



Criteria for choosing a mesh implant in laparoscopic Transabdominal Preperitoneal Patch hernioplasty

Natalya Voytyuk*

Graduate Student
Bogomolets National Medical University
01601, 13 T. Shevchenko Blvd., Kyiv, Ukraine
<https://orcid.org/0000-0002-6821-1707>

Abstract. Laparoscopic Transabdominal Preperitoneal Patch hernioplasty is an important method of treating inguinal hernias, but the lack of data on the comparative effectiveness of anatomical 3D mesh and traditional flat mesh makes it difficult to choose the optimal implant to reduce the risk of recurrence and complications. The aim of the study was to compare the effectiveness of anatomical 3D mesh and traditional flat mesh in laparoscopic hernioplasty with Transabdominal Preperitoneal Patch, as well as to determine the key criteria for implant selection. The objectives of the study were to analyse the recurrence rate, duration of surgery, postoperative pain, complication rate and patient satisfaction in the two groups. The study included 187 patients who were divided into two groups: 92 patients received traditional flat meshes and 95 patients received 3D anatomical meshes. Data were collected over 18 months and analysed using statistical methods. The use of anatomical 3D meshes reduced the time of surgery. The average level of postoperative pain according to the Visual Analogue Scale in the group with anatomical meshes was 30% lower. The complication rate in the anatomical mesh group was 5%, while in the flat mesh group it was 12%. Patient satisfaction in the group with anatomical 3D meshes was significantly higher. The results of the study confirm the advantage of anatomical 3D mesh in laparoscopic hernioplasty with Transabdominal Preperitoneal Patch, which reduces the time of surgery, reduces the incidence of recurrence, postoperative pain and complications, and increases patient satisfaction

Keywords: inguinal hernia; three-dimensional materials; postoperative discomfort; complications; effectiveness; comparative review

INTRODUCTION

Laparoscopic Transabdominal Preperitoneal Patch (TAPP) hernioplasty, despite its popularity due to its minimally invasive approach that reduces the risk of recurrence and speeds up recovery, remains a subject of debate as its effectiveness requires further research, especially regarding the optimal choice of mesh implant to minimise complications. Anatomical 3D meshes offer an innovative approach that can improve surgical outcomes due to their ability to better adapt to patient anatomy, reduce postoperative pain, reduce complications and speed recovery, although their effectiveness compared to traditional flat meshes remains to be seen; individualised implant selection remains key to accommodate unique patient anatomy. However, to confirm these findings, large-scale clinical trials are needed to compare the long-term results of using 3D anatomical meshes with traditional methods. It is also

relevant to investigate the impact of different types of mesh on postoperative pain and quality of life in the long term after surgery. Only after obtaining more detailed data, will it be possible to definitively state the advantages of a particular type of mesh implant. So, although laparoscopic TAPP hernioplasty shows encouraging results, it needs further study to definitively confirm its effectiveness and safety. It is also important to continue research into the development of new implant materials and fixation techniques, which will improve the quality of inguinal hernia treatment and patient outcomes.

The study conducted by V. Hrubnik *et al.* [1] emphasises the key role of the choice of surgical method in the treatment of recurrent inguinal hernias, highlighting the significant advantages of laparoscopic techniques, including shorter surgery time, reduced risk of complications,

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*Corresponding author



postoperative pain and faster recovery of patients compared to traditional open surgery. Less traumatic than open surgery, laparoscopic hernioplasty is particularly suitable for patients with previous surgeries where scar tissue is difficult and provides reliable hernia repair, reducing the risk of recurrence; however, further research remains to compare the early and long-term outcomes of laparoscopic and open surgery, including technical aspects, pain levels, recovery rates and recurrence rates.

The results of the work by A. Bilay [2] confirmed the high effectiveness of laparoscopic TAPP hernioplasty in patients with primary and recurrent inguinal hernias, especially due to the use of modern anatomical 3D meshes that reduce the risk of complications and shorten recovery time. A study of the modified technique showed that the improved technique significantly reduces the operation time, reduces the recurrence rate due to a more secure mesh implant fixation, and reduces postoperative complications such as seromas, haematomas, infections, and pain, facilitating faster recovery and increasing patient satisfaction with treatment results.

I. Babiy [3] conducted a study on the comparative evaluation of various alloplastic methods of surgical treatment of inguinal hernia. The purpose of the study was to determine the most effective approaches to alloplasty in the treatment of inguinal hernias, ensuring a minimum recurrence rate, low postoperative complications and high quality of life for patients. The results have shown that the use of modern mesh implants with different fixation methods significantly affects the success of the surgical intervention. In particular, self-fixing meshes reduce the risk of seromas and infections, while lightweight polypropylene materials are better at reducing chronic pain and shortening recovery time. 3D anatomical meshes have been shown to significantly reduce the risk of hernia recurrence compared to flat meshes, increasing the long-term effectiveness of operations and reducing the need for repeat interventions. The study by the researcher confirmed that the choice of alloplasty method and type of mesh implant has a decisive impact on the success of treatment, reducing complications and improving the quality of life of patients in the postoperative period.

The scientific work of Q. Saïding *et al.* [4] showed that a properly selected mesh implant, especially an anatomical 3D mesh, can minimise postoperative pain and improve overall patient satisfaction with the results of surgery. This is especially important for patients at increased risk of complications, such as the elderly or patients with chronic diseases. The relevance of this approach is also confirmed by M. Meng *et al.* [5] and Y. Wu *et al.* [6], who demonstrate the benefits of 3D anatomical meshes in the long term, including a reduced risk of recurrence and improved quality of life.

Analysis of the researches of N. Thanh Xuan & N. Huu Son [7], S. Savoliuk *et al.* [8] confirms the feasibility of using anatomical 3D meshes in laparoscopic TAPP hernioplasty to reduce the recurrence rate and improve the postoperative period. Further improvement of inguinal hernia treatment methods based on these data will contribute to improving the quality of medical care. However, despite the benefits of 3D anatomical mesh, its use remains a matter of debate, and more research is needed to accurately assess its effectiveness compared to traditional flat mesh, with

particular attention to recurrence rates, postoperative pain, complications, and patient satisfaction.

The study was focused on analysing the main factors in choosing a mesh implant for laparoscopic inguinal hernia surgery. The research paper pays special attention to the comparison of traditional flat meshes and anatomical 3D meshes in terms of their effectiveness, impact on postoperative recovery and long-term results.

✦ MATERIALS AND METHODS

The study was conducted at one of the leading medical Kyiv surgery centres specializing in hernia surgery – Kyiv City Clinical Hospital No. 1 – for 18 months from 09.2021 to 03.24. The study involved 187 patients with a confirmed diagnosis of inguinal hernia who were undergoing elective laparoscopic hernioplasty using the TAPP method. All patients who participated in the study provided informed consent to participate in the study and to use their data for scientific purposes. The first group (group A (92 patients)) received traditional flat meshes that are widely used in surgical practice. The second group (group B (95 patients)) received 3D anatomical meshes with a more complex structure designed to better fit the patient's anatomical structures. All surgeries were performed under general anaesthesia according to standard surgical protocols.

All participants were informed of the study objectives, methods, possible risks and benefits before the study began. Participants were ensured the right to voluntary participation and could refuse to participate or withdraw from the study at any stage without negative consequences. Informed consent was obtained from all participants, and the process of obtaining it complied with the principles of confidentiality and personal data protection. The study was also approved by the relevant ethics committee at the institution where it was conducted, which ensures that all ethical standards were met. The study reports, data collected and analysed were conducted with due regard for the confidentiality of participants, in accordance with applicable national and international regulations, such as the World Medical Association Declaration of Helsinki [9], Law of Ukraine No. 2297-VI "On Personal Data Protection" [10]. These ethical standards ensure proper protection of the rights and interests of research participants and guarantee compliance with high standards of research practice.

Patients had to be 18 years of age or older and could be either male or female. Surgery was indicated in cases of primary inguinal hernia. At the same time, patients had to have no serious comorbidities that could affect the results of the study. Patients with congenital or severe comorbidities, such as cancer, diabetes mellitus in the stage of decompensation, severe cardiovascular disease or blood clotting disorders, were excluded from the study. All surgeries were performed by the same team of surgeons to ensure standardization of surgical procedures and minimise variations that could affect the results. The TAPP technique was used, which involves accessing the hernia sac through the preperitoneal space and then placing a mesh implant. In group A, the traditional flat mesh was used, which was fixed with a geonio-stapler. In group B, anatomical 3D meshes were used, which, due to their shape, provided a tighter fit to the anatomical structures and did not require fixation.

The study lasted for 18 months, during which the following key parameters were evaluated: duration of surgery, recurrence rate, postoperative pain, complication rate and patient satisfaction. The duration of the operation was recorded for each patient, from the first incision to the last suture. The hernia recurrence rate was determined based on regular patient examinations every three months for a year, which included clinical examination and ultrasound. The level of postoperative pain was assessed using a visual analogue scale (VAS) on the first, third, seventh and thirtieth day after surgery, where patients rated pain on a scale from 0 (no pain) to 10 (unbearable pain). The incidence of complications such as seroma, haematoma, infection or chronic pain was carefully documented and classified as early (up to 30 days postoperatively) and late (more than 30 days postoperatively). Patient satisfaction was assessed through questionnaires administered 3 and 6 months after surgery, where patients rated their satisfaction with the results on a scale from 1 (completely dissatisfied) to 5 (completely satisfied). Data were also collected using a standardised questionnaire administered at two time points: 3 months and 6 months after surgery. The questionnaire included questions aimed at assessing patient satisfaction based on several criteria, such as quality of life after surgery, presence, or absence of postoperative complications, postoperative pain, and overall sense of treatment success. Patients were asked to rate their satisfaction on a five-point scale, with 1 indicating complete dissatisfaction and 5 indicating complete satisfaction with the results. To assess satisfaction, a scale was used that allowed patients to rate different aspects of treatment. For example, patients rated their physical activity after surgery, discomfort or pain, and the overall impact of the surgery on their daily lives. In addition, the questionnaire included questions about postoperative complications, such as infections, seromas, haematomas and chronic pain, which allowed for a comprehensive assessment of the effectiveness of the surgery.

The data analysis procedure included processing the results of the questionnaire to determine the mean values of patient satisfaction scores, complication rates, and postoperative pain levels. The data were analysed using appropriate statistical methods to determine significant differences between patient groups. The analysis also included a comparison of results at different time points to identify the dynamics of patient satisfaction during the follow-up period. All data were systematised and used to draw conclusions about the effectiveness of the surgical interventions and their impact on the quality of life of patients. The

collected data were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS) software. The t-test for independent samples and the χ^2 -test for categorical variables were used to compare the two groups for each of the parameters. The level of significance was set at 0.05. Data were presented as means (M) and standard deviations (SD) for quantitative indicators, and as percentages for qualitative indicators.

The results of the study were presented in the form of tables and graphs, which allowed us to visually compare the effectiveness of traditional flat meshes and anatomical 3D meshes in laparoscopic TAPP hernioplasty. Particular attention was paid to the recurrence rate, postoperative pain level and overall patient satisfaction, as these indicators are critical for assessing the long-term effectiveness of the operation.

RESULTS

The selection of the appropriate mesh implant and the correct placement technique are critical to the success of TAPP hernioplasty surgery. It is crucial that surgeons have all the necessary skills and knowledge to make optimal use of these materials to achieve the best clinical results. Different types of mesh implants have a significant impact on the course of surgery and the postoperative period. The study covered several key parameters, such as the duration of surgery, recurrence rate, postoperative pain level, complication rate and patient satisfaction. These parameters are critical for assessing the long-term effectiveness and safety of mesh implant surgery.

One of the key parameters that was carefully evaluated in this study was the duration of the surgery. According to the results obtained, the use of anatomical 3D meshes has significantly reduced the operation time. Reducing the duration of the operation is directly related to a number of important factors: reduced risk for the patient, reduced time under anaesthesia, and, as a result, reduced likelihood of postoperative complications. In addition, the use of 3D anatomical meshes contributed to a more accurate and faster implant fixation due to their optimal conformity to the patient's anatomical features. This allowed surgeons to perform fewer manipulations during mesh placement, which not only reduced the time of surgery but also reduced the trauma of the procedure for the patient. Thus, as shown in Table 1, the study demonstrates the importance of using 3D anatomical mesh in laparoscopic TAPP hernioplasty, emphasizing its ability to improve surgical outcomes and patient safety.

Table 1. Duration of surgery

Research team	Type of hernia defect	Number of patients	Mean value of the duration of surgery (in min), $\bar{X} \pm m$
Control group (simple grid)	Lateral (oblique)	48	74.5 \pm 0.8
	Medial (straight)	41	65.6 \pm 0.5
	Femoral	3	67.7 \pm 1.5
Main group (3D grid)	Lateral (oblique)	43	47.7 \pm 0.4
	Medial (straight)	47	38.3 \pm 0.6
	Femoral	5	32.4 \pm 1.1

Source: compiled by the author

One of the key indicators of the effectiveness of hernioplasty is the recurrence rate, which directly affects the long-term success of treatment. According to the results of an 18-month follow-up, the recurrence rate among patients implanted with traditional flat mesh was 8%, while in the group of patients who received anatomical 3D mesh, this figure was only 2%. These data indicate a significant advantage of anatomical 3D mesh in preventing hernia recurrence. The main factor behind this advantage is the ability of 3D anatomical meshes to optimally adapt to the individual anatomical features of the patient. Due to their three-dimensional structure, such meshes provide a more

precise fit to the tissues, which creates a more stable and secure implant fixation. In contrast, traditional flat meshes often do not take into account individual anatomical features, which can lead to their displacement and, as a result, to an increased risk of hernia recurrence. Thus, the use of 3D anatomical mesh in hernioplasty seems to be a more effective approach that helps to reduce the recurrence rate and improve the quality of life of patients after surgery. These results emphasise the importance of an individualised approach to implant selection based on a detailed consideration of the patient's anatomical characteristics, which is key to successful hernia repair and is presented in Table 2.

Table 2. Relapse rates in groups with different types of mesh

Mesh type	Relapse rate, %
Traditional flat meshes	8
Anatomical 3D meshes	2

Source: compiled by the author

One of the key aspects that was thoroughly analysed in the study was postoperative pain in patients who underwent mesh implantation during TAPP laparoscopic hernioplasty. The results of the study show a significant reduction in postoperative pain in patients who underwent implantation of anatomical 3D mesh compared to those who underwent traditional flat mesh. In particular, the average pain level in patients who received anatomical 3D meshes was 3.5 points on the VAS (Visual Analogue Scale), which is significantly lower by 30% compared to 5.0 points in the group with traditional flat meshes. This reduction in postoperative pain is attributed to the

improved adaptation of 3D anatomical meshes to individual patient anatomical structures. Due to their three-dimensional shape, these meshes fit better to the tissues, minimizing pressure on the surrounding structures, which significantly reduces the risk of inflammation and discomfort. This adaptation not only helps to reduce patient pain, but also speeds up the recovery process by reducing the need for painkillers after surgery. These results highlight the importance of choosing the right type of mesh implant to optimise postoperative recovery, which is key to improving patients' quality of life in the postoperative period (Table 3).

Table 3. Postoperative pain according to the VAS scale

Mesh type	Average pain level, points
Traditional flat meshes	5
Anatomical 3D meshes	3.5

Source: compiled by the author

The study thoroughly evaluated the incidence of postoperative complications that occur after laparoscopic hernioplasty using different types of mesh implants. The results showed that the overall complication rate in patients who had 3D anatomical mesh implants was 5%. This is significantly lower than in patients who received traditional flat meshes, where the complication rate reached 12%. The most common postoperative complications were seroma, haematoma, infection, and chronic pain. The decrease in the complication rate in patients who received 3D anatomical mesh can be explained by several factors. Firstly, due to their three-dimensional structure, these meshes integrate better with the surrounding tissues, which ensures their stable fixation and reduces the risk of implant displacement or deformation. This, in turn, reduces the risk of developing infectious complications, as the implant remains in a stable position and does not create conditions for fluid accumulation or seroma formation. Secondly, better adaptation of 3D meshes to the patient's anatomy helps to reduce postoperative pain, as it reduces pressure on the surrounding tissues and nerve endings. These results highlight the advantages of using

anatomical 3D meshes compared to traditional flat meshes, which significantly reduce the risk of postoperative complications. This, in turn, improves overall treatment outcomes and increases the quality of life of patients in the postoperative period.

The level of patient satisfaction is one of the key indicators of the success of a surgical intervention, as it reflects not only the technical efficiency of the operation, but also the quality of life of patients after treatment. The post-operative survey found that patients who received anatomical 3D mesh implants demonstrated a significantly higher level of satisfaction with the results of the surgery compared to those who received traditional flat mesh. Specifically, 95% of patients in the anatomical 3D mesh group expressed full or partial satisfaction, while the figure for the flat mesh group was only 80%. Patients who received anatomical 3D meshes reported a significantly higher level of comfort after surgery, which is explained by the more natural fit of the meshes to the tissues and the absence of a foreign body sensation that often occurs when using flat meshes. This, in turn, had a positive impact on their quality of life in the postoperative period. In addition, patients who received 3D

anatomical mesh had a lower incidence of complications and reduced postoperative pain, which also contributed to their high level of satisfaction. Thus, the results of the

study shown in Table 4 demonstrate the superiority of 3D anatomical meshes over traditional flat meshes in terms of patient experience and overall surgical success.

Table 4. Level of patient satisfaction

Mesh type	Full satisfaction, %	Partial satisfaction, %
Traditional flat meshes	70	10
Anatomical 3D meshes	85	10

Source: compiled by the author

The results of this study clearly demonstrate the advantages of using anatomical 3D meshes compared to traditional flat meshes in laparoscopic hernioplasty using the TAPP technique. All key indicators – from the duration of the operation to the level of patient satisfaction – indicate that 3D anatomical mesh is more effective and safer for patients. A 10-minute reduction in surgery time can have a significant impact on reducing surgical risks and improving outcomes. The lower recurrence rate (2% vs. 8%) is a testament to the more stable anchoring of 3D anatomical meshes and their ability to better conform to the patient's anatomy. A 30% reduction in postoperative pain makes the rehabilitation period less stressful for patients and reduces the need for painkillers. In addition, a significantly lower incidence of postoperative complications (5% vs. 12%) underscores the advantage of 3D anatomical meshes in preventing serious problems after surgery. The high level of patient satisfaction (95% vs. 80%) indicates that 3D anatomical mesh not only improves clinical outcomes, but also improves the quality of life of patients after surgery.

Thus, the results of the study confirm the feasibility of using anatomical 3D meshes in laparoscopic hernioplasty using the TAPP method, making them the best choice for surgeons and patients. The study showed that the use of 3D anatomical mesh in TAPP laparoscopic hernioplasty is more effective than traditional flat mesh in a number of key ways. Reduced surgery time and reduced recurrence rates confirm that anatomical meshes provide better adherence to the tissues and minimal trauma during surgery. The reduction in postoperative pain and complications is also a strong argument in favour of 3D anatomical meshes, which increase overall patient satisfaction with the results of surgery.

DISCUSSION

In a study that focused on the use of 3D anatomical mesh in laparoscopic TAPP hernioplasty, several important benefits of these implants were identified. In particular, 3D meshes resulted in shorter operative times, lower recurrence rates, reduced postoperative pain, and increased patient satisfaction. These results differ from those obtained in studies of traditional flat meshes, which allows for a detailed comparison. For example, a study by C.S. Seefeldt *et al.* [11] showed that biological meshes have a lower risk of chronic pain, but at the same time demonstrate a higher recurrence rate compared to synthetic meshes. In this study, anatomical 3D meshes showed both a low level of postoperative pain and a significantly lower recurrence rate (only 2%). This indicates that anatomical 3D meshes may be more effective in ensuring long-term implant stability than biological meshes, while reducing the risk of chronic pain.

Another scientific work by J.F. FitzGerald & A.S. Kumar [12] also notes that biological meshes have a higher risk of recurrence, but better biocompatibility and a lower risk of chronic pain compared to synthetic meshes. In our study, anatomical 3D meshes, although synthetic, demonstrate excellent results in both of these aspects: they provide a low recurrence rate and reduce postoperative pain. This indicates that properly selected and structured synthetic meshes, such as 3D anatomical meshes, can provide benefits that exceed both biological and traditional synthetic meshes. Thus, the results of the study highlight that 3D anatomical mesh may be the best choice for patients who need not only pain relief but also a reliable, long-term solution for hernia repair. This distinguishes them from biological meshes, which, while offering a high level of biocompatibility and a lower risk of chronic pain, have an increased risk of recurrence, which can be a critical factor in choosing a treatment method. The results of the study, which focused on the use of 3D anatomical meshes in TAPP laparoscopic hernioplasty, showed significant advantages of these implants in terms of operative time, recurrence rate and postoperative pain. These indicators are also related to the methods of mesh fixation, which is confirmed by the study by Q. Saïding *et al.* [4], which showed that the method of mesh fixation significantly affects the recurrence rate, with adhesive and self-adhesive meshes showing better results. This study, which focused on anatomical 3D meshes, confirms this conclusion. The use of anatomical 3D meshes, which provide better conformity to anatomical structures and natural self-locking, led to a reduction in the recurrence rate of up to 2%. This confirms the effectiveness of self-locking meshes and emphasises the importance of choosing the right fixation method.

A. Jangjoo *et al.* [13] noted that the wrong choice of mesh size and shape, as well as inadequate fixation, are key risk factors for mesh migration. The results of the study showed a low complication rate and no cases of implant migration when using anatomical 3D meshes, pointing out the importance of choosing the right size and shape of the mesh, as well as proper fixation to prevent migration. M. Matikainen *et al.* [14] found that the choice of mesh and the method of fixation affect the incidence of chronic pain after surgery. In our study, 3D anatomical meshes showed a significant reduction in postoperative pain, which may also be the result of effective mesh fixation. This confirms the importance of selecting fixation methods that minimise chronic pain and improve overall surgical outcomes [15, 16]. Thus, this study complements and confirms the findings of other studies, demonstrating that the correct choice of anatomical 3D mesh and appropriate fixation methods are

critical to reduce the incidence of recurrence, implant migration, and postoperative pain, which generally improves the results of laparoscopic TAPP hernioplasty. The results of this study, which compared the effectiveness of 3D anatomical mesh in laparoscopic TAPP hernioplasty with traditional flat mesh, are largely consistent with the findings of other studies looking at new materials and mesh coatings.

O.A. Olanrewaju *et al.* [17] emphasised the importance of choosing a mesh based on the patient's anatomy and the type of hernia. The study showed that the use of anatomical 3D meshes that better match the patient's anatomy reduces the time of surgery and the incidence of recurrence. This confirms that taking into account anatomical features is a key factor in choosing a mesh implant. S. Elango *et al.* [18] point out the importance of using lightweight and biocompatible materials to reduce the risk of chronic pain. In the study, anatomical 3D meshes demonstrated a reduction in postoperative pain, which is consistent with recommendations for choosing lightweight materials that reduce pressure on surrounding tissues and reduce chronic pain.

R. Bittner *et al.* [19], A.L. Vorst *et al.* [20] and K.Y. Wu *et al.* [21] noted that coated mesh reduces the incidence of postoperative complications such as infections compared to uncoated mesh. Although the study did not include a comparison of coated and uncoated meshes, the reduced complication rate with 3D anatomical meshes may be partly due to their design, which allows for better adaptation to the tissues and reduces the risk of infectious complications. Polypropylene meshes have better results in reducing recurrence and chronic pain compared to polyester meshes. The results of the study support these findings, as anatomical 3D meshes, which are predominantly made of polypropylene, provided a significant reduction in recurrence and postoperative pain compared to flat meshes. Thus, this study confirms the importance of mesh materials and coatings in achieving optimal results in laparoscopic TAPP hernioplasty. Due to their design and material, 3D anatomical meshes demonstrate significant benefits in reducing operative time, recurrence rates, postoperative pain, and complications, which is consistent with the findings of other researchers in this field. In this study, 3D anatomical meshes demonstrated significant benefits over traditional flat meshes, which is reflected in reduced operative time, reduced recurrence rates, reduced postoperative pain, and increased patient satisfaction. These results provide an interesting comparison with studies evaluating the effectiveness of lightweight polypropylene mesh.

Studies by J. Li *et al.* [22], P. Prakash *et al.* [23] and A. Currie *et al.* [24] found that the use of heavy meshes led to an increase in the incidence of chronic pain and complications compared to lightweight polypropylene meshes. In comparison to the study, anatomical 3D meshes, although not directly compared to heavy meshes, also showed a reduction in postoperative pain, which may indicate similar benefits associated with the lightness and anatomical conformity of these meshes. In addition, the results of a study by foreign scientists indicate that lightweight polypropylene mesh showed better results in reducing chronic pain and faster recovery of patients compared to heavy mesh. This is in line with the findings of M. Melkemichel *et al.* [25] and C.D. Deveci *et al.* [26], where anatomical 3D meshes provided pain reduction and improved patient comfort,

which is likely due to their optimal structure and lightness. Lightweight polypropylene meshes provide better results in elderly patients, reducing the incidence of chronic pain and accelerating recovery. The study did not separately analyse the age of the patients, but the overall reduction in postoperative pain and improved outcomes observed may also be relevant for older patients.

K.F. Pedersen *et al.* [27] emphasised that lightweight mesh reduces the risk of chronic pain and improves long-term outcomes after surgery. This conclusion coincides with the data obtained by B. Shiroud Heidari *et al.* [28], where the use of anatomical 3D meshes helped to reduce chronic pain and increase overall patient satisfaction with the results of surgery. Thus, although the study focused on comparing 3D anatomical meshes with traditional flat meshes, the results are consistent with the benefits of lightweight polypropylene mesh described in the literature. This indicates that the lightness and conformity of the mesh to the patient's anatomy are critical factors affecting the success of laparoscopic hernioplasty.

The use of three-dimensional self-locking meshes significantly reduced the operation time and reduced the recurrence rate compared to lightweight polypropylene meshes [29]. The study also confirms this, as the average duration of surgery for anatomical 3D mesh was 10 minutes shorter than for flat mesh, and the recurrence rate was reduced to 2%. The studies by K. Baylón *et al.* [30] and A. Robbins *et al.* [31] emphasise the reduction in the duration of surgery and the incidence of complications when using self-locking mesh. In the study, the complication rate in the group with anatomical 3D meshes was 5%, while in the group with flat meshes, it was 12%, which confirms the advantages of three-dimensional meshes. Three-dimensional mesh provides better stability and a lower risk of recurrence in the long term. The study confirmed these findings, demonstrating that anatomical 3D meshes adhere better to the tissues, reducing the risk of implant displacement.

In the study, patients with anatomical 3D meshes reported a 30% reduction in VAS pain compared to flat meshes, which is confirmed by the data of other scientists M. Schulze *et al.* [32] and G. Natale *et al.* [33], who found that three-dimensional meshes provide better stability and a lower risk of implant displacement. The use of self-locking meshes reduces the time of surgery and reduces the risk of recurrence, especially in patients at high risk of complications. The study also showed a reduction in the recurrence rate of up to 2% in the group with 3D meshes, which confirms these findings. Research by Ukrainian and foreign scientists confirms the importance of choosing the right mesh implant in TAPP laparoscopic hernioplasty, emphasizing the benefits of three-dimensional, lightweight and biocompatible mesh in reducing the risk of complications, recurrence and increasing patient satisfaction.

✦ CONCLUSIONS

Laparoscopic TAPP hernioplasty is one of the most effective treatments for inguinal hernias, where the choice of mesh implant plays a key role in reducing the risk of recurrence and complications. The study results clearly demonstrated the significant advantages of 3D anatomical mesh. In particular, the use of such meshes has significantly reduced the operation time, which is an important factor in

surgical practice. In addition, patients who had 3D anatomical meshes implanted had a lower level of postoperative pain, which was confirmed by the VAS scale. The incidence of postoperative complications, such as infections and seromas, was also significantly lower in the group with anatomical 3D meshes. Patients who had 3D anatomical mesh implanted demonstrated a significantly higher level of satisfaction with the results of the surgery, which is a critical indicator of the quality of medical services. The study also showed that the use of anatomical 3D meshes reduces the recurrence rate by ensuring better adhesion of the implant to the tissues and minimal trauma during surgery. The reduction in postoperative pain and complication rates are strong arguments in favour of 3D anatomical meshes, which increase the overall satisfaction of patients with the results of surgery.

It is worth noting that the duration of patient follow-up was relatively short, which limits the assessment of long-term outcomes and recurrence. In addition, the study did not take into account all possible factors that could affect the outcome of the surgery, such as individual anatomical differences and patient comorbidities. These

limitations highlight the need for larger and longer studies to definitively determine the effectiveness of 3D anatomical mesh compared to traditional implants.

The data obtained can be used to improve surgical protocols, which will contribute to the improvement of the quality of medical services and raise the standards of surgical practice. The introduction of anatomical 3D meshes in TAPP laparoscopic hernioplasty can increase the effectiveness of inguinal hernia treatment, improving the quality of life of patients and reducing the risk of reoperation. Further studies should include larger patient samples and longer follow-up periods to determine the long-term effectiveness of 3D anatomical meshes. In addition, it is relevant to evaluate the cost-effectiveness of using such meshes in different clinical settings, which may help improve the standard of care for inguinal hernias.

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◆ CONFLICT OF INTEREST

All author declares no conflict of interest in this article.

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Критерії вибору сітчастого імплантату у лапароскопічній герніопластиці Transabdominal Preperitoneal Patch

Наталя Войтюк

Аспірант

Національний медичний університет імені О.О. Богомольця

01601, бульв. Т. Шевченка, 13, м. Київ, Україна

<https://orcid.org/0000-0002-6821-1707>

Анотація. Лапароскопічна герніопластика Transabdominal Preperitoneal Patch є важливим методом лікування пахових гриж, але недостатність даних про порівняльну ефективність анатомічних 3D сіток і традиційних плоских сіток ускладнює вибір оптимального імплантату для зниження ризику рецидивів і ускладнень. Метою дослідження було порівняння ефективності анатомічних 3D сіток і традиційних плоских сіток у лапароскопічній герніопластиці Transabdominal Preperitoneal Patch, а також визначення ключових критеріїв для вибору імплантату. В задачі дослідження входило проаналізувати частоту рецидивів, тривалість операції, рівень післяопераційного болю, частоту ускладнень та задоволення пацієнтів у двох групах. Дослідження включало 187 пацієнтів, які були поділені на дві групи: 92 пацієнтів отримали традиційні плоскі сітки, і 95 пацієнтів – анатомічні 3D сітки. Дані збиралися протягом 18 місяців і аналізувалися статистичними методами. Використання анатомічних 3D сіток дозволило скоротити час операцій. Середній рівень післяопераційного болю за шкалою Visual Analog Scale у групі з анатомічними сітками був на 30 % нижчим. Частота ускладнень у групі з анатомічними сітками склала 5 %, у той час, як у групі з плоскими сітками цей показник був 12 %. Задоволення пацієнтів у групі з анатомічними 3D сітками було значно вищим. Результати дослідження підтверджують перевагу анатомічних 3D сіток у лапароскопічній герніопластиці Transabdominal Preperitoneal Patch, що забезпечує зменшення часу операції, зниження частоти рецидивів, післяопераційного болю і ускладнень, а також підвищення рівня задоволення пацієнтів

Ключові слова: пахові грижі; тривимірні матеріали; післяопераційний дискомфорт; ускладнення; результативність; порівняльний огляд