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Evaluating the Compartment-Specific Effects in Superficial Facial Fat Compartments After Thread-Lifts by the Tensiometer and FACE-Q

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Abstract

Background: The thread-lifts have been popularized because they offered minimally invasive procedures of facial rejuvenation, but not evaluated by the objective assessment system.

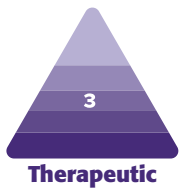
Objectives: The purpose of this study is to evaluate the compartment-specific effects after thread-lifts by the tensiometer and FACE-Q.

Methods: Retrospective cohort study was performed on 369 consecutive patients undergoing the thread-lifts with V-Loc devices ($n = 173$) and the limited scar face lifts ($n = 196$), with the mean follow-up period of 32.2 ± 5.2 months, between January 2014 and December 2015. Two hundred-seventy patients had intraoperative tension measurements performed. In an online survey, the blinded study coordinator registered all data in 12 FACE-Q scales.

Results: The average age was 46.0 ± 10.1 years. The complication rate was 4.8%. The mean value of the tensions was 9.5 ± 1.9 N. Patients were better satisfied with the appearance of their marionette (44.3 ± 24.8) lifted by device 3&4 (10.1 ± 1.6 N), compared with satisfaction with the appearance of their nasolabial folds (37.9 ± 20.7) lifted by device 1&2 (8.7 ± 2.1 N). The satisfaction of patients of the 40s and 50s&60s was higher than that of patients of the 20s&30s with decision. The satisfaction of patients undergoing limited scar face lifts was higher than that of patients undergoing thread-lifts with social and psychological functions.

Conclusions: The tension measurements correlate with compartment-specific effects and play the same role as the indicator between gravitational and volumetric theories, but the limited effectiveness of thread-lifts was found to look 2.3 years younger during a mean follow-up of 2.5 years.

Level of Evidence: 3



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In the historical review of the thread-lift, it is not mentioned that the results were evaluated by an objective assessment system. The barbed sutures offer minimally invasive procedures of facial rejuvenation without significant downtime, incision, and dissection, but show limited duration of correction, suture failure, visible and palpable suture, and limited longevity of results.[1]

The author proposed the hypothesis that the weak points could be caused by the lack or shortage of anchoring structures in the subdermal or subcutaneous placement of the sutures, the use of nonabsorbable suture substance, and the influence of excessive skin (Figure 1).[2] Also, there was no objective evaluation system in both intraoperative and postoperative processes to assess the elevation of the ptotic tissues by the thread-lifts.[3]

For improving these weak points, the absorbable sutures could provide an alternative to prevent the palpability,

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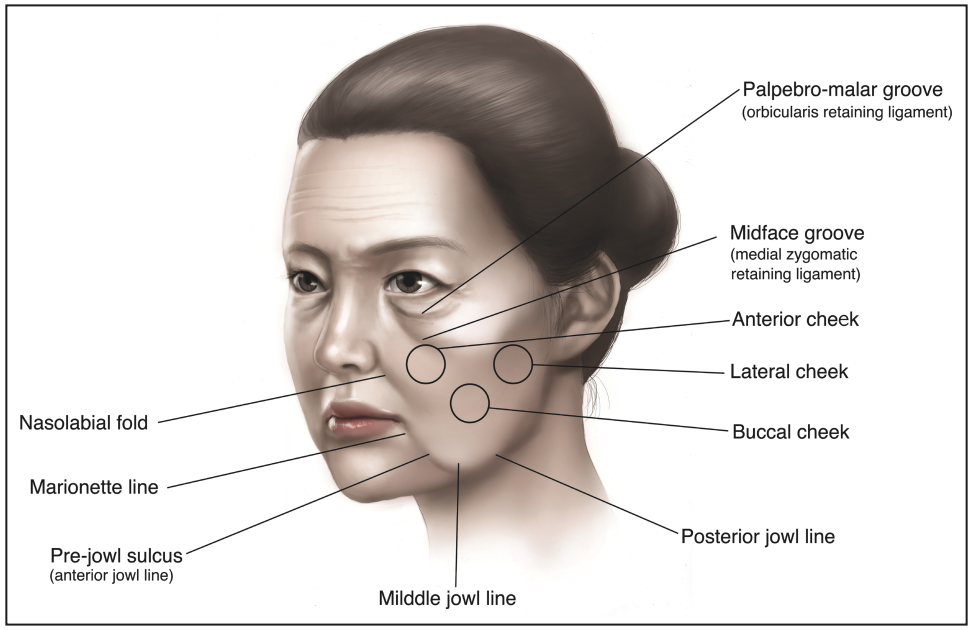

Figure 1. The surface anatomy of the face.

exposure, and extrusion issue of the nonabsorbable suture, and to satisfy the patients who do not want to have nonabsorbable materials as foreign bodies in their faces. The author selected 3-0 V-Loc 180 devices (Covidien, Mansfield, MA) because they, in preliminary clinical studies, were significantly stronger than the Quill PDO device, size 2-0 (Angiotech Puerto Rico, Inc., Aguadilla, Puerto Rico) during the critical phases of wound healing in skin.[4-7] In this article, the author describes "compartment thread-lifts" for the reinforcement of anchoring sutures: utilizing deep temporal fascia, mastoid fascia, retaining ligaments, and compartment septa as anchor points. The intraoperative tensions (tensiometer: model DFG82 [Omega, Stamford, CT]) were measured by the devices for the evaluation of the soft tissue's characteristics including the presence and suture entrapment of firm structures (dermis, compact fat, septal network, vasculature, and SMAS): the soft tissue provides an optimal environment for the thread-lifts and anchors.[8,9] The slippage tensions, at which the initial anchor points release from the tissue, are a measure of the effectiveness of suture design and integrity of tissue composition, which are characteristics of the applied force.[8] Additionally, the author utilized FACE-Q as a validated questionnaire to assess patient-reported satisfaction for the evaluation of postoperative outcomes.[10-12] The purpose of this study is to evaluate the compartment-specific effects after thread-lifts by using the tensiometer in vivo and FACE-Q.

METHODS

The retrospective cohort study was performed on 369 consecutive patients undergoing thread-lifts (n = 173) with 3-0 V-Loc 180 devices, and the limited scar face lifts (n = 196) for facial rejuvenation between January 2014 and December 2015. The follow-up period ranged from 22 months to 43 months, with a mean of 32.2 ± 5.2 months. This study was in line with the institutional review board requirements of Korean Society of Aesthetic Surgery and the Declaration of Helsinki. Written consent was provided, by which the patients agreed to the use and analysis of their data.

The preoperative data included patient demographic information and previous operative histories (Tables 1, 2). The intraoperative data included main procedures, intraoperative tensions, additional procedures, and other plastic surgeries (Table 2).[13] The classification of subcutaneous fat compartments with septa and retaining ligaments of the face is shown in Figures 1 and 2.[14-21] Two hundred-seventy patients had intraoperative tension measurements performed on the first anchor points of the devices. Thread-lifts with 3-0 V-Loc 180 devices consisted of temporal and mastoid thread-lifts: temporal, with 3 temporal anchor points on one side, were responsible for lateral orbital, midfacial, middle cheek, lateral temporal-cheek, and jowl compartments; mastoid, with one mastoid anchor point on one side, were responsible for subauricular and submandibular compartments. For measuring the tensions of the devices, 8 tracts on one side were projected (Table 3, Figure 3).

The postoperative data included secondary procedures, contour injection, complications, and the results of questionnaires (Table 2). Secondary procedures were defined as the procedures performed within 12 months postoperatively. For reducing the edema, the contour solution (containing hyaluronidase, triamcinolone acetonide) was injected into the jowls postoperatively. In an online

Table 1. Patient Demographics

Characteristic	No. (%) of total patients	No. (%) of respondents in FACE-Q
No. of patients	369 (100)	50 (100)
Race		
Asian	369 (100)	50 (100)
Sex		
Female	349 (94.6)	49 (98)
Male	20 (5.4)	1 (2)
Age, yrs		
Mean	46.0 ± 10.1years	44.6 ± 9.3 years
Range	23–76 years	28–64 years
20-29	12 (3.25)	1 (2)
30-39	90 (24.39)	14 (28)
40-49	137 (37.13)	18 (36)
50-59	95 (25.75)	15 (30)
60-69	29 (7.86)	2 (4)
70-79	6 (1.62)	
BMI, kg/m^2		
No. of patients	267 (72.36)	50 (100)
Mean	20.7 ± 2.4 kg/m^2	20.0 ± 1.9 kg/m^2
Range	15.6-29.1 kg/m^2	16.88–25.11 kg/m^2
BMI < 18.5	38 (10.3)	13 (26)
18.5 ≤ BMI < 25.0	213 (57.72)	36 (72)
25 ≤ BMI	16 (4.34)	1 (2)
Follow-up period		
Mean	32.2 ± 5.2 months	29.5 ± 3.9 months
Range	22–43 months	22–35 months

BMI, body mass index.

survey using Google Questionnaire (Google, Mountain View, CA), the blinded study coordinator registered all data during the survey period of 3 months (from January to March in 2018) when asking the patients to answer the 12 FACE-Q scales; when Rasch-transformed scores (range, 0 to 100) were assessed for each scale, higher FACE-Q scores indicate greater satisfaction (Table 4).

Operative Techniques

Before sedative anesthesia, the operator performed the skin markings in the sitting position (Table 3, Figure 3). With the patient under local and sedative anesthesia, a 3-0 V-Loc 180 device was placed in the lumen of the long, 18-gauge spinal needle, which was passed along tract 1 into insertion point 1, at first subcutaneously and more deeply into the retaining ligament, then proceeded subcutaneously in undulation mode to the subdermal plane under end point 1 (Video). The needle was withdrawn with no exit, leaving one half of the device in place and one half outside (Figure 4). After this procedure was done again from tract 2 to tract 8, the tensiometer was attached to the hemostat connected to the end of the device. After the tensiometer was zeroed, the tension was measured at the first sign of slippage after the point of clinical correction (Figure 5).[8,9] This was repeated twice and averaged at 2 devices together sequentially (examples: device 1&2, 3&4, and 5&6), which were anchored to the deep temporal fascia while 2 devices in tracts 7 and 8 were anchored to the mastoid fascia.

For excising redundant skin tissues, the operator used 3 methods for subcutaneous limited scar face lift: (1) temporal face lift; (2) minimal access cranial suspension (MACS) lift[22,23]; and (3) posterior auricular face lift. Temporal face lift is a subcutaneous face lift undermining the temple, from the lateral margin of the orbital rim to the upper margin of the zygomatic arch, through about 3 cm-sized incision along the temporal hair line, simultaneously performing temporal thread-lifts. MACS lift combines a subcutaneous dissection of the cheek and suspension of the soft tissue by temporal thread-lifts instead of 2 or 3 purse string sutures on both sides of the face. Posterior auricular face lift is a subcutaneous face lift undermining the posterior auricular and submandibular area through an approximately 3 cm incision along the posterior sulcus with mastoid thread-lifts.

Statistical Analysis

The study proceeded in the following manners: (1) analyzing the factors affecting the intraoperative tension, the complications, and the results of FACE-Q after the procedures; (2) looking for the correlations between these factors; and (3) examining the compartment-specific effects after compartment thread-lifts.

To compare the mean values of groups, the independent *t*-test was used first for the difference in the mean values between 2 independent groups. Sometimes the ANOVA (analysis of variance) was used for the difference between 3 or more mean values. The paired *t*-test was implemented for the tensile differences between on the right and left side. For testing the relationships between the categorical variables, the chi-square test was used.

Of the 369 patients, 99 (26.8%) patients without tension measurements were excluded from the tension analysis but were included in the complications analysis. Two hundred ninety-five patients who were not contacted by the blinded study coordinators via cell phones or e-mails were excluded from the survey. Twenty-four patients who were

Table 2. Summary of Preoperative, Intraoperative, and Postoperative Data For Evaluation

Items	No. (%) of total patients	No. (%) of respondents in FACE-Q
Preoperative Data		
Patient demographics		
Previous operative histories		
• No. of patients without histories	199 (53.93)	27 (54)
• Thread-lift	63 (17.08)	9 (18)
• Reduction malarplasty + mandibular angle ostectomy	24 (6.51)	2 (4)
• Lower blepharoplasty	21 (5.69)	2 (4)
• Fat graft	16 (4.34)	5 (10)
• Thread-lift + reduction malarplasty + mandibular angle ostectomy	10 (2.71)	
• Thread-lift + fat graft	7 (1.9)	1 (2)
• Thread-lift + lower blepharoplasty	5 (1.35)	2 (4)
• Maxillofacial surgery	3 (0.81)	
• Thread-lift + maxillofacial surgery	3 (0.81)	1 (2)
• Thread-lift + face lift	3 (0.81)	
• Others	15(4.06)	1 (2)
Total	369 (100)	50 (100)
Intraoperative Data		
Tensions of 3-0 V-Loc 180 devices		
• No. of patients with measurements	270 (73.17)	50 (100)
• No. of patients without measurements	99 (26.83)	
Total	369 (100)	50 (100)
Main procedures		
• temporal thread-lift	166 (44.99)	20 (40)
• temporal face lift	120 (32.52)	14 (28)
• temporal face lift + posterior auricular face lift	41 (11.11)	7 (14)
• temporal thread-lift + posterior auricular face lift	20 (5.43)	3 (6)
• MACS lift	8 (2.17)	3 (6)
• temporal thread-lift + mastoid thread-lift	6 (1.62)	1 (2)
• others	8 (2.17)	2 (4)
Total	369 (100)	50 (100)
Additional procedures		
• No. of patients without additional procedures	168 (45.53)	21 (42)
• Injectable fillers + botulinum toxin	78 (21.14)	7 (14)
• injectable fillers	68 (18.43)	10 (20)
• botulinum toxin	36 (9.77)	8 (16)
• fat graft	8 (2.17)	3 (6)
• fat graft + botulinum toxin	8 (2.17)	1 (2)
• others	3 (0.81)	
Total	369 (100)	50 (100)
Other plastic surgeries		
• No. of patients without other plastic surgeries	304 (82.39)	42 (84)
• Lower blepharoplasty	19 (5.16)	2 (4)
• Upper & lower blepharoplasty	7 (1.89)	1 (2)
• Platysmal suspension[24]	5 (1.36)	
• Liposuction	5 (1.36)	2 (4)
• Upper blepharoplasty	4 (1.08)	1 (2)
• Rhinoplasty	4 (1.08)	
• Reduction malarplasty	4 (1.08)	1 (2)
• Breast augmentation	3 (0.81)	1 (2)
• Scar revision	2 (0.54)	
• Lower blepharoplasty + platysmal suspension	2 (0.54)	
• Lower blepharoplasty + rhinoplasty	2 (0.54)	
• Others	8 (2.17)	
Total	369 (100)	50 (100)
Postoperative Data		
Secondary procedures		
• No. of patients without secondary procedures	334 (90.51)	43 (86)
• Injectable fillers	12 (3.25)	2 (4)
• Injection fillers + botulinum toxin	5 (1.36)	2 (4)
• IFUS	5 (1.36)	1 (2)
• Injection fillers + IFUS	5 (1.36)	1 (2)
• Botulinum toxin	2 (0.54)	1 (2)
• Botulinum toxin + IFUS	2 (0.54)	
• Injection fillers + botulinum toxin + IFUS	2 (0.54)	
• Others	2 (0.54)	
Total	369 (100)	50 (100)
Contour injection		
• No. of patients without contour injection	135 (36.6)	27 (54)
• No. of patients with contour injection	234 (63.4)	23 (46)
Total	369 (100)	50 (100)
Complications		
• No. of patients without complications	351 (95.13)	47 (94)
• Suboptimal outcomes	9 (2.44)	2 (4)
• Revision	4 (1.08)	
• Asymmetry	2 (0.54)	
• Dimpling	1 (0.27)	1 (2)
• Stitch abscess	1 (0.27)	
• Scar revision	1 (0.27)	
Total	369 (100)	50 (100)
FACE-Q*		
• Non-respondents	24 (32.43)	
• Respondents	50 (67.57)	50 (100)
Total	74 (100)	50 (100)

*A validated tool and questionnaire for evaluating patient satisfaction and outcomes in aesthetic facial surgery. IFUS, intense focused ultrasound (model Contlex; Chungwoo Co., Seoul, South Korea); MACS, minimal access cranial suspension.

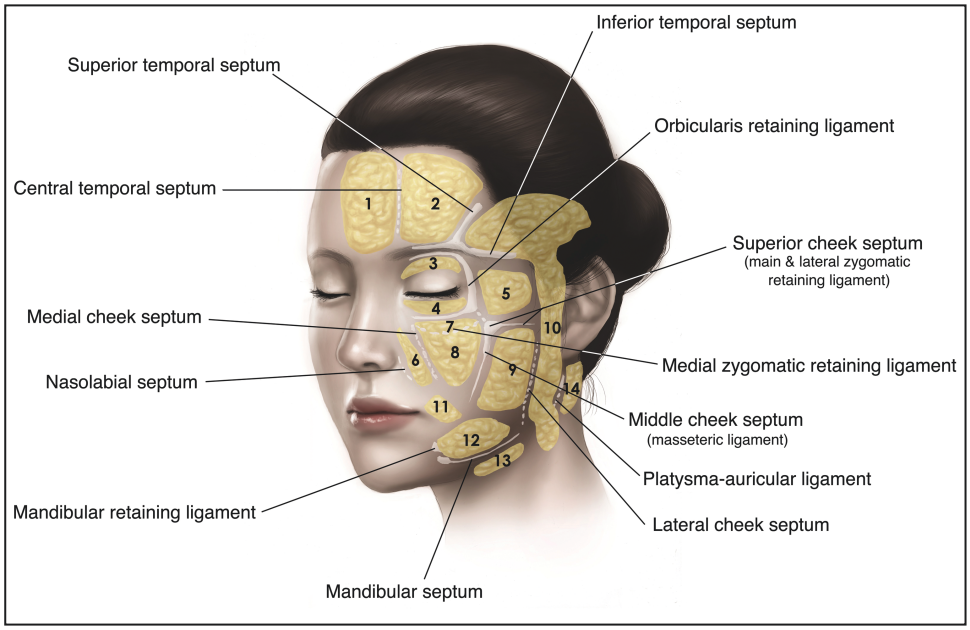

Figure 2. Superficial facial fat compartments and their relationship to the septa and retaining ligaments. The subcutaneous fat compartments of the face include (1) central forehead compartment, (2) middle forehead compartment, orbital compartment ([3] superior, [4] inferior, and [5] lateral compartments), midfacial compartment ([6] nasolabial, [7] infraorbital, and [8] medial cheek compartments), (9) middle cheek compartment, (10) lateral temporal-cheek compartment, jowl compartment ([11] superior and [12] inferior compartments), (13) submandibular compartment, and (14) subauricular compartment.

contacted but did not respond to FACE-Q were excluded from FACE-Q analysis.

The empirical analysis in this study was verified all at the significance level of $P < 0.05$. The statistical processing was analyzed by using SAS 9.4 program (SAS Institute Inc., Cary, NC).

RESULTS

Of the 369 consecutive patients, 270 (73.2%) patients had intraoperative tension measurements performed by the devices. Fifty (67.6 %) of 74 patients who had been contacted by the blinded study coordinators returned the completed FACE-Q. The average age, which ranged from 23 to 76 years, was 46.0 ± 10.1 years with the ratio of 349 women and 20 men. The average body mass index was 20.7 ± 2.4 kg/m^2. The follow-up period ranged from 22 months to 43 months postoperatively, with a mean of 32.2 ± 5.2 months (Table 1).

One hundred seventy-three of 369 patients (46.9%) underwent only the thread-lifts (temporal or mastoid thread-lifts, or both), but 196 patients (53.1%) underwent the limited scar face lifts with thread-lifts (temporal or mastoid thread-lifts, or both). The complications in a total of 18 patients (4.8%) were summarized as follows: suboptimal outcomes were 9 cases (2.4%), revisions were 4 (1.1%), asymmetries were 2 (0.5%), dimpling was 1 (0.3%), stitch abscess was 1 (0.3%), and scar revision was 1 (0.3%). Revisions were performed in a total of 4 cases (1.1%): 3 cases underwent the temporal face lift and one case underwent the temporal thread-lift (Table 2).

Intraoperative Tensions

The mean value of the tensions on one device was 5.0 ± 1.0 N and the mean value of the tensions on 2 devices was 9.5 ± 1.9 N. The highest force of 2 devices was shown at device 3&4 (10.1 ± 1.6 N) in lateral orbital-jowl tract (L-J tract); the lowest of 2 devices was at device 1&2 (8.7 ± 2.1 N) in lateral orbital-nasolabial tract (L-N tract).[9,24,25] In analysis of the tensile difference between on the right and left side, it was statistically significant that the right devices' tensions were lower than the left devices' tensions on the devices ($P < 0.05$) (Table 5). The range of the mean values was from 10.4 ± 1.7 N in 20s to 8.6 ± 1.4 N in 70s on 2 devices. The mean value of the tensions in females (9.4 ± 1.8 N) was lower than that in males (10.8 ± 1.1 N) on 2 devices.

In analysis of the tensions, statistically significant variables included age, sex, previous operative histories (lower blepharoplasty, thread-lift, face lift), and the limited scar face lifts ($P < 0.05$). The elasticity of the face decreased gradually with getting older, especially in women. The left jowl tensions of the patients with previous operative histories were lower than that of the patients without previous operative histories. The

Table 3. Description of Thread-lift Types, Tracts, V-Loc Devices, Anchor Points, Suspension Compartments, Improved Clinical Areas, and Improved Appearance Appraisal in FACE-Q Scale

Thread-lift type	Tract name	Device no.	1st. Anchor point	2nd. Anchor point	3rd. Anchor Point	4th. Anchor Point	Suspension Compartments	Improved Clinical Areas	Improved Appearance Appraisal
Temporal	L-N tract	Device 1	Deep temporal fascia	Medial zygomatic retaining ligament	Medial cheek septum		Lateral orbital, Infraorbital, medial cheek, nasolabial	Nasolabial folds, midface groove, anterior cheek	Q1-Satisfaction with facial appearance overall Q2-Satisfaction with cheeks Q3-Appraisal of nasolabial folds
Temporal	L-N tract	Device 2	Deep temporal fascia	Medial zygomatic retaining ligament	Medial cheek septum		Lateral orbital, infraorbital, medial cheek, nasolabial	Nasolabial folds, midface groove, anterior cheek	Q1-Satisfaction with facial appearance overall Q2-Satisfaction with cheeks Q3-Appraisal of nasolabial folds
Temporal	L-J tract	Device 3	Deep temporal fascia	Superior cheek septum	With or without middle cheek septum	Mandibu-lar ligament	Lateral orbital, medial cheek, superior jowl, inferior jowl	Buccal cheek, marionette line, pre-jowl sulcus (anterior jowl line)	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin Q6-Appraisal of marionette
Temporal	L-J tract	Device 4	Deep temporal fascia	Superior cheek septum	With or without middle septum	Mandibu-lar septum	Lateral orbital, middle cheek, inferior jowl	Lateral cheek, buccal cheek, marionette line, pre-jowl sulcus (anterior jowl line)	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin Q6-Appraisal of marionette
Temporal	L-I tract	Device 5	Deep temporal fascia	Superior cheek septum	Lateral septum	Mandibu-lar septum	Lateral temporal-cheek, inferior jowl	Lateral cheek, pre-jowl sulcus (anterior jowl line), middle jowl line, posterior jowl line	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin
Temporal	L-I tract	Device 6	Deep temporal fascia	Superior cheek septum	Lateral septum	Mandibular septum	Lateral temporal-cheek, inferior jowl	Lateral cheek, pre-jowl sulcus (anterior jowl line), middle jowl line, posterior jowl line	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin
Mastoid	S-S tract	Device 7	Mastoid fascia	Platysma-auricular ligament	Fibrous septum between submental and submandibular compartments		Subauricular, lateral temporal-cheek, submandibular	Sagging submandibular area, undefined mandibular border and angle	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin

Table 3. Continued

Thread-lift type	Tract name	Device no.	1st. Anchor point	2nd. Anchor point	3rd. Anchor Point	4th. Anchor Point	Suspension Compartments	Improved Clinical Areas	Improved Appearance Appraisal
Mastoid	S-S tract	Device 8	Mastoid fascia	Platysma-auricular ligament	Fibrous septum between sub-mental and submandibular compartments		Subauricular, lateral temporal-cheek, submandibular	Sagging sub-mandibular area, undefined man-dibular border and angle	Q1-Satisfaction with facial appearance overall Q4-Satisfaction with lower face and jawline Q5-Satisfaction with chin

L-N tract is lateral orbital-nasolabial tract including tract 1 and 2. L-J tract is lateral orbital-jowl tract including tract 3 and 4. L-I tract is lateral temporal-inferior jowl tract including tract 5 and 6. S-S tract is subauricular-submandibular tract including tract 7 and 8. (1) Insertion point 1 was located where the line passing horizontally from the eyebrow and the temporal hair line meet; (2) insertion point 2 located 1 cm below insertion point 1; (3) insertion point 3 located 1 cm below insertion point 2; (4) insertion point 4 located 1cm below insertion point 5; (5) insertion point 5 located 1 cm anterior to the spine of helix of auricular cartilage; (6) insertion point 6 located 1 cm above the tip of mastoid process; (7) insertion point 7 located 1 cm above insertion point 6; (8) end point 1 located 1 cm above and 2 cm lateral to the alar base; (9) end point 2 located 1 cm lateral to end point 1; (10) end point 3 located 1cm below and 1cm lateral to the oral commissure, on the marionette line; (11) end point 4 located 1 cm below end point 3, on the pre-jowl sulcus (anterior jowl line); (12) end point 5 located 1 cm lateral to end point 4, on the middle jowl line; (13) end point 6 located 1 cm lateral to end point 5, on the posterior jowl line; (14) end point 7 located 2 cm below end point 5; (15) end point 8 located 1cm below end point 7. Tract 1 for device 1 was the passage from insertion point 1 to end point 1, tract 2 for device 2 the passage from insertion point 2 to end point 2, tract 3 for device 3 the passage from insertion point 2 to end point 3, tract 4 for device 4 the passage from insertion point 3 to end point 4, tract 5 for device 5 the passage from insertion point 4 to end point 5, tract 6 for device 6 the passage from insertion point 5 to end point 6, tract 7 for device 7 the passage from insertion point 6 to end point 7, and tract 8 for device 8 the passage from insertion point 7 to end point 8. Device 1 and 2 in tract 1 and 2, so-called lateral orbital-nasolabial tract (L-N tract), were to lift lateral orbital, infraorbital, medial cheek, and nasolabial compartments via medial zygomatic retaining ligament and medial septum; device 3 and 4 in tract 3 and 4, so-called lateral orbital-jowl tract (L-J tract), to lift lateral orbital, medial cheek, middle cheek, and jowl compartments via superior cheek septum, mandibular ligament, and mandibular septum; device 5 and 6 in tract 5 and 6, so-called lateral temporal-inferior jowl tract (L-I tract), to lift lateral temporal-cheek and inferior jowl compartments via lateral and mandibular septum; device 7 and 8 in tract 7 and 8, so-called subauricular-submandibular tract (S-S tract), to lift subauricular, lateral temporal-cheek, and submandibular compartments via platysmal-auricular ligaments and fibrous septum between submental and submandibular compartments.

anterior cheek and jowl tensions of the patients undergoing the limited scar face lifts was lower than that of the patients undergoing the thread-lifts because the mean age of the patients undergoing the limited scar face lifts (49.7 ± 10.0 yrs) was obviously higher than that of the patients undergoing the thread-lifts (41.7 ± 8.5yrs); Supplemental Tables 1 and 2 demonstrate the detailed data values.

Complications

The variables affecting complications included age and secondary intense focused ultrasound (IFU) ($P < 0.05$) (Table 6). Although the complications were statistically related to age, they showed a nonspecific pattern in all age groups except for the 20s. Regarding the correlation between the complications and secondary IFU, it seemed to be the result of the IFU being performed mainly on the patients with suboptimal outcomes.

FACE-Q

In FACE-Q scores, patients demonstrated middle levels of satisfaction ranging from 37.9 ± 20.7 to 57.7 ± 21.7. The score of Q1 was 43.4 ± 21.3, with the highest score of 44.3 ± 24.8 in Q6 and the lowest score of 37.9 ± 20.7 in Q3. Patients demonstrated better satisfaction with the quality of life than with appearance appraisal (Figure 6). Patients felt that they appeared 2.3 ± 1.9 years younger than their actual age (Figure 7, Table 4).

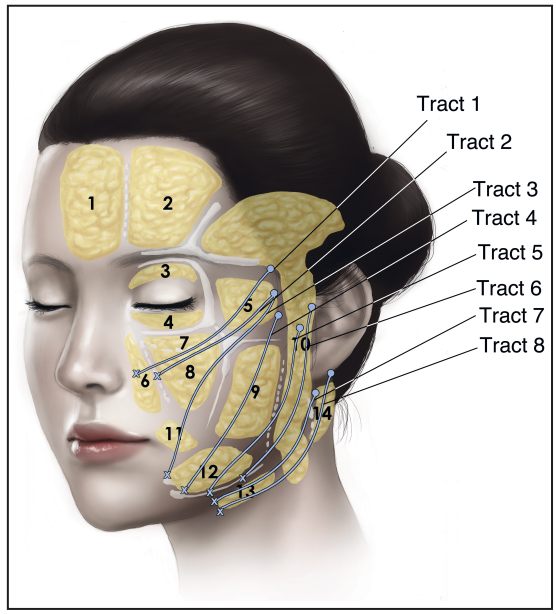

Figure 3. Stylistic drawing of the anatomical relationships of the superficial fat compartments and the 8 tracts for V-Loc 180 devices. Tract 1 for device 1 was the passage from insertion point 1 to end point 1, tract 2 for device 2 the passage from insertion point 2 to end point 2, tract 3 for device 3 the passage from insertion point 2 to end point 3, tract 4 for device 4 the passage from insertion point 3 to end point 4, tract 5 for device 5 the passage from insertion point 4 to end point 5, tract 6 for device 6 the passage from insertion point 5 to end point 6, tract 7 for device 7 the passage from insertion point 6 to end point 7, and tract 8 for device 8 the passage from insertion point 7 to end point 8.

Table 4. FACE-Q Scales and Scores Related to the Direct Effect of 3-0 V-Loc180 Devices (Covidien, Mansfield, MA)

FACE-Q domain and scale	Device	Mean +/- SD score
Appearance appraisal		
Q1- Satisfaction with facial appearance overall	From 1 to 8	43.4 ± 21.3
Q2- Satisfaction with cheeks	From 1 to 2	39.8 ± 24.3
Q3- Appraisal of nasolabial folds	From 1 to 2	37.9 ± 20.7
Q4- Satisfaction with lower face and jawline	From 3 to 8	38.5 ± 23.4
Q5- Satisfaction with chin	From 3 to 8	43.5 ± 21.2
Q6- Appraisal of marionette	From 3 to 4	44.3 ± 24.8
Area under chin		
Cheekbones		
Eyelashes		
Eyelids-Lower		
Eyelids-Upper		
Eyes		
Forehead & eyebrows		
Lines: between eyebrows		
Lines: crow's feet		
Lines: forehead		
Lines: lips		
Lines: overall		
Lips		
Neck		
Nose		
Nostrils		
Skin		
Temples		
Health-related quality of life		
Q7- Social function (confidence)		49.4 ± 17.7
Q8-Psychological function (well-being)		53.0 ± 19.2
Q9- Early life impaction of treatment		57.7 ± 21.7
Q10- Aging appraisal visual analogue scale,yr		-2.3 ± 1.9
Q11- Satisfaction of outcome		38.7 ± 24.8
Q12- Satisfaction of decision		42.6 ± 27
Adverse effects		
Cheeks, lower face, neck		
Eyes		
Forehead, eyebrows, scalp		
Lips		
Nose skin		

Q1- satisfaction with facial appearance (measuring patient satisfaction with the overall appearance of their faces); Q2- satisfaction with cheeks; Q3- appraisal of lines-nasolabial folds; Q4- satisfaction with lower face and jawline; Q5- satisfaction with chin; Q6- appraisal of lines-marionette; Q7- social function (measuring social confidence); Q8- psychological function (measuring psychological well-being); Q9- early life impaction of treatment (assessing patient recovery following the procedure); Q10- aging appraisal visual analogue scale (asking patients how old they believe they look compared with their actual age); Q11-satisfaction with outcome (measuring patient satisfaction with the overall outcome of the procedure); Q12-satisfaction with decision (measuring patient satisfaction with their decision to undergo the procedure). SD, standard deviation.

Video. Watch now at http://academic.oup.com/asjopenforum/article-lookup/doi/10.1093/asjof/ojac065

In analysis of the FACE-Q scales, statistically significant variables included age, BMI, the limited scar face lifts, additional toxin, additional filler, secondary filler or toxin, and contour injection ($P < 0.05$). $18.5 \leq BMI < 25.0$ contributed to the satisfaction with facial appearance, cheeks, early life impaction of treatment, and outcome. The additional toxin contributed to the satisfaction with the chin. With regards to social and psychological functions, the satisfaction of the patients undergoing the limited scar face lifts was higher than the satisfaction of the patients undergoing the thread-lifts. Secondary filler or toxin influenced the improvement of social function satisfaction. The aging appraisal was improved by $18.5 \leq BMI < 25.0$ (from 1.1 ± 1.2 yrs to 2.9 ± 2.0 yrs), additional filler (from.9 ± 1.6yrs to 3.2 ± 2.3yrs), and contour injection (from 1.8 ± 1.5 yrs to 3 ± 2.2 yrs). Also, the satisfaction with decision was improved by 40s & 50s, $18.5 \leq BMI < 25.0$, additional filler (Table 7). Supplemental Table 3 demonstrates the detailed data values.

DISCUSSION

In the late 1990s, the suspension technique of the barbed sutures, with Aptos threads (Kolster Methods, Inc, Anaheim, CA), were first introduced by Sulamanidze.[1,26,27] The good outcomes were preserved from 1 year and more in most, and the complications and unfavorable events were rare and inconsiderable.[28] In 2004, Dr. Lycra reported his results of 350 Aptos procedures with the reduction of ptosis in brow, midface, and lower face.[29] In 2004, Dr. Woffles reported the results of thread lifts with 2 types of barbed sutures. The results after 30% loss of initial effect in postoperative 3 months remained stable for up to 1 year.[30] The Contour Thread (Surgical Specialties, Reading, PA) was developed by Dr. Gregory Ruff in 2004.[2] The study by Abraham et al reported the results of 33 patients undergoing the Contour Thread in the mean follow-up period of 21 months.[31] Also, the study by Garvey et al reported the results of 72 patients and the study by Rachel et al reported the results of 29 patients.[32,33] In Dr. Ruff's first 350 cases,

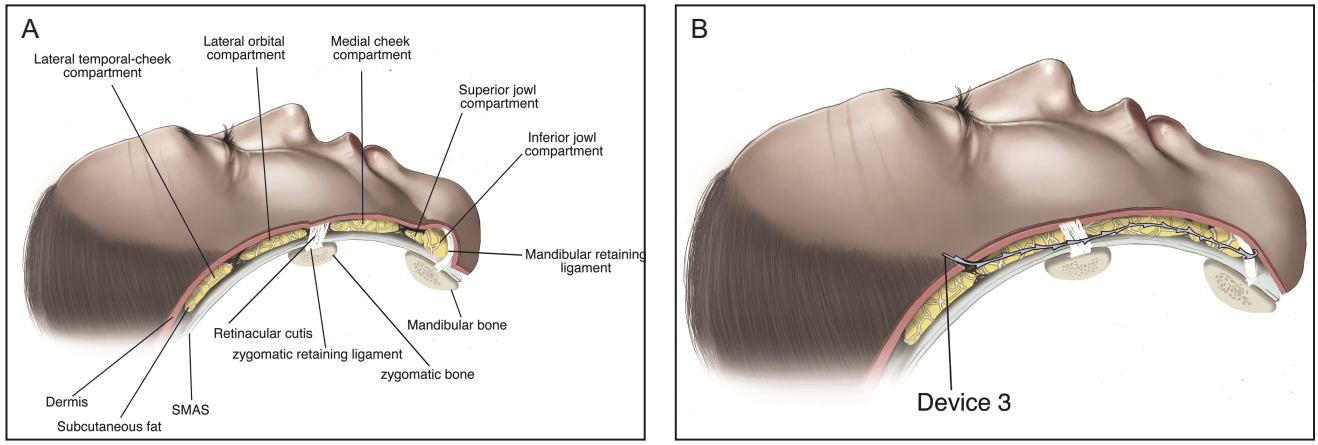

Figure 4. Schematic drawing of the arrangement of the V-Loc 180 device in the subcutaneous plane. (A) is preoperative state showing the descent of the jowl compartment. The retinacular cutis of the ligaments are hanging down. The lateral temporal-cheek, lateral orbital, and medial cheek compartments are atrophied but the inferior jowl compartment is hypertrophied. For this reason, it makes the hollow buccal cheek and jowl formation. (B) is postoperative state showing the upward displacement of the jowl compartment by the V-Loc 180 device 3. The device 3, placed subcutaneously in undulation mode, gathers the fat compartments together and moves them upwards, pulling the ligaments upwards to tighten them. As a result, the rejuvenation effect is expected by filling the hollow buccal cheek and eliminating the prominent jowl.

Figure 5. Intraoperative photograph of the tensiometer in vivo. A hemostat is attached to device 1 and the tensiometer (model DFG82; Omega, Stamford, CT) attached to the hemostat. After the tensiometer is zeroed, the tension is measured at the first sign of slippage after the point of clinical correction. This is repeated twice and averaged at device 1.

24% of patients were dissatisfied due to minimal improvement.[34] Dr. Nicanor Isse first developed the Silhouette Mid-Face Suture (Kolster Methods, Inc, Anheim, CA).[35] Patient satisfaction in 17 cases was 90% at 9 months.[2,36]

It can be found that the tension measurements correlate with compartment-specific effects and the FACE-Q helps to objectively evaluate the effects after the thread-lifts through the following findings. First, patients were better satisfied with the appearance of their marionette (Q6:44.3 ± 24.8) lifted by device 3&4 (10.1 ± 1.6 N), compared with satisfaction with the appearance of their nasolabial folds (Q3:37.9 ± 20.7) lifted by device 1&2 (8.7 ± 2.1 N). These results exhibit the possibility of a direct correlation between the tension and the results in facial shape. Second, the satisfaction with decision of the patients in their 40s, 50s and 60s was higher than that of the patients in their 20s and 30s, even though the elasticity of the face decreased gradually with getting older. Third, satisfaction with the social and psychological functions of the patients undergoing the limited scar face lifts was higher than that of the patients undergoing the thread-lifts, even though the elasticity of the patients undergoing the limited scar face lifts was lower than that of the patients undergoing the thread-lifts, whereas there was not statistically significant difference between the satisfaction with aging appraisal of the patients undergoing the limited scar face lifts and the satisfaction with aging appraisal of the patients undergoing the thread-lifts. Therefore, in terms of aging appraisal, it could be a good choice to choose the thread-lifts instead of the limited scar face lifts (Table 7). Supplemental Table 3 demonstrates the detailed data values.

There are two theories that explain the cause of facial aging: gravitational and volumetric theories. These theories are by no means mutually exclusive, and facial aging likely reflects a complex morphologic change that involves both elements of gravitational ptosis and volume deflation,[15] but it is not easy to discriminate between 2 theories in clinical practice. The tensiometer is needed as a method to help discriminate them because the elasticity of the patient's face can be objectively standardized and evaluated in each region. For example, when incomplete correction can be found immediately after the thread-lift is performed to improve deep wrinkled areas, the cause of aging can be evaluated. That is, if the measured value of the tension is below the mean value, the gravitational ptosis can be

Table 5. Analysis of the Tensile Difference between on the Right Side and on the Left Side in Slippage Tensions of 3-0 V-Loc 180 Devices in Right 8 Tracts and Left 8 Tracts

Device	Mean value (*n*) on right side (*n* = frequency)	Mean value (*n*) on left side (*n* = frequency)	Mean value (*n*) on both sides	T-value	*P*-value
Device 1&2*	8.6 ± 2.0 (*n* = 249)	8.8 ± 2.1 (*n* = 248)	8.7 ± 2.1	−2.03	0.0438*
Device 3&4*	10.0 ± 1.5 (*n* = 256)	10.3 ± 1.6 (*n* = 244)	10.1 ± 1.6	−3.65	0.0003*
Device 5&6*	9.3 ± 1.6 (*n* = 256)	9.5 ± 1.5 (*n* = 244)	9.4 ± 1.6	−2.02	0.044*
Device 7&8	9.9 ± 2.1 (*n* = 62)	9.8 ± 2.5 (*n* = 63)	9.9 ± 2.3	0.34	0.7329
Mean value (*n*)	9.5 ± 1.8	9.6 ± 1.9	9.5 ± 1.9	−1.22	0.227

The statistic technique used in this table is paired t-test. *Devices where *P*-value < 0.05 is considered statistically significant. Device 1&2 means the device 1 and 2 together in lateral orbital-nasolabial tract (L-N tract) including tract 1 and 2. Device 3&4 means the device 3 and 4 together in lateral orbital-jowl tract (L-J tract) including tract 3 and 4. Device 5&6 means the device 5 and 6 together in lateral temporal-inferior jowl tract (L-I tract) including tract 5 and 6. Device 7&8 means the device 7 and 8 together in subauricular-submandibular tract (S-S tract) including tract 7 and 8. N, newton.

Table 6. Analysis of the Complications according to Age Group, Sex, BMI, Previous Operative Histories, Main Procedures, Other Plastic Surgeries, Additional Toxin, Additional Filler, Secondary Filler or Toxin, Secondary Intense Focused Ultrasound, and Contour Injection

Variables	Level	Complications			DF	χ2 value	*P*-Value
		Without	With	Row total			
Age*	20s	12	0	12	4	9.6498	S(*P* = 0.0468)*
	30s	84	6	90			
	40s	133	4	137			
	50s	92	3	95			
	60s	30	5	35			
	Column total	351	18	369			
Secondary Intense Focused Ultrasound*	Without	321	13	334	1	7.3754	S(*P* = 0.0066)*
	With	30	5	35			
	Column total	351	18	369			
Others							NS

The statistic technique used in this table is chi-square test. *Variables where *P*-value < 0.05 is considered statistically significant. BMI, body mass index (kg/m^2); DF, degree of freedom; NS, statistically not significant; S, statistically significant.

judged as the cause of aging, while if the volume is insufficient after the concave area is filled with the tissue lifted and moved upward, the volume deflation can be judged as the cause of aging. After all, the tension measurements play the same role as the indicator between gravitational and volumetric theory. In the algorithm for compartment thread-lifts, there are six factors including BMI, age, lateral pull skin stretch on the temporal area, intraoperative tensions, clinical correction immediately, and subcutaneous fat volume. After lateral pull skin stretch on the temporal area, toxin and filler were recommended if it was less than 1 cm, and the limited scar facelift was recommended if it was more than 2 cm. This recommends the adequate procedures for a variety of cases (Figure 8).

The characteristics of ideal candidates are as follows: among patients in their 40s, 50s, and 60s having a body mass index of 18.5 or more, the condition is possible if they are satisfied with looking 2.3 years younger than their actual age during a mean follow-up of 2.5 years after the thread-lifts.

A strength of this study is that it is one of the first investigations into the correlation between the tension measurements and the long-term results after thread-lifts by the objective assessment system. It is also one of the first investigations into measuring and quantifying the biomechanical properties of the compartments of the face by using the tensiometer in vivo.

A weakness of this study is that no one knows whether different regions of the face exactly maintain durability of correction based on preoperative and postoperative tension measurement. Another limitation is that the tensions measured may vary depending on the type of suture system. Last, the study is limited by the small size (*n* = 50) of the samples, and that the samples are limited to Asian in the FACE-Q.

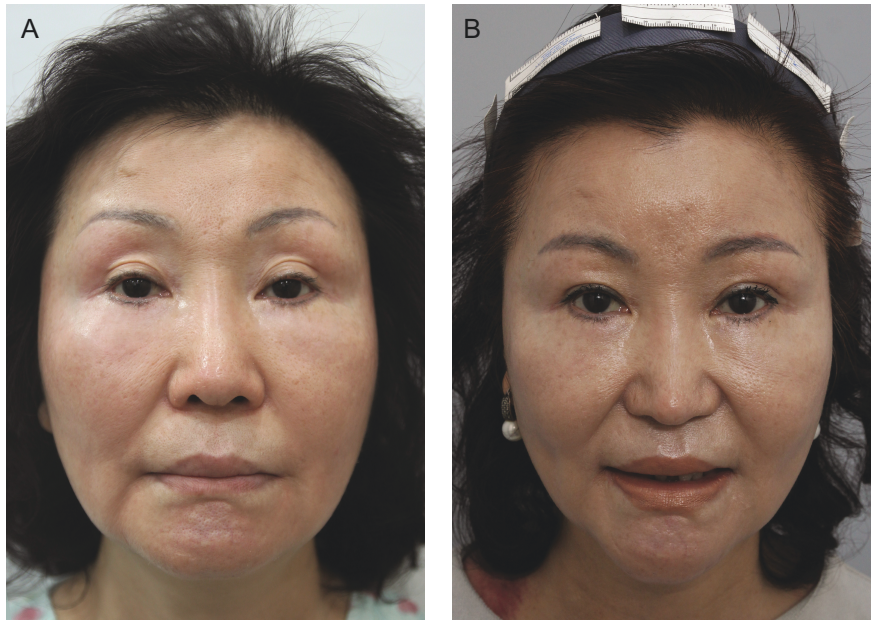

Figure 6. (A) Preoperative and (B) postoperative photographs of a 57-year-old female patient. The patient (BMI: 18.9kg/m2) presented with a deep nasolabial fold, deep marionette line, deep pre-jowl sulcus, prominent jowl, and wide chin on the right side. She previously underwent the thread-lift, sub-brow lift, and lower blepharoplasty. One year and 4 months postoperatively, she presented with the improvement of her marionette line, pre-jowl sulcus, jowl, and chin, but with a deep nasolabial fold. The procedures she underwent included the temporal thread-lift, mastoid thread-lift, posterior auricular face lift, rhinoplasty, secondary filler, and contour injection.

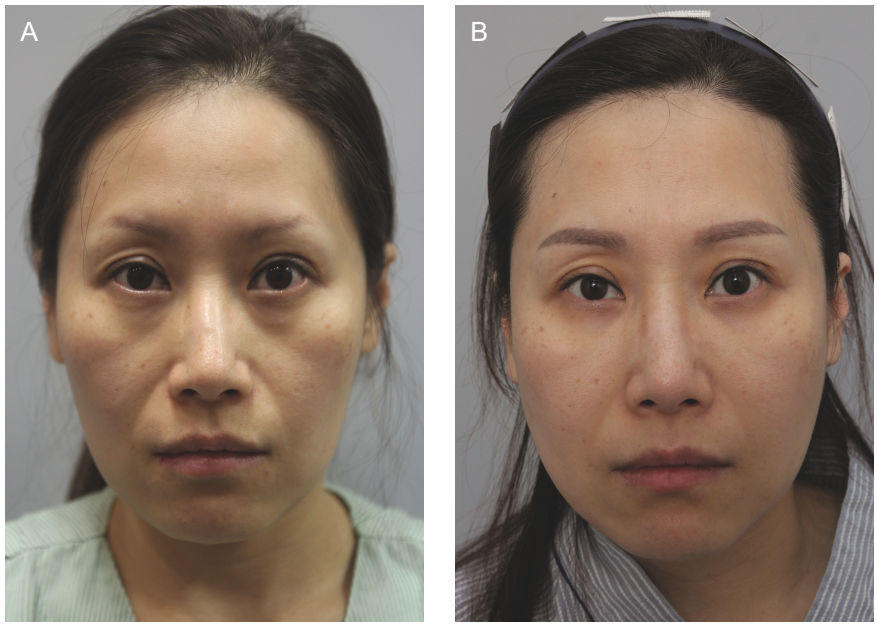

Figure 7. (A) Preoperative and (B) postoperative photographs of a 37-year-old female patient. The patient (BMI: 20.1 kg/m^2) presented with deep tear troughs, deep midface grooves, moderate nasolabial folds with hollow anterior and buccal cheeks. She previously underwent the thread-lift and intense focused ultrasound. Eight months postoperatively, she showed the improvement of her tear troughs, midface grooves, and nasolabial folds with full anterior and buccal cheeks. The procedures she underwent included the temporal thread-lift, mastoid thread-lift, additional filler, secondary filler, and contour injection. But, after all, she was not satisfied with her improved appearance and then underwent the temporal and posterior auricular face lifts.

Table 7. Analysis of the Intraoperative Tensions, Complications, and FACE-Q

Variables	Intraoperative tensions	Complications	FACE-Q
Age*	S	S	S
Sex*	S	NS	NS
BMI*	NS	NS	S
Previous operative histories*	S	NS	NS
Previous lower blepharoplasty histories*	S	NS	NS
Previous thread-lift histories*	S	NS	NS
Previous face lift histories*	S	NS	NS
Previous reduction malarplasty and/or mandibular angle ostectomy histories	NS	NS	NS
Previous maxillofacial surgery histories	NS	NS	NS
Previous fat graft histories	NS	NS	NS
The limited scar face lifts*	S	NS	S
Other plastic surgeries	NA	NS	NS
Additional toxin*	NA	NS	S
Additional filler*	NA	NS	S
Secondary filler or toxin*	NA	NS	S
Secondary intense focused ultrasound*	NA	S	NS
Contour injection*	NA	NS	S
Complications	NS	NA	NS

The statistical techniques used in this table include independent t-test, ANOVA, and chi-square test. *Variables where *P*-value < 0.05 is considered statistically significant. BMI, body mass index (kg/m^2); NA, not applicable; NS, statistically not significant; S, statistically significant.

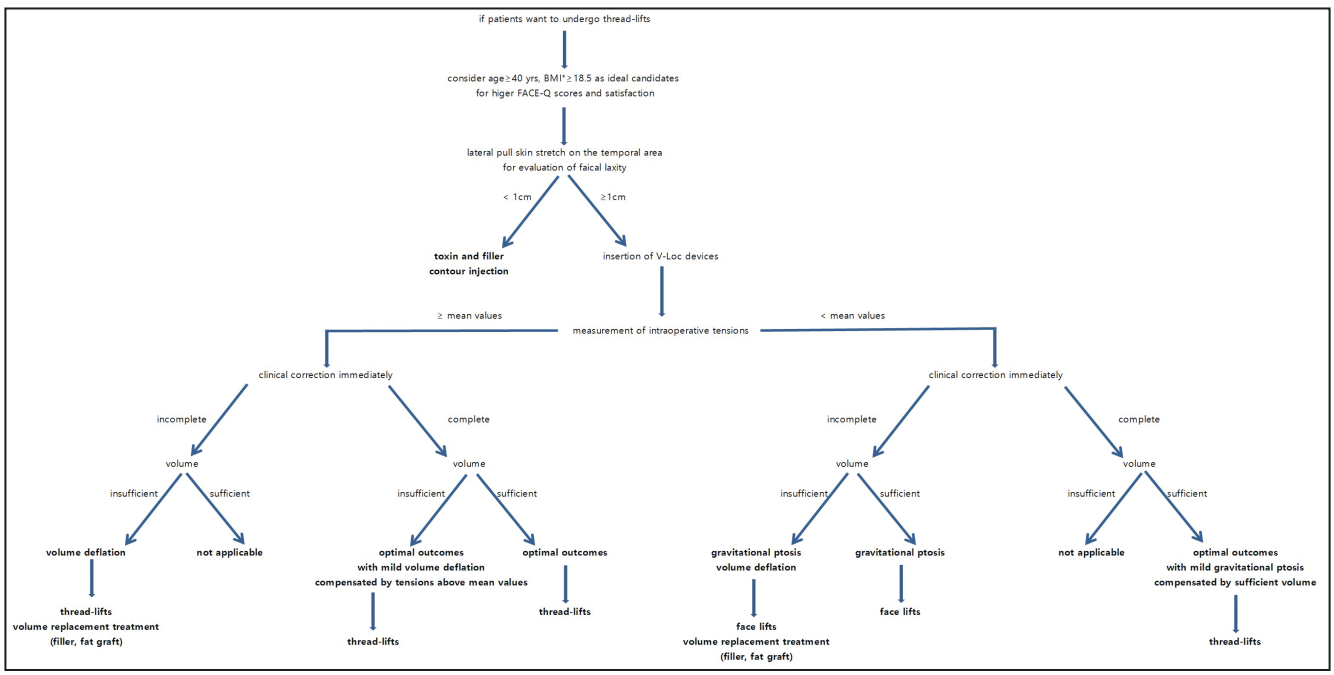

Figure 8. Algorithm for compartment thread-lifts. Lateral pull skin stretch on the temporal area means that the operator measures the skin pushed upward above the zygomatic arch. After lateral pull skin stretch on the temporal area, toxin and filler were recommended if it was less than 1 cm and the limited scar facelift was recommended if it was more than 2 cm. Also intraoperative tensions can be compared with mean values of each tract in Table 5. BMI, body mass index (kg/m^2).

CONCLUSIONS

The tension measurements, playing the same role as the indicator between gravitational and volumetric theories, correlate with compartment-specific effects, and FACE-Q helps to objectively evaluate the effects after thread-lifts. The limited effectiveness of thread-lifts was objectively found to make patients look 2.3 years younger than their actual age during a mean follow-up of 2.5 years.

Supplemental Material

This article contains supplemental material located online at www.asjopenforum.com.

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