


BRIEF REPORT

Drainage tube hole suture improvement: Removal-free stitches

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Abstract

Surgical method improvements aim to optimize the patient experience. The problem of healing of the drainage tube hole has not received attention and is of concern because it can plague patient recovery. In this article we report on how we have improved the method of suturing the drainage tube hole and explore the safety and effectiveness of this method. Between December 2017 to August 2018, 102 patients underwent thoracoscopic lung resection (single port or single utility port) using different methods of suturing drainage tube holes. The intervention group received improved methods with subcuticular and intradermal suture and removal-free stitches, whilst the control group received a conventional mattress suture and fixed chest tube. A preset line was left to tie knots and close the hole after the removal of the chest tube. The stitches were removed 7–12 days after surgery. The baseline clinical features of the patients were subsequently analyzed. The objective and subjective conditions of scars were evaluated using the Vancouver Scar Scale (VSS) and the Patient and Observer Scar Assessment Scale (POSAS) at one month after surgery. The intervention group ($n = 71$) and control group ($n = 31$) had balanced baseline clinical characteristics. There were no significant differences between the two groups in terms of three-day postoperative pain and postoperative hospital stay. In the intervention group, three patients (4.23%) had wound splitting that required re-suturing, which was better than five patients (16.13%) in the control group ($P < 0.05$). The incidence of pleural fluid outflow, wound infection, post-removal pneumothorax, chest tube prolapse and incisional hernia were not different between the two groups. We conclude that the objective and subjective evaluation results of scars were significantly different between the two groups ($P < 0.05$), and the experimental group was superior to the control group. A balanced result between aesthetic appearance and safety as regards video-assisted thoracic surgery can be achieved through the chest tube hole improved suture method. This method also improves the patient's recovery experience.

Introduction

Better outcomes for patients with less damage caused by drainage tube holes are the consistent pursuit of surgeons. That is why the surgical treatment of lung cancer has undergone changes in the technical aspect and extent of resection, from pneumonectomy to lobectomy to even sublobar

resection in select situations, and from rib spreading thoracotomy to thoracoscopic surgery to robotic-assisted thoracic surgery.¹ Compared with open lobectomy, video-assisted thoracic surgery (VATS) has proven to be more feasible and safe and is even associated with better outcomes.² People are exploring a multimodal perioperative care program, which

is called Enhanced Recovery After Surgery (ERAS).³ Thoracic-ERAS (T-ERAS) was considered key in achieving low morbidity after VATS lobectomy.⁴ However, during the VATS lobectomy, surgeons may overlook the aesthetics of the wound and focus more on perfecting and gracefully transecting and stapling pulmonary vessels, bronchus and lung tissue. In contrast, surgical incisions and drainage tubes are the most intuitive understanding of the surgical outcomes of patients and their families. If the incision is not well healed, it will not only increase the amount of additional medical work, but also affect the evaluation of the overall treatment by patients and their families. Scarring and aesthetic appearance should be carefully considered by doctors, especially in early-stage patients, because they have a better survival prognosis.⁵ A previous study reported that 61% of people surveyed said that their partners' opinions of scars were important after breast cancer surgery.⁶ A total of 50% of patients believe that the extent of scarring greatly affects their self-assessment of treatment outcomes.⁷ Scars can not only induce local pain and itch but also cause psychosocial sequelae, including anxiety and depression among others.⁸ At the same time, basic postoperative safety requirements because of achieving a desirable aesthetic appearance cannot be ignored, and the chest tube must be securely attached to prevent accidental detachment. There are a myriad of techniques employed worldwide to secure chest tubes and seal thoracostomy wounds, but none of them can be called the "gold standard". Conventional mattress suture is one of the basic and most reliable methods. Here, we present a new method which balances postoperative safety with the aesthetic appearance of wound scars. This method securely fixes the chest tube, sutures the wound, involves removal-free stitches, and improves the appearance of the scar.

Methods

This study analyzed the clinical data of patients who underwent VATS at Guangdong Provincial People's Hospital and the study protocol was approved by the Ethics Committee of the hospital.

The study was retrospectively analyzed data from 102 patients who received VATS surgery (single port or single utility port) with a chest tube in the Guangdong Provincial People's Hospital between December 2017 and August 2018 (Fig 1). A total of 71 patients (intervention group) received subcuticular and intradermal sutures with absorbable sutures for fixation of the chest tube and suture incision. A total of 31 patients (control group) received a conventional mattress suture with absorbable sutures and fixation of the chest tube while leaving a preset line to close the hole after removal of the chest tube. Baseline clinical characteristics were collected for all patients, including sex,

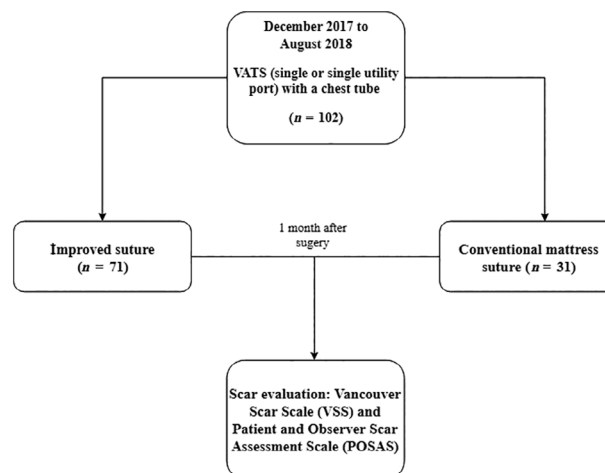


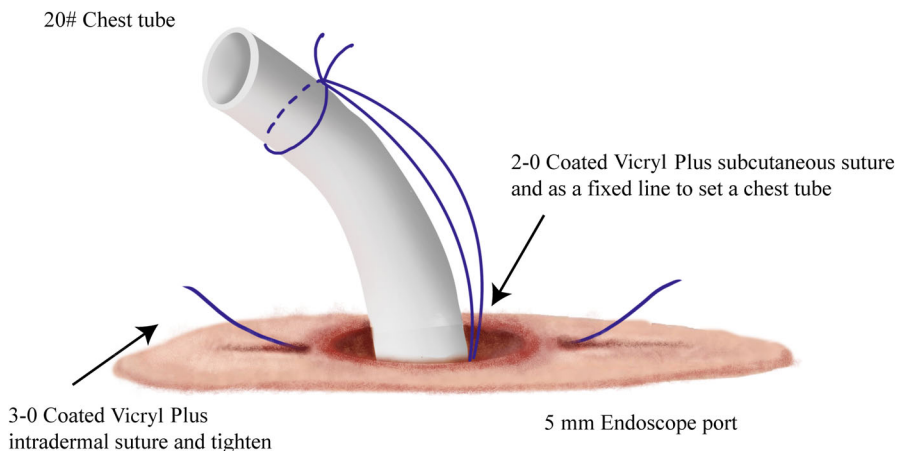
Figure 1 Flowchart detailing the study participants.

age, BMI, history of diabetes, history of hypertension, smoking status, port status, postoperative hospital stay, postoperative complications, and numeric rating scale (NRS) scores three days after surgery. None of the patients had a history of use of glucocorticoids or any other immunosuppressive agents. All the main operative slit lengths were unified to 3.5 cm and all thoracoscopic sizes were 5 mm in diameter in order to rule out the effect of length and size on the results. Postoperative complications include wound dehiscence, wound infection, chest tube dislocation, and incisional hernia. Wound dehiscence was defined by the margins of the wound being 1 mm or more apart and requiring resewing or conservative treatment. Post-removal pneumothorax was defined as a pneumothorax or subcutaneous emphysema exacerbation after the removal of chest tube, and wound infections as tenderness, swelling, erythema, purulence and/or fever.

Suture

Coated Vicryl Plus Antibacterial Synthetic Absorbable Suture (Ethicon, Somerville, NJ) is a synthetic absorbable sterile surgical suture composed of a copolymer made from 90% glycolide and 10% L-lactide and impregnated with triclosan to provide antimicrobial protection of the suture line.⁹ The suture holds its tensile strength for approximately two to three weeks in tissues and is completely absorbed by hydrolysis within 56 to 70 days. Subcutaneous suture is a simple and effective method of suturing tissue under the skin. Continuous intradermal sutures only pass through the dermis and are recognized for their simplicity. All patients in this study were treated with a single port or single utility port for VATS. In the intervention group, a 5 mm endoscope port was used as the chest tube drainage

Figure 2 In single utility port VATS, a 5 mm endoscope port was used as a chest tube drainage port. The 2-0 Coated Vicryl Plus Suture is used to perform subcutaneous suture for muscle and other subcutaneous tissues, and is as a fixed line to set a 20# chest tube. A 3-0 Coated Vicryl Plus Suture is used for continuous intradermal suturing and tightening. After tightening, each end of the suture is left with enough length to tighten again after the removal of the chest tube followed by cutting off the extra suture.



port in single utility port VATS (Fig 2). The 2-0 Coated Vicryl Plus Suture is used to perform subcutaneous sutures for muscle and other subcutaneous tissues and is used as a fixed line to set a 20# chest tube. A 3-0 Coated Vicryl Plus Suture is used for continuous intradermal suturing and tightening. After tightening, each end of the suture is left with enough length to tighten again after the removal of the chest tube. For nondrainage port (such as single utility port), the suture method is to use 2-0 Coated Vicryl Plus Suture for continuous subcutaneous sutures for muscle layers, 3-0 for fat layers, and finally 3-0 for intradermal skin sutures. A 20# chest tube is placed on one side of the incision in single-port VATS, and similar suture and fixation methods used (Video S1, Fig 3). The traditional suture method was applied to the control group using 2-0 and 3-0 Coated Vicryl Plus Suture to perform interrupted vertical mattress sutures, which passed through the entire layer of the skin, in the drainage port and the fixation of the chest tube with a preset line left in place, which was used to tie knots and close the hole after removal of the chest tube. All suturing operations were performed by the same chief physician. Povidone iodine solution was used to disinfect the wound every other day after surgery in the hospital. The control group had stitches removed 7–12 days after surgery based on the extent of wound healing. The stitches were not removed in the intervention group.

Follow-up and scar evaluation

The Vancouver Scar Scale (VSS) and the Patient and Observer Scar Assessment Scale (POSAS) were used for the assessment of scars by a specially trained physician at the outpatient clinic one month after surgery. VSS and POSAS are commonly used scar assessment scales. VSS was developed both for the assessment of burn scars and the evaluation of linear scars.^{10,11} The POSAS¹² evaluation

system includes objective assessments and subjective feelings. VSS has four evaluation variables: vascularity, pliability, pigmentation and height. All variables were ranked using a score, and the total score was from 0 to 13 points. The higher the score, the more severe the scar. POSAS is divided into two parts: observer scar assessment scale (OSAS) and patient scar assessment scale (PSAS). OSAS evaluates five components: vascularization, thickness, relief, pigmentation and pliability. The score ranges from 5 to 50, with 50 indicating the most serious scar. PSAS includes six characteristics: pain, itching, color, stiffness, thickness and irregularity. Six points represents normal skin and 60 points corresponds to the most severe scar. The scales were translated into Chinese by the Chinese Clinical Scar Prevention Experts Consensus Development Team.¹³

Statistical analysis

All statistical analyses were performed with SPSS version 19.0 software (SPSS, Inc., Chicago, IL, USA). The data are expressed as the mean \pm standard deviation or

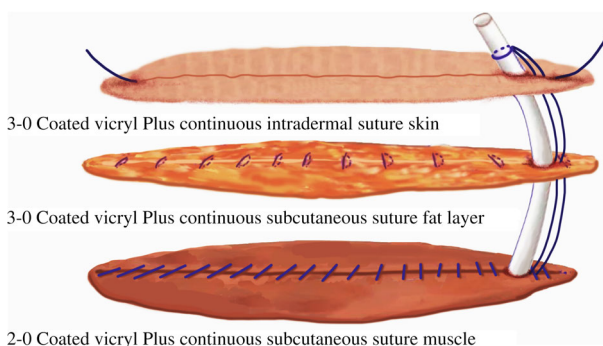


Figure 3 A chest tube was placed on one side of the incision in single-port VATS, and similar suture and fixation methods were used.

Table 1 Clinical characteristics

Characteristics	Mean ± SD/number (%) / mean (range)			P-value
	Total	Intervention group	Control group	
Number of patients	102	71	31	
Male	57 (55.88%)	39 (54.93%)	18 (58.06%)	0.77†
Age (years)	55.96 (28–78)	56.15 (28–78)	55.52 (33–72)	0.77‡
Smoking	32 (31.37%)	23 (32.39%)	9 (29.03%)	0.74†
Body mass index (kg/m ²)	22.59 ± 3.20	22.49 ± 3.14	22.82 ± 3.36	0.63‡
Diabetes	10 (9.80%)	5 (7.04%)	5 (16.13%)	0.16†
Hypertension	25 (24.51%)	16 (22.54%)	9 (29.03%)	0.48†
Port status				
Single port	14 (13.73%)	7 (9.86%)	7 (22.58%)	0.09†
Single utility port	88 (86.27%)	64 (90.14%)	24 (77.42%)	
Operation				0.74†
Wedge resection	30 (29.41%)	22 (30.99%)	8 (25.81%)	
Segmentectomy	13 (12.75%)	8 (11.27%)	5 (16.13%)	
Lobectomy	59 (57.84%)	41 (57.75%)	18 (58.06%)	
Postoperative hospital stay (Day)	4.18 (1–17)	3.99 (1–17)	4.65 (3–15)	0.22‡
Day1 NRS	1.83 ± 0.80	1.73 ± 0.74	1.80 ± 0.75	0.64‡
Day2 NRS	1.53 ± 0.59	1.41 ± 0.65	1.61 ± 0.50	0.12‡
Day3 NRS	1.31 ± 0.54	1.04 ± 0.71	1.29 ± 0.46	0.08‡
Postoperative complications				
Pleural fluid outflow	9 (8.82%)	6 (8.45%)	3 (9.68%)	0.84†
Wound splitting/Re-sewing	8 (7.84%)	3 (4.23%)	5 (16.13%)	0.04†
Post-removal pneumothorax	0	0	0	
Wound infection	0	0	0	
Tube dislocation	1 (0.98%)	1 (1.41%)	0	0.51†
Incisional hernia	0	0	0	

†According to a Pearson χ^2 test. ‡According to an unpaired *t*-test.

mean (range). For continuous variables, we tested the equality of variance with Levene's test. Independent sample *t*-tests were used to compare the differences of parameter variables. A Chi-square test was used to compare nonparametric variables. The VSS and POSAS scores for each individual were analyzed by an unpaired *t*-test. A *P*-value less than 0.05 was considered to be statistically significant.

Results

The clinical characteristics of the patients are shown in Table 1. There were no significant differences in clinical features between the two groups (*P* > 0.05). There were no significant differences in terms of three-days postoperative pain (*P* > 0.05) and postoperative hospital stay (*P* = 0.22). Six (8.45%) patients in the intervention group and 3 (9.68%) patients in the control group had pleural fluid outflow from the drainage orifice, which was treated by dressing changes, and there was no significant difference between the two groups (*P* = 0.84). Five (16.13%) patients in the control group developed wound dehiscence and poor healing after the removal of the chest tube, which required resuturing, compared with three

(4.23%) patients in the intervention group. There was a significant difference between the two groups in the rate of wound dehiscence and resuturing (*P* = 0.04), and the intervention group was superior to the control group. One (1.41%) of the patients in the intervention group had accidental chest tube detachment requiring re-fixation (*P* = 0.51). There were no wound infection, post-removal pneumothorax and incisional hernias in either groups. Table 2 shows a comparison of the cosmetic outcomes between the two groups at one month postoperatively. In the objective evaluation and subjective feeling of scar, there were significant differences between the two groups (*P* < 0.05), and the intervention group was superior to the control group.

Table 2 Scar evaluation

Variable	Case group	Control group	P-value
VSS	2.30 ± 1.37	3.77 ± 2.01	0.000†
POSAS OSAS	7.34 ± 1.63	9.93 ± 5.49	0.000†
PSAS	11.58 ± 3.38	16.39 ± 5.61	0.000†

†According to an unpaired *t*-test. OSAS, observer scar assessment scale; POSAS, patient and observer scar assessment scale; PSAS, patient scar assessment scale; VSS, Vancouver scar scale.

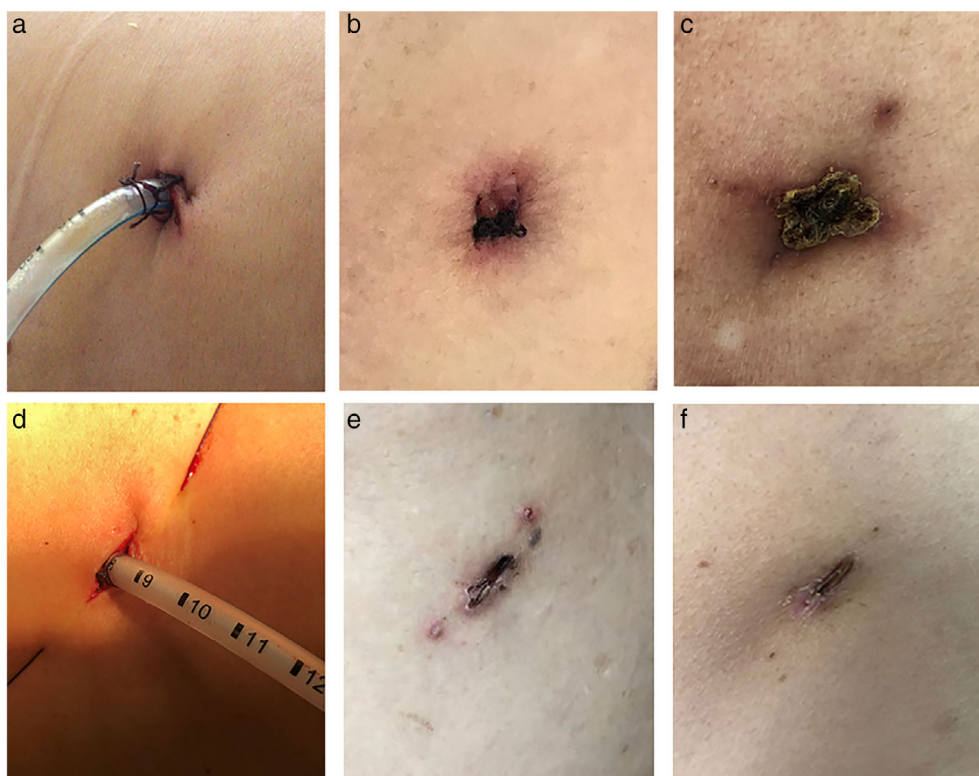


Figure 4 Comparison of the control group (a–c) and the intervention group (d–f) in single utility port VATS at the same time point. (a) Day of surgery. (b) Two weeks after surgery. (c) One month after surgery. (d) Day of surgery. (e) Two weeks after surgery. (f) One month after surgery.

Discussion

Better outcomes with less damage to drainage tube holes are the consistent pursuit of surgeons. Conventional mattress suture is one of the most traditional and reliable methods to secure chest tubes and seal thoracostomy wounds but squeezing of the slit by the suture may cause poor healing and ugly scars. ERAS includes a multi-angle rehabilitation improvement during the perioperative period.^{3,4} Concerns about the diagnosis and persistent nature of scars are common in surgical patients.¹⁴ In addition, scars affect the patient in five ways: physical comfort and functioning; acceptability to self and others; social functioning; confidence in the nature and management of the condition and emotional well-being.¹⁴ However, these concerns have not received widespread attention from thoracic surgeons. Unempathic management by general physicians and frustrations with their current treatment cause distress to patients.¹⁴ During the VATS lobectomy, surgeons may overlook the aesthetics of the wound and focus more on perfecting and gracefully transecting and stapling pulmonary vessels, bronchus and lung tissue, and attaching a safe and effective thoracic drainage after surgery. We use a new method of suturing wounds and

fixing the chest tube with the intent to balance the need for aesthetics and safety.

Our preliminary results showed that the incidence of wound dehiscence and resuturing in the intervention group was lower than that in the control group. The remaining perioperative complications associated with the wound were not significantly different between the two groups. The modified suture method is safe and reduces the incidence of resuturing. In the one-month postoperative scar assessment, the intervention group was superior to the control group in both objective and subjective scar evaluations. This indicates that the improved suturing method is superior to the conventional mattress suture in terms of the objective shape of the wound and the subjective feeling of the patient. The reason for this difference may be that the conventional suture method of the control group can easily cause skin compression and necrosis due to the use of mattress sutures and preset lines to tie knots, thereby affecting wound healing. Resuturing was required in the intervention group because the suture was loose, while the control group was due to excessive compression of the skin and poor blood supply. It is worth mentioning that the preset line firmly seals the wound after removal of the drainage tube but also causes a large squeeze on the skin.

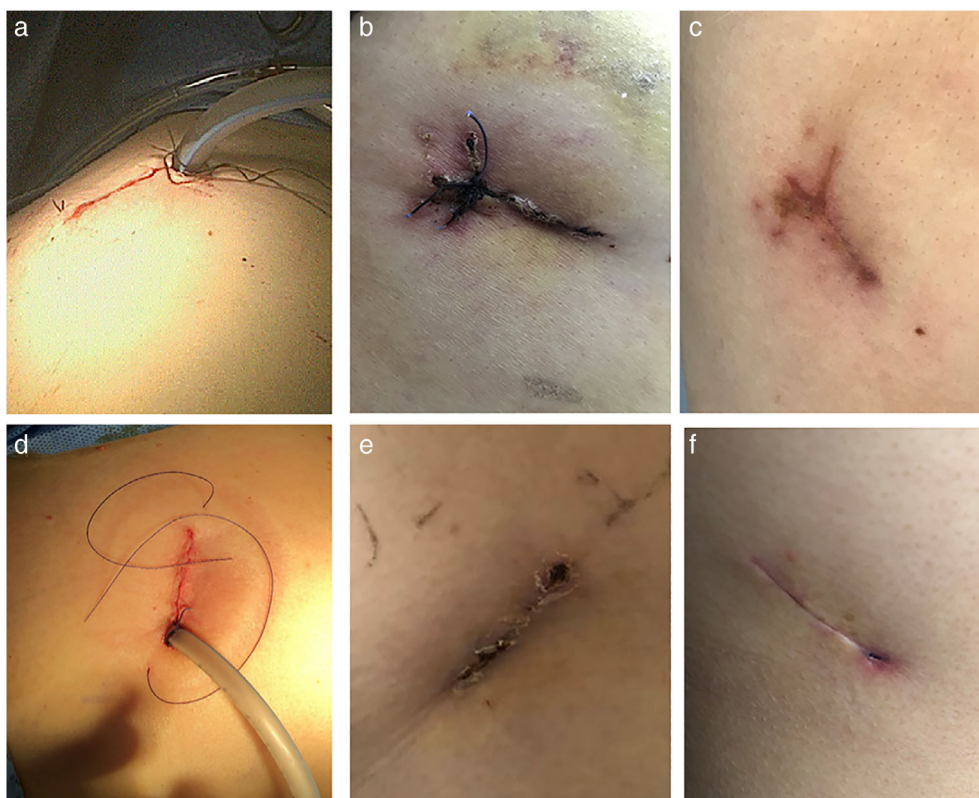


Figure 5 Comparison of the control group (a–c) and the intervention group (d–f) in single-port VATS at the same time point. (a) Day of surgery. (b) Two weeks after surgery. (c) One month after surgery. (d) Day of surgery. (e) Two weeks after surgery. (f) One month after surgery.

The improved suture method sutures the skin layer by layer and brings more parallel pressure, while the traditional method penetrates the full layer of the skin and brings more vertical pressure. The scars of the intervention group were mostly linear, while the scars of the control group were often cross-shaped, and we took the representative photographs at the same time point (Figs 4 and 5). These photos are not the best or the worst aesthetic representatives, but just in the middle. Cross-shape of the wound increased the discomfort caused by the scar and increased the thickness and area of the scar. Intradermal suture has been proven on the one hand to reduce the discomfort caused by hypertrophic scars, which includes a prominent surface, thick texture, local pain, and itching, and on the other hand can also improve the quality of sleep.^{15–18} Continuous subcuticular and intradermal suturing is more convenient for the surgeon, which saves time in thread trimming and the number of sutures used. A lower rate of resuturing is also beneficial to both the patient and doctor. At the same time, there is no need to remove the sutures, which not only is more convenient but also avoids the discomfort associated with suture removal. In our limited clinical experience, chest tubes

larger than 20# are also suitable for this improved suture method.

Since this is a preliminary retrospective study, we acknowledge that it has some limitations, including the retrospective design and subjective bias, the lack of a recording of the time duration for each suture, and an inadequate follow-up period.

Conclusions

In summary, our thoracic drainage tube hole improved suture method is safe and effective with a good cosmetic outcome. This method improves the patient's recovery experience and could be included as part of ERAS. However, it is necessary to investigate this technology further.

A balanced result between cosmetic result and safety as regards video-assisted thoracic surgery can be reached through the chest tube hole improved suture method. This method improves the patient's recovery experience.

Disclosure

The authors declare there are no conflicts of interest.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Video S1 This video shows the whole process of suture and removal in single-port VATS.