INTRODUCTION

Thread lifting is popular due to its effectiveness in correcting facial ptosis. It is performed at the subcutaneous level or deeper planes to pull the tissues in the desired direction. The lower end of the thread should be tightly suspended at the hanging point against gravity. From previous studies, the facial tissue density was investigated by the histological and cadaveric methods. However, the hanging ability in different tissue planes was still not clearly determined in terms of quantitative measurements. Therefore, this study aimed to evaluate the implications of the tissue resistance for the ability of the tissue layers to hold the thread. High resistance implies the ideal layer having strong and dense fibrous components, which would be effective hanging points.

MATERIALS AND METHODS

Twenty hemi-faces of 10 soft cadavers, which were divided into 45 blocks, were used to measure the tissue resistance in the midface area. The resistance of the soft tissue in the four facial layers in each block was measured while a 22G cannula connected with a force gauge was passed through it. The results showed that the tissue resistance in the sub-SMAS was higher than the SMAS and subcutaneous layers in the blocks located in the nasolabial and perioral regions. This was also significantly greater than the resistance in the subcutaneous layer in the three medial blocks below the oral commissure (P < 0.05). However, the low resistance of the sub-SMAS was found in the blocks located in the buccal and lower parotidomasseteric regions.

Summary: The thread lift procedure is a minimally invasive alternative to facelift surgery. The hanging point, which the terminal end of the thread is hooked into, is an important component. If it is loose and cannot stabilize the passage when the inserted thread is pulled, the lifting effect will fail. Therefore, the aim of this study was to elucidate the ability of the tissue to support the thread attachment in the different facial layers while performing this procedure. Twenty hemi-faces of 10 soft cadavers, which were divided into 45 blocks, were used to measure the tissue resistance in the midface area. The resistance of the soft tissue in the four facial layers in each block was measured while a 22G cannula connected with a force gauge was passed through it. The results showed that the tissue resistance in the sub-SMAS was higher than the SMAS and subcutaneous layers in the blocks located in the nasolabial and perioral regions. This was also significantly greater than the resistance in the subcutaneous layer in the three medial blocks below the oral commissure (P < 0.05). However, the low resistance of the sub-SMAS was found in the blocks located in the buccal and lower parotidomasseteric regions. Moreover, the sub-SMAS layer within the buccal and lower parotidomasseteric regions should be avoided due to the loose attachment in the buccal capsule and subplatysmal fat. (Plast Reconstr Surg Glob Open 2021;9:e3701; doi: 10.1097/GOX.0000000000003701; Published online 15 July 2021.)

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The measurements were performed in 45 blocks in four anatomical layers: the subdermal, subcutaneous, SMAS, and sub-SMAS layers. The resistance was measured three times in each block using a 22G blunt-tip cannula attached to a force gauge. It measured the axial force and was not affected by the lateralizing movements. At the beginning, the scale was set to zero, and the cannula was inserted from the same puncture point that was previously made. The cannula was pierced in the inferomedial direction relating to the vector in thread lifting for 1 cm. The measurement at the subdermal layer was initially performed in intact skin. The skin was peeled for the subcutaneous measurement under direct vision. Then, the subcutaneous layer was removed for the measurements in the SMAS and sub-SMAS layers, respectively. (See figure 1, Supplemental Digital Content 1, which displays the SMAS measurement. The cannula was inserted from the same puncture point that was previously made at the superolateral angle of each block. The cannula insertion through the target layer in the inferomedial direction relating to the vector in thread lifting was performed at a 1 cm-distance of the cannula.

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**Table 1. Tissue Resistance in Each Block according to Four Anatomical Layers**

| Blocks                  | Subdermal, Mean ± SD | Subcutaneous, Mean ± SD | SMAS, Mean ± SD | Sub-MAS, Mean ± SD |
|-------------------------|----------------------|-------------------------|-----------------|--------------------|
| Apex of nasolabial      | 7.71 ± 4.28          | 2.50 ± 0.85             | 1.81 ± 0.45     | 3.08 ± 1.08        |
| Medial nasolabial       | 7.82 ± 3.55          | 1.93 ± 0.76             | 2.05 ± 0.34     | 3.03 ± 1.06        |
| Lateral nasolabial      | 5.94 ± 2.76          | 1.80 ± 1.05             | 1.31 ± 0.48     | 2.10 ± 0.69        |

Above oral commissure

| Block 1 | 5.40 ± 2.97 | 2.11 ± 1.22 | 2.38 ± 1.25 | 2.44 ± 0.86 |
|---------|-------------|-------------|-------------|-------------|
| Block 2 | 6.51 ± 4.44 | 1.52 ± 0.52 | 1.74 ± 1.31 | 2.15 ± 0.79 |
| Block 3 | 5.26 ± 2.21 | 2.14 ± 1.15 | 1.71 ± 0.72 | 2.30 ± 0.85 |
| Block 4 | 6.54 ± 2.87 | 2.38 ± 0.00 | 2.11 ± 1.04 | 1.95 ± 1.04 |
| Block 5 | 7.12 ± 3.81 | 2.55 ± 1.13 | 2.81 ± 2.29 | 1.80 ± 0.73 |
| Block 6 | 8.72 ± 4.26 | 2.01 ± 0.76 | 2.40 ± 1.12 | 2.21 ± 1.40 |
| Block 7 | 5.58 ± 2.84 | 1.86 ± 0.63 | 2.40 ± 1.10 | 1.66 ± 0.90 |
| Block 8 | 6.37 ± 4.28 | 1.98 ± 0.77 | 3.23 ± 1.54 | 3.01 ± 1.70 |
| Block 9 | 6.24 ± 3.88 | 2.17 ± 0.78 | 3.25 ± 1.56 | 3.28 ± 2.17 |

Below oral commissure

| Block 1 | 6.68 ± 3.31 | 1.54 ± 0.52 | 2.38 ± 0.70 | 2.84 ± 1.05 |
|---------|-------------|-------------|-------------|-------------|
| Block 2 | 4.56 ± 1.79 | 1.66 ± 0.56 | 1.59 ± 0.69 | 2.28 ± 0.67 |
| Block 3 | 5.92 ± 3.67 | 1.42 ± 0.72 | 2.12 ± 0.56 | 2.45 ± 0.77 |
| Block 4 | 5.10 ± 2.79 | 2.06 ± 0.92 | 1.91 ± 0.92 | 1.83 ± 0.97 |
| Block 5 | 5.07 ± 2.07 | 1.89 ± 0.72 | 1.75 ± 0.68 | 1.62 ± 0.75 |
| Block 6 | 7.17 ± 4.49 | 1.87 ± 0.59 | 2.14 ± 1.02 | 1.83 ± 1.04 |
| Block 7 | 7.39 ± 5.25 | 1.71 ± 0.56 | 2.40 ± 1.19 | 1.83 ± 1.04 |
| Block 8 | 7.99 ± 4.37 | 2.39 ± 0.76 | 2.27 ± 1.12 | 1.60 ± 0.62 |
| Block 9 | 6.11 ± 2.89 | 2.13 ± 0.64 | 2.60 ± 1.44 | 1.89 ± 1.67 |
RESULTS

The measured resistance is summarized in Table 1. The resistance in the subdermal layer was approximately three times higher than those of other layers ($P < 0.05$).

In the other three layers, the statistically significant differences of the resistance in each block according to the facial layers were found in the apex and medial blocks of the nasolabial region, and in the first, second, and third blocks below the oral commissure (Tables 2, 3). In the nasal region, the measured resistance in the SMAS layer ($P = 0.004$). In the medial nasal block, there were significant pairwise differences between the sub-SMAS and subcutaneous layers ($P = 0.022$), and between the subcutaneous and SMAS layers ($P = 0.045$) and the sub-SMAS and subcutaneous layers ($P = 0.022$). In addition, in the area 1 cm below the oral commissure, there were significant pairwise differences between the SMAS and subcutaneous layers of the first block ($P < 0.001$) and between the sub-SMAS and subcutaneous layers ($P < 0.001$). In the second block, there were significant pairwise differences between the sub-SMAS and subcutaneous layers ($P = 0.017$) and between the sub-SMAS and SMAS layers ($P = 0.014$). Lastly, the resistance in the sub-SMAS of the third block was significantly greater than the subcutaneous layer ($P = 0.002$).

DISCUSSION

The resistance in the subdermal layer was extremely high compared with the other layers because of the numerous retinacular cuts. The thread could not be practically placed in this plane because the thread would be visible and palpable from the external surface. As such, this was beneficial for comparing with other layers as a control.

From Figure 2, the resistance in the SMAS layer was high in the medial and lateral parts below the oral

| Block        | Layer (1)- Layer (2) | Tissue Resistance (N) between Layer Comparison |
|--------------|----------------------|-------------------------------------------------|
|              | Mean ± SD (1) | Mean ± SD (2) | p-value |
| Apex         | Subcutaneous-SMAS | 2.50 ± 0.85 | 1.81 ± 0.45 | 0.021 |
|              | Subcutaneous-SubSMAS | 2.50 ± 0.85 | 3.08 ± 1.08 | 1.000 |
|              | SMAS-SubSMAS | 1.81 ± 0.45 | 3.08 ± 1.08 | 0.004* |
| Medial nasolabial | Subcutaneous-SMAS | 1.93 ± 0.76 | 2.05 ± 0.34 | 1.000 |
|              | Subcutaneous-SubSMAS | 1.93 ± 0.76 | 3.03 ± 1.06 | 0.045* |
|              | SMAS-SubSMAS | 2.05 ± 0.34 | 3.03 ± 1.06 | 0.022* |
| Lateral nasolabial | Subcutaneous-SMAS | 1.80 ± 1.05 | 1.31 ± 0.48 | 1.000 |
|              | Subcutaneous-SubSMAS | 1.80 ± 1.05 | 2.10 ± 0.69 | 1.000 |
|              | SMAS-SubSMAS | 1.31 ± 0.48 | 2.10 ± 0.69 | 0.058 |

*There was a statistically significant difference between the tissue resistance of 2 layers, $P < 0.05$.

| Block        | Layer (1)- Layer (2) | Tissue Resistance (N) between Layer Comparison |
|--------------|----------------------|-------------------------------------------------|
|              | Mean ± SD (1) | Mean ± SD (2) | p-value |
| Above Oral Commissure | Mean ± SD (1) | Mean ± SD (2) |  |
| 1 Subcutaneous-SMAS | 2.11 ± 1.22 | 2.38 ± 1.25 | 1.000 |
| Subcutaneous-SubSMAS | 2.11 ± 1.22 | 2.44 ± 0.86 | 1.000 |
| SMAS-SubSMAS | 2.38 ± 1.25 | 2.44 ± 0.86 | 1.000 |
| 2 Subcutaneous-SMAS | 1.52 ± 0.52 | 1.74 ± 1.31 | 1.000 |
| Subcutaneous-SubSMAS | 1.52 ± 0.52 | 2.15 ± 0.79 | 0.221 |
| SMAS-SubSMAS | 1.74 ± 1.31 | 2.15 ± 0.79 | 0.156 |
| 3 Subcutaneous-SMAS | 2.14 ± 1.15 | 1.71 ± 0.72 | 0.535 |
| Subcutaneous-SubSMAS | 2.14 ± 1.15 | 2.30 ± 0.85 | 0.963 |
| SMAS-SubSMAS | 1.71 ± 0.72 | 2.30 ± 0.85 | 0.105 |
| 4 Subcutaneous-SMAS | 2.38 ± 0.90 | 2.11 ± 1.04 | 0.855 |
| Subcutaneous-SubSMAS | 2.38 ± 0.90 | 1.95 ± 1.04 | 0.521 |
| SMAS-SubSMAS | 2.11 ± 1.04 | 1.95 ± 1.04 | 0.956 |
| 5 Subcutaneous-SMAS | 2.55 ± 1.13 | 2.81 ± 2.29 | 1.000 |
| Subcutaneous-SubSMAS | 2.55 ± 1.13 | 1.80 ± 0.75 | 0.598 |
| SMAS-SubSMAS | 2.81 ± 2.29 | 1.80 ± 0.75 | 0.834 |
| 6 Subcutaneous-SMAS | 2.01 ± 0.76 | 2.40 ± 1.12 | 1.000 |
| Subcutaneous-SubSMAS | 2.01 ± 0.76 | 2.21 ± 1.40 | 1.000 |
| SMAS-SubSMAS | 2.40 ± 1.12 | 2.21 ± 1.40 | 1.000 |
| 7 Subcutaneous-SMAS | 1.86 ± 0.63 | 2.40 ± 1.10 | 1.000 |
| Subcutaneous-SubSMAS | 1.86 ± 0.63 | 1.66 ± 0.90 | 1.000 |
| SMAS-SubSMAS | 2.40 ± 1.10 | 1.66 ± 0.90 | 0.375 |
| 8 Subcutaneous-SMAS | 1.98 ± 0.77 | 3.29 ± 1.54 | 1.000 |
| Subcutaneous-SubSMAS | 1.98 ± 0.77 | 3.01 ± 1.70 | 0.106 |
| SMAS-SubSMAS | 3.29 ± 1.54 | 3.01 ± 1.70 | 0.460 |
| 9 Subcutaneous-SMAS | 2.17 ± 0.78 | 3.25 ± 1.56 | 1.000 |
| Subcutaneous-SubSMAS | 2.17 ± 0.78 | 3.28 ± 2.17 | 0.317 |
| SMAS-SubSMAS | 3.25 ± 1.56 | 3.28 ± 2.17 | 1.000 |

*There was a statistically significant difference between the tissue resistance of 2 layers, $P < 0.05$.
commissure, which were the fibrous components of the perioral and platysma muscles, respectively. The low resistance in the lateral nasolabial block was the oblique fiber of the zygomaticus minor and major muscles. In the sub-SMAS layer, the SMAS of the upper parotid area was strongly attached to the parotidomasseteric fascia. The highest resistance at the ninth block was the Lore’s fascia and the platysma-auricular ligament that would benefit the platysma suspension sutures. The substantially high resistance was found in the sub-SMAS and subdermal layers in the nasolabial and perioral regions due to indirect myocutaneous insertions from the SMAS to the oral mucosa, and the skin forming a confluence of multiple tissue layers. Furthermore, the slightly high resistance in the sub-SMAS layer at the sixth and seventh blocks in the lower masseteric region implied the masseteric ligament. Although the high resistance was suitable for hanging the thread, the physician should be aware of the facial artery in the sub-SMAS layer of the nasolabial region and facial nerve buccal branches in the upper parotidomasseteric region. The physician should slowly insert or redirect the thread without any vigorous movement when encountering high resistance. Additionally, low resistance in the sub-SMAS layer was found in the buccal, premasseteric and lower parotid regions. These areas represented the buccal capsule, premasseteric space, and subplatysmal fat that continued from the neck, respectively.

In general, the sub-SMAS layer was thin and not recommended as a hanging point because the retaining ligament would restrain the SMAS, and the thick subcutaneous tissue could descend when the sub-SMAS layer was elevated. Two areas were exceptionally recommended. The nasolabial and perioral regions inherited the oral mucosa lining that facilitated lifting without the sagging of any dense overlying tissue. The other area was the upper parotidomasseteric regions in which the elastic parotid parenchyma allowed the effective lifting of the overlying sub-SMAS layers.

However, a cadaveric study had the limitation of less tissue resistance compared with a study in live patients because the superficial layer was removed to insert the cannula under direct vision for precise measurement and tissue elasticity, and the muscle tones were not well-preserved. The resistance from this study was the guidance to choose appropriate hanging points for the thread lifting. The clinician could practice and verify the correct tissue plane for the thread placement in the cadaver workshops. The suggestions for the effective lifting of elongated muscles and ptotic tissues may be applied in a myomodulation live patient, resulting in achieving the optimal outcomes of the facial animations when the mimetic muscles contracted under new optimal environments.

**CONCLUSIONS**

The effective hanging point in the nasolabial and perioral regions should be the sub-SMAS as the first choice, whereas the SMAS layer would be the secondary recommendation. In the buccal region, the best choice was the subcutaneous layer for sufficient lifting. The hanging point in the parotidomasseteric regions should be the SMAS layer as the primary option. The secondary options for the upper and lower parotidomasseteric regions were the sub-SMAS and subcutaneous layers, respectively. Lastly, the sub-SMAS layer within the buccal and lower parotidomasseteric regions should be avoided to prevent the thread slipping out from the loose attachment in the buccal capsule and subplatysmal space. (See figure 2, Supplemental Digital Content 2, which displays the recommendation for the effective hanging point (A). The green area in the nasolabial and perioral regions showed that the hanging point in the sub-SMAS and SMAS layers were the first and second recommendations, respectively. The white area in the buccal region represented that the hanging point should be the subcutaneous and SMAS layers to avoid the loose attachment in the buccal capsule (arrow heads in Fig. B). The blue area in the upper parotidomasseteric region representing the hanging point should be in the SMAS or sub-SMAS layer because of the dense fibrous connective tissue (arrows in Fig. C). Lastly, the
yellow area in the lower parotidomasseteric region representing the hanging point should be the SMAS and subcutaneous layers, respectively to avoid the loose attachment in the subplatysmal fat (D).  

![](http://links.lww.com/PRSGO/B712.)

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