method. However, traumatic mesh fixation may be associated with a higher risk of postoperative pain, including chronic pain due to nerve damage and/or osteitis.

For meshes placed posteriorly (retromuscular or preperitoneal) for defects of up to 3cm, an overextension of at least 3cm is sufficient for stability without any additional fixation. However, in cases where the defect-overlap ratio was only 1.5cm, significant mesh movements were observed in cases without fixation[31].

There is no difference in the risk of relapse when comparing repairs with or without mesh fixation[1,12]. Most studies were performed using the TEP technique, at the end of which, with the removal of CO_2, the preperitoneal space collapses and naturally fixes the mesh[32]. Several authors have reproduced the same results after TAPP repairs[12].

The advantages of non-fixation are the lower cost and lower potential risk of postoperative pain. This is associated with the number of staples/tacks applied, and is increased when more than eight to ten staples/tacks are used and the principles of attachment locations are not respected (see mesh attachment, section 8)[2,12]. Studies have consistently demonstrated a lower risk of postoperative pain associated with atraumatic fixation,

with glues or fibrin sealants, without change in the risk of recurrence[33]. The use of self-adhesive meshes follows the same principle; however, there is no clear evidence in the literature of a reduction in the risk of pain when compared to the traumatic fixation.

The main causes of relapse are inadequate dissection of the inguinal region, no dissection/reduction of the funiculum lipoma (when present), hidden hernias, or placement of an inadequately sized mesh to cover all potential weakness areas. Although most authors cite mesh displacement or migration as reasons for relapse, the mechanisms and factors involved are not yet fully known.

Recently, this topic has been further studied in open surgery. Fixation with glue/sealant or self-adhesive meshes has shown lower of equivalent risk of postoperative pain when compared with suture fixation[1].

10. Treatment of inguinocrural hernias in women.

- The most common hernia in women is the indirect one.
- Crural hernias occur approximately four times more in women than in men, and it should always be considered in the differential diagnosis of a mass in the inguinocrural region in women.
- Women have a higher risk of recurrence than men after open repairs due to the higher occurrence of femoral hernias. Preperitoneal repairs, especially laparoscopic TAPP and TEP techniques, are recommended.

- Laparoscopic femoral hernia repairs result in less recurrence rates and less postoperative pain compared with open inguinotomy.
- Section of the uterine round ligament during an open repair should be avoided due to the increased risk of nerve damage. In laparoscopic repairs, the section is optional.
- Femoral hernias have a higher risk of incarceration and strangulation than other hernias of the inguinocrural region, and surgical correction of an incarcerated or strangulated femoral hernia presents a higher risk of requiring intestinal resection.
- The most common diagnosis of a tumor in the inguinocrural region in pregnant women is round uterine ligament varicose veins rather than hernia, and should be evaluated by color Doppler ultrasonography.
- Active observation is the best approach for inguinocrural hernias in pregnant women, unless the patient becomes very symptomatic.

Hernias of the inguinocrural region in women have peculiarities that make their management different from that in men. The risk of a lifelong hernia of the inguinocrural region is 3% in women. The most common hernia in women is indirect. Crural hernias occur approximately four times more in women than in men[34,35].

Surgical repair of inguinocrural hernias is eight to ten times more common in men compared with women. Only 8% to 9% of all surgical corrections for inguinal and crural hernias are performed in women[34,35]. Large epidemiological studies from national databases show that reoperation rates after inguinotomy hernia repair in women are higher compared with the same rates in men[1,2,36]. In approximately 40% of reoperations after repairs with or without a mesh, a crural recurrence is found[35,36]. This data represents a risk almost ten times higher in women. A subgroup analysis of these epidemiological studies also shows that the rates of reoperation following laparoscopic approaches (TEP, TAPP) are smaller when compared with the Lichtenstein technique or other open approaches[12,26]. The laparoscopic repairs offer, through a relatively simple access, a full view of the entire Fruchaud myopectineal orifice, an opportunity to identify all types of hernias of the inguinal region and to cover direct, indirect, and crural defects. Therefore, the high frequency of crural hernias in women and the aforementioned high risk of crural recurrence argue in favor of the laparoscopic repair (TAPP or PTE).

The division of the round ligament in open repairs necessarily imply the section of genital nerve and probable division of the ilioinguinal nerve. This nerve section is generally low in morbidity and has minimal consequences[34]. However, it presents a small risk of hypersensitivity or ipsilateral numbness that may contribute to complaints of sexual dysfunction. Therefore, it is advisable to avoid division of the round ligament in open repair of hernias of the inguinocrural region[1].

In laparoscopic repairs, on their turn, the round ligament can be observed enveloped by the peritoneum, which may lead to a bending of the lower part of the mesh or a sliding of the peritoneum below the mesh. Thus, the division of the round ligament, despite technically optional, is frequently performed in laparoscopic repairs, because it facilitates the placing and positioning of the mesh, and reduces the risk of peritoneal injury. There are fewer implications of division of the round ligament in the preperitoneal space, since the nerves do not adhere to the ligament until they enter the inner inguinal ring. If performed, the division of the ligament must be proximal to its conjunction with the genital branch of the genitofemoral nerve in fusion with the peritoneum. At this site, its division seems to have no functional implication.

About 17% of women with inguinocrural hernia require urgent surgical repair *versus* 5% of men[1,12]. Crural hernias have a higher risk of incarceration and strangulation than inguinal hernias[2]. In the Swedish and Danish national hernia registries, 36% to 39% of crural hernias were operated on emergency versus only 5% of inguinal hernias[1]. In addition, patients with crural hernia are at higher risk for bowel resection. Twenty-three percent of patients undergoing an emergency repair of crural hernia will undergo intestinal resection compared with approximately 5% of patients undergoing an emergency repair of inguinal hernia.

The risk of death of a woman within 30 days of elective repair of a crural hernia (regardless of the technique used) is comparable to the risk of death in a population of the same age and gender (less than 0.1%). However, 3.8% of women die within 30 days of an emergency crural hernia repair[34,35].

A mass in the inguinocrural region in pregnancy is more often varicose veins of the round ligament than a hernia. The formation of a hernia in the inguinocrural region during pregnancy is rare, estimated at 1:2,000. The diagnosis can be easily confirmed by color Doppler ultrasound. Surgical treatment of round ligament varicose veins is only necessary in cases of severe pain. Varicose vein tend to regress soon after delivery. Therefore, an active observation strategy is recommended for patients with bulging in the inguinocrural region during pregnancy. Patients who develop a hernia in this region should also undergo active observation during pregnancy and undergo surgical treatment only if the hernia is incarcerated or strangulated.

11. Postoperative considerations and quality of life.

- Patients should resume normal activities as soon as they feel fit, i.e., no pain during activities, which happens about two to seven days postoperatively. Encouraging early activities reduces the period of convalescence. Excessive exercise and lifting over 10kg should be avoided for a period of four to six weeks.
- Surgical wound infiltration with anesthetic should be performed, as it results in less pain after surgery.
- Routine use of drains is not indicated, even with evidence that seromas, bruises and hematomas are frequent complications.
- Systematic removal of monofilament and large-pore meshes when deep surgical site infections occur is not recommended.

- The use of meshes to correct bilateral inguinocrural hernias in men seems not to cause infertility as an isolated factor.
- Laparoscopic repairs offer better quality of life indices when compared with open inguinotomy repairs.
- Hernia relapses are best treated when performed with a different approach from the previous surgery (anterior access - inguinotomy *versus* posterior one - open or laparoscopic).

Studies show that there is no relationship between the early resumption of normal physical activity and the onset of relapses when using a mesh in the treatment of inguinal hernias by the conventional access[37]. Therefore, it is recommended that the patient assume normal activity as soon as he/she feels fit. Patients should be encouraged to do work and recreational activities as soon as they feel comfortable. In average after three days, and in some cases within seven days of surgery, one can do everyday activities without problems or restrictions. If work does not require weight bearing, postoperative pain should be the only limiting factor. In these cases, working after one or two weeks is reasonable. All patients should avoid excessive weight and physical exertion for four to six weeks.

Local anesthetic infiltration into the surgical wound showed better results than placebo injection[16]. It promotes an additional pain control due to being obviously associated with analgesia with oral medicines.

The incidence of seroma is approximately 7% and of hematomas, 8%[38]. Patients may confuse the bulging caused by the seroma with an early recurrence.

Seromas usually evolve well without decompression and have little clinical relevance. Hematomas may require specific treatment if they generate hemodynamic repercussions or other consequences, but often do not require intervention. The routine use of drains does not improve the clinical outcome of hematomas and seromas. Thus, drainage is recommended for cases with known risk factors, such as the use of anticoagulants, coagulopathies and large diffuse transoperative bleeding.

More attention has recently been paid to the effects of inguinal mesh repairs on male fertility. Testicular atrophy due to vascular deficiency and hydrocele are identified in the set of possible long-term complications. However, no direct relationship of the procedure with increased incidence of infertility was found[39]. It is possible, nonetheless, that bilateral lesions of the vas deferens, if they occur, may lead to infertility. Therefore, one should perform an accurate dissection and take care so that the proximity with the mesh does not generate duct injury.

Most studies comparing the effect of laparoscopic and open repairs in relation to quality of life favor the TAPP and TEP techniques due to pain reduction in the early period[40,41]. However, the difference in postoperative pain scores in favor of laparoscopic approaches decreases over time.

Reoperation through already operated tissues that have undergone scar reaction with anatomical changes can generate significant postoperative pain, prolonging recovery. Thus, subsequent endoscopic approaches have generated less pain and faster return to regular activities in cases of previous open surgery. The probability of occurrence of surgical site infections was also reduced with TAPP or TEP[41].

12. Postoperative chronic pain: prevention and treatment.

- Chronic postoperative pain is the one lasting for three months or more after herniorrhaphy surgery and not related to other causes.

- Attention should be paid to patients in risk groups for chronic postoperative pain, such as young people, history of preoperative pain, less than three years after previous surgery, severe early postoperative pain, postoperative complications. (hematoma and infection), preoperative sensory disorder, open or conventional surgery, female gender, and recurrent hernia repair.

- During open surgery, there must be routine identification of three main nerves of the region (ilioinguinal, ilio-hypogastric and genital branch of the genitofemoral).

- In laparoscopic surgery, identification is not recommended, but traumatic dissection on the topography of the three nerve branches (lateral cutaneous of the thigh, femoral and femoral branch of the genitofemoral) should be avoided.

- Prophylactic neurectomy is not recommended.

- If a nerve is accidentally severed or severely tractioned, or ends up in a position where the surgeon considers that it is heavily exposed to the mesh, it should be divided and ligated with absorbable suture and buried within the adjacent musculature, both the proximal and the distal stumps.

- Postoperative pain mapping is recommended for the diagnosis of chronic pain, as well as for monitoring the treatment employed.
- A multidisciplinary approach should be implemented in cases of chronic post herniorrhaphy pain. Several non-operative alternatives, such as oral medications, regional blocks, and nerve ablation exist, and surgical treatment should be reserved for specific causes of chronic post herniorrhaphy pain, including resection of trapped nerves, mesh removal when the pain is related to it, removal of laparoscopic clips or of fixation sutures.

Persistent pain after inguinal hernia surgery is relatively common. There are patients who report some degree of residual pain in the first year of follow-up, but a small portion report moderate to severe, sometimes disabling, pain. The overall incidence of moderate to severe chronic pain after hernia surgery is approximately 10% to 12%[12,42].

Two distinct mechanisms may result in a perception of pain after surgery. Acute pain is predominantly due to nociceptive and inflammatory stimulation, which decrease over a predictable time period (typically six to eight weeks)[43,44]. In contrast, chronic neuropathic pain, due to abnormal neural activity, may persist without continuous inflammation. Thus, if post-herniorrhaphy pain persists for more than eight weeks, it is probably neuropathic in nature. Primary nerve damage occurs at the time of surgery and may be caused by complete or partial nerve transection, which may lead to neuroma formation, by nerve injury related to manipulation (stretching, crushing and cautery injuries) or nerve entrapment, by sutures or staples. Nerve damage may also occur because of an adjacent inflammatory process, most commonly due to the presence of a mesh. When a peripheral nerve is exposed to the mesh, degeneration of the myelin sheath, associated edema and fibrosis can cause pain.

In open inguinotomies, the nerves most exposed to injuries are the ilioinguinal, the ilio-hypogastric and the genital branch of the genitofemoral. It is not necessary to dissect them in their extension for identification. It suffices to locate them to prevent their entrapment by inadvertent suturing. The ilioinguinal nerve is the most commonly identified nerve during open inguinotomy, followed by the ilio-hypogastric[44]. Another possible cause of chronic pain is the mesh fixation to the pubic tubercle. If the suture reaches the periosteum of the pubis, it may lead to chronic periostitis and subsequent pain. The fixation of the mesh in this distal portion should be done in the Colles reflex ligament or in the inguinal ligament, without touching the pubis.

Although routine prophylactic neurectomy during inguinal hernia repair is safe and may reduce the incidence of post herniorrhaphy neuralgia, this may lead to sensory changes, such as numbness or dysesthesia. Thus, the choice of nerve preservation versus sacrifice must be made individually[42].

Dermatome postoperative pain mapping is an excellent diagnostic option for approaching the patient with inguinodynia in its various presentations. Its high specificity, as well as its easy implementation, provides a very useful tool for the diagnosis, follow-up and treatment of patients with inguinodynia.

The acute postoperative pain after inguinal hernia surgery is common and easily treated with opioids and nonsteroidal anti-inflammatories and decreases within six to eight weeks. In patients where pain persists, multimodal analgesia, including nerve blockage, can be administered, both to control pain and to confirm the diagnosis. Nerve blockages are usually performed by a pain specialist, but can be performed by a surgeon familiar with the technique. At blockage, a long-acting local anesthetic mixture with glucocorticoid is injected into the tissue surrounding the affected nerve. In some patients, performing a nerve blockage breaks the pain cycle and may resolve post-herniorrhaphy neuralgia. In others, the pain recurs after the effect of treatment disappears, within a few days. Patients with a positive response to an initial nerve blockage may be treated with weekly injections until pain relief is sustained. For those who cannot obtain a sustained response to repeated blockages, nerve sacrifice may be the best option, by either percutaneous ablation or surgical neurectomy[42-45].

Nerve ablation is performed similarly to blockage, but by injecting a solution with phenol or alcohol to replace the local anesthetic.

Percutaneous ablation results are less favorable than neurectomy. However, as it does not cause significant side effects, it may be a first treatment alternative in patients with neuralgia refractory to repeated nerve blocks. Those who respond to nerve ablation may be spared the possible complications of a surgical neurectomy[43,44].

Neurectomy is usually indicated when non-surgical measures, including medication, blockage and nerve ablation have been tested but failed to control the pain. Its success rates range from 70% to 100%. Exploration of the inguinal region and neurectomy with mesh removal and replacement seem to be the preferred surgical approach. Other procedures, including neurolysis, simple nerve sectioning, and single mesh removal are associated with higher failure rates than nerve excision. Surgery involves identifying, dissecting, and resecting, ideally the entire length of the nerve, leaving smooth ends to be ligated, cauterized, or buried within the muscles. It is suggested to wait for a minimum of six months after hernia repair before indicating a neurectomy. It is worth remembering that this waiting for surgery does not mean absence of treatment with other nonoperative modalities[42,45].

R E S U M O

As hérnias inguinais são um problema frequente e o seu reparo representa a cirurgia mais comumente realizada por cirurgiões gerais. Nos últimos anos, novos princípios, produtos e técnicas têm mudado a rotina dos cirurgiões que precisam reciclar conhecimentos e aperfeiçoar novas habilidades. Além disso, antigos conceitos sobre indicação cirúrgica e riscos de complicações vêm sendo reavaliados. Visando criar um guia de orientações sobre o manejo das hérnias inguinais em pacientes adultos, a Sociedade Brasileira de Hérnias reuniu um grupo de experts com objetivo de revisar diversos tópicos, como indicação cirúrgica, manejo perioperatório, técnicas cirúrgicas, complicações e orientações pós-operatórias.

Descritores: *Hérnia. Hérnia Inguinal. Cirurgia Geral.*

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