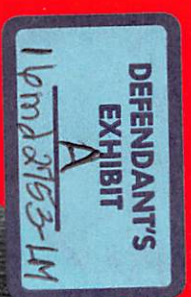


C-Quir™ Hernia Mesh Science Day Presentation

October 27, 2017



Outline of Presentation

- What is a Hernia?
- Types of Hernias
- Various Treatment Modalities
- History of C-Qur™ Mesh
- Types of C-Qur™ Mesh
- Complications Encountered in Hernia Repair

Introduction to Atrium Medical Corporation

- Founded in 1981 on the simple premise that improved patient outcomes is “job one” for every member of the company
- Local success story having grown from a small core group to approximately 500 employees
- Privately-held company until November 2011 when it was acquired
- Today, Atrium’s headquarters remain in Merrimack, New Hampshire

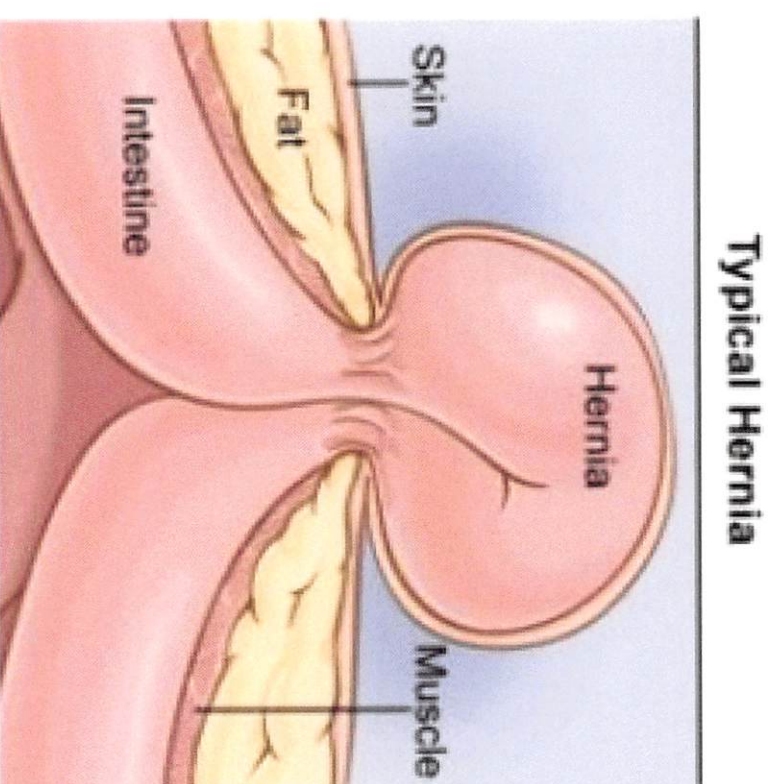


What is a Hernia?



What is a Hernia?

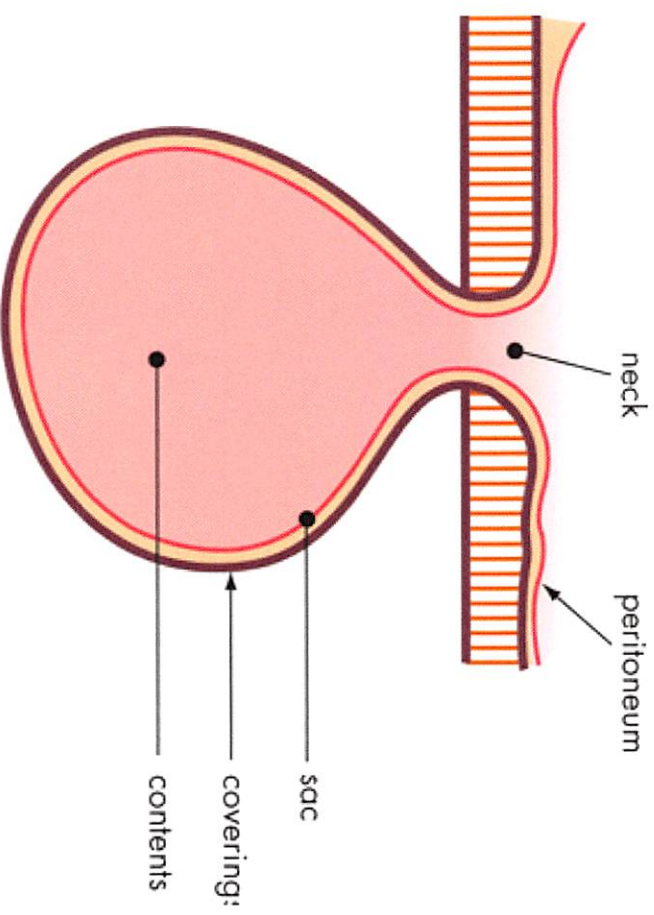
- A hernia occurs when an organ, intestine or tissue squeezes through the abdominal wall



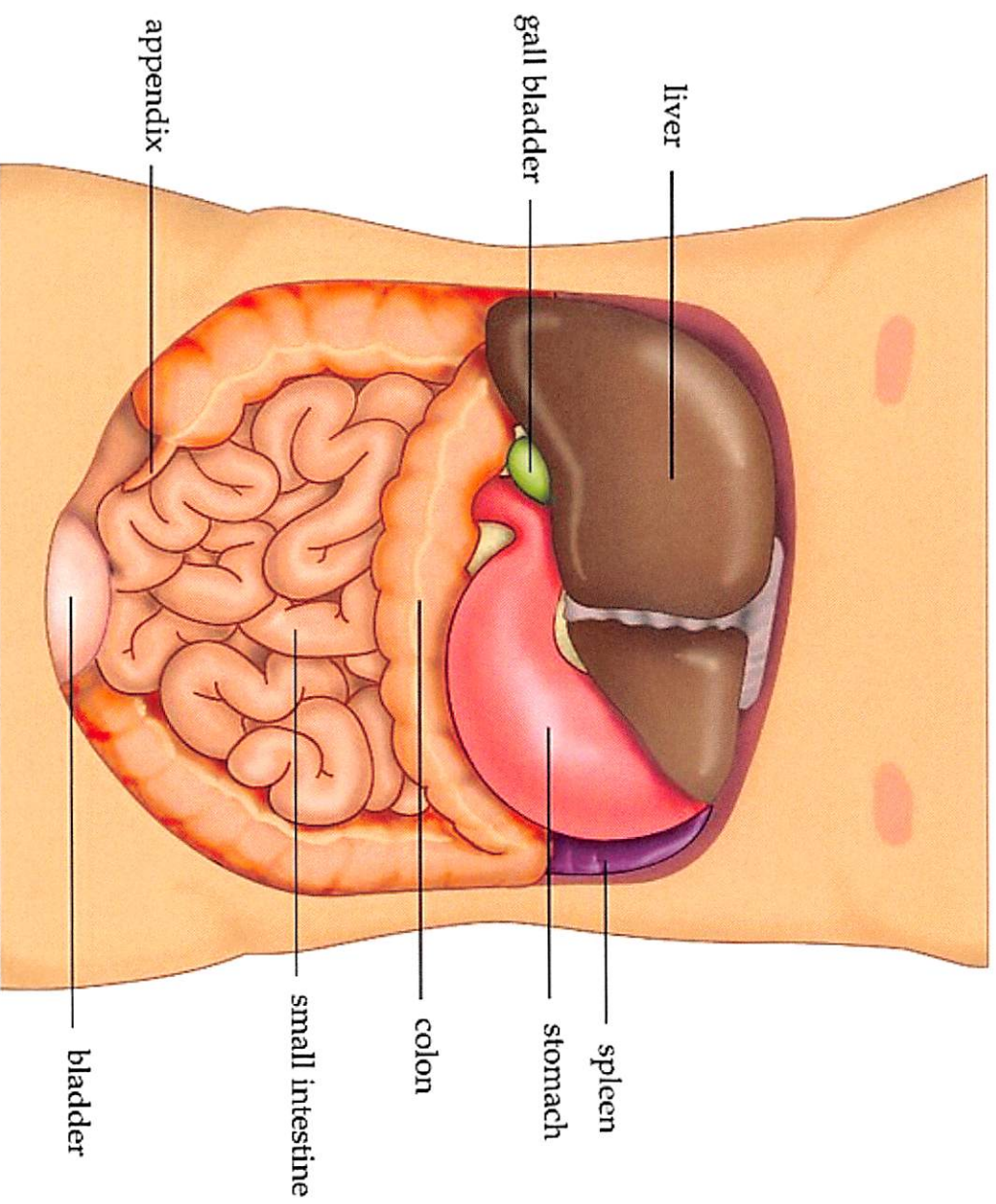
Composition of a Hernia

Three Parts –

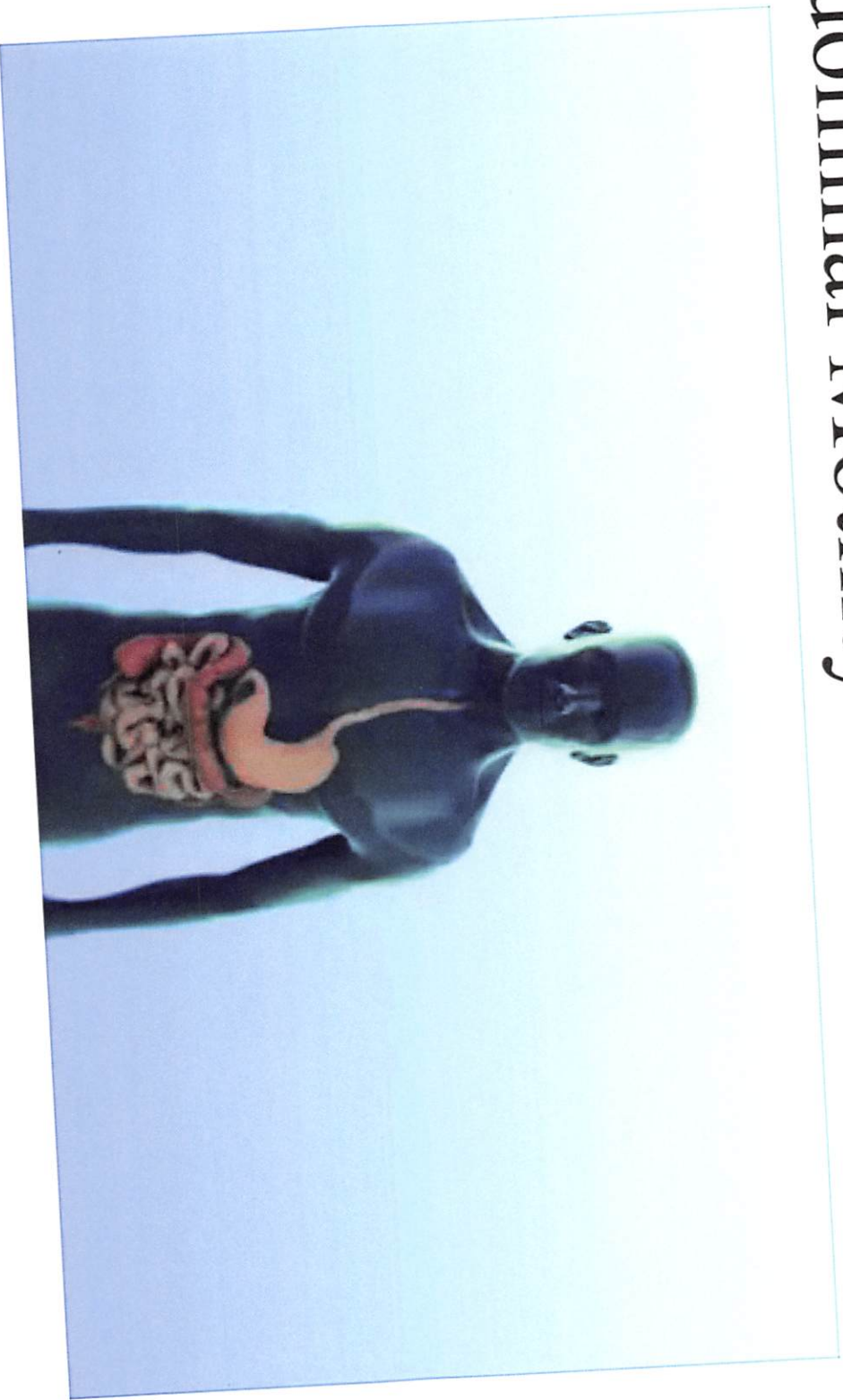
- The sac
- The covering of the sac
- The contents of the sac



The Abdominal Cavity

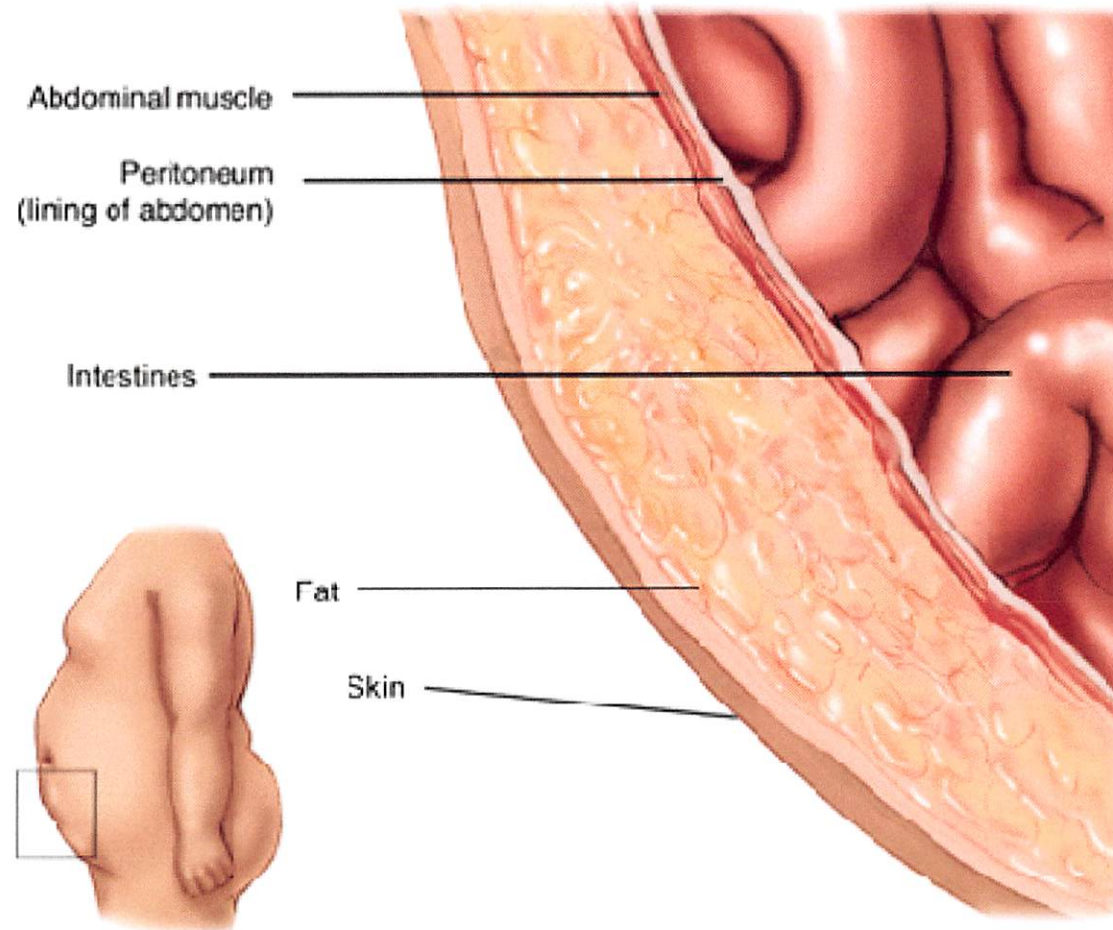


Abdominal Motility



Source: YouTube

The Abdominal Wall

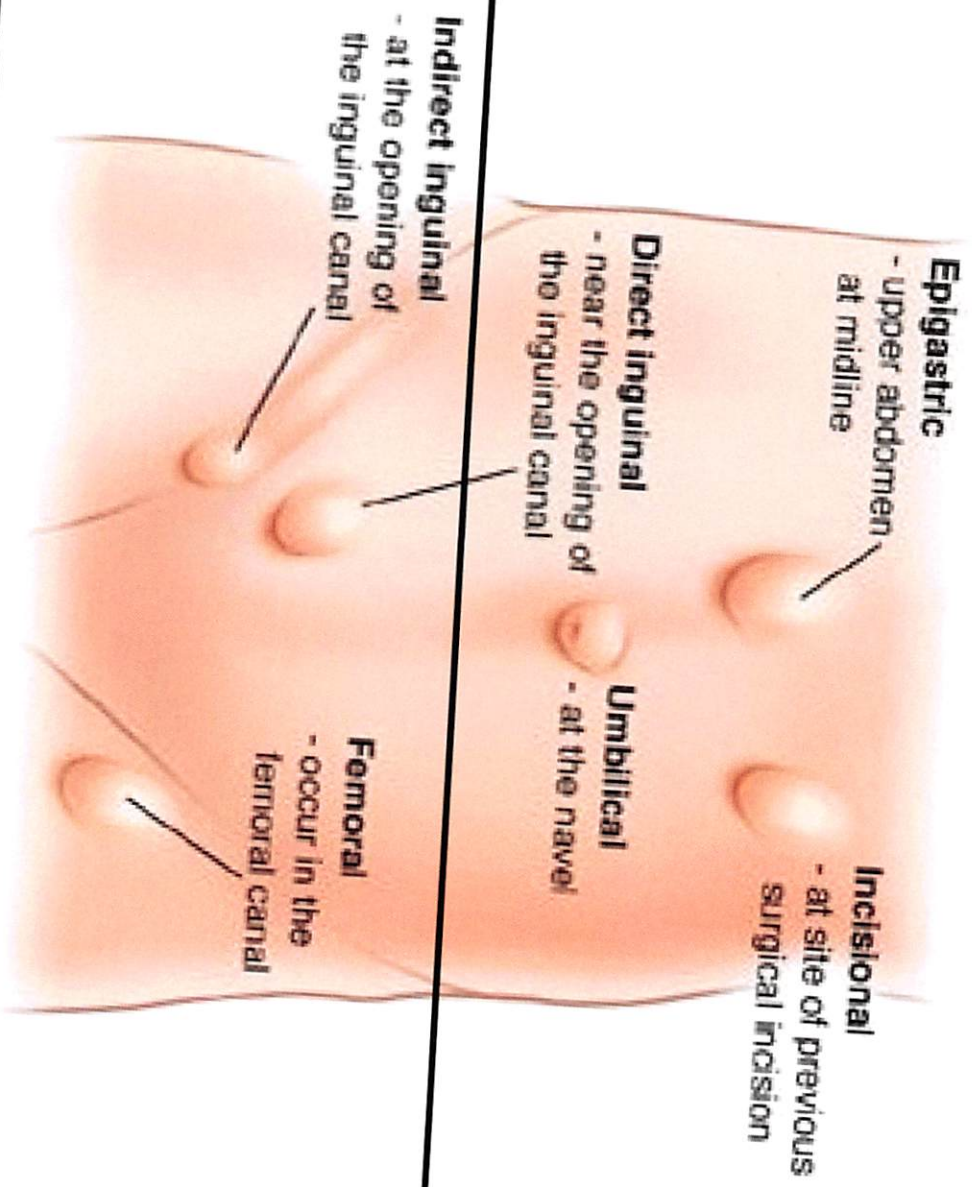


Types of Common Hernias



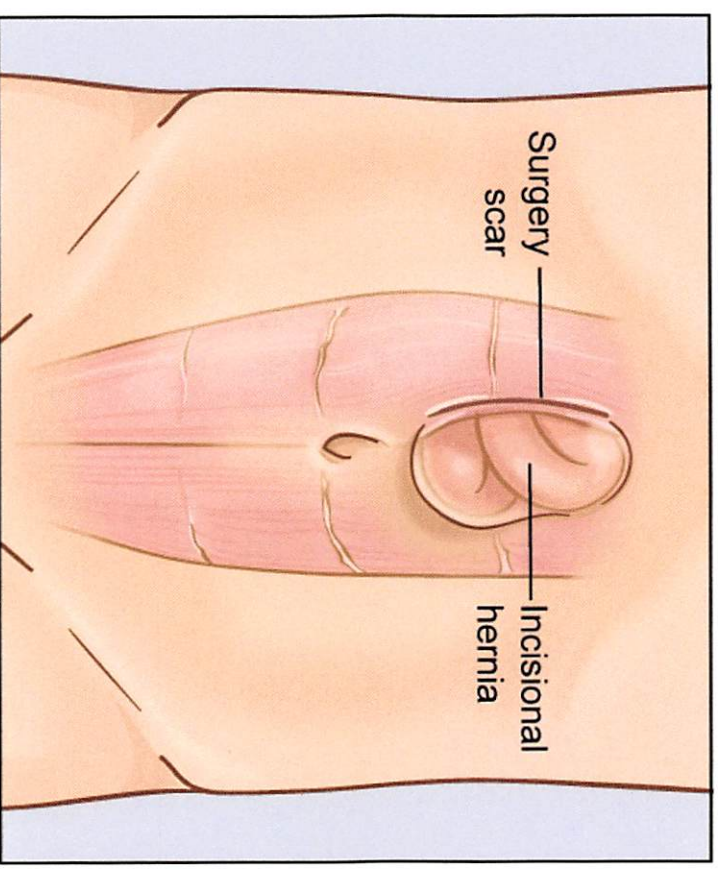
Types of Common Hernias by Location

- Ventral (Non-Groin)



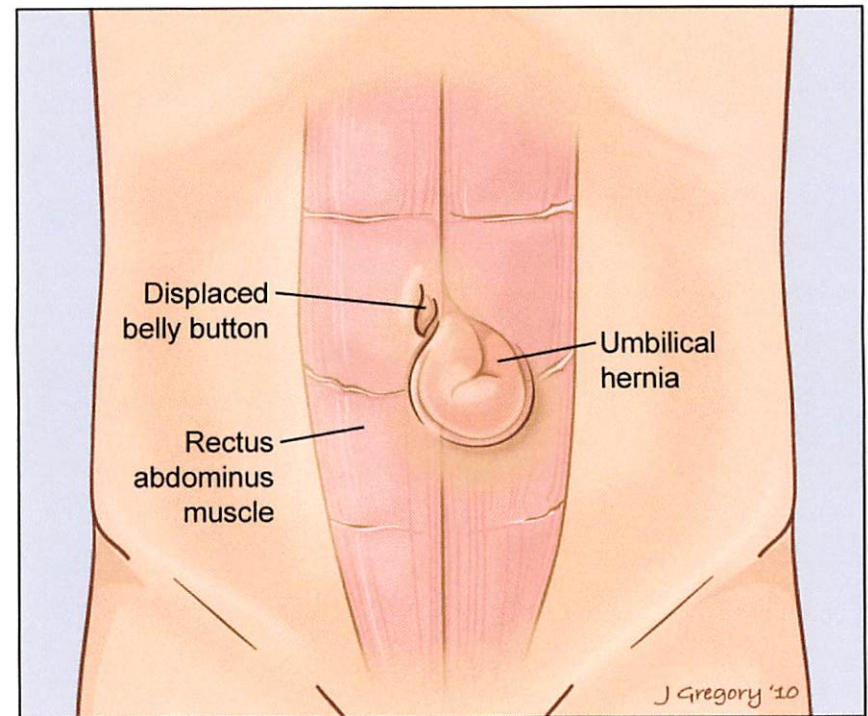
Ventral Hernias - Incisional

- Occur at the site of a previous surgical incision
- Occur in approximately 10% of all surgeries
- An incisional hernia can develop months or years after surgery
- If not repaired early, can develop into large complicated defects



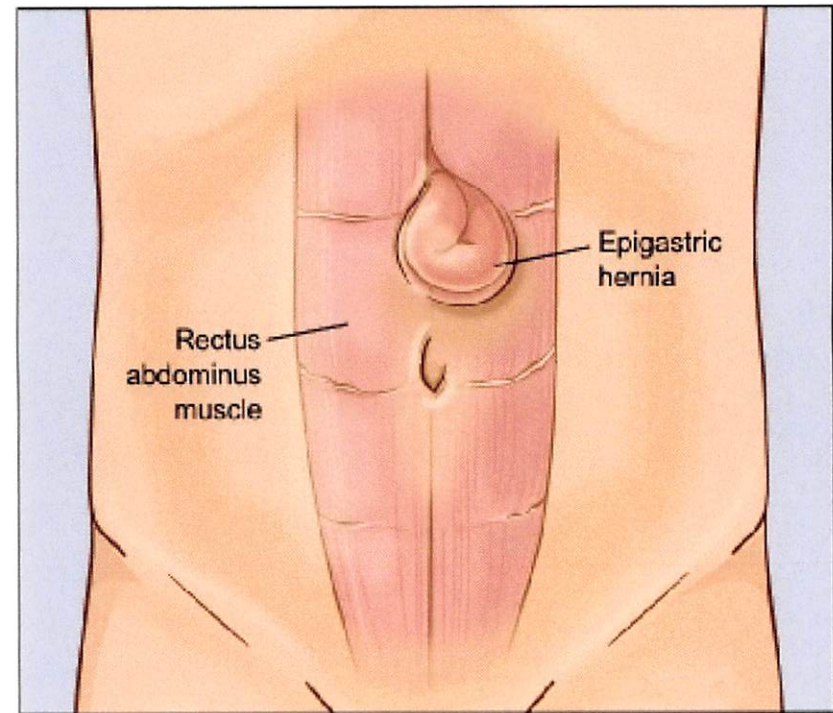
Ventral Hernias - Umbilical

- Occur at the belly button where the umbilical cord once passed through the abdominal wall
- Umbilical hernias in adults are more common in women than in men
- Obesity is a risk factor for umbilical hernias

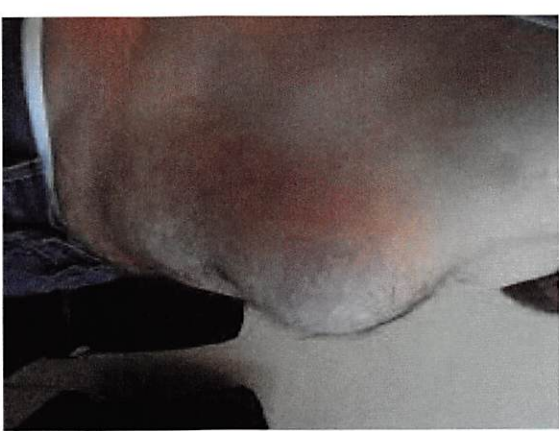


Ventral Hernias - Epigastric

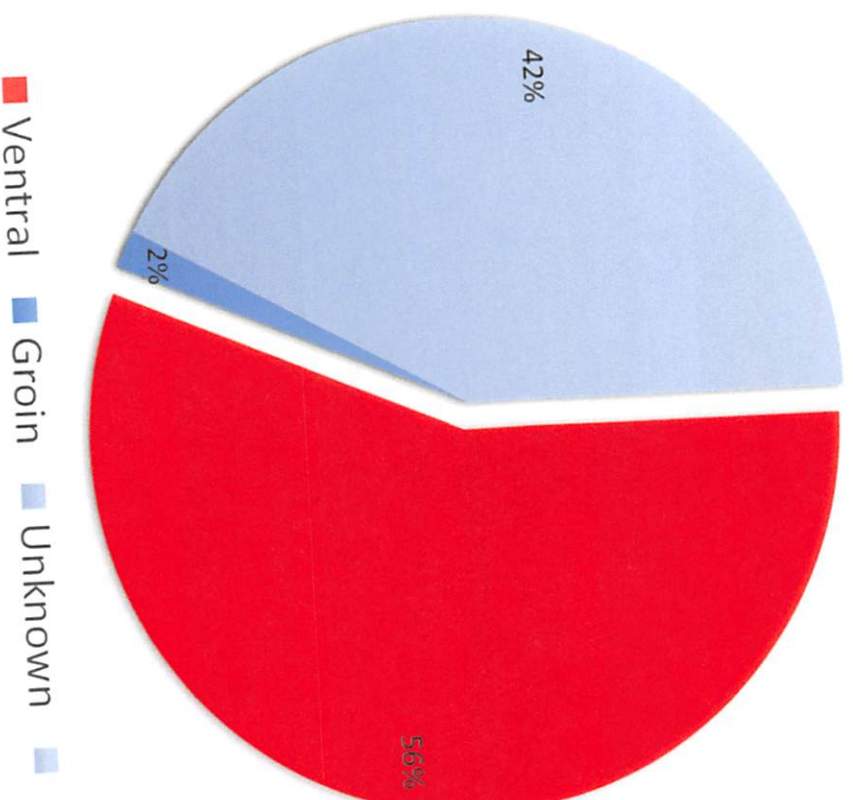
- Occurs in the upper abdomen at the midline between the lower breastbone and navel
- It is usually the result of a weakness present at birth combined with intra-abdominal pressure



Ventral Hernias



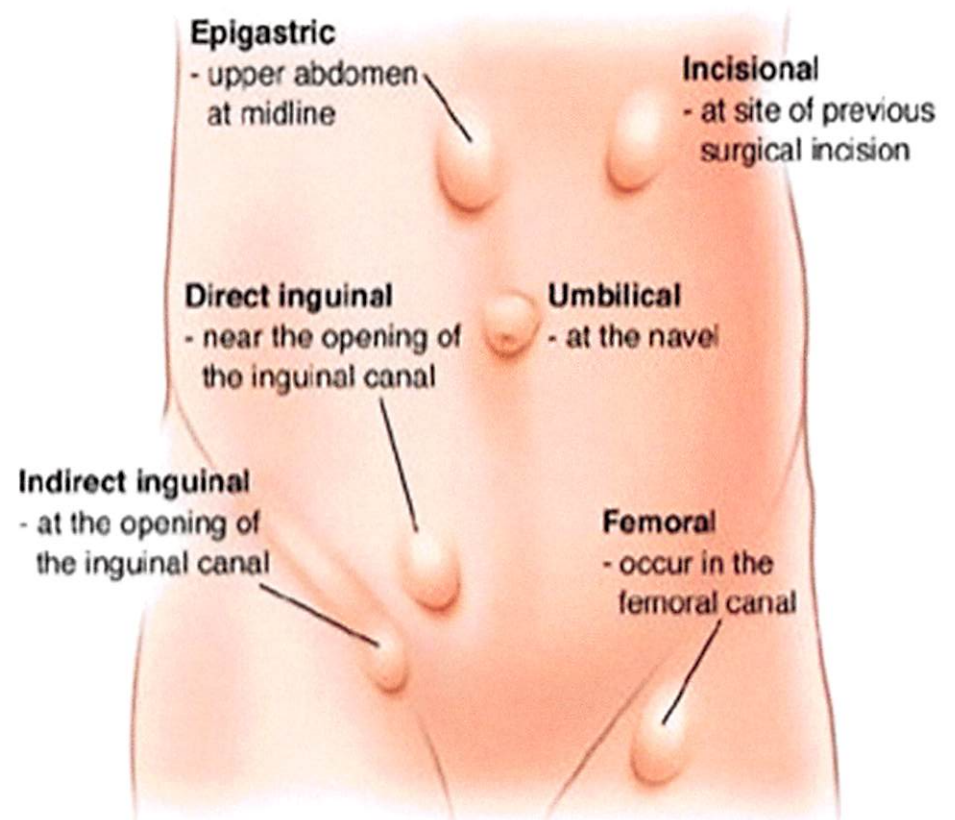
Percentage of Ventral Hernias in MDL and State Court Proceedings



Groin Hernias

Inguinal Hernias

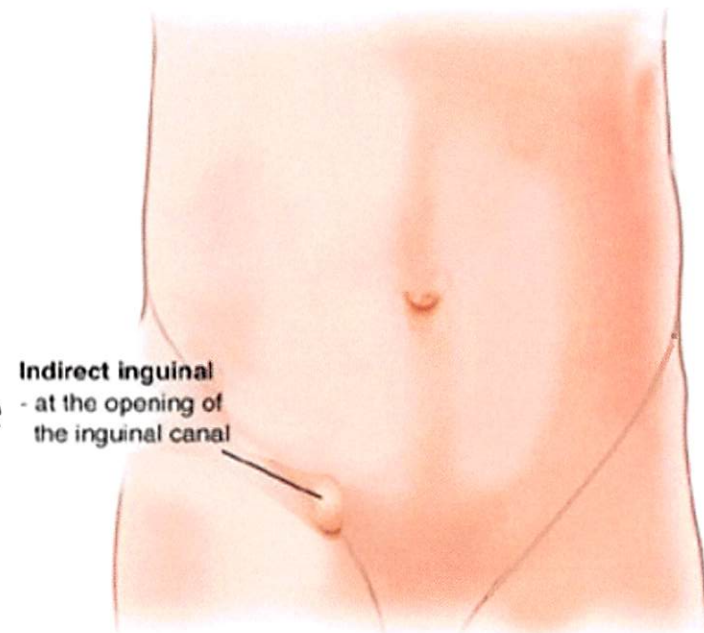
- Occur at or near the inguinal canal
- More common in men than in women



Groin Hernias

Indirect Inguinal Hernias

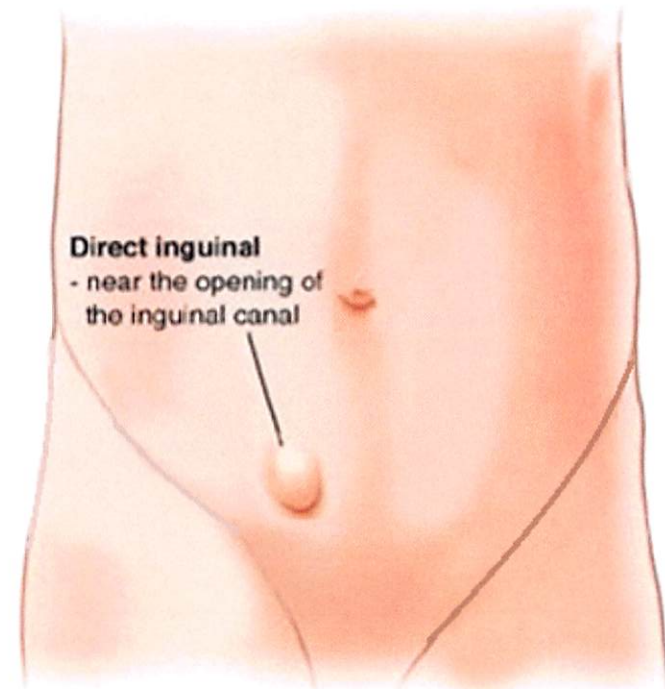
- Occurs when the intestine bulges through the inguinal canal
- This area may be weak at birth allowing hernias to form later in life
- Most common type of hernias in men



Groin Hernias

Direct Inguinal

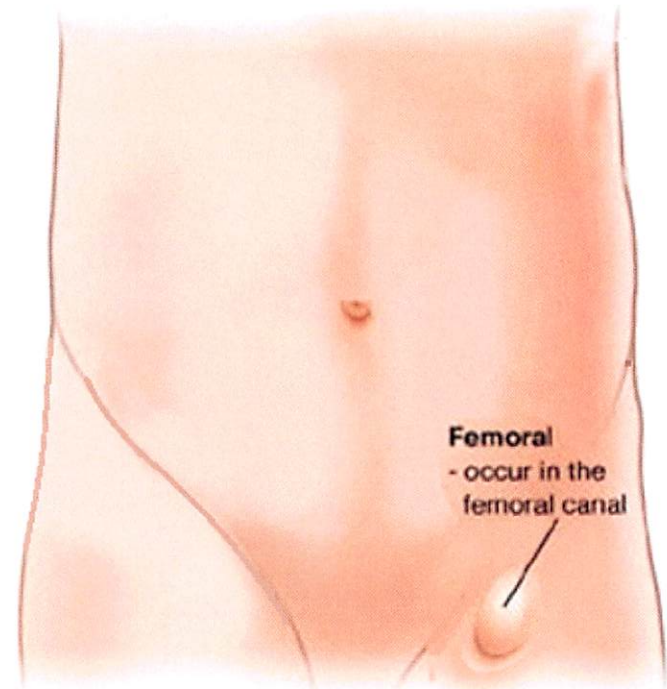
- Less common than an indirect inguinal hernia
- Occurs when the intestine bulges through the abdominal wall next to the inguinal canal
- Typically occur in men over 40 and may result from aging or injury



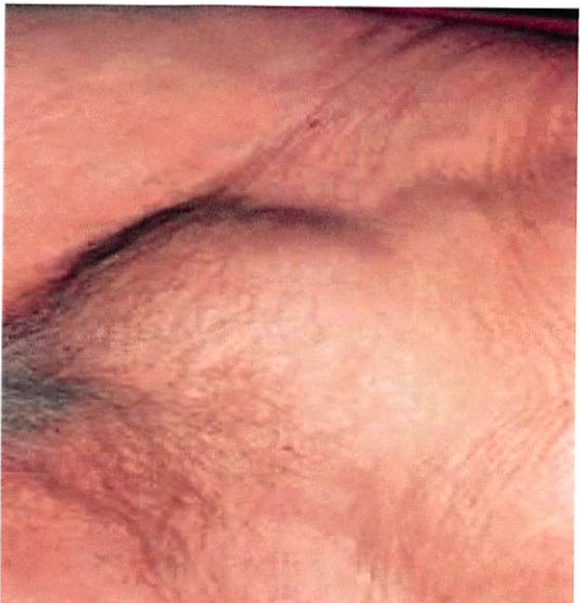
Groin Hernias

Femoral

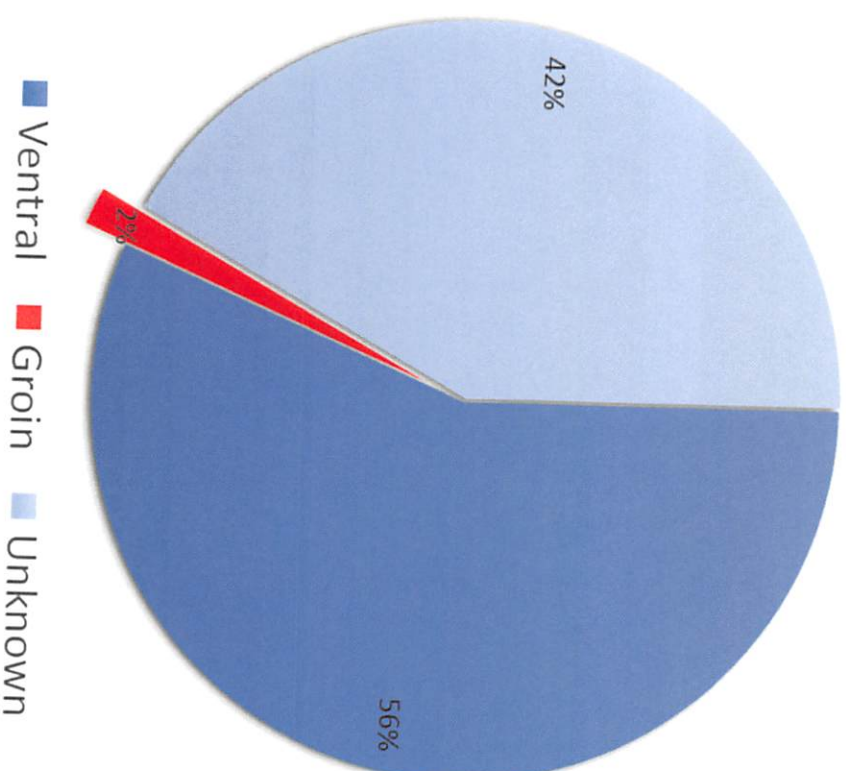
- Occurs high in the thigh
- More common in women but also occur in men



Groin Hernias

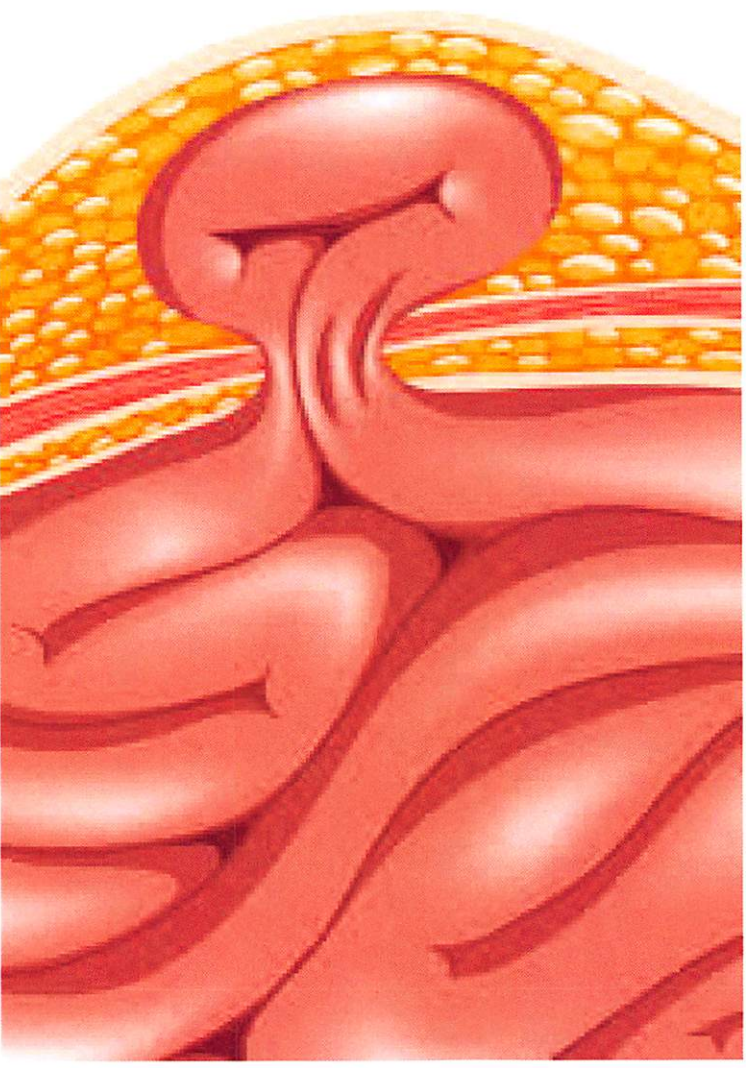


Percentage of Groin Hernias in MDL and State Court Proceedings



Types of Hernias by Severity

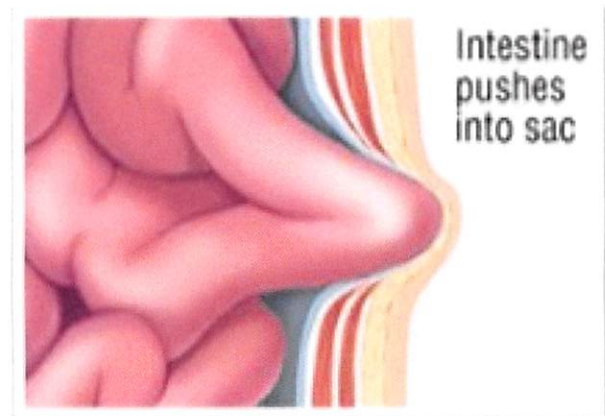
- Reducible
- Nonreducible/Incarcerated
- Strangulated



Types of Hernias by Severity

Reducible

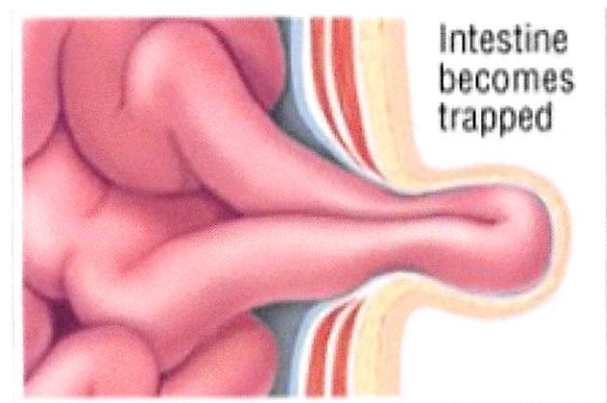
- Most hernias form a bulge as the intestine pushes into the hernia sac
- If the bulge flattens out upon laying down or pushing against it, it is a reducible hernia
- Although there is no immediate danger, surgery is still necessary



Types of Hernias by Severity

Nonreducible/Incarcerated

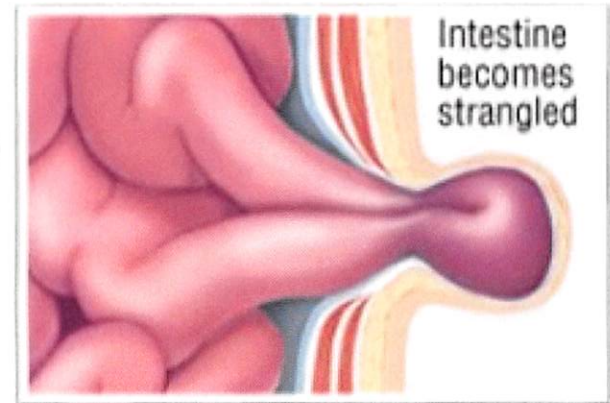
- If the intestine becomes trapped, the bulge cannot become flattened
- Nonreducible hernias can disrupt digestion and require prompt surgery



Types of Hernias by Severity

Strangulated

- Where the intestine is trapped tightly, it can lose blood supply and oxygen, and die
- Associated with a significant amount of pain
- A strangulated hernia can obstruct digestion
- Emergency surgery is required to relieve the obstruction and repair the hernia



Types of Hernias – Congenital vs. Acquired

Congenital

- Present from birth
- Forms at a point of natural weakness such as the inguinal canal and belly button

Acquired

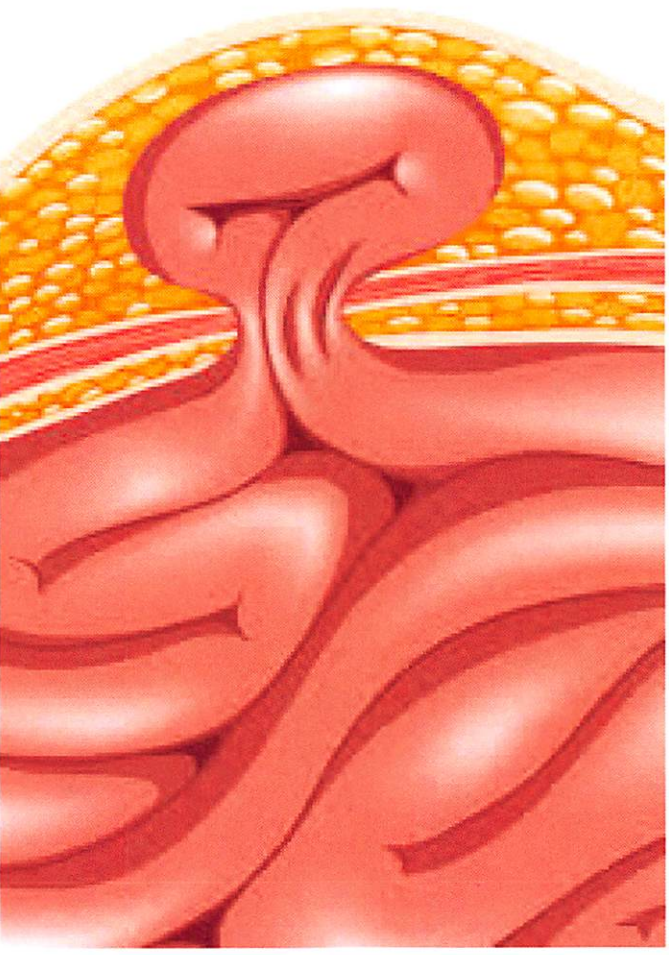
- Forms over time due to forces over-stretching the tissue
- Areas of acquired weakness include previous surgical sites

Causes of Hernias

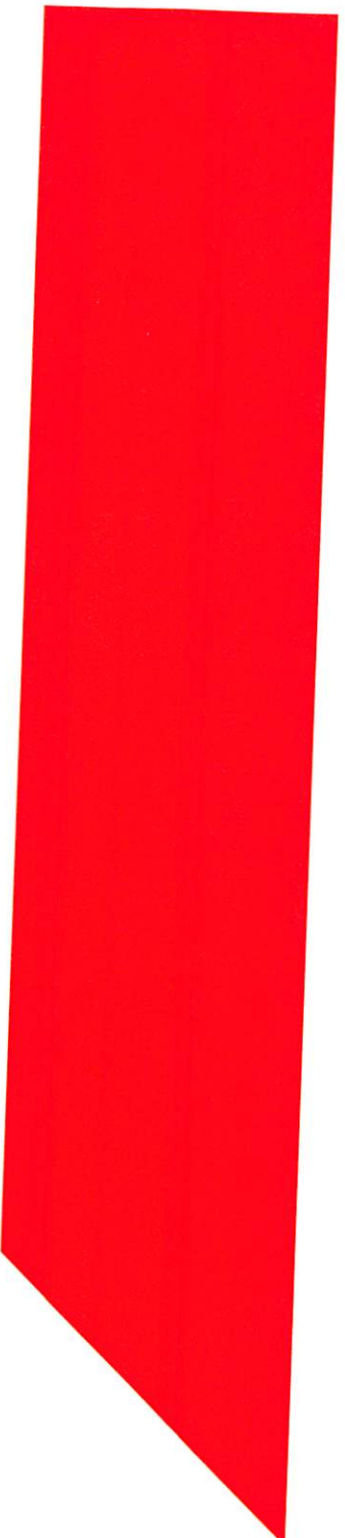
- Most hernias are caused by a combination of pressure and an opening or weakness in the abdominal wall. Any opening in the abdominal wall is prone to weakness:
 - Canals in the groin area
 - Previous openings that have closed, e.g. belly button, site of a healed surgical incision
 - The abdominal wall can be weakened by injury or aging
- Anything that increases abdominal pressure can cause a hernia:
 - Obesity
 - Lifting heavy objects
 - Persistent coughing or sneezing
 - Diarrhea or constipation
 - Sudden weight gain
- Lifestyle choices can increase the likelihood of a hernia:
 - Poor nutrition
 - Smoking
 - Overexertion

Common Symptoms of Hernias

- A bulge
- Pain
- Pressure or a feeling of heaviness in the abdomen
- Constipation or blood in the stool



Various Treatment Modalities



Surgical Hernia Repairs are Common

- Hernia repair is one of the most common types of surgery performed in the United States
- Hernia repair is the second most frequently performed surgical procedure
- More than 1,000,000 hernia repairs are performed each year in the United States
- The most common procedure performed by general surgeons
- Approximately 800,000 repairs are to inguinal hernias and the rest of the repairs are for other kinds of hernias

Treatment – Nonsurgical Approach

- Watchful Waiting:
 - Physician watches the hernia to ensure it is not getting larger or causing problems

- Girdle:

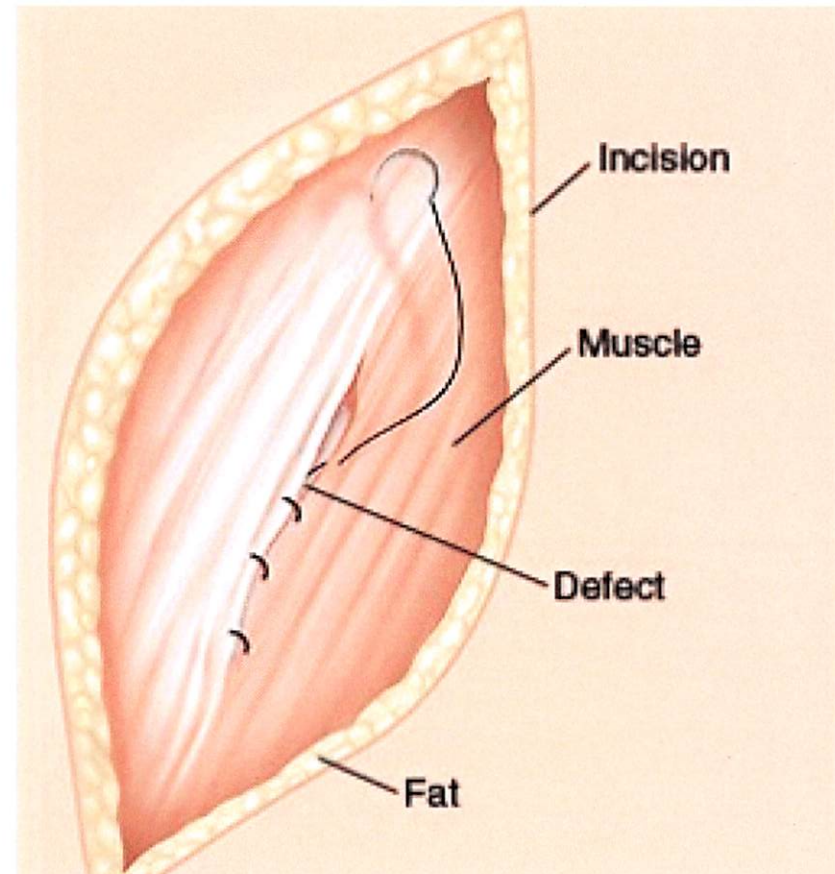


- These nonsurgical approaches were not available to or appropriate for the Plaintiffs given the severity or complexity of their defect.

Treatment – Surgical Approach

Non-Mesh Tension Repair

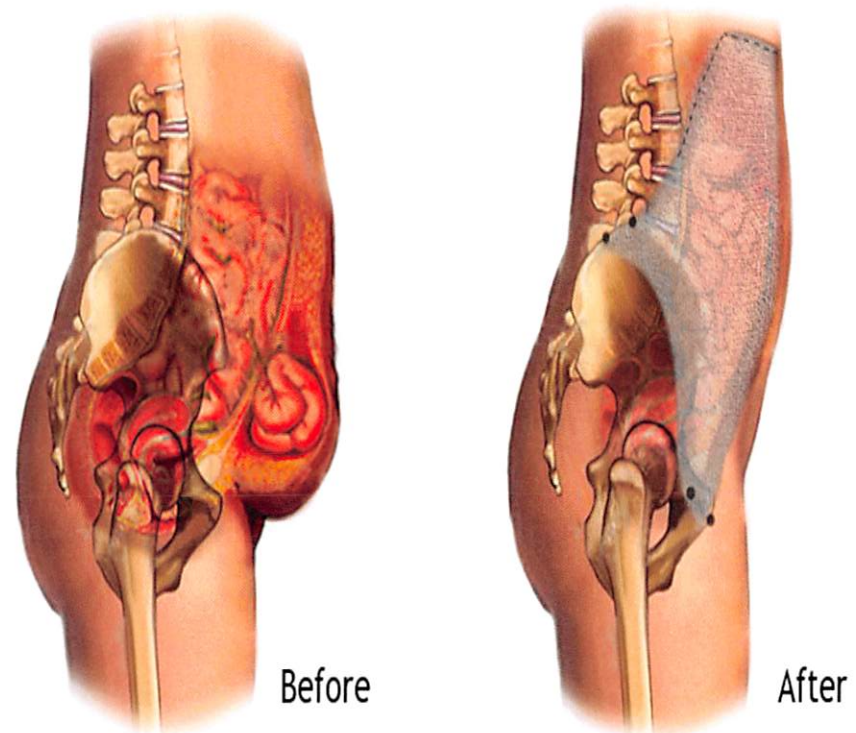
- Tissue to Tissue
- Surgeon sutures tissue and muscle together to repair hernia
- This causes “tension” on the sutures as well as the muscle
- More painful and longer recovery time
- High recurrence rate
- This technique has been used since the late 1800s



Treatment – Surgical Approach

Hernia Mesh History

- Until the late 1950s, abdominal wall hernias were repaired with sutures using the tension technique
- Polypropylene mesh was introduced in 1958 for hernia repairs
- Since the 1980s, there has been an increase in mesh-based hernia repairs
- Today, the use of mesh for hernia repair has virtually replaced suture repair in the developed world



Treatment – Surgical Approach

What is Surgical Mesh?

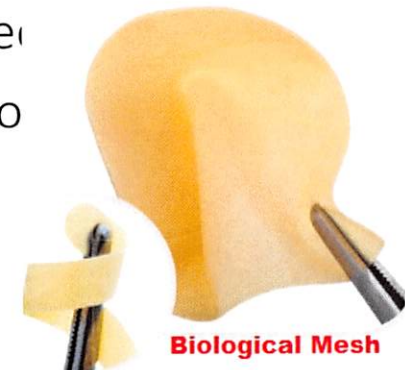
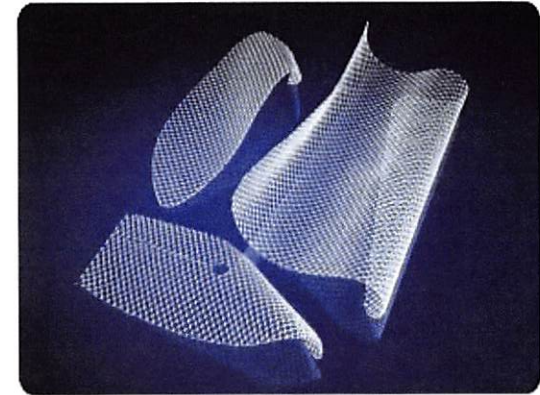
- A material used to reinforce the defect in the abdominal wall with the formation of scar tissue
- Surgical mesh is used to provide additional support to weakened or damaged tissue
- The mesh serves as a framework for the ingrowth of connective tissue



Treatment – Surgical Approach

Types of Hernia Mesh

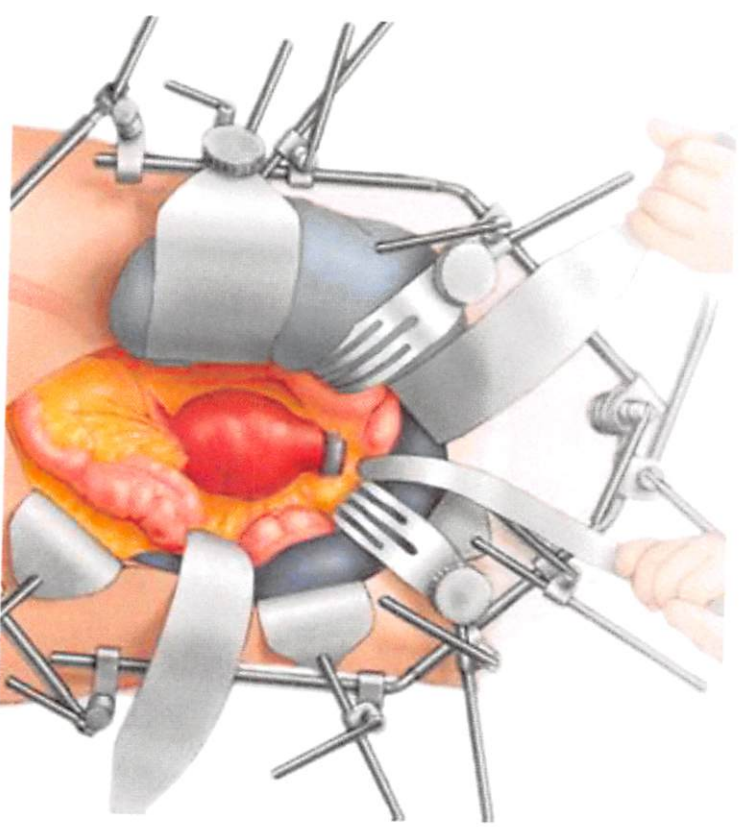
- Synthetic
 - Polypropylene
 - Polyester
 - Expanded Polytetrafluoroethylene (ePTFE)
- Biological/Animal Tissue
 - Made of tissue that has been processed and disinfected
 - Majority are from a pig (porcine) or cow (bovine) so
 - Advisable where there is a contaminated field or a prior infection
 - Very expensive
 - Not as strong as a synthetic mesh repair, higher recurrence rate



Treatment – Surgical Approach

Open Repair

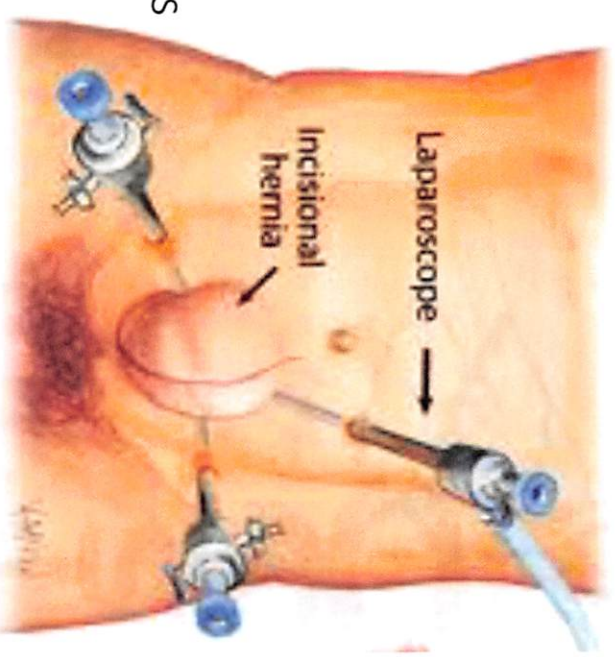
- Surgeon makes an incision near the hernia and the defect is repaired
- Dissect the sac and reduce the hernia into its correct anatomical position



Treatment - Surgical Approach

Laparoscopic Repair

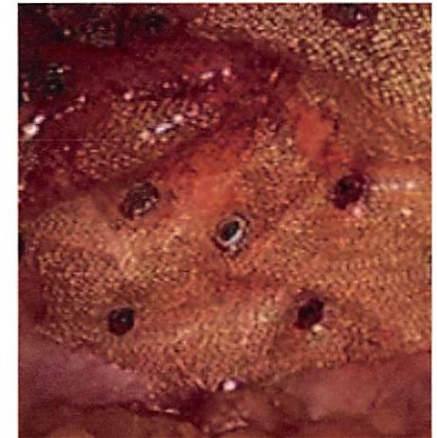
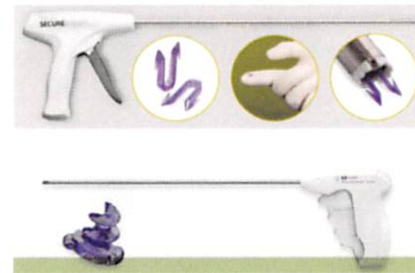
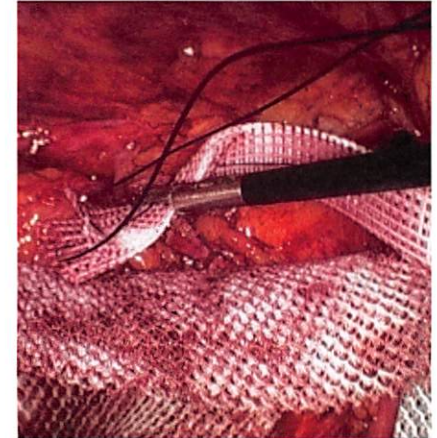
- Surgeon makes several small incisions that allow surgical tools into the openings
- First performed in 1990
- A more complicated procedure than open
- Advantages:
 - Less post-operative pain
 - Faster recovery
 - Lower infection rate
 - Fewer complications
 - Less hospital days



Treatment – Surgical Approach

Fixation

- In either an open or laparoscopic procedure, the mesh is secured to the tissue using sutures, staples and/or tacks
- This ensures that the mesh stays in place
- Obtaining adequate fixation is one of the critical technical points that significantly impacts the success of the repair



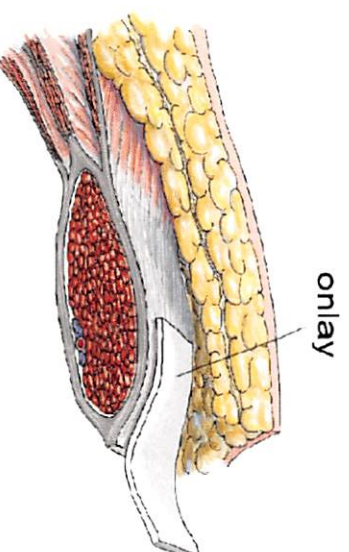
Mesh Selection

- Considerations for type of mesh used:
 - Location of hernia
 - Size of hernia
 - Patient specific considerations
 - Active infection
 - Prior history of wound complications
 - Surgical Technique
 - Where the mesh will be placed

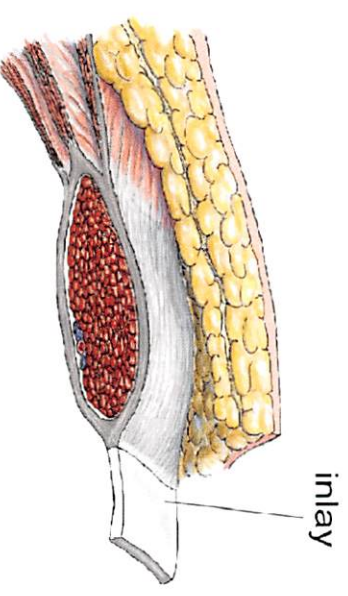
Mesh Placement

- There are four spaces to place mesh:

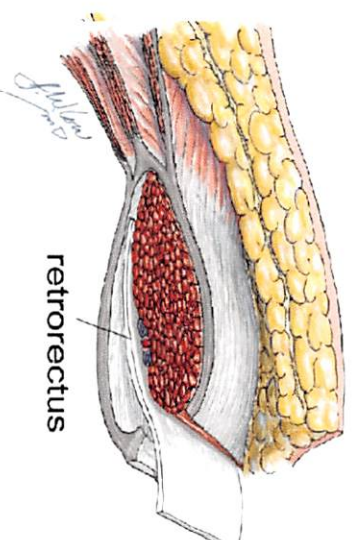
- Onlay



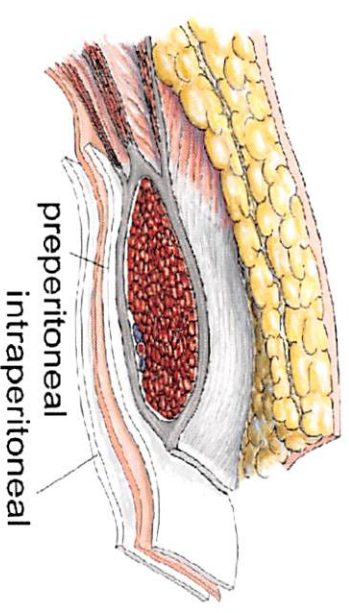
- Inlay



- Sublay

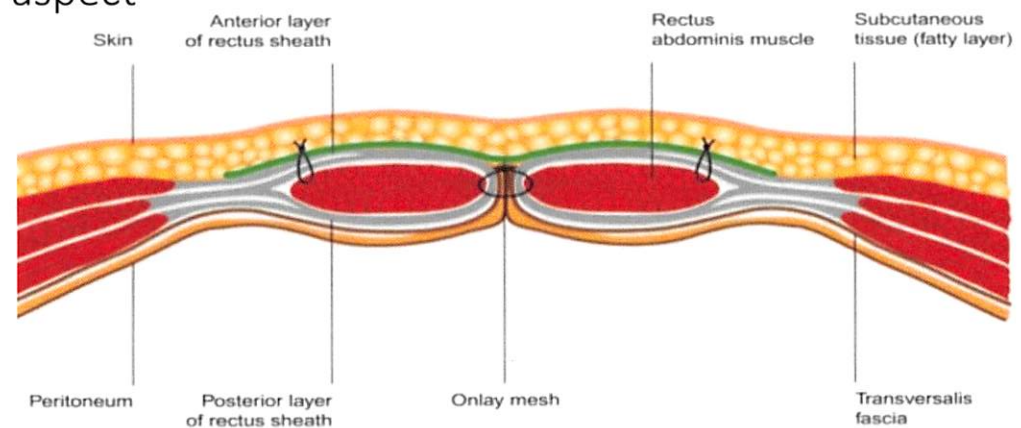


- Underlay/IPOM

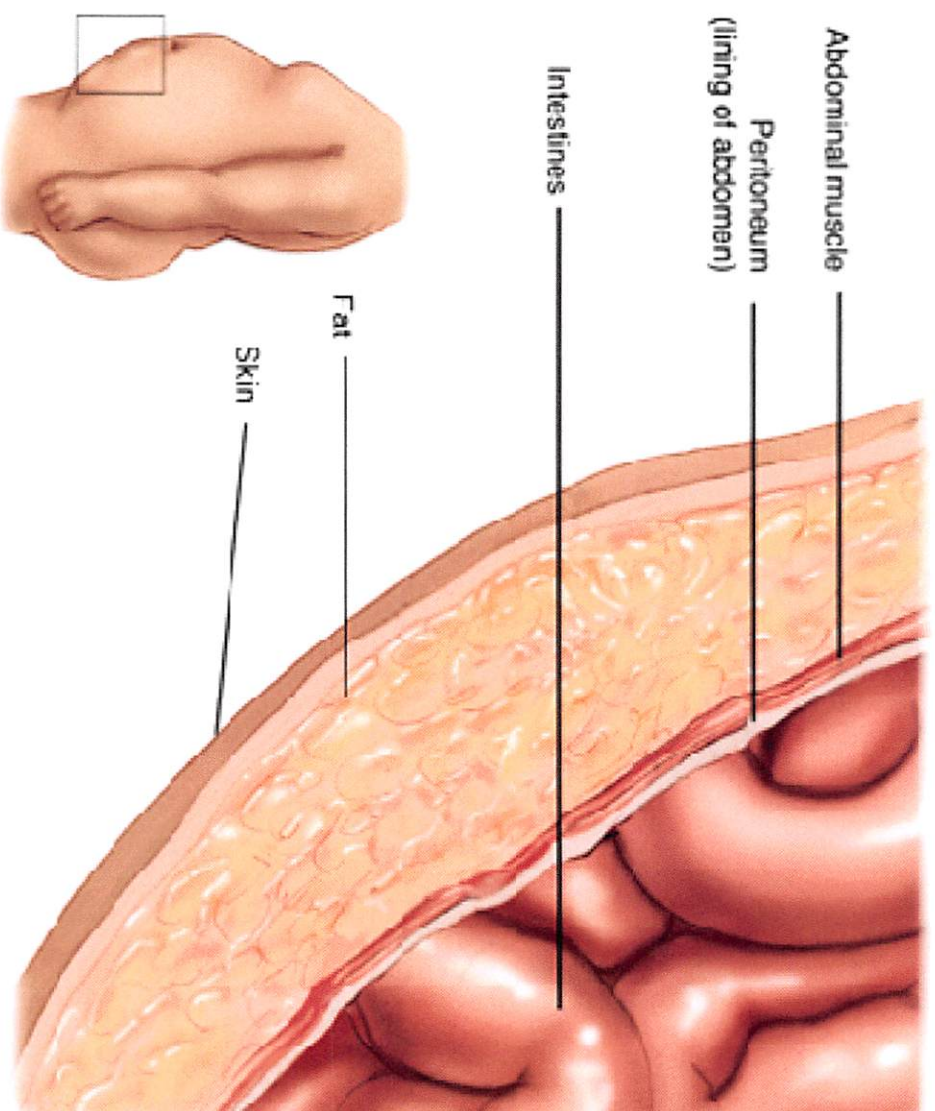


Mesh Placement - Onlay

- Mesh placed on top of the defect and muscle, close to the skin
- Part-tension repair
 - Tissue-to-tissue
- Pros:
 - Avoids contact with the bowel
 - Imparts less tension than in a non-mesh repair
- Cons:
 - Higher recurrence rate
 - Still has a tension repair aspect
 - Requires wide tissue undermining

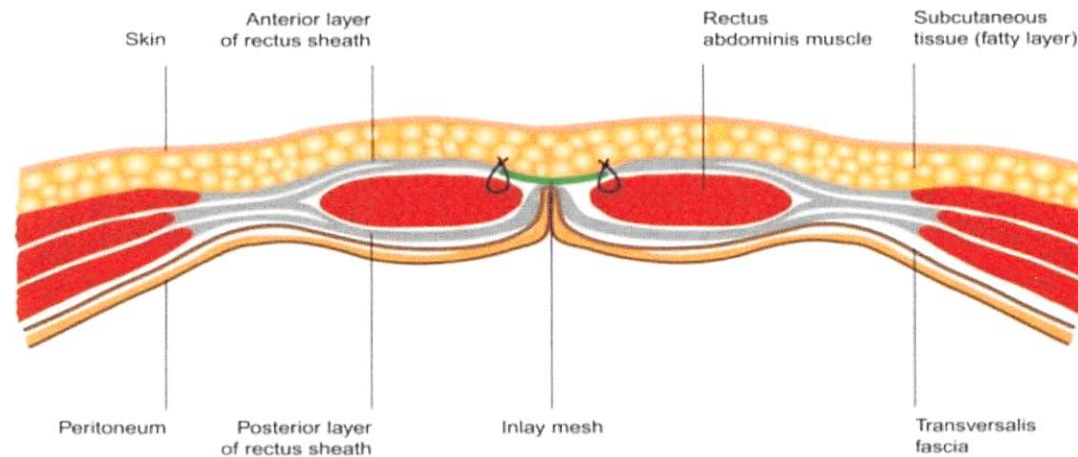


The Abdominal Wall



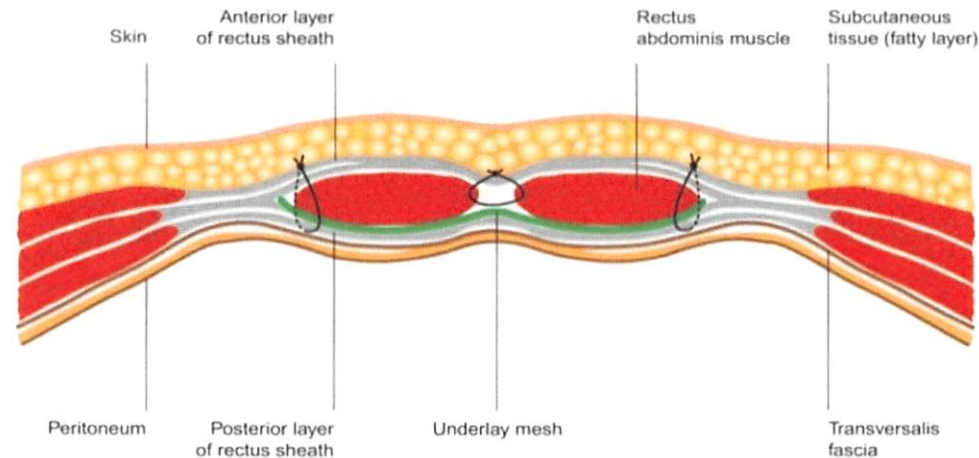
Mesh Placement – Inlay

- Placed inside the defect and sutured to edges
- High recurrence rate
- Pros:
 - Less superficial so less chance of erosion
 - Technically an easier repair
- Cons:
 - Suturing to the edge of the defect may involve sutures in attenuated and abnormal tissue.
 - Intra-abdominal pressure and gravity which may lead to recurrence



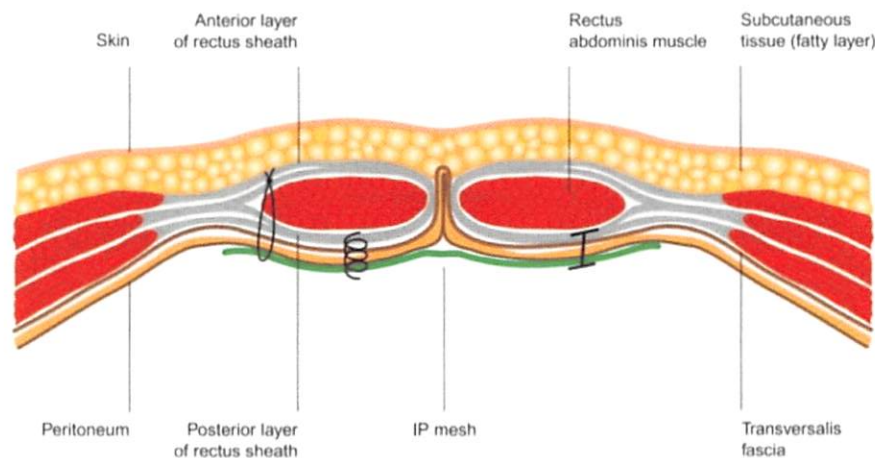
Mesh Placement – Pre-Peritoneal Underlay/Sublay

- Placed under the defect and the under the muscle above the peritoneum
- Pros:
 - Allows for tissue ingrowth from two directions
 - Lower recurrence rates
- Cons:
 - More challenging and complex procedure
 - Dissection of this plane risks damaging muscle, blood supply and nerves



Mesh Placement – Underlay/ Intra-Peritoneal Onlay Mesh (IPOM)

- Placed in the intra-peritoneal space on the peritoneum under the defect
- Popularized by the advent of laparoscopic hernia repairs
- Requires a coated mesh to separate the polypropylene mesh from the organs
- Pros:
 - Reduced wound complication rate
 - Lower recurrence
 - Decreased infection rate
- Cons:
 - Mesh is exposed to the organs
 - Can be technically cumbersome



History of C-Qur™ Mesh



The Mesh Design Dilemma

- Strong Repair vs. Biocompatibility
- Biocompatibility: *The capability of coexistence with living tissues or organisms without causing harm*



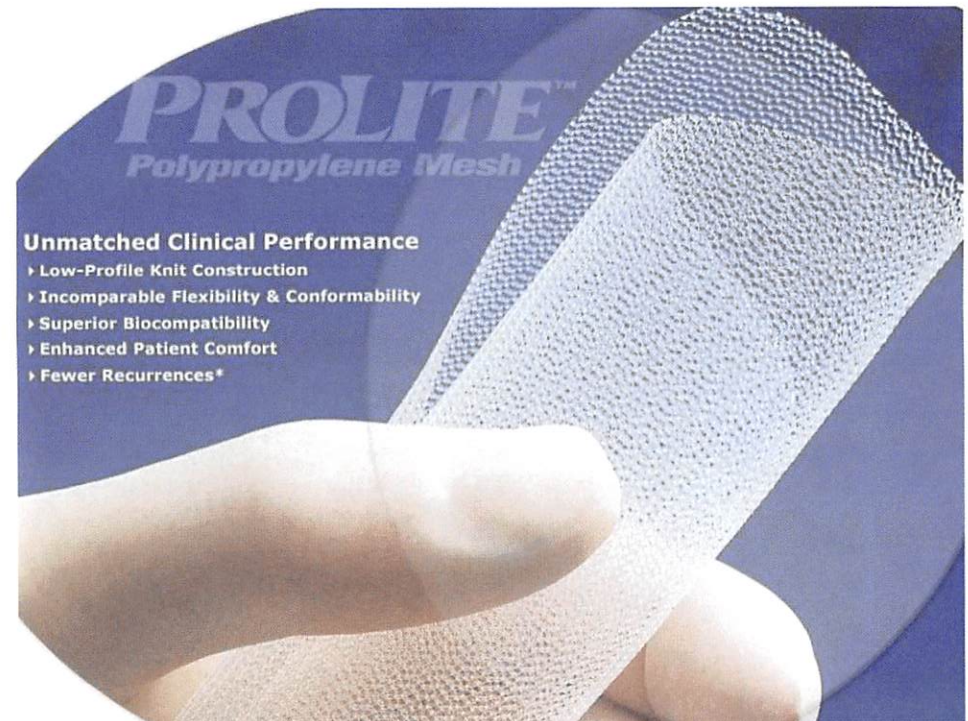
What is C-Qur™ Mesh?

- C-Qur™ Mesh combines Atrium's Prolite™ lightweight polypropylene mesh with an all-natural Omega 3 gel coating
- The absorbable coating serves as a barrier between the polypropylene mesh and organs



The Polypropylene Base Mesh in C-Qur™

- Polypropylene mesh has been used for hernia repair since the 1960s
- Atrium's ProLite™ mesh
- Monofilament polypropylene
- Designed to facilitate faster tissue integration and a more normal healing response
- On the market for over 20 years, since 1994



The Omega 3 Gel Coating in C-Qur™

- Derived from highly purified pharmaceutical grade fish oil consisting of triglycerides and Omega 3 fatty acids
- The fatty acids are familiar, naturally occurring biological components commonly found in the body
- Thermal crosslinking process transforms the natural oil into a stable, absorbable gel coating (“O3FA”)
- No chemical agents used to convert the oil into the gel
- Non-allergenic – contains no heavy metals or proteins



Prior Use of Omega 3 in Medical Devices

- First use of Omega 3 rich fish oil as a viscous liquid coating was on coronary stents in 2001-2002
- In 2003, Atrium initiated an R&D effort to develop Omega 3 technology for use on a broad range of medical devices



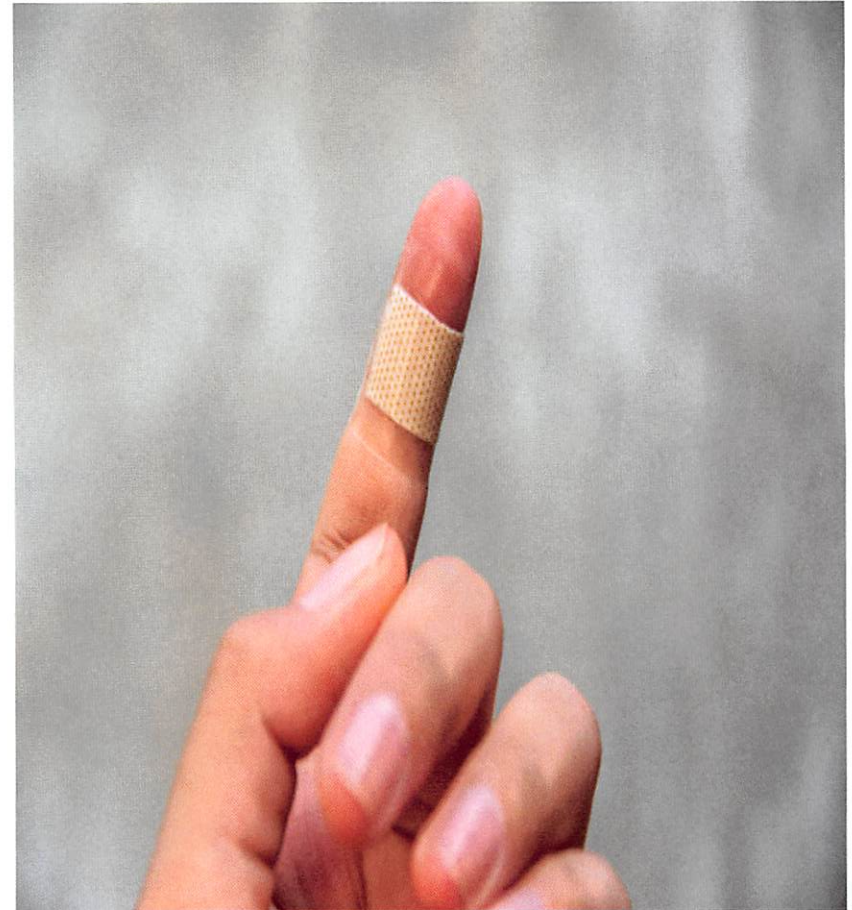
Why O3FA for Hernia Mesh?

- O3FA coating reduces inflammatory response allowing the lightweight mesh construction to heal rapidly with the new tissue
- Every medical device implanted in the body elicits a foreign body response.



O3FA and Wound Healing

- Phases of wound healing
 - Inflammation
 - Proliferation
 - Wound Remodeling
- If these stages are prolonged, the patient is more susceptible to complications
- Smooth muscle cell healing cannot occur until inflammatory response is completed
- A shorter and less intense inflammatory phase increases wound strength by getting to the next healing stage faster



How C-Qur™ Works

- Two sides to the mesh, both coated with different amounts of the O3FA coating
- The “Rough” side:
 - Exhibits a thin uniform coating resulting in an easily distinguishable textured finish
 - Designed for complete tissue incorporation
- The “Smooth” side:
 - Suitable for placement within the peritoneal space or along visceral organs
 - The O3FA barrier stays in place while the neoperitoneum is formed over the mesh



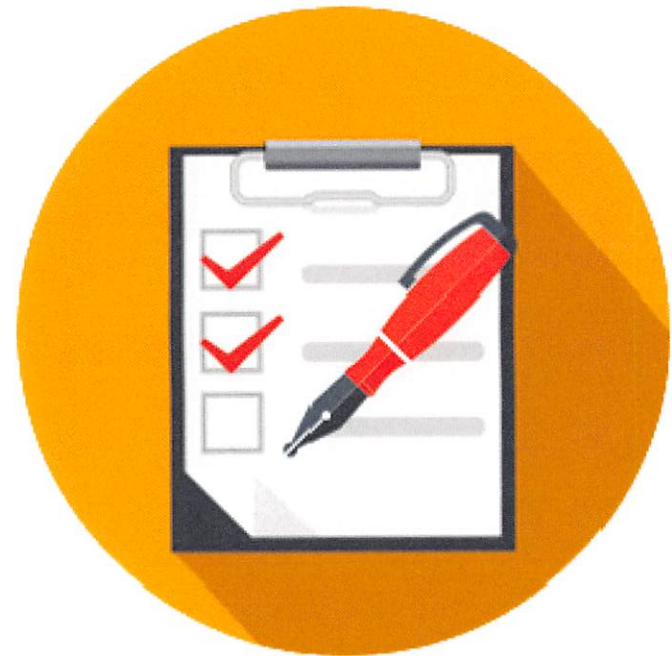
How C-Qur™ Works

- The O3FA contains familiar, naturally occurring lipid components commonly found in the human body and are broken down by the body
- Typically absorbed within 90-120 days
- Preclinical studies demonstrated that the coating is completely absorbed over time leaving the mesh incorporated with fully remodeled, well healed tissue

C-Qur™ Mesh Cleared to Market

Cleared by the FDA Through the 510(k) Process:

- This is a pre-market submission made to the FDA to demonstrate that the device to be marketed is at least as safe and effective (i.e. substantially equivalent) to a legally marketed device



Types of C-Qur™ Mesh



C-Qur™ Mesh

- Cleared to market via 510(k) on March 31, 2006
- Flat sheet
- Designed for open and laparoscopic hernia repair when a tissue separating layer is needed
- Available in a variety of sizes up to 12 in. x 18 in.



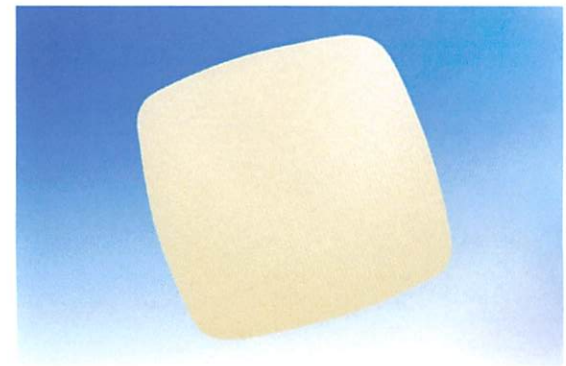
C-Qur™ Edge

- Second layer of Prolite™ around the perimeter for fixation stability
- Greater concentration of the O3FA coating
- Designed for open and laparoscopic hernia repair when a tissue separating layer is needed



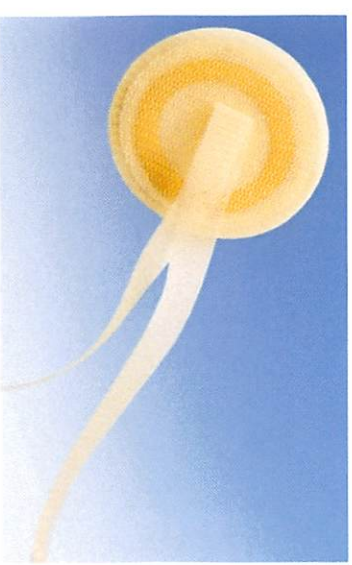
C-Qur™ FX

- Initially cleared to market via 510(k) on March 8, 2007
- Has a light coating of O3FA
- Designed for open and laparoscopic hernia repair when a tissue separating layer is NOT needed.
- Not a barrier mesh; not for IPOM placement
- Available in various sizes and shapes



C-Qur™ V-Patch

- Initially cleared to market via 510(k) on April 16, 2008
- Round, double layer patch with a mesh stabilizing ring and two extended fixation straps
- Designed for repair of small hernias such as umbilical, epigastric and trocar site defects and other small abdominal wall defects



C-Qur™ TacShield

- Cleared to market via 510(k) on January 26, 2010
- Round, oval and oblong C-Qur mesh platform with a Symmetrical Fixation Apron
- Designed for fixation guidance and ease of handling during the surgical repair of medium to large size open ventral hernias



C-Qur™ CentriFX

- Cleared to market via 510(k) on February 15, 2011
- Designed for laparoscopic inguinal hernia repair
- Not a barrier mesh; not for IPOM placement

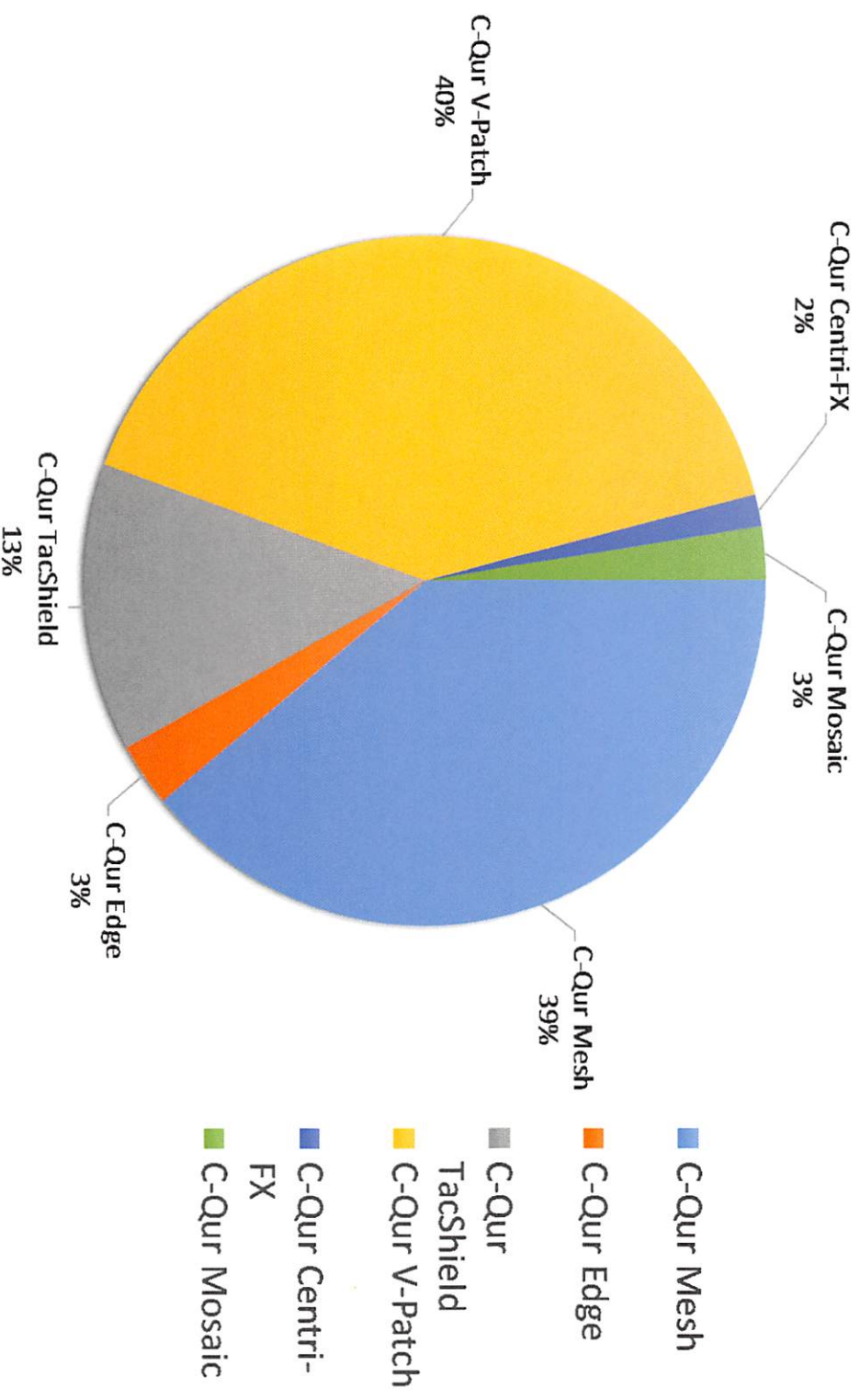


C-Qur™ Mosaic

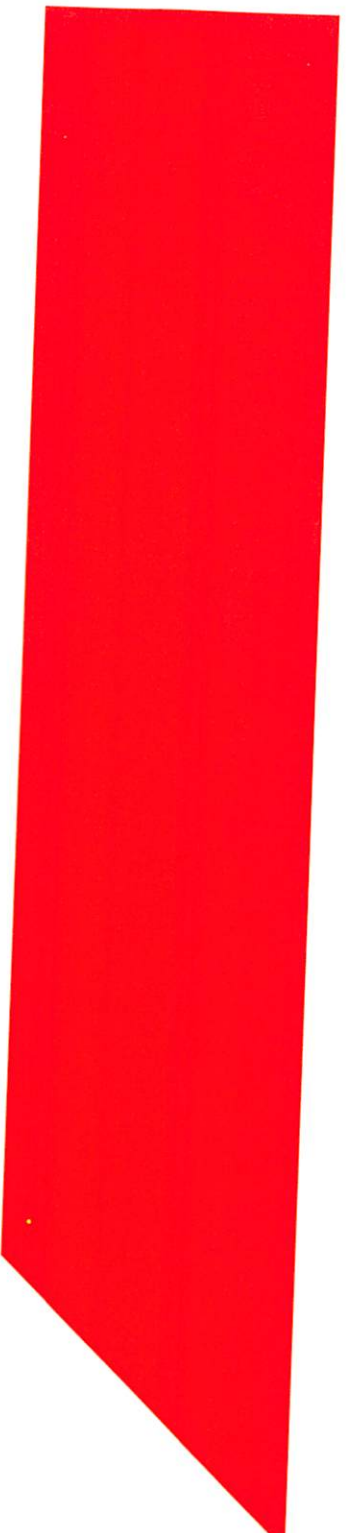
- Cleared to market via 510(k) on April 26, 2012
- Flat sheet with see-through clarity
- Designed for open and laparoscopic hernia repair when a tissue separating layer is needed
- Lowest O3FA coating density
- Generally, 3 – 4 month total coating absorption rate



Percentage of Various C-Qur™ Products in MDL and State Court Proceedings



Complications Encountered in Hernia Repair



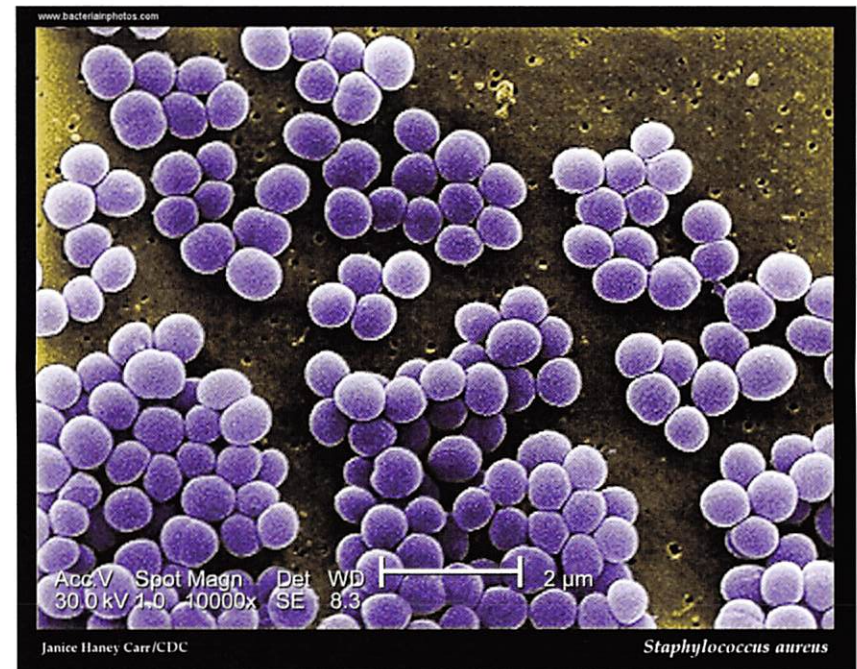
Most Common Complications For Surgical Hernia Repair With or Without Mesh:

- Infection
- Pain
- Adhesions
- Hernia Recurrence
- Bowel Obstruction
- Seroma
- Bleeding
- Fistula
- Perforation

Infection

An invasion and multiplication of microorganisms such as bacteria, fungi or virus

- All people are colonized with bugs
- All surgical wounds will become contaminated with bacteria during surgery but not all wounds will become infected



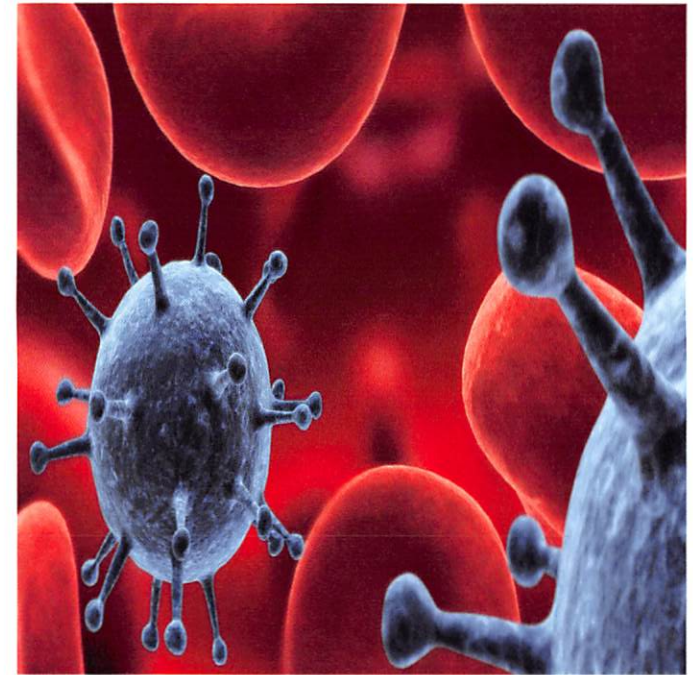
Infection - Source

- A typical adverse event associated with surgery is a Surgical Site Infection (SSI)
- An SSI occurs after surgery in the part of the body where the surgery took place
- Primary source of infection for most SSIs is the patient
- Infections can also be acquired from other patients, hospital staff or contaminated objects



Infection – Device

- Bacteria adhere to the structural matrix of any medical device by creating a microenvironment called a biofilm
- Different devices have differing abilities to withstand biofilm formation
- Atrium conducted in-vitro testing that showed that C-Qur™ mesh will not accentuate biofilm formation
- The mesh itself is not the source of a “mesh infection” rather the mesh has been contaminated and an infection has developed in and around the mesh



Infection – Surgical Factors

Surgical Factors that can increase the risk of infection:

- Duration of Operation
- Open vs. Laparoscopic
- Mesh Placement
- Use of Drains



Infection – Patient Factors

Patient Factors that can increase the risk of infection:

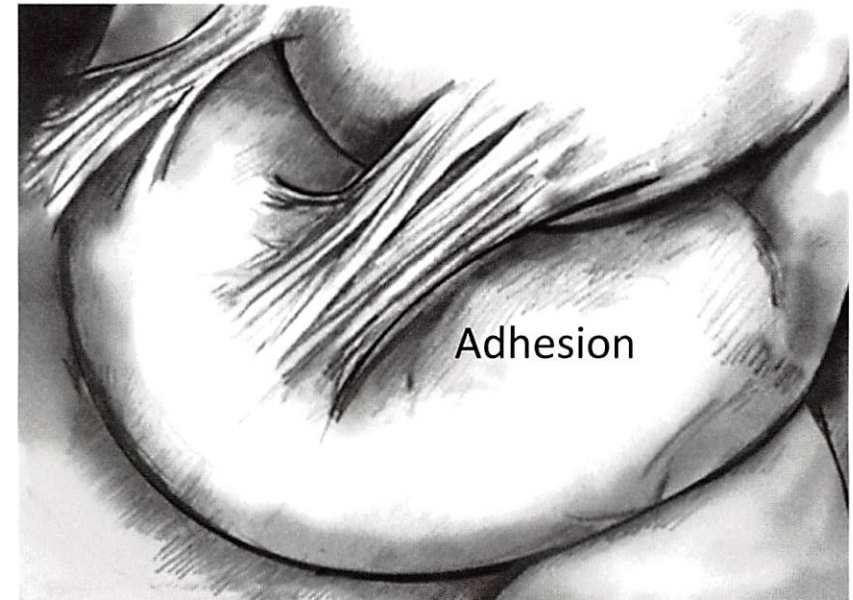
- American Society of Anesthesiologists (ASA) Score
- Diabetes
- Obesity and Body Mass Index
- Malnutrition
- Age
- Tobacco Use
- Pre-existing and Previous infection
- Certain Medications
- Immunosuppressive Conditions



Abdominal Adhesions

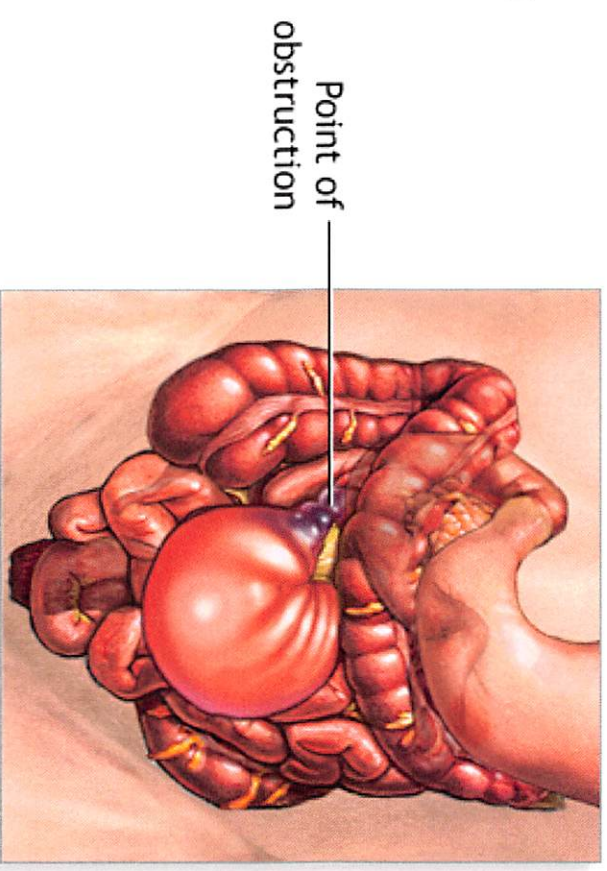
Abdominal adhesions are bands of fibrous tissue

- Can cause pain or intestinal obstruction
- 93% of patients who undergo abdominal surgery develop abdominal adhesions
- A study showed that C-Qur™ mesh had less tenacious tissue attachment than competitors



Bowel Obstruction

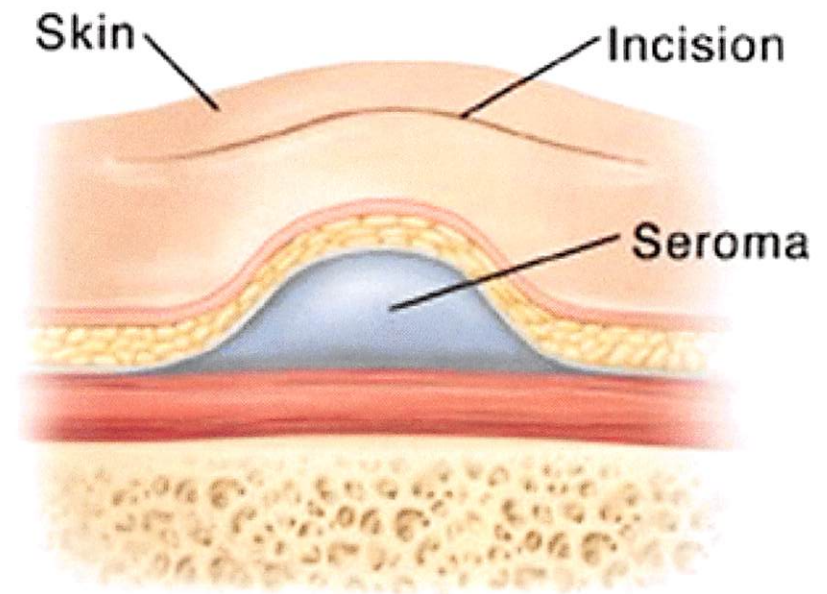
- A bowel obstruction occurs when the contents of the intestines cannot pass through and exit the body



Seroma

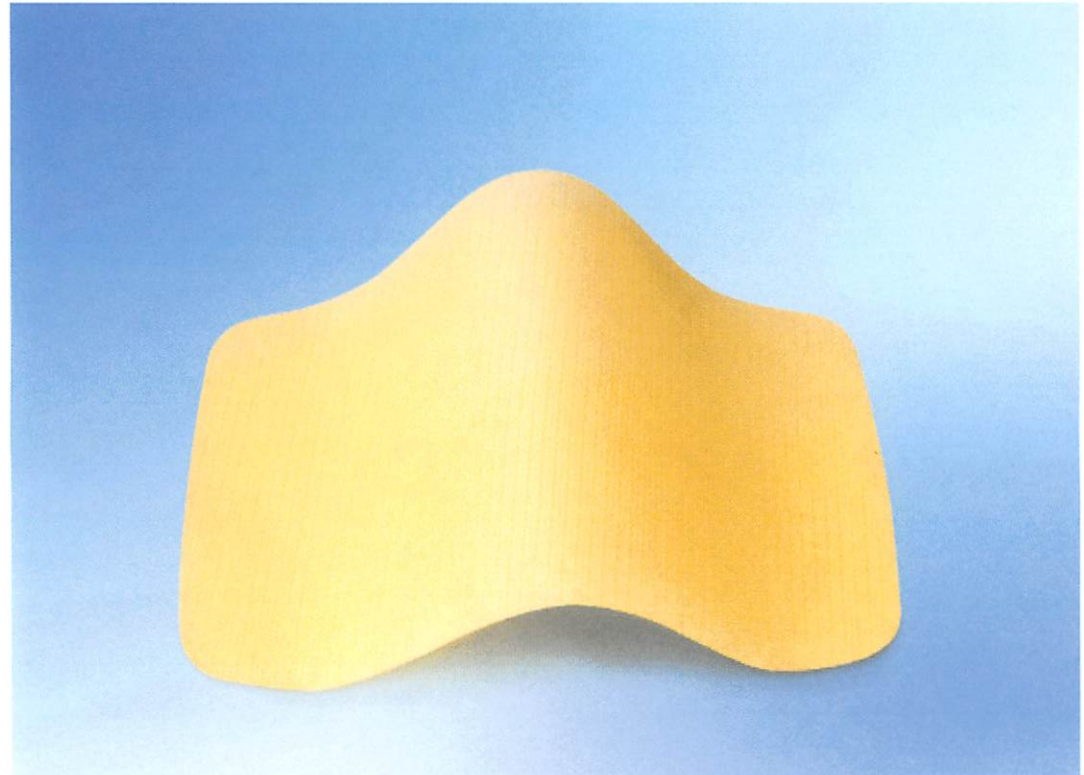
A seroma is a pocket of serous fluid that sometimes develops after surgery

- Seromas form because the body is reacting to a vacant space within the tissue
- Some papers contend that 100% of hernia patients develop seromas



Most Common Complications:

- Infection
- Pain
- Adhesions
- Hernia Recurrence
- Bowel Obstruction
- Seroma
- Bleeding
- Fistula
- Perforation



- Rates of occurrence no greater with C-Qur™ devices -

Questions?

