Clinical, Cosmetic and Investigational Dermatology

REVIEW

Thread Lifting Materials: A Review of Its Difference in Terms of Technical and Mechanical Perspective

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Abstract: Thread lifting involves the use of slender materials, reminiscent of threads, for aesthetic procedures. These materials are distinct from traditional sutures and vary in composition, purpose, and performance. The introduction delves into the literal and material significance of threads, establishing the broad concept of thread lifting materials. The article revisits the evolution of thread lifting materials, emphasizing the preexistence of cog threads for tissue manipulation before their widespread adoption in plastic surgery. Observations regarding the efficacy and longevity of absorbable versus non-absorbable threads are discussed, stressing the efficiency of high-quality absorbable cog threads. The conclusion underlines the proliferation of thread lifting materials beyond PDO, highlighting the importance of considering multiple factors beyond duration when selecting threads for lifting procedures.
Keywords: thread lifting, Aesthetic procedures, silicone threads, gold thread lifting, PCL polycaprolactone, Poly-L-lactic acid, polydioxanone, mesh scaffolds thread lifting

Introduction[1]

In the context of thread lifting, the term "thread" denotes a material that is thin, slender, and fine. This terminology carries connotations of strands that are twisted to produce elongated lines, typically employed in the manufacture of textiles such as clothing, fur, cotton, silk, nylon, and similar materials. Consequently, any substance structured as thin and elongated lines might be broadly classified as a form of thread lifting procedure.[2] However, from the material perspective of utilized surgical or procedural materials, they can be categorized into materials resembling sutures used for tissue closure (commonly known as threads in the form of monofilament and cog threads) and materials differing from those configurations.[3,4]

Thread lifting was first introduced by Sulamanidze et al in the 1990s.[5] Initially, conventional sutures led to poor long-term efficacy.[6] To address this, barbed sutures known as Aptos threads were introduced, which improved the effectiveness of thread-lifts.[[7]] Several variations of thread-lifting techniques have been developed subsequently, such as ptosis, Isse Endo Progressive Facelift Sutures, Silhouette Sutures, and Contour Threads.[8,9] These advancements have gained popularity among aesthetic practitioners.[10–15]

The authors perceive a notable gap in understanding regarding thread lifting materials within the field of aesthetic procedures. Recognizing the increasing relevance of thread lifting in contemporary clinical practices, the aim is to clarify the diverse characteristics and implications of various thread materials. Through this review, the objective is to equip practitioners with the requisite knowledge to make informed decisions and optimize clinical outcomes in thread lifting procedures.

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Materials Used

Silicone Threads

A prominent example of non-suture thread forms includes silicone threads, which differ from conventional threads in their composition and functionality. Silicone threads resemble rubber bands and are utilized for tissue manipulation. The procedure involves threading the silicone through the tissue, pulling it in the desired direction, and securely anchoring it to the underlying solid tissue. In cases where the inserted band loosens over time, it is purported that the loosened area can be reopened to trim the stretched portion before re-tightening, offering a promoted advantage of restoring tautness.[16] The utilization of silicone threads, initially marketed as "M-sling" in Korea, remains prevalent in certain sectors of the market, capitalizing on their elasticity as a key feature. Recently, particularly within obstetrics and gynecology, these threads have found frequent use in vaginal reconstruction procedures (see Figure 1A). Furthermore, a novel technique known as Elasticum lifting has emerged, employing Elasticum bands composed of a silicone monofilament core encased in a polyester weaving. This method, which utilises Elasticum bands, has been adopted by some practitioners. Essentially, it involves a lifting procedure using elastic rubber-band-like threads akin to the M-sling approach (refer to Figure 1B).[17]

These techniques often require small incisions for material insertion, posing challenges for achieving completely non-incision procedures. Consequently, they necessitate small access points for material insertion, distinguishing them fundamentally from what is typically referred to as non-incision thread lifting procedures. Initially, the perceived advantage lay in the strong pulling effect facilitated by the exceptional elasticity of silicone threads. However, as these materials are non-absorbable, some individuals may experience discomfort. Furthermore, excessive tightening of tissues with highly elastic threads can result in tissue tearing due to the pulling force. Over time, there is also a heightened risk of inflammation or foreign body reactions compared to the use of suture-like materials.[18] These drawbacks are more likely to occur when employing highly elastic threads as opposed to traditional suture-type materials.

Gold Threads

Instead of traditional threads, there is a method called gold thread lifting, which employs threads resembling acupuncture needles, frequently employed in traditional medicine. The history of gold thread lifting extends further than expected, attributed to the advantageous properties of gold, the material composing the gold thread.[19–21] Gold has long been proven to possess anti-inflammatory properties and promotes increased blood circulation and collagen production within the human body.[22] In the 1970s, gold threads were initially developed in France and began to be used for procedures.[23] They were widely used across several European countries for various purposes, including whitening effects on blemishes or dark circles, enhancing skin tone and elasticity, and reducing facial skin wrinkles, exhibiting anti-aging effects by relaxing muscle tension and improving areas with indurations.

Gold threads utilized in gold thread lifting are crafted from 99.99% pure gold, drawn into medical-grade threads with a thickness ranging from 0.06 to 0.07 mm. Because these threads are composed entirely of pure gold, they provoke

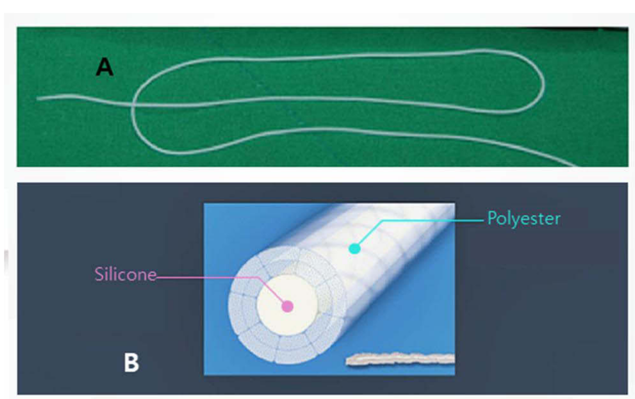

Figure 1 The figure illustrates the utilization of silicone threads (**A**), capitalizing on their elasticity, notably in obstetrics and gynecology for vaginal reconstruction. Elasticum lifting (**B**) involves a non-absorbable suture with a silicone monofilament core encapsulated in a polyester weaving, highlighting its sheath-like form.

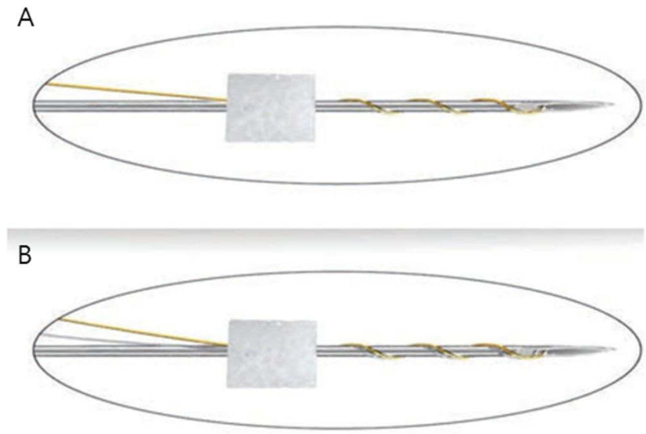

Figure 2 The ultra-fine construction of gold threads minimizes metallic sensations within tissues. Earlier models comprising solely gold threads (**A**) had a propensity to dislodge due to their rigid nature. The incorporation of PDO threads alongside gold ones (**B**) facilitated better anchoring within the skin, compensating for gold's slower tissue reaction compared to PDO threads.

minimal allergic reactions. Furthermore, their ultra-fine construction reduces metallic sensations within tissues. Early versions comprised threads made exclusively from gold, which, owing to their rigid nature, had a propensity to dislodge easily after insertion (Figure 2A). Subsequently, products were designed that combined PDO (polydioxanone) threads with gold threads. The PDO threads inserted alongside the gold threads played a supportive role in ensuring better anchoring within the skin, making the insertion of gold threads smoother and compensating for the slower tissue reaction to gold compared to PDO threads (Figure 2B). More recently, advancements have resulted in more user-friendly gold threads, combining the effects of PDO monofilament and gold by coating PDO threads with gold on the outside.[24]

The primary aim of gold thread lifting is to improve the skin's overall quality. It is challenging to claim that any form of the product directly elevates the skin and connective tissues. Regardless of the product form, gold particles remain in the body, providing enduring effects. However, concerns have arisen regarding the potential long-term presence of non-degradable metallic particles in the body, which could pose issues during various medical examinations due to their visibility in radiographs. Additionally, some suggest that patients undergoing frequent laser treatments may experience pigment deposition caused by gold particles superficially embedded in the skin.

Pdo, Plla, Pcl

In the mid-2000s, another method known as Silhouette Instalift emerged as an alternative method for skin and tissue retraction, distinct from traditional barbed threads used for lifting. Instead of barbs, Silhouette Instalift employed dissolvable PDO conical cones that could grip tissues and provide tension in a 360-degree manner.[25–27] These cones were utilized to retract tissues, with non-absorbable threads subsequently secured to the temporal area using mesh to ensure the lifting effect persisted post-dissolution of the PDO cones (Figure 3). Initially, the product combined non-absorbable polypropylene threads with dissolvable

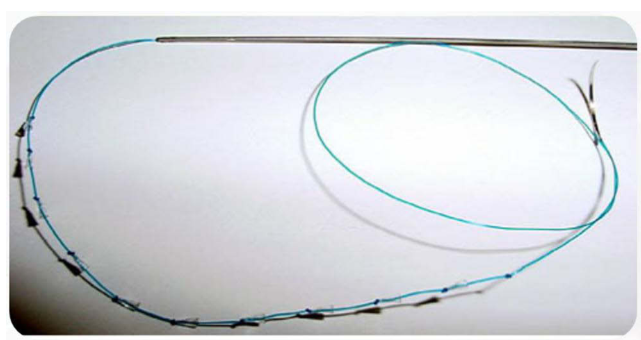

Figure 3 The Silhouette Lift utilizing dissolvable PDO conical cones for tissue grip and tension instead of barbs. Non-absorbable threads secured to the temporal area through mesh ensured a sustained lifting effect post-dissolution of the PDO cones.

cones, but as the thread lifting market shifted towards predominantly dissolvable threads, the product was redesigned to consist of both dissolvable threads and cones.

Silhouette Soft consisted of threads made of dissolvable PLLA (poly-L-lactic acid) material with bidirectional cones made of dissolvable polylactic glycolic acid material at both ends. These cones were inserted to grip tissues in opposite directions from both ends of the thread, aiming to pull tissues toward the center. The design facilitated thread insertion into the skin and tissues without the need for additional equipment, as long needles were attached at both ends of the thread. Though the principle was primarily based on the long length cannula-guided bidirectional cogged thread, due to the size of the cones, they could not be inserted into a cannula-guided system. Hence, the design evolved into a long length double needle cogged thread, allowing for easy usage without the assistance of a guide.

Compared to the bidirectional needles used for inserting long PDO cog threads with a standard 1–0 thickness or those attached at both ends of the cannula, the needles associated with Silhouette Soft offer the advantage of minimal bleeding and reduced swelling during procedures performed in a finer manner. However, these needles may feel slightly bulky when going through the procedure, making them difficult to use if not familiar. Particularly in navigating areas of facial curvature, the elongated needles tend to bend, making it challenging to maintain an accurate plane. Additionally, during the final removal of the inserted needles from beneath the skin, it might be difficult to retract the needle tip beyond the skin surface, potentially causing perforation.

Regarding cone size, compared to typical PDO threads, the cones associated with Silhouette Soft are thicker, thereby potentially producing a greater lifting effect where they interact with tissues. However, if the number of cones is limited or they are excessively large, there might be increased pressure on each cone. This can potentially result in dimpling if the threads are placed too close to the skin surface. Moreover, in cases of thin skin, the cones under the skin might be palpable or even visible.

One of the significant advantages of Silhouette Soft lies in its primary material, PLLA, contrasting with the common PDO composition found in dissolvable threads. PLLA takes longer to dissolve compared to PDO, significantly extending the procedure's maintenance duration to approximately 18–24 months.[28] This distinct characteristic sets apart from conventional PDO threads, potentially offering a synergistic effect in terms of shape alongside standard PDO threads, while also promising a longer-lasting effect.[14,29]

Among the various thread types, the PCL thread has garnered significant attention recently.[30] PCL, known for its high flexibility and elasticity, induces less pain and discomfort compared to PDO and PLLA threads. Furthermore, PCL is biodegradable, decomposing into CO2 and H2O, and its safety is corroborated by the approval of various biodegradable medical devices by the US Food and Drug Administration.[31] Threads composed of PCL are absorbed into the body gradually over 1 to 1.5 years, in contrast to PDO threads (6 to 8 months) and PLLA threads (12 months).[32] Cho et al compared PCL threads with PDO and PLLA threads for collagen synthesis and wrinkle improvement.[28] They inserted threads into 6-week-old male SKH-1 hairless mice and analyzed biopsy specimens at 1, 4, and 8 weeks. Results at 8 weeks showed significant increases in neocollagenesis and collagen type III, as well as transforming growth factor-β expressions, in the new PCL group. Additionally, the new PCL group exhibited a 20% reduction in wrinkles. The study suggested that the new PCL thread had superior skin rejuvenation effects, making it potentially useful in dermal filler and cosmetics. The new PCL thread, with less residual monomer and a higher molecular weight, is expected to offer prolonged durability and enhanced efficacy. However, further research is needed to confirm clinical effectiveness and long-term effects. These findings underscore the potential benefits of PCL threads in skin rejuvenation compared to other materials

Technology Used Mesh Scaffold Type Thread

There was a time when a lifting procedure, using small incisions to dissect tissues around the ear, was in vogue. This method involved pulling stretched connective tissues and adhering them to broad mesh-shaped plates to affix the tissue. There was also a technique that combined mesh-based lifting with cog threads. This involved using cogged threads to manipulate tissues, followed by making incisions to affix the mesh to the temporal fascia, aimed at prolonging the maintenance duration by securing tissues.[33–35]

A mesh scaffold with a high porosity tends to have a large surface area for cellular attachment and formation of multiple focal adhesion. The majority of strength and holding power from tissue ingrowth is fairly achieved within 2

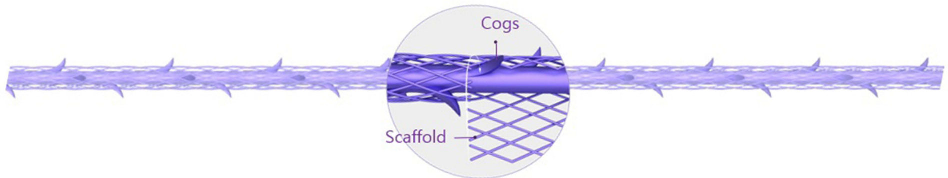

Figure 4 An alternative approach was observed, employing mesh-like structures in the thread middle portion for tissue manipulation. Tess Inc. Korea's product incorporated elongated cylindrical mesh structures enhancing tissue adhesion, enabling sustained effects even after thread tension dissipation. However, concerns about incisions around the temporal region limited the widespread adoption of such products.

weeks.[36] The overall holding power and duration performance with mesh type threads, distinct from the traditional threads, shall emphasize on the structure and design factors.

As the most recent method using mesh scaffolds, TESSLIFT by Tess Inc., Korea, (Figure 4) emerged as an alternative method for skin and tissue retraction, focused on high total surface area interaction and tissue ingrowth phenomena through mesh pores. Such thread is designed to integrate 3D mesh scaffolds structure with conventional PDO (polydioxanone) cog threads in the center, utilizing mesh-tissue manipulation to a greater significance. The elongated cylindrical mesh enveloping the 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. The applied tension forces for fixation concentrated on the cogs during and post-procedure, are slowly dispersed throughout the mesh, reducing patients' feeling of irritation and dimpling occurrences. In the last decade, these products, although potentially effective, were not widely adopted due to concerns about the need for incisions around the temporal region. The recent versions, however, TESSLIFT SOFT, are introduced 100% absorbable PDO (polydioxanone) with long 18G blunt cannulas, enabling an easy deployment of the mesh on layers and without the need for incisions.

Absorbable Vs Non-Absorbable

The choice between absorbable and non-absorbable threads depends on factors such as desired duration of effectiveness and potential complications. While absorbable threads offer gradual degradation within the body, non-absorbable threads may pose long-term risks such as inflammation and foreign body reactions. Careful consideration of these factors is essential in selecting the most suitable thread material for thread lifting procedures.

The meta-analysis and systematic review by Niu et al aimed to estimate the incidences of complications following facial thread lifting and to compare short- and long-term satisfaction rates.[37] A total of 26 studies were included, revealing swelling as the most commonly reported complication (pooled incidence of 35%), followed by skin dimpling (10%), paresthesia (6%), thread visibility/palpability (4%), infection (2%), and thread extrusion (2%). Absorbable threads were associated with lower risk of paresthesia and thread extrusion compared to non-absorbable threads, while patients older than 50 had a higher risk of dimpling and infection. The long-term satisfaction rate significantly decreased compared to immediately after facial thread lifting (88% vs 98%). Swelling was the most common complication, and absorbable threads and younger age were associated with lower risk of complications. The study suggested judicious use of non-absorbable threads and facial thread lifting in older patients and highlighted the potential decrease in long-term satisfaction rates.

Discussion

The threads mentioned above can be characterized as types of threads that are not traditional sutures typically used in thread lifting procedures, as they lack the typical structure associated with suturing.

A prevailing misinterpretation persists regarding the chronological evolution of cog threads, primarily employed for tissue lifting rather than suturing, within the domain of surgical practice. Empirical data indicate that the utilization of cog threads for tissue manipulation preceded the widespread integration of conventional suturing threads in surgical procedures.[38] Initially, many surgeons attempted to manipulate tissues around the eye, temples, forehead furrows, and perioral areas using existing sutures after making small incisions inside the hairline. The foundational principle of current thread lifting procedures using small incisions mostly involves lifting and suturing facial tissues—such as those around the eyes, cheeks, and jawline—using sutures akin to[39] those typically used for tissue suturing in the temporal area.

Later, various cog threads emerged, leveraging the creation of cogs on the threads to more efficiently engage and pull tissues. Initially, the primary purpose of these cog threads was not direct tissue insertion through perforations.[40] Instead, they were primarily employed in a suturing technique, utilizing the cog threads to engage and suture tissues, ultimately achieving a tightened tissue effect. As a result, they were commonly employed to suture tissues around incision sites resulting from various surgical procedures.

Gradually, practitioners transitioned from using cog threads primarily for suturing to deploying them through small incisions to lift tissues around facial areas like the periorbital, cheek, and jawline, or body areas such as the neck, chest, and buttocks, aiming to achieve a lifting effect post-suturing. This marked the significant emergence of thread-based lifting procedures, accompanied by the development of various techniques to facilitate the use of cog threads more effectively than the traditional suture method.

Initially, in the early stages of thread lifting, the choice between non-absorbable and absorbable threads did not necessarily determine the purpose of using threads for lifting. Non-absorbable threads, such as silicone threads, were presumed to have a longer-lasting effect of 1 to 2 years, while absorbable threads, like PDO threads, were expected to lose their effect within 1 to 2 months due to degradation. Methods involving non-absorbable threads were primarily employed to lift and pull the skin and underlying tissues upward. However, observations from patients who underwent surgical face lifting and received thread lifting procedures revealed that the cog effects of non-absorbable threads engaging the tissues were hardly noticeable even within the first year post-procedure. While factors such as the condition of the patient's skin and tissues post-surgery, the surgeon's technique, and the quality of the threads could influence this, it became apparent that the cog effect of non-absorbable threads did not last as long as expected. Therefore, from today's perspective, there is not necessarily exceptional value in inserting non-absorbable materials into the skin compared to biocompatible absorbable threads in terms of effects or duration.

Before the introduction of absorbable cog threads capable of providing sufficient thickness and tension for effective lifting, absorbable threads mainly consisted of thin monofilaments. Examples of imported threads like Quill lift, which created cogs on thicker PDO threads, or V-loc, made of polytrimethylene carbonate, were utilized in South Korea. Overcoming technical challenges, domestically produced absorbable cog threads made of PDO began to be used for actual lifting by engaging and pulling tissues. Moreover, as the quality of absorbable cog threads improved over time, their effects and duration experienced a significant improvement, leading to the prevalent use of thread lifting methods involving absorbable cog threads today.

The thicker the thread are and larger the surface area of the thread makes more of stimulatation of fibroblast and stem cells to have lifting effect.

In authors view, when high-quality absorbable cog threads are used for lifting, not only do they create a lifting effect, but during the absorption process, they also lead to various tissue regeneration effects. Hence, in the long run, they appear more efficient than non-absorbable threads. However, it's important to note that if the thread is too thin or lacks tension, the cog's thickness and tension would inevitably decrease, causing a rapid decline in the cog's ability to engage tissues and in the thread itself, minimizing the tissue regeneration effects achievable during absorption. Therefore, to achieve a lifting effect that truly changes the tissue's position and provides a tangible result of actual lifting, it is crucial to have threads with adequate thickness and tension (Table 1).

Thicker threads with a larger surface area stimulate fibroblasts and stem cells more effectively, resulting in a greater lifting effect. Furthermore, the tensile strength of the thread is influenced by its thickness, material, and manufacturing processes.

An aspect we acknowledge as a limitation in our review manuscript is the possibility of not encompassing all types of permanent threads commonly employed in thread lifting procedures. We prioritized the inclusion of threads commonly encountered in our clinical practice to ensure relevance to our review. As a result, some less common or niche types of permanent threads may not have been included.

In conclusion, in addition to PDO, there has been a proliferation of lifting threads made from materials such as PCL and PLLA, incorporating cog structures to enhance their lifting effects. When considering the use of these threads, it is

Table 1 Factors Influencing the Outcome of Thread Lifting

Factors Influencing the Outcome of Thread Lifting
1. Materials of Threads
2. Thickness of Thread – Tensile Strength
3. Shape, Location and Number of Cogs Anchoring & Holding Strength
4. Direction of Cogs
5. Insertion Depth of the Threads According to the Toughness of Tissues
6. Selection of Appropriate Lifting Vector & Fixing Point According to Facial Area
7. Difference Between Flap & String Methods
8. Expiration Date of Absorbable Threads

crucial not only to focus on the duration of their effects but also to consider factors such as thread thickness, tension, consistency, and overall characteristics for an informed selection of threads.

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

Disclosure

The authors report no conflicts of interest in this work.

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