


The barbed sutures

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ABSTRACT

OBJECTIVE: This study aims to analyze the use of barbed sutures in minimally invasive procedures, considering safety, efficiency and reduction of surgical time. **METHODS:** The analysis included 43 articles selected from the PubMed electronic databases, using the descriptors "Barbed sutures", "Suture Suspension", and "Absorbable Knotless Barbed Suture". **RESULTS:** Among the selected articles, it was observed that the reduction in operative time provided by barbed sutures potentially cancels out the slight increase in cost and can also improve overall results due to shorter anesthesia time. The use of barbed sutures decreased the closure time in relation to standard sutures by 32.8%. The unidirectional barbed suture allows a higher concentration and more homogeneous distribution of soft tissues, avoids the subtle sliding of the edges of the sutured tissue, providing a safer and more stable environment for tissue healing, resulting in scars less prone to inflammation and, consequently, thinner and more imperceptible in an aesthetic analysis. The barbed suture is also seen as a useful tool in the plication of the rectus abdominis, being used in the fascia of the abdominal wall after the removal of the transverse rectus abdominis myocutaneous flap (TRAM) for breast reconstructions, for example, or associated with abdominoplasty. Although not a formal outcome of the study, the suture extrusion rate was 10% in the barbed suture group compared to 20% in the conventional suture group. In the study, the mean complication rate was 9.7% and the mean surgical time was 108 minutes for mammoplasty and 156 minutes for abdominoplasty. **CONCLUSION:** The present review demonstrated similar safety between the barbed suture technique and the conventional suture. Among the advantages of barbed sutures, it allows greater concentration and more homogeneous distribution of soft tissues, providing greater

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support with less tension on the thread, and better aesthetic results with less possibility of inflammation. Therefore, the data indicate an improvement in the complication rate, surgical time and safety for the patient in reduction mammoplasties and panniculectomies. It was concluded that barbed thread has greater applicability in plication of the rectus abdominis, superficial closure of the skin and accommodation of the deep layers in body contouring procedures. In the region of the arms, it is not applicable, as it can trigger problems in the healing of the surgical wound, due to a similar prolonged response of a foreign body by the sharper barbs and its slower absorption.

Keywords: Barbed sutures, Suture Suspension, Absorbable Knotless Barbed Suture.



INTRODUCTION

Barbed sutures - which appeared in 1964(1) - have several surgical applications: they are used in aesthetic, urological, general, orthopedic, obstetric, gynecological and other surgeries. The advent of barbed sutures was a revolution to traditional methods (mono-Nylon thread, for example); being evaluated for the first time in 1967 by McKenzie(2) in his clinical trial; in which the use of barbed wire in unidirectional sutures in lacerated human tendons was tested. This study aimed to allow the use of sutures in minimally invasive procedures, making them safer and more efficient, without the need for knots (which increase tissue movement and consequent inflammatory response); In addition, it generates a reduction in surgical time due to the absence of knots during suturing (3). Currently, barbed yarns are available in both absorbable and non-absorbable monofilament materials.

OBJECTIVE

To analyze the use of barbed sutures in minimally invasive procedures, considering safety, efficiency and reduction of surgical time.

METHODS

The analysis included 43 articles selected from the PubMed electronic databases, using the descriptors "Barbed sutures", "Suture Suspension", and "Absorbable Knotless Barbed Suture".

RESULTS

The barbed wire consists of a wire with unidirectional or bidirectional projections (angled cuts) that, when lodged in the tissue, ensures stabilization and fixation of the suture and adjacent tissues; this design was inspired by the porcupine's feather and fishing hooks(4). The barbs present in the thread allow the closure of the suture to be done without the need for surgical knots, as this morphology of the barb allows for the retention and tensile strength necessary for proper closure to the tissue. Currently, there are two types of barbed wire cleared by the FDA: Quill (Surgical Specialties Corporation, Vancouver, Canada) and V-Loc (Covidien, Mansfield, MA, USA). The first device, Quill, has 2 needles at each end, requiring them to be positioned at the midpoint of the suture at the beginning of the closing movement; the V-Loc, on the other hand, because it is unidirectional, should be positioned at one end at the beginning of the suture; it is available in two versions: slow (V-Loc 180) and fast (V-Loc 90) absorption (5). According to Hurwitz(6), in body contouring surgeries, the prolonged retention of the Nylon or Polypropylene suture would not be necessary, because in the long term it could be palpable to the touch and becomes a means for the formation of abscesses.



Given the high stress placed on the skin and the closure of the superficial fascia of tummy tuck and circumferential tummy tuck procedures, it is natural for surgeons to question whether a barbed, knot-free suture can reliably maintain wound closure. To transition to knotless barbed sutures, it is important to understand that the weakest point in any surgical suture line is the knot, while the second weakest point is the portion immediately adjacent to the knot.(7-9) In addition, the suture knot results in a high density of foreign body material that increases the surrounding inflammation.(10-11) Minimizing wound inflammation by eliminating suture knots can improve wound healing.

Regarding the support force, it can be said that the three-dimensional configuration of the barbed suture is the most influential factor in generating greater force, since a curved path works better than a straight path (12).

APPLICABILITY, ADVANTAGES AND DISADVANTAGES

The reduction in operative time provided by barbed sutures potentially negates the slight increase in cost and may also improve overall results due to shorter anesthesia time [15-17]. Although a quick and safe repair without complications is the goal, wound closure typically consumes a substantial percentage of operative time and often leads to delayed wound healing, fat necrosis, exposed sutures, dehiscence, bruising, seromas (18-21), suture abscesses, and localized cellulitis and abscesses.(13-17)

In a study by Aliano et al [22], **the use of barbed sutures decreased the closure time compared to standard sutures by 32.8%** (24.4 minutes versus 36.3 minutes, $p = 0.003$). In a 2011 study, Jandali and colleagues reported that the use of barbed sutures decreased the duration of unilateral breast reconstruction by 50 minutes, although there was no significant difference in the duration of bilateral breast reconstruction [23]. According to their cost analysis, despite the increased cost of barbed sutures over standard sutures, a 50-minute reduction in operative time would save a total of \$7600 in operating room and anesthesia fees.

Compared with conventional sutures, barbed sutures can reduce suture time (MDS = -0.95 , 95% CI -1.43 to -0.46 , $P = 0.0001$) and operative time (MDS = -0.28 , 95% CI -0.46 to -0.10 , $P = 0.003$), does not significantly increase estimated blood loss (MDS = -0.09 , 95% CI -0.52 to 0.35 , $P = 0.70$), but may lead to further postoperative complications (OR = 1.43, 95% CI 1.05 to 1.96, $P = 0.03$). These results varied across subgroups. Thus, barbed sutures are effective in reducing suture and operative time, but safety evidence is still not sufficient. It needs to be evaluated based on special surgeries and types of sutures before putting it into clinical practice. (24)

Regarding the advantages and disadvantages of barbed suture types, we can highlight some points: first, the unidirectional barbed suture allows a greater concentration and more homogeneous



distribution of the soft tissues; second, the bidirectional barbed wire allows 2 surgeons to suture at the same time, since the closure begins at the midline of the wound; finally, HAMMOND (25) in his study reports that regardless of the type of wire, both offer ease and safety in the closure of wounds.tag.

In the literature, we find several viable applications of barbed wire in plastic surgery; this versatility is mainly due to its design and material composition (it may or may not be absorbable). Its barbed technology can be beneficial for long incisions that are associated with tissue support in a higher position than the original **one (25)**, such as Body Lifting; this is because by providing greater support to the tissue, the surgeon is able to perform the suture in a less laborious way and with less tension on the thread.

In addition, the use of barbed wire is indicated for brachioplasties and mastopexies; in the first case, the wire technology ensures the ability of the suture to resist the movement of the incision edge, attenuating the effect of the patient's arm movement. **(26)** In the second case, the indication for its use in mastopexy is due to the fact that it helps to support portions of the breast (which is usually very busy in this type of procedure), ensuring stabilization of scars and excellent aesthetic results(**27**).

Perhaps one of the most considerable applications is in abdominoplasties (one of the surgeries most prone to complications at the time of closure) **(28)**; although a significant reduction in surgical time has not been reported in the literature, the use of barbed threads prevents subtle slippage of the edges of the sutured tissue, providing a safer and more stable environment for tissue healing. resulting in scars that are less likely to become inflamed and, consequently, thinner and more imperceptible in an aesthetic analysis **(29)**.

Currently, facelifting techniques include excision and lifting of the skin, the superficial musculoaponeurotic system (SMAS) and its associated planes; in this context, barbed wire has been shown to be an effective tool for allowing the stabilization and suspension of these mobilized tissues, ensuring an adequate functional and aesthetic aspect**(30-34)**. Finally, barbed sutures are also seen as a useful tool in plication of the rectus abdominis, being used in the fascia of the abdominal wall after the removal of the transverse rectus abdominis myocutaneous flap (TRAM) for breast reconstructions, for example, or associated with abdominoplasty (**35**).

Regarding the safety of barbed sutures, it was demonstrated in an initial, prospective, randomized, controlled clinical trial of bidirectional barbed sutures reported by Murtha et al.**(36)** That the safety profile and cosmetic outcome is similar to that of a conventional suture technique. In this study, 188 women had the dermal portion of their Pfannenstiel incisions closed with either a conventional 3-0 polydioxanone (PDO) non-dotted suture or a 0 PDO barbed suture. The mean dermal closure times, rates of wound dehiscence and incision infection, and objectively scored



cosmetic outcome at 5 weeks were statistically similar between the 2 groups. Although not a formal outcome of the study, the suture extrusion rate was 10% in the barbed suture group compared to 20% in the conventional suture group. The investigators noted that the technique of placing the suture on the bar bed was easily learned during the training sessions.

Generally, in abdominoplasties, intraoperative drains are inserted, which are removed only when the flow rate is already low; however, Mladick(37,38) in his study suggests that there is the possibility of reducing the time of use of the drain in abdominoplasties, for which it would be necessary to use the barbed wire, suturing the deep surface of the abdominal skin flap and the fascia of the abdominal wall. This would reduce the need for long-term drains and also the emergence of seromas. This theory regarding the use of drains was taken more seriously in the study by Pollock and Pollock(39,40), where they demonstrated that it would be possible, using the appropriate technique, to omit the use of drains and eliminate cases of seroma with the use of barbed wire, without reducing safety and aesthetic results.

REDUCTION OF COMPLICATIONS

In 2016, a study was published by Aliano et al., comparing the use of barbed sutures versus conventional sutures in reduction mammoplasties and panniculectomies. A total of 27 patients were evaluated, all female, and 18 patients completed the evaluations of the study, where 5 panniculectomies and 13 bilateral reduction mammoplasties were performed, operated by 2 plastic surgeons. To enable the control of the study, a bidirectional Quill barbed suture was used in one of the breasts and a monocryl or vycril suture was used in the contralateral suture; In panniculectomies, barbed wire is used in half of the incision and conventional wire in the other half. It is worth mentioning that in this study, the aesthetic evaluators were the patients themselves. Based on the results found, the organizers of the study concluded that barbed wire proved to be a good option for this type of procedure, with slightly superior aesthetic results, shorter surgical time and similar complication rates.(22)

Duscher et al. published in 2016 a study that evaluated the use of barbed wire in body contouring surgeries; the study included 623 patients who were followed for a period of at least 12 weeks postoperatively, surgical time, suture-related complications (suture dehiscence, infection) and patient demographics were evaluated. According to the authors, barbed wire can be used in plication of the rectus abdominis, superficial closure of the skin, and accommodation of the deep layers in body contouring procedures. In the study, the mean complication rate was 9.7% and the mean surgical time was 108 minutes for mammoplasty and 156 minutes for abdominoplasty. Based on this, they concluded that the use of barbed wire for these purposes would be advantageous in terms of complication rate, surgical time, and patient safety. (41)



COMPLICATIONS

The characteristics of the materials that make up the barbed sutures make this type of suture have slower absorption rates than the conventional suture -approximately 120 days to be minimally absorbed-; this allows that in some circumstances the penetration of the barbed thread occurs on the surface of the dermis even before its total absorption occurs; causing wound dehiscence and the formation of pathological scars. For this reason, there are recommendations that polydioxanone PDO wire should only be used for deeper closures. (42)

A gauze sponge should not be used along the length of the suture thread to perform cleaning, as the barbs are sharp enough to trap the sponge fibers in the interstices of the barbs, which are transported along with the suture to the wound (Figure 7), which may lead to a prolonged foreign body response and possible postoperative infection. Specific effort may be required to remove the wire in segments to ensure that all suture material is removed. This removal is most easily accomplished with a one-way suture that is not locked into position at the midline. In addition to these recommendations, barbed sutures behave like other types of sutures and are no more prone to complications than any other type of comparable suture material. (42).

Shermak et al. (43) describe a series of 114 patients who underwent body contouring surgery with Quill-type sutures. In the analysis of the results of the study, the authors conclude that the compared to the abdomen, thorax and thighs, the arms are the areas that had a significant rate of wound complications; One of the theses that supports this result postulates that the continuous suture, the prolonged absorption period and the surface of the barbs are capable of promoting an inflammatory environment in the surgical wound, causing problems in wound healing.

Murtha et al. (36) published a prospective, randomized, controlled clinical trial using bidirectional barbed sutures and conventional PDO 3-0 sutures in 188 women. In the clinical trial, they found that at a 5-week endpoint, the suture extrusion rate was 10% in the barbed suture group compared to 20% in the conventional suture group; The other results: mean dermal closure times, rates of wound dehiscence and incision infection, and cosmetic outcome had similar results between the techniques.

CONCLUSION

The present review demonstrated similar safety between the barbed suture technique and that of a conventional suture. Among the advantages of barbed sutures, it allows greater concentration and more homogeneous distribution of soft tissues, providing greater support with less tension on the thread, and better aesthetic results with less possibility of inflammation. Therefore, the data indicate an improvement in the complication rate, surgical time and safety for the patient in reduction mammoplasties and panniculectomies. It was concluded that barbed wire has greater applicability in



plication of the rectus abdominis, superficial closure of the skin and accommodation of the deep layers in body contouring procedures. In the region of the arms, it is not applicable, as it can trigger problems in the healing of the surgical wound, due to a similar prolonged response of a foreign body by the sharper barbs and their slower absorption. However, it is important to carefully consider the application and possible risks associated with these sutures in each clinical case.



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