

Ultrasound-guided thread lifting for the prevention of parotid gland and diagnosing parotid duct complications

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Abstract

Background: Thread lifting is a common minimally invasive plastic surgery procedure. Parotid gland injury caused by thread lifting is a known complication; however, visual evidence of this complication is lacking.

Objectives: This study aimed to present cases of parotid gland injury by thread lifting shown using ultrasound and to discuss the importance of ultrasound detection of the location of the parotid gland before thread insertion.

Methods: This study included eight patients diagnosed with parotid gland perforation and one with parotid duct injury due to threads from November 2020 to October 2022.

Results: Six patients showed tenderness and swelling, three were asymptomatic, and one with duct injury showed severe swelling and pain. Although the severity and duration of symptoms have differed, we confirmed the progress of improvement with conservative treatment and confirmed ultrasound findings progressed.

Conclusions: Using ultrasound to detect the parotid gland's location before thread lifting might reduce the chance of parotid duct injury. Identifying immediate parotid duct or gland injury with ultrasound can help to act quickly for delayed pain or swelling and reduce the likelihood of additional complications.

KEYWORDS

parotid duct, parotid gland, parotitis, polydioxanone threads, thread lifting, ultrasound

1 | INTRODUCTION

Thread lifting is a recently popular procedure used for minimally invasive face lifting.¹ The benefits of using thread for face lifting include short recovery time, minimal scarring, and a high patient satisfaction rate.

There are various techniques for midface thread lifting, but the usual vector is the upper lateral for soft tissue repositioning.² Hair-line entry points are usually made and directed to the mouth corner

area. During the procedure, threads encounter various structures of the face. It might seem obvious, but complications can occur if thread lifting is performed without sufficient anatomical knowledge. The complications include thread protrusion, infection, and dimpling.³⁻⁵ One of the troublesome complications of thread lifting is perforation of the parotid gland, leading to chronic inflammation.⁶

The parotid gland is the largest salivary gland, which lies anteriorly and inferiorly to the external acoustic meatus over the mandible and sternocleidomastoid muscle.^{6,7} The anterior border of the parotid

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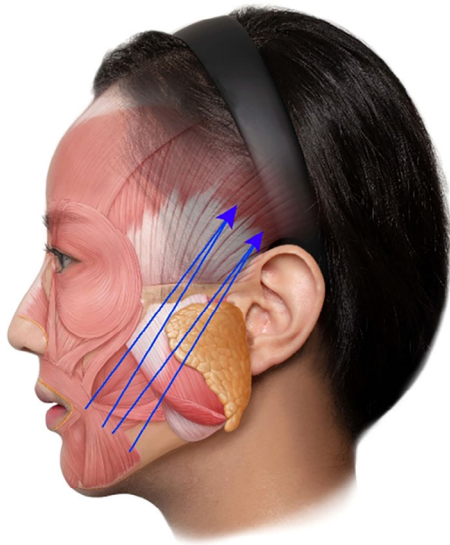


FIGURE 1 Schematic representation of common vectors used in thread lifting and the location of the parotid gland.

gland passes inferiorly along the masseter muscle and overlies its lateral surface. As it crosses the mandibular angle, the parotid gland tapers to a blunt apex inferiorly, called the tail of the parotid gland.⁸ If the lifting vector and anatomical plane placing thread are not considered accurately, the thread can encounter the upper or medial side of the parotid gland during the midface thread lifting procedure and make it prone to damage (Figure 1).

Doppler ultrasound is also a non-invasive imaging test, and its application to esthetic procedures is gradually expanding to reduce complications that can occur in blind invasive procedures.⁹ Regarding patient safety during thread lifting, a Doppler ultrasound can be performed to detect blood vessels during thread-lifting procedures to prevent arterial damage.¹⁰ Furthermore, Doppler ultrasound can be applied to detect the location of the parotid gland and prevent damage during facial rejuvenation using threads. However, there are still limited reports on the application of Doppler ultrasound for parotid gland protection and imaging findings or the progress of patients whose parotid glands are injured during thread lifting. This study aimed to present various cases of parotid gland perforation caused by threads that were detected using ultrasound and discuss the importance of ultrasound detection of the parotid gland location before thread insertion.

2 | PATIENTS AND METHODS

This single-centered retrospective case series included 703 patients who visited the clinic and underwent facial lifting using polydioxanone (PDO) threads from November 2020 to October 2022. All patients were assessed with ultrasound preoperatively. In total, 6–9 threads were inserted on one side of the midface for each patient, with an average of 7.8 threads. A skin insertion site was made with a 21 G needle tip, and the thread was introduced into the SMAS layer towards the ante-

rior face, beginning at the temple. The location where the thread was pulled out crossed the nasolabial fold or the nasolabial fat pad before the nasolabial fold.

For patients who complained of pain during the operation, an ultrasound FU was performed immediately after or on the day of the procedure. Postoperative complications, such as swelling, hematoma, persistent pain, bruising, and chronic inflammation were also evaluated.

This study was approved by each individual participated for the study and written consents were obtained. All procedures in the study were performed in accordance with the ethical standards of the institutional and national research committee and the Declaration of Helsinki.

2.1 | Doppler ultrasound detection

Doppler ultrasound was performed before thread lifting using a hockey stick probe (8–17 MHz, E cube platinum probe; Alpinion Co., Seoul, South Korea) (Figure 1). Doppler ultrasound was applied to the lateral side of face preoperatively; the location of the masseter muscle and parotid gland could be clearly identified by asking the patient to bite the teeth firmly.

When the ultrasonic probe was placed parallel to the thread, it was possible to identify a thread contour that looked like a hyperechoic path rod. If the pain was severe during the procedure, ultrasound could be applied before removing the cannula immediately to identify the inserted layer more clearly than the cannula.

3 | RESULTS

Among the 703 patients, 675 were female, and 28 were male. The mean age of the patients was 55 (range, 34–76) years. In total, 79 patients who received thread lifting experienced acute moderate swelling. None of the patients who experienced major infections required IV antibiotics. Also, eight patients developed inflammation and persistent pain over 7 days and required anti-inflammatory medication, and 21 were dissatisfied with the dimple and thread protrusion.

Further, eight patients had thread-induced parotid gland perforation, and one had been diagnosed with parotid duct injury complications using postoperative Doppler ultrasound. Also, six patients showed tenderness and swelling, three did not complain of tenderness but mild swelling, and one with duct injury showed severe swelling and pain.

3.1 | Case series

3.1.1 | Case 1

A healthy 50-year-old woman visited the clinic for thread lifting. She underwent bilateral thread lifting with bidirectional clogged threads. In

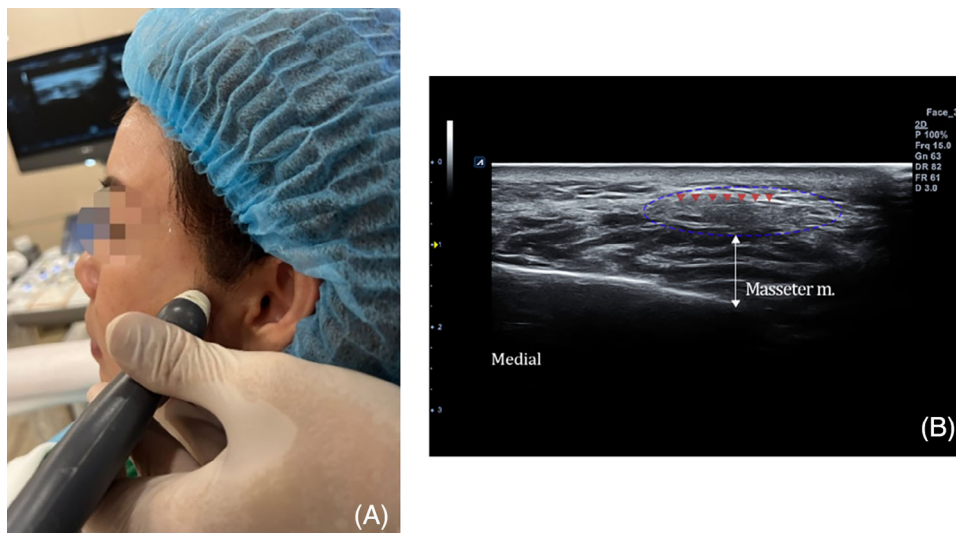


FIGURE 2 Ultrasound imaging of the parotid gland. (A) Ultrasound scan of the parotid gland. (B) Ultrasound finding showing thread penetration of the parotid gland (blue dot circle) with the thread indicated by a red arrowhead.

total, 28 threads were inserted bilaterally (14 threads unilaterally). The patient experienced pain when thread lifting was performed on the left side near the masseteric muscle area. Immediately after the operation, she experienced pain when chewing. Augmentin 625 mg (amoxicillin 500 mg + clavulanate 125 mg) and acetaminophen 500 mg bid were prescribed for 3 days to prevent infection. Eight days after the operation, she continued to experience pain when chewing, and mild swelling persisted. Methylprednisolone 4 mg and additional Augmentin 625 mg bid for 7 days were prescribed. By postoperative day 22, her symptoms had subsided. Ultrasound scanning showed thread perforation of the parotid gland and confirmed that the unusual swelling was due to the damage to the thread penetrating the parotid gland (Figures 2A and 2B).

3.1.2 | Case 2

A healthy 77-year-old man visited the clinic for thread lifting. He underwent bilateral thread lifting with four bidirectional cogged threads on each side. The patient experienced pain during the operation on the left side. Seven days after the operation, swelling on the left side did not subside even after applying a cold compress. Upon physical examination, tenderness and swelling were observed. Ultrasound revealed the presence of the thread inside the parotid gland and inflammation. Augmentin 625 mg and acetaminophen 500 mg were prescribed for 7 days. Intermittent swelling and pain persisted for 1 month after the 1-week postoperative visit. Five months after the procedure, the patient visited the clinic, and all symptoms had disappeared. The patient had no pain or swelling anymore. An ultrasound showed an indistinct appearance of the thread in the parotid gland (Figure 3).

3.1.3 | Case 3

A healthy 51-year-old woman visited the clinic for thread lifting. In total, 24 threads were inserted bilaterally (12 threads unilaterally). The entry points were the medial side of the tragus, sideburn area, and hairline near the eyebrow. On postoperative day 28, an ultrasound was performed, which revealed that the thread had perforated the parotid gland (Figure 4). This case was asymptomatic. However, thread perforation was detected on the right parotid gland during a routine postoperative ultrasound examination.

3.1.4 | Case 4

A healthy 58-year-old woman visited the clinic for thread lifting. Twelve threads were inserted into the entry point at the sideburn and hairline near the eyebrow. The patient complained of pain during the operation and immediately after an ultrasound examination. The thread had perforated the parotid gland (Figure 5).

3.1.5 | Case 5

A healthy 51-year-old woman visited the clinic for thread lifting. Pre-operative ultrasound showed parotid gland extension located at the anterior border of the masseter muscle (Figure 6A). Thread lifting was performed from entry points at the hairline and sideburn with six threads ipsilaterally. During the procedure, the patient did not complain of any painful sensation. Prophylactic antibiotics (Augmentin 625 mg) and acetaminophen 500 mg bid were prescribed for 3 days. Seven days after the operation, right-side tenderness was observed.

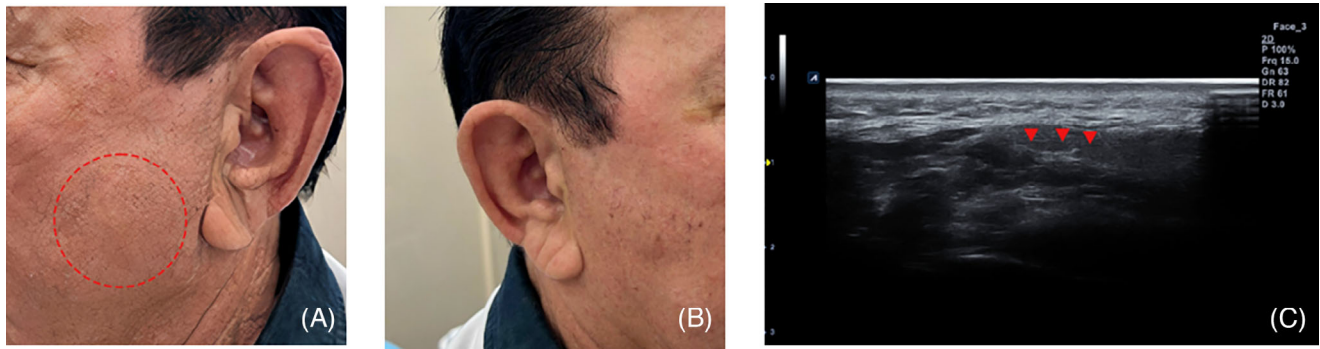


FIGURE 3 Ultrasound images of a 77-year-old patient, taken 7 days postoperatively. (A) Swelling observed on the left side (red dot circle). (B) No complications observed on the right side. (C) Ultrasound finding 5 months postoperatively showing the presence of the thread (red arrowhead) inside the parotid gland.

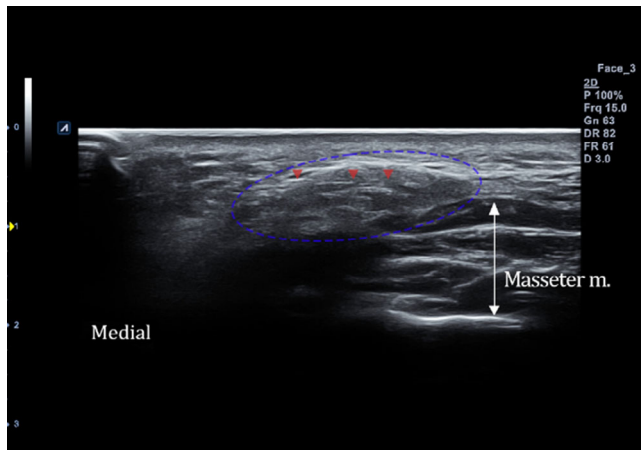


FIGURE 4 Ultrasound image showing the location of the thread (red arrowhead) inside the parotid gland (blue dot).

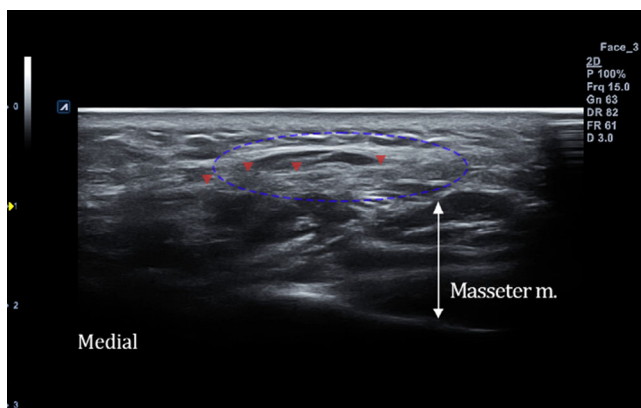


FIGURE 5 Ultrasound finding immediately after thread lifting in a 58-year-old patient. The thread has perforated the parotid gland (blue dot), indicated by a red arrowhead.

Ultrasound showed that one thread had perforated the parotid gland (Figure 6B).

3.1.6 | Case 6

A healthy 47-year-old woman underwent thread lifting. The patient complained of mild pain on the left side during the procedure. When the symptom was noticed, cannula insertion was stopped. Before removing the cannula, an ultrasound was performed. A thread was found to have perforated the parotid gland (Figure 7). Prophylactic antibiotics (Augmentin 625 mg) and acetaminophen 500 mg bid for 3 days were prescribed, and ice bag application was encouraged. Three days after the procedure, the patient did not complain of any swelling or pain. No additional medication was prescribed. The patient visited the clinic again 78 days after the procedure; the thread was not detected on ultrasound, and she did not complain of any symptoms (Figure 8).

3.1.7 | Case 7

A 58-year-old woman underwent thread lifting bilaterally. The patient did not visit the clinic until 38 days after the operation day. She had mild tenderness on the left side and experienced mild pain when chewing. Ultrasound revealed that a thread was perforating the left parotid gland. Another thread was found to perforate the masseter muscle at the medial and lower portion. Although ultrasound findings showed intramuscular thread, the patient received conservative treatment for mild symptoms, mild swelling, and tenderness that did not interfere with daily life activities, such as chewing. No medication was prescribed for this patient.

3.1.8 | Case 8

A healthy 39-year-old woman visited the clinic for thread lifting. The patient did not have any history of disease besides atopic dermatitis. Nine threads were inserted ipsilaterally. During the right-side thread lifting, the patient complained of pain and showed mild swelling immediately after the operation. The patient visited 3 days after the operation, complaining of right-side pain and swelling (Figure 9A). Ultrasound revealed perforation of the right parotid gland by a thread

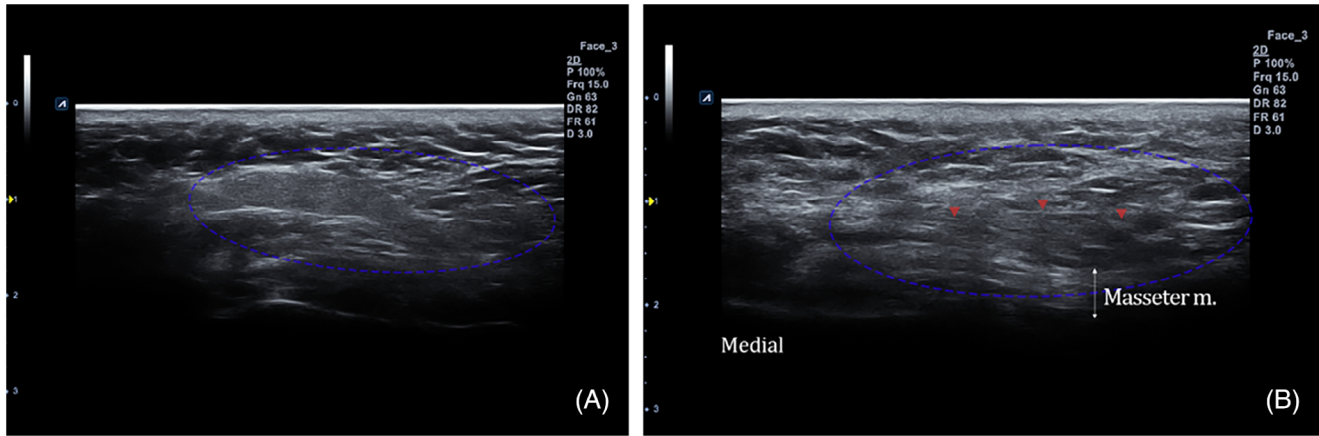


FIGURE 6 Ultrasound finding in a 51-year-old female patient. (A) Preoperative image showing a large parotid gland extending until the anterior border of the masseter muscle (blue dot). (B) Postoperative image taken 7 days after the procedure, showing thread perforation of the parotid gland (red arrowhead).

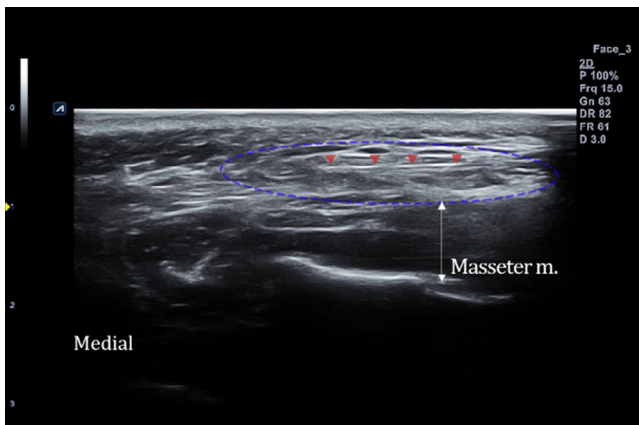


FIGURE 7 Ultrasound finding immediately after thread lifting in a 47-year-old patient. The thread has perforated the parotid gland (blue dot), indicated by red arrows.

(red arrowhead) and inflammation (Figure 9B). Antibiotics (Augmentin 625 mg), an NSAID (aceclofenac 100 mg), and methylprednisolone 4 mg bid were prescribed for 7 days. However, 8 days after the operation, the swelling had not subsided, and the pain prolonged, especially after eating. On ultrasound, fluid collection, inflammation, and parotid duct injury were observed (Figure 9C). A dose of 100 IU botulinum toxin A was injected into the right parotid gland under ultrasound guidance. On postoperative day 22, the swelling had subsided to some extent, and the pain after eating was relieved. However, the fluid collection was still observed on ultrasound (Figure 9D).

3.1.9 | Case 9

A healthy 44-year-old woman visited the clinic for thread lifting (Figure 10A). Multiple threads were inserted at the hairline, tragus, and mastoid process. Postoperative prophylactic antibiotics were pre-

scribed for 3 days. On postoperative day 2, a routine ultrasound examination was performed. Right-side mild tenderness and minimal swelling were noticed (Figure 10B). The patient did not complain about the progress of the surgery because of her mild symptoms. Ultrasound showed that the thread was perforating the right parotid gland. The thread on her left side was inserted more superficially in relation to the parotid gland. On postoperative day 4, symptoms subsided, and the patient did not experience discomfort during mastication (Figure 10C).

4 | DISCUSSION

Previous studies have described thread-induced parotid gland perforation. However, no study has shown visible findings of the damaged parotid gland, such as that using ultrasound. Here, we report eight parotid gland perforation cases and one case of parotid duct injury caused by threads, as shown by ultrasound findings. Our findings suggest that the relative location of the parotid gland when thread lifting, considering the lifting vector, might be more vulnerable to damage than we expected. Also, identifying immediate parotid duct or gland injury using ultrasound can help reduce the likelihood of additional complications.

There are several studies on the parotid gland's anatomical location.^{6,11} A recent study showed that the border of the parotid gland varies from the inferior margin of the zygomatic arch to the anterior part of the sternocleidomastoid muscle.¹² Clinical ultrasound findings show that the parotid gland is often distributed widely. In addition, an accessory lobe of the parotid gland is seen in many cases. These differences may be due to eating habits or racial differences. The accessory parotid gland is the variation of an anterior extension of the parotid gland and has been found in 21%–69% of cadaveric cases.^{13,14} A previous study showed an accessory parotid gland incidence of 10.2% and a facial process of parotid gland incidence of 28.3% on computed tomography.¹⁵ These findings indicate that parotid gland perforation may occur during thread-lifting procedures.

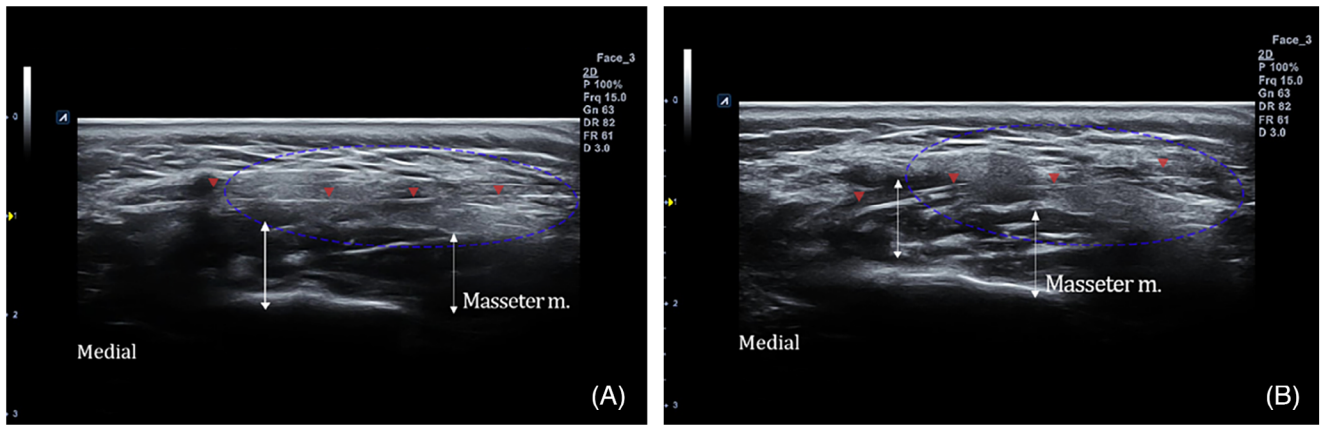


FIGURE 8 Ultrasound findings in a 58-year-old patient after thread lifting. (A) Image taken after the procedure. (B) Image taken 38 days postoperatively, showing thread perforation of the parotid gland (blue dot circle) and another thread perforation in the lower medial portion of the masseter muscle (parotid gland: blue dot circle, thread: red arrow, masseteric muscle: bidirectional white arrows).

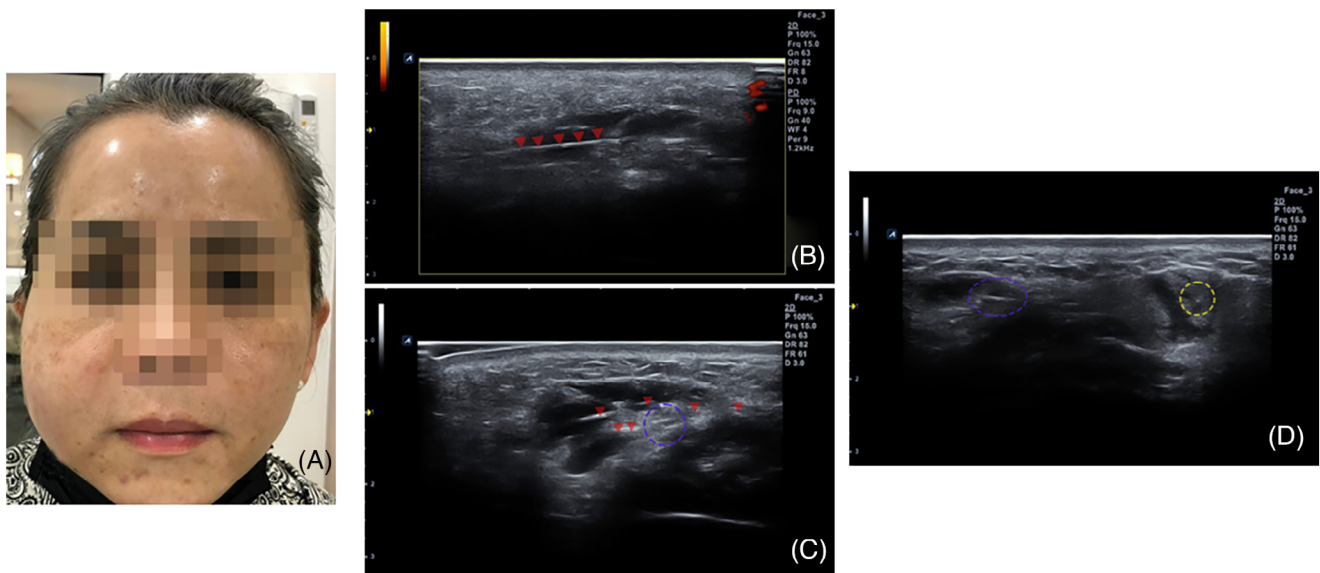


FIGURE 9 Ultrasound findings in a 39-year-old female patient who underwent bilateral thread lifting. (A) Preoperative and postoperative 3-day images showing swelling on the right side. (B) Postoperative 3-day ultrasound showing parotid gland perforation (red arrows indicate the inserted thread, dotted region represents the parotid gland). (C) Image taken 8 days postoperatively, with the purple circle indicating the middle of the thread and the yellow circle indicating the endpoint of the thread.

Besides anatomical variation of the parotid gland, a specific layer of thread lifting is one of the considerations to avoid parotid gland injury. Inserting the thread in the subcutaneous layer or superficial musculoaponeurotic system layer is recommended.¹⁶ However, considering the curved surface from the lateral to the anterior aspects of the face, it is difficult to locate the thread at the exact desired layer; the thread, therefore, tends to be inserted into a deeper layer, which can cause vascular injury, nerve injury, parotid gland perforation, and parotid duct injury.¹

The entry points of thread lifting are the anterior portion of the hairline, tragus, sideburn, and mastoid process area. The entry point threads are usually inserted into the medial and inferior vectors. There

might be some resistance when the threaded cannula passes the masseteric retaining ligament; nevertheless, the occurrence of parotid gland injury or duct injury should always be considered when there is resistance or when the patient feels pain during the process.

There is a wide variation in the presence of the accessory parotid gland and the size of the parotid gland. Ultrasound helps detect the exact location of the parotid gland in individual patients. The parotid gland can be clearly visualized when enlarged at the medial side of the tragus area.¹⁷ However, it usually cannot be detected clearly, especially in the cheek area. Inserting the thread at the subcutaneous layer at the parotid gland area is recommended. However, as seen in Cases 4 and 5 in the current study, there is benign parotid hypertrophy

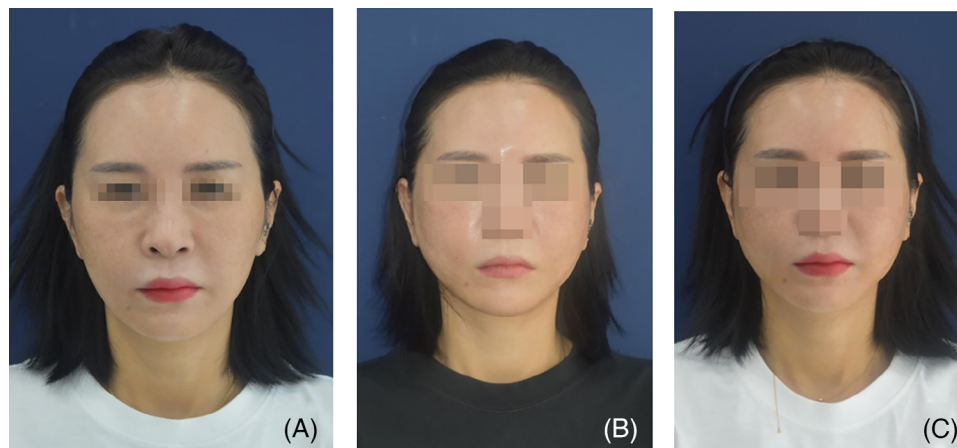


FIGURE 10 A 44-year-old patient showing thread lifting perforation of the parotid gland. (A) Preoperative image. (B) Image taken 2 days postoperatively. (C) Image taken 4 days postoperatively.

and limited space in the subcutaneous layer. Therefore, inserting the thread a little deeper might perforate the parotidotemporal fascia, causing the thread to be inserted into the parotid gland. Therefore, we recommend using ultrasound to locate the parotid gland's location and size before thread insertion. Once the parotid gland location is detected, it is recommended that the thread is inserted into the medial and superficial to the parotid gland.

Doppler ultrasound can be used during the thread lifting as it allows visualizing the cannula during the process. However, it is difficult to use because thread insertion requires using both hands, thus limiting the availability of the hands to hold the ultrasound probe. Therefore, inserting the thread more superficial to the parotid gland area or inserting it medial from the parotid gland after detecting its location on ultrasound is recommended.

In the case of a parotid gland injury, the patient has tenderness, swelling, and pain during mastication. Ultrasound should be used when the patient presents with swelling or tenderness during postoperative follow-up. Although the degree of fluid collection seen on ultrasound and the degree of swelling expressed on the skin did not necessarily match, it is recommended to perform an ultrasound examination repeatedly in case of perforation, even if the symptoms have been improved. Meanwhile, as seen in our cases, some asymptomatic patients require further evaluation. Parotid gland perforation due to the thread can occur without symptoms.

Unlike gland injury, parotid duct injury can show severe complications and require a relatively longer duration for treatment. The parotid duct can also be located superficially, and ductal injury should be considered, significantly when the gland is enlarged. When parotid gland injury was suspected, such as the presence of swelling immediately after thread lifting or confirmed by an ultrasound finding, antibiotics (Augmentin 625 mg) and NSAIDs were prescribed. If parotid duct injury is suspected on ultrasound, Augmentin is used, and methylprednisolone is used initially to respond to inflammation. When parotid duct injury is confirmed, antibiotics (Augmentin) and methylprednisolone are used to observe, and then quinolone is added.

This study's limitation was that the study population included only Asians. Thus, the anatomical variabilities between races were not considered. In terms of ultrasound findings, they normally seem okay for about a month before becoming hazy or difficult to view. After three months, it appears to be nearly invisible. In future studies related to thread lifting, comparing the period known for the PDO thread to be maintained in the tissue and ultrasound finding can be used as clinically valuable data.

5 | CONCLUSIONS

Using ultrasound to detect the parotid gland's location before thread lifting might reduce the chance of parotid duct injury. Identifying immediate parotid duct or gland injury with ultrasound can help to act quickly on delayed pain or swelling and reduce the likelihood of additional complications.

ACKNOWLEDGMENTS

This study was conducted in compliance with the Declaration of Helsinki. Consent was received from the families of the deceased patients before beginning the dissection. The authors sincerely thank those who donated their bodies to science for anatomical research. The results of such research can aid in mankind's overall knowledge, which can improve patient care. Therefore, these donors and their families deserve the greatest gratitude.

CONFLICT OF INTEREST STATEMENT

The authors have all considered the conflict of interest statement included in "Author Guidelines". To the best of our knowledge, no aspect of the authors' current personal or professional life might significantly affect the views presented on this manuscript. The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data are available in request to corresponding author.

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