



Review



Pre-operative factors associated with short- and long-term outcomes in the patient with inguinal hernia: What does the current evidence say?

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ABSTRACT

Hernia repair is one of the most frequent interventions in surgery worldwide. The approach to abdominal wall and inguinal hernias remains a challenge due to emerging evidence on aspects such as timely diagnosis, use of innovative techniques or post-surgical care. However, pre-operative preparation is also a factor that substantially affects the absolute success rate of this type of condition. Time management between diagnosis and intervention, control of diseases that increase intra-abdominal pressure, weight and nutritional status, are some of the many elements to be considered in this type of patients before surgery. Considering that this condition carries high health care costs, especially in case of recurrence, has a risk of complications and affects the individual's functional capacity, the objective of this review is to synthesize evidence on the role of these factors on the short- and long-term outcome of inguinal hernia management, and to make suggestions on the general approach to this type of patients.

1. Introduction

Hernia remains one of the major surgical conditions that generates a high burden of disease and substantial health costs globally [1–4]. It is estimated that approximately 20 million hernia repairs are performed annually worldwide [4]. This disease, which has many presentations, causes direct and indirect costs, due to the high rate of recurrence, general complications and work incapacity [1,2]. Overall, the hernia

generates net losses averaging \$500, depending on the need for mesh or not, or whether the mesh is synthetic or biological (costs \$7590 when synthetic mesh is used vs. \$16,970 when biological mesh is used) [2]. Inguinal hernia, which can be either congenital or acquired, is the most common (75% of cases) and one of the most disabling [3]. Many risk factors have been described that can precipitate the onset throughout life, including a family history of inguinal hernia, obesity, constipation, chronic cough, among others [3,5–7]. However, there has been little

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discussion on the consideration of aspects immediately prior to surgery, and the predictive value they have on the post-operative period, and medium- and long-term outcomes.

Although there is a considerable body of evidence, the overall outcomes of hernia management remain heterogeneous, and it is a challenge to define the most appropriate management, depending on the patient, caregivers and the context of health care delivery [8–10]. Although attempts are often made to determine which intervention results in lower overall morbidity and mortality, few synthesis studies have analyzed the impact of pre-operative preparation of the patient with inguinal hernia [6]. Knowing the pre-operative aspects related to short-, medium- and long-term outcomes in the management of inguinal hernia, will allow modifying the general approach to this group of patients, by correcting or omitting certain factors that may or may not significantly influence surgical performance [5,7]. Probably, factors such as nutritional status, specific associated comorbidities, symptomatology or previous active treatment explain the differences that are not so significant in some studies on the overall success rate of the different approaches used in the management of this disease [6,7,9,10]. In this order of ideas, the aim of this manuscript is to synthesize recent evidence on aspects to consider during the pre-operative stage of the patient with inguinal hernia, and their impact on overall outcomes.

2. Methods

A literature search was carried out using search terms such as “Inguinal Hernia” and “Pre-operative”, as well as synonyms, which were combined with the Boolean operators “AND” and “OR”, in the databases PubMed, ScienceDirect, Embase, EBSCO, and MEDLINE. As inclusion criteria, it was determined that any article that focused on relating preoperative factors to postoperative outcomes of inguinal hernia management would be included, giving priority to original articles and systematic reviews and meta-analyses. In addition, they had to be available in full text. As non-inclusion criteria, it was established that articles published in a language other than Spanish and English would not be included. Taking into account the breadth of the topic and the wide variety of publications, articles published between 2000 and 2022 were included. A total of 809 potentially relevant articles were identified, with a review of the title and abstract of all of them, of which 49 articles were finally included, after discrimination according to the inclusion and non-inclusion criteria. The estimates and calculations found were expressed in their original measures, whether frequencies, percentages, confidence intervals (CI), mean difference (MD), relative risk (RR), odds ratio (OR) or hazard ratio (HR).

3. Pre-operative symptomatology, functional outcomes and quality of life

In the review of the literature on the relationship between pre-operative symptomatology and post-operative outcomes, it was observed that the vast majority of studies have not researched a specific symptomatology, but include a heterogeneous group of signs and symptoms, contrasting them with divergent results [11–21]. Evaluating the level of evidence in descending order (from highest level to lowest level of available evidence) on pre-operative symptomatology and its relationship with outcomes, only one systematic review [11], one clinical trial [12] and a considerable number of observational studies were found [13–20]. Reinbold W [11] conducted a systematic review where he evaluated risk factors for the development of chronic pain after inguinal hernia repair, showing that intense pre-operative pain, alteration in the patient’s mood and history of chronic pain regardless of its cause, are associated with the onset and persistence of this chronic pain [11]. However, the quality of the synthesized studies was variable, with a tendency to be low. Magnusson et al. [12] performed a randomized clinical trial, where they evaluated the relationship between pre-operative symptomatology with post-operative quality of life,

observing that those patients who reported pain during the pre-operative period ($n = 197$), had an affectation of the physical quality of life score after the intervention compared to the control group (43.5 vs. 53.9, $p < 0.001$). The authors did not find any relationship between pre-operative and post-operative emotional state. But they did find that pain decreased over time (first year [14% of patients], second year [12% of patients], and third year [7% of patients] after surgery) [12]. These results are interesting, as the authors conclude that pre-operative pain is favorably associated with improvement in postoperative pain over time.

Among the observational studies, most of them are prospective cohorts with a representative sample (>1000 patients), which generates some confidence in their statistical power. Mitura et al. [13] analyzed the factors influencing pre-operative symptomatology and subsequent outcomes in 1647 patients, reporting that those patients <40 years old present more frequently with more intense pain (63.7%; Visual Analogue Scale [VAS] 5.4, $p = 0.068$), and this is mainly associated with the performance of physical activity [13]; therefore, these patients benefit more from an earlier repair, to contribute to the decrease of pain in the medium- and long-term, and thus, rapidly improve their physical and emotional quality of life. Forester et al. [14] prospectively analyzed the outcomes of 1720 patients, finding the same evolutionary behavior over time as Magnusson et al. [12]. However, they showed that over time, in addition to pain, patients also reported unpleasant sensation of the mesh and limitations of movement, which were not specifically related to pre-operative factors other than pain [14]. Knox and Berney [15] used The Modified Carolinas Comfort Scale (MCCS), which evaluates the presence and intensity of pre-operative symptomatology, composed mainly of pain, limitation of movement and decreased functional capacity in 88 patients prospectively for 16 months, in order to determine the relationship between this score and post-operative outcomes [15]. The authors found that a high score predicts discomfort at 6 weeks (OR 4.3; 95% CI, 1.5–12.6). Of note, they observed that the MCCS score correlates inversely with the size of a direct defect ($p = 0.011$), with no impact on additional intraoperative findings that need to be corrected [15]. This study highlights the usefulness of the scale in the evaluation of this type of patients, and suggests that it has a significant predictive value.

Romain et al. [16], Mier et al. [17] and Kuo et al. [18], conducted prospective studies with the aim of evaluating the long-term quality of life of patients with inguinal hernia, according to pre-operative symptomatology, finding similar results, on the prevalence of pre-operative pain ($>25\%$ of cases) vs. pain at two years ($<5\%$ of cases), and predominantly this pain was moderate [16–18]. Similarly, quality of life is restored more quickly in those who have no pain or very mild pain ($p = 0.048$) [17]. Particularly, the study by Kuo et al. [18] associated not only pain, but general clinical characteristics with the use of medical resources and global outcomes ($p < 0.05$) [18]. Thus, it can be seen that the main symptom evaluated as a predictor of functional outcome is pain, which has a similar behavior, without discriminating by the surgical technique used [19]. Although some studies mention other symptoms, they do not seem to be significant or relevant on global outcomes, nor on physical or emotional quality of life [18].

On the above, some authors such as Burney R [20] and Bugridze et al. [21] discuss the relevance of pre-operative symptomatology, going beyond the clinical, where they involve aspects of evidence-based practice, since many surgeons define the technique to be used depending on the context of the patient, which would indirectly influence also on the functional and overall outcome of patients. However, one point to note is that we did not find a study in Latino patients with a representative sample to evaluate whether this behavior is similar, or whether it is necessary to consider additional factors. Therefore, despite the volume of publications, there is still a gap in the evidence on the relationship between pre-operative symptomatology and post-operative outcomes in patients with inguinal hernia. In this order of ideas, pre-operative pain is the most frequently studied predictor symptom, and suggests a strong predictive value with respect to quality of life and

long-term functional capacity.

4. Risk factors, interventions and their impact on functional and global outcomes

In performing the literature review, it was found one systematic review and meta-analysis [22], one systematic review [23], two narrative reviews [24,25], one clinical trial [26], eight observational studies [27–34], and one case series [35], that discussed the relationship between some risk factors, interventions and outcomes in the management of inguinal hernia.

Johner et al. [22] performed a meta-analysis including four randomized clinical trials, with a total of 1074 herniorrhaphy, where they observed that those patients with the presence of pain and who underwent neurectomies had a higher incidence of postoperative chronic pain (OR 3.70; 95% CI, 2.61–5.25) [22]. Piga et al. [23] conducted a systematic review of various imaging modalities and their impact on the approach to the patient with inguinal hernia, showing that ultrasound had better performance than computed tomography and magnetic resonance imaging, generally favoring the outcomes in the management of inguinal hernia, especially because it allowed to observe some findings that would facilitate the choice of the most appropriate surgical technique [23]. However, there is the disadvantage that ultrasound is operator-dependent, although it is now a portable tool that is easy to handle and mobilize.

Siddaiah-Subramanya et al. [24] and Ashrafi et al. [25] synthesized some years ago the main risk factors for recurrence of both open and laparoscopic herniorrhaphy, where they found a large number of factors, which are modifiable and non-modifiable, and some are patient or surgeon-specific. For example, on the part of the patient, age, gender, smoking, high body mass index, diabetes, surgical wound infection, time to return to physical activity and work. On the surgeon's side, experience, operative time, anesthesia, omission of associated femoral hernia, use or not of mesh, type of mesh used, mesh size, mesh fixation or not, and tension encountered [24,25]. In this case, it is very difficult to be very specific when considering so many risk factors during the management of the patient with inguinal hernia, since these factors have heterogeneous estimates and many risk factors may coexist. These factors substantially impact the overall risk of recurrence, and in turn, the risk of prolonging the patient's functional recovery. However, it should be noted that the factors associated with the surgeon's experience mostly correspond to perioperative factors.

Wright et al. [26] conducted a randomized clinical trial, where they evaluated the histology of distal and proximal segments of the ilioinguinal nerve in patients with pre-operative pain, to define whether there was a finding compatible with any compressive neuropathy and that this mechanism explained the presence and evolution of pain [26]. Of 22 resected and examined segments, several indicators were quantified, finding that an elevated pre-operative pain score correlated with increased nerve diameter, increased number of fascicles and abundant myxoid material in both perineurium and endoneurium [26]. It is presumed then, that the higher the pain score and neuronal involvement, the slower and more difficult will be the long-term post-operative pain recovery process. Recently, Chang et al. [27] published an interesting study, where they studied 1801 men with a congenital collagenopathy vs. a control group (6493 men), showing that the risk of developing inguinal hernia was significantly higher in the group with the pathological history (HR 2.237; 95% CI, 1.646–3.291, $p < 0.001$), compared to the control group [27]. This risk is much higher in those under 18 years of age (HR 3.040; 95% CI, 1.819–5.083, $p < 0.001$), compared to any other age group. The authors concluded that this was an at-risk population that should be followed closely [27], because there are no recommendations for preventive interventions at present.

Other cohort studies, such as those developed by Wright et al. [28], Pierides et al. [29], and Jarrard et al. [30], which studied hernia growth, pre-operative pain, compressive neuropathy, and the presence of occult

contralateral hernias, showed that these factors contribute to the development and persistence of chronic post-operative pain, which is associated with the presence of abundant fibrosis in the external oblique fascia at the level of the inguinal ring [28], higher risk of recurrence (OR 6.77, $p = 0.005$), complications (OR 5.16, $p = 0.002$) [29] and reoperation [30]. In the case of occult contralateral hernias, Ozgur et al. [31] evaluated the usefulness of ultrasound in the pre-operative detection of this condition, finding that approximately 25% of cases present occult hernias, modifying the overall outcome of patients having to be reoperated days later [31]. Although not with the same performance and ease of access, dynamic magnetic resonance imaging can also aid in the visualization of structures and post-operative monitoring of mesh placement or fluid presence [35].

A pre-operative risk factor that has been significantly associated with longer hospital stay, chronic pain, increased risk of surgery and post-operative complications is the presence of a strangulated inguinal hernia [32–34]. Studies have shown that this condition substantially increases the need for bowel resection due to necrosis, thus increasing the risk of infection at the operative site, but not of general morbidity and mortality [32]. Strangulated inguinal hernias occur more frequently in patients older than 65 years and in males [33]. Complications in the management of this type of hernia are more frequent when laparotomy is used as the surgical technique [33]. It has been shown that management times in strangulated hernias requiring emergency management are critical, mainly between the initial evaluation and the time of transfer to a highly complex institution [34]. Patients who initially present to a specialized center have a lower frequency of bowel resection as a complication of hernia [34].

Thus, there are numerous risk factors, both of the patient and of the surgeon and the context of the health service provided, in addition to some pre-operative interventions, which substantially impact both positively and negatively on the functional and overall outcome and quality of life of the patient with inguinal hernia. These factors should be carefully analyzed, since it is evident that many factors often coexist, which further increases the risk of complications, reoperation and prolongation of the patient's recovery time.

5. Previous treatment and postoperative outcome

During the literature review, a total of 13 articles, 4 systematic reviews [36–39], 1 narrative review [40], and 7 observational studies were found [41–47].

One of the most discussed topics is antibiotic prophylaxis in herniorrhaphy. In 2012, Sanchez-Manuel et al. [36] performed a systematic review and meta-analysis, where they evaluated the effectiveness of prophylactic antibiotic therapy in the management of inguinal hernia, including 17 clinical trials with a total of 7843 individuals, showing that the frequency of infection was lower in the intervention group (3.1% vs. 4.5%, OR 0.64; 95% CI, 0.50–0.82). Patients who underwent hernioplasty were less likely to develop infection compared to those who underwent herniorrhaphy (2.4% vs. 3.1%) [36]. Recently, Orelio et al. [37] systematically reviewed in an updated manner the evidence on the effectiveness of prophylactic antibiotic therapy in this group of patients, including 27 studies with a total of 8308 individuals, evidencing that this intervention reduces the risk of developing any type of surgical site infection (RR 0.86; 95% CI, 0.56–1.33). However, these associations were not significant and the studies were of low quality. Therefore, the authors could not conclude with certainty whether or not it is necessary to make this recommendation [37]. On the same problem question, Boonchan et al. [38] performed a meta-analysis with the aim of determining the usefulness of different groups of cephalosporins, fluoroquinolones and β -lactamase inhibitors in the prophylaxis of surgical site infection during herniorrhaphy, finding that β -lactamase inhibitors and first-generation cephalosporins were more effective compared to placebo (RR 0.44; 95% CI, 0.25–0.75 and RR 0.62; 95% CI, 0.42–0.92) [38]. However, it should be noted that there was no evidence of

superiority between one group of antibiotics over another. However, the analysis by curve determined that β -lactamase inhibitors and first-generation cephalosporins should constitute the first and second line of intervention for prophylaxis [38,39]. Although it could be concluded that the evidence suggests that prophylactic antibiotic therapy is useful, there are many questions, especially in low- and middle-income countries as mentioned by Mwita et al. [40], where it is not clearly known from when and how long the prophylaxis should last, in addition to not knowing the epidemiology of post-herniorrhaphy surgical site infections, which makes it difficult to extrapolate general results, since the incidence varies greatly among this group of countries [40].

Varga et al. [41], studied the impact of immunosuppressive conditions and previous use of corticosteroids on the outcomes of inguinal hernia repair, finding that out of 2312 patients studied, evidencing that corticosteroids and personal history of immunosuppression did not significantly impact the outcome of postoperative infection (0.65% vs 0.70%) or occurrence of seroma (1.22% vs 1.57%). In this study, the frequency of complications was similar in the intervention group vs. the control group (3.40% vs. 4.31%) [41]. Although there is no solid evidence on this intervention, the existing evidence suggests that corticosteroids do not influence the outcome of inguinal hernia repair.

On the impact of recurrent hernia repair, Köckerling et al. [42] analyzed the Herniated Registry including a total of 17,594 patients, observing that those with recurrent hernia (who may have had previous repairs) have a higher risk of developing intraoperative ($p = 0.01$) or perioperative complications ($p = 0.05$), recurrence ($p < 0.001$) and postoperative pain ($p < 0.001$). It is necessary to highlight that those patients who were repaired with open mesh and present recurrence, have less favorable results when they are reintervened. Another study by the same author [43], where he evaluated the outcome of endoscopic repair of recurrent hernia vs. primary hernia in 20,624 individuals, found that those with recurrent hernia have worse outcomes when operated by endoscopic repair, compared to those with primary hernia; this was observed in the parameters of post-operative complication (3.20 vs 4.03%; $p = 0.036$), reoperation for complications (0.84 vs 1.33%; $p = 0.023$), post-operative pain (4.08 vs 6.16%; $p < 0.001$), recurrence rate (0.94 vs 1.45%; $p = 0.0023$), and need for chronic pain management (2.31 vs 3.83%; $p < 0.001$) [43]. To date, there are divergent recommendations on what the international guidelines establish, because some studies have found better results when managing recurrent hernias with more current techniques such as laparo-endoscopic repair, which generates less postoperative pain (OR 0.643; 95% CI, 0.476–0.868, $p = 0.004$) [44] and therefore, celerity in the clinical evolution and recovery of the individual's functional capacity.

In the case of second or third recurrences, an analysis of 16,206 patients from the Herniated Registry found that as recurrences increase, the risk of intraoperative complications increases (first recurrence, 3.97% vs. second recurrence, 5.75% vs. third recurrence, 8.65%; $p < 0.001$). Similarly, the risk of reoperation secondary to complications increases (first recurrence, 1.50% vs. second recurrence, 2.21% vs. third recurrence, 2.66; $p = 0.020$), and the need for post-operative chronic pain management increases (first recurrence, 5.21% vs. second recurrence, 6.70% vs. third recurrence, 10.86; $p < 0.001$) [45]. The authors concluded that for cases of second and third recurrence, diagnostic laparoscopy could be very useful in choosing the best technique, allowing the benefits vs. risks to be weighed. On the other hand, there is another relevant point to discuss and that is the incidence of undiagnosed femoral hernia in patients with recurrent inguinal hernia. Henriksen et al. [46] conducted a comparative study where they included 461 patients, finding that the incidence of undiagnosed femoral hernia is significantly higher in the recurrence group (9.2%; 95% CI, 5.9–13.5%); and it is also more frequently detected in women than in men (38.1% vs. 6.6%, $p = 0.003$) [46]. Therefore, during the pre-operative examination of the patient with recurrent inguinal hernia, the existence of a hidden

femoral hernia should be suspected and ruled out. In this order of ideas, within the group of previous treatments, the use of corticosteroids, antibiotic prophylaxis, surgical history of inguinal hernia, and any other factor that may alter the normal evolution of the recovery of the hernia repair and the functional results should be considered [47]. The factors influencing outcomes in the management of inguinal hernia are summarized in Fig. 1. The factors categorized by subtitle studied are shown in Table 1.

6. Future perspectives

There are numerous questions and gaps in the evidence regarding pre-operative considerations and preparation of the patient with inguinal hernia. In general, nutrition is known to be a prognostic factor in surgical outcomes [48]. However, no recent study was found that aimed to evaluate the impact of different nutritional states and the evolution of overall outcomes of inguinal hernia repair. Similarly, in order to improve the quality of the evidence in surgery, more robust studies should be conducted in low- and middle-income countries, and to assess whether the behavior is similar or whether there are previously undescribed factors that may influence the quality of the evidence [49–51]. There is also a need for eco-epidemiological studies and genomic analyses [49], which will facilitate the understanding of the difference in risk between the different subgroups, and the recurrence or overall risk that certain individuals have, since they have higher rates of both intraoperative and post-operative complications. Inguinal hernia is one of the most frequent surgical pathologies in the world, and although numerous techniques have been described over the years, in third world countries the same traditional techniques and tools are still used, which do not favor the improvement of functional outcomes. More clinical and translational research in surgery is needed to facilitate the significance of inguinal hernia management and improve the quality of evidence sufficiently to determine with certainty which recommendations can be extrapolated to global surgery [52,53].

7. Conclusions

There are currently many gaps in the evidence on pre-operative considerations in the management of the patient with inguinal hernia. Pre-operative symptomatology, mainly pain, is a predictor of post-operative chronic pain that influences the patient's functional capacity and quality of life. There are risk factors specific to the patient, the surgeon and the provision of health services that influence the overall outcome, and generally tend to disrupt the proper evolution of the affected person. Recurrence, undiagnosed associated hernias and the choice of surgical technique are factors that significantly impact intra-operative and post-operative risks, which should be carefully analyzed prior to surgery.

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Author contributions

Please specify the contribution of each author to the paper, e.g. study design, data collections, data analysis, writing. Others, who have contributed in other ways should be listed as contributors.

All authors equally contributed to the analysis and writing of the manuscript.

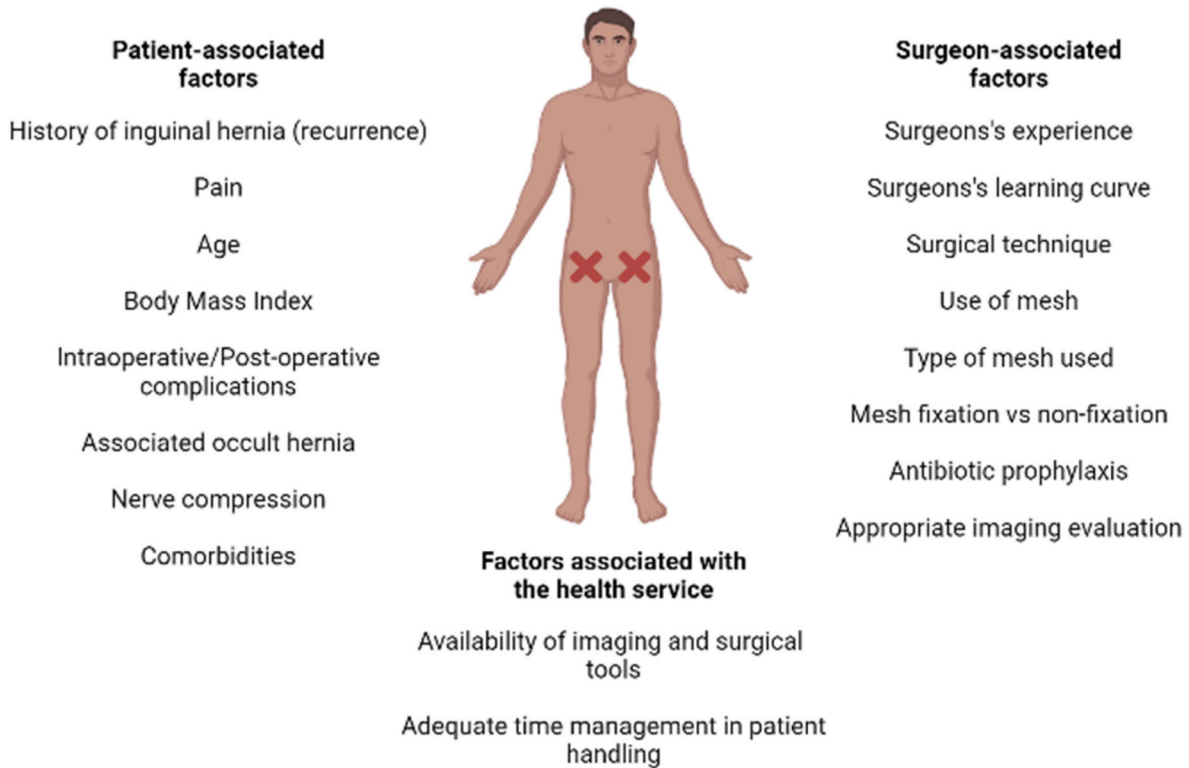


Fig. 1. Summary of pre-operative and surgical factors predicting overall outcome in inguinal hernia repair [11–43]. Created with BioRender. Source: authors.

Table 1

Summary of factors influencing the functional outcome and quality of life of patients with inguinal hernia, categorized by subtitle studied [11–43].

Pre-operative symptomatology
Pain presence
Pain intensity
Patient's mood
History of chronic pain
Risk factors and interventions
Neurectomy
Strangulated hernia
Preliminary imaging evaluation
History of distal and proximal segments of the ilioinguinal nerve
Congenital collagenopathy
Hernia growth
Compressive neuropathy
Presence of occult contralateral hernias
Comorbidities
Age
Recurrence
Previous treatment
Prophylactic antibiotic therapy
Use of corticosteroids
History of primary or recurrent inguinal hernia repair
Type of technique used in previous repair

Research registration Unique Identifying number (UIN)

1. Name of the registry: Not applicable.
2. Unique Identifying number or registration ID: Not applicable.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): Not applicable.

Guarantor

The Guarantor is the one or more people who accept full

responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. Please note that providing a guarantor is compulsory.

Please state any conflicts of interest

None.

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