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Revolutionizing thread lifting: Evolution and techniques in facial rejuvenation

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Abstract

Objective: This review explores the utilization of thread lifting materials, distinct from traditional sutures, in aesthetic procedures. It aims to elucidate the varied composition, purpose, and performance of these slender materials.

Methods: The article contextualizes thread lifting materials by exploring their literal and material significance. The evolution of these materials is traced, emphasizing the preexistence of cog threads for tissue manipulation before their widespread adoption in plastic surgery.

Results: Observations regarding the efficacy and longevity of absorbable versus non-absorbable threads are discussed, with a particular emphasis on the efficiency of high-quality absorbable cog threads.

Conclusion: The proliferation of thread lifting materials extends beyond PDO, necessitating consideration of multiple factors beyond duration when selecting threads for lifting procedures. This underscores the importance of comprehensive evaluation in choosing appropriate thread lifting materials.

KEYWORDS
facial aging, facial rejuvenation, mesh-lifting, polydioxanone, poly-L-lactic acid, thread-lifting

In the past, the use of threads to pull and tighten the sagging facial skin and tissues was primarily in an auxiliary capacity during surgery or by suturing the skin and tissues together using minimal incisions.[1] To maximize the tissue-grasping effect of the threads, some threads were used with barbs created by cutting the outer side of the thread.[2] This allowed for tissue manipulation by pulling with threads featuring only small barbs, requiring minimal incisions.[3] However, the initial products introduced during the early stages of thread lifting were mostly made of non-absorbable materials.[4] Dissolvable threads, except for some foreign products, were primarily used domestically in the early models not for the practical lifting effect of pulling tissues but to enhance skin tone and elasticity through collagen formation resulting from tissue reactions during the thread's dissolution process.[5] Consequently, until the early 2000s, when selecting threads for facial lifting, non-absorbable threads that maintained their pulling effect over time were primarily used for pulling sagging tissues in the lower face. Dissolvable threads were thought to be used mainly for improving skin elasticity or refining the indistinct contour lines around the jawline without causing excessive tightening, or merely addressing moderate sagging.

However, as the technology for creating threads advanced, many companies gradually started producing dissolvable threads with various lifting effects, and the technique of creating cogs on threads also evolved over time. Improved cog shapes and advancements in the technology to create cogs have led to the development of various products that are easier to use for achieving effective thread lifting results.

The type of material used for threads has a big impact on the results of thread lifting. In the past, non-absorbable polypropylene (Prolene™) threads were popular, but now absorbable polydioxanone (PDO) threads are more common. There are also absorbable threads like poly-L-lactic acid (PLLA) and polycaprolactone (PCL) that have become available. Some threads are made from blends of these materials, such as Quill lift (75% PGA, 25% PCL) and V-loc (60% PGA, 26% PTMC, 14% PDO).

Unlike non-absorbable threads, which are usually made of one material such as polypropylene, absorbable threads blend different materials to take advantage of their unique tissue reactions, strengths, and rates of dissolution in the body. For instance, chromic catgut threads provoke a positive tissue response but have low tensile strength and dissolve quickly. In contrast, PDO threads provide strong tensile strength and dissolve gradually over 6 months or more, which is why they are widely used in thread-lifting procedures.[6,7]

The makeup of threads also influences their elasticity, which pertains to an object's capacity to revert to its initial state after undergoing deformation. Elasticity is determined by the thread's composition and affects the elastic force, as calculated by Hooke's Law ($F = k\Delta X$).[8–10]

In simpler terms, elasticity describes how well an object can recover its original shape after being stretched or deformed, similar to how a rubber band returns to its original form after being stretched. The concept of elasticity considers factors such as the material's stiffness (elastic modulus) and its ability to stretch (elastic limit).

When comparing objects, those with higher stiffness and less stretchiness feel more rigid, like a hard surface. Conversely, objects with less stiffness but greater stretchiness feel more pliable, akin to something soft and flexible.

For instance, Silhouette Soft threads, primarily composed of PLLA (poly-L-lactic acid), exhibit a higher elastic limit compared to other threads.[2,11–13] Their flexibility enables them to respond effectively to facial movements and expressions, potentially minimizing post-procedural discomfort. However, it's crucial to note that superior elasticity doesn't always equate to better performance. For example, PDO threads, despite their lower elastic limit, provide strong support due to their rigid material. This stiffness helps sustain lifted skin, even during facial movements. Thus, comprehending the diverse degrees of firmness and flexibility in thread materials aids in choosing the most suitable option according to each patient's requirements. Moreover, combining thread materials can result in more balanced results.[14,15]

With such quality improvements, the lifting effects of dissolvable cog threads have improved, and simultaneously, their duration of sustenance has increased. Consequently, the demand for dissolvable thread lifting has gradually risen due to the increasing number of patients undergoing these procedures. This surge in patients has led to a significant shift in perceptions regarding the effects of absorbable and non-absorbable threads.[16] As mentioned earlier, with the growing number of patients undergoing thread lifting procedures, the differences in the clinical duration of lifting effects between absorbable and non-absorbable threads no longer seem significant enough to be a determining factor in choosing non-absorbable threads. Furthermore, patients who have undergone absorbable thread lifting exhibit noticeably more collagen regeneration-induced fibrosis compared to those with non-absorbable threads, which aids in preventing tissue sagging and improving skin quality.[6] The outcomes of thread-lifting are influenced by various factors, including the type of thread material, thread thickness, shape, and number of cogs, as well as the direction and depth of thread placement. Additionally, the vector and fixation point of the threads, along with the utilization of techniques such as the U, V, and I methods, and the expiration date of the threads, play significant roles in determining the effectiveness of the procedure.

Therefore, in today's widespread use of dissolvable thread lifting to tighten lax skin and tissues, the primary criterion for selecting the initial thread may revolve around choosing a product with manipulations such as cogs, cones, or mesh on the outer surface of the dissolvable thread or opting for a product primarily composed in a monofilament form without such manipulations.[4,17]

The representative type of thread that incorporates manipulations on its surface to engage tissues is known as cogged threads, often utilized in procedures referred to as cogged thread lifting. The commonly used types of cogged threads include long cannula-guided or double needle bidirectional cogged threads, typically used in U or V shapes, extending 40 cm or more, as explained in the context of fixed cogged threads. Additionally, short bidirectional or multidirectional cogged threads, employed in I shapes, are also prominent in these procedures.[18]

The long cogged threads, primarily bent into U or V shapes, perform a dual role in their structure by having a relatively long section devoid of a central cog and featuring two rows of cogs on either side of this central area. These threads are folded, with the direction of the cogs in a single bidirectional type facing each other around the empty central space, as observed in Figure 1.

The shorter I-shaped threads, unlike the long U-shaped threads primarily folded to serve a dual purpose, are named I-shaped threads as they do not simply fold but are inserted in a straight manner without the bending. Typically inserted within a cannula for ease of use, these threads are produced for simpler insertion. In the case of the single bidirectional type of I-shaped thread, as depicted in the illustration, the basic positioning, direction, and mechanism of action of the cogs are similar to those of the long U-shaped cogged threads (Figure 2).

Short I-shaped threads, unlike long U-shaped threads that utilize only single bidirectional cogs focusing force towards the center, can be designed and manufactured in various types based on the position and shape of the cogs, such as single or double bidirectional types, multiple bidirectional types, and twin or spiral bidirectional types.

As previously mentioned, the shapes of cogs used in lifting threads were initially simplistic, often resembling sharp, spiky forms. However, with advancements in cog manufacturing technology, there has been the emergence of cogs resembling the head of a cobra, curved thorns similar to rose thorns, arrowhead shapes close

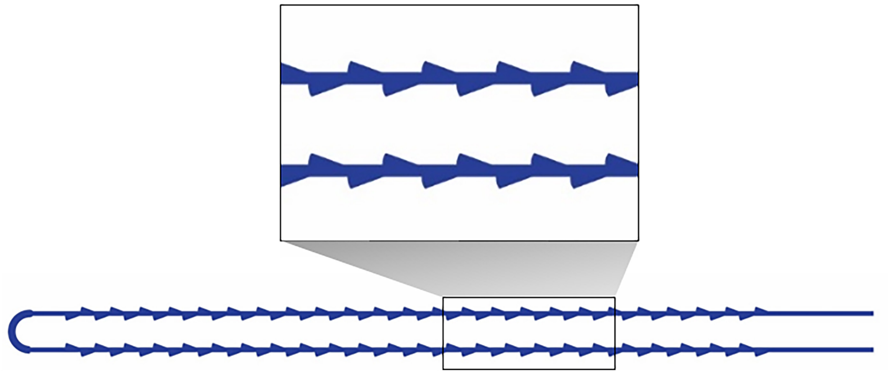

FIGURE 1 Long cogged threads, bent in U or V shapes, feature a long section without a central cog and two rows of cogs on either side. They fold with bidirectional cogs facing each other around the central empty space.

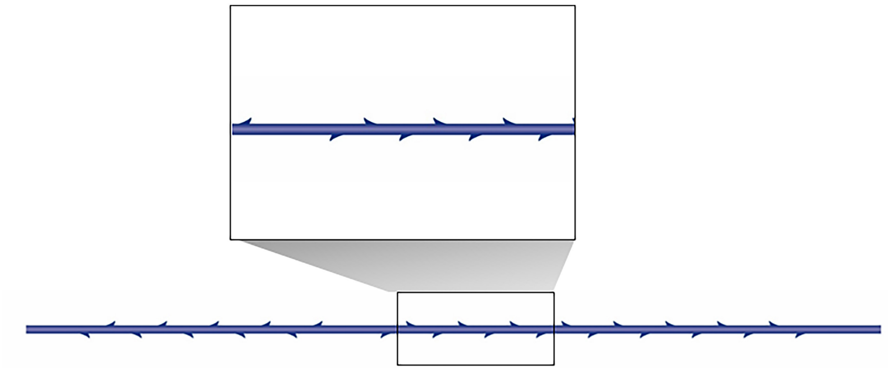

FIGURE 2 Shorter I-shaped threads, unlike U-shaped threads, are straight and inserted without folding. They are designed for simple insertion, often placed within a cannula. The single bidirectional I-shaped thread functions similarly to long U-shaped threads in cog positioning, direction, and action.

to triangles, and more recently, the production of inner punching type cogs shaped like a reverse trapezoid, eliminating the need to distinguish between forward and backward directions.

Typically, long U-shaped threads can be utilized in various forms such as V-shapes, L-shapes, I-shapes, and other designs depending on the purpose and the specific area targeted for the procedure. Moreover, in certain product variations where the thread thickness is relatively thin, some threads have needles directly attached to their ends, allowing for their use without the aid of a cannula (Figure 3).

However, for threads with thicker protrusions, in order to facilitate smooth movement without causing irritation to the tissues through which the thread passes, the use of a cannula is necessary. In the case of the long U-shaped threads, pre-attaching the thread inside the cannula is not feasible due to procedural limitations. Consequently, during the actual procedure, the cannula is employed as a guide, and the product is supplied with the thread only, packaged separately.

The primary objective behind the design of these elongated lifting threads is to pull and tighten the loose lower facial area, including sagging jawlines, upwards as much as possible by bending a long thread to serve the function of pulling with two ends, creating the U-shape. Upon examining each thread from left to right, the protrusions are fundamentally designed to gather the tissue from the sides of the thread towards the center, where no protrusions exist. Although these longer-threaded designs allow for diverse customization during procedures, the convention often follows the labeling of the most symbolically utilized design format as the U-shaped thread.

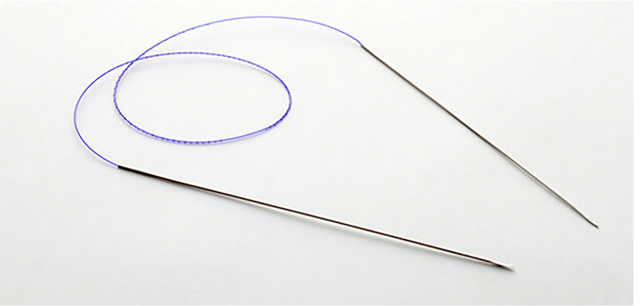

FIGURE 3 Long U-shaped threads are versatile, used in V, L, I shapes, or other designs based on procedure needs. Some thinner threads come with needles attached, enabling use without a cannula.

On the contrary, I-shaped thread lifting procedures do not necessitate altering the form of the threads based on the procedural goals or the specific areas targeted. This method represents a more convenient approach, allowing for the insertion of I-shaped threads near the hairline, around the ears, mouth, or any other desired location without the need to specifically place threads into the temporal region. Unlike the relatively longer U-shaped threads, the usage of comparatively shorter I-shaped threads was initially perceived to result in a diminished lifting effect on tissues compared to their lengthier counterparts. Consequently, they were utilized not primarily for uplifting lower facial tissues but rather for delicately adjusting wrinkles around the nasolabial folds, perioral lines, crow's feet, or the anterior cheek area, serving partial tissue tightening needs.

However, recent advancements in the manufacturing process of barbed threads, including improvements in the design of barbs and their locations on the threads, have significantly enhanced the actual lifting effects of these I-shaped threads. Consequently, there has been a noticeable improvement in the effectiveness of these I-shaped threads for lifting, leading to a growing trend in their frequency of use.

The initial I-shaped lifting threads designed for lower facial traction displayed barbs positioned oppositely on the upper and lower sides of the threads, similarly to the long U-shaped threads, with identical counts and lengths of barbs. This design aimed to direct force towards the center of the thread, resulting in tissue convergence towards the midline. However, a drawback surfaced, particularly evident in patients with broad and expansive foreheads, accentuating bulging in this area.

Subsequent modifications targeted the upper barbs situated near the zygomatic arches. Instead of gathering tissue, these upper barbs were primarily intended to prevent the threads inserted into the relatively firm upper lateral facial tissues from descending. Conversely, the lower barbs positioned below the zygomatic arches, encompassing the lax tissues, including sagging cheek tissues, were increased in number. This adjustment aimed to maximize tissue traction by strategically placing more barbs, thereby pulling the loose tissues upwards. Consequently, this strategy ensured that the upper firm tissues, including the zygomatic arches, had threads applied flatly, while the lower lax tissues beneath the zygomatic arches were gathered, preventing the post-procedure accentuation of the cheeks in patients with lateral cheek hollows and prominent zygomatic arch regions.

In recent times, the purpose of thread lifting has evolved, shifting focus from forcibly pulling tissues (forced lifting) to the effective preservation of relocated tissues in their new positions. When lying down, elevating the chin naturally prompts the loose tissues of the midface and lower face to reposition towards the firmer areas around the head, ears, and jawline. This natural change in facial position facilitates the repositioning of lax tissues, enhancing stabilization efficiency. To optimize this, multiple or spiral directional cogged threads have emerged, embodying a tailored shape for effective stabilization. These types of thread configurations, unlike single bidirectional cogged threads, distribute force not only towards the center but also across multiple points. Rather than maximizing tension to pull tissues, these cogged threads maximize stress to maintain the repositioned tissues in place after their relocation, allowing them to resist displacement and support tissue retention effectively (Figure 4).

Some practitioners have previously employed a method in I-shaped thread lifting where the upper entry points of the threads were not cut but rather intertwined to enhance tissue tightening and prolong the duration of tissue retention, minimizing sagging over time. However, with recent improvements in the shape and form of barbs produced in I-shaped threads, the focus has shifted towards enhancing immediate tension for pulling tissues upwards and generating better immediate effects. Moreover, newer thread lifting products prioritize maximizing stress, which is considered crucial for sustaining the effects of the lifting threads over time. Consequently, additional fixation methods like the one described earlier are gradually becoming less common as newer products emphasize maximizing stress to maintain lifting effects for an extended period.

Especially with recent products, when creating an entry point above, there is a notable advantage in terms of fixation into the firm ligamentous tissues without the necessity of making incisions within the hairline region. Examining the procedural mechanism, these products offer superior fixation into the firm upper tissues without the requirement for an exit point, similar to long U-shaped threads that penetrate the skin. This method involves burying the threads within the tissue, thereby reducing potential advantages such as

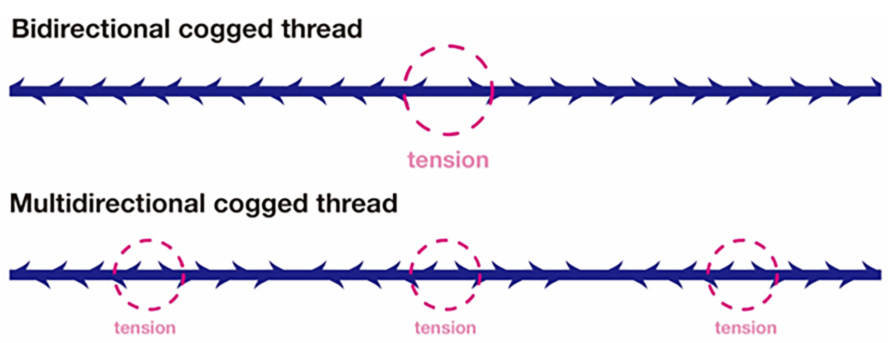

FIGURE 4 Lying down and lifting the chin naturally shifts midface and lower face tissues towards firmer areas around the head, ears, and jawline, enhancing stabilization. Newer spiral directional cogged threads distribute force across multiple points, maximizing stress to maintain tissues in place after relocation, supporting effective tissue retention.

minimized bleeding in the lower facial area due to vascular damage or reduced risk of damage to nerves and other structures during the process of piercing through the skin.

Additionally, with I-shaped barbed threads being pre-loaded on cannulas, they are convenient to use without the necessity of a separate guiding cannula. Furthermore, the design of cannulas for thread attachment has significantly evolved in recent products compared to the initial ones, offering enhanced user convenience. The most crucial aspect, the shape of the cannula tip, has been improved in various products to facilitate easy passage through challenging areas where tissue adherence to firm ligaments makes passage difficult while minimizing potential damage to anatomical structures such as blood vessels and nerves. A compilation of the diverse shapes of needles and cannulas available on the market is illustrated as follows (Figure 5).

Thread lifting has undergone a significant evolution, transitioning from primarily non-absorbable threads for tissue pulling to advanced dissolvable threads with improved lifting effects. This shift in perception favors thread manipulations over duration, leading to tailored approaches like long U-shaped and shorter I-shaped threads with enhanced barb designs. Modern techniques prioritize stabilizing relocated tissues and immediate tension for immediate effects while aiming for sustained results. Advancements in entry points and cannula designs offer better fixation and reduced risks. Overall, these innovations signal a new era of sophisticated, minimally invasive facial rejuvenation techniques. A prominent example of innovative method prioritizing tissue preservation and immediate tension for sustained lifting effects is mesh scaffold lifting. TESSLIFT SOFT by Tess Inc., Korea, made of 100% absorbable PDO with blunt cannulas, has unique advantages over collagen regeneration-induced fibrosis and prolonged effects due to shape and spatial factors of mesh (Figure 6). In fact, the higher surface area entices higher degree of tissue reactions, increasing the collagen formation during dissolution. The elongated 3D scaffold mesh enveloping the central cogged thread was known to enhance tissue adhesion, allowing for the maintenance of effects through robust adhesion generated by the mesh even after the tension from the threads had dissipated. Within 2 weeks, the majority of strength from tissue ingrowth through the pores of mesh is achieved.[19] The central cogs are tailored only to the initial stage of the overall holding power for fixation. The cogs of the central thread are built in proper sizes to minimize tissue trauma and enable sufficient pulling before adequate mesh fixation is achieved. Furthermore, the blunt 18G cannula is used to avoid vessel injuries and perforations. Shifting focus from forcibly pulling tissues (forced lifting) to the effectively repositioning in their new positions, the mesh scaffold is positioned to help lift and pull subdermal and subcutaneous layer using the retaining ligaments without the necessity of incisions. Through handling of the ligaments, mesh scaffold, in form of a matrix, enables effective response to the facial movements and expressions more naturally, minimizing feelings of irritations during post-procedure. Besides, various factors shall be considered for natural lifting and minimize dimpling cases.

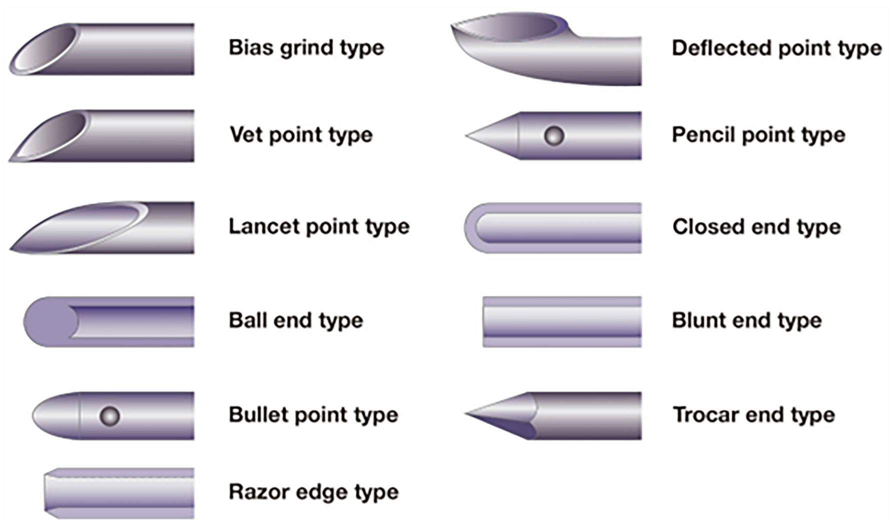

FIGURE 5 An illustration showcases a variety of needle and cannula shapes offered in the market.

FIGURE 6 One notable instance of a pioneering technique emphasizing tissue preservation and immediate tension for lasting lifting results is the mesh scaffold lifting method. TESSLIFT SOFT, developed by Tess Inc. in Korea, utilizes blunt cannulas and is crafted from 100% absorbable PDO (polydioxanone), offering distinct benefits compared to collagen-based alternatives.

AUTHOR CONTRIBUTIONS

All authors have reviewed and approved the article for submission. Conceptualization, Gi-Woong Hong, Kyu-Ho Yi, Soo Yeon Park. Writing—Original Draft Preparation, Gi-Woong Hong, Kyu-Ho Yi, Soo Yeon Park. Writing—Review & Editing, Gi-Woong Hong, Kyu-Ho Yi, Soo Yeon Park. Visualization, Gi-Woong Hong, Kyu-Ho Yi. Supervision, Gi-Woong Hong, Kyu-Ho Yi.

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There is no financial disclosure to report.

CONFLICT OF INTEREST STATEMENT

I acknowledge that I have considered the conflict of interest statement included in the "Author Guidelines." I hereby certify that, to the best of my knowledge, that no aspect of my current personal or professional situation might reasonably be expected to significantly affect my views on the subject I am presenting.

DATA AVAILABILITY STATEMENT

Research data are not shared.

ETHICS STATEMENT

This study was conducted in compliance with the principles set forth in the Declaration of Helsinki.

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