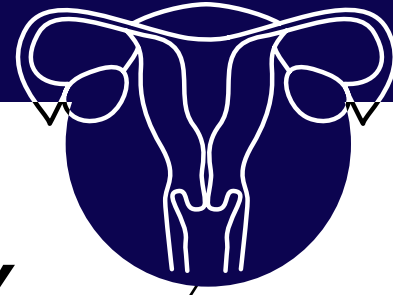




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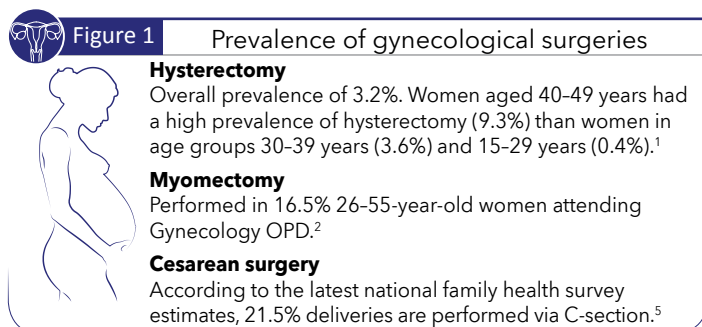
ROLE OF BARBED SUTURES IN GYNECOLOGICAL SURGERY

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Introduction

Hysterectomies and myomectomies cases are increasing rapidly in India, with more young women opting for surgery to manage gynecological issues such as irregular bleeding, fibroids etc.^{1,2} Data of women aged 15-49 years from the National Family Health Survey-IV (2015-2016) showed that, in India, the prevalence of hysterectomy was 3.2%. Women aged 40-49 years had a high prevalence of hysterectomy (9.3%) than women in age groups 30-39 years (3.6%) and 15-29 years (0.4%).¹ A prospective study carried out in 26-55-year-old women attending Gynecology OPD in India showed that myomectomy was performed in around 16.5% of the women.²

Number of Cesarean deliveries in institutional births have increased in India in the past 5 years and projected to rise.³ The latest National Family Health Survey (NFHS) done in 2021 showed that the national C-section rate was 21.5%.⁴ Reports suggest more than 4 million c-sections have been performed in India currently (Figure 1).⁵



Minimally invasive surgery (MIS) has become the standard procedure for treating gynecologic diseases, such as hysterectomy, fibroids, endometriosis, and ovarian cystectomy for the past two decades.⁶⁻⁷ Currently, laparoscopy has wide applications with about 80% of all gynecological surgical procedures being performed laparoscopically in advanced centers.⁸

Benefits of MIS: There is reduced post-surgical pain and shorter hospital stays and recovery times. The smaller incision in laparoscopic surgery allows for faster healing, smaller scars and lower risk of infection compared to open surgery.⁹ MIS and microsurgery also reduces the risk of adhesion formation.¹⁰



Advantages of MIS

- Safer compared to laparotomy
- Less expensive compared to laparotomy
- Shorter recovery time
- Less pain
- Fast healing due to smaller scars
- Reduced risk of adhesion formation

Challenges of suturing in MIS

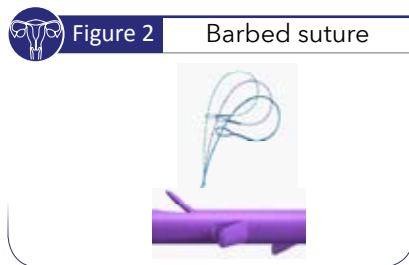
MIS is increasingly replacing the conventional surgery because of its patient-related benefits. However, laparoscopic suturing and knot tying in MIS can be tedious, time-consuming, and frustrating. It is one of the most difficult skills to master in the MIS environment because of the limitations of laparoscopic surgery such as altered

depth perception, 2-D vision, counterintuitive movements, dependence on visuospatial skills, and small working field, etc.¹¹ The complexities of laparoscopic surgery are summarized in Table 1.

Table 1. Complexities of minimally invasive surgery	
<ul style="list-style-type: none"> • Difficult to Learn • Limited range of motion • Visualization • Depth perception 	<ul style="list-style-type: none"> • Laparoscopic suturing • Inconsistencies in the suturing techniques taught • Complicated knot tying techniques

Barbed sutures

Sutures are important part of surgeries and trauma management. Following an injury or surgical procedure, sutures primarily aim to hold apposing tissues together to facilitate and hasten the healing process with minimal or no scar formation. It is important to select the optimal suture materials for tissue approximation to maximize wound healing and scar aesthetics. More recently, barbed sutures have transformed the way surgeons' approximate wounds by eliminating knots, distributing wound tension, and increasing the efficiency of closure (Figure 2).¹³



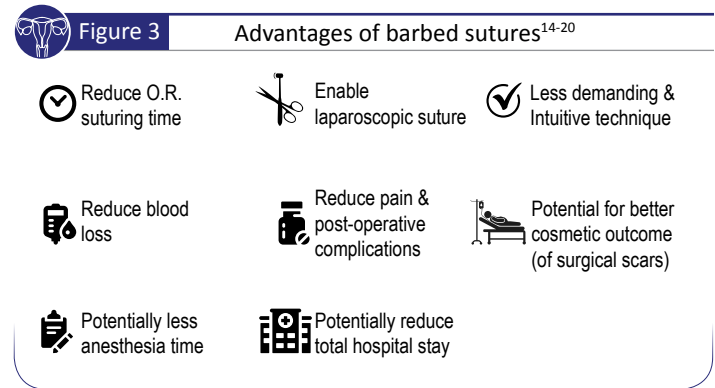
Properties of barbed sutures

Barbed sutures, first designed by John Alcamo in 1956, were granted a US patent in 1964. The barb in a barbed suture provides the grip in the tissue in a continuous manner and retains tensile strength. Barbed sutures have made it possible to eliminate surgical knots, knot-related complications, and increased the efficiency of wound closure. The size and spacing of the barbs, which are integrally formed into the core, are designed to provide maximum holding in soft tissue such as fascia and provide tactile feedback to regulate tension.¹⁴

Recent years have encountered an increased use of barbed sutures, particularly in MIS and laparoscopic procedures where they may reduce operating time, improve surgical efficiency, and eliminate the need to tie knots.¹⁵

Advantages of barbed sutures

Advantages of barbed sutures are summarized in Figure 3.



Use of barbed sutures in obstetric and gynecologic procedures

Understanding the various characteristics of available suture materials is important to make an educated selection. Surgeons should consider tissue characteristics, tensile strength, reactivity, absorption rates, and handling properties while selecting a wound closure suture. When these characteristics are considered, the physical characteristics of barbed sutures make these materials preferred option.¹⁹

The first use of barbed sutures in gynecologic surgery was reported by Greenberg and Einarsson in 2008. Since that report, numerous print and video publications have followed. The use of barbed sutures has become widespread in surgeries such as laparoscopic myomectomy and hysterectomy.¹⁹

Myomectomy **Performed in 16.5% 26-55 year-old women visiting gynecology department²**

Uterine myoma is the most common benign tumor of the female genital tract that is characterized by pelvic pain, metrorrhagia, and abnormal uterine bleeding in 25% of women. Hysteroscopic myomectomy is an effective technique for the management of submucous myomas; however, laparotomic myomectomy should be considered the traditional surgical treatment in patients of childbearing age due to its substantial advantages, such as reduction of postoperative pain and hospital stay, drop in blood loss, and better cosmetic results of surgical scars.²⁰

The introduction of barbed suture in laparoscopic myomectomy entails good results because they eliminate the need of intracorporeal knots to ensure good control of tissue bleeding. The presence of barbs leads to the cohesion of filament to tissues, eliminating the need for knots.²⁰

A meta-analysis by Tulandi, et al compared the efficacy of laparoscopic suturing with or without barbed suture for myomectomy. The main outcome measures chosen for the current meta-analysis were operative time, suturing time, estimated blood loss or change in hemoglobin level, and degree of suturing difficulty.²¹

- Barbed sutures were associated with significantly reduced total operative time of laparoscopic myomectomy and the suturing time to close the uterine incision as compared to conventional sutures.²¹
- Barbed sutures were associated with lower estimated blood loss as compared to conventional sutures.²¹

In a meta-analysis by Gardella, et al analyzed the feasibility and effectiveness of barbed suture during laparoscopic myomectomy and reported that.²⁰

- Barbed sutures were superior to traditional suture technique in terms of **blood loss** during laparoscopic myomectomy, **Hb drop, suturing difficulty, suturing time**, and **total operative time**.²⁰
- Barbed sutures were better in with regard to the length of hospitalization and to perioperative complications.²⁰

EXPERT OPINION:

- Barbed sutures allow a good control of the quality of laparoscopic myomectomy by reducing the total operative/suturing time, estimated blood loss/Hb drop, and reduction of perioperative complications

CONSENSUS FROM THE ADVISORY:

- Barbed sutures are the sutures of choice in laparoscopic myomectomy. They have almost replaced conventional sutures in laparoscopic myomectomy
- The utility of the barbed suture has been instrumental in laparoscopic myomectomy due to its strength, the secure approximation of tissues, and the reduction of operation time

“Barbed suture significantly facilitates laparoscopic myomectomy by reducing the total operative/suturing time, estimated blood loss/Hb drop, and reduction of perioperative complications.”²⁰



Hysterectomy

Overall prevalence of 3.2%. Women aged 40 -49 years had a high prevalence of hysterectomy (9.3%) than women in age groups 30 -39 years (3.6%) and 15 -29 years (0.4%).¹

In a total hysterectomy, the closure of the vaginal cuff is the most difficult part because of the difficulty of laparoscopic suturing techniques:²²

- The vaginal cuff is prone to bacterial contamination from the vaginal vault, which results in febrile morbidity and infectious complications such as vaginal cuff cellulitis and pelvic abscess.¹⁹
- The vaginal cuff is also prone to persistent granulation tissue with annoying postoperative vaginal discharge and bleeding.¹⁹

The knotless barbed sutures minimize local tissue response and infection and achieves equal tensile strength throughout the approximated cuff margins. The self-anchors of the barbed suture reapproximate the wound tissue every 1 mm with balanced distribution over the course of suture line.²³

A retrospective study by Karacan, et al compared a barbed suture and a standard braided suture in the intracorporeal vaginal cuff closure of patients undergoing TLH due to benign disease and reported that.²⁴

- The duration of surgery in the barbed suture group was significantly shorter compared with the standard suture group.²⁴
- Vaginal cuff dehiscence was identified in only three (3.3%) patients within the standard suture group and none in the barbed suture group.²⁴
- Five (5.6%) patients in the standard suture group and two (0.9%) patients in the barbed suture group developed postoperative cuff infection/cellulitis.²⁴

In a retrospective review study, researchers evaluated the safety and efficacy of unidirectional barbed suture

technique for vaginal cuff closure in 165 patients who underwent a total laparoscopic hysterectomy (TLH).²³

- The median completion time for hysterectomy time was 100 min (range, 40-240 min) and the median vaginal cuff closure time was 7 min (range, 4-15 min).
- The median estimated blood loss was 87.8 mL (range 30-250 mL) and the median uterine weight was 200 g (range, 40-900 g).²³
- Intraoperative complication included bladder perforation (1.2%) and postoperative complications were vaginal cuff dehiscence (1.8%), cuff cellulitis (0.6%), vesicovaginal fistula (0.6%), and unexplained fever (0.6%).²³

“The use of unidirectional barbed suture without backward stitching appears to be safe and effective for cuff closure.”²³

“The barbed suture used for vaginal cuff closure during TLH is an applicable, safe and tolerable alternative, because it causes no significant increase in vaginal cuff complications, and it shortens the duration of surgery.”²⁴

EXPERT OPINION:


- The use of barbed suture is safe and is associated with reduced operative time of laparoscopic vaginal vault closure in laparoscopic hysterectomy.

CONSENSUS FROM THE ADVISORY:


- Barbed sutures are associated with reduced operative time and it may be an alternative to conventional sutures for vaginal closure, however there's a need for robust clinical evidence and experience to assess the clinical outcomes.
- Barbed sutures can be used with equal efficacy as conventional sutures, but more studies are needed for it to be recommended as first line sutures in total laparoscopic hysterectomy.

Cesarean surge Reports suggest more than 4 million surgeries currently being performed in India.⁵

The challenges associated with C-section surgeries and the role of barbed sutures is summarized in Figure 4. Barbed sutures are used in cesarean delivery with the intended benefits of better tissue approximation, hemostasis, and strength, as well as reduced operative time (Figure 5).²⁵

 **Figure 4** Challenges of cesarean surgery^{16, 18-19, 26-28}

Security of the closure	<ul style="list-style-type: none"> • Key step in cesarean section, particularly given the increasing awareness of future scar dehiscence • Unlocked single-layer closures were associated with a higher uterine rupture risk • In women who are considering a vaginal birth after cesarean, a single-layer closure should be avoided.
Intraoperative blood loss	<ul style="list-style-type: none"> • As with any delivery and with surgery in general, there is a risk of excessive bleeding during and after a cesarean section • A running closure decreases operating time and blood loss compared to interrupted closure.
Speed of closure	<ul style="list-style-type: none"> • Helps to minimize bleeding • Less operating time means less time under anesthetics

 **Figure 5** Role of barbed sutures in cesarean surgery¹⁶

Barbed sutures can deliver uncompromised tensile strength and improved wound healing vs conventional sutures.	Barbed sutures help in delivering better homeostasis by facilitating a reduction in intraoperative blood loss	Barbed sutures help in reducing the suturing time, total operating time, and the risks associated with knot-related complications.
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In a meta-analysis of randomized controlled trials, researchers determined if knotless BS can be reasonable alternative to conventional sutures in a meta-analysis and reported that:²⁹

- Barbed sutures were associated with a significantly shorter uterine incision closure time, significantly lesser need of additional hemostatic sutures and significantly lesser blood loss during uterine incision closure.²⁹

A retrospective cohort study compared knotless barbed and conventional synthetic suture use for uterine closure in different settings of c-section and reported that:³⁰

- Mean OR times, mean EBL, and complication rates were lower for knotless barbed compared to conventional synthetic suture across all uterine closure scenarios.
- Statistically significant differences were observed for EBL in aggregate (752.9 vs. 820.9 mL; p=0.03), two-layer closure (643.6 vs. 850.4 mL; p=0.002) and repeat CS (712.2 vs. 824 mL; p=0.03) groups.

“ *The use of knotless Barbed sutures for uterine closure can reduce suturing time and the additional suture requirement.*²⁹
*Using knotless barbed suture compared with conventional synthetic suture for uterine closure during CS is associated with significantly lower EBL, particularly for two-layer closure and repeat CS groups.*³⁰ ”

EXPERT OPINION:

- Moderate to high-quality evidence suggests the use of knotless Barbed sutures can reduce suturing time and the additional suture requirement for uterine closure

CONSENSUS FROM THE ADVISORY:

- Barbed sutures are convenient and a good alternative to prevent postoperative inconveniences and provide better wound healing for the repair of deep fascia particularly the rectus sheath
- Barbed sutures can be used for the closure of the subcutaneous space in caesarean surgery
- Barbed suture is associated with shorter uterine closure time and can be used for uterine incision closure in caesarean surgery

Conclusion

The knotless barbed suture has significantly decreased the challenges of laparoscopic suturing. The barbed suture has completely changed the field of minimally invasive gynecologic surgery since its introduction. Barbed sutures promote faster and more uniform wound closure by distributing tissue tension evenly across the suture line, resulting in more secure wound closure. The absence of

knots, the even distribution of tissue strength, the secure approximation of tissues, and the reduction of surgical time are the main benefits of using barbed sutures. Applications for this innovative technology will definitely increase with the availability of newer barbed suture options, but further randomized clinical trials are required to fully understand its potential.

Summary

Type of Surgery	Consensus on Use of Barbed Sutures
Laparoscopic Myomectomy	Barbed sutures can be considered the gold standard for the closure of myometrium after laparoscopic myomectomy
Hysterectomy - Vaginal Cuff closure	Barbed sutures are a good alternative to conventional sutures for vaginal cuff closure during total Laparoscopic Hysterectomy
Cesarean Section	Barbed sutures are a good alternative to conventional sutures for uterine closure during cesarean section

Consensus statement

No.	Consensus Statement
1	Barbed sutures have proven to lower complications and improve patients' outcomes while saving the time and money in Gynecological procedures ^{16, 19} <ul style="list-style-type: none"> - overall reduction suturing time by 6–65 min³¹⁻³² - overall reduction in blood loss by 164.8 ± 137.2 ml³³ - reduced vaginal cuff infections compared with non-barbed sutures, reducing the risk of wound dehiscence
2	Use of Barbed suture in laparoscopic hysterectomy can reduce difficulty and make the procedure easy to perform, which help decrease operative duration and blood loss, shorten postoperative and total hospital stay, and reduce the formation of vaginal cuff granulomas. ³⁴
3	Barbed suture allows for vaginal stump approximation and a shorter operative time, as there is an ease of suturing without the complication of knot tying. ³⁵
4	Barbed sutures minimize tissue recoil and do so with accurate soft tissue approximation, achieving hemostasis without the use of locking ³⁵
5	Use of barbed suture significantly facilitates the suturing of the uterine wall defects quickly, and effectively ²⁰

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