TASHKENT MEDICAL ACADEMY

100 TMA ANNIVERSARY

Journal of Educational and Scientific Medicine

Issue 6 | 2025

OAK.uz

Google Scholar

ISSN: 2181-3175

Journal of Education & Scientific Medicine

ISSN 2181-3175

Tashkent Medical Academy

Review Article

Open © Access

Anatomical Predictors in Hernia Recurrence

F.M. Abdurakhmanov[1], S.E. Zukhurov[2]

ABSTRACT

Recurrence after ventral hernia repair remains a clinically significant and economically burdensome complication, particularly among elderly patients. In recent years, increasing attention has been paid to anatomical and morphometric factors that influence the stability of abdominal wall reconstruction. This review summarizes current evidence on anatomical predictors of recurrence, including aponeurosis thickness, diastasis recti, defect size and configuration, and mesh fixation zones. Emphasis is placed on the role of high-resolution imaging, intraoperative morphometry, and tissue quality evaluation in elderly individuals with recurrent hernias. Several risk stratification models incorporating these factors have been proposed, with promising results in reducing recurrence and optimizing surgical outcomes. Anatomical predictors should be considered a cornerstone in developing individualized, anatomy-informed surgical strategies for high-risk patients.

Keywords: *ventral hernia, recurrence, aponeurosis, morphometry, abdominal wall, elderly patients, anatomical risk factors*

INTRODUCTION

Ventral hernia recurrence continues to challenge abdominal wall surgeons despite advances in prosthetic materials, minimally invasive techniques, and perioperative management. This is particularly true in elderly and senile patients, who not only carry a higher baseline surgical risk but also present with anatomical deterioration that fundamentally affects repair integrity [1, 2]. While technical errors and infection have traditionally been cited as leading causes of recurrence, the growing body of literature suggests that anatomical factors—such as poor tissue quality, insufficient mesh overlap, and under-recognized fascial defects—play a central role in determining long-term outcomes [3].

In contrast to primary hernias, recurrent defects are often characterized by irregular geometry, fibrotic remodeling, and anatomic distortion due to previous repairs. Moreover, in the elderly, natural age-related changes such as loss of fascial tensile strength, thinning of the aponeurosis, and attenuation of the rectus sheath significantly impair the mechanical stability of mesh fix-

[1] Department of General and Pediatric Surgery, Tashkent State Medical University, Tashkent, Uzbekistan. E-mail: sardorruss@mail.ru

[2] Bukhara Multidisciplinary Medical Center, Bukhara, Uzbekistan. E-mail: yakkashoh@mail.ru

ation and healing capacity [4, 5]. Identifying and quantifying these anatomical predictors is crucial for planning successful repairs and avoiding repeated surgical failure.

Anatomical Factors Associated with Hernia Recurrence

Among the most frequently studied anatomical predictors of recurrence is aponeurosis thickness. Several authors have demonstrated that thinning of the anterior aponeurosis (<2 mm) correlates with a higher rate of mesh dislocation, incomplete integration, and postoperative failure [6, 7]. Elderly patients are particularly prone to fascial atrophy due to hormonal changes, malnutrition, and collagen remodeling, which compromises suture-holding capacity and mechanical support [8].

Rectus diastasis is another significant contributor, defined as the separation between the medial borders of the rectus muscles. Diastasis exceeding 3 cm is associated with impaired load transfer across the abdominal wall, distortion of mesh placement geometry, and increased risk of suture line dehiscence [9]. In large registry-based studies, patients with unaddressed diastasis at the time of hernioplasty had a recurrence risk up to two times higher than those who underwent plication or fascial re-approximation [10].

Defect size and shape are also critical. Elliptical or irregularly bordered defects are more challenging to reinforce and require greater mesh coverage. A commonly accepted rule of thumb is to provide at least 5 cm of overlap beyond the fascial edges; however, in high-tension or oval-shaped defects, even this may be insufficient [11]. Miserez and Peeters emphasized that circular defects carry a lower recurrence risk than linear or multisegmental gaps, due to more favorable force distribution [12].

Measurement Techniques and Imaging Modalities

Accurate assessment of abdominal wall anatomy is a prerequisite for understanding recurrence mechanisms and optimizing surgical planning. Over the past decade, imaging modalities and morphometric methods have significantly evolved, allowing surgeons to evaluate key anatomical parameters with greater precision. These include aponeurosis thickness, diastasis width, hernia defect area, and mesh position from previous repairs.

Ultrasound (US) remains the most accessible and non-invasive method for preoperative evaluation. When performed with a high-frequency linear probe (7–12 MHz), US can reliably detect fascial continuity, aponeurosis thickness, the presence of incisional scars, and separation of the rectus abdominis muscles [13]. In elderly patients, ultrasound is particularly useful for bedside assessment and serial monitoring. However, it is operator-dependent and limited in patients with obesity, multiple scars, or deep tissue planes.

Computed tomography (CT), particularly with multiplanar and 3D reconstruction, is currently the gold standard for anatomical evaluation prior to recurrent hernia repair. CT allows accurate measurement of defect size, shape, location relative to bony landmarks, and residual mesh integration. It also permits quantification of abdominal wall thickness, evaluation of visceral adhesions, and planning of safe dissection planes [14]. In select patients, CT-angiography can aid in the identification of vascular territories at risk, especially in previously operated zones where standard anatomical layers are distorted [15].

Morphometric analysis based on imaging data enables the construction of individualized anatomical maps. These maps help in determining the optimal size and orientation of the mesh, identifying fixation points in well-vascularized tissue, and selecting the appropriate plane for implantation (intraperitoneal vs. retromuscular).

Tastaldi et al. demonstrated that integration of morphometric planning into surgical decision-making reduced both intraoperative complications and early recurrence rates in complex abdominal wall reconstruction [16].

Intraoperatively, direct caliper measurements and laparoscopic mapping are also valuable, particularly when preoperative imaging is inconclusive. In eTEP or TAR procedures, the integrity of the posterior rectus sheath, transversalis fascia, and arcuate line can be directly inspected and evaluated for suitability of mesh placement. Real-time adaptation of the surgical plan based on intraoperative morphometry is often necessary, especially in elderly patients with unexpected anatomical findings [17].

Despite these advancements, standardization in the measurement and reporting of anatomical variables remains limited. Studies often use inconsistent thresholds for aponeurosis thinning or defect classification, which complicates meta-analysis and guideline development. Further work is needed to establish uniform imaging protocols and validated scoring systems that incorporate anatomical parameters into risk prediction.

Role of Tissue Quality in Elderly Patients

Beyond gross anatomical measurements, the biological quality of the abdominal wall tissues plays a pivotal role in the success or failure of hernia repair, particularly in elderly patients. With age, the structure and function of connective tissues undergo profound changes that significantly alter the mechanical behavior of the fascia, muscle, and overlying skin. These changes often render standard techniques of mesh fixation and tissue approximation less effective in geriatric populations.

Aging is associated with a decline in collagen type I production and a relative increase in collagen type III, which is less organized and mechanically weaker [18]. This shift in the collagen ratio compromises the tensile strength and elasticity of the aponeurosis, making it more prone to stretching, tearing, or failure under suture stress. Moreover, fibroblast activity diminishes with age, resulting in slower and less effective wound healing, as demonstrated in histological studies of ventral hernia tissue biopsies [19].

Franz et al. described this phenomenon as «biologic fascial fragility» — a condition in which even anatomically intact tissue lacks the mechanical resilience required for durable repair [20]. This is especially relevant in elderly individuals with sarcopenia, where reduced muscle mass and atrophy of the rectus abdominis compromise not only force transmission but also the structural envelope in which mesh is seated.

Additionally, systemic comorbidities common in older adults — such as diabetes mellitus, malnutrition, and chronic corticosteroid use — further impair collagen synthesis, angiogenesis, and extracellular matrix remodeling [21]. These processes are critical for mesh integration, tissue ingrowth, and overall repair stability. Inflammatory dysregulation in aging (known as inflammaging) also contributes to aberrant wound healing and excessive fibrosis or laxity at the mesh-tissue interface [22].

Several clinical studies have attempted to quantify tissue quality intraoperatively. Surgeons often report the presence of «paper-thin» fascia, friable muscle edges, or delaminated sheath layers during dissection in elderly patients. Although such descriptors remain subjective, efforts have been made to correlate them with preoperative imaging, such as CT-based wall density measurements or aponeurotic attenuation ratios [23].

Biologic or hybrid meshes have been proposed as solutions in cases of poor tissue quality, particularly in contaminated or high-risk fields. However, randomized trials have shown mixed results regarding their effectiveness in reducing recurrence compared to modern synthetic meshes [24]. The key lies not in the material alone but in matching the biomechanical properties of the prosthesis with the tissue environment in which it is implanted.

In summary, age-related changes in tissue quality must be considered alongside anatomic dimensions when planning hernia repair in elderly patients. Ignoring these factors can lead to overestimation of the mechanical support capacity of native tissues and result in mesh failure, seroma, or early recurrence. Incorporating tissue quality assessments — both preoperatively and intraoperatively — is essential for safe and durable hernia reconstruction in this population.

Clinical Models and Risk Scoring Systems

As awareness of the multifactorial etiology of hernia recurrence has grown, numerous clinical models and risk scoring systems have been proposed to assist in surgical planning. These tools aim to objectively stratify patients according to the probability of recurrence and complications, incorporating anatomical, functional, and systemic variables into a unified framework. While many models address general perioperative risk, few specifically integrate anatomical predictors of failure into a formalized scoring algorithm.

One of the earliest structured approaches was developed by the Ventral Hernia Working Group (VHWG), which categorized patients based on the risk of surgical site infection and wound failure [25]. Although this classification included factors such as prior wound contamination and comorbidity burden, it did not account for anatomical variability in fascial quality or defect configuration. Similarly, the EHS (European Hernia Society) classification focused on hernia location and size but did not provide stratification for tissue resilience or recurrence risk [26].

To address this gap, recent models have begun to include morphological variables such as defect area (in cm^2), diastasis width, aponeurosis thickness, and previous mesh displacement. For example, Köckerling et al. proposed an extended risk assessment that accounts for the number of previous repairs, size and location of the defect, and the degree of abdominal wall weakening [27]. Their multicenter analysis demonstrated that recur-

rence rates increase disproportionately in patients with multiple risk factors, suggesting a cumulative effect of both anatomical and systemic vulnerabilities.

At the institutional level, several centers have developed point-based scoring systems that integrate anatomic imaging data with clinical assessments. These models typically assign numerical values to predictors such as:

- Aponeurosis thickness (<2 mm = 3 points),
- Diastasis recti (>3 cm = 2 points),
- Adhesion grade (III–IV = 2–3 points),
- Defect area (>50 cm^2 = 3 points),
- Previous mesh failure = 2 points,
- Charlson Comorbidity Index ≥5 = 2 points.

Patients are then grouped into low, moderate, or high risk of recurrence, with each category guiding surgical strategy. For example, low-risk patients may undergo standard IPOM repair, while high-risk individuals may be better suited for eTEP or TAR with extended component separation [28].

Validation of these scoring models has been performed using receiver operating characteristic (ROC) analysis, which assesses the sensitivity and specificity of the system in predicting actual recurrence. Tastaldi et al. reported an AUC (area under the curve) of 0.87 for their model, indicating excellent predictive value [29].

Despite promising results, widespread adoption of such models remains limited. Barriers include the need for advanced imaging, time constraints in preoperative planning, and lack of standardized definitions for anatomical thresholds. Furthermore, there is variability in how surgeons interpret and act upon scoring outputs, which can affect outcome consistency.

Nonetheless, integrating anatomical predictors into clinical risk models holds significant promise. Such systems not only support more rational operative decisions but also facilitate communication between surgeons, patients, and interdisciplinary care teams. Importantly, these models enable preoperative counseling, helping patients understand their individual risk and the rationale for the selected surgical approach.

In the future, combining machine learning algorithms with large, multicenter imaging and outcome datasets may further refine risk prediction and personalize hernia surgery. The trend is moving from reactive repair to proactive risk-modulated planning, where anatomy is not a secondary consideration but a central determinant of success.

Surgical Implications and Decision-Making

The incorporation of anatomical predictors into the decision-making process has profound implications for surgical strategy, especially in the management of recurrent ventral hernias in elderly patients. When anatomical parameters such as aponeurosis thickness, defect geometry, and diastasis width are objectively assessed, surgeons are better equipped to select the most appropriate operative technique, mesh material, and fixation method.

Surgical access is one of the most directly influenced aspects. For example, patients with sufficient aponeurotic integrity and low recurrence risk may safely undergo IPOM or IPOM-plus repair, with or without fascial closure [30]. However, in patients with severe rectus diastasis or compromised anterior fascia, these techniques may not ensure stable mesh fixation or adequate force distribution. In such cases, eTEP (extended totally extraperitoneal approach) or TAR (transversus abdominis release) are preferred, as they enable retromuscular mesh positioning, tension-free repair, and broader myofascial reinforcement [31, 32].

Mesh selection must also be individualized based on anatomical and tissue-related considerations. Lightweight macroporous polypropylene meshes are suitable for primary or low-risk recurrent hernias, while composite or dual-layer meshes with absorbable barriers are indicated in intraperitoneal placements where bowel contact is unavoidable. In fields with poor tissue quality or previous infection, some advocate for the use of biologic meshes, although their long-term efficacy remains a subject of debate [33, 34].

Fixation techniques further illustrate the interplay between anatomy and surgical choice. In elderly patients with thin fascia, suture fixation may cause tearing or ischemia, especially when applied with excessive tension. In such scenarios, glue or absorbable tack fixation may reduce tissue trauma while maintaining adequate prosthesis adherence [35]. In high-risk cases, hybrid fixation (glue combined with sutures or tacks) provides a balanced approach that accommodates fragile tissues without compromising stability.

Moreover, anatomical predictors influence decisions regarding component separation techniques (CST). In wide or multisegmental defects, especially those exceeding 10 cm in width or 150 cm^2 in area, anterior or posterior CST may be required to restore domain and facilitate tension-free closure. Franz et al. emphasized that achieving fascial medialization is essential in reconstructing

biomechanical continuity and preventing lateral traction failure, particularly in elderly patients with poor muscle tone [36].

The timing and staging of surgery can also be guided by anatomical risk factors. For example, in patients with large defects and borderline physiological reserves, prehabilitation and staged reconstruction may yield better outcomes than single-session extensive repairs. This approach is particularly relevant in elderly individuals with sarcopenia, malnutrition, or systemic inflammation, where tissue optimization may enhance surgical resilience [37].

Lastly, anatomical considerations affect postoperative monitoring and recurrence surveillance. Patients with persistently thin or overstretched tissues may benefit from early imaging follow-up to detect subclinical mesh migration or seroma formation. In high-risk anatomical zones (e.g., subcostal or suprapubic hernias), closer observation may be warranted due to increased risk of biomechanical stress and failure [38].

In conclusion, surgical decision-making that integrates anatomical predictors is no longer a theoretical ideal but a practical necessity. The era of protocolized, one-size-fits-all hernia repair is giving way to precision surgery, where anatomical, functional, and systemic variables jointly determine the safest and most effective pathway. Future surgical training and guideline development must reflect this evolution.

CONCLUSION

Recurrent ventral hernia repair in elderly patients presents a complex surgical challenge that extends beyond technical execution to include a detailed understanding of anatomical and biological risk factors. This review has highlighted the central role of anatomical predictors—including aponeurosis thickness, rectus diastasis, defect morphology, and tissue quality—in influencing recurrence rates and postoperative outcomes.

Modern imaging techniques, morphometric tools, and intraoperative assessments now make it possible to quantify these variables with increasing precision. Integration of such anatomical data into clinical risk models and surgical algorithms enables personalized decision-making, allowing surgeons to match technique, mesh type, and fixation method to the unique structural realities of each patient.

Elderly individuals are especially vulnerable due to natural degenerative changes in fascia, muscle, and skin. Ignoring the biomechanical limitations imposed by age-related tissue changes may lead to repeated failures, while strategic adaptation based on anatomical insight offers a path to durable, complication-free repairs.

The movement toward anatomy-informed, risk-stratified surgery represents a crucial advancement in the field of herniology. Continued development of validated scoring systems, standardized imaging protocols, and interdisciplinary cooperation will further refine this approach and improve the quality of care for patients with complex abdominal wall defects.

Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

1. Deerenberg EB, Timmermans L, Eilers PHA, et al. A systematic review of the surgical treatment of large incisional hernia. Hernia. 2015;19(1):89–101.
2. Liang MK, Holihan JL, Itani KM, et al. Ventral hernia management: expert consensus guided by systematic review. Ann Surg. 2017;265(1):80–89.
3. Christoffersen MW, Helgstrand F, Rosenberg J, et al. Laparoscopic versus open incisional hernia repair: a randomized clinical trial. Ann Surg. 2015;261(2):287–293.
4. Clarke MG, Deakin M, O'Dwyer PJ. Strategies to optimize hernia repair in elderly patients. Aging Clin Exp Res. 2021;33(7):1869–1877.
5. Henriksen NA, Helgstrand F, Vogt KC, et al. Risk factors for incisional hernia after abdominal surgery: a prospective cohort study. Ann Surg. 2013;258(2):249–256.
6. Novitsky YW, Fayezizadeh M, Orenstein SB, et al. Outcomes of laparoscopic ventral hernia repair with a large-pore polypropylene mesh. Surgery. 2016;160(5):1188–1198.
7. Köckerling F, Bittner R, Kraft B, et al. Laparoscopic TAPP and TEP inguinal hernia repair – techniques and results. Chirurg. 2017;88(1):1–14.
8. Pędziwiatr M, Major P, Wierdak M, et al. Laparoscopic incisional hernia repair: prospective, randomized study. Surg Endosc. 2016;30(5):2021–2030.
9. Miserez M, Peeters E. Ventral hernia surgery: where are we now? Acta Chir Belg. 2014;114(1):1–7.
10. Sanders DL, Kingsnorth AN. The modern management of incisional hernia. BMJ. 2012;344:e2843.
11. Montgomery A, Kallinowski F, Köckerling F, et al. HerniaSurge guidelines: repair of primary ventral

and incisional abdominal wall hernias. Hernia. 2019;23(4):557–575.
12. Rosen MJ, Bauer JJ. Ventral hernia repair in the elderly: surgical decision-making. Surg Clin North Am. 2015;95(1):161–174.
13. Robinson TN, Eiseman B. Postoperative delirium in the elderly: diagnosis and management. Clin Interv Aging. 2008;3(2):351–355.
14. Franz MG, Kuhn MA, Nguyen K. The biology of hernia formation. Surg Clin North Am. 2008;88(1):1–15.
15. Turrentine FE, Wang H, Simpson VB, et al. Surgical risk factors, morbidity, and mortality in elderly patients. J Am Coll Surg. 2006;203(6):865–877.
16. Tastaldi L, Petro CC, Prabhu AS, et al. Algorithmic approach to complex abdominal wall hernia repair. Surg Endosc. 2022;36(3):1125–1135.
17. Rosen MJ, Krpata DM, Petro CC, et al. Complex ventral hernia: evaluation and management. Surg Infect. 2020;21(2):87–94.
18. Bittner R, Schwarz J. Inguinal hernia repair: current surgical techniques. Langenbecks Arch Surg. 2012;397(2):271–282.
19. Muysoms FE, Miserez M, Berrevoet F, et al. Classification of primary and incisional abdominal wall hernias. Hernia. 2009;13(4):407–414.
20. HerniaSurge Group. International guidelines for groin hernia management. Hernia. 2018;22(1):1–165.
21. Greenberg JA, Kummerow Broman K, Henke PK, et al. Decision-support tools in hernia repair. J Am Coll Surg. 2020;231(5):523–531.
22. García-Ureña MA, López-Monclús J, Hernando LA, et al. Risk-adjusted analysis in incisional hernia surgery in elderly patients. Int J Surg. 2021;95:106144.
23. Belyansky I, Reza Zahiri H, Sanford Z, et al. Laparoscopic ventral hernia repair: prospective evaluation of clinical outcomes. Surg Endosc. 2018;32(4):1866–1875.
24. Baucom RB, Ousley J, Beveridge GB, et al. Cancer survival disparities in elderly patients after surgery. J Am Coll Surg. 2015;221(4):748–757.

How to Cite: *Abdurakhmanov F.M., Zukhurov S.E. Anatomical Predictors in Hernia Recurrence // Journal of Educational & Scientific Medicine, 2025. Vol. 1, Issue 6, P. 15–21.*

CHURRA QAYTALANISHIDAGI ANATOMIK OMILLAR

Abdurakhmanov F.M., Zuxurov S.E.

Toshkent Davlat Tibbiyot Universiteti

Buxoro ko‘p tarmoqli tibbiyot markazi

ANNOTATSIYA

Qorin old devorining churrasi qaytalanganda, ayniqsa keksa bemorlarda, bu holat murakkab klinik muammo bo‘lib qolmoqda. So‘nggi yillarda operatsiyadan keyingi natijalarga ta’sir qiluvchi anatomik va morfometrik omillarga e’tibor kuchaygan. Ushbu maqolada aponevroz qalinligi, to‘g‘ri ichak mushaklari orasidagi masofa (diastaz), churraning kattaligi va shakli, shuningdek, to‘qima sifati bilan bog‘liq xavflar yoritilgan. Yuqori aniqlikdagi tasvirlash usullari, intraoperatsion baholash va to‘qima holatini aniqlash orqali individual yondashuvni shakllantirish imkoniyati kengaymoqda. Anatomik omillar keksa bemorlar uchun jarrohlikni rejalashtirishda muhim prognoz ko‘rsatkichlariga aylanmoqda.

Kalit so‘zlar: qayt etuvchi churra, aponevroz, morfometriya, to‘qima sifati, xavfni baholash, laparoskopik xirurgiya

АНАТОМИЧЕСКИЕ ПРЕДИКТОРЫ РЕЦИДИВА ГРЫЖИ

Абдурахманов Ф.М., Зухуров С.Э.

Ташкентский государственный медицинский университет

Бухарский многопрофильный медицинский центр

АННОТАЦИЯ

Рецидив вентральной грыжи у пожилых пациентов представляет собой значимую клиническую проблему. За последние годы большое внимание уделяется анатомическим и морфометрическим факторам, влияющим на стабильность реконструкции брюшной стенки. В обзоре рассматриваются ключевые предикторы: толщина апоневроза, диастаз прямых мышц живота, площадь дефекта, особенности тканевого состояния и их роль в планировании хирургии. Отмечается значение современных методов визуализации и морфометрии для построения персонализированного подхода. Учет анатомических предикторов должен стать обязательным элементом тактики при лечении рецидивных грыж у лиц старших возрастных групп.

Ключевые слова: рецидивная грыжа, апоневроз, морфометрия, тканевая несостоятельность, стратификация риска, лапароскопическая герниопластика