RESEARCH PAPER

Thread Lifting in Facial Rejuvenation: Current Concepts of Classification, Mechanisms, Technique, and Complications

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Received 19 July 2026, Revised 25 July 2026, Accepted 09 August 2026, Available Online 12 August 2026

Abstract

Thread lifting has emerged as a widely used minimally invasive technique for facial rejuvenation, offering an alternative to surgical facelifting in patients with modest facial sagging, fine wrinkles, and enlarged facial pores. Since the introduction of non-absorbable polypropylene Aptos threads in the 1990s, thread technology has evolved considerably, culminating in absorbable polydioxanone (PDO) threads, which now represent the mainstay of clinical practice owing to their favorable safety profile. Threads are classified according to mode of absorption, presence and configuration of barbs, and length, with cogged PDO threads being the most widely used for facial suspension and contouring. Beyond their mechanical lifting effect, PDO threads exert a biostimulatory action, triggering a controlled foreign-body and wound-healing response that promotes fibroblast activation and neocollagenesis, improving skin texture, tone, and elasticity. Poly-L-lactic acid threads represent a further development, offering more prolonged collagen stimulation. Correct insertion technique and sound knowledge of facial anatomy are essential to maximize efficacy and minimize complications. Reported adverse effects range from mild, self-limited bruising, swelling, and transient asymmetry to rarer events such as infection, nerve injury, parotid gland injury, thread migration or extrusion, and vascular complications including pseudoaneurysm. This review summarizes the history, classification, biological mechanisms, insertion technique, tissue response, expanding clinical applications, and safety profile of thread lifting, with emphasis on polydioxanone threads as a cornerstone of modern non-surgical facial rejuvenation.

How to cite this article: Doha Mohamed Ibrahim Aboanber1 Prof. Dr. Naeim Mohamed Abd El-Naby2 Prof. Dr. Naglaa Ibrahim Sarhan3 Prof. Dr. Nahla Elsayed Ramzy Ghaly4. Thread Lifting in Facial Rejuvenation: Current Concepts of Classification, Mechanisms, Technique, and Complications. Int J Drug Deliv Technol. 2026;16(78s): 456-461. DOI: 10.25258/ijddt.16.78s.54.

Introduction

Thread lift is a minimally invasive technique for facial rejuvenation. This procedure is safe and effective with minimal complications when performed on patients with modest facial sagging, fine wrinkles, and marked facial pores[1].

Historical Background

Threads, or barbed sutures, were first utilized for cosmetic procedures to lift facial tissue as early as the 1990s by Sulamanidze and colleagues[2]. These sutures, named Aptos threads, were non-absorbable and made of polypropylene, in contrast to current threads, which are absorbable and primarily made of polydioxanone. There were many reports of complications due to the Aptos threads, including extrusion, migration, infection, and scarring that occurred even years after the procedure, and their popularity waned as they did not gain Food and Drug Administration (FDA) approval at that time[3].

Subsequently, another suture called Contour Threads, again non-absorbable polypropylene with barbs, did achieve FDA approval in 2004. However, these were shortly thereafter reported to have a high rate of complications, including infection, extrusion, severe pain, swelling, and recurrent laxity, and the FDA approval was revoked only three years later. Due to the high rate of complications with nonabsorbable suture material, absorbable sutures emerged as the safer, albeit temporary, option and have since established a stable and growing presence in the market. Absorbable PDO threads were first introduced in the United States in 2016 after FDA approval, although in South Korea absorbable PDO threads for aesthetic purposes were first introduced in 2011[3].

The first experiments were performed with a polypropylene thread containing unidirectional barbs also attached to a long guide needle. Through a small incision in the temporal area, several strands were inserted into the subcutaneous tissue, then what was left of the thread was cut off and slightly

pulled; the most superficial thread was sutured to the temporal muscle fascia. In the submaxillary and cervical areas, the technique was similar, with fixation performed in the periosteum of the mastoid process[5].

In 1998, this technique was improved with a thread that was no longer coupled to a needle. This thread contained convergent barbs and was developed to be introduced into the subcutaneous tissue through a guide needle[6], eliminating the need for a previous incision. The barbs anchor in the subcutaneous tissue when pulled, converging toward the center and acting as vectors that prevent the thread from migrating through the tissue, producing the lift effect[6,27]. This technique was used for all areas of the face, but after long experience it was found to be better indicated for improving the contour of the central face and lifting the mental area; to achieve chin lift, the threads were inserted parallel to the mandible, while in the midface region the threads were inserted forming relatively steep arches followed by traction alignment of their final portions, with better results than the first method[5].

In 2002, the technique was improved again, based on the initial idea of the thread being connected to a needle. A thread with converging barbs attached to two needles, one at each end (Aptos Thread 2G®), was developed, coupled by a temporary weld so that its pointed tips constituted a single whole, again requiring no prior incision. The two needles were placed on the skin through the same puncture point and separated once in the proper plane, then advanced in opposite directions[5]. This new thread allowed greater lifting power; results in the middle portion of the face were moderate, but good results were achieved in the eyebrows and chin[5].

With further experience, it became apparent that some sites required a lace- or purse-shaped suture, with the thread soft enough for the tissue to slide over it. Based on this, a double-ended needle with a soft wire attached (Aptos Needle) was developed, allowing work in the central face and other areas such as the submaxillary region, neck, chin, ear lobes, and mammary ptosis[5]. The material was subsequently reshaped to combine the capabilities of Aptos Thread 2G with Aptos Needle (Aptos Needle 2G), made up of several barbs attached to two double-pointed needles; this achieved an even stronger and more stable lift and was indicated mainly for central-facial zone lift, using essentially the same application technique as Aptos Thread 2G[5].

A special thread to treat kinetically active regions, such as the perioral lines and mouth angle ptosis, was also developed (Aptos Spring Method), a heliciform thread made of polypropylene with a special technology[6]. To lift the perioral lines, a thread is inserted on each side, perpendicular to the wrinkle[5].

In 2009, Sulamanidze, Marlen, and Georgii Sulamanidze published the 10-year results of the APTOS method, observing that outcomes held for one year or more, with the best results achieved using the Aptos Needle and Aptos Needle 2G threads. They found the method especially effective in the central face, improving the nasolabial folds, softening the lacrimal portion, and raising and laterally moving the subcutaneous tissue to improve the contour of the central-facial zone[5]. For the submandibular and cervical regions, in more recent years only the Aptos Needle method has been used, with no complete return of the skin to its pretreatment state observed even after 3 to 4 years; where some weakening of the thread occurred after 1 to 3 years, correction was achieved through traction of the area and re-anchoring in a higher position[5].

The Silhouette suture is composed of an 8-inch (20cm) straight needle attached to a 14.7-inch (37.3cm) 2-0 or 3-0 polypropylene suture. In the distal part of the suture are 8 (2-0) or 9 (3-0) knots spanning 8 cm at approximately 10 mm intervals, each intercalated with an absorbable cone to compose a series of eight or nine engaging elements[6]. The cones are hollow, with an outer diameter of 1.27 mm at the base and 0.46 mm at the top, and a length of 2.53 mm, made of a polymer composed of L-lactic acid and glycolic acid[7]. The physical and chemical configuration of the Silhouette suture allows repositioning of the facial tissue through immediate traction and formation of new collagen fibers around its structure, adding support against gravitational force; the initial traction is produced by the existing cones and reinforced by the neoformation of collagen, and after absorption of the cones, tissue tension is maintained by the collagen formed around the nodes in the thread[7]. The Silhouette Soft suture is available as a complete device with two straight 12-cm steel suture needles pre-attached at each end, with the cones held in place by a PGLA suture; a total of 4 to 8 cones are positioned on each side of the central suture, with each set of cones facing the opposite direction, hence the term bidirectional[7].

Classification of Threads

Threads can be classified according to three main categories[4]:

1. Mode of Absorption

Absorbable threads include PDO thread, Silhouette Soft thread (poly-L-lactic acid, or Sculptra, in solid form), and fine thread with a bi-directional absorbable cone. Non-absorbable threads include Aptos thread, Contour thread, Silhouette lift thread, and Woffles thread, all made of polypropylene. **2. Barbed and Non-Barbed (Smooth) Threads**

Barbed threads are further divided into bi-directional threads (long sutures), inserted through a hollow needle; uni-directional barbed threads (long sutures), anchored to a fixed structure such as the deep temporal fascia; and cogged threads (short sutures), which include unidirectional, bidirectional, and multidirectional PDO cogged threads. Nonbarbed (smooth) threads include monofilament

plain threads, such as Miracu plain thread and TR lift thread, and monofilament screw or spiral threads, such as K2 screw lifting and T screw lifting threads[4]. The value of bi-directional threads over unidirectional threads is that they cannot migrate in either direction because of two-way barb fixation; however, if facial asymmetry results from thread insertion, uni-directional or non-barbed threads allow easier postoperative correction[4].

3. Length of Threads

Threads are also classified by length: a short suture is defined as any thread shorter than 90 mm, while a long suture is defined as any thread longer than 90 mm[4].

Polydioxanone Threads

PDO threads for facial rejuvenation can be categorized into three main types[6]. Mono-PDO thread is a monofilament, non-barbed, thin thread (0.07–0.15 mm). Spring or twin thread, made from a twined single monofilament or two monofilaments braided together, is more tensile than mono-PDO thread. Cog PDO thread has barbs, which cling to tissue to produce a lifting effect upon insertion, and depending on the direction of the spikes is categorized as unidirectional, bidirectional, or multidirectional[1].

When loaded onto a needle, the thread forms a Vshape, with an inner half within the caliber of the needle and the other half on the outside; after removal of the needle or cannula, the thread remains intact within the tissue[1]. The shapes of cogs used in lifting threads were initially simplistic, often resembling sharp, spiky forms; however, with advances in cog manufacturing, cogs resembling the head of a cobra, curved thorns similar to rose thorns, arrowhead shapes, and more recently innerpunching cogs shaped like a reverse trapezoid have emerged, eliminating the need to distinguish forward and backward directions[8]. Long U-shaped threads may also be configured as V-, L-, or I-shapes depending on the treated area, and in some thinner product variations the needle is directly attached to the thread ends, allowing use without a cannula[8].

Mechanisms of PDO Thread Lifting

PDO is a synthetic absorbable surgical suture material that has been used in surgery for many years and is completely reabsorbed by the body over 4 to 6 months through hydrolysis, a process that triggers fibroblast production and consequent collagen production in the targeted area[9]. Once the thread is inserted, granulation tissue forms together with the different collagen types found in human skin; type I and type III collagen are created and play a role in the tensile strength of the dermis[10]. Myofibroblasts and fibroblasts generated within this new granulation tissue are related to wound contraction and healing, and contribute to the skin elasticity and tightening observed in the treated area as part of the skin regeneration process[11].

Recent advancements in thread design have introduced barbs situated on four to six sides of the thread, significantly enhancing its grip within the tissue, increasing retentiveness within the subcutaneous layer, and amplifying the mechanical pull exerted for superior lifting capabilities[12]. This approach harnesses the mechanical and biological interactions between the PDO threads and the body's tissue to achieve tangible aesthetic improvement[13]. When barbed sutures are used beneath the skin, they tighten and lift loose facial areas, creating better definition and contour, while the fibrous tissue formed helps keep the ptotic tissue in place; the combined effects of repositioning lax tissue, neocollagenesis, and generation of myofibroblasts and fibroblasts ultimately impact skin texture, tone, pore size, and elasticity[1,4,14,9].

Another classification of threads according to their function distinguishes bio-stimulation, which stimulates collagen production and tissue regeneration to improve skin elasticity, firmness, and thickness, from suspension, which mechanically lifts and repositions soft tissue for aesthetic enhancement[14,13]. The bio-stimulatory impact of threads remains an area of ongoing research: initial bio-stimulation may occur due to needle- or cannula-induced trauma during insertion, leading to vasodilation and hyperemia even in the absence of threads, while the subsequent inflammatory response triggered by thread insertion further contributes to the bio-stimulatory effect. True biostimulation should result in enrichment and an increase in type III collagen and connective tissue, along with enhanced action against free radicals and improved skin elasticity, firmness, and thickness[15]. Furthermore, post-insertion fibrosis is a commonly reported phenomenon, underscoring the threads' capacity to produce significant structural changes within the treated tissue[16].

Thread Insertion Technique

Thread insertion technique is critical for maximizing the benefits of both suspension and biostimulation[17]. The procedure can be performed under local anesthesia, intravenous sedation, or general anesthesia. The skin is carefully prepped and draped, and the insertion area is injected with local anesthesia, usually 1% lidocaine with epinephrine, for analgesia and hemostasis; perioperative antibiotic prophylaxis is usually not recommended. An 18G needle is used to create an entrance in the skin, after which the suture needle is placed perpendicular to the skin and advanced approximately 5 mm[18]. The thread is introduced against the direction of the barb's bevel to prevent premature engagement with the tissue; once positioned, pulling the thread in the reverse direction engages the barbs with the fatty, fibrous adipose tissue, effectively transferring force, anchoring the thread, and facilitating the desired lifting effect on the overlying skin[17].

Tissue Reaction to Threads

The tissue's reaction to suture placement is a dynamic process that unfolds in several stages, reflecting the body's natural healing and immune response[13,19]. Day 1 to 3 is marked by infiltration of polymorphonuclear leukocytes, signaling the body's immediate response to the foreign material. Day 3 to 4 constitutes the acute response phase, characterized by infiltration of lymphocytes and monocytes. Day 4 to 7 sees the presence of macrophages and fibroblasts, crucial for phagocytosis and the beginning of tissue repair, while day 7 to 10 involves maturation of fibrous connective tissue alongside chronic inflammation, indicating the body's ongoing efforts to integrate or encapsulate the suture material[19].

Within the first week post-implantation, the differential in tissue reactivity between synthetic absorbable and non-absorbable sutures is minimal; nonetheless, absorbable sutures may elicit a slightly heightened inflammatory response that subsides as the suture material is metabolized and absorbed. In contrast, non-absorbable sutures typically provoke a mild, chronic inflammatory response that culminates in a thin fibrous tissue capsule around the suture by approximately day 28, securing the suture in place while minimizing further tissue irritation[19].

Other Clinical Applications of PDO Threads In addition to facelifts, PDO threads are used for non-surgical rhinoplasty in the form of nasal tip augmentation, considered a primary aspect of achieving a natural and balanced nasal appearance[20]. More recently, PDO threads have been used for cosmetic procedures in body parts other than the face: in the United States, they have been used after liposuction to improve the shape of the umbilical position, permanently tighten the lower abdomen, and redefine liposuction results, achieving an improved overall body shape and proportion[21].

Poly-L-Lactic Acid Threads

Poly-L-lactic acid (PLLA) is a synthetic molecule discovered in France in 1954[22]. PLLA-based filler was first introduced in Europe in 1999 under the trade name New Fill and subsequently in 2004 in the United States market under the trade name Sculptra, for use in HIV-related lipoatrophy. Several studies have examined PLLA safety, efficacy, and persistence. Derived from lactic acid, a product naturally produced by muscle contraction, PLLA is used mostly for facial volumizing and as a collagen biostimulator, and also has orthopedic applications such as pins, rods, and screws[23,24,25].

PLLA threads are newer threads that can last longer and generate more collagen than other thread types, developed from the same ingredients found in absorbable PDO sutures. They act as a foreign material, creating microinjuries that trigger macrophages, mast cells, and lymphocytes to induce new collagen formation (type I and type III) as the sutures are reabsorbed, helping to increase volume and restore smoothness of facial contour gradually and naturally[26]. PLLA threads are degraded into water and carbon dioxide and absorbed over a period that may range from 9 to 30 months, with subsequent stimulation of the patient's own natural collagen production, producing effects that can last 12 to 18 months[26].

Complications of Thread Lifting

In general, the incidence of complications following thread lifting is small, and it is considered a safe procedure[27]. The most commonly observed complications are moderate bruising, erythema, and edema. Facial asymmetry can occur and may persist for about 1 to 2 weeks, requiring no intervention during this period. Ripples on the surface of the skin can occur when the thread is introduced too superficially and may remain for an extended period, underscoring the importance of correct plane selection during insertion[5,28]. Infection, migration, formation of scar tissue, and extrusion of the thread may also occur, though less frequently[5,28].

Pain and Nerve Injury

While pain is expected post-procedure and may be managed with analgesics, symptoms such as unmanageable pain, tingling, numbness, or abnormal facial sensation may signal nerve injury, especially if affecting areas such as the ear or temple, warranting immediate medical evaluation. Causes include incorrect thread placement, overly aggressive insertion, or use of sharp instruments; management involves NSAIDs or corticosteroids for inflammation, with thread removal reserved for persistent neurosensory symptoms[29].

Hematoma and Swelling

Hematomas result from injury to blood vessels during thread insertion, particularly in patients with fragile vessels or those who used NSAIDs, alcohol, or supplements pre-procedure, and can be prevented by avoiding these agents before and after the procedure[29]. Swelling, another common side effect, usually subsides within two weeks and is managed with cold compresses and NSAIDs[30].

Infection

Infections are common at insertion sites, especially on the scalp due to hair contamination or poor aseptic technique. Management includes topical and oral antibiotics, with removal of threads reserved for resistant infections[31].

Skin Dimpling or Depression Dimpling or depression arises from superficial thread placement, excessive tension, or prior scar tissue. Treatment options include manual massage and tension release, subcision, laser therapy, or dermal fillers[30,32].

Asymmetry

Facial asymmetry post-thread lift may reflect preexisting imbalances or technical errors and is often noticeable after swelling subsides. Documenting facial asymmetry pre-procedure and ensuring symmetrical thread placement and equal tension are important; treatment includes

adjustment of threads, additional thread lifts, dermal fillers, or, in severe cases, surgery[29].

Post-Inflammatory Hyperpigmentation Post-inflammatory hyperpigmentation typically occurs at insertion or exit points, especially in patients with darker Fitzpatrick skin types (III–VI). Although it tends to fade over time, treatment with topical hydroquinone, azelaic acid, kojic acid, retinoids, vitamin C, or niacinamide can accelerate resolution[29].

Thread Visibility, Migration, or Exposure Superficial placement of threads can cause palpability or extrusion. Migration may result from inflammation, poor anchoring, or thread breakage, and treatment includes manual massage or thread removal using clamps or dissection[30].

Parotid Gland Injury

Injury to the parotid gland or duct presents as acute swelling and pain, often resulting from poor technique or incorrect depth of thread placement. Management includes application of pressure with a facial band, administration of antibiotics and steroids, and use of anticholinergic medications to decrease saliva production; injection of botulinum toxin into the salivary gland may also be beneficial, with surgical repair and stenting of the Stensen duct rarely required[33,34].

Hair Loss (Alopecia)

Hair loss at insertion points is typically temporary and results from trauma or poor local circulation; it is usually self-limiting, although persistent cases may require microneedling, laser therapy, or hair transplantation[29].

Rare Complications

Pseudoaneurysm of the superficial temporal artery has been reported following thread lift and generally requires surgical excision; it can be prevented through thorough knowledge of vascular anatomy and palpation of superficial arteries before insertion[35]. Chronic inflammatory reactions, mostly seen with non-absorbable threads, may manifest as nodules or persistent swelling and may require thread removal[36]. **Contraindications to Thread Lifting**

Thread lifting is contraindicated in patients with allergy to any of the component materials or atopy; acute skin inflammation or infection; immunologically compromising diseases such as cancer or HIV; systemic disease including diabetes mellitus, systemic lupus erythematosus, or tuberculosis; use of anticoagulant or antiplatelet medication; pregnancy or lactation; mental disorders; bleeding disorders such as hemophilia; and body dysmorphic disorder or unrealistic patient expectations[37].

Conclusion

Thread lifting has evolved from the early nonabsorbable polypropylene sutures of the 1990s into a diverse, safety-oriented family of absorbable devices, with polydioxanone cog threads now representing a cornerstone of non-surgical facial rejuvenation. Their dual suspensory and biostimulatory action, favorable safety profile, and expanding range of applications support their continued integration into routine aesthetic practice, provided that meticulous technique, sound anatomical knowledge, and appropriate patient selection are observed.

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