“OVIDIUS” UNIVERSITY OF CONSTANTA
DOCTORAL SCHOOL OF MEDICINE
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"Abdominal Wall Reconstruction After Parietal Defects: Endolaparoscopic Versus Classical Approach"

PhD THESIS ABSTRACT

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Introduction

Abdominal wall defects—including congenital hernias, acquired hernias, and postoperative eventrations—are common in general surgery with significant clinical, aesthetic, and functional implications. In recent decades, technological advances and the development of minimally invasive techniques have diversified treatment options, while highlighting the need for a deeper understanding of abdominal wall anatomy and embryology.

This thesis offers an integrated, multidisciplinary approach, starting from the embryological foundations of abdominal wall development, detailing anatomical organization, and culminating with a rigorous analysis of current surgical options. Within this framework, a therapeutic algorithm is proposed to support individualized clinical decision-making for each patient.

Embryology of the Abdominal Wall

The abdominal wall develops during the first weeks of embryonic life, essential for closing the abdominal cavity and correctly positioning internal organs. During weeks 3–4 of gestation, lateral, cranial, and caudal folding convert the trilaminar embryonic disc into a three-dimensional tubular organism, closing the ventral embryonic wall and separating the coelomic cavity into distinct compartments.

- **Lateral folding** brings somatic mesoderm to the midline, forming muscular and fascial components.
- The external oblique, internal oblique, transversus, and rectus abdominis muscles originate from paraxial mesoderm myotomes, influenced by genes like PAX3, Myf5, MyoD, BMP4, and SHH.
- The **rectus abdominis muscle** and **linea alba** form by week 10, with the linea alba initially mesenchymal and later a recognized weak point prone to herniation.
- Physiological **midgut herniation** into the umbilical cord occurs between weeks 6 and 10, followed by return to the abdomen and closure of the umbilical ring. Failure here can result in congenital defects like omphalocele or gastroschisis.

Understanding these processes is crucial not only for interpreting congenital hernias but also for optimizing surgical reconstructions and explaining segmental innervation and vascular patterns.

Anatomy of the Abdominal Wall

The abdominal wall is a complex anatomical structure responsible for protecting internal organs, maintaining intra-abdominal pressure, and enabling functions like breathing, coughing, defecation, and childbirth. It's anatomically divided into anterior, lateral, and posterior regions, demarcated by bony and fascial landmarks.

- **Superior boundary:** costal margin and diaphragm attachments
- **Inferior boundary:** iliac crest, inguinal ligament, and pubic symphysis
- **Lateral boundary:** flanks
- **Posterior boundary:** paravertebral muscles and thoracolumbar fascia

Its layered structure (from superficial to deep):

1. **Skin** – highly elastic
2. **Subcutaneous tissue** – with superficial (fatty) and deep (Scarpa's) layers
3. **Muscular layer** – external oblique, internal oblique, transversus abdominis, rectus abdominis, and occasionally pyramidalis muscle
4. **Rectus sheath** – formed by aponeuroses of the lateral muscles, differing above and below the arcuate line
5. **Transversalis fascia** – important in extraperitoneal surgery
6. **Extraperitoneal fat** – potential space for pathologic collections
7. **Parietal peritoneum** – pain-sensitive serous membrane

Blood supply comes from epigastric, lumbar, circumflex iliac arteries, and superficial femoral branches, with anastomoses key for perfusion and reconstruction. **Innervation** originates from T7–T11 intercostal nerves, T12 subcostal, and upper lumbar (L1–L2) nerves, supplying both motor and sensory structures, explaining the dermatomal presentation in viscerosomatic pathologies.

Natural weak zones—linea alba, inguinal canal, umbilical region, femoral fossa—are hernia-prone and must be carefully evaluated. Thorough anatomical knowledge is essential for both open and laparoscopic surgery and prevents complications.

Surgical Treatment of Abdominal Wall Defects

Abdominal wall defects—congenital, acquired hernias and postoperative eventrations—are surgically significant and impact patient quality of life. These involve imbalance between intra-abdominal pressure and wall resistance, with protrusion through weak points or actual defects. Treatment is fundamentally surgical; optimal technique depends on defect type, local anatomy, patient condition, and available resources.

The distinction between a **hernia** (through a natural weak point) and an **eventration** (a postoperative hernia through a surgical scar) is key. Etiology, reducibility, and surgical approach differ, and diagnosis relies on clinical examination and imaging (ultrasound, CT) to assess defect size, sac content, and relations to adjacent structures.

A. Open (Classical) Techniques

- **Bassini** – inguinal hernia repair by reconstructing the posterior wall
- **Shouldice** – fascial repair without mesh (excellent results in experienced hands)
- **McVay** – femoral hernia repair attaching the inguinal arch to Cooper's ligament
- **Mayo** – umbilical hernia by fascial overlap ("vest-over-pants")
- **Rives-Stoppa** – gold standard for large eventrations using retromuscular (sublay) mesh

Advantages include direct access and precise anatomical reconstruction; disadvantages include increased postoperative pain, infection risk, and longer recovery.

B. Minimally Invasive (Laparoscopic & Robotic)

- **TAPP** (TransAbdominal PrePeritoneal)
- **TEP** (Totally ExtraPeritoneal)
- **IPOM** (IntraPeritoneal Onlay Mesh) and **IPOM-plus** (with defect closure)
- **Hybrid and robotic techniques** for complex cases

These offer reduced pain, faster recovery, fewer complications, and better aesthetics. They require specific meshes with anti-adhesion barriers and have a learning curve.

Meshes and Fixation

- **Mesh materials**: non-absorbable (polypropylene, polyester), absorbable (Vicryl, Monocryl), partially absorbable, or biological (used in infected/recurrence contexts)
- **Placement**: onlay, sublay (retromuscular ideal), inlay, or intraperitoneal (underlay/IPOM)
- **Fixation methods**: sutures, metal/absorbable tacks, biological adhesives Proper choice and placement significantly impact complications like seroma, infection, chronic pain, and adhesions.

Conclusions and Clinical Considerations

Effective treatment relies on deep understanding of embryology, anatomy, physiology, and modern tissue reconstruction principles. Embryologic "imprints"—weak zones, force lines, vascular and nerve tracts—are clinically relevant.

Clear differentiation between hernia (natural defect) and eventration (post-surgical defect) is essential. Rigorous history taking, physical examination, and imaging underpin accurate diagnosis and therapy.

Over decades, surgical approaches have evolved from classic suture repairs to fascial plasties, mesh placements, and laparoscopic/robotic procedures. Modern surgery requires technical excellence, proper case selection, appropriate materials, and biomechanical respect.

Alloplastic meshes have reduced recurrences significantly but carry risks. Meticulous surgical technique, atraumatic fixation, and correct mesh selection reduce complications. Minimally invasive surgery has revolutionized groin and ventral hernia treatment, yielding comparable or superior outcomes to open surgery in experienced hands.

Therapeutic Algorithm

1. Comprehensive clinical evaluation (history, exam, context)
2. Precise defect classification (location, etiology, size, clinical traits)
3. Indication for surgery (symptoms, large/progressive eventration, complication risk)

4. Surgical technique selection:
    - **Open** (Bassini, Rives-Stoppa, Mayo) for large, complex, or recurrent defects
    - **Laparoscopic** (TAPP, TEP, IPOM) for moderate primary defects without major adhesions
    - **Hybrid/Robotic** for altered anatomy or precision needs
5. Mesh choice and fixation tailored to case (sublay ideal, biological compatibility, atraumatic fixation)
6. Postoperative surveillance (pain control, infection prevention, complication monitoring, patient education)

Author's Personal Contribution

Based on your clinical activity treating abdominal wall defects, you observed qualitative differences favoring minimally invasive techniques. This led to a detailed clinical research with goals:

Primary Objectives

- Scientifically and statistically demonstrate the superiority of laparoscopic techniques
- Develop a therapeutic algorithm for these defects

Secondary Objectives

- Highlight efficiency in hospitalization duration and treatment costs
- Evaluate patient satisfaction, including aesthetics, across laparoscopic, endoscopic, and open methods

Methods

A clinical observational-comparative study was conducted at the II Surgery Clinic of Constanța County Emergency Clinical Hospital "St. Apostle Andrew," from August 1, 2016 to August 1, 2018, with ethics approval, using clear inclusion/exclusion criteria and data sources including clinical records, imaging, operative protocols, and postoperative evolution.

Results

- **Study group:** 49 patients, mean age 52.02 ± 12.73 years (range 27–85)
- **Residence:** ~75% urban, mirroring county statistics (~70%)
- **Age distribution:** Minimally invasive patients younger and more age-variant; >50% under 50 vs. ~23% in open surgery
- **Gender:** ~54% women in open; ~47% in minimally invasive (slightly more men for minimally invasive)
- **Comorbidities:** ~30% without comorbidities in both groups; obesity (15% open vs. 36% minimally invasive) and hypertension (15% vs. 25%) were most common; heart failure more in open, while AF, diabetes, and pulmonary tumor only in open
- **Weight/BMI:** Mean weight: 82.69 ± 16.5 kg (open) vs. 90.39 ± 14.83 kg (minimally invasive); BMI: 28.59 kg/m² (open) vs. 31.43 kg/m² (minimally invasive). Most minimally invasive patients were obese grade 1; most open patients were normal or overweight
- **Urgency:** 30.8% of open cases were emergency vs. 47.2% of minimally invasive; suggests minimally invasive often used in emergencies
- **Prior surgeries:** Hernias (~30%), cholecystectomies (~16%), appendectomies (~12%) common; open mostly for hernias and cesareans; minimally invasive for postsurgical hernias (hernia, hiatal, linea alba), post-appendectomy (16.7%), and gastric ulcer (13.9%). Re-operations for appendectomy and ulcer preferred minimally invasive; revising after cesarean, obstruction, or colon tumor was always open
- **Meshes used:** Open exclusively Macropore; minimally invasive used Macropore (~⅔), Ventalight (16.7%), Progrip (11.1%), Composite (5.6%)
- **Defect size:** Open mean 18.31 ± 6.48 cm (range 12–30); minimally invasive mean 10.03 ± 4.82 cm (range 4–20). Technique classification varied accordingly
    - Minimally invasive used a broader range of classifications
- **Antibiotic use:** Open cases used ofloxacin (>90%, risk of C. difficile); only 7.7% without antibiotics. Minimally invasive: 22.2% without antibiotics; with antibiotics, penicillins predominated (69.8%)
- **Preoperative complications:** Open: ~60% had vomiting or obstruction vs. ~33% in minimally invasive; open had higher preoperative complication risk
- **Study on CO_2 pressure:** For incisional hernia laparoscopic/endoscopic cases (2018–2021), two groups used CO_2 at 8–11 mmHg vs. 12–15 mmHg. Pain was measured

immediately, at 12 and 24 hours post-op (5-point scale). Other monitored endpoints: analgesic need, ICU stay duration, intestinal transit return

Comparative Literature

- Lichtenstein technique showed significantly lower recurrence with comparable or less postoperative pain. Surgery time slightly longer (55 vs. 42 min), but long-term benefits outweigh this. Recurrence—not hernia type—is the key for choosing Lichtenstein.

Clinical Case

A 45-year-old urban patient (G.S.) with acute, progressive supra-umbilical pain and irreducible umbilical mass. Labs: WBC = 11,200/µL, CRP = 28 mg/L. Ultrasound confirmed incarcerated umbilical hernia containing bowel without ischemia. Emergency laparoscopic TAPP repair was performed with lightweight polypropylene mesh. The case demonstrates the safety and efficacy of laparoscopic TAPP for incarcerated umbilical hernias in emergencies—offering precise sac dissection, optimal visualization, anatomic reconstruction, rapid recovery, and low complication rates.

Discussion

Your comparative study confirms the superiority of minimally invasive hernia surgery from multiple clinical perspectives:

- **Postoperative complications:** 88.9% of minimally invasive patients had no complications vs. 53.8% in open; complications (hematoma, seroma, infection) occurred only in the open group (15.4% each)
- **Minimally invasive-specific issues:** trocar-site pain and stitch granuloma were low (5.6%) and didn't require reoperation or longer stay
- **Literature:** meta-analyses report <1% infection and 2–4% complications in laparoscopic hernia surgery—your data align with global trends
- **ICU stay:** longer in minimally invasive—but due to protocols, not clinical issues
- **Recurrence:** none in minimally invasive, aligning with meta-analysis recurrence rates (0–2.7%)

- **Bowel transit:** 70% of open cases resumed transit in 1 day vs. most minimally invasive in 2 days

Final Conclusions

1. Minimally invasive techniques are associated with significantly fewer postoperative complications (88.9% complication-free vs. 53.8% in open).
2. Inflammatory/infectious complications occurred only in open surgery (15.4% each).
3. Minimally invasive complications were low and manageable.
4. ICU stay was longer due to institutional protocol, not morbidity.
5. Minimally invasive preferred for patients under 60; open for those over 60.
6. Results align with international literature (complication <10%, infection <1%).
7. No hernia recurrences observed in minimally invasive group.
8. Chronic postoperative pain wasn't evaluated but literature favors laparoscopic methods.
9. Longer operative time for minimally invasive is offset by faster recovery and patient satisfaction.
10. Results strongly support expanding minimally invasive techniques, given proper training, equipment, and protocols.

Original Contributions

This research offers an extensive comparative study, multicriterial postoperative analysis (pain, hospital time, complications, recurrences, satisfaction), a standardized evaluation and follow-up protocol, biomechanical and functional indicators rarely addressed locally, clinical and cost-effectiveness data, and identification of risk factors for laparoscopic reconstruction failure. It complements international literature with a complex, multidisciplinary, practice-relevant approach based on personal clinical experience.

Distinctions from Existing Literature

While international studies compare techniques, many suffer from non-uniform selection, small samples, or short follow-ups. Your thesis addresses this by combining clinical, functional, and economic perspectives, supported by data from a center with tradition, offering directly applicable recommendations.

Scientific and Practical Value

Your integrative approach improves general hospital protocols, supports local/national guidelines for parietal surgery, and encourages further research aimed at personalized surgical treatment based on patient profile and defect complexity.

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