Micro-Shuttle Lifting of the Neck: A Percutaneous Loop Suspension Method Using a Novel Double-Ended Needle

Kemal Tunc Tiryaki, MD; Esin Aksungur, MD; and James C. Grotting, MD, FACS

Abstract

Background: Most younger patients expect to be able to achieve significant improvements and lift to their neck, yet they don’t want to undergo extensive surgery. They are now able to do that and restore their youthful appearance thanks to new concepts the techniques through volume redistribution.

Objectives: The authors’ goal was to achieve results that are comparable to a necklift and durable through minimally invasive surgery, utilizing punctures instead of incisions.

Methods: The concept of micro-shuttle lifting creates a percutaneous hammock to achieve the lifting of all different planes of the neck at once. This is accomplished by putting nonabsorbable sutures on nonundermined platysma through the use of a double-ended (micro-shuttle) needle and anchoring it to fixed thread loops around the ears. Mitigation of gravitational force is accomplished through the loop suspensions, to obtain effective skin redraping over the suture-created internal splint.

Results: This combined technique for the neck was applied in 221 selected patients between December 2005 and May 2014, with follow-up ranging from 8 months to 7 years. The mean age of the patients was 42.5 years. Outcomes were satisfactory in all but 12 cases, of which 7 found the result inadequate. The operation time for the neck was less than 40 minutes under local anesthesia or local anesthesia with sedation, and the recovery time was 5-7 days.

Conclusions: The sustainability of this percutaneous procedure does not rely on the suspensions, but rather on the skin redraping in the new position in a similar manner to orthopedic fracture treatment. In selected patients, this safe and simple percutaneous necklifting method can be quickly and easily performed under local anesthesia with long-term durability, low morbidity, and a high patient satisfaction rate.

Level of Evidence: 4

Accepted for publication December 7, 2015; online publish-ahead-of-print February 23, 2016.

An increasing number of younger patients are consulting with plastic surgeons for facial surgery. These patients are not interested in extensive invasive procedures and usually do not require dramatic changes in their appearance but still seek significant improvement. If they are asked about their goals, most of these younger patients wish to obtain natural results with less surgery, less risk, and minimal downtime.1,2 A desire to improve their neck is often why these patients go to the plastic surgeon’s office. The aging of the lower third of the face is characterized by skin and soft tissue descent and the related loss of contour in the neck region. The minimally invasive alternatives for neck rejuvenation can be classified in three major groups: liposuction, open short-scar facelifts (such as MACS-lifting), and percutaneous suspension methods.

Drs Tiryaki and Aksungur are plastic surgeons in private practice in Istanbul, Turkey. Dr Grotting is a Clinical Professor, Division of Plastic Surgery, University of Alabama at Birmingham, Birmingham, AL; a Clinical Professor, Division of Plastic and Reconstructive Surgery, University of Wisconsin, Madison, WI; and is the CME/MOC Section Editor for Aesthetic Surgery Journal.

Corresponding Author:
Dr Esin Aksungur, Cellest Clinic, Levent Caddeesi, Altzeren sok. No5, Levent, Istanbul, Turkey, 34330. E-mail: eaksungur@gmail.com
Liposuction in the neck area offers limited improvement in patients with sagging neck skin because of limited skin contractibility in this region, as well as frequent complications such as postoperative visibility of the platysmal edges, oversuctioning, and unresolved problems related to the deeper structures. Submental lipectomy and platysmaplasty can be performed with limited indications. Short-scar facelift methods can treat structures at different planes very effectively, but the major drawback of these techniques is that they are actually not at all minimally invasive.

Suspension techniques, on the other hand, have been criticized for their lack of sustainability and undercorrection. However, the major reason for this is the fact that most of these suspensions are designed as single-point suspensions, in which the traction forces cause the ripping of the tissue at the anchor points. Some examples include barbed suture products such as an APTOS Lift or Happy Lift. Our results on eight patients with single-point suspensions for the neck area supported this view. In all patients, the neck deformities relapsed after 3 months (Figure 1). Loop suspensions, on the other hand, are shown to be effective and long-lasting either as a part of an open technique or as a stand-alone procedure. In a loop suspension, the force affecting one point on the loop is counterbalanced by another force on the opposite side. The better loop that can be created to carry the tissue, the less sheer force will be effective on each point on the loop (Figure 2).

In this article, we described a simple, effective, and cost-effective technique based on the concept of loop suspensions. Our objective was to access the surgical field through small punctures, to suspend the neck by utilizing strong and permanent cross-neck suspension sutures such as a hammock, anchored to the loops around the ears, and to undermine the skin through minimal liposuction to obtain effective redraping and fibrosis of the skin over the created internal splint.

This is accomplished through the use of a double-sided reusable needle, which has two sharpened ends together with a centrally placed eye for any chosen suture material; the use of this type of needle also decreases the cost of the procedure. Both ends of the needle can be utilized; thus, when keeping one end of the needle inside the skin, it is possible to smoothly carry the thread in the subcutaneous tissues without drawing the skin (Figure 3). The use of this double-sided reusable needle was first described by Wilson, and its patent application was made by the year 1986. However, its use has been popularized by Sulamanidze and Sulamanidze. In fact, the device is a surgical alteration of a shuttle or micro-shuttle, the ancient spindle-shaped device holding the thread in tatting, knotting, or netting, which is utilized in weaving to carry the thread back and forth between the warp threads. In simple terms, this method can be described as a percutaneous MACS-lift for the neck, and to stress the difference between loop suspensions and single-point suspensions, we named the technique micro-shuttle lifting.

METHODS

The study was approved by Institutional Review Board of the Florence Nightingale Group, Gayrettepe Hospital Ethical Committee (Istanbul, Turkey) All patients accepted and signed the necessary informed consents before the surgery, which conformed to the ethical guidelines of the 1975 Declaration of Helsinki.

Patient Selection

The described neck suspension method was utilized in 221 patients between December 2005 and May 2014. Patients

Figure 1. This 49-year-old woman presented with the complaint of neck aging. (A) The patient’s neck is shown with preoperative markings. A single-point suspension was designed using barbed sutures. (B) The patient is shown preoperatively, and (C) 3 months postoperatively with the deformity relapsed.
were selected for micro-shuttle lifting based on the five criteria that contribute to a loss of shape and contour of the neck: 1) skin and subcutaneous tissue thickness; 2) loss of tonus and elasticity of the skin; 3) loss of mandibular border definition and cervico-mental angle; 4) submandibular gland protrusion; and 5) banding of the platysma muscles at the anterior neck. The patients with thin skin and subcutaneous tissue who had visible banding of platysma, lacked good tonus and elasticity, and were older than 65 were excluded routinely. This was easily assessed by grabbing the neck tissue with two fingers. If the tissue thickness was less than .7-1 cm, an open necklifting was suggested. All patients were evaluated preoperatively by the operating surgeons for the presence of these aspects of the neck. The ideal candidate was a middle-aged patient with thick skin, a thick underlying fat layer, and acceptable skin elasticity. Patients with loss of mandibular border definition and cervico-mental angle, as well as submandibular gland protrusion, made the most improvement. Thin-skinned patients with visible platysmal banding, and old patients with poor skin elasticity, were not considered as good candidates for this procedure and were therefore consulted for open necklifting. No full-face peelings were performed during the operations. All of the patients who could be monitored were asked to fill in a satisfaction questionnaire, which was created by the authors, but their names were not noted. (A blank copy of the questionnaire is available as Supplementary Material at www.aestheticsurgeryjournal.com). All the patients in this study underwent only the procedures mentioned in this article.

**Surgical Technique**

The marking is performed when the patient is in a sitting position. The laxity on the jowl area, as well as the desired...

---

**Figure 2.** Force diagrams on the loops. (A) In single-point suspensions, the traction forces cause ripping of the tissue at the anchor points and suspension points. (B) In loop suspensions, on the other hand, the force effecting one point on the loop is counterbalanced by another one on the opposite side. The better the loop that can be created to carry the tissue, the less sheer force will be effective on each point on the loop.

**Figure 3.** Different sizes and shapes of reusable micro shuttles: 2 cm curved, 4 cm shuttles, 4 cm lightly curved, moderately curved and heavily curved, 6 cm curved, and 10 and 14 cm straight shuttles.
neck angle location and mandibular definition lines, are marked. The surgery is usually performed under sedation. The patient is positioned on the operating table with the neck extended. After the asepsis and antisepsis are completed, the area around both ears and the whole neck is infiltrated with approximately 150-200 cc of lidocaine with epinephrine, (500 NS with 25 cc 1% lidocaine and 1 cc of 1:1000 epinephrine).

On both sides, 1-2 cm incisions are made behind the ears over the mastoid bone, and the skin caudal to the incision is undermined with thin scissors (Figure 4A). A sterile marking pen is utilized to draw the three lined “hammock” pattern between both mastoids, the anterior line defining the posterior border of the mandible, the posterior line defining the desired cervicomental angle, and the middle line traveling in between the anterior and posterior lines. Utilizing a #15 blade, the surgeon creates 3 mm access ports for shuttling and liposuction on each marking at the midline, as well as three stab incisions on both sides midway to the midline. The skin at the puncture sites is released from the subcutaneous attachments with the use of a thin clamp through simple pulling; releasing the skin at the puncture sites is very important to avoid future dimpling (Figure 4B). A simple 2/0 polypropylene thread is attached to the central eye of the micro-shuttle needle and introduced through the postauricular incision. The thread is carried around the ear at the subcutaneous level by utilizing the needle in both directions in a shuttling manner.

Once at the entrance port again, the loop is secured by tying the suture ends together in the usual fashion, and two anchor loops are created around both ears at the end. These loops do not only carry the whole neck hammock system but also lift the skin in the preauricular region as well as the jowl area in a constrictive manner toward the ears (Figure 5). Then, starting from one side, three 2/0 polypropylene threads are tied to the loop and carried across the neck with the needle in the same shuttling manner, following the marking lines in the deep subcutaneous level on top of the platysma, utilizing the previously prepared exit/entrance ports. Visible tethering of the overlying skin and increased resistance is a sign that the suture track is at an overly superficial level, and the lack of suspension capacity is a sign that the level of suture placement is too deep. These three uninterrupted cross-neck threads

**Figure 4.** Marking and incisions. (A) The three lined “hammock” pattern is drawn over the neck, the anterior line defining the posterior border of the mandible, the posterior line defining the desired cervicomental angle, and the middle line traveling between the anterior and posterior lines. (B) Skin incisions are made behind the ears over the mastoid bone, and the skin caudal to the incision is undermined with thin scissors. The skin at the puncture sites is released from subcutaneous attachments using a thin clamp. (C) A simple 2-0 polypropylene thread is attached to the micro-shuttle.

**Figure 5.** The thread is carried around the ear at the subcutaneous level using the needle in both directions in a shuttling manner.
create a hammock-like suspension system over the platysma, and the underlying structures are sutured to the round-block ear loop on the opposite side as well as the mastoid periosteum.

It is important that the most anterior cross-neck line is placed immediately below the mandibular border to redefine the jaw line. The posterior thread is put directly on the planned angle of the neck, which is determined by pulling the skin backward below the mandibular border, and the middle thread is placed between the anterior and posterior lines to bridge the first two. Light suction lipectomy utilizing a 2 mm blunt cannula was utilized to create the necessary redraping and fibrosis of the skin over the created internal splint after the thread placement (Figure 6). Residual dimpling at the portal areas are simply dealt with by releasing the skin from the underlying suspension utilizing a mosquito clamp. Any tethering of the dermis would result in irreversible sequel. A compression dressing or garment is applied, and the patient is instructed to remove it after 48 hours. At home, cold compresses are applied as often as possible for the first 4 days during waking hours, with the compression garment applied at nighttime.

The patients usually return to normal activities in 4-5 days, often with minor bruising that can be concealed with makeup. Most patients experience pain during the first week, particularly when opening the mouth, which is the

Figure 6. (A) Once the loop and is secured to the periosteum, three 2/0 polypropylene threads are tied to the loop and carried across the neck with the needle in the same shuttling manner used in the deep subcutaneous level on top of the platysma. (B) These three uninterrupted cross-neck threads create a hammock-like suspension system over the platysma, and the underlying structures are sutured to the round-block ear loop on the opposite side as well as the mastoid periosteum. (C, D) Light suction lipectomy using a 2 mm blunt cannula is used to create the necessary redraping and fibrosis of the skin over the created internal splint after the thread placement.
major drawback of the technique in our opinion. This technique is designed to obtain anti-gravitational volume redistribution in the neck by vertically suspending the soft tissues with permanent percutaneous sutures. The gravitational force affecting the neck structures is compensated by the polypropylene hammock, and skin redraping is achieved through the inherent retraction capacity of the skin after undermining through minor liposuction.14

A video and animation demonstrating the operative technique are available as Supplementary Material at www.aestheticsurgeryjournal.com.

RESULTS
A total of 214 (96.8%) of the patients were female, and seven (3.2%) were male. The mean age of the patients was 42.5 years (range, 25-62 years), and the mean follow-up was 2.5 years (range, 8 months-7 years).

Overall patient satisfaction with micro-shuttle lifting has been very high, according to the results of a specifically designed questionnaire that was completed by 197 patients 6 months postoperatively (Table 1). Twelve patients found the result unsatisfactory, six of whom did not have the initial loops around the ears. This finding taught us to always perform the procedure with the ear anchor loops placed to carry the neck system. Eight patients came back with ripped threads; seven of those occurred after the first critical month, during which remodeling occurs. After one month, removal of the neck threads resulted in no deformity of the newly created neck definition (Figure 7). One patient had a suture failure immediately after the surgery; this patient underwent an open necklift. Six patients had the suspension performed with PDS sutures, all of which failed. Seven patients had the suture knots exposed in the mastoid area. Three subacute infections occurred in the postauricular incision area with culture-positive Staphylococcus Aureus; two responded to antibiotics, and the other one required removal of the whole suspension system. Two patients wanted the sutures to be removed because of prolonged headaches and regional pain. Two patients experienced marginal mandibular nerve paresis, which resolved in 3 weeks. No prolonged dimpling occurred, thanks to preemptive skin release around the ports during the operation. No hematomas were observed (Table 2).

DISCUSSION
The trend in recent years has been toward performing less invasive techniques in facial rejuvenation surgery. Following the basic skin resection lifts in 1970s, the discovery of the superficial musculoaponeurotic system led surgeons to operate on deeper structures of the face.13-16 For the neck, José Guerrerosantos described his cervical rhytidoplasty in 1974, proposing the elevation and anchorage of platysma muscle flaps posterior to the mastoid fascia.17 Illouz introduced liposuction in 1980, a technique for minimally invasive defatting of the neck. After various approaches to the area,18 the publication of the article “Corset Platysmaplasty” by Joel J. Feldman in 1990, adding anterior band plication in necessary situations, became the standard approach for the neck.14

In the late 1990s, plastic surgeons became increasingly convinced about the importance of volumetric rejuvenation.19-21 This was a basic paradigm shift, in which plastic surgeons started thinking that skin tightening does not always accomplish rejuvenation and thus that volume restoration is necessary. Ramirez showed that the separation of platysma and depressors of the lip subperiostally by submental incision allows upward pulling in the midface to be transmitted to the lower face.22 Giampapa utilized submental and postauricular incisions for undermining soft tissue, resection of platysma, and permanent fixation interlocking sutures to the mastoid fascia bilaterally.9 This fixation material was an angle loop suture located near the angle of the mandible. Platysma imbrication and controlled tension of interlocking sutures, as well as anatomic suction-assisted lipectomy, was needed, with a major problem of cheese-wiring. Because volumetric correction appeared to be more important, the next step was to obtain comparable results with these techniques through even shorter incisions or punctures.

Today, any article reviewing minimally invasive procedures for neck rejuvenation would necessarily include three

| Table 1. Satisfaction Questionnaire Results (197 patients completed the questionnaire) |
|---------------------------------|--------|--------|--------|--------|--------|
|                                | 1 (worst) | 2     | 3      | 4      | 5 (best) |
| Neck angle                     | 9 (4.6%)  | 5 (2.5%) | 11 (5.6%) | 136 (69.0%) | 36 (18.3%) |
| Mandibular definition          | 5 (2.5%)  | 9 (4.6%) | 2 (1.0%) | 120 (60.9%) | 61 (30.9%) |
| Skin excess improvement        | 4 (2.0%)  | 11 (5.6%) | 59 (29.9%) | 101 (51.3%) | 22 (11.2%) |
| Dissatisfaction about the scars related to the suspension | 1 (0.5%) | 6 (3.0%) | 10 (5.1%) | 12 (6.1%) | 168 (85.3%) |
| General appearance             | 7 (3.6%)  | 9 (4.6%) | 7 (3.6%) | 141 (71.6%) | 33 (16.7%) |
major approaches: 1) liposuction; 2) short-scar necklifting techniques; and 3) suspension methods.

Liposuction in the neck area is limited by various factors, such as the fibrous character of the region, the possibility of unraveling the platysmal edges, the ease of oversuction, and the inability of the technique to solve structural problems related to deeper-plane problems such as submandibular gland visibility.

Short-scar facelift methods can treat structures at different planes very effectively, but the major drawback of these techniques is that they are actually not at all minimally invasive.23-25

As the third alternative, many suspension methods have been described in the literature.26,27 The majority of these techniques have been criticized for lack of durability and undercorrection. However, most of these suspensions are designed as single-point suspensions such as barbed sutures or similar approaches, in which the traction forces
cause the ripping of the tissue at the anchor points, particularly in mobile areas. The financial cost of the proposed products that are necessary to perform the related techniques is another major drawback of suspension methods such as the APTOS Lift, Happy Lift, and Silhouette. On the other hand, loop suspensions have shown to be effective and long-lasting. They may be utilized as part of an open technique or as stand-alone procedures. The long-lasting efficacy of open/closed loop suspension techniques has a firm physical explanation: by creating a carrier loop in the tissue, we basically have tissue resistance work against itself to balance the sheer forces. The force vector effecting one point on the loop is counterbalanced by another one in the opposite direction. Therefore, the more perfect the loop is, the less sheer force will be effecting opposing suspension-tissue junctions.

The necessity of treating all three anatomic and surgical planes simultaneously—namely the deep, middle, and superficial planes of the neck in an ideal patient—gives this technique an upper hand even compared to traditional necklifting. Problems related to deep anatomical landmarks, such as submandibular glands, might be dealt with easier and safer with this closed method, simply because by creating a neck hammock suspended on loops around the ears, it is possible to lift all layers of the neck at once.30 The repositioning of the superficial and deep

Figure 8. This 40-year-old woman presented with the complaint of facial aging. Micro-shuttle lifting of the neck and the midface was performed, along with the injection of stem-cell-enriched tissue to the upper midface. Problems related to deeper anatomical landmarks like submandibular glands might be dealt with easier and safer with micro-shuttle lifting, because the neck hammock that is created is suspended on loops around the lifts, lifting all different layers of the neck at once. (A, C, E) This patient is shown preoperatively. (B, D, F) The result is sustainable 7 years postoperatively.
structures seems to have remained intact even after 7 years (Figure 8).

It was very interesting to observe the failure of the technique in the patients who had PDS suspensions. All six patients with PDS suspensions had their sutures ripped very soon after the surgery at the knots behind the ears, most likely because of early resorption and loss of resistance.

The advantages of micro-shuttle lifting compared with the other techniques are that it is a quick procedure that can be accomplished even with local anesthesia, it does not require hospital admission, it has a short recovery period, and it has inconspicuous punctures. The financial cost of any proposed product is also worth considering. The fact that the surgeon has no product cost and needs to use simple needles and polypropylene sutures effectively reduces the cost of this technique. More importantly, micro-shuttle lifting is a safe procedure. Facial nerve injury, skin slough, hematoma, and postoperative numbness are not very likely to occur. In this technique, the threads suspending the neck are not interlocked but rather are running without interruption from one ear to the other, thus preventing cheese-wiring and creating a smooth bridge for the sliding neck system. The older patient group who did not want any open surgery under any circumstance was content even with sub-optimal results.

The lack of any delaminating surgery damaging the existing ligamentous systems and the use of nonabsorbable suture materials as a support of the original ligamentous fixation might be considered as advantages of this procedure for both young and older candidates (Supplemental Figures 1 and 2) (Dr M Jewell, personal communication, 2010). Also, any combination with other minimally invasive procedures, laser resurfacing or application of ultrasonic energy can be performed safely without any facelift stigmata. According to our experience as well as the dynamics of facial structures, even though the effect of a midface suspension on the neck is negligible, such combination therapies usually give higher patient satisfaction rates. Consequently, we always advise our patients to address also the midface either with a suspension or fat grafting.

A negative aspect of the procedure is acute postoperative pain in some patients, which lasts up to 1 week. The fact that the patient satisfaction questionnaire was not validated is another limitation of the study.

A final comparison can be made with the iGuide (Implicitcare, LLC, West Hollywood, CA). Basic manual and visual surgical skills are enough to assess the depth of the micro-shuttle or any other device without utilizing any lighted guide, because the plane is subcutaneous. Leaving roughly a half-centimeter of subcutaneous tissue over the device will be ideal. Utilizing simple micro-shuttles with simple Prolene sutures gives comparable results without any additional expense.

CONCLUSION

The concept of necklifting with a micro-shuttle consists of creating a percutaneous hammock, constructed of strong and nonabsorbable sutures over nonundermined platysma, utilizing a double-ended (micro-shuttle) needle, and anchoring it to fixed loops around the ears, which can solve the problem of different depths on the neck at the same time. Skin resection is principally not performed, because the gravitational force is compensated by the suspension bridge and skin redraping is achieved through the inherent retraction capacity of the undermined skin.

Micro-shuttle lifting of the neck is not indicated for all neck problems, but it might give even better results than traditional methods, particularly when dealing with deep-plane landmarks such as sagging submandibular glands. In selected patients, this safe and simple percutaneous necklifting method can be quickly and easily performed under local anesthesia with long-term durability, low morbidity, and a high patient satisfaction rate. The lack of any particular product expense is another advantage of the proposed technique.

Our method of micro-shuttle lifting might be an advance in the ongoing search for less invasive surgery with better results.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

Disclosures

Dr Grotting is a founder and shareholder of CosmetAssure (Birmingham, AL). He also receives book royalties from Quality Medical Publishing (St. Louis, MO) and is a shareholder in Keller Medical, Inc. (Stuart, FL) and Ideal Implant, Inc. (Dallas, TX). The other authors have nothing to disclose.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

REFERENCES


