

MINIMALLY INVASIVE FACIAL REJUVENATION: A PROMISING ALTERNATIVE TO SURGICAL FACELIFT

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Abstract

Introduction: This study aims to evaluate the effectiveness and safety of minimally invasive aesthetic procedures, focusing on the use of PDO threads for facial rejuvenation, comparing them with traditional surgical facelift. **Methodology:** A literature review was conducted to investigate the efficacy of PDO threads, considering aspects such as safety, popularity, and cost-effectiveness compared to surgical techniques. **Theoretical Framework:** PDO threads are biodegradable monofilaments that stimulate the production of collagen and elastin, providing support and rejuvenation to the skin. They are inserted following the natural tension lines of the skin and have demonstrated efficacy in improving skin laxity and facial rejuvenation. **Results and Discussions:** The analysis revealed that PDO threads offer a safe and effective alternative for facial rejuvenation, with natural and progressive results. The technique is minimally invasive, with a low complication rate and a faster recovery compared to traditional facelift surgery. **Conclusion:** Minimally invasive aesthetic procedures with PDO threads are an effective and safe option for facial rejuvenation. They offer significant advantages over surgical facelift, including lower risk of complications and a reduced recovery period. The growing popularity of these procedures reflects the demand for rejuvenation solutions that combine safety, efficacy, and affordability.

Keywords: Facial rejuvenation; absorbable threads; polydioxanone (PDO); minimally invasive facelift; collagen stimulation.

RESUMO

Introdução: Este estudo visa avaliar a eficácia e segurança dos procedimentos estéticos minimamente invasivos, focando no uso de fios de PDO para o

rejuvenescimento facial, comparando-os com o lifting facial cirúrgico tradicional. **Metodologia:** Foi realizada uma revisão de literatura para investigar a eficácia dos fios de PDO, considerando aspectos como segurança, popularidade e custo-benefício em comparação com técnicas cirúrgicas. **Referencial Teórico:** Os fios de PDO são monofilamentos biodegradáveis que estimulam a produção de colágeno e elastina, proporcionando sustentação e rejuvenescimento da pele. Eles são inseridos seguindo as linhas de tensão natural da pele e têm demonstrado eficácia na melhora da flacidez e no rejuvenescimento facial. **Resultados e Discussões:** A análise revelou que os fios de PDO oferecem uma alternativa segura e eficaz para o rejuvenescimento facial, com resultados naturais e progressivos. A técnica é minimamente invasiva, com baixo índice de complicações e uma recuperação mais rápida em comparação com o lifting facial tradicional. **Conclusão:** Os procedimentos estéticos minimamente invasivos com fios de PDO são uma opção eficaz e segura para o rejuvenescimento facial. Eles oferecem vantagens significativas sobre o lifting facial cirúrgico, incluindo menor risco de complicações e um período de recuperação reduzido. A popularidade crescente desses procedimentos reflete a demanda por soluções de rejuvenescimento que combinam segurança, eficácia e custo acessível.

Palavras-Chaves: Rejuvenescimento facial; fios absorvíveis; polidioxanona (PDO); lift facial minimamente invasivo; estímulo ao colágeno.

INTRODUCTION

As facial aging progresses, the soft tissues of the face sag due to the effects of gravity. This phenomenon is particularly pronounced in the anterior cheek region, where the downward migration of adipose tissue and volume loss can result in deeper nasolabial folds and an older facial appearance [1,2]. Various traditional facial rejuvenation techniques have been developed to restore volume in the reduced anterior craniofacial region and

correct soft tissue ptosis [3,4]. Minimally invasive aesthetic procedures are gaining increasing recognition and preference among individuals seeking to enhance their appearance without resorting to surgery. These procedures are in high demand globally, with patients often seeking techniques that can improve signs of aging without the risks associated with surgical interventions [5].

Absorbable threads, available in various shapes and sizes, are particularly popular. Their low incidence of adverse effects, reactions, and complications, coupled with a short procedure time, attracts patient interest. It is essential that these procedures be performed by trained specialists with extensive anatomical knowledge to ensure the best and safest outcomes [3,5]. Additionally, the affordable cost of these protocols and their minimal occurrence of side effects appeal to many individuals. Polydioxanone (PDO) threads consist of fine suture filaments that are delicately inserted beneath the skin, providing a supportive effect that counteracts tissue sagging and stimulates collagen production, thus improving skin density [6,7]. One of the primary anatomical signs of aging is the deepening of the nasolabial fold and the reduction of malar prominence, resulting from midface sagging [6-8].

In this context, surgical facelifts have commonly been performed to remove excess skin and promote facial rejuvenation [9,10]. However, patients undergoing this procedure are subject to postoperative complications such as infection, skin necrosis, hematoma, seroma, nerve injuries, and visible scarring [11]. Therefore, there has been an imperative to develop minimally invasive facial rejuvenation techniques that offer advantages such as lower morbidity and faster wound healing [11,12]. Facial aging is a natural process that results in soft tissue sagging and volume loss, leading to signs of aging such as deep nasolabial folds. While surgical facelifts have been widely used to address these signs, they are associated with significant postoperative complications. In this regard, the objective of this literature review is to investigate the efficacy and safety of minimally invasive aesthetic procedures, such as the use of absorbable PDO threads, for facial rejuvenation. Additionally, this study aims to evaluate the popularity of these procedures, their affordable cost, and their ability to deliver satisfactory results compared to traditional surgical facelifts.

METHODOLOGY

This literature review aims to analyze the efficacy and safety of minimally invasive aesthetic procedures, with a specific focus on the use of absorbable polydioxanone (PDO) threads for facial rejuvenation. Searches were conducted in academic and scientific databases, including PubMed, Scopus, Web of Science, and Google Scholar. Systematic reviews and meta-analyses published in dermatology and plastic surgery

journals were also considered. A combination of keywords was used, including "absorbable PDO threads," "facial rejuvenation," "minimally invasive aesthetic procedures," "PDO thread efficacy," and "complications of suspension threads." Inclusion criteria encompassed clinical studies, randomized controlled trials, systematic reviews, and meta-analyses that evaluated the efficacy and safety of PDO threads for facial rejuvenation, as well as studies describing the technique, benefits, and possible associated complications. Excluded were studies not directly related to the use of PDO threads, articles with low methodological quality, and works that did not provide data on the efficacy or safety of the procedures. Data extraction was performed using a standardized spreadsheet to ensure consistency, and the data will be reviewed and validated by two reviewers to minimize errors.

THEORETICAL FRAMEWORK

Barbed DOP Line Facelift

The unidirectional barbed suture focuses more and distributes soft tissues more transparently, initiating closure at the midline of the wound. In contrast, the bidirectional barbed thread allows two surgeries to be sutured simultaneously. Barbed technology can benefit longer incisions, such as in body lifting, by supporting tissues in a higher position than their original, providing greater tissue support and facilitating suturing with less effort and tension on the thread [13].

Suspension threads feature barbs or spikes in two-dimensional, unidirectional, and multidirectional designs. The barbed sutures can be 4D or 6D, with barbs on four or six sides that increase tissue traction [14]. These barbs are designed to hook the skin and aid in supporting tissues in different facial regions. Bidirectional barbed threads have better fixation in the dermis compared to unidirectional ones. One advantage of this suture is that it does not need to be anchored to anatomical structures such as the temporal fascia and periosteum [14].

The use of barbed threads is also indicated for brachioplasty and mastopexy. This suture technology ensures the ability to resist incision movement, accelerating the arm movement effect. In mastopexy, it helps support breast portions, offering comfort, stability, and excellent aesthetic results with minimal scarring. Various barbs suspend the tissue when lifted, improving sagging [14].

Definition of PDO Threads

Polydioxanone threads, also known as DOP threads, are made from a monofilament, biodegradable, and biocompatible synthetic material, making them absorbable by the body. Therefore, this procedure is

often recommended to improve skin laxity, commonly referred to as suspension threads [15]. This technique has existed for over thirty years in cardiac, gynecological, urological, and plastic surgery. In addition to providing skin support, it improves texture and elasticity and aims to stimulate collagen in specific areas such as the face, neck, décolleté, and other regions [15].

When PDO threads are inserted under the skin, they create a controlled inflammatory response, stimulating cells to produce more collagen and elastin around the threads. This process helps restore the skin's structure and firmness [16]. Being a minimally invasive procedure, it reduces recovery time and associated risks. Furthermore, the results are natural and progressive, with collagen production gradually occurring over weeks and months following the procedure. It is an option for patients seeking to rejuvenate their facial appearance safely, effectively, and with long-lasting benefits [16].

As people age, dissatisfaction with structural changes due to aging arises. Therefore, there is a high demand for non-invasive aesthetic procedures that provide superior results in reducing the signs of aging, with low risks and good benefits [14]. PDO threads are a technique that assists in rejuvenation, showing positive results in collagen induction. They are composed of absorbable material and are suitable for minimally invasive lifting techniques [14].

Anatomical Considerations for Point Determination

The intermediate layer of the skin, known as the dermis, is composed of collagen and is highly vascularized. It is a connective tissue structure containing collagen, elastin, and fibroblasts, essential for youthful, healthy, and supportive skin, providing comfort, ease, and strength [17]. The PDO thread procedure is performed based on the skin's natural tension lines, determining the thread insertion points, and is one of the most commonly used techniques for facial rejuvenation [15].

Skin Anatomy

The skin consists of two main layers: the epidermis, the outermost layer, and the dermis, located beneath the epidermis. The epidermis functions to protect the body from the external environment and prevent the entry of microorganisms that can cause infectious diseases. It is mainly composed of keratinocytes and contains no blood vessels or nerves. The epidermis undergoes a constant process of cell renewal [18]. The epidermis is subdivided into the stratum corneum, granular, spinous, and lucid layers, with cells differentiated according to their phase. In addition to keratinocytes, the epidermis contains Merkel cells and Langerhans cells. Merkel cells are responsible for touch, while Langerhans cells

capture antigens and present them to T cells for the control of detected infections. These cells are found in the basal layer of the epidermis [18].

The dermis, in turn, is characterized by the presence of reticular collagen and elastin fibers, providing skin resistance and stability. It contains blood vessels, lymphatic vessels, and nerves and is subdivided into the reticular and papillary dermis [17]. The papillary dermis is located just below the epidermis and is specifically where the dermoepidermal junction occurs. This region houses cells responsible for skin pigmentation, known as melanocytes, and tactile corpuscles. The reticular dermis is the deeper layer of the dermis, situated near the hypodermic layer, and contains nerve endings, adipose cells, hair follicles, blood vessels, lymphatic vessels, and other structures [18].

Entry and Exit Indications for Treatment Procedures

The PDO thread procedure is based on a technique that follows the skin's natural tension lines, where markings are made to guide the procedure. Local anesthesia is used for cannula insertion in the marked area, and it is crucial that the cannula is introduced at a 90-degree angle to avoid retention of the epidermal tissues. This is a minimally invasive procedure, causing only mild discomfort and presenting low risks [19]. During thread insertion into the dermis, new collagen and connective tissue production is stimulated, resulting in improved skin elasticity, firmness, and coloration, as well as a substantial reduction in oxidative stress [15]. PDO threads can be available in absorbable or non-absorbable materials, with different needle types and varying lengths, and they can be applied in various ways, such as self-fixation, anchoring to the temporal fascia, fixation of both thread ends at a single point, among others [20]. Combining PDO threads with specially designed needles creates an innovative approach, making the application minimally invasive and allowing thread insertion at desired locations with minimal visibility in the dermis [20]. When correctly inserted, the threads maintain a lifting effect supported by collagen stimulation. However, if inserted superficially, the procedure may become painful to the touch, fail to stimulate collagen, and leave the threads visible. Conversely, deep insertion can cause injuries or reach blood vessels, nerves, arteries, or other deeper structures [19].

The Use of Mint Lift Fine

Mint Lift is an absorbable violet PDO monofilament thread featuring bidirectional helical barbs, providing anchorage in the skin without the need to secure the thread to the needle. Various Mint Lift products are available, such as Fine, Easy, 43, and 17 [21]. Mint Lift Fine, for instance, is a fine line lift with a USP size of 2-

0, equipped with a blunt W-type cannula of 18G caliber, ideal for facial rejuvenation in patients with thinner skin [21]. Marking for this procedure involves creating a triangle formed by three lines: a horizontal line along the superior border of the zygomatic arch, a vertical line passing through the temporal process, and the Pitanguy line, identified by the temporal branch of the facial nerve, located 0.5 cm below the tragus and up to 1.5 cm above the lateral eyebrow [21, 22]. Within this triangle, four parallel entry points are determined below the Pitanguy line, along with four exit points located in the center of the target fat compartment, such as the upper and lower cheek fat, nasolabial fat, or mid-cheek fat [21, 22]. This procedure, utilizing Mint Lift Fine, is indicated for patients seeking facial rejuvenation and is performed by inserting the thread into the subcutaneous fat compartment in areas such as nasolabial folds, marionette lines, nasojugal grooves, and sagging jowls [21]. This technique is simple and effective, offering advantages such as a short recovery period and the ability to correct mid-cheek hollowness, among other benefits provided by the bidirectional thread lift [23].

Midface Rejuvenation

Suspension techniques have been integrated into minimally invasive procedures for the midface, using endoscopy to anchor and reposition the temporal fascia, periosteum, or soft tissues through minimal incisions. Simple transfixation of smooth threads through the skin can be a viable alternative to lift the eyebrows in the midface with low morbidity [24]. Claw threads, besides being applied to the neck, can be used in the mid and lower face, as well as the forehead [24]. Brow dissection over the superficial fascia of the temporal muscle is interrupted to access the midface. The mid-lateral dissection continues through the temporal fascia, following the lateral edge and superior margin of the zygomatic arch [25]. This results in the occupation of the two medial thirds of the arch, as well as the lateral third. A 1 cm subperiosteal fissure is created over the arch, with a periosteal incision occurring laterally and a dissection extending medially over the arch above the periosteum [26].

As facial skin ages, changes such as pronounced wrinkles and sagging occur, also affecting the midface. The superficial fat compartments are located between the skin and the Superficial Muscular Aponeurotic System (SMAS) plane [27]. Fat in the midface is highly compartmentalized, with deep compartments providing structural support for the midface. Age-related changes in the deep fat compartments of the midface are critical for physiological rejuvenation in this region [28].

Facial Rejuvenation

Facial rejuvenation is not just on the rise; it plays a crucial role in non-verbal communication. Facial aging

results in changes that can reflect emotions such as sadness, bad temper, a worn-out or pale appearance, and even tiredness [29]. Facial surgery offers an option to restore a youthful appearance by reintegrating volume and improving soft tissue sagging. Additionally, surgery can inadvertently eliminate non-verbal signs of health issues or an unhappy personality [30].

Non-surgical procedures can also enhance these non-verbal cues. For some patients, restoring self-confidence means physically altering their emotional and subliminal expressions, aiming for a happier and healthier persona [29]. As age advances, economic changes are predominantly driven by aging, spurring the demand for facial rejuvenation procedures. These include hyaluronic acid fillers, botulinum toxin applications, and the use of PDO threads [31, 32].

Non-surgical aesthetic treatments, such as PDO threads, aim for facial rejuvenation, support, and fixation of soft tissues. PDO thread technology is widely sought for its rejuvenation capability and for offering prevention and healing benefits. Fully biocompatible and absorbable, these threads result in a shorter recovery period [33]. Although non-absorbable threads theoretically last longer, absorbable threads induce collagen production, making them the preferred choice for those seeking facial rejuvenation [34].

Indications for Treatment Procedures

Thread lifting treatment is an outpatient and painless procedure, administered with local anesthesia and minimally invasive. The occurrence of surgical complications leads patients to seek less invasive treatments, such as thread lifting. This treatment has shown effectiveness in facial rejuvenation, though it may present usually reversible and modest side effects [35, 36]. The fact that the procedure is performed under local anesthesia contributes to a quick recovery, making it attractive to patients seeking minimally invasive treatments. It improves facial volume and promotes rejuvenation without the need for surgical interventions, also enhancing collagen and soft tissue laxity. Although non-absorbable thread treatments may have consequences, absorbable thread treatments have become preferred for facial lifting [35, 36]. Several treatment options are suggested to reduce facial aging, including surgical procedures, cosmetic formulations, and aesthetic interventions such as lasers, fillers, thread lifting, and botulinum toxin. Thread lifting has been successful in treating glabellar wrinkles, stimulating the formation of new collagen fibers in the applied area [37, 38].

The Use of Mint Lift Easy

For Mint Lift Easy, the entry point is made at the platysma-auricular ligament located below the ear, and the exit point is positioned at the submental area and

lateral to the ear. The vertical and horizontal vectors are used to gently lift the tissue towards the medial line of the chosen area. Mint Lift Easy is indicated for jawline and neck rejuvenation. Jawline rejuvenation requires analyzing the causes of skin laxity as age increases, which includes gland development, muscle laxity, and adipogenesis [23]. For patients with muscle laxity, the procedure on the double chin has proven to be the most effective treatment. Liposuction has been widely performed for jawline rejuvenation, although lifting is the most effective treatment for patients with pronounced muscle laxity. The mesh procedure uses bidirectional barbed threads for fixation; the entry point is in the central part of the jaw, and the exit point is located on the outer part of the jaw [23].

A bidirectional barbed thread is used to traction the tissue in the central part of the jaw, causing bulging in the conventional fixation procedure. The mesh procedure, on the other hand, is characterized by the traction of sagging tissue without causing bulging; therefore, the entry point is located in the central part of the jaw, affecting the traction of the sagging tissue and also serving as the exit. The aim of the treatment is to lift the platysma layer. Patients with mild fat laxity and superficial insertion at the entry point may affect the lifting of the fat layer. Furthermore, patients with an excessive amount of fat can also be treated with monofilament thread lifting [23].

PDO Thread Lift Mechanism

PDO threads represent an opportunity for non-surgical facial rejuvenation, providing soft tissue support and stimulating collagen fiber production, resulting in younger-looking skin. All these advantages can be enhanced to increase prescription, including new basic techniques in biodegradable properties [37]. Threads known as APTOS (antipitosis sutures) are the first non-absorbable metallic threads, demonstrating positive results in facial tissue lifting [34]. Non-absorbable barbed sutures have shown that lifting using these threads can be an excellent alternative to invasive procedures [39]. However, non-absorbable threads remain in the tissue, potentially resulting in complications such as occasional suture extrusion through the skin and palpitations. Late or acute complications after the use of non-absorbable threads can also be reported, with cellulitis being an uncommon late complication after thread lifting [40].

With technological advancements, PDO threads are being used as both non-absorbable and absorbable materials, featuring various types of embedded needles and different lengths [41]. This allows for various application methods, such as fixing both ends of the thread at a single point, self-fixation, and anchoring to the temporal fascia or other deep points. This innovative approach promotes minimally invasive application, allowing threads to be subtly incorporated into desired

locations, becoming nearly imperceptible in the dermis [20]. New suspension techniques have been added for procedures in the mid and upper face, allowing facial soft tissue to be fixed to the temporal bone and repositioned, or the periosteum to be accessed through small incisions. Smooth threads can be used to lift the eyebrow or midface with lower morbidity. However, because sutures and support techniques may have unpredictable outcomes, threads can potentially cut through tissues [20].

Types of PDO Threads

PDO threads can be classified according to various aspects, such as material origin, structure, and permanence in tissues. Thread materials can be synthetic or natural fibers, with synthetic fiber threads being more commonly used due to lower tissue occurrence [42]. However, natural materials can also provide excellent results. Regarding absorption by the body, there are absorbable and non-absorbable threads. Absorbable threads are made of materials such as PDO, PLLA, or polycaprolactone (PCL), while non-absorbable ones are made of polypropylene or nylon [18].

Absorbable threads can be barbed or smooth. Barbed threads are designed for soft tissue suspension, preventing laxity and stimulating collagen. In contrast, smooth threads are used for collagen bio-stimulation and skin elasticity, and can be unidirectional or bidirectional [42]. Non-absorbable threads are not widely adopted due to the high rate of complications, such as infections, granulomas, thread migration, and causing skin irregularities, leading to their replacement by absorbable threads [18].

The main types of PDO threads include smooth threads, primarily used for collagen bio-stimulation. Fixed or spiral threads consist of twisted threads that aim to provide volume and reduce sagging [43]. Barbed threads, which have unidirectional, bidirectional, or multidirectional barbs, are used to support soft tissue suspension, providing an immediate lifting effect in cases of pronounced laxity [18].

Complications

Thread lifting procedures are increasingly adopted due to their non-surgical nature, quick recovery time, minimal scarring, beneficial facial lifting effects, and other advantages [44]. Additionally, the chances of complications are minimal, and when they occur, they are usually mild and easily resolved. However, the likelihood of complications is related to the number of threads used [45]. Non-absorbable threads can lead to common complications such as infection, although this has been increasingly avoided with the use of absorbable threads made from PDO and poly-L-lactic acid (PLLA) [44]. Late complications, such as abscess

formation and chronic cellulitis, can be prevented with a thorough understanding of facial anatomy and preventive measures against trauma in the procedure area [45].

Common complications include edema, bruising, hematomas, undulations, thread extrusion, infections, asymmetries, dimples, and granulomas. Severe infections such as open wounds, abscesses, and tissue necrosis may occur in specific cases, such as rhinoplasties with PDO threads, potentially due to a synergistic occurrence between the implants used in the surgery and PDO threads [46]. Although it is a minimally invasive and effective technique, it is crucial to carefully assess vectors, exit points, and fixation, and to have a deep understanding of the subcutaneous layer. With technological advancements and improved material quality, efficacy has improved and complications have decreased [45].

Non-Modifiable Risk Factors

Intrinsic aging, also known as chronological aging, is directly related to age and individual genetics. This type of aging results in changes in the appearance and normal functions of the skin over time, reflecting a natural wear and tear of the organism, similar to what occurs in organs and cells [51]. Changes caused by chronological aging are characterized by thinner, drier, more fragile skin with fine and inelastic wrinkles due to the progressive reduction of elements in the epidermis. This process occurs gradually and subtly, resulting in loss of elasticity, atrophy, and increased expression lines [52].

Intrinsic aging is of natural origin and is related to cumulative genetic factors, including recurrent mitochondrial DNA damage and decreased cellular control, leading to the appearance of fine wrinkles, skin dryness due to reduced water and hyaluronic acid, and atrophy, characterizing the process of senescence [53]. This type of aging is also referred to as true or chronological aging [48]. Among intrinsic factors are the reduction of steroid hormones, such as menopause in women and andropause in men. These hormonal changes are primary markers of aging, resulting in alterations in female and male physiology, respectively [54]. Additionally, the shortening of telomeres, related to the risk of developing age-associated diseases, is also considered an important intrinsic factor [55].

Modifiable Factors

Extrinsic aging, also known as photoaging, depends on the association of environmental factors such as alcoholism, pollution, and smoking with skin exposure to solar radiation over time, at varying intensities and frequencies [51]. This type of aging is characterized by thinner, yellowed, thickened, dry, sagging skin with deep wrinkles, due to the accumulation of DNA damage

caused by these factors, contributing to the aged appearance of the skin [49]. As sun exposure increases, the skin becomes thinner, drier, paler, and develops wrinkles, while the superficial capillary system becomes visible. The firmness of the skin decreases, its mechanical properties are reduced, and hyperpigmentation occurs [51]. Additionally, there is an increase in collagen and elastic fibers, resulting in loss of elasticity. The visible cell turnover in the epidermis becomes irregular, with fibroblasts and keratinocytes reproducing more slowly [49]. The skin's defense system is also affected, with Langerhans cells becoming less active due to depletion. These changes contribute to the aged appearance of the skin [49]. Among extrinsic factors, photoaging stands out as a set of modifications related to chronic exposure to UV rays, which intensify chronological skin aging [56]. UV radiation causes oxidation of molecules in the body, triggering an inflammatory response. This exposure also leads to the destruction of collagen in the skin and contributes to premature aging, resulting in the loss of skin integrity and other body components [55].

Pathophysiology of Skin Aging

In the aging process, there is a global reduction in skin thickness, influenced by subcutaneous fat and changes in the dermal architectural organization, resulting in skin wrinkling [57]. Additionally, the reduction in epidermal cells and their functionality, as well as that of the dermis, contributes to the decreased impermeability of the organ, which serves as a barrier during aging [58]. Despite the reduction of keratinocytes and the redistribution and alteration of cell types, no significant structural changes occur that reflect disruption in the differentiation of these cells [57]. Free radicals are highly reactive atoms or molecules with an unpaired electron pair. This lack of pairing gives these molecules or atoms high reactivity as they seek stability by donating or capturing electrons from other molecules or atoms [58, 52]. They can be formed by the loss or gain of electrons from non-radical substances, or when a covalent bond breaks, resulting in the division of electrons in a process called homolytic fission [36]. Chemical and enzymatic oxidations involve the formation of free radicals, which accelerate aging or cause damage to DNA, dehydrogenation, protein glycation, and hydroxylation [58]. These reactions lead to the loss of biological functions of proteins such as proteoglycans and collagen, resulting in changes in membrane structure and increased skin laxity. The primary source of free radicals in biological systems is oxygen molecules, which are essential for energy production and cellular metabolism [59].

Mechanism of Action of PDO Threads

Non-absorbable threads were developed by Sulamanidze and were composed of polypropylene. Currently, absorbable threads composed of PDO (polydioxanone) are widely recommended for facial revitalization and rejuvenation, as demonstrated by Bortolozzo and Bigarella (2016) [20]. They can be made from various materials such as polylactic acid, polydioxanone, polypropylene, and others, but PDO threads are among the most popular [20]. PDO is derived from polyester and has non-allergenic, non-toxic, and non-pyogenic characteristics. Absorption occurs through hydrolysis, where two monomers of 2-hydroxyethylacetic acid (C₄H₈O₄) are formed, and after this process, they are decomposed into CO₂ and H₂O, being absorbed by the skin [20]. The chemical structure of polydioxanone results in minimal weight loss compared to PGA and PLA (polyglycolic acid and polylactic acid), which have a higher ester bond reactivity. When this type of bond exists with an additional group, the CH₂ molecular structure provides flexibility to PDO compared to hydroxy acids, carrying changes in the main chain of a carbonyl group, thus offering greater flexibility to the polymer due to the methylene group. Its degradation is low due to hydrolysis, considering it has a low ester concentration, hence maintaining its resistance for a longer period [20].

RESULTS AND DISCUSSIONS

The effectiveness of PDO (polydioxanone) threads in dermal support and skin aging treatment has been extensively discussed in the literature (Tab. 1). Silva et al. (2019) [37] reviewed the impact of these threads on skin support, corroborating their efficacy in treating skin aging. In contrast, Koury et al. (2021) [45] addressed potential complications associated with the use of PDO

threads, providing guidelines for treatment and prevention of adverse effects. Faria et al. (2024) [41] conducted a systematic review to evaluate the role of PDO threads in mitigating facial aging, reinforcing the relevance of this treatment.

The literature also highlights the impact of extrinsic factors on premature aging (Ferraz et al., 2021) [51] and the importance of aesthetic approaches to delay skin aging (Novais and Souza, 2020) [50]. Additionally, Rodrigues et al. (2024) [25] presented a clinical case on mid-face lifting with PDO threads, discussing its efficacy, safety, and risks. Esteves and Brandão (2022) [17] explored the direct relationship between collagen and skin aging, emphasizing the crucial role of this biomarker in skin senescence. Oliveira et al. (2023) [13] provided a literature review on the use of barbed sutures in minimally invasive procedures, highlighting safety, efficacy, and reduced procedure time. The article by VANESSA et al. (2023) [14] demonstrates the effectiveness of PDO suspension threads in smoothing expression lines resulting from facial aging.

The article by MACHADO, S. A. DE S. L. et al. (2023) [16] is a literature review focusing on HOF techniques, with a special emphasis on the impressive benefits and results provided by PDO threads. MENDONÇA, R. L. (2023) [18] aims to describe the mechanisms of collagen bio-stimulation by absorbable threads and demonstrate the efficacy of aging reversal after using this technique and its safety profile. Finally, TAVARES, J. DE P. et al. (2017) [24] is a bibliographic review that aims to analyze the durability of results, efficacy, safety, and risk of severe adverse events associated with procedures using various types of sutures. The table below summarizes 12 articles related to the research objectives.

Author/Date	Title	Research Methodology	Objective
Silva, L. M. et al., 2019 [37]	Dermal Support in the Treatment of Skin Aging	Literature Review	To verify the efficacy of PDO threads in dermal support.
Koury, J. F. de A. et al., 2021 [45]	Complications of PDO Threads: How to Treat and Prevent?	Literature Review	To relate the possible complications associated with this material, as well as treatment and prevention methods.
Faria, I.; Joao; Borgas, N. et al., 2024 [41]	Polydioxanone Threads – Effect on the Aging Process – Systematic Review	Systematic Review	To determine whether PDO threads can play a role in mitigating facial aging.
Ferraz, Isabela Nascimento et al., 2021 [51]	Impacts of Extrinsic Factors on Premature Aging: A Theoretical Reflection	Literature Review	To describe the impacts of extrinsic factors on premature aging from a theoretical perspective.
Rodrigues, Miyahira, A.; Feitosa, P. et al., 2024 [25]	Mid-Face Lifting with PDO Threads – Case Report	Clinical Case Report	To report a clinical case with PDO threads for repositioning superficial fat pads and improving skin quality, addressing efficacy, safety, advantages, indications, and risks.
Novais, Maíra de Jesus Araújo; de Souza, Érika Pereira, et al., 2020 [50]	Use of Aesthetic Treatments in Delaying Skin Aging: Integrative Review	Integrative Review	To describe the types of aesthetic treatments that can be used to delay skin aging.
Esteves, Maria Luiza D'Agostini Borges; Brandão, Byron José Figueiredo, et al., 2022 [17]	Collagen and Skin Aging	Literature Review	To show the direct relationship between collagen and the physiological aging of the skin.
Oliveira, R. K. de et al., 2023 [13]	Barbed Sutures	Literature Review	To analyze the use of barbed sutures in minimally invasive procedures, considering safety, efficiency, and reduced surgical time.
Vanessa et al., 2023 [14]	The Use of Polydioxanone Suspension Threads to Smooth Expression Lines	Literature Review	To determine the effectiveness of using PDO suspension threads to smooth expression lines resulting from facial aging.
Machado, S. A. de S. L et al., 2023 [16]	The Benefits of PDO Threads in Facial Rejuvenation	Narrative Literature Review	To comprehensively explore HOF techniques, with a special focus on the impressive benefits and results provided by PDO threads.
Mendonça, R. L. 2023 [18]	The Use of Absorbable Threads for Collagen Bio-stimulation and Aging Reversal	Narrative Literature Review	To describe the mechanisms of collagen bio-stimulation by absorbable threads and demonstrate the effectiveness of aging reversal after using this technique and its safety level.
Tavares, J. de P. et al., 2017 [24]	Facial Thread Lifting with Suture Suspension	Literature Review	To analyze the durability of results, efficacy, safety, and risk of severe adverse events associated with procedures using various types of sutures.

CONCLUSION

The Face Lift using PDO threads, specifically the barbed threads from the DOP line, represents an innovative and effective approach to facial rejuvenation. The use of unidirectional and bidirectional barbed sutures allows for a more even distribution of soft tissues and provides more robust support, aiding in the correction of sagging and improving skin texture. PDO thread technology is highly valued for its ability to stimulate the production of collagen and elastin, resulting in natural and progressive lifting effects. The choice between absorbable and non-absorbable threads, as well as the application of different types of barbs, provides versatility and customization in treatment. Although it is a minimally invasive technique with a low risk of complications, precision in insertion and the appropriate choice of points are essential to optimize results and minimize adverse effects. Continuous advancements in this technology promise to further enhance the efficacy and safety of non-surgical aesthetic procedures.

CONFLICT OF INTEREST

The authors affirm that they have no conflicts of interest.

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