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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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...
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). 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; 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 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 ± 10.1 years | 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/m² | | |
| No. of patients | 267 (72.36) | 50 (100) |
| Mean | 20.7 ± 2.4 kg/m² | 20.0 ± 1.9 kg/m² |
| Range | 15.6–29.1 kg/m² | 16.88–25.11 kg/m² |
| 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.
### 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 | 154 (40.6) | 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) |

| Items | No. (%) of total patients | No. (%) of respondents in FACE-Q |
|-------|--------------------------|---------------------------------|
| • Lower blepharoplasty | 19 (5.16) | 2 (4) |
| • Upper & lower blepharoplasty | 7 (1.89) | 1 (2) |
| • Platysmal suspension | 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) | | |
| • Scar revision | 2 (0.54) | | |
| • Lower blepharoplasty + platysmal suspension | 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 | 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) |

*FACE-Q*: 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.
Kim 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/m². 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 | Mandibular ligament | 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 cheek septum | Mandibular ligament | 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 | 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 | 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 submandibular area, undefined man- dibilular 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 1 cm 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 1 cm below and 1 cm 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 1 cm 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 platysma-auricular ligaments and fibrous septum between submental and submandibular compartments.

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 ± 217. 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).
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 ($P < 0.05$). $18.5 \leq \text{BMI} < 25.0$ contributed to the satisfaction with facial appearance, cheeks, early life impactation 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 threadlifts. Secondary filler or toxin influenced the improvement of social function satisfaction. The aging appraisal was improved by $18.5 \leq \text{BMI} < 25.0$ (from $1.1 \pm 1.2$ yrs to $2.9 \pm 2.0$ yrs), additional filler (from $3.9 \pm 1.6$ yrs to $3.2 \pm 2.3$ yrs), and contour injection (from $1.8 \pm 1.5$ yrs to $3 \pm 2.2$ yrs). Also, the satisfaction with decision was improved by $40$s & $50$s, $18.5 \leq \text{BMI} < 25.0$, 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,
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24% of patients were dissatisfied due to minimal improvement. Dr. Nicanor Isse first developed the Silhouette Mid-Face Suture (Kolster Methods, Inc, Anheim, CA). Patient satisfaction in 17 cases was 90% at 9 months. 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). Supplementary 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, 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
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).

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 1&2* | 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        |         |
|                                           | 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       |         |
|                                           | With   | 30      | 5   | 35        |         |
|                                           | Column total | 351     | 18 | 369       |         |
| Others                                   |       |         |     |           |         |

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/m²); DF, degree of freedom; NS, statistically not significant; S, statistically significant.

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: 18.9 kg/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/m²) 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/m²); 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/m²).
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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