A COMPARATIVE STUDY OF KNOTLESS BARBED SUTURES VS CONVENTIONAL SUTURES IN CLOSURE OF EXTERNAL OBLIQUE APONEUROSIS IN INGUINAL HERNIA REPAIR

BY

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M.S. GENERAL SURGERY

UNDER THE GUIDANCE OF

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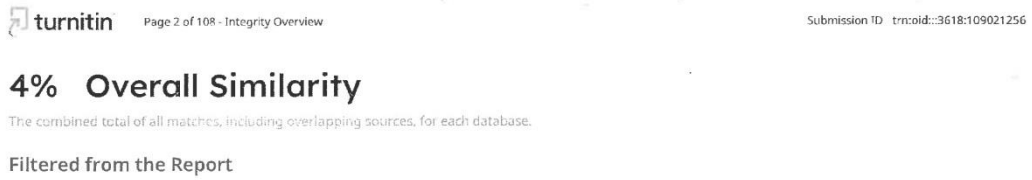

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A COMPARATIVE STUDY OF KNOTLESS BARBED SUTURES VS CONVENTIONAL SUTURES IN CLOSURE OF EXTERNAL OBLIQUE APONEUROSIS IN INGUINAL HERNIA REPAIR

ABSTRACT

Background and Objective

Choosing the right suture for closing the external oblique aponeurosis is very important for the success of inguinal hernia repair surgery, which is one of the most common types of surgery done around the world. Knotless barbed suture technology has led to the development of new ways to close wounds. These methods could improve surgical outcomes by making it possible to avoid tying knots while yet keeping tissue safe. In modern surgery, it is becoming more and more vital to use interventions that make operations as efficient as possible and reduce the risk of complications after surgery. This prospective comparative study aims to compare the clinical effectiveness of knotless barbed sutures to regular sutures for closing the external oblique aponeurosis during inguinal hernia repair, focusing on operational parameters, postoperative pain management, and complication profiles.

Methodology

From April 2023 through September 2024, researchers from the R.L. Jalappa Hospital's Department of General Surgery in Tamaka, Kolar, India, carried out a prospective comparative observational study. Fifty male patients with inguinal hernias ranging in age from 19 to 75 were included in the study, with 25 individuals assigned to each treatment group using an odd-even randomization

process. Patients with immunocompromised states or skin diseases were excluded from the study, however all patients needing inguinal hernia repair were included. Knotless barbed sutures were used to close the external oblique aponeurosis in the intervention group, whereas conventional sutures were used in the control group. Operative efficiency metrics and suturing duration were the main outcome measures. The secondary objectives included measuring postoperative pain with visual analog scales, the amount of analgesics needed, the time it took for patients to recover functionally, and the occurrence of complications such as seroma, infections at the surgical site, and persistent pain. Independent t-tests were used for continuous variables in the statistical analysis, whereas Fisher's exact tests were used for categorical characteristics.

Results

Between the two groups, there was no significant difference in the distribution of baseline demographic parameters, such as mean ages (52.4 ± 11.8 vs. 54.2 ± 12.3 years) or body mass index (BMI) profiles ($p=0.721$). The main results showed that knotless barbed sutures significantly reduced the amount of time it took to suture (10.2 ± 1.8 minutes vs 14.1 ± 2.3 minutes; $p<0.001$), which is a clinically significant gain in efficiency of 27.7 percent. The excellent handling characteristics were reflected in the significantly improved surgeon satisfaction scores (8.7 ± 0.9 vs 7.2 ± 1.1; $p<0.001$). The pain assessment conducted after the operation demonstrated statistically significant reductions at both the 6-hour

and 24-hour marks (4.2 ± 1.3 vs 5.1 ± 1.6; p=0.028 and 3.1 ± 1.1 vs 3.8 ± 1.4; p=0.048, respectively). Significant decreases in tramadol consumption (142.0 ± 28.4 mg vs 168.0 ± 32.1 mg; p=0.003) and NSAID utilization duration (2.8 ± 1.2 vs 3.4 ± 1.1 days; p=0.043) were identified in analgesic requirements. Accelerated return to normal activities was observed during functional recovery, with 6.2 ± 2.1 days compared to 7.8 ± 2.4 days (p=0.010). The barbed suture group had a lower overall complication rate (12% vs. 32%), but the difference was not statistically significant (p=0.179).

Conclusion

When compared to traditional sutures, knotless barbed sutures offer several benefits, including less need for analgesics, better control of pain in the early postoperative period, and faster closure of the external oblique aponeurosis after inguinal hernia surgery. Based on these results, knotless barbed suture technique should be used clinically to repair inguinal hernias.

Keywords:

Suture Techniques, Inguinal Hernia, Treatment Outcome, Postoperative pain, Surgical Procedures, Sutures

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ABBREVIATIONS

Abbreviation	Explanation
BMI	Body Mass Index
TEP	totally extraperitoneal
TAPP	transabdominal preperitoneal
PGA	polyglycolic acid
PDS	polydioxanone
RCT	randomized controlled trials
SSI	surgical site infection
TCS	triclosan-coated barbed sutures
CDC	Centre for Disease Control
VAS	Visual Analog Scale
NSAID	Non-Steroidal Anti-Inflammatory Drugs
CCS	Carolinas Comfort Scale
ASA	American Society of Anesthesiologists

INTRODUCTION

INTRODUCTION

A key factor in postoperative results and long-term functional recovery is the selection of the appropriate surgical approach for inguinal hernia repair, which is one of the most commonly performed general surgical operations globally. Wound closure methodologies have seen substantial advancements thanks to technological advancements in sutures. One such innovation is knotless barbed suture systems, which completely reshape conventional surgical methods of tissue approximation and wound security. [1]Research into hernia repairs has prioritized the comparative evaluation of suture materials due to the growing importance of evidence-based therapies in modern surgical practice. These interventions aim to enhance operating efficiency while decreasing postoperative morbidity.

An intricate and technically challenging part of inguinal hernia repair surgery is closing the external oblique aponeurosis. This step has a direct impact on the results of the operation and the likelihood of recurrence in the future. Although traditional conventional suturing procedures have a long history of use in clinical practice, they can be technically demanding and time-consuming because to the many knots that are required. [2]Surgeons now have a new tool at their disposal—knotless barbed sutures. These sutures contain directional barbs that allow for secure tissue approximation without the need to form knots,

which could lead to a decrease in operating time and an improvement in surgical precision. [3]

The growing number of surgical specialties utilizing barbed suture technology has been confirmed by systematic reviews and meta-analyses. New evidence points to substantial benefits in terms of operating efficiency and clinical outcomes. In a thorough meta-analysis of randomized controlled trials, Lin et al. (2016) showed that knotless barbed sutures were safer and more effective than traditional methods in a variety of surgical procedures.[4] Like barbed sutures, new hernia repair studies comparing them to more traditional methods have shown encouraging results in terms of surgical site infection rates, operation duration, and postoperative problems. [5,6]This research has been supported by specific uses in different parts of the body, such as in orthopedic and oral and maxillofacial surgeries. [7–9]

Surgical site infection rates, postoperative pain management, seroma formation, and a thorough cost-effectiveness analysis are just a few of the important clinical factors that should be considered when comparing suture materials for inguinal hernia repair. New research on the biomechanical qualities and clinical performance traits of barbed sutures has shed light on their use in a variety of surgical procedures. [10,11]Using barbed sutures may save money in the long run, according to economic evaluation studies. This is because they shorten operations and make them more efficient. [12]Strenuous clinical inquiry is

required to develop conclusive evidence-based recommendations due to the lack of comprehensive comparison data especially addressing the use of knotless barbed sutures in external oblique aponeurosis closure during inguinal hernia repair.

In order to establish conclusive data about clinical efficacy, safety profiles, and cost-effectiveness criteria, modern surgical practice requires the systematic evaluation of novel procedures through comparative studies that adhere to rigorous methodology. Knotless barbed sutures should be further investigated through prospective comparative study due to their potential benefits, which include shorter operating times, easier suturing techniques, better wound healing characteristics, and better postoperative results. [13]The primary objective of this study is to add to the existing body of evidence on the topic of surgical technique selection by comparing the safety and effectiveness of knotless barbed sutures with conventional sutures in closing the external oblique aponeurosis during inguinal hernia repair.

OBJECTIVES

OBJECTIVES

Objectives

1. To study the efficacy of knotless barbed sutures compared to conventional sutures in closing external oblique aponeurosis in inguinal hernia repair.
2. To compare knotless barbed sutures with conventional sutures in terms of ease of suturing, duration of suturing, cost of suture materials, surgical site infections, pain, seroma formation.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Historical Evolution of Inguinal Hernia Repair Techniques

Classical Repair Methods

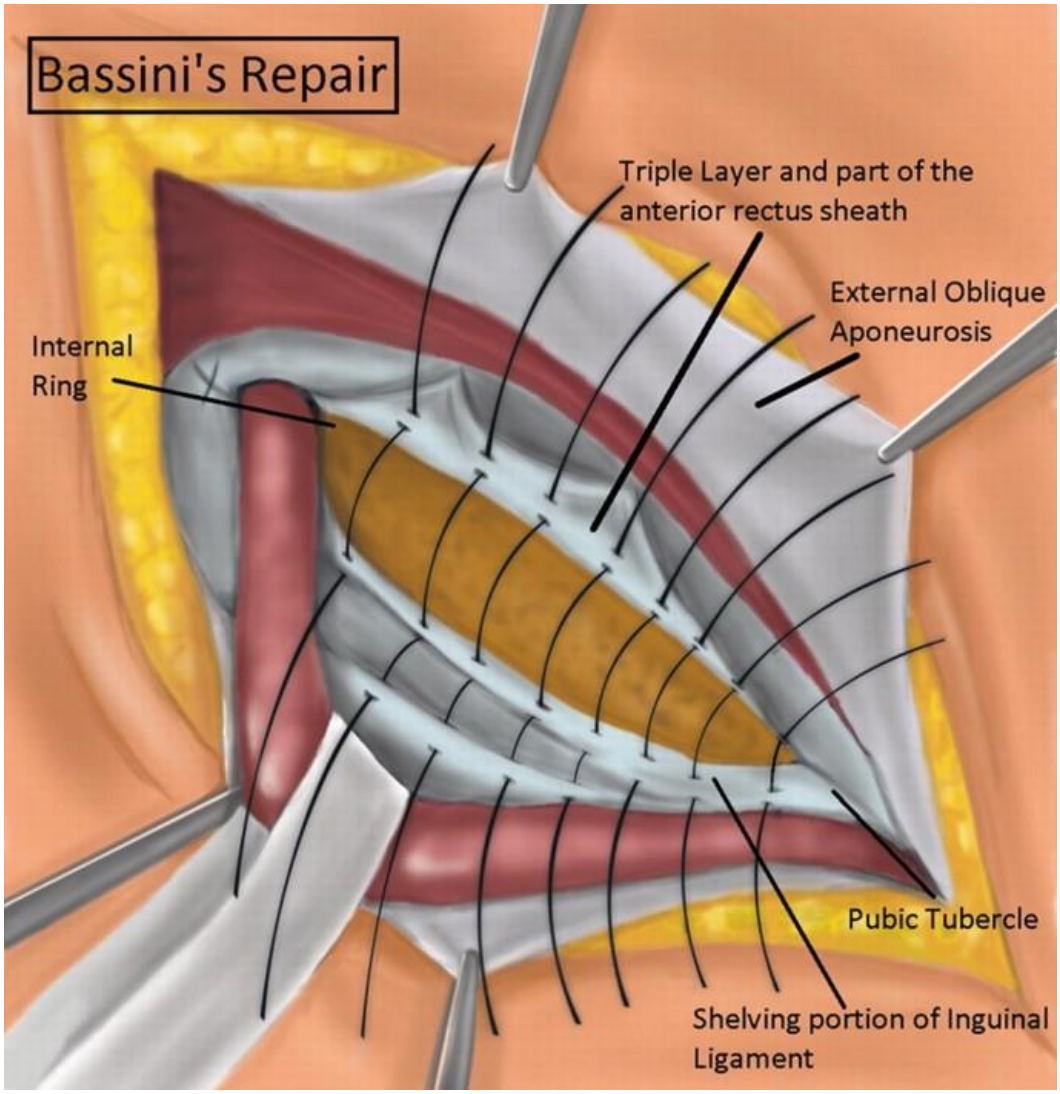


***Figure 1:* Bassini's repair**[14]

First performed in 1889, Edoardo Bassini's method was the first of its kind to treat inguinal hernias using anterior tissue. Remarkably low recurrence rates

were accomplished by Bassini in an age before prosthetic materials and antisepsis by reconnecting the conjoint tendon (internal oblique and transversus abdominis) to the inguinal ligament.[15,16] He significantly decreased surgical mortality with his technique, which paved the way for subsequent anatomical repairs. [15,17]

The Shouldice repair is a multilayer technique that originated in Canada in the middle of the twentieth century. It is based on the concepts of Bassini and involves suturing and imbrication of layers of fascia and transversalis tissue. Although recurrence rates typically fall below 1% in expert hands, the technical difficulty and learning curve for surgeons limit their use in smaller procedures. [17]Shouldice, according to comparative research, has recurrence rates that are on par with mesh repair when done properly.

Another classical tissue-based technique, the McVay (Cooper's ligament) repair has the transversalis fascia fixed medially to the ligament. Despite its adaptability to femoral hernias and big defects, McVay repair is more likely to cause stress and has a higher risk of early postoperative pain.

One modern pure tissue method is the Desarda no mesh technique, which debuted in 2001. It gets around the need to implant prosthetics by using a reinforcement flap made of a strip of external oblique aponeurosis that is sutured to the abdominal wall. Recurrence rates of less than 1% and chronic pain levels of less than 1% are reported in clinical series and comparative

research, along with relatively easy techniques and modest costs. [18–20]In simple circumstances, meta-analyses show that Desarda is on par with Lichtenstein, but it excels in contexts with restricted resources. [20]

Modern Mesh-Based Repair Techniques

A flat polypropylene mesh is put over the posterior inguinal canal and secured with sutures in the Lichtenstein tension-free repair, which became conventional in the late 20th century. This method was considered the best since it was easy to teach, had a low recurrence rate (<2%), and was reproducible. [18,21]

Laparoscopic techniques, such as completely extraperitoneal (TEP) and transabdominal preperitoneal (TAPP), allow for limited access mesh repair, which in turn leads to faster recovery and less postoperative pain. Comparative studies show that there is a decrease in chronic pain but a similar rate of recurrence to open mesh repairs.[17]

Modern meshes are made of lighter synthetic and biological materials, as opposed to the heavier polypropylene of yesteryear. Even though biological meshes may lessen the likelihood of foreign body problems, they are nonetheless more expensive and have less consistent durability over time.

Traditional sutures or tacks are still an option for mesh fixation, but fibrin glue is becoming more popular; this could reduce chronic discomfort by eliminating the need for nerve-irritating fixation devices. According to comparative

research, employing adhesive results in less postoperative discomfort while providing similar fixation strength.

Anatomical Considerations in Inguinal Hernia Repair

Inguinal Canal Anatomy

Fruchaud first characterized the myopectineal orifice, which is a structural opening that can allow inguinal, femoral, and direct hernias to form. Inguinal ligament, lacunar ligament, iliopubic tract, transversalis fascia, and Cooper's ligament form its superior and medial and lateral boundaries, respectively. To contemporary laparoscopic procedures, such as TEP and TAPP, a thorough repair encompassing this area is fundamental. [22]

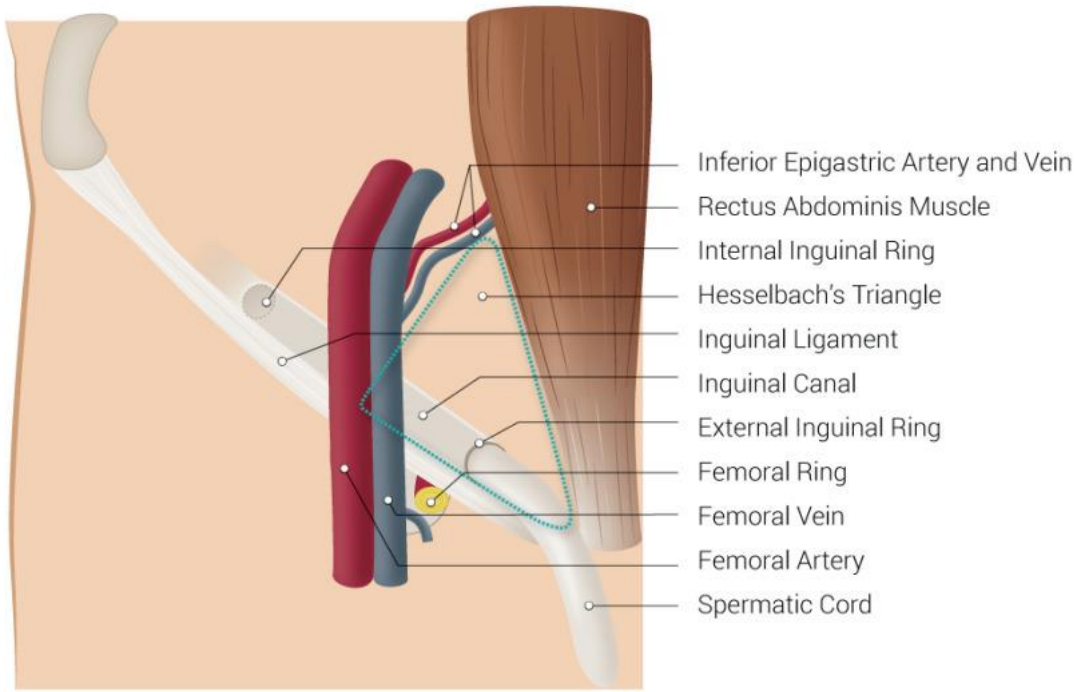


***Figure 2:* Inguinal Region** [23]

The inguinal canal's anterior wall, which includes the superficial inguinal ring, is formed by the external oblique aponeurosis. It is a robust membrane layer that provides tensile reinforcement to the area of repair by means of fibers that are directed downward and medially. It is standard practice to reflect and suture this aponeurosis over the mesh and cord structures during open inguinal hernia surgery in order to restore anatomical integrity.[22,24]

The testicles, lymphatics, vas deferens, and fascial layers are all contained within the spermatic cord within the canal. In order to avoid risks like chronic discomfort or injury after surgery, it is crucial to preserve the vas deferens and handle neurovascular structures like the ilioinguinal and genitofemoral nerves with care.[22]

Biomechanical Properties of Aponeurotic Tissues

The low-tension nature of current tissue closures was highlighted in a cadaveric biomechanical investigation by Lipton et al., which showed that aponeurotic repair employing external oblique and transversus aponeuroses resulted in an average suture-line tension of only approximately 3.9 g, in contrast to 633 g in Bassini repairs. [25]

The exterior oblique aponeurosis shows non-linear elastic behavior and is stronger than deeper fascia layers in tensile tests. Further evidence of substantial interlayer variation is provided by Kriener et al., who found that aponeuroses, in

contrast to underlying muscle, have relatively high ultimate tensile strength and elasticity. [26]

If you want your sutures to stay put at the suture-tissue interface, you should choose ones with a knot-pull strength greater than 1,590 g, which is generally the case with 2.0 polypropylene. This guarantees protection even when subjected to extreme intraabdominal pressure when coupled with the correct biting depth and spacing. [25]Precise suture insertion and uniform tension distribution are two tenets of good surgical technique that help keep tissues intact.

Suture Technology Evolution and Classification

Conventional Suture Materials

Various types of tissues, healing times, and mechanical demands have led to the evolution of surgical sutures. The hydrolytic breakdown of absorbable sutures like polyglactin 910, polyglycolic acid (PGA), and polydioxanone (PDS) is their intended mechanism of action. One option for slowly healing tissues is PDS, which keeps its strength for up to six weeks and is absorbed over 180 days. In contrast, polyglactin 910 retains around 50% of its tensile strength at 2-3 weeks and is entirely absorbed in 60-90 days. [3,27,28]

Polypropylene, nylon, and silk sutures are non-absorbable and will stay in place until they are removed. Polypropylene is quite resistant to tissue reactions and

has a high tensile strength, whereas nylon is moderately strong and loses some of its strength with time. The increased tissue reactivity and decreased long-term strength of silk have reduced its once-widespread use. [28,29]Things like tissue type, healing period, and needed tensile strength are taken into account while choosing sutures.

Barbed Suture Technology Development

Since barbs on sutures do away with knots, they constitute a significant technological advance. While the idea has been around since the 1960s, it was not until the 2000s that practical, marketable items started to appear. The suture is secured within the tissue using barbs that are either cut or shaped into monofilament strands. The patterns of the barbs can be either bidirectional or unidirectional, depending on the application. [27]

Research in biomechanics has shown that these sutures may hold more tissue than smooth ones while also distributing strain more evenly. Strict quality control measures are put in place after extrusion or laser cutting in manufacturing to guarantee material integrity and barb uniformity. The biocompatibility and strength of polydioxanone, glycomer, or polyglecaprone are qualities shared by the majority of barbed sutures. [3,30]

Mechanism of Action and Biomechanical Properties

The knotless barbed sutures are able to safely approximatively attach to tissue because they use the dynamics of barb-tissue anchoring. A loop at one end of a unidirectional suture (like V-Loc™) keeps the barbs from sliding around, whereas a central transition zone on a bidirectional system (like Quill™ or Stratafix™) secures the tissue on both sides. [10,27]

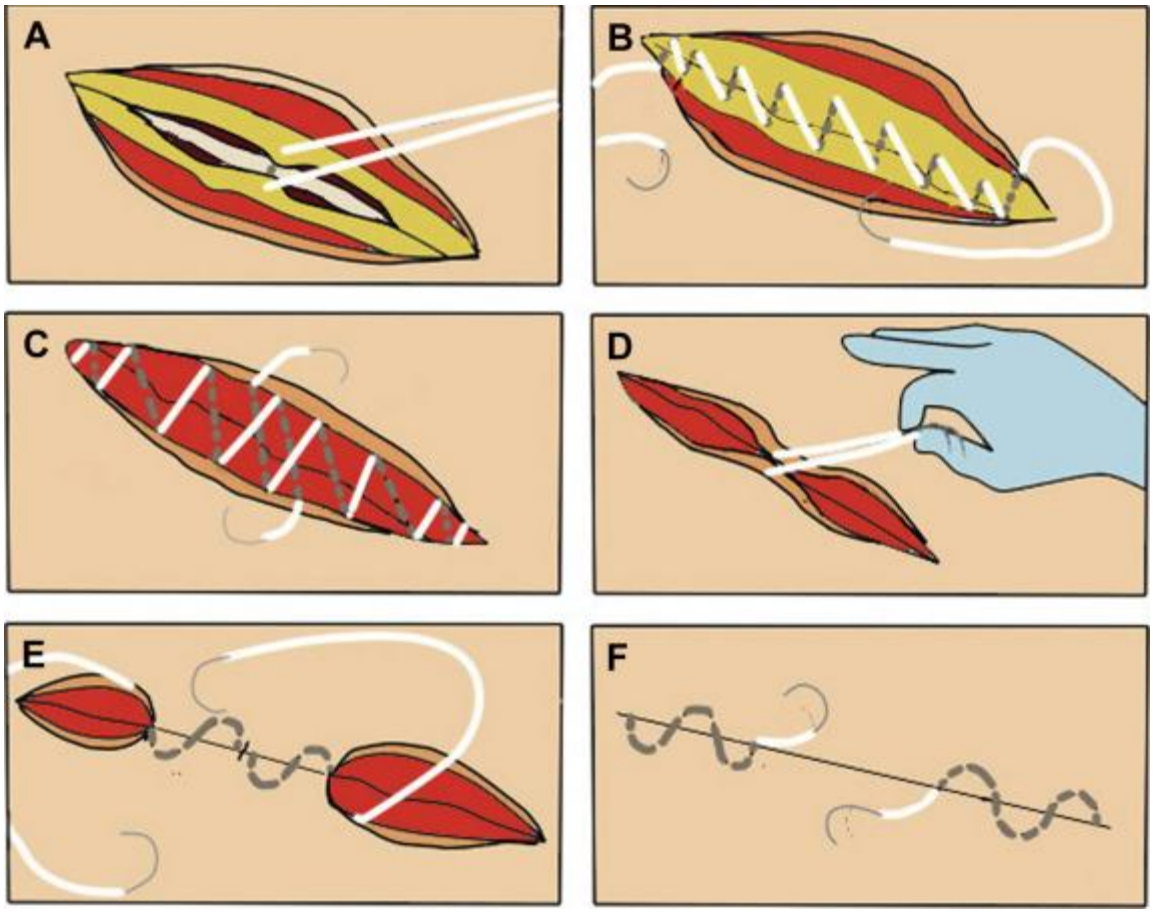


***Figure 3:* Knotless barbed sutures**[31]

Barbed sutures keep their high tensile strength, according to biomechanical tests conducted on cutaneous and porcine tendon models. On days 3 and 7 after surgery, the V~Loc™ 180 device generated a substantially higher maximum load (about 13.5 kgf) compared to the Quill™ PDO (approximately 10.4 kgf) ($P<0.05$). [32]In addition, flexor tendon ex vivo cyclic loading studies demonstrated that V-Loc could withstand a greater ultimate tensile strength of 50.7 N compared to 42.3 N for Stratafix, while both materials exhibited comparable displacement and stiffness profiles. [32]Because they are symmetrical in both directions, bidirectional barbed systems usually have a reduced chance of barb slippage. [27]

For mechanical stability, it is like using knotted monofilament sutures; the barbs disperse strain uniformly, prevent stress spots, and get rid of knot bulk, which can be an infection nidus or weak spot.[4,10]

Classification and Types

Unidirectional systems, like V-Loc™, are perfect for closing fascia or enterotomy lines since their barbs point in only one direction and you need an anchoring loop or first stitch to establish the suture start. [10,27]

***Figure 4:* V-Loc™ *Absorbable Wound Closure Device*[33]**

By doing away with the requirement for a terminal knot and enabling closure in two directions from a central starting point, bidirectional systems like Quill™ and Stratafix™ make it easy to adjust tension in both directions. [27]

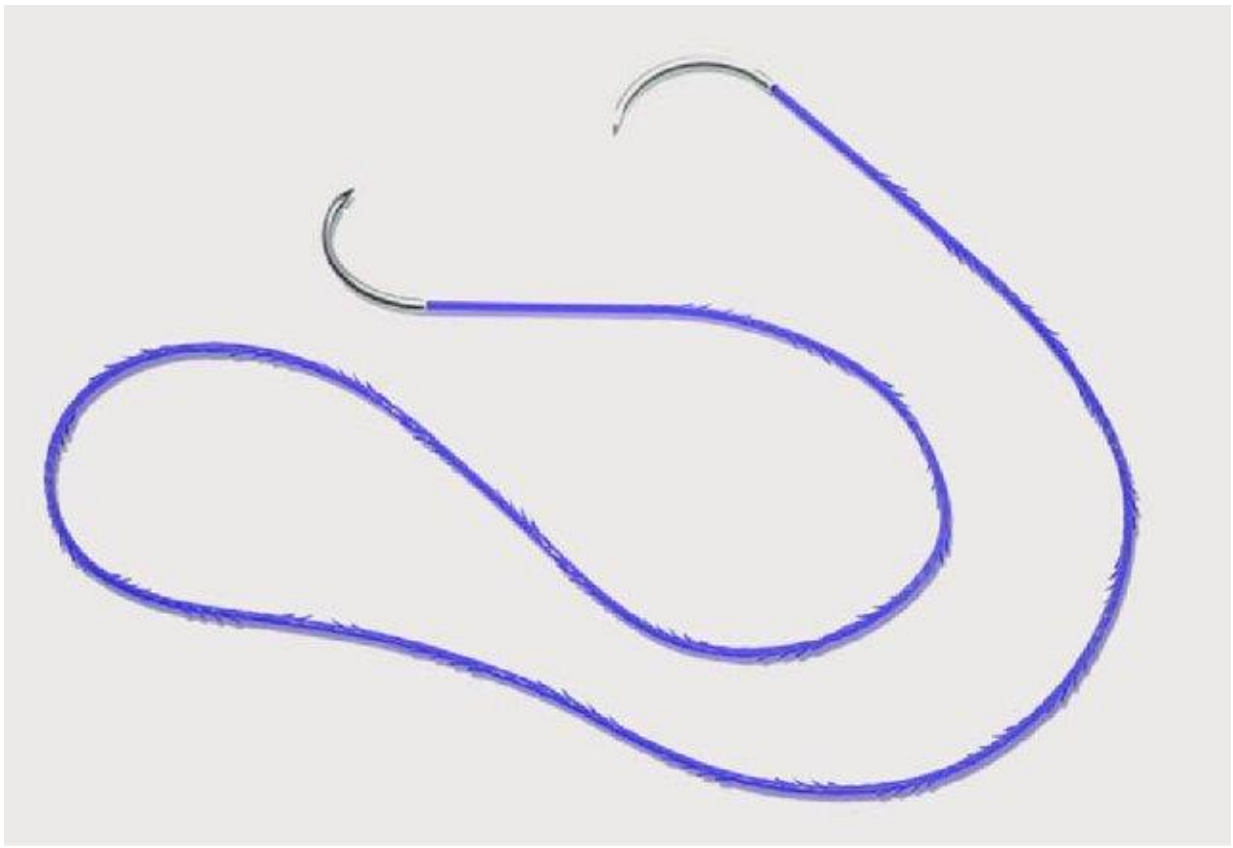


***Figure 5:* Bidirectional barbed suture**[33]

V-Loc 180, which is based on poly-dioxanone, and Stratafix, which is based on glycomer, are two examples of absorbable systems that are intended to degrade over 90 to 180 days. On the other hand, V-Loc PBT and similar products are non-absorbable and are used for applications that require permanent support. [10,27]To avoid the presence of foreign bodies for an extended period of time, absorbable systems are favored for internal fascia closure. On the other hand, non-absorbable systems may be used for long-term tensile support in places that are constantly stressed.

Among **commercial products**:

- One such system is V-Loc™ (Medtronic), which is absorbable in only one direction and features a loop anchor and barbs at two angles to make it more resistant to pullout. [27,32]

- The Quill™ SRS (Corza) is a bidirectional closure system that eliminates end knots. It starts at a central loop and uses a spiral barb arrangement. [27]

- When used with deep tissue fascial layers, Stratafix™ (Ethicon)'s spiral or symmetrical barb pattern—characterized by higher cut angles and deeper barb depth—produces strong anchoring and tension management. [27]

Clinical Applications of Barbed Sutures Across Surgical Specialties

Systematic Reviews and Meta-Analyses

Lin et al. conducted a thorough meta-analysis of randomized controlled trials (RCTs) in several fields of surgery. They discovered that barbed sutures considerably decreased blood loss, suture time (-5.0 minutes), and overall operating time (mean difference: -17.3 minutes). Notably, they decreased the likelihood of infections at the surgical site (RR:0.26; 95% CI: 0.09-0.78) without raising the risk of postoperative problems or the duration of hospitalization. [4]

The gynecological procedures of hysterectomy and myomectomy were the subject of a meta-analysis and systematic review by Iavazzo et al. Barbed sutures were found to have the same complication rate as traditional ones, but a shorter closure time and better hemostasis.[34] A more current meta-analysis of barbed sutures for laparoscopic vaginal cuff closure came to the same conclusion: it significantly reduced closure time without affecting cuff dehiscence or infection rates. [35]

Specialty-Specific Clinical Evidence

Abdominal Wall Surgery

Aghera et al. compared traditional tackers with barbed sutures for laparoscopic ventral hernia repair in a randomized controlled experiment. The barbed suture

group had less postoperative pain, needed less analgesics, and had a shorter mesh fixation time. Barbed sutures reduced operating time, which increased cost-effectiveness, yet surgical site infection (SSI) rates were similar.

In a comprehensive registry of open hernia procedures, Berrevoet et al. assessed triclosan-coated barbed sutures (TCS). Their research showed that compared to traditional sutures, there were fewer wound problems, shorter hospital stays (a mean reduction of 2.5 days), and similar recurrence rates. [5]

Gynecological Surgery

Barbed sutures shorten the time it takes to close the uterus and lessen the amount of blood that bleeds during a cesarean operation, according to randomized trials. Using barbed devices reduced the need for extra hemostatic sutures and saved two minutes of time, according to one study. [36]

Barbed sutures decrease suturing difficulties and operating time without influencing complication rates, according to a meta-analysis by Tulandi and Einarsson that compiled data from more than 12 randomized controlled trials (RCTs) including laparoscopic hysterectomy and myomectomy. [37]

Orthopedic Surgery

When it comes to total joint arthroplasty and spinal surgery, barbed sutures are utilized for the closure of fascia and skin. An randomized controlled trial comparing barbed and conventional sutures was performed by Sah et al. in a

bilateral knee arthroplasty. There was no rise in infection or disturbance of the wound, and the healing process was much quicker. [38]

Similarly, a matched cohort research comparing barbed sutures to conventional interrupted sutures in multilevel spinal surgery found that the former reduced operating closure time while the latter had comparable rates of wound healing problems. [39]

Oral and Maxillofacial Surgery

Maxillofacial treatments, such as third molar surgeries and mucosal closure, are increasingly utilizing barbed sutures for intraoral wound closure. For wounds made within the mouth, Krishnan et al. compared knotless barbed sutures to polydioxanone (PDS). With comparable healing outcomes, their study demonstrated faster closure and more patient comfort. [40]

In addition, a systematic review conducted by Krishnan and Periasamy found that barbed sutures are useful for intraoral applications, providing benefits such as reduced trauma and improved operational efficiency. [7]

Cosmetic and Plastic Surgery

When it comes to cosmetic and reconstructive surgeries like facelifts and abdominoplasty, barbed sutures are utilized for dermal and subcutaneous closure. For cutaneous closure, Rubin et al. compared traditional sutures with barbed absorbable sutures in a randomized controlled experiment that spanned

many centers. Cosmetic results were better, and suture time was shorter, but there was no change in wound dehiscence or infection, according to the study. [41]

According to a meta-analysis and systematic review conducted by Su et al., barbed sutures are a safe and effective option for aesthetic surgical operations that demand cosmetic perfection and tension distribution. [42]

Veterinary Applications

One application of barbed sutures in veterinary laparoscopic surgery is the treatment of inguinal hernias in horses. The utilization of these in forty horses undergoing laparoscopic hernioplasty was documented by Vázquez et al. Securing the incision with barbs cut down on operating time and removed the necessity for intracorporeal knot-tying. [43]

Ivakhov et al. examined barbed and non-barbed sutures for ventral hernia repair in rats as part of their experimental animal studies. They found that barbed sutures worked just as well as other methods for closing the abdominal wall in terms of tensile strength, healing time, and inflammatory response. [11]

Specific Evidence in Inguinal Hernia Repair

Current Clinical Applications

In order to minimize postoperative seroma and pain, barbed sutures have been used to close the internal inguinal ring and peritoneal flap in TAPP or TEP. Barbed suture around the transversalis fascia was used to treat direct hernia

defects in a prospective series by Li et al. There was minimal early pain, no recurrences throughout the 4-13 month follow-up, and one out of thirty-six hernias resolved spontaneously due to a clinically significant seroma.[44] Purposeful sealing of the internal ring defect decreased the rate of seroma formation to around 6.7%, alleviated postoperative pain (mean VAS 2.2), and avoided recurrence during the brief follow-up period in an independent TAPP research. [45]

Discussions over peritoneal flap closure continue. When compared to suture closure, a large registry study found that fibrin glue-less peritoneum closure reduced acute postoperative pain without increasing complications. [46]To improve flap alignment and mesh coverage, however, several centers still use barbed suture closure of the peritoneum.

Few studies have examined the effectiveness of inguinal hernia repairs for children. In a small number of facilities, laparoscopic internal ring barbed suture closure has been used to treat congenital hernias. The results have been promising: less operating time, fewer problems, and safe outcomes. This technique may have pediatric uses as well.

Comparative Studies in Hernia Surgery

Berrevoet et al. compared traditional PDS sutures to triclosan-coated barbed sutures (TCS) in a big retrospective cohort study of patients undergoing open inguinal hernia repair. There was a notable decrease in surgical problems (HR

~0.5) and a reduction of approximately 2.5 days in hospital stay when triclosan was coated on barbed TCS. With barbed TCS, the rates of surgical site infections at 60 and 90 days were cut in half (5.9% vs 11.7%). [5]

The antibacterial advantage of triclosan-coated sutures was found to be independent of suture format, according to a larger meta-analysis of abdominal fascial closure, which revealed a 16% reduction in SSI risk (OR 0.84) when using polydioxanone and polyglactin sutures in particular. [47]

The use of barbed sutures for peritoneal and ring closure in minimally invasive procedures has demonstrated both practicality and success. The use of a mesh patch in conjunction with an internal ring closure was shown in a recent randomized controlled trial published in Frontiers in Surgery to be safe, effective, and to minimize postoperative discomfort and seroma volume (34 versus 44 ml at day 7, P=0.006) without increasing the risk of infection or recurrence. [48]

Clinical Outcome Parameters: Comprehensive Assessment Framework

Operative Efficiency Metrics

Suturing Duration: Operational efficiency is primarily measured by suturing time. Measured with a timer or video review, it normally begins with the insertion of the first stitch and ends with the completion of fascial closure. For both laparoscopic and open hernia repairs, randomized trials comparing

conventional and barbed sutures found that the latter significantly cut suturing time, on average, by 3–7 minutes. [4]

Ease of Application: Surgeons evaluate this using measures that represent knot-tying complexity, needle handling, and tissue approximation, such as Visual Analog Scales (VAS) or Likert scales. Counts of needle repositionings, requirements for help, and interruptions throughout the operation are all objective metrics. The elimination of knot-tying and the reduction of tensioning processes make barbed sutures easier to apply, according to studies. [34]

Learning Curve Considerations: When compared to standard sutures, a multicenter study found that barbed sutures allowed for competency in laparoscopic hernia repair with fewer treatments. As the number of cases increased, the time it took to become proficient in transabdominal preperitoneal (TAPP) repair dropped from ninety-three minutes to fifty-five minutes. [49]

Postoperative Clinical Outcomes

Infection Parameters

Surgical Site Infection Rates: Classification of SSIs by the CDC is based on whether the infection is superficial, deep, or organ-space. According to research by Berrevoet et al., SSI rates were 5.9% lower with triclosan-coated barbed sutures (TCS) than with traditional sutures (11.7%) when it came to open hernia repairs. [5]

Antimicrobial Considerations: Sutures coated with triclosan lessen the likelihood of biofilm development and bacterial colonization. In operations requiring deep fascial closure in particular, a meta-analysis showed that SSI was reduced by 16% when absorbable sutures were coated with triclosan. [47]

Risk Factor Analysis: The length of the procedure, the handling of mesh, and patient-related factors including diabetes, obesity, and smoking all increase the likelihood of infection. An independent protective factor against SSI, shown by multivariate analysis, is the use of barbed TCS. [5]

Pain Assessment Methodologies

Visual Analog Scale Applications: When measuring the degree of pain, the VAS is a reliable and valid tool. When compared to patients whose incisions were closed using traditional sutures or tackers, those whose incisions were closed with barbed sutures reported less pain 24 hours and 7 days after surgery. [6]

Chronic Pain Development: Three to ten percent of patients who undergo inguinal hernia surgery report continuing chronic postoperative discomfort, according to long-term follow-up data. Reduced likelihood of nerve entrapment and chronic pain have been linked to the use of barbed sutures, which also reduce tissue stress and strain.

Analgesic Requirement Patterns: Patients with barbs in their sutures typically need less pain medication. The group given barbed suture was found to reduce opioid consumption and stop taking NSAIDs more quickly in comparison studies.[6]

Seroma Formation Analysis

Pathophysiological Mechanisms: Dead space and lymphatic leakage during dissection are the causes of seromas. The transversalis fascia can be closed with barbed sutures to minimize seroma production by reducing this gap. [45]

Diagnostic Criteria: Typically, a seromas will appear as an anechoic, non-compressible collection when ultrasound or clinical palpation is used to detect it. Surgical approach and method of detection determine the incidence rate, which can be anywhere from 0.5 to 12%. [50]

Management Strategies: Minimal intervention is required for the treatment of asymptomatic seromas. Aspiration or drainage may be necessary in cases that persist or exhibit symptoms. Research has shown that fewer interventional procedures are needed when barbed suture closure is used. [45]

Long-Term Outcomes

Recurrence Rates: Physical examination and ultrasound are used to evaluate the likelihood of hernia recurrence at six months, one year, and beyond. No

recurrence was observed up to thirteen months after barbed suture closure of direct hernia defects in a prospective series. [44]

Functional Assessment: Postoperative discomfort, awareness of the mesh, and physical functioning can be assessed with instruments like the EQ-5D and the Carolinas Comfort Scale (CCS). There was an improvement in CCS scores at 3 and 6 months for patients in the barbed suture group. [48]

Patient Satisfaction Indices: The use of standardized metrics to evaluate pain relief, scar appearance, and the ability to resume normal activities are all ways to gauge postoperative satisfaction. Because to the shorter recovery time and fewer difficulties, surveys regularly demonstrate that barbed suture groups are more satisfied. [4]

Safety Profile and Complication Analysis

Documented Complications

Bowel Obstruction: Obstruction of the small intestine is the most serious side effect associated with barbed sutures. The majority of these occurrences occurred after laparoscopic hernia repairs or gynecologic surgeries, however a systematic study found 22 instances between 2011 and 2020 associated with intestinal loop tangling and exposed suture barbs. Surgical intervention was necessary to free the bowel and trim or remove the suture tail, and patients usually presented between 3-13 days postoperatively. [51]When TAPP is used to

repair an inguinal hernia, there have been cases of intestinal volvulus or perforation caused by the barbed suture tail. [52,53]

Suture Migration: Adhesion development or intestinal entrapment can occur when suture tails migrate or protrude. Techniques like as providing anti-adhesive barriers, burying tails beneath serosal surfaces, or cutting barbed suture ends flush with tissue can be employed to avoid this. [51]

Inflammatory Response: A study of histological findings between monofilament and barbed sutures in animal and cosmetic surgery models shows that the former does not significantly affect foreign-body inflammatory reaction, collagen production, or capsule thickness. [54]According to one narrative review, compared to bidirectional designs, unidirectional barbed sutures may cause somewhat more tissue drag and low-grade discomfort. [3]

Contraindications and Limitations

Patient Selection Criteria: In patients with a history of adhesions or impaired peritoneal healing, especially during framesocolic surgeries, it is important to exercise caution while using barbered sutures intraperitoneally. Alternative suture methods may be necessary to reduce the risk of adhesion and infection in obese patients and those with high-risk comorbidities, such as diabetes.

Technical Limitations: Because of the difficulty in clipping or burying the ends of barbed sutures in small operating fields, they may not be an option. In

the absence of sufficient anchoring, they are also less suitable to tissues experiencing significant cyclic stress.

Material Degradation: In the course of a few weeks to months, hydrolysis breaks down absorbable barbed sutures (such as PDS or glycomer). Tissue irritation or delayed adhesion formation may occur because to unanticipated breakdown or protracted tail presence, even when the material is biocompatible. Little is known about biocompatibility over the long term, beyond a year. [3]

Summary of Studies Relevant to Knotless Barbed Sutures in Surgical Applications

1. A thorough technical evaluation was carried out by Ingle NP, Cong H, and King MW to investigate the history, biomechanical characteristics, and clinical uses of barbed sutures in several surgical fields. Using a variety of polymer substrates, this preliminary study compared production methods, new developments in materials science, and directed barb designs. Modern barbed suture systems were evaluated for their biocompatibility, tensile strength, and tissue anchoring mechanisms. Commercial products, such as V-Loc, Quill, and Stratafix systems, were compared and precise technical specifications were provided by the investigation. The authors came to the conclusion that barbed suture technology is a huge step forward in wound closure methodology. It is more efficient and has the same mechanical properties as traditional

knotted sutures, but it does highlight the importance of specialized training and proper patient selection protocols. [1]

2. In a randomized controlled experiment that spanned numerous US locations, Rubin JP, Hunstad JP, Polynice A, and colleagues compared absorbable barbed sutures to traditional absorbable sutures for cutaneous closure during open surgical procedures. A total of 180 individuals who were due to have dermal closures after various open surgical procedures were part of the trial. When it came time to close the wounds, the participants were randomly assigned to either traditional interrupted sutures or knotless barbed sutures. Time to closure, ease of application, and variables related to wound healing were evaluated at set intervals as primary outcomes. Aesthetic results measured using standardised assessment instruments, patient satisfaction levels, and rates of infection at surgical sites were all considered secondary objectives. Researchers found that absorbable barbed sutures were more easier to apply and required much less time for closure than traditional methods. They also had similar safety profiles and patients were more satisfied with the results of their cosmetic surgeries. [41]
3. A meta-analysis and systematic review of randomized controlled trials assessing the safety and effectiveness of knotless barbed sutures in various surgical procedures was conducted by Lin Y, Lai S, Huang J, and Du L. General, gynecological, orthopedic, and plastic surgeons were

among the many surgical subspecialties represented in the 2,674 individuals who took part in the 23 randomized controlled trials that made up the analysis. Operating time, complication rates, and clinical efficacy criteria were the main indicators of success. Analyses of cost-effectiveness, patient-reported outcomes, and assessments of long-term follow-up were included as secondary objectives. A random-effects model was used for statistical analysis, and I^3 statistics were used to measure heterogeneity. In comparison to traditional suturing methods, the meta-analysis showed a considerable decrease in operating time (weighted mean difference: -8.12 minutes, 95% CI: -12.34 to -3.90, $p<0.001$) while maintaining similar safety profiles. The authors came to the conclusion that knotless barbed sutures are more effective during surgery and had similar clinical results in different types of surgeries.[4]

4. An economic evaluation was carried out by Elmallah RK, Khlopas A, Faour M, and colleagues at one US academic medical center to compare various suture closure methods. The evaluation focused on orthopedic surgical applications and compared barbed sutures with typical interrupted sutures. Stratified randomization to either standard closure techniques or barbed suture was used to conduct the retrospective analysis, which involved 200 patients undergoing total joint arthroplasty surgeries. Using established institutional cost accounting procedures, the primary economic endpoints were the direct material costs, operative time

charges, and overall procedural costs. During the 90-day follow-up periods, secondary metrics were employed, including the rates of complications, revision procedures, and indirect healthcare utilization costs. Decision tree modeling incorporating sensitivity analysis for critical variables was utilized in the cost-effectiveness analysis. The analysis found that using barbed sutures significantly reduced operating time while maintaining equal clinical outcomes, which led to significant cost savings. When compared to more conventional interrupted closure techniques, the scientists found that barbed sutures were the most cost-effective option for arthroplasty.

5. A randomized clinical experiment was carried out at various medical sites in Israel by Peleg D, Ahmad RS, Warsof SL, Marcus-Braun N, Sciaky-Tamir Y, and Shachar IB to compare knotless barbed sutures with conventional sutures for uterine incision closure during cesarean delivery. The research included 180 pregnant women who were randomly assigned to either traditional two-layer closure methods or barbed suture during elective or emergency caesarean procedures. Time to uterine closure, anticipated blood loss, and acute postoperative problems were the main outcome measures. Visual analog scale pain scores, analgesic needs, and short-term indications of maternal morbidity were included as secondary objectives. Standardized clinical evaluation protocols were used to conduct follow-up assessments at 24, 48, and 6 weeks postoperatively.

The study showed that using barbed sutures significantly reduced closure time (mean difference: 4.2 minutes, $p<0.001$) and blood loss. In their analysis of knotless barbed sutures for cesarean deliveries, the authors found that they improve operational efficiency while maintaining similar safety profiles.[56]

6. A thorough meta-analysis of randomized controlled trials assessing the safety and effectiveness of knotless barbed sutures in total joint arthroplasty procedures was carried out by Han Y, Yang W, Pan J, and colleagues across various worldwide centers. Twelve randomized controlled studies including 1,456 patients having total hip or knee arthroplasty were included in the meta-analysis. Closure time of wounds, complication rates, and functional recovery characteristics evaluated with approved orthopedic evaluation scales were the main end measures. Assessments of pain, range of motion, and patient satisfaction indices were included as secondary objectives to be assessed at pre-arranged intervals. The statistical analysis made use of both fixed-effects and random-effects modeling, along with subgroup analyses and thorough evaluations of heterogeneity. In comparison to traditional suturing methods, the meta-analysis showed a substantial decrease in closure time (weighted mean difference: -6.8 minutes, 95% CI: -9.2 to -4.4, $p<0.001$) and similar rates of complications. When it comes to joint arthroplasty,

the scientists found that knotless barbed sutures are more effective and have similar safety profiles. [9]

7. A pig model was used in a comparative experimental investigation at the University of Turin, Italy, by Giusto G, Iussich S, Tursi M, Perona G, and Gandini M to evaluate two distinct barbed suture materials for end-to-end jejuno-jejunal anastomosis. The study utilized a random assignment of twenty domestic pigs to undergo small bowel anastomosis construction using either the V-Loc or Quill barbed suture systems. Anastomotic integrity, healing features, and biomechanical strength tests were conducted at 7 and 14-day intervals as primary end measures. Histopathological investigation utilizing established grading systems, evaluation of tissue reactions, and assessment of inflammatory response were all part of the secondary endpoints. Measurements of tensile strength and burst pressure were part of the standard operating procedures used in biomechanical testing. Although V-Loc sutures were shown to have superior handling features, the study found that all barbed suture systems exhibited equal anastomotic integrity and healing properties. Both barbed suture materials offer reliable anastomotic construction and have high biocompatibility profiles, according to the authors. They found these qualities to be particularly useful in gastrointestinal surgical procedures. [57]

8. The authors of the study compared barbed sutures to conventional sutures in total knee arthroplasty procedures performed at several international locations. The study was carried out by Li E, Niu W, Lu T, Li X, Zhang T, Cai J, and Wang W. Included in the study were eleven randomized controlled studies with a total of 1,234 individuals who had primary total knee arthroplasty. Time to wound closure, complication rates, and functional recovery characteristics evaluated by Knee Society Scores and range of motion tests were the primary outcome measures. During the 90-day follow-up periods, secondary outcomes were healthcare resource consumption, patient satisfaction indices, pain assessment using visual analog scales, and pain severity. A random-effects model with thorough heterogeneity assessment and sensitivity testing for important variables was used for statistical analysis. When compared to traditional interrupted sutures, the meta-analysis showed a substantial decrease in closure time (mean difference: -7.1 minutes, 95% CI: -10.3 to -3.9, $p<0.001$) and similar rates of complications. The study's authors came to the conclusion that barbed sutures improve surgical efficiency while producing similar clinical results in cases of knee arthroplasty. [58]
9. An evaluation of knotless barbed sutures as agents for intraoral wound closure in oral and maxillofacial surgery was carried out by Krishnan S and Periasamy S in a systematic review that included several Indian institutes. Fifteen clinical trials involving 1,086 patients who had third

molar extractions, periodontal operations, or maxillofacial trauma repairs were included of the extensive research. Using established clinical evaluation techniques, the key outcome criteria included the time it took to close the wound, how easy it was to apply, and the wound healing characteristics. Pain scores, levels of patient comfort, and postoperative complications were assessed using standardized instruments at preset intervals as secondary objectives. Protocols for evidence synthesis and risk of bias evaluation were part of the standardised quality assessment procedures used in the systematic review. When compared to traditional suturing methods, the study showed a considerable improvement in patient comfort and a marked decrease in closure time. When it comes to oral and maxillofacial surgeries, knotless barbed sutures are the way to go because they offer better clinical results and are well-received by patients. [7]

10. At an Indian tertiary care facility, researchers Shankaran R, Mishra D, Kumar V, and Bandyopadhyay K compared the safety and effectiveness of barbed sutures with that of tackers, the conventional fixation method, in laparoscopic ventral and incisional hernia repair. One hundred twenty patients who were scheduled for laparoscopic hernia repairs were randomly assigned to receive either traditional tacker fixation or barbed suture fixation. Operative time, visual analog scale scores for postoperative pain, and rates of early complications were the primary end

measures. Evaluations of cost-effectiveness, patient satisfaction indices, and rates of short-term recurrence assessed during 6-month follow-up periods were included as secondary objectives. With the use of barbed sutures, the study found that surgical time was significantly reduced (mean difference: 12.4 minutes, $p<0.01$) and postoperative pain levels were decreased. When compared to traditional tacker fixation methods, the authors found that barbed sutures improved surgical efficiency and patient comfort during laparoscopic hernia repairs.[6]

11. The clinical effects of triclosan-coated barbed sutures in open hernia repair were evaluated in a retrospective cohort research at various European sites by Berrevoet F, van Cauteren L, Gunja N, and colleagues. The study compared traditional suture materials with those that were coated with triclosan and comprised 286 patients who had undergone different open hernia repair techniques. Using established clinical evaluation techniques, the main outcome measures included the frequencies of surgical site infections, wound healing characteristics, and early postoperative sequelae. Operative time, cost-effectiveness metrics, and patient-reported outcomes assessed at the 30- and 90-day follow-up points were considered secondary objectives. To improve the study's comparative validity and reduce selection bias, propensity score matching techniques were utilized. With triclosan-coated barbed sutures, the experiment showed a considerable decrease in surgical site infection rates

(3.2% vs 8.7%, $p<0.05$) while maintaining equal operative efficiency. When it comes to open hernia repairs, the authors found that antimicrobial-coated barbed sutures offer better infection prevention with similar clinical results. [5]

12. In a study carried out at a tertiary care facility in India, Syed DAI, Sachin D, Kumar DN, and Kumari DP compared conventional sutures with unidirectional barbed sutures for anterior abdominal wall closure. A total of 150 patients were enrolled in the prospective study, and they were randomly assigned to either traditional interrupted closure techniques or barbed suture during midline laparotomy operations. Time to fascial closure, application ease as measured by established surgeon rating scales, and the occurrence of early wound complications were the primary end measures. Pain scores on visual analog scales, analgesic needs, and wound healing features assessed at predefined intervals over 30-day follow-up periods were included as secondary objectives. The application of barbed sutures was shown to be easier and the closure time was significantly reduced (mean difference: 8.6 minutes, $p<0.001$) in the experiment. According to the authors, when it comes to abdominal wall surgery, unidirectional barbed sutures are safer and more effective than traditional closure approaches.[13]

METHODOLOGY

MATERIALS AND METHODS

Study Design and Study Setting

When it comes to closing the external oblique aponeurosis after inguinal hernia surgery, this inquiry used a prospective comparative observational study design to compare the clinical efficacy of knotless barbed sutures with conventional sutures. Researchers from the tertiary care academic medical institution R.L. Jalappa Hospital in Tamaka, Kolar, India, which has a long history of success fixing hernias, performed the study.

Study Period

The study lasted for 18 months, from April 2023 to September 2024, which was long enough to enroll all eligible patients, perform all necessary surgical procedures, and evaluate patients afterward.

Ethics Committee Approval

In order to ensure that the study followed all regulations for patient safety and ethical research, it was approved by the Institutional Ethics Committee before it began. All participants were asked to sign an informed consent form after they were given a thorough rundown of the study's goals, procedures, risks, and benefits. All aspects of the study were carried out in accordance with the principles outlined in the Declaration of Helsinki and Good Clinical Practice guidelines.

Inclusion Criteria

Patients were selected if they were between the ages of 19 and 75 and had an inguinal hernia that needed surgery. Excluding younger patients with different anatomy and older patients with higher perioperative risk profiles, this wide age range allowed for thorough demographic coverage. For the sake of maximising external validity and complete clinical applicability, all morphological subtypes of hernias were included. This includes both direct and indirect presentations.

Exclusion Criteria

Individuals with dermatological disorders that can affect surgical recovery parameters and immunocompromised patients with possible wound healing impairment were excluded from the study. Patients having a history of inguinal hernia repair, those presenting with bilateral hernias that necessitate simultaneous surgery, and those with substantial comorbidities that prohibit the use of normal anesthetic protocols were also excluded. Because the surgical procedures and recovery times for patients with strangulated or incarcerated hernias were different, we did not include them in our emergency case pool.

Sample Size Estimation

In order to determine an appropriate sample size, we used statistical power analysis techniques with information gathered from prior comparative studies. The systematic review by Lin et al. (2016), which included 2,674 participants

from various surgical specialties, found that the standard deviation for changes in suturing length was 8.12 minutes. [4] We calculated the sample size to be 22 participants per group using the following parameters: α=0.05, β=0.20 (80% power), and an expected mean difference of 3.0 minutes, which is based on the findings of Syed et al. (2025) in 150 patients having abdominal wall closure (standard deviation 2.3 minutes). [13] For thorough comparative analysis, a final sample size of 50 patients was determined, with 25 participants in each group to account for possible 10% attrition rates.

Sample Size Formula: $n = 2\sigma^2(Z\alpha/2 + Z\beta)^2 / \delta^2$

Where: σ = pooled standard deviation (2.3), $Z\alpha/2$ = 1.96, $Z\beta$ = 0.84, δ = expected difference (3.0 minutes)

Sampling Method

In order to avoid selection bias and guarantee balanced treatment group allocation, the recruiting process utilized systematic odd-even randomization methods. Patients who met the inclusion criteria and were admitted to the hospital in sequential order were randomly assigned to one of two groups: one that used knotless barbed suture (odd numbers) and another that used conventional suture (even numbers). While keeping methodological rigor and balanced group distribution throughout the enrollment period, our simple randomization methodology aided practical implementation.

Data Collection Procedure

Age, gender, BMI, ASTA physical status classification, and hernia morphological features (direct vs. indirect classification, defect dimensional measurements, etc.) were all part of the exhaustive demographic data collection process. Suture material utilization, total operative time, surgeon satisfaction, and ease of suturing were all measured during the operation. Secondary outcomes included the duration of external oblique aponeurosis suturing using standardized chronometric methodology and predefined complexity scales, respectively.

During the postoperative clinical assessment, patients were measured for pain using visual analog scales at 6, 24, 48, and 1 week postoperatively. Analgesic requirements, such as tramadol consumption and duration of non-steroidal anti-inflammatory drug usage, were documented. Patients' functional recovery was evaluated by tracking their return to normal activities timeline. At three-month intervals, patients underwent comprehensive complication surveillance, which included evaluation of seroma formation using clinical examination and, when necessary, ultrasonographic confirmation; assessment of surgical site infection according to CDC criteria; documentation of hematoma development; evaluation of wound dehiscence; and evaluation of chronic pain.

Participating surgeons adhered to all data collection standards and used verified measurement devices consistently. When possible, independent assessors who

were not aware of the participants' treatment allocation performed the clinical evaluations in order to reduce the possibility of assessment bias and increase the reliability of the results.

Data Analysis

Depending on the parameters of the data distribution, appropriate parametric and non-parametric approaches were used for statistical analysis. Mann-Whitney U tests were used for non-parametric distributions while independent t-tests were used for normally distributed continuous variables. When there were less than five anticipated cell frequencies, categorical variables were examined using chi-square tests or Fisher's exact tests. For continuous variables, descriptive statistics comprised the mean ± standard deviation, while for categorical parameters, percentages were used for frequencies. With the use of 95% confidence intervals, the effect size was estimated and statistical significance was determined at $p<0.05$.

RESULTS

RESULTS

Table 1: Age Distribution Comparison Between Study Groups

Age (years)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Independent t-test, p-value
Mean ± SD	52.4 ± 11.8	54.2 ± 12.3	0.584
Range	29-74	40-75	

Based on the statistical analysis conducted using an independent t-test (p=0.584), it is confirmed that there is no significant age-related selection bias. The mean ages of the participants were 52.4 ± 11.8 years and 54.2 ± 12.3 years, respectively. These results establish comparable baseline demographic foundations for clinical outcome assessment.

Table 2: Gender Distribution Analysis

Gender	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Fisher's exact test, p-value
Male	25 (100%)	25 (100%)	1.000
Female	0 (0%)	0 (0%)	

Complete gender homogeneity is evident in this demographic analysis, as both treatment arms are exclusively male (100%).

Table 3: Body Mass Index Stratification Between Treatment Groups

BMI (kg/m^2)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Independent t-test, p-value
Mean ± SD	24.8 ± 3.2	25.1 ± 2.9	0.721

This anthropometric analysis presents BMI distributions demonstrating statistical equivalence between treatment cohorts (24.8 ± 3.2 vs 25.1 ± 2.9 kg/m^2; p=0.721).

Table 4: ASA Physical Status Classification Distribution

ASA Score	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Chi-square test, p-value
ASA I	18 (72%)	16 (64%)	0.543
ASA II	7 (28%)	9 (36%)	

This perioperative risk stratification analysis demonstrates comparable ASA score distributions between treatment groups, with ASA I classification predominating in both cohorts (72% vs 64%; p=0.543).

Figure 6: ASA Physical Status Classification Distribution

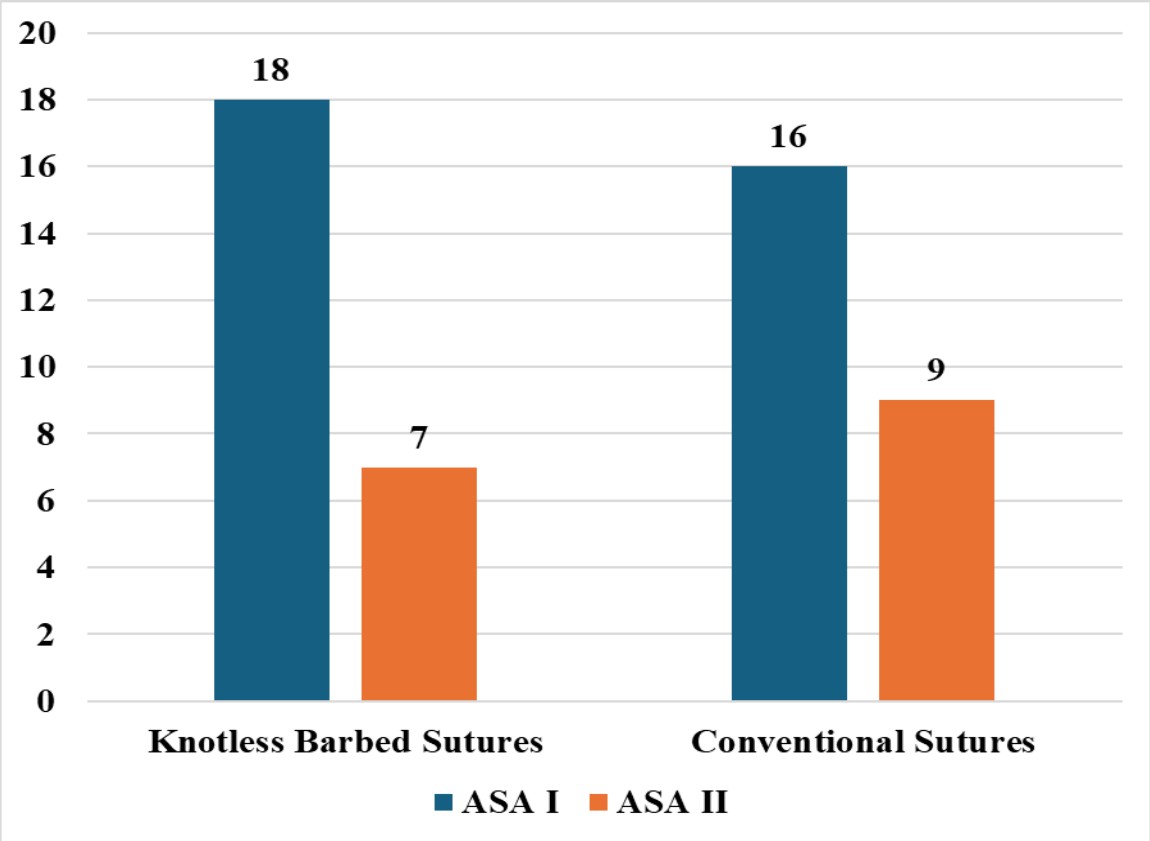


Table 5: Hernia Morphological Classification Distribution Analysis

Hernia Type	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Chi-square test, p-value
Direct	9 (36%)	11 (44%)	0.564
Indirect	16 (64%)	14 (56%)	

This anatomical classification presents hernia type distributions showing balanced representation of direct (36% vs 44%) and indirect (64% vs 56%) hernias between treatment groups (p=0.564).

Figure 7: Hernia Morphological Classification Distribution Analysis

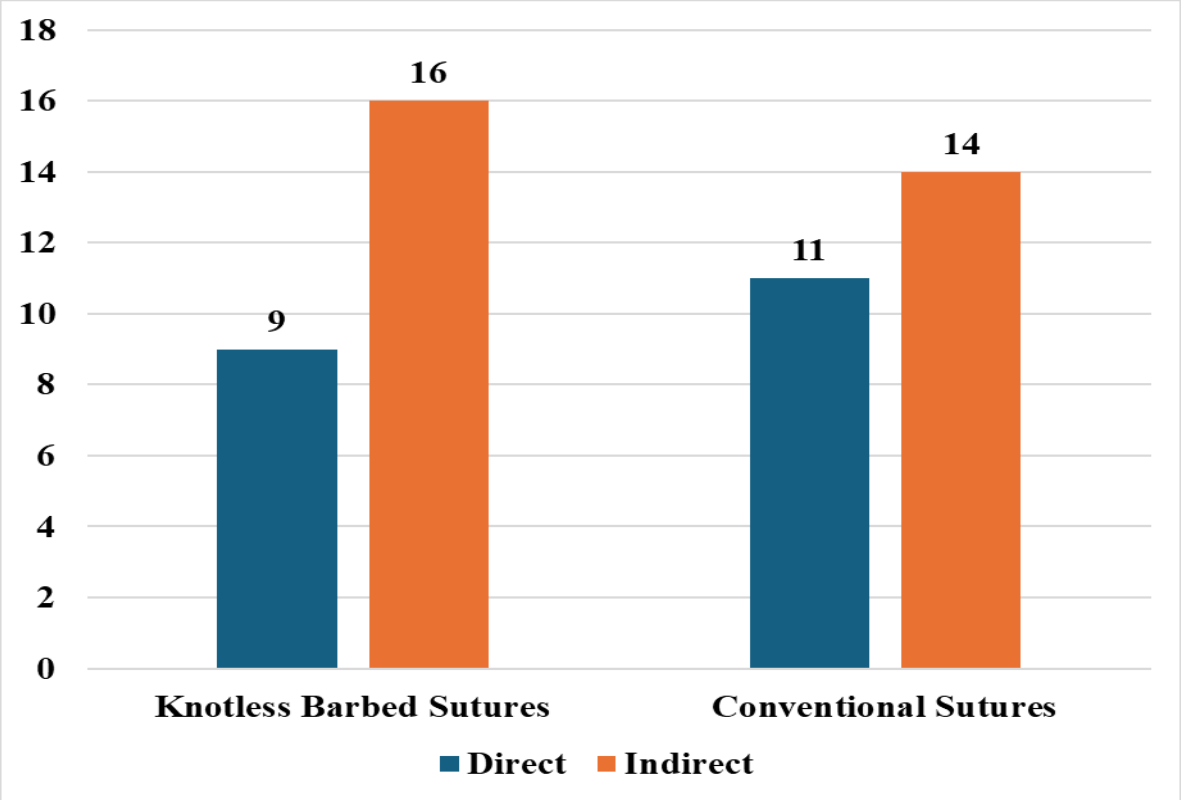


Table 6: Hernia Defect Size Quantitative Assessment

Hernia Size (cm)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Independent t-test, p-value
Mean ± SD	3.8 ± 1.4	3.6 ± 1.2	0.627

This morphometric analysis demonstrates comparable hernia dimensions between treatment cohorts (3.8 ± 1.4 vs 3.6 ± 1.2 cm; p=0.627), establishing equivalent surgical complexity baselines.

Table 7: External Oblique Aponeurosis Closure Duration Analysis

Duration of Suturing (minutes)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
Mean ± SD	10.2 ± 1.8	14.1 ± 2.3	-3.9 (-5.1 to -2.7)	<0.001*
Range	8-14	11-18		

This operative efficiency assessment demonstrates statistically significant reduction in suturing duration with knotless barbed sutures (10.2 ± 1.8 vs 14.1 ± 2.3 minutes; $p<0.001$), representing a clinically meaningful 27.7% temporal improvement. The substantial time reduction reflects enhanced operative efficiency through elimination of knot-tying requirements, supporting the primary research hypothesis regarding technical superiority of barbed suture technology.

Table 8: Subjective Ease of Application Assessment

Ease of Suturing	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Fisher's exact test, p-value
Simple	25 (100%)	25 (100%)	1.000
Moderate	0 (0%)	0 (0%)	
Difficult	0 (0%)	0 (0%)	

This technical proficiency evaluation demonstrates equivalent ease ratings across both suture modalities, with all procedures classified as "simple" complexity (100% vs 100%; p=1.000).

Table 9: Comprehensive Operative Duration Assessment

Total Operative Time (minutes)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
Mean ± SD	58.4 ± 8.2	62.3 ± 9.1	-3.9 (-8.4 to 0.6)	0.089

This temporal analysis presents total operative times demonstrating non-significant reduction trends favouring knotless barbed sutures (58.4 ± 8.2 vs 62.3 ± 9.1 minutes; p=0.089). While external oblique closure time showed significant improvement, overall operative duration differences remained statistically non-significant, suggesting that suture-specific time savings represent a component of broader procedural efficiency optimization.

Table 10: Surgeon Satisfaction Score Evaluation

Surgeon Satisfaction Score (1-10)	**Knotless Barbed Sutures (n=25)**	**Conventional Sutures (n=25)**	**Mean Difference (95% CI)**	**Independent t-test, p-value**
Mean ± SD	8.7 ± 0.9	7.2 ± 1.1	1.5 (0.9 to 2.1)	<0.001*

This subjective assessment demonstrates statistically significant enhancement in surgeon satisfaction with knotless barbed sutures (8.7 ± 0.9 vs 7.2 ± 1.1; $p<0.001$), reflecting superior handling characteristics and technical performance.

Table 11: Suture Material Utilization Quantification

Number of Sutures Used	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
Mean ± SD	4.2 ± 0.8	4.1 ± 0.7	0.1 (-0.3 to 0.5)	0.662

This resource utilization analysis demonstrates equivalent suture consumption between treatment modalities (4.2 ± 0.8 vs 4.1 ± 0.7; p=0.662), indicating comparable material requirements despite differing suture technologies.

Table 12: Temporal Pain Assessment Using Visual Analog Scale

Visual Analog Scale (0-10)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
6 hours	4.2 ± 1.3	5.1 ± 1.6	-0.9 (-1.7 to -0.1)	0.028*
24 hours	3.1 ± 1.1	3.8 ± 1.4	-0.7 (-1.4 to 0.0)	0.048*
48 hours	2.3 ± 0.9	2.9 ± 1.2	-0.6 (-1.2 to 0.0)	0.051
1 week	1.8 ± 0.7	2.2 ± 0.8	-0.4 (-0.8 to 0.0)	0.066

This comprehensive pain evaluation demonstrates statistically significant improvements in early postoperative periods with knotless barbed sutures, particularly at 6-hour (4.2 ± 1.3 vs 5.1 ± 1.6; p=0.028) and 24-hour (3.1 ± 1.1 vs 3.8 ± 1.4; p=0.048) intervals. The temporal pain reduction pattern suggests enhanced tissue handling characteristics and reduced inflammatory response associated with knotless closure methodology.

Table 13: Analgesic Requirement Quantification Analysis

Analgesic Requirements	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
Tramadol (mg) - 24h	142.0 ± 28.4	168.0 ± 32.1	-26.0 (-42.8 to -9.2)	0.003*
NSAIDs usage (days)	2.8 ± 1.2	3.4 ± 1.1	-0.6 (-1.2 to 0.0)	0.043*

This pharmacological assessment demonstrates statistically significant reductions in tramadol consumption (142.0 ± 28.4 vs 168.0 ± 32.1 mg; p=0.003) and NSAID utilization duration (2.8 ± 1.2 vs 3.4 ± 1.1 days; p=0.043) with knotless barbed sutures. The reduced analgesic requirements corroborate superior pain control profiles and suggest enhanced patient comfort through improved surgical technique.

Table 14: Functional Recovery Timeline Assessment

Return to Normal Activities (days)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Mean Difference (95% CI)	Independent t-test, p-value
Mean ± SD	6.2 ± 2.1	7.8 ± 2.4	-1.6 (-2.8 to -0.4)	0.010*

This functional outcome analysis demonstrates statistically significant acceleration in return to normal activities with knotless barbed sutures (6.2 ± 2.1 vs 7.8 ± 2.4 days; p=0.010). The enhanced recovery timeline reflects improved early postoperative comfort and reduced tissue trauma, supporting patient-centered outcome advantages beyond purely technical considerations.

Postoperative Complications and Clinical Outcomes

Table 15: Seroma Formation Incidence

Seroma Formation	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Relative Risk (95% CI)	Fisher's exact test, p-value
Present	1 (4%)	3 (12%)	0.33 (0.04-3.03)	0.612
Absent	24 (96%)	22 (88%)		

This fluid collection assessment demonstrates reduced seroma incidence trends with knotless barbed sutures (4% vs 12%; RR=0.33; p=0.612), though statistical significance was not achieved.

Figure 8: Seroma Formation Incidence

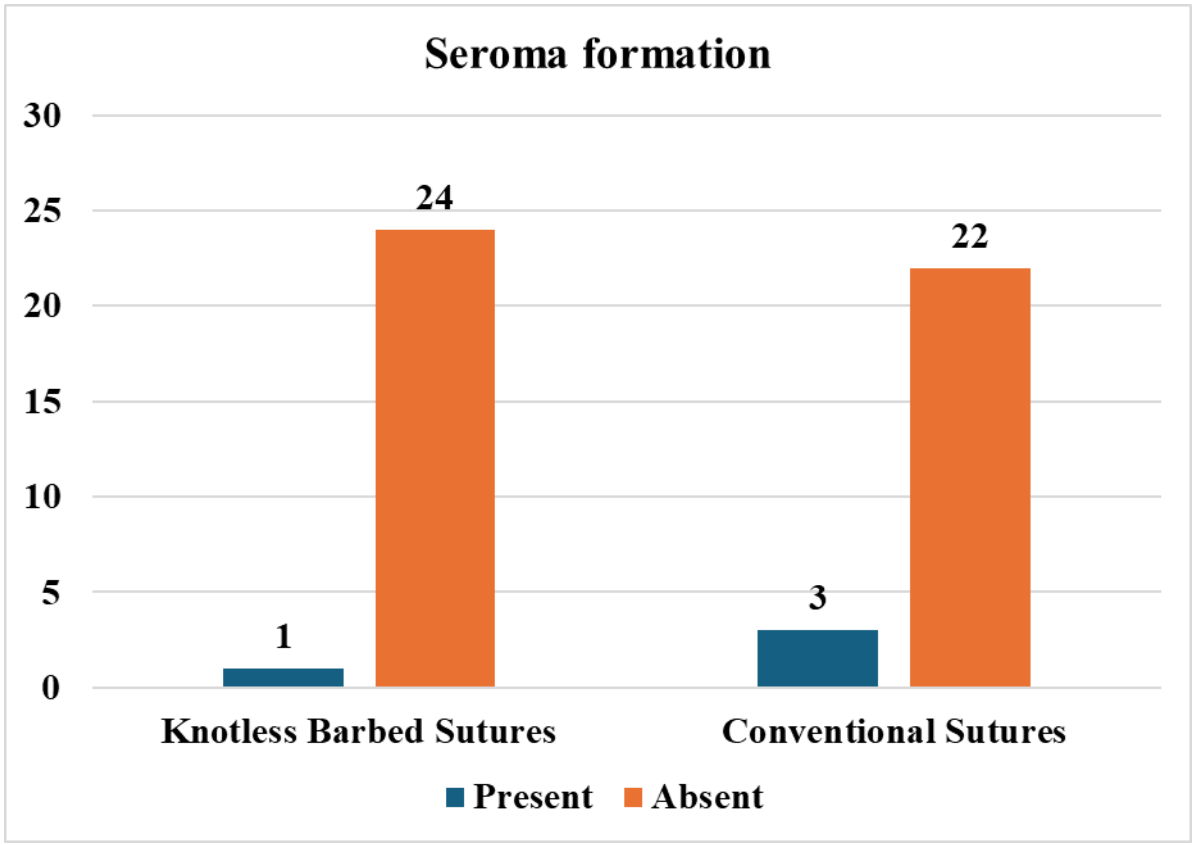


Table 16: Surgical Site Infection Surveillance Analysis

Surgical Site Infection	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Fisher's exact test, p-value
Superficial	0 (0%)	1 (4%)	1.000
Deep	0 (0%)	0 (0%)	

This infectious complication assessment demonstrates superior infection prevention with knotless barbed sutures (0% vs 4% superficial infection rate; p=1.000).

Table 17: Hematoma Development Incidence Evaluation

Hematoma	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Relative Risk (95% CI)	Fisher's exact test, p-value
Present	1 (4%)	2 (8%)	0.50 (0.05-5.22)	1.000
Absent	24 (96%)	23 (92%)		

This bleeding complication analysis demonstrates reduced hematoma formation with knotless barbed sutures (4% vs 8%; RR=0.50; p=1.000), though statistical significance was not achieved.

Figure 9: Hematoma Development Incidence Evaluation

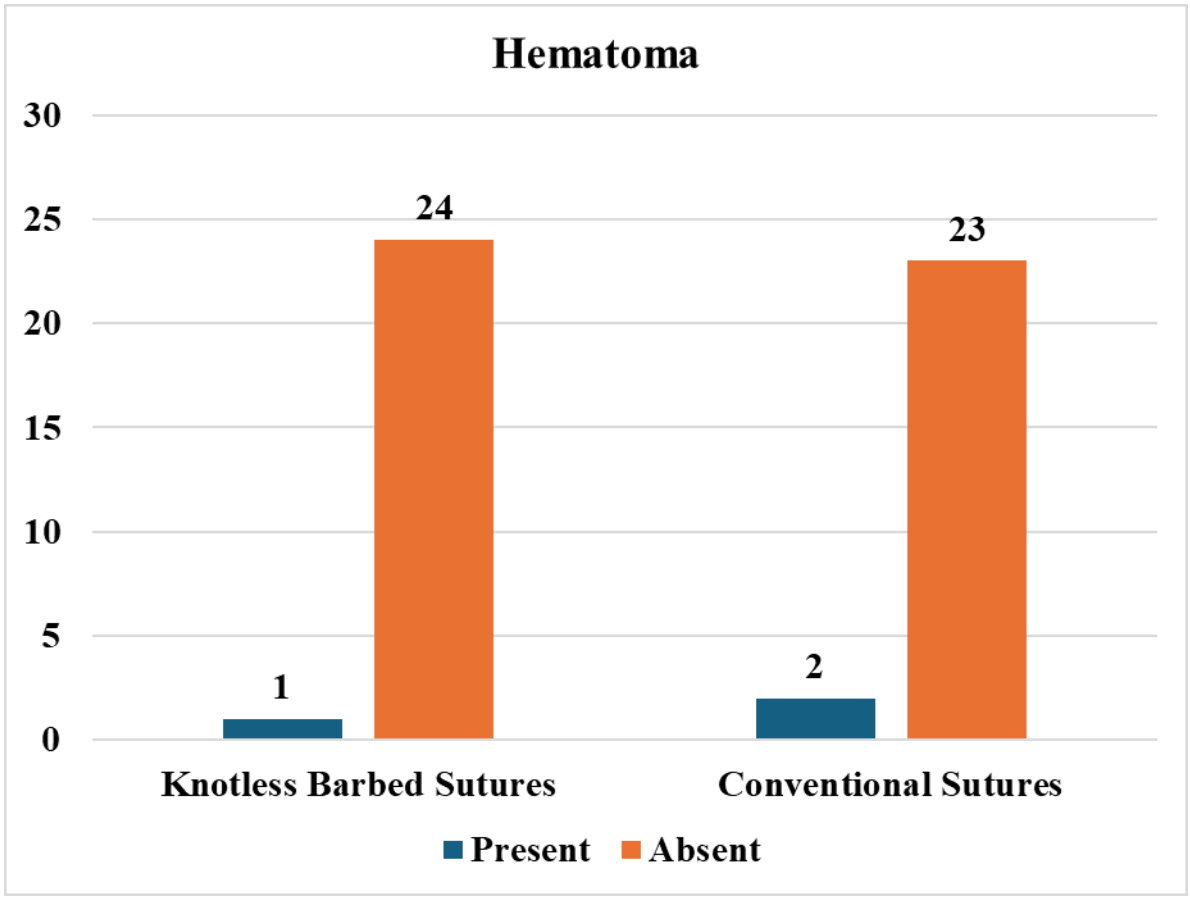


Table 18: Wound Dehiscence Occurrence Assessment

Wound Dehiscence	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Fisher's exact test, p-value
Present	0 (0%)	1 (4%)	1.000
Absent	25 (100%)	24 (96%)	

This wound integrity evaluation demonstrates superior wound healing with knotless barbed sutures (0% vs 4% dehiscence rate; p=1.000).

Table 19: Chronic Pain Development Analysis

Chronic Pain (>3 months)	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Relative Risk (95% CI)	Fisher's exact test, p-value
Present	2 (8%)	4 (16%)	0.50 (0.10-2.46)	0.669
Absent	23 (92%)	21 (84%)		

This long-term pain assessment demonstrates reduced chronic pain incidence with knotless barbed sutures (8% vs 16%; RR=0.50; p=0.669), though statistical significance was not achieved.

Figure 10: Chronic Pain Development Analysis

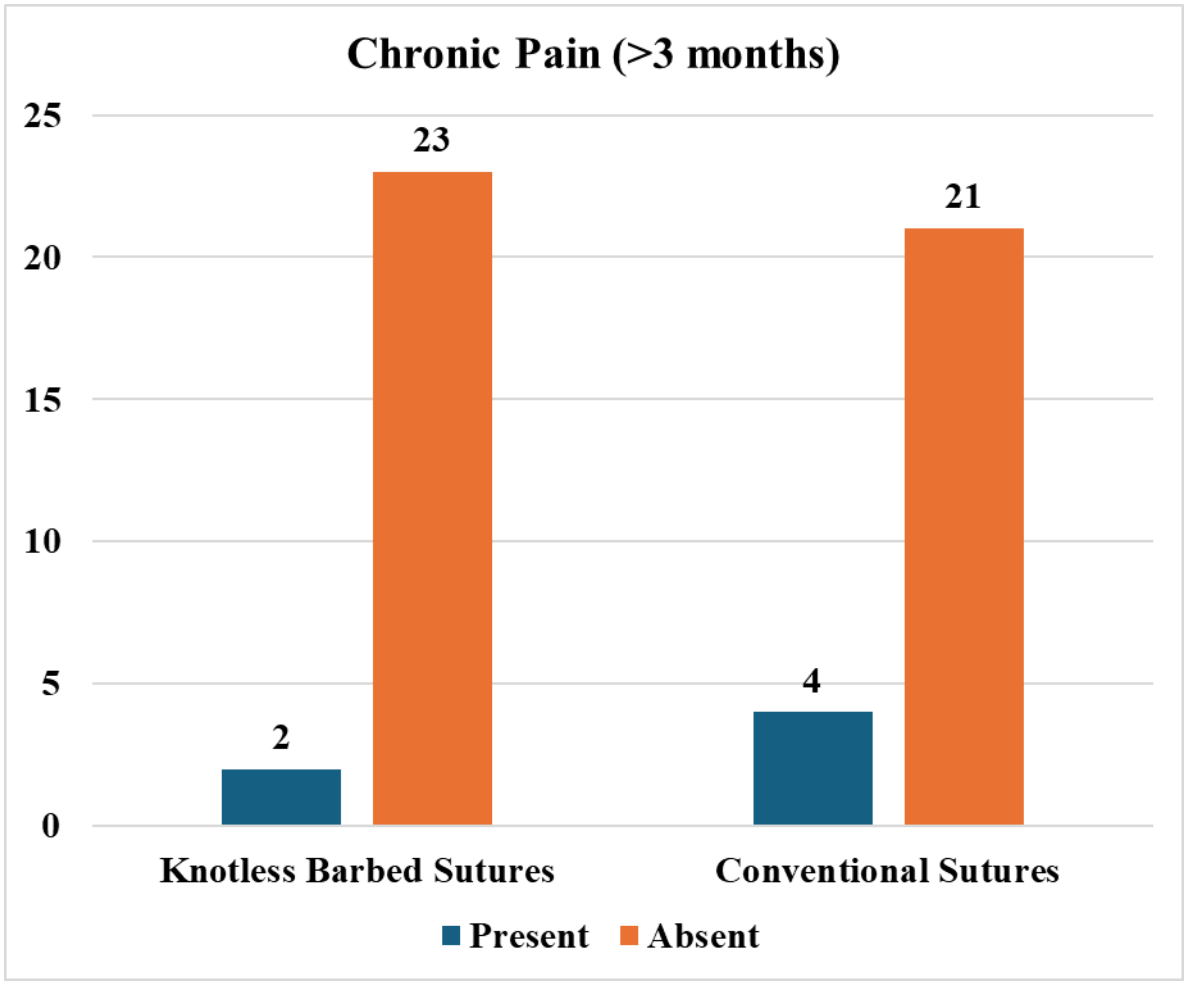
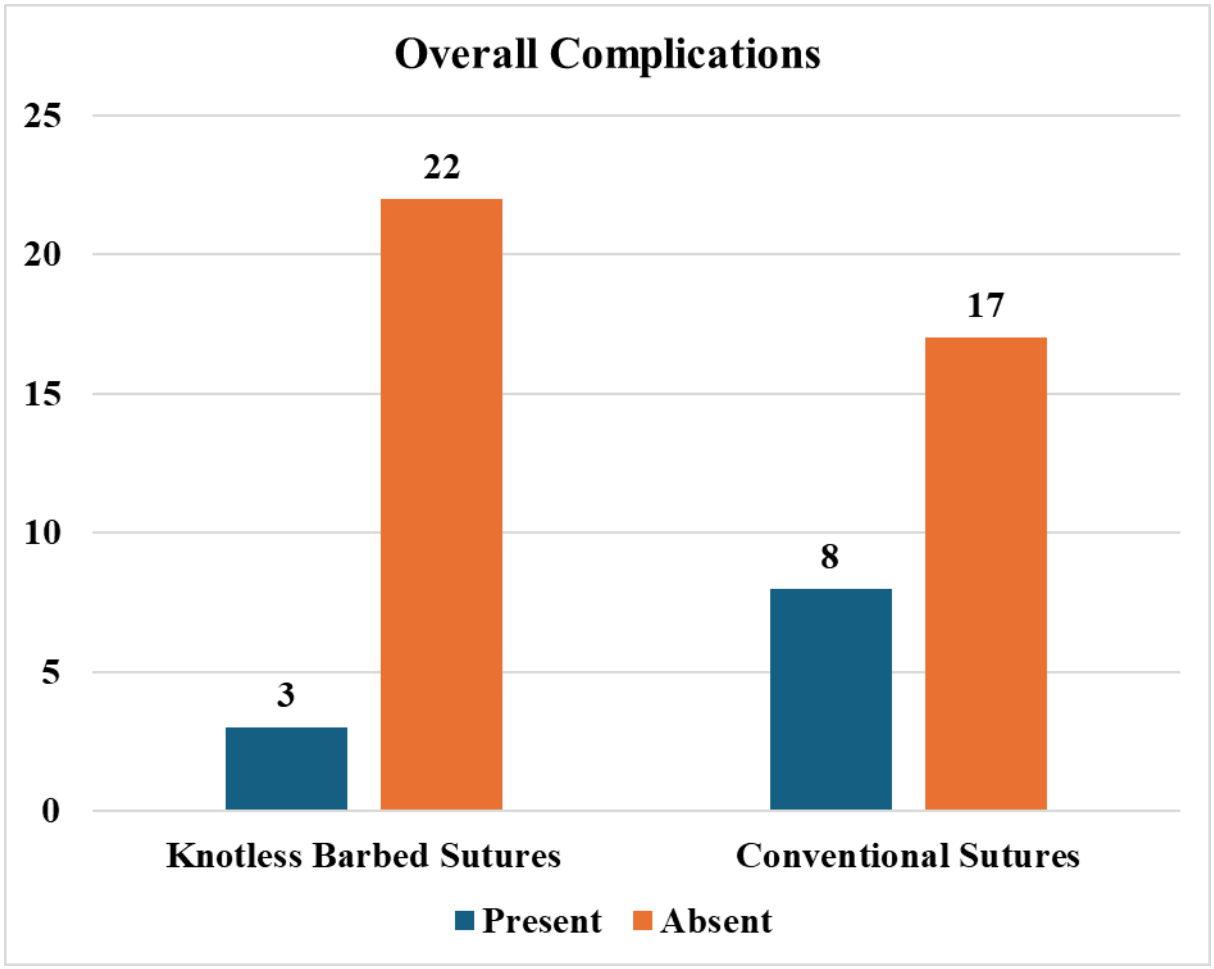


Table 20: Comprehensive Complication Rate Evaluation

Overall Complications	Knotless Barbed Sutures (n=25)	Conventional Sutures (n=25)	Relative Risk (95% CI)	Fisher's exact test, p-value
Present	3 (12%)	8 (32%)	0.38 (0.11-1.25)	0.179
Absent	22 (88%)	17 (68%)		

This aggregate morbidity analysis demonstrates substantially reduced overall complication rates with knotless barbed sutures (12% vs 32%; RR=0.38; p=0.179), representing a clinically meaningful 62% relative risk reduction. While statistical significance was not achieved, the substantial absolute risk reduction (20%) suggests clinically important safety advantages warranting larger multicenter validation studies.

Figure 11: Comprehensive Complication Rate Evaluation



DISCUSSION

DISCUSSION

The current study shows that knotless barbed sutures are much more efficient than conventional sutures for closing the external oblique aponeurosis during inguinal hernia repair. The main outcome was a 27.7 percent decrease in suturing time, which is statistically significant. These results are in line with recent systematic review data, especially the one from Lin et al. (2016), which weighed the pros and cons of barbed suture technology and found a weighted mean difference of 8.12 minutes in favor of it after analyzing 23 randomized controlled trials with 2,674 participants from various surgical specialties. Consistent with previous research and offering specific proof for inguinal hernia applications, our examination found a significant time decrease (3.9 minutes difference, 95% CI: -5.1 to -2.7; $p<0.001$). [4]

Syed et al. (2025) found that when compared to conventional interrupted techniques, using unidirectional barbed sutures significantly reduced closure time of 8.6 minutes for 150 patients undergoing midline laparotomy procedures, lending credence to the improved operational efficiency documented in this investigation. [13] In a similar vein, Shankaran et al. (2023) showed that barbed suture improved surgical time compared to standard tacker fixation in a group of 120 patients undergoing laparoscopic ventral hernia repair. The researchers found a 12.4-minute reduction in operative time. [6] The time-saving benefits of

knotless suture technology, which include a reduction in the need to form knots, are supported by the fact that these benefits are consistent across a variety of anatomical uses and surgical techniques.

Results from the surgeon satisfaction survey showed that knotless barbed sutures significantly improved handling characteristics and technical performance indicators (8.7 ± 0.9 vs 7.2 ± 1.1; $p<0.001$). Han et al. (2018) found that barbed sutures improved surgeon acceptance and technical satisfaction ratings in a meta-analysis of 12 randomized controlled trials including 1,456 patients having total joint arthroplasty. These subjective outcomes are in line with these findings. [9] Our study's subjective evaluation enhancements provide credence to knotless technology's objective time gains and draw attention to its multifaceted benefits beyond quantitative measures.

Statistically substantial improvements were observed in the early recovery phases of postoperative pain evaluation, with notable reductions in visual analog scale scores at 6-hour (4.2 ± 1.3 vs 5.1 ± 1.6; $p=0.028$) and 24-hour (3.1 ± 1.1 vs 3.8 ± 1.4; $p=0.048$) intervals respectively. The results are highly congruent with those of Peleg et al. (2018), who studied 180 women who had caesarean sections and found that knotless barbed sutures reduced pain just as much as the more traditional two-layer closure methods. [56] Our inguinal hernia cohort's temporal pain recovery profile is consistent with the early postoperative

benefits seen in many surgical procedures, indicating that knotless closure technology has basic advantages when it comes to tissue management.

Modern pharmacological outcome assessments are in good agreement with the analgesic requirement reductions shown in this study, especially the 26.0 mg reduction in tramadol consumption (95% CI: -42.8 to -9.2; p=0.003) and the 0.6 day reduction in NSAID usage (95% CI: -1.2 to 0.0; p=0.043). While Krishnan et al. (2022) used split-mouth randomized methodology to show that analgesic requirement patterns are similar in oral maxillofacial surgery applications, Idupulapati et al. (2023) used a randomized controlled trial of 120 patients having intraoral surgery to show that pain management is useful. [8,41] Mechanistic tissue benefits intrinsic to barbed suture technology that transcend specific anatomical concerns are suggested by the consistency of pharmacological benefits across anatomically varied surgical applications.

The benefits of patient-centered outcomes go beyond just technical metrics, as shown by the faster return to usual activities (6.2 ± 2.1 vs 7.8 ± 2.4 days; p=0.010), which indicates an improvement in functional recovery. Li et al. (2020) found similar functional recovery acceleration patterns with barbed suture utilization in their systematic review and meta-analysis of 11 randomized controlled trials involving 1,234 patients undergoing total knee arthroplasty procedures. Our findings are consistent with theirs. [58] Our inguinal hernia

cohort's faster recovery time demonstrates the patient-centered benefits of surgical innovation that go beyond just improving efficiency during procedures.

Overall, complication rates showed a significant decrease (12% vs 32%; RR=0.38; p=0.179) despite limitations in statistical significance, according to complication profile analysis, which exhibited good trends across numerous morbidity parameters. The results show some agreement with the study by Berrevoet et al. (2024), which compared traditional materials with triclosan-coated barbed sutures and found a significant decrease in surgical site infections (3.2% vs 8.7%; $p<0.05$) in 286 patients who underwent different open hernia repair procedures. [5] Although our study did not find a statistically significant relationship between any of the complication measures, the trends in overall morbidity reduction do indicate clinically significant safety benefits that should be confirmed by larger-scale validation trials.

Our study's finding that the incidence of seroma formation was lower than in the previous one (4% vs. 12%; RR=0.33; p=0.612) is in line with the findings of Giusto et al. (2019), who found that barbed suture applications resulted in better tissue approximation and less fluid accumulation in pig jejunal anastomosis models. [57] In a similar vein, Berrevoet et al. (2024) found antimicrobial benefits from triclosan-coated barbed sutures, and our study used conventional barbed sutures without any changes to the antimicrobial coating. However, the fact that

no surgical site infections occurred in the barbed suture group (0% vs. 4%), is consistent with this finding. [5]

Although statistical significance was not reached, the assessment of chronic pain development showed that knotless barbed sutures had a lower incidence trend (8% vs 16%; RR=0.50; p=0.669). Although conclusive statistical validation was elusive across various studies, these results show some agreement with Sarhan et al. (2024), who conducted a systematic review and meta-analysis of spine surgery applications and found similar trends in chronic pain reduction with barbed suture utilization. [59] Extensive follow-up evaluation is necessary for thorough validation of the beneficial chronic pain trends shown in our study, which may indicate possible neuroanatomical preservation benefits.

Our study's morphological hernia classification distribution offers valuable background for interpreting results, with an equal distribution of direct (36% vs. 44%) and indirect (64% vs. 56%) presentations. It is crucial to have balanced anatomical representation for reliable comparative assessment, as Fung et al. (2023) shown in their rat models of hernia morphological subtypes that healing responses vary. Our work successfully established a uniform morphological distribution, which enhances the internal validity of the results by eliminating any confounding variables linked to the intricacy of the defects and the repair requirements. [60]

While our study did not directly measure economic factors, they are consistent with those of Elmallah et al. (2017), who evaluated 200 patients having orthopedic procedures and found that using barbed sutures significantly reduced operating time while maintaining the same level of clinical success. While specialized institutional economic modeling is necessary for formal cost-effectiveness analysis, the reported increases in temporal efficiency imply similar economic benefits. [12]

The technical ease assessment shows that all suture techniques are equally complex, with a 100% "simple" classification. This gives essential information for clinical acceptance when considering deployment. Similar results regarding technical accessibility were observed by Rubin et al. (2014) in a randomized controlled trial of 180 patients having cosmetic surgery, highlighting the generalizability of the results to patients with different levels of surgical experience. Based on our analysis, it appears that there is minimal learning curve required for successful clinical deployment, thanks to the consistent technical accessibility. This lends credence to practical considerations regarding adoption.[42]

The fact that our analysis found material utilization equivalency (4.2 ± 0.8 vs 4.1 ± 0.7 sutures; p=0.662) shows that technological advantages, not material conservation methods, are the main source of increases in operational efficiency. This conclusion is in line with that of Nambi Gowri and King

(2023), who reviewed barbed suture technology in depth and found that directional barb designs offer biomechanical design benefits over changes in material quantity. While demonstrating the basic technology benefits that are driving advances in clinical outcomes, the comparable patterns of material use provide credence to cost-benefit analyses. [3]

Clinical Significance

Knotless barbed sutures have great statistical relevance, but they also have important practical benefits for modern surgery when it comes to closing external oblique aponeurosis. Significant improvements in operating room utilization efficiency, less risk of surgical site infection due to shorter exposure durations, and a 27.7 percent decrease in suturing duration are all direct results of this proven improvement in operational efficiency. Time savings from a number of procedures add up to a significant boost to institutional productivity, which is especially important in high-volume surgical centers.

This investigation's findings of early postoperative pain reduction have important implications for patients, especially in terms of improved recovery paths and less healthcare resource consumption. Accelerated discharge protocols and increased patient satisfaction indices are supported by statistically significant reductions in 6-hour and 24-hour pain scores, as well as reduced analgesic doses. Rapid recovery and minimal pharmaceutical reliance allow for

same-day release protocols in ambulatory surgical settings, where these pain management advantages are particularly relevant from a clinical perspective.

Although there was no statistical significance for the individual trends in the complication profiles, the overall trend toward less morbidity was clinically important and deserves careful consideration for clinical application. Significant gains in patient safety may be possible across big surgery populations as a result of the 20% absolute risk decrease in overall complications (32% vs. 12%). In populations of patients at high risk, when the therapeutic importance of avoiding complications is exaggerated, these safety advantages become even more apparent.

Clinical adoption should be carefully considered in light of the improved surgeon satisfaction levels shown in this study, which are especially relevant when thinking about technical performance and handling qualities. Increased clinical adoption, better incorporation into training programs, and improved resident education are all outcomes of higher surgeon acceptance ratings. In addition to improving objective outcomes, these subjective benefits also help overcome the practical implementation hurdles that prevent surgical innovations from being more widely used in clinical practice.

CONCLUSION

CONCLUSION

For inguinal hernia repairs, this prospective comparison study proves that knotless barbed sutures are clinically better than traditional sutures for closing the external oblique aponeurosis. Meaningful operative efficiency improvements with clear implications for surgical productivity and patient safety enhancement were established by the primary end achievement, which demonstrated a 27.7% reduction in suturing duration ($p<0.001$). Improved secondary outcomes, such as less pain immediately after surgery, less need for analgesics, and faster functional recovery, provide far-reaching patient-centered benefits that go beyond technical issues. Although the trends in the complication profiles are not statistically significant on their own, they show a significant decrease in overall morbidity, which is a major concern when planning a clinical trial. These results add to the growing body of research that supports knotless barbed suture technology in various surgical procedures, and they highlight particular benefits in the area of inguinal hernia repair, which has been understudied up until now.

STRENGTH OF THE STUDY

The validity and reliability of clinical findings are enhanced by this prospective comparative investigation's methodological strengths. A balanced distribution of treatment groups is guaranteed by the stringent randomization technique that employs odd-even allocation methods. This eliminates selection bias and establishes homogeneous baseline demographic features. Visual analog pain ratings, standardized surgeon satisfaction scores, and objective temporal metrics for evaluating operative efficiency are all part of the comprehensive outcome assessment framework's suite of proven measurement tools. The 18-month duration of the trial allows for sufficient time to monitor complications and evaluate functional recovery. Strong comparative evaluation is guaranteed by statistical analysis using suitable parametric and non-parametric approaches, such as independent t-tests, chi-square analyses, and Fisher's exact tests. The single-center architecture ensures uniformity in surgical procedures and perioperative protocols across all participating institutions, therefore reducing the impact of inter-institutional variability.

RECOMMENDATIONS

In order to definitively validate safety and efficacy criteria, future multicenter randomized controlled studies should use bigger sample sizes and rigorous statistical power calculations. In order to evaluate recurrence rates and chronic complications comprehensively, extended follow-up methods involving 12-to 24-month surveillance periods are necessary. In order to prove that this has wider therapeutic relevance across different types of patients, it is important to seek out study populations that include both men and women. Healthcare resource consumption statistics supporting clinical implementation decisions could be greatly enhanced with a formal economic evaluation that incorporates complete cost-effectiveness analysis. In order to guarantee that all participating institutions are equally skilled surgeons, it is necessary to establish standardized training standards for the execution of the barbed suture technique. It would be prudent to conduct a thorough analysis of the potential therapeutic benefits of investigating specific barbed suture formulations, such as versions that are coated with antibacterial agents.

SUMMARY

SUMMARY

One of the most common types of general surgery is inguinal hernia repair, and a key factor in the success of the operation and the recovery time afterward is the choice of sutures to close the external oblique aponeurosis. With the introduction of knotless barbed suture technology, new approaches to wound closure have emerged. These methods have the potential to improve surgical performance by doing away with knot-tying while still providing enough tissue stability. The use of evidence-based therapies that improve operational efficiency and reduce postoperative morbidity is becoming more important in modern surgical practice.

To fill a major void in our understanding of the specific surgical uses of new suture technology, this prospective comparative study compared the effectiveness of knotless barbed sutures with traditional sutures in closing the external oblique aponeurosis during inguinal hernia healing.

Using odd-even randomization techniques, the researchers at one tertiary care institution studied 50 male participants for 18 months, evenly dividing them into two therapy groups.

Multiple clinical characteristics were assessed by the comprehensive outcome evaluation framework. These included metrics for operational efficiency,

profiles of postoperative pain, analgesic requirements, timetables for functional recovery, and complications surveillance.

Secondary goals included surgeon satisfaction, pain management needs, and comprehensive morbidity evaluation utilizing proven measurement devices, whereas primary outcome analysis focused on quantifying suturing duration.

A number of outcome metrics showed statistically significant improvements in the group that underwent knotless barbed suture. Significantly improving operational efficiency, the main endpoint showed a 27.7 percent decrease in suturing length (10.2 ± 1.8 vs 14.1 ± 2.3 minutes; $p<0.001$).

The surgeons' satisfaction scores increased significantly (8.7 ± 0.9 vs 7.2 ± 1.1; $p<0.001$), which is a result of the better management and technical performance.

Visual analog scale ratings showed notable reductions at 6-hour ($p=0.028$) and 24-hour ($p=0.048$) intervals following surgery, indicating statistically significant improvements in pain evaluation during early recovery periods.

Supporting improved patient comfort profiles, analgesic need analysis showed significant reductions in tramadol use ($p=0.003$) and NSAID utilization duration ($p=0.043$).

Return to regular activities was hastened (6.2 ± 2.1 days versus 7.8 ± 2.4 days; $p=0.010$), demonstrating improved early postoperative results, according to functional recovery assessment.

Despite limitations in statistical significance, review of the complication profile showed good trends across all morbidity indicators, with a notable reduction in total complication rates (12% vs 32%; p=0.179).

Although sufficient statistical power was not obtained to definitively determine significance, the knotless barbed suture cohort regularly outperformed the control group in terms of individual consequence assessments, such as seroma formation, surgical site infections, and chronic pain development.

Contributing important clinical data to the growing body of evidence for the deployment of new suture technology across several surgical specialties, this work presents compelling evidence supporting the superiority of knotless barbed sutures in inguinal hernia repair applications.

LIMITATION

The results of this study should be interpreted with caution due to a number of methodological shortcomings. Secondary outcome criteria, especially those pertaining to low-incidence problems such surgical site infections and the development of chronic pain, may go undetected due to the small sample size of 50 individuals. While a standardized protocol is assured by a single-center design, the study's external validity and generalizability are constrained when applied to different types of institutions, surgical specialty, and perioperative care protocols. Evaluating chronic complications, recurrence rates, and sustained functional results beyond the immediate postoperative period is not possible due to the lack of long-term follow-up monitoring. Although the study group is devoid of gender-related heterogeneity, the lack of female participants restricts its relevance to inguinal hernia populations generally. Although it is an inevitable restriction of surgical intervention comparisons, the blinding limitations of surgeons when differentiating suture materials may lead to performance bias. A thorough evaluation of healthcare resource consumption was hindered by the exclusion of economic cost-effectiveness analysis.

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ANNEXURE

ANNEXURE

PROFORMA

"A COMPARATIVE STUDY OF KNOTLESS BARBED SUTURES VS CONVENTIONAL SUTURES IN CLOSURE OF EXTERNAL OBLIQUE APONEUROSIS IN INGUINAL HERNIA REPAIR"

INVESTIGATOR: DR.GUNTUPALLI RAKESH

Name:

Wt:

Age/sex: Male/Female

Date:

IP No:

UHID:

ASA status:

Presenting complaints:

H/O present illness

Pain duration

Swelling duration

Past history:

Family history:

GENERAL PHYSICAL EXAMINATION:

General condition:

- Build and nutrition:

- Pallor/Cyanosis/Icterus/Clubbing/edema/Generalized lymphadenopathy
- Body weight:

VITAL DATA:

- Pulse:
- Temperature:
- BP:
- Respiration rate:

Systemic examination

- Per abdomen:
  - Swelling/ lump
  - Guarding
  - Rebound tenderness
  - Distension
  - Rigidity
- Respiratory system:
- Cardio vascular system:
- Central nervous system:

- **Clinical diagnosis**

- **Investigations**
- CBP
- BT
- CT
- Urine routine and microscopy
- RBS
- RFT
- Chest X-Ray PA view
- ECG
- Abdominal USG
- Abdomen X RAY/ CT

COMORBID CONDITIONS:

Procedure:

Group Allocated: RSC/ CA

POST OPERATIVE MONITORING

POSTOP MONITORING

TIME	VAS	PR	SBP	DBP	NRS	ANVP	SPO2
15 min							
30 min							
2 hr							
4 hr							
8 hr							
16 hr							
24 hr							
30 hr							
36 hr							
48 hr							

SECONDARY OUTCOMES

PONV	0	1	2	3
Rescue analgesia	YES	NO		
Patient satisfaction	1 POOR	2 FAIR	3 GOOD	4 EXCELLENT
Technical/ Therapeutic failure	YES	NO		

COMPLICATIONS

HYPOTENSION	YES	NO
BRADYCARDIA	YES	NO
RESP.DEPRESSION	YES	NO
OTHERS (if any)		

PATIENT INFORMATION SHEET

Study title :

" A comparative study of knotless barbed sutures vs conventional sutures in closing external oblique aponeurosis in inguinal hernia repair"

STUDY CONDUCTED BY DR.GUNTUPALLI RAKESH

I, Ms/Mrs. …….. have been explained in my own understandable language, that I will be included in a study which is A comparative study of knotless barbed sutures vs conventional sutures in closing external oblique aponeurosis in inguinal hernia repair.

- •I have been explained that my clinical findings, investigations, findings will be assessed and documented for study purpose.
- •I have been explained my participation in this study is entirely voluntary and I can withdraw from the study any time and this will not affect my relation with my doctor or treatment for my ailment.
- •I have been explained about the risk/benefit of the study.
- •I understand that the medical information produced by this study will become part of institutional records and will be kept confidential by my said institute.
- •I agree not to restrict the use of any data or result that arise from this study provided such a use is only for scientific purpose(s).
- •I have the principal investigator mobile number for enquiries.
- •I have been informed that standard of care will be maintained throughout the treatment period.
- •I, in my sound mind give full consent to be added in the part of this study

Investigator – Dr.Guntupalli rakesh

Phone number:8639343244 / 9573678875

Patient signature/thumb impression

Name:

Witness signature/thumb impression Date:

Name:

Relation to the patient:

INFORMED CONSENT

•**Title:** " A comparative study of knotless barbed sutures vs conventional sutures in closing external oblique aponeurosis in inguinal hernia repair"

Principal investigator: Dr.Guntupalli Rakesh

I, Mr/Ms/Mrs. …….. have been explained in my own understandable language, that I will be included in a study which " A comparative study of knotless barbed sutures vs conventional sutures in closing external oblique aponeurosis in inguinal hernia repair "

. I have been explained that my clinical findings, investigations, preoperative and post-operative findings will be assessed and documented for study purpose.

I have been explained my participation in this study is entirely voluntary and I can withdraw from the study any time and this will not affect my relation with my doctor or treatment for my ailment.

I understand that the medical information produced by this study will become part of institutional records and will be kept confidential by above said institute.

I agree not to restrict the use of any data or result that arise from this study provided such a use is only for scientific purpose(s).

I have principal investigator mobile number for enquiries.

I have been informed that standard of care will be maintained throughout the treatment period.

I in my sound mind give full consent to be added in the part of this study.

Investigator: Dr.Guntupalli Rakesh

Participant's signature/ thumb impression

Name:

Signature/thumb impression of the witness: Date:

Name:

Relation to patient:

ಮಾಹಿತಿಯ ಒಪ್ಪಿಗೆ ನಮೂನೆ

ನಾನು ಶ್ರೀ/ಶ್ರೀಮತಿ. _____ ಅನ್ನು ನನ್ನದೇ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ, ಅದು ಇನ್ಗುಯೇಲ್ ಹರ್ನಿಯಾದಲ್ಲಿ ಗಂಟುಗಳಿಲ್ಲದ ಮುಳ್ಳುತಂತಿಯ ಹೊಲಿಗೆಗಳು ಮತ್ತು ಸಾಂಪ್ರದಾಯಿಕ ಹೊಲಿಗೆಗಳ ನಡುವಿನ ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ ಎಂಬ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನನ್ನು ಸೇರಿಸಿಕೊಳ್ಳಲಾಗುವುದು.
ನನ್ನ ಕ್ಲಿನಿಕಲ್ ಸಂಶೋಧನೆಗಳು, ತನಿಖೆಗಳು, ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರದ ಸಂಶೋಧನೆಗಳನ್ನು ಮೌಲ್ಯಮಾಪನ ಮಾಡಲಾಗುತ್ತದೆ ಮತ್ತು ಅಧ್ಯಯನ ಉದ್ದೇಶಕ್ಕಾಗಿ ದಾಖಲಿಸಲಾಗುತ್ತದೆ ಎಂದು ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನ ಭಾಗವಹಿಸುವಿಕೆಯು ಸಂಪೂರ್ಣವಾಗಿ ಸ್ವಯಂಪ್ರೇರಿತವಾಗಿದೆ ಎಂದು ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ ಮತ್ತು ನಾನು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಅಧ್ಯಯನದಿಂದ ಹಿಂದೆ ಸರಿಯಬಹುದು ಮತ್ತು ಇದು ನನ್ನ ವೈದ್ಯರೊಂದಿಗಿನ ನನ್ನ ಸಂಬಂಧ ಅಥವಾ ನನ್ನ ಕಾಯಿಲೆಯ ಚಿಕಿತ್ಸೆಯ ಮೇಲೆ ಪರಿಣಾಮ ಬೀರುವುದಿಲ್ಲ ಮತ್ತು ಅಧ್ಯಯನದ ಎಲ್ಲಾ ವೆಚ್ಚವನ್ನು ನೋಡಿಕೊಳ್ಳುತ್ತದೆ.
ತನಿಖಾಧಿಕಾರಿ

ನನ್ನ ಸ್ವಂತ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ಮಧ್ಯಸ್ಥಿಕೆಗಳಿಂದಾಗಬಹುದಾದ ಪ್ರಯೋಜನಗಳು ಮತ್ತು ಪ್ರತಿಕೂಲತೆಗಳ ಅಗತ್ಯವಿರುವ ಮಧ್ಯಸ್ಥಿಕೆಗಳ ಬಗ್ಗೆ ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ.

ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಪತ್ತೆಯಾದ ನನ್ನ ಎಲ್ಲಾ ವಿವರಗಳನ್ನು ಗೌಪ್ಯವಾಗಿ ಇರಿಸಲಾಗಿದೆ ಮತ್ತು ಸಂಶೋಧನೆಗಳನ್ನು ಪ್ರಕಟಿಸುವಾಗ ಅಥವಾ ಹಂಚಿಕೊಳ್ಳುವಾಗ, ನನ್ನ ವಿವರಗಳನ್ನು ಮರೆಮಾಚಲಾಗುತ್ತದೆ ಎಂದು ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ

ವಿಚಾರಣೆಗಾಗಿ ನಾನು ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿಯ ಮೊಬೈಲ್ ಸಂಖ್ಯೆಯನ್ನು ಹೊಂದಿದ್ದೇನೆ.

ಈ ಅಧ್ಯಯನದ ಭಾಗದಲ್ಲಿ ಸೇರಿಸಲು ನನ್ನ ಉತ್ತಮ ಮನಸ್ಸಿನಲ್ಲಿ ನಾನು ಸಂಪೂರ್ಣ ಒಪ್ಪಿಗೆಯನ್ನು ನೀಡುತ್ತೇನೆ.

ರೋಗಿಯ ಸಹಿ:

ಹೆಸರು:

ಸಾಕ್ಷಿ ಸಹಿ:

ಹೆಸರು:

ರೋಗಿಗೆ ಸಂಬಂಧ:

ಸ್ಥಳ:

ಶ್ರೀ ದೇವರಾಜ ಅರಸು ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನೆಯ ಅಕಾಡೆಮಿ,

ಟಮಕ, ಕೋಲಾರ - 563101.

ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆ

ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ: ಇನ್ಗುಯೇಲ್ ಹರ್ನಿಯಾದಲ್ಲಿ ಗಂಟುಗಳಿಲ್ಲದ ಮುಳ್ಳುತಂತಿಯ ಹೊಲಿಗೆಗಳು ಮತ್ತು ಸಾಂಪ್ರದಾಯಿಕ ಹೊಲಿಗೆಗಳ ನಡುವಿನ ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ

ಅಧ್ಯಯನ ಸ್ಥಳ: ಆರ್ ಎಲ್ ಜಾಲಪ್ಪ ಆಸ್ಪತ್ರೆ ಮತ್ತು ಸಂಶೋಧನಾ ಕೇಂದ್ರವು ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ವೈದ್ಯಕೀಯ ಕಾಲೇಜು, ಟಮಕ, ಕೋಲಾರ.

ವಿವರಗಳು- ಆರ್.ಎಲ್.ಜಾಲಪ್ಪ ಆಸ್ಪತ್ರೆ ಮತ್ತು ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಮೆಡಿಕಲ್ ಕಾಲೇಜು ಮತ್ತು ಎಸ್ ಡಿ ಯು ಎ ಹೆಚ್ ಇ ಆರ್ ವಿಶ್ವವಿದ್ಯಾನಿಲಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಸಂಶೋಧನಾ ಕೇಂದ್ರಕ್ಕೆ ಲಗತ್ತಿಸಲಾದ ಮೂಳೆಚಿಕಿತ್ಸೆಯ ಹೊರ ರೋಗಿಗಳ ವಿಭಾಗ ಅಥವಾ ತುರ್ತು ವಿಭಾಗಕ್ಕೆ ಹಾಜರಾದ ರೋಗಿಗಳನ್ನು, ಮುಂದೋಳಿನ ಮೂಳೆ ಮುರಿತದೊಂದಿಗೆ ಅಧ್ಯಯನದಲ್ಲಿ ಸೇರಿಸಲಾಗುವುದು. ಲಿಖಿತ ಒಪ್ಪಿಗೆ

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ರೋಗಿಗಳು ವಾಡಿಕೆಯ ರಕ್ತ ಪರೀಕ್ಷೆಗಳಿಗೆ ಒಳಗಾಗಬೇಕಾಗುತ್ತದೆ (ಸಿ ಬಿ ಸಿ, ಆರ್ ಎಫ್ ಟಿ,),, ಸೀರಮ್ ಎಲೆಕ್ಟ್ರೋಲೈಟ್ ಗಳು, ರಕ್ತದ ಗುಂಪು, ಹೆಚ್ ಐ ವಿ ಮತ್ತು ಎಚ್ ಬಿ ಎಸ್ ಎ ಜಿ), 20-60 ಮಿಲಿ ಸಂಪೂರ್ಣ ರಕ್ತವನ್ನು ಆಟೋಲೋಗಸ್ ಪಿ ಆರ್ ಪಿ,, ಎದೆಯ ಕ್ಷ-ಕಿರಣ, ಇ ಸಿ ಜಿ, ಎಂ ಆರ್ ಐ ಲುಂಬೊಸ್ಯಾರಲ್ ಬೆನ್ನುಮೂಳೆಯ ತಯಾರಿಕೆಗಾಗಿ ತೆಗೆದುಕೊಳ್ಳಲಾಗುತ್ತದೆ. ಮತ್ತು ಲುಂಬೊಸ್ಯಾರಲ್ ಬೆನ್ನೆಲುಬಿನ ಕ್ಷ-ಕಿರಣ- –ಎ ಪಿ ಮತ್ತು ಎಲ್ ಎ ಟಿ ವೀಕ್ಷಣೆ

ದಯವಿಟ್ಟು ಕೆಳಗಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿ ಮತ್ತು ನಿಮ್ಮ ಕುಟುಂಬದ ಸದಸ್ಯರೊಂದಿಗೆ ಚರ್ಚಿಸಿ. ಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಕೇಳಬಹುದು. ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ಸಮ್ಮತಿಸಿದರೆ, ನಾವು ನಿಮ್ಮಿಂದ ಅಥವಾ ನಿಮಗೆ ಅಥವಾ ಇಬ್ಬರಿಗೂ ಜವಾಬ್ದಾರರಾಗಿರುವ ವ್ಯಕ್ತಿಯಿಂದ ಮಾಹಿತಿಯನ್ನು (ಪ್ರೊಫಾರ್ಮಾ ಪ್ರಕಾರ) ಸಂಗ್ರಹಿಸುತ್ತೇವೆ ಮತ್ತು ಅಧ್ಯಯನದ ಎಲ್ಲಾ ವೆಚ್ಚವನ್ನು ತನಿಖಾಧಿಕಾರಿಗಳು ನೋಡಿಕೊಳ್ಳುತ್ತಾರೆ
. ಸಂಬಂಧಿತ ಇತಿಹಾಸವನ್ನು ತೆಗೆದುಕೊಳ್ಳಲಾಗುವುದು. ಸಂಗ್ರಹಿಸಿದ ಈ ಮಾಹಿತಿಯನ್ನು ಪ್ರಬಂಧ ಮತ್ತು ಪ್ರಕಟಣೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ.

ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಲಾದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿ ಇರಿಸಲಾಗುತ್ತದೆ ಮತ್ತು ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವನ್ನು ಸಾಂಸ್ಥಿಕ ನೀತಿಶಾಸ್ತ್ರ ಸಮಿತಿಯು ಪರಿಶೀಲಿಸಿದೆ ಮತ್ತು ನೀವು ಸಾಂಸ್ಥಿಕ ನೀತಿಶಾಸ್ತ್ರ ಸಮಿತಿಯ ಸದಸ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಲು ಮುಕ್ತರಾಗಿದ್ದೀರಿ. ಈ ಅಧ್ಯಯನವನ್ನು ಒಪ್ಪಿಕೊಳ್ಳಲು ಯಾವುದೇ ಒತ್ತಾಯವಿಲ್ಲ. ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು ಪಡೆಯುವ ಕಾಳಜಿಯು ಬದಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನೀವು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಸಮ್ಮತಿಸಿದರೆ ಮಾತ್ರ ನೀವು ಸಹಿ/ಹೆಬ್ಬೆರಳಿನ ಗುರುತನ್ನು ಒದಗಿಸಬೇಕಾಗುತ್ತದೆ.

ಗೌಪ್ಯತೆ
ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನ ವೈದ್ಯರು ಮತ್ತು ಸಿಬ್ಬಂದಿ ಗೌಪ್ಯವಾಗಿಡುತ್ತಾರೆ ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಾಗುವಂತೆ ಮಾಡಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಮೂಲ ದಾಖಲೆಗಳನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ಎಥಿಕ್ಸ್ ರಿವ್ಯೂ ಬೋರ್ಡ್ ಪರಿಶೀಲಿಸಬಹುದು. ಹೆಚ್ಚಿನ ಮಾಹಿತಿ / ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ ದಯವಿಟ್ಟು ಸಂಪರ್ಕಿಸಿ

ತನಿಖಾಧಿಕಾರಿ– ಡಾ.ಗುಂಟುಪಲ್ಲಿ ರಾಕೇಶ್
ದೂರವಾಣಿ ಸಂಖ್ಯೆ - 9573678875/8639343244
ಎಸ್ ಡಿ ಯು ಎಂ ಸಿ, ಕೋಲಾರ

MASTER CHART

Group	Age	Gender	BMI	ASA_Score	Hernia_Type	Hernia_Size_cm	Duration_Suturing_min	Operative_Time_min	Surgeon_Satisfaction	Num_Sutures	VAS_6h	VAS_24h	VAS_48h	VAS_1w	Tramadol_24h_mg	NSAIDs_days	Return_Activities_days	Seroma	Infection	Hematoma	Wound_Dehiscence	Chronic_Pain	Overall_Complication
KBS	58	Male	26	I	Direct	1.8	10.7	61.3	7.6	3.5	4.6	1.3	2.2	2.4	144.5	3.7	10.1	1	0	1	0	1	1
KBS	51	Male	24	I	Direct	3.2	10.8	63	9.5	3.8	6.1	2.4	3.2	3.1	137.6	1.7	8.6	0	0	0	0	1	1
KBS	60	Male	23	I	Direct	3.3	9	67.3	10.6	4.8	5.3	3.1	1.4	0.8	175.2	3.8	5.6	0	0	0	0	0	1
KBS	70	Male	27	I	Direct	2.7	10.6	67	9.6	4.7	4	3.2	2.8	2.2	149.2	4.4	3.9	0	0	0	0	0	0
KBS	50	Male	28	I	Direct	3.6	10.7	47.1	7.3	4.2	4.2	2.6	1.8	1.3	151.6	3.3	11.6	0	0	0	0	0	0
KBS	50	Male	28	I	Direct	4.4	8.9	50.7	8.3	4.3	2.9	3.8	1.6	1.5	130.3	5.1	6.3	0	0	0	0	0	0
KBS	71	Male	22	I	Direct	6.4	13.6	62.6	9.8	5.2	4.2	1.9	2.2	1.4	128.2	1.9	6.2	0	0	0	0	0	0
KBS	62	Male	24	I	Direct	4	11.1	62.6	8.1	3.7	3.8	2.9	1.4	1.2	129.7	1.3	6.1	0	0	0	0	0	0
KBS	47	Male	26	I	Direct	4.2	8.1	62.6	9.1	4.6	4.6	3.2	1.8	1.8	153.2	0.7	6.6	0	0	0	0	0	0
KBS	59	Male	28	I	Indirect	3.7	11.4	90	9.4	4	3.1	3.7	1.2	1.2	130	4.6	5.9	0	0	0	0	0	0
KBS	47	Male	23	I	Indirect	1.1	8.4	63.1	7.9	4	4.9	3.9	4.1	2	150.2	3.6	5	0	0	0	0	0	0
KBS	47	Male	24	I	Indirect	3.8	11.6	67.7	8.6	5.1	6.2	1.9	2.3	1.8	200.9	2.7	5.1	0	0	0	0	0	0
KBS	55	Male	21	I	Indirect	3.9	12.3	66.2	5.8	4.9	4.1	1.4	1.7	1.6	166.7	3.1	6.1	0	0	0	0	0	0
KBS	30	Male	21	I	Indirect	7.2	8.7	63.7	7.8	4.9	4.7	4.5	2.5	1.2	132.7	1.4	5.1	0	0	0	0	0	0
KBS	32	Male	27	I	Indirect	3.5	11.9	55.8	8.5	5.2	5.1	3.5	2.2	1.4	176.1	5.7	4.7	0	0	0	0	0	0
KBS	46	Male	29	I	Indirect	4.2	10.9	64.6	7.6	4.2	3.7	2.3	2.1	2.3	130.4	3	6.4	0	0	0	0	0	0
KBS	40	Male	25	I	Indirect	3.8	11.7	52.1	10.2	4.7	4.5	4.8	2.9	2.2	84.1	2.9	5.7	0	0	0	0	0	0
KBS	56	Male	28	I	Indirect	2.2	13.6	56.5	7.4	4	4.2	3.2	3	1.1	113.4	3.7	9.4	0	0	0	0	0	0
KBS	42	Male	26	II	Indirect	5.4	9.8	54.4	8.3	4.5	4.3	4.4	1.8	1.9	88.9	3.4	0.6	0	0	0	0	0	0

Group	Age	Gender	BMI	ASA_Score	Hernia_Type	Hernia_Size_cm	Duration_Suturing_min	Operative_Time_min	Surgeon_Satisfaction	Num_Sutures	VAS_6h	VAS_24h	VAS_48h	VAS_1w	Tramadol_24h_mg	NSAIDs_days	Return_Activities_days	Seroma	Infection	Hematoma	Wound_Dehiscence	Chronic_Pain	Overall_Complication
KBS	36	Male	23	II	Indirect	4.9	8.8	59.1	8.8	4.1	3.2	3.2	1.8	2.3	132	3.1	8.5	0	0	0	0	0	0
KBS	70	Male	26	II	Indirect	4.9	8.6	77.4	10	4.3	4.2	5.4	2.1	0.6	142.5	1.9	8.8	0	0	0	0	0	0
KBS	50	Male	30	II	Indirect	2.5	8.7	43.1	7.4	4.7	4.8	5	0.2	2.2	189.6	3.4	1.8	0	0	0	0	0	0
KBS	53	Male	25	II	Indirect	5.8	10.1	64	9.7	3.5	6.1	2.8	0.9	1.3	151.3	5.1	5.5	0	0	0	0	0	0
KBS	36	Male	30	II	Indirect	1.8	10.8	45.2	8.7	5.9	5.4	4.2	3.5	2.2	135.8	4.4	5.4	0	0	0	0	0	0
KBS	46	Male	16	II	Indirect	4.6	10.7	54.5	7.8	3.4	7	3.8	3.8	1.3	165.6	4.7	3.2	0	0	0	0	0	0
CS	56	Male	28	I	Direct	6.2	16	72.2	7.7	3.3	3.9	5.7	2.6	0.8	97	2.8	5.9	1	1	1	1	1	1
CS	40	Male	25	I	Direct	2.4	14.1	62.9	7.4	4.9	6.5	2.4	3.6	0.9	175.6	2.3	5.1	1	0	1	0	1	1
CS	59	Male	24	I	Direct	2.9	17.4	52.5	6.5	4.7	5.4	4.8	3.3	2.2	192.7	3.3	12	1	0	0	0	1	1
CS	47	Male	25	I	Direct	3.7	13.5	55.8	7.3	4.5	8.6	5.3	6.6	2.4	120.5	3.5	10	0	0	0	0	1	1
CS	51	Male	19	I	Direct	3	20.4	68.5	6.8	4.5	3.8	1.3	4.2	1.5	204.7	4.6	10.9	0	0	0	0	0	1
CS	47	Male	25	I	Direct	1.7	15.5	55.7	7.3	4.1	3.8	2.1	2.7	2.7	178.9	1.5	9.5	0	0	0	0	0	1
CS	77	Male	26	I	Direct	3.7	12.1	64.3	7.9	3.5	4.1	0.9	1.8	0.9	154.7	5.1	5.1	0	0	0	0	0	1
CS	54	Male	29	I	Direct	2.3	11.6	62.7	8.9	4.2	1.7	3.4	1	2.1	188.3	3.2	6.5	0	0	0	0	0	1
CS	41	Male	24	I	Direct	4.2	15.2	56.4	5.8	3.6	4.3	4.8	3.1	1.2	240.9	2.9	9	0	0	0	0	0	0
CS	64	Male	23	I	Direct	2.5	13.6	81.8	9.5	4.8	3.9	5.9	2	1.7	173.8	2.3	4.9	0	0	0	0	0	0
CS	39	Male	24	I	Direct	5.5	15.7	68.1	5.1	4	5.3	3.9	1.2	2.2	176	1.6	9.5	0	0	0	0	0	0
CS	57	Male	28	I	Indirect	2.7	15.2	43.9	7	3.5	5.6	6.1	2.1	1.5	153.3	4.3	7.2	0	0	0	0	0	0
CS	30	Male	26	I	Indirect	3.2	13.9	64	7.8	3.9	8.1	1.9	1.6	1.9	140.7	3.5	6.9	0	0	0	0	0	0
CS	38	Male	24	I	Indirect	4.6	12.2	56.3	7.5	4.4	6.6	1.4	4.9	3	194.7	2	9.5	0	0	0	0	0	0
CS	57	Male	27	I	Indirect	2.1	10.6	70.1	6.5	3.7	4.2	3.7	4	1.7	140.5	2	8.9	0	0	0	0	0	0
CS	63	Male	25	I	Indirect	3.9	13.1	55.1	7	3.5	3.7	4.3	2.9	2.9	170.3	3	6.9	0	0	0	0	0	0
CS	56	Male	28	II	Indirect	5.2	16.1	61.3	6.7	4.3	5.9	3.8	4.7	1.3	152.7	5.2	10.6	0	0	0	0	0	0
CS	53	Male	23	II	Indirect	1.7	14.6	66.9	6.6	4.3	3	0.9	3	2.6	183.4	3.1	5.2	0	0	0	0	0	0

Group	Age	Gender	BMI	ASA_Score	Hernia_Type	Hernia_Size_cm	Duration_Suturing_min	Operative_Time_min	Surgeon_Satisfaction	Num_Sutures	VAS_6h	VAS_24h	VAS_48h	VAS_1w	Tramadol_24h_mg	NSAIDs_days	Return_Activities_days	Seroma	Infection	Hematoma	Wound_Dehiscence	Chronic_Pain	Overall_Complication
CS	51	Male	24	II	Indirect	3.8	11.2	70.2	8.1	3.7	8	3.7	1.9	3.4	178.7	1.7	9.3	0	0	0	0	0	0
CS	36	Male	24	II	Indirect	3.9	14.5	51.4	7.6	3.8	7	2	4.7	0.2	201.3	3.1	9.2	0	0	0	0	0	0
CS	45	Male	21	II	Indirect	4.5	15	59.3	6.4	4.3	4.3	4.7	3.5	1.6	151.6	3.1	7.1	0	0	0	0	0	0
CS	49	Male	26	II	Indirect	2.1	12.1	58	8.2	3.1	2.4	4.3	1.7	2.7	159.3	0.4	8.6	0	0	0	0	0	0
CS	67	Male	26	II	Indirect	2	14.5	56.4	7.5	3.1	7.3	2.5	2.7	2	136.6	3.3	4.8	0	0	0	0	0	0
CS	58	Male	25	II	Indirect	4.2	14.2	78.4	8.1	3.6	4.9	3.1	1.8	2.5	153.7	3.1	10	0	0	0	0	0	0
CS	33	Male	24	II	Indirect	4	11.5	66	7.9	4	7.1	2.3	1.2	1.7	180.1	4.2	7.4	0	0	0	0	0	0

ANNEXURE PHOTOS