



Maximizing Thread Usage for Facial Rejuvenation: A Preliminary Patient Study

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Abstract

Background Surgical facial rejuvenation techniques with thread lifting have gained popularity. To effectively rejuvenate an aging face, it is necessary to perform both soft tissue envelop repositioning and volume restoration procedures. With the trend toward less invasive techniques and long-lasting results with minimal complications, many surgeons have continued changing the techniques.

Objectives In the present study, we developed the 4 M (Multi-target, Multi-vector, Multi-layer, Multi-material) thread lift technique for long-lasting results.

Methods A prospective study was conducted on 73 patients who underwent the 4 M thread lifting procedure between January 2016 and February 2018. To evaluate the surgical outcomes objectively, two plastic surgeons compared photographs using a 5-point Global Aesthetic Improvement Scale (GAIS) at 1, 3, 6, 12, 18, and 24 months of follow-up.

Results Based on the GAIS objective assessment, in most patients (85%) experienced better than 3 score

(“improved”) changes. Approximately 42.5% of the patients experienced better than 4 score (“much improved”) changes. The mean GAIS grade improved significantly ($p < 0.005$) without decline throughout a period of 12 months. No serious adverse complication was observed except one patient, who experienced skin irregularities and dimpling for up to 9 months after the procedure.

Conclusions This 4 M thread lifting is the multiple layer lifting and rejuvenation using different materials in addition to the multiple targets. Using the concepts of structural rejuvenation, the 4 M thread lifting technique presented modest to significant improvement, maintaining good results at 12 months after procedure.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Thread lift · Facial rejuvenation · Aging · Face lift

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Introduction

Aging plays a major role in the facial changes that occur at every level of underlying soft tissue and bony structures. Epidermal thinning with loss of elasticity, loss of fat, muscle atrophy, and morphologic changes in facial bone structure result in the appearance of a person having aged [1, 2]. With this in mind, aiming for optimal rejuvenation requires an adequate understanding of the dynamic aging process. To reverse gravitational effects, pure skin lifting and removal of excess facial soft tissue may be used to help

reduce wrinkles, drooping, and sagging. However, without adding the lost skin volume, it is impossible to achieve the desired result. Therefore, to effectively rejuvenate an aging face, it is necessary to perform both soft tissue envelope repositioning, volume restoration procedures, and skin envelope rejuvenation.

With the trend toward less invasive techniques, minimal complications, rapid recovery, and ease of application to plastic surgery, the thread lift is attractive for both surgeons and patients, as compared with traditional rhytidectomy procedures [3–5]. Surgical facial rejuvenation techniques have evolved from approaches using minimal access to more extensive and meticulous dissections of the superficial muscular aponeurotic system (SMAS). Numerous techniques, such as rhytidectomy, SMAS plication, SMASectomy, subperiosteal face-lifting, and composite face-lifting have been used over the past decade, but these have been associated with complications [4, 6–8]. In particular, deeper plane techniques with more extensive SMAS dissection in facelift surgery are associated with significant postoperative morbidity and neurologic complications. With the trend toward less invasive techniques, rapid recovery, and long-lasting results with minimal complications, this study assessed the effectiveness of the 4 M (multi-target, multi-vector, multi-layer, multi-material) thread lift technique. It is expected that this new procedure can achieve both soft tissue envelope repositioning and volume restoration in a noninvasive manner and ensure the longevity of the effects. The purpose of our study is to redefine current best practice methods of structural rejuvenation of aging tissues.

Materials and Methods

A prospective study was conducted on patients who underwent a 4 M thread lifting procedure between January 2016 and February 2018 with the aim of repositioning the tissue and volumes of the midface. The inclusion criteria were that patients be between the ages of 30 and 69 years, with moderate-to-severe wrinkle as evaluated by the surgeon. The patients were excluded if they had anticoagulation with warfarin, and history of hypertrophic scarring or keloid. All procedures were performed by a senior surgeon (Y.J.P.) with the 4 M thread lifting technique. Two plastic surgeons, who were not involved in the surgical procedures, evaluated the preoperative and postoperative photographs of all the patients. Surgical outcomes of the 4 M thread lifting procedure were assessed by comparing photographs using a 5-point Global Aesthetic Improvement Scale (GAIS) (5: “very much improved,” 4: “much improved,” 3: “improved,” 2: “no change,” and 1: “worse”) at 1 (GAIS1), 3 (GAIS3), 6 (GAIS6), 12

(GAIS12), 18 (GAIS18), and 24 (GAIS24) months post-operatively. The GAIS scores in the follow-up period were compared using a paired *t* test, while the GAIS scores based on the thread type were compared using a 2-sample *t* test. All statistical analyses were performed using SPSS version 25.0 software for Macintosh (IBM Cor, Armonk, NY, USA). All *p* values were 2-sided, and *p* < 0.05 was considered as statistically significant.

Surgical Techniques

The procedure was performed with the patient under IV sedation with local anesthesia (1% lidocaine with epinephrine, 1:200,000). The patient was marked preoperatively in order to determine the vector of the thread.

The procedure consisted of several steps (Video 1). The 4 M (multi-target, multi-vector, multi-layer, multi-material) thread lift technique using various threads, such as TAPS Concertina®, TAPS Cavern®, screw threads and mono-threads.

1. First Step: Deep Layer Approach (Fig. 1)

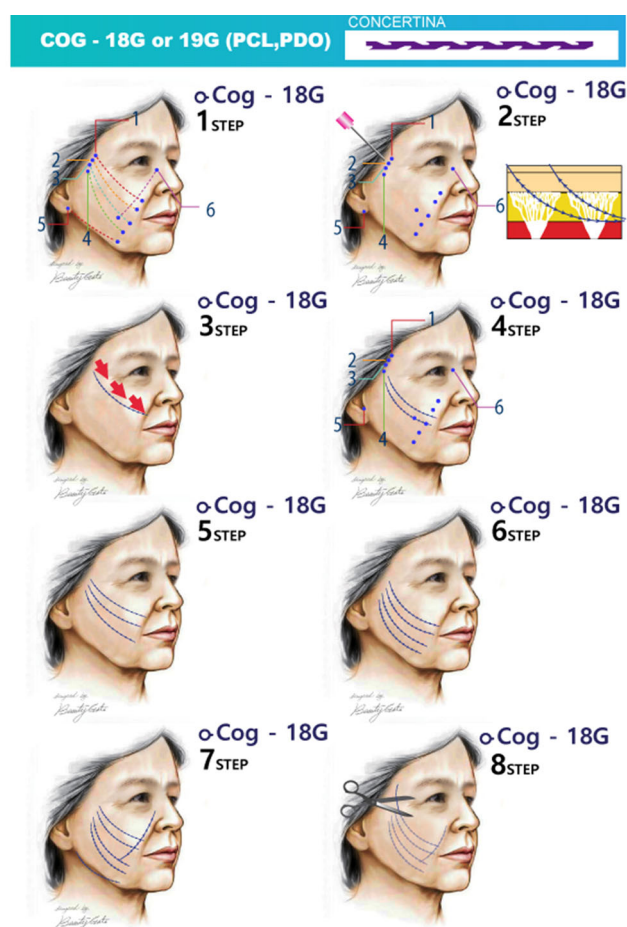


Fig. 1 First Step: deep layer approach

The first entry point of the thread was located along the hair line, where the inferior temporal septum is located, and usually above the lateral canthus. Upon entry, the long cannula penetrated the zygomaticocutaneous ligamentous region and the masseteric cutaneous ligament and finally ran lateral to the risorius muscle fascia the corner of the mouth. For the deep SMAS layer and reticular cutis, a PDO 18G 3.0 USP 100 mm (Concertina® by MediRope Co®) was used on either side for upward lifting and suspension as well as lateral oblique suspension. This led to the formation of jam wrinkle, which is a reduction in skin elasticity, caused by squeezing of soft tissues.

To lift the lower facial skin of the mandibular border and to obliquely lift the loose ligamentous lateral structures, another insertion of the thread was performed in the mandibulocutaneous ligament. The other one is usually placed between those two across to the marionette line and above the depressor lower lip muscle fascia. Medially, another lifting was performed using 2 pieces of thread from the lateral to the nasal base that had dense maxillary cutaneous ligaments and dense fibrocutaneous ligamentous parotid masseteric fascia. A medial oblique lifting vector played a role in both anterior cheek augmentation and the maintenance of lateral oblique suspension from jowl to the temporal area. A medial oblique and lateral oblique insertion of a total of 5–6 threads was performed in the deep tissues, including SMAS and septal structures as the reticular cutis.

2. Second Step: Middle Layer Approach (Fig. 2)

For greater volume enhancement and adhesion, it is also preferable to perform a lifting in the middle layer. In patients with reduced skin elasticity, even after 19G concertina lifting, the 21 or 23G PDO USP 2-0 100 mm thread (Mediropo®) was used in the subcutaneous layer to maximize squeezing and foreign body reactions. For structural enforcement, 2 pieces of Cavern® PDO 21G 2-0 USP (NeoDoctor Co®) were placed along each side of the midcheek groove around the zygomaticocutaneous ligament. In addition, 2 pieces of Cavern® PDO 23G 4-0 USP were vertically placed along the mandibulocutaneous ligament lateral and vertically. This step was then followed by a third envelop rejuvenation step, which involved strutting and the provision of a physical support using 10–20 screws of 27 or 29G USP 5-0 (Mediropo®, DongBangMedical®) on each side.

3. Third step: Superficial Layer (Fig. 3)

In the last step, the rejuvenation effect was maximized on the jam wrinkles and jowling using 15–30 pieces of 27 to 29G USP 5-0 mono-threads. It is technically challenging to inject a mono-thread that extends to the dermis in the skin layer, as it might lead to the formation of fibroblasts in

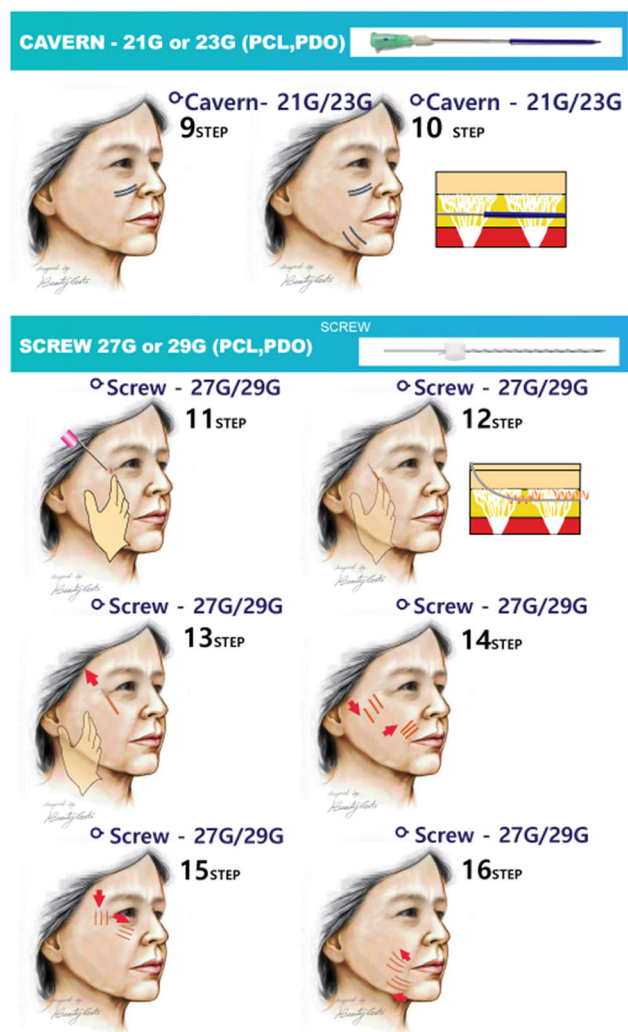


Fig. 2 Second step: middle layer approach

the subdermis layer. As a result, a technique that uses numerous mono-threads under the dermis was employed for skin rejuvenation.

For maintenance of the lift after completion of the procedure, a paper tape splinting was recommended for at least 8 h. For the purpose of evaluation of the results, the patients were followed up regularly for a postoperative duration of 2 years.

Results

Seventy-three patients with a mean age of 50.53 years (31–67 years) met our inclusion criteria. Sixty-eight female and 5 male patients underwent a 4 M thread lifting procedure on both sides of the face. The follow-up period ranged from 18 to 24 months (mean duration of follow-up was 22 months). All the patients were Orientals from East Asia to South Asia, except 4 Caucasians and 6 Middle

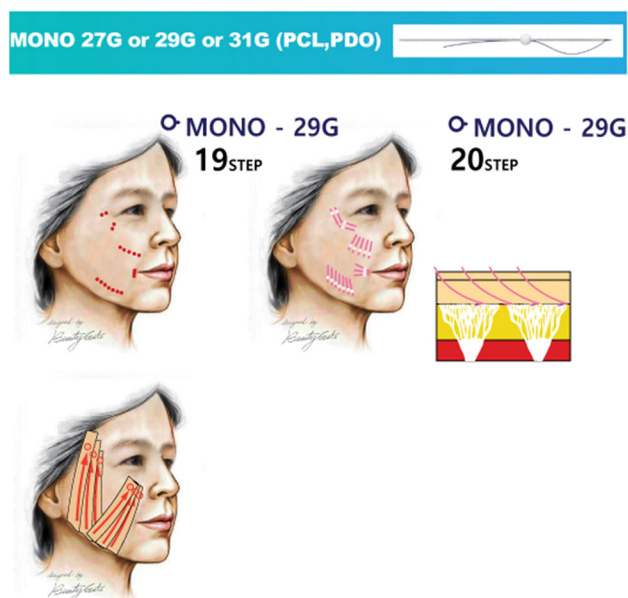


Fig. 3 Third step: superficial layer approach

Easterners. Representative pre- and postoperative photographs are presented in Figs. 4, 5 and 6. To assess the surgical efficacy, a 5-point GAIS score was used to compare the photographs taken at 1, 3, 6, 18, and 24 months of follow-up (Table 1). Based on the GAIS objective assessment, approximately 42.5% of the patients experienced better than “much improved” changes, and 85.0% of the patients experienced better than “improved” changes. The mean GAIS score was 3.27 ± 0.71 . None of the patients experienced permanent contour irregularity, suture extrusion, or facial numbness. Minor skin dimpling in 7 patients

was spontaneously resolved in 7–20 days, by a soft, tissue massage. Despite vigorous massage, one patient complained of skin irregularities and dimpling for up to 9 months after the procedure. However, the dimpling and irregularities faded after 1 year. Mean GAIS1 was 4.55 ± 0.58 ; GAIS3, 4.51 ± 0.58 ; GAIS6, 4.47 ± 0.58 ; GAIS12, 4.36 ± 0.61 ; GAIS18, 3.68 ± 0.51 ; and GAIS24, 3.13 ± 0.65 (Fig. 7). According to the paired t test, the GAIS6–GAIS12 was 0.10 ± 0.32 ($p = 0.004$), GAIS12–GAIS18 was 0.68 ± 0.57 ($p = 0.000$), and GAIS18–GAIS24 was 0.55 ± 0.54 ($p = 0.000$), and significant differences were observed.

Discussion

Nowadays, the thread lift procedure is becoming increasingly popular as a minimally invasive alternative to standard rhytidectomy [9–11]. Addressing overall volume depletion and the drooping of soft tissues are both emphasized in a thread lift. Existing conventional invasive methods cannot adequately and simultaneously satisfy the need for lifting of drooped tissue and volume enhancement. As a result, various kinds of minimally invasive aesthetic surgery procedures using threads have been developed. Among these, Aptos®, which consists of nonabsorbable polypropylene, has a unique position in thread lifting procedures [12–15]. In addition, other techniques, such as Silhouette®, etc., have been introduced to satisfy the need for effective anchoring [16, 17]. However, there is currently no single thread lift technique that is regarded as most effective.



Fig. 4 Serial results during follow-up of 67-year-old male. A slight relapse is noted at 12 months of follow-up

Fig. 5 Serial results during follow-up of 40-year-old female. Improvement in jowl sagging at 16 months. A slight relapse is noted at 18 months



Fig. 6 Serial results of a 52-year-old female; followed up for 24 months. Prominent jowling and weakness of underlying soft tissues after mandibular angle bone resection operation seen preoperatively. Jowling improvement is maintained at 24 months post-surgery

Table 1 5-point global aesthetic improvement scale (GAIS)

Grade	Description	No. of cases (%)
5	Very much improved	0 (0.0)
4	Much improved	31(42.5)
3	Improved	31(42.5)
2	No change	11(15.1)
1	Worse	0 (0.0)

Facial supportive structures of young people are initially healthy and strong but become weaker as they age, thus prompting the inner content of their skin to extrude. Evaluation of the drooping site is essential for midface-

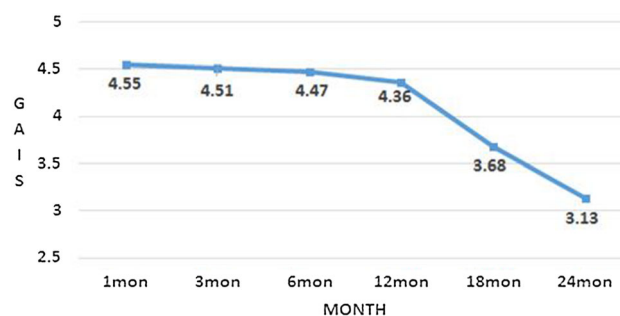


Fig. 7 Comparison of global aesthetic improvement scale scores (GAIS) in follow-up duration

lifting; moreover, factors such as sagging from loss of elasticity of the skin and soft tissue, including SMAS and

retaining ligaments, must be considered [18–21]. Lifting of the sagging soft tissue of SMAS resolves the issue of superficial skin or fat drooping. However, to efficiently improve the elasticity of the skin surface and treat drooping, simultaneous lifting of the deep, middle, and superficial layers is the best approach. At the time of lifting, the thread needs to be positioned so that it holds the midface fatty septum along the deep layer, which is an extension of the SMAS layer. The concept of the animal cage theory provides a background for the 4 M thread lift technique (Fig. 8). If a dense material acts as a support, similar to iron bars in an animal cage, the content will not be extruded. The interplay among suspension, truss, and piers, similar to that seen in a suspension bridge, resembles the technique introduced in this study (Fig. 9). In the 4 M thread lift technique employed in this study, the structural support designed for the face was composed of a suspension with a pier from the temple and medial cheek to caudal targets, accompanied by trussing with Concertina® (a press cog with a concertina shape) and Cavern® in the cephalic direction followed by superficial rejuvenation with small-diameter polydioxanone (PDO) or polycaprolactone (PCL) threads. This method uses the retaining ligaments to perform a piercing function like that of a suspension bridge. The anchoring points that take on the role of piercing are strong tissues from the inferior temporal septum, zygomaticocutaneous ligament, masseteric cutaneous ligaments, mandibular cutaneous ligaments, and maxillary ligaments, to the parotid masseteric fascia (Fig. 10).

The major mechanism of the 4 M thread lift is the maintenance of the suspended tissue after squeezing the sagging tissue to place it in the desired position. The tissue is then maintained in the desired position by adhesion due to fibroblastic reaction. This type of wire entanglement-shaped thread undergoes minimal movement, it can be effectively used for suspension between dense structures

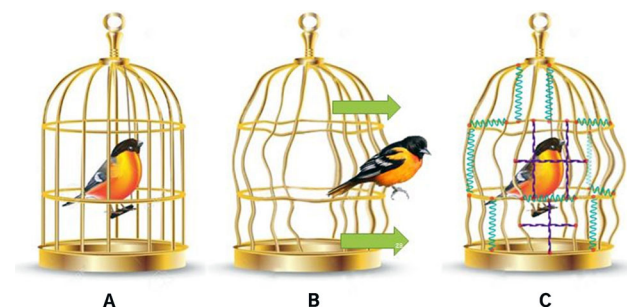


Fig. 8 Animal cage theory is compared with the aging. **a** Strong and well aligned soft tissues can be a good barrier from escape when young. **b** Underlying supporting ligamentous structures becomes weak with aging. **c** Enforcement of weak structures are necessary by way of multiple materials

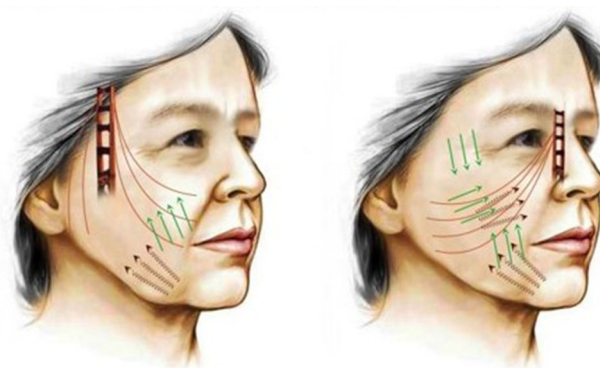
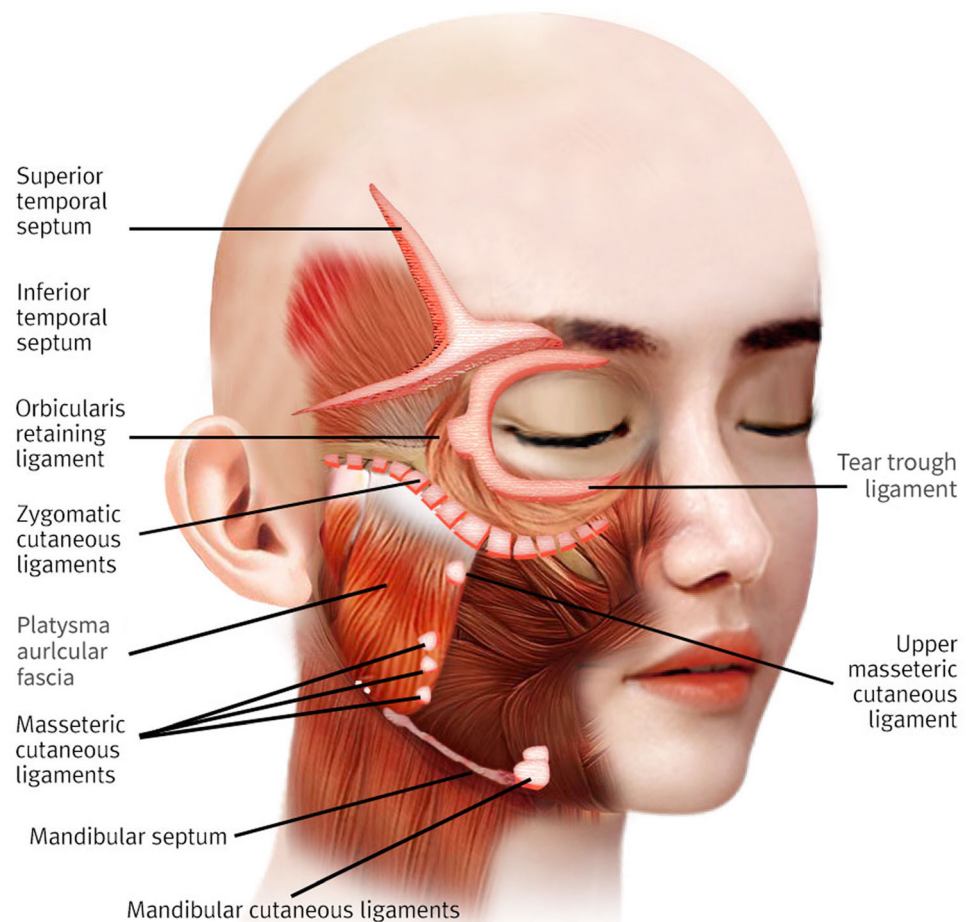


Fig. 9 Mechanism of suspension bridge: suspension of drooped tissues in deep layers to lateral oblique vectors. Another medial oblique vectors are necessary for adding further suspension. Cavity containing Cavern® thread can play a role in volumetric enhancement and trussing in midcheek and jowl

without ligation. The cavity-containing Cavern® thread positioned in the zygomaticocutaneous ligament goes through the cellular infiltration into the cavity, leading to collagen infiltration by fibroblasts, and eventually, formation of a scar stick. As the contracture is formed around the scar stick, upward and downward pulling forces are applied to the midcheek groove area, and when this tube like Cavern® pops up, the cheek protrudes in an anterior direction, which results in a lifting and anterior protrusion effect. For Caucasian or Middle Eastern patients with ethnic characteristics of midcheek depressions, popping up the Cavern® threads more while placing greater emphasis on the horizontal direction of the press cog vector or filling the area slightly with a biocompatible filler can help the patients look younger. In terms of the prominent midcheek groove (also referred to as the Indian band), there is no effective solution to correct it except cavern popping up accompanied by mediolateral suspension of midface. As the final desired result, making scar sticks around a weak ligamentous structure to form a pseudoligament serves as the basis for reinforcement of the ligaments. This scar stick produces a strong adhesion effect in the subcutaneous layer, acting pull the jowl fat inward and causing a lifting of the sagging part at the same time. This ultimately serves as the mechanism underlying structural rejuvenation, the effort of which is to increase the sustainability of the results [23, 24]. In the typical aging process, the percentage of surface area increases as the underlying volume decreases [19, 26, 27]. Consequently, even if this thread procedure is used, the surface to volume ratio cannot be maintained at adequate levels in younger patients without making a skin incision in the lifted tissue, as can be seen in the traditional method [28]. Because there is no resection of the skin, realignment of the skin is inevitable. To resolve this issue, smaller threads (mono or screw) are used for volumizing,

Fig. 10 Anchoring points: soft tissue suspension is achieved by anchoring the threads to ligaments from the temporal septum, through the zygomaticocutaneous ligament, masseteric cutaneous ligaments passing to the mandibular cutaneous ligament. These ligaments play roles of piercing in suspension



and the representative thread used for this is the screw-type thread. This method has 4 vectors capable of resolving inner drooping, with better adhesion and induction compared to traditional methods.

In terms of longevity, we usually inform our patients that the effect will last for approximately a year and a half based on our statistical analysis. Most patients were found to be satisfied for up to 1 year after the procedure, although there was a gradual decline in elasticity and tightening. Moreover, our statistics have shown that younger people feel that the lift's effects are sustained for longer, and thus, thread lifting could show an optimal effect in younger age groups who still have some degree of elasticity remaining, whereas in older age groups, the aging process is already substantially progressed. In addition, we determined that the effect of the thread design was also influenced by how well the thread can squeeze soft tissues and how scar tissues are formed by fibroblastic activity inside the tissues. Ultimately, the lifting procedure does not simply lift sagging tissues, but the duration for which adhesion reactions can be sustained is a major factor. In fact, the emergence of new materials such as polycaprolactone (PCL) will have a

big impact on the sustainability of adhesion reactions like non-absorbable threads because of long degradation time [25].

Our early experience has been positive, although the gradual decline in elasticity and tightening was observed over time. More studies are necessary to prove the longevity of results, as well as the role of various types of threads in enhancing durability. It is meaningful that 4 M thread lifting concept of structural rejuvenation of aging tissues are introduced and evaluated the sustained effect of this method in this study.

Conclusions

Aging is a phenomenon wherein different tissues are weakened and collapse in different directions and is not a simple drooping of soft tissue or skin caused by gravity, improvements in the ratio of the surface area to the volume are considered the ultimate antiaging methods.

The 4 M thread lifting method retains the principles of face-lifting, repositions aged tissue back into its original

location, and lifts several layers of the structures overlying the tissue. For the best results, physiologically drooping tissues should be lifted using thick cog threads, the middle layer should be lifted using appropriate Cavern® threads, and the epidermal layer should be treated using the concept of structural rejuvenation. That is why we proposed multiple layer lifting and rejuvenation using different materials and multiple targets, including the periorbital, midcheek, jawline and neck line areas. It is meaningful that 4 M thread lifting concept of structural rejuvenation of aging tissues are introduced and evaluated the sustained effect of this method in this study.

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Compliance with Ethical Standards

Conflict of interest None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

Statement of Human and Animal Rights, or Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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