Video-assisted thoracoscopic surgery surgical stabilization of rib fractures: surgical technique and case report

Francesco Londero[1]^, Jacqueline Cinel[2], William Grossi[1]^, Elisa De Franceschi[1], Luca Melan[1]^, Gianluca Masullo[1], Elisa Copetti[3], Beatrice Raffaelli[4], Andrea Zuin[1,4]^

[1]Thoracic Surgery Unit, Cardiothoracic Department, S. Maria della Misericordia University Hospital, Udine, Italy; [2]Thoracic Surgery Unit, Division of Surgery, University Hospital of Padua, Padua, Italy; [3]Anesthesia and Intensive Care Unit, S. Maria della Misericordia University Hospital, Udine, Italy; [4]Department of Medicine, University of Udine, Udine, Italy

Contributions: (I) Conception and design: F Londero, J Cinel, A Zuin; (II) Administrative support: None; (III) Provision of study materials or patients: F Londero, J Cinel, E Copetti, B Raffaelli, W Grossi, E De Franceschi; (IV) Collection and assembly of data: F Londero, J Cinel, E Copetti, L Melan, G Masullo; (V) Data analysis and interpretation: F Londero, J Cinel, W Grossi, E Copetti, A Zuin; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Dr. Francesco Londero, MD, PhD. Thoracic Surgery Unit, Cardiothoracic Department, S. Maria della Misericordia University Hospital, P.le S. Maria della Misericordia 15, 33100 Udine, Italy. Email: francesco.londero@asufc.sanita.fvg.it.

Abstract: Rib fractures are a common consequence of chest trauma. In some instances, the presence of rib fractures may cause chest instability, leading to respiratory failure, dependance from ventilatory support and increased risk of pulmonary infections. Surgical stabilization of rib fractures (SSRF) is a well-established treatment to restore the stability of the rib cage and prevent respiratory complications. While this procedure is commonly performed through an open approach that allows a wide exposure of the ribs surface, in recent years a minimally invasive procedure consisting in thoracoscopic-assisted rib plating has been introduced. The lower invasiveness of this technique is associated with excellent post-operative outcomes. We present the case of a patient with post-traumatic flail chest treated with thoracoscopic rib stabilization, with a video describing the surgical procedure step-by-step. The sixth and the seventh left rib were stabilized with dedicated intrathoracic bridges. Surgery time was 120 minutes. The patient was extubated 8 hours after surgery. Pain score decreased from 6/10 to 2/10 according to the Numeric Rating Scale and respiratory parameters improved, with partial pressure of arterial oxygen (PaO_2)/inspiratory fraction of oxygen (FiO_2) increasing from 250 to 420. Discharge occurred on post-operative day 8. Thoracoscopic rib plating demonstrated to be a viable, seemingly less invasive treatment option for rib fractures with chest instability. The lower invasiveness of a minimally invasive approach and the anatomical basis to favor an intrathoracic deployment of the costal implants makes the procedure particularly suitable for this indication. Comparative prospective trials are required to confirm our findings.

Keywords: Flail chest; ribs; video-assisted thoracoscopic surgery (VATS); stabilization; thoracic trauma

Received: 30 March 2026; Accepted: 18 June 2026; Published online: 24 July 2026.

doi: 10.21037/jovs-2026-0015

View this article at: https://dx.doi.org/10.21037/jovs-2026-0015

^ ORCID: Francesco Londero, 0000-0001-8955-6053; William Grossi, 0000-0003-1905-9099; Luca Melan, 0009-0001-6269-0567; Andrea Zuin, 0000-0001-8377-6418.

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Introduction

Background

Rib fractures are a common finding in patients sustaining chest traumas, with an incidence that may reach 50% in blunt chest injuries (1,2). The clinical scenario may be variable, based on the number of bone segments involved and on the pattern of chest wall involvement. The presence of fractured ribs imposes adequate analgesic treatment, in order to guarantee appropriate bronchial clearance and good lung expansion and prevent further pulmonary complications (1). However, in case of multiple ribs involved, instability of the chest wall may occur, leading to severe patterns of respiratory failure. Chest wall instability can be defined as the presence of a flail chest. While radiologically a flail chest is defined as the presence of two points of fracture on at least 3 consecutive ribs, a clinical flail chest is defined by a paradoxical motion of a chest wall segment during respiration, leading to inadequate ventilation and reduced vital capacity (3). This usually manifests as progressively worsening hypoxia, hypercapnia, progressive respiratory muscles exhaustion and need for mechanical ventilation (MV). Moreover, patients with chest instability are keen to develop pulmonary infections, chronic pain and chronic respiratory failure (3). In light of this, in case of clinical flail chest patients may be referred to surgical stabilization of rib fractures (SSRF), with the aim of restoring the physiological motion of the rib cage and promoting lung expansion. Many retrospective and prospective investigations demonstrated how patients undergoing SSRF improve pain control and respiratory function, which translates in a reduced rate of pulmonary infections, reduced admission in the intensive care units (ICUs), reduced overall costs and earlier return to daily activities (3-6).

Highlight box

Surgical highlights

- Video-assisted thoracoscopic surgery (VATS) surgical stabilization of rib fractures (SSRF) was performed to treat chest instability. Needle insertion from the outer chest wall surface under thoracoscopic vision allowed identification of the exact localization of fractures and guided surgical incision to expose the target ribs. Ribs were drilled on either sides of the fracture points and two metal wires with a pre-assembled 6 cm bridge was introduced inside the chest from the surgical port, and fixed on the target ribs. Wires were then removed leaving the implant firmly anchored to the bone.

What is conventional and what is novel/modified?

- SSRF is conventionally performed through a wide exposure of the rib cage with plates screwed on the external surface of the injured rib. This procedure often requires chest muscles division and bone stump alignment, which makes the procedure rather traumatic and time-consuming.
- The employment of an intrathoracic plating system render SSRF less traumatic, easier and more expedite, with perceived advantages both for the patient and the operators.

What is the implication, and what should change now?

- VATS SSRF is expected to broaden its application for the treatment of post-traumatic chest instability.
- Large prospective studies are warranted to confirm the assumed advantages of this approach.

Rationale

SSRF sinks its roots in the early 1900s, when Charles Locke Scudder proposed open stabilization of comminuted fractures and displaced ribs with sutures (7). However, it was not until the 1970s that a dedicated set of instruments, constituted by metal plates, was introduced to restore the ribs continuity (8). While different types of plates have been widely utilized to fix rib fractures, they all had in common the necessity of being applied on the outer surface through an open thoracotomy approach, with the frequent necessity of division of the thoracic muscles to gain wide exposure of the rib cage.

In recent years a less invasive alternative have been proposed for SSRF, using plates which are applied to the inner surface of the ribs through a minimally invasive approach (9,10). Video-assisted thoracoscopic surgery (VATS) gained widespread acceptance in the last 30 years, as it is well-known to produce a lower surgical impact in patients necessitating different kind of thoracic procedures, compared with open thoracotomy. In the context of SSRF, VATS may be of great advantage to fully explore the pleural cavity, identify associated injuries and directly locate rib fractures (11). Performing a procedure with low surgical impact might be particularly relevant in subjects who sustained complex traumatic injuries of the chest and who had an impairment of variable degree of their respiratory apparatus. Under these circumstances, performing a surgical repair which preserves the integrity of respiratory muscles seems of particular importance for post-operative recovery.

Objective

In this work we report our early experience with VATS

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SSRF for flail chest, presenting a video that describes the procedure from patient positioning in the operating room (OR), intraoperative identification of the fracture points and deployment of the intrathoracic plates. We present this article in accordance with the SUPER reporting checklist (available at https://jovs.amegroups.com/article/view/10.21037/jovs-2026-0015/rc).

Preoperative preparations and requirements

Setting

The surgical procedure was performed at S. Maria della Misericordia University Hospital in Udine, Italy, a tertiary medical institution which serves a population area of about 1,500,000 inhabitants. The hospital is located in a central position of the county, serving as the reference point for regional traumas. About 150 thoracic surgery consultations are performed annually at the Emergency Department on acute patients sustaining major chest traumas.

Team/training prerequisites

The intervention was performed in the OR under general anaesthesia and on one-lung ventilation. The surgical team had moderate experience in open SSRF and large experience in VATS surgery, including single port major pulmonary resections and mediastinum surgery. However, this was the first case of VATS SSRF performed at our institution. The surgical team included two senior surgeons and one trainee, which were trained with only few video sessions on the steps of the surgical procedure.

Indications

SSRF is usually indicated in diverse conditions, such as chest wall instability with or without the need for MV, presence of offset fractures, and chronic chest pain from displaced rib fractures (12). In the present case, the indication for surgery was offered by the presence of chest wall instability with progressive deterioration of the respiratory function.

Case presentation

The patient was a 71 years old woman who, in January 2026, sustained a left chest and shoulder trauma after an accidental 2 meters falling from a stair. Her past medical history included an initial cognitive impairment with memory loss, arterial hypertension, raised serum cholesterol levels, osteoporosis and a systemic mastocytosis under investigation. Her current medical treatment included amlodipine, pramipexole, cetirizine, famotidine, escitalopram and atorvastatin. Moreover, the patient referred to be under evaluation of subjective dyspnea for several months. Cardiology consultation did not reveal any significant heart disease and the patient was waiting for a lung physician consultation.

Following the trauma, she was conducted to the Emergency Department of our hospital, where first-level investigations were performed: blood sample test revealed normal hemoglobin levels and chest X-ray (CXR) demonstrated a left clavicle fracture and multiple left rib fractures, some of them displaced and/or bifocal, without significant effusion or pneumothorax (*Figure 1*). Arterial blood gas (ABG) analysis on room air revealed moderate hypoxia (44 mmHg) and hypercapnia (50 mmHg) with a consequent ratio of partial pressure of arterial oxygen (PaO_2)/inspiratory fraction of oxygen (FiO_2) (P/F ratio) of 209. After oxygen administration at a fraction (FiO_2) of 40% on Venturi mask, arterial oxygen pressure raised to 87 mmHg, corresponding to a P/F ratio of 217, whereas the values of carbon dioxide (CO_2) persisted elevated. Pain was initially controlled with morphine, paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) with partial response. An orthopedic consultation was requested for the clavicle fracture, which was managed conservatively with arm support. However, in the following two days a progressive deterioration of respiratory parameters occurred, with ABG analysis revealing increasing CO_2 values (60 mmHg) and worsening hypoxia even on oxygen implementation. Pain sensation was rated as 6/10 according to Numeric Rating Scale (NRS). In the attempt to improve pain control and respiratory dynamics, an epidural catheter at level of T6-T7 was placed, and analgesia with ropivacaine 0.2% and morphine was started. The patient was therefore supported with high-flow nasal cannula (HFNC) oxygen administration without significant improvement, and subsequently with non-invasive ventilation (NIV) with only partial effect on respiratory parameters (*Figure 2*) and pain perception (NRS 5/10). On physical examination, a paradoxical motion of the left posterobasal segment of the chest became evident, which connoted the presence of a clinical flail chest (see *Video 1*). Therefore, for a higher definition of the rib fractures, a chest computed tomography (CT) scan was performed, revealing unifocal fractures involving the first and second left ribs and several bifocal,

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Figure 1 Chest X-ray at presentation.

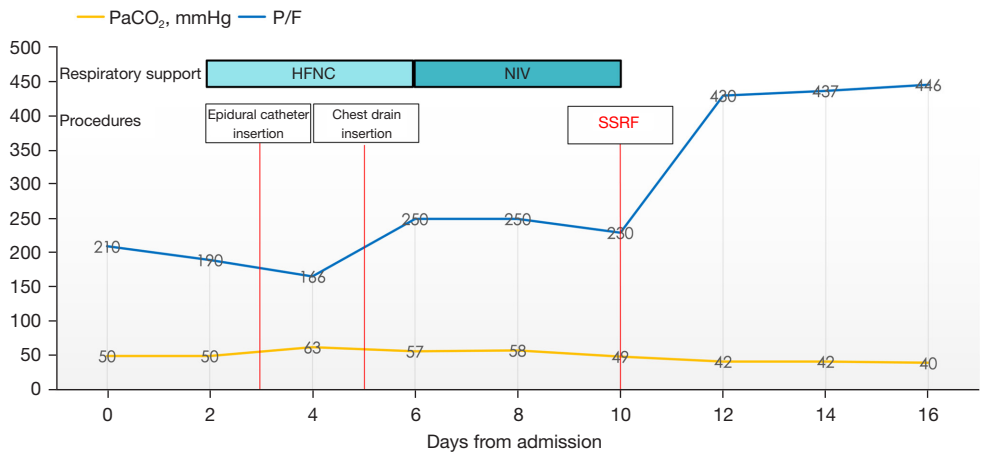


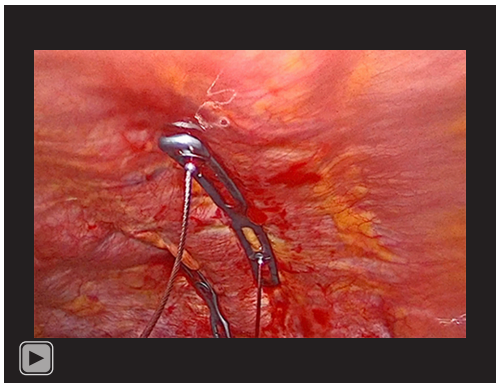
Figure 2 Graph reporting the PaO_2/FiO_2 ratio (P/F, blue line) and $PaCO_2$ levels (orange line) during the clinical course. The light blue boxes indicate the time under HFNC oxygen support and NIV. The red vertical lines indicate the days of epidural catheter placement, chest drain insertion and chest stabilization (SSRF) respectively. FiO_2, inspiratory fraction of oxygen; HFNC, high-flow nasal cannula; NIV, non-invasive ventilation; PaO_2, partial pressure of arterial oxygen; P/F, PaO_2/FiO_2; SSRF, surgical stabilization of rib fractures.

partially displaced rib fractures involving ribs from 3 to 10, with an associated homolateral mild pleural effusion. A daily radiological follow-up with thoracic ultrasound was carried out and two days later a small-bore 10 French (Fr) pleural catheter (Pleural Drainage Set, Cook Medical®, Bloomington, IN 47404, USA) was inserted upon evidence of increased pleural effusion. The catheter drained about 1,000 mL of serous-blood fluid and full lung re-expansion was obtained but, despite all the attempts to improve the situation with non-operative measures, respiratory function did not improve significantly, and the patient was therefore scheduled for urgent surgical stabilization. During the time interval up to the day of surgery the patient was supported with NIV on FiO_2 40% and epidural analgesia with borderline respiratory function. However, the patient's vital parameters did not impose ICU preoperatory admission or invasive ventilation. The intervention was eventually performed 10 days after the traumatic event.

Ethical consideration

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from the patient for the publication of this study, accompanying images and the video. A copy of the written consent is available for review by the editorial

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Video 1 Description of the clinical case and surgical technique. Dr. Francesco Londero, February 2026.

office of this journal.

Step-by-step description

Anesthesia and positioning

After anesthesia induction with fentanest 2 µg/kg, propofol 2 mg/kg and rocuronium 0.6 mg/kg, the patient was intubated with a double-lumen tube. The patient was therefore positioned on right lateral decubitus with mild bending of the operating bed. The left shoulder was kept in a neutral position to avoid further displacement of the clavicle fracture. During the surgical procedure, anaesthesia was maintained using a total intravenous protocol with propofol and remifentanil under bispectral index (BIS) and train of four (TOF) neurological monitoring. The patient was ventilated with a Tidal volume of 3–4 mL/kg on one lung ventilation.

Surgical kit description

The Ribfix Advantage (Zimmer Biomet, Jacksonville, FL 32218-2480, USA) surgical kit was employed for rib stabilization: the kit is composed of two different size bridges (6 and 9 cm respectively, depending on the extent of the fracture to be stabilized) pre-assembled with two 23-mm locking posts, which are applied on the inner face of the ribs, and a standard size locking cap with a washer which are applied on the outer face of the rib to stabilize the implant. The dedicated instrumentation is composed by a 4 mm drill tip, a drilling guide, two guiding wires, a cannulated handle (which serves to screw the locking cap on the post) and a post cutter.

Port placement and exploration

After sterile field setup, a 5-cm single port in the sixth intercostal space on the anterior axillary line was performed for both camera and instruments' introduction. The site of incision was established based on anatomical considerations: in the light of the posterior location of the target fracture points, an anterior access was deemed appropriately distant to allow wide visualization of the inner surface of the rib cage and instruments handling.

Fracture localization

After insertion of a 10 mm 30° camera, the inner surface of the chest is explored, and the fracture points identified with chest wall external compression to identify the points of instability. In the present case the target fractures were identified on the 6th and 7th rib on the posterior and middle axillary line, respectively. Transcutaneous needle insertion under thoracoscopic vision in this phase is of great help to precisely identify the location of the target fracture and guide skin incision so that a proper exposure of the fracture point and of the respective rib may be achieved.

Rib exposure and drilling

Subsequently, a 4–5 cm skin incision is performed above the target fracture point and the muscles layers bluntly dissected to the rib surface, which is exposed for about 2–3 cm on either side of the fracture. The rib is therefore drilled at about 2 cm from the fracture line on either side under both external and thoracoscopic view with a 4-mm diameter drill. The employment of the provided drill guide

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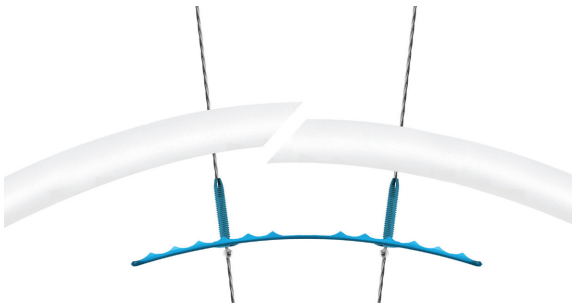


Figure 3 Representation of the surgical implant before its deployment within the fractured rib. The wires are passed through the holes created after rib drilling. Reproduced with permission from RibFix AdvantageTM system brochure, Zimmer Biomet.

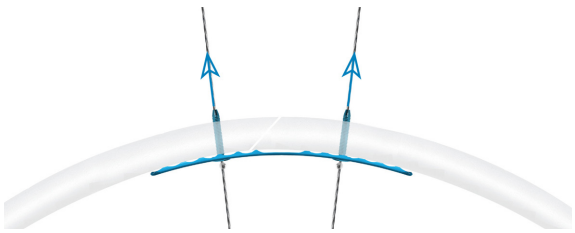


Figure 4 Representation of the implant after full thickness engagement of the rib, obtained by pulling the metal wires from the outer side of the fracture. Note how pulling the wires determines the fracture reduction. Reproduced with permission from RibFix AdvantageTM system brochure, Zimmer Biomet.

is of great importance to avoid the risk of intrathoracic organs perforation due to excessive introduction of the instrument tip. In addition, the provided drill guide has a groove-shaped tip which embraces the curved outer surface of the rib and ensures that the bone is perforated in its central part, thus preventing accidental injuries to the intercostal neurovascular bundle.

Bridge insertion

After hole creation, the drill guide also serves to facilitate the passage of a soft polypropylene 10-Fr cannula which facilitates the insertion of the device metal wires through the rib orifices. Once that both cannulas have been passed through the perforated ribs, they are retracted from the utility port, and from this latter side the two wires are passed through the cannulas with a 6-cm bridge pre-assembled on them. Once the wires exit from the target rib the cannulas are withdrawn.

Fracture fixation

The wires are therefore pulled from the side of the fractured rib (*Figure 3*), while an operating surgeon guides the bridge through the utility port under vision. Further pulling the wires from outside aligns the bone stumps around the fracture point and allows the implant posts to engage the bone at full thickness (*Figure 4*). At this point, under continuous pulling, the locking caps and the washers are passed through the wires from the outer side and secured to the posts with the cannulated screwing handles. Subsequently, the wires are removed from the utility port, leaving the bridge anchored to the rib.

Trimming and closure

Eventually, the posts are cut at their base above the locking caps to avoid soft tissues injuries after wound closure. In the present case, even though multiple fractures were present, we decided to fix two ribs only, with the aim of correcting the anatomical basis for chest instability. After identifying the displaced fracture on the 7th rib with chest compression and the ideal points of rib drilling on either side of the fracture through needle insertion, a 2-cm incision was performed above the fracture line. The procedure was therefore repeated in a similar manner and a further 6-cm

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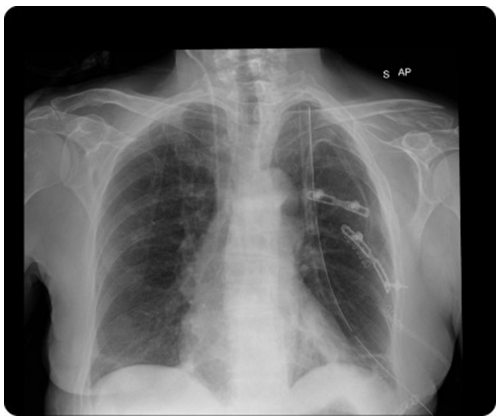


Figure 5 Post-operative chest X-ray showing the regular position of the implants and good post-operative lung expansion.

bridge deployed over the fracture. After hemostasis check, positioning of one intrapleural and one submuscular drain and verification of the correct lung re-expansion the wounds were closed in layers.

Time of surgery was 120 minutes. Total blood loss was 50 mL. No intraoperative complication occurred.

Postoperative considerations and tasks

Pain management was addressed with epidural ropivacaine 0.2% 7 mL/h and morphine 1.5 mg/day for the first 3 days, and intravenous paracetamol 1 g three times a day (TID) and ketorolac 30 mg twice a day (BID).

According to our institutional protocol, patients undergoing SSRF are admitted to the ICU under MV for post-operative monitoring. A CXR is performed within 2 hours after surgery to verify good lung re-expansion and the correct position of the implants and, upon evidence of a regular early post-operative course, they are progressively awakened and weaned from the endotracheal tube. In the present case CXR revealed a regular surgical outcome (*Figure 5*) and the patient was extubated 8 hours after the intervention, upon evidence of good gas exchange on autonomous ventilation. On post-operative day (POD) 1, she was transferred to the surgical ward, where she was set on strict respiratory physiotherapy and active mobilization and progressively weaned from oxygen supplementation. Subjectively, the patient referred an immediate improvement of dyspnea and chest pain, which was rated as 3/10 on NRS. The chest drains were removed on POD 6 and the patient discharged home on POD 8, with adequate pain control (NRS 2/10), good respiratory parameters on room air and able to carry on with light daily activities. No post-operative complication occurred. At 30 days follow-up visit, the patient was in good overall conditions, with satisfactory pain control on paracetamol 1 g BID and ibuprofen 600 mg on demand (maximum twice daily). She did not complain of any significant dyspnea, even though she cautiously self-limited in her daily activities.

Tips and pearls

- Port positioning for camera and operative instruments should be adapted based on the localization of the fractures. A sufficient distance between the target fracture points and the camera should be maintained to facilitate a wide visualization of the internal aspect of the rib cage and provide enough space for the movement of the bridge and related instruments within the pleural cavity.
- Transcutaneous needle mapping allows tailored incisions to correctly expose the target fractured rib avoiding excessive muscle division.
- In case of osteoporosis or other bone fragility conditions, attention should be paid to preserve the bone integrity: drilling should be performed at least 1.5 cm from the fracture line and once the locking posts are secured to the outer surface of the rib, avoiding excessive screwing may prevent further bone damage.
- Adequate exposure of the outer rib surface should be accomplished to facilitate adherence of the drill guide, and avoid dislocation of the instrument during bone perforation and potential injuries to the neurovascular intercostal bundle.
- Bony segments alignment should be carefully

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checked to ensure good results of the intervention. While pulling the wires is usually sufficient to guarantee a proper fracture reduction, if this does not occur the mobile segments may be guided using robust instruments from the internal side under thoracoscopic view and gentle wires pulling.

- ❖ Chest compressions before and after implants deployment ensure that chest stabilization has been achieved.

Discussion

Surgical highlights

Since its introduction in the early 1900s, SSRF has progressively gained wider acceptance among the surgical community. The superior outcomes observed in surgically treated patients compared with those managed conservatively led to an expansion in surgical indications and technique refinements, along with the introduction of new devices which could better serve for the purpose. Within this scenario, the employment of an intrathoracic stabilization system apparently configures itself as the ultimate advancement in the field. While to date no prospective study compared the results between open and VATS SSRF, several retrospective series mention in a quite unanimous way how intrathoracic rib fixation is characterized by a lower invasiveness, which translates in enhanced recovery and improved clinical outcomes (10,11).

Aside from the assumed benefits for the patients, this technique appears advantageous even from the surgeon's point of view. Indeed, the provided instrumentation is essential and very operator friendly: the fact that, compared with the open approach, before the implant deployment there is no need for bony segments alignment, which is obtained just pulling the metal wires, makes the fracture reduction extremely easy and straightforward. This results also in reduced operative times: in our case, albeit being the first procedure performed with this equipment after instructional video training only, the operative time was 2 hours. We consider this result satisfactory and indicative of a steep learning curve for surgeon who already have moderate experience in SSRF.

Beyond the surgeon's perspective of a particular suitability of this technique for stabilizing rib fractures, several studies unraveled the anatomic and physiologic ground to favor a total intrathoracic approach. Indeed, anatomical studies based on cadaveric models showed that the inner cortex of the ribs is thicker and denser than the outer, implying a theoretical stronger stability of an intrathoracic implant (13,14). This might be particularly reasonable, as in the present case, in patients suffering from low density bone conditions such as osteoporosis, where the lower bone compactness may account for implant displacement and failure of the procedure.

While in view of the good results the indications for SSRF are broadening, there are still several points of debate among the surgical community, mainly regarding the number of ribs to be fixed in flail chest patients and the optimal time window to perform the stabilization. Concerning the former, Baumann and colleagues performed a finite element analysis on chest wall models and concluded that fixing all the points of fractures restores chest wall stability and may lead to a better respiratory function (15). On the other hand, He and colleagues argued that not all rib fractures need to be fixed, leaving the decision on the stabilization priority to a comprehensive injury assessment, in a case-by-case approach (16). This opinion is supported also by Reindl and associates, who described in their retrospective analysis the usefulness of VATS for precise assessment of the point of fractures and selective stabilization to restore chest stability (17). However, to date no prospective study on trauma patients has been conducted to respond to this issue, and the ideal approach remain largely speculative and based on the surgeon personal judgement. In the present case, while multiple fractures were outlined at CT scan, we decided to stabilize only two ribs, with the aim of restoring the thoracic contour and resolving the anatomical basis for the flail chest. The effectiveness of the procedure was appraised intraoperatively with chest compression after the implant deployment, which confirmed the resolution of the chest segment movement. The regular post-operative course and the rapid improvement in respiratory parameters confirmed our impression.

With regard to the best timing to perform SSRF, several authors agree that, unless other associated post-traumatic injuries with higher treatment priority impose to delay chest stabilization, this should be performed within 3 days, in order to reduce the risk of pneumonia, ventilator support and time of admission in ICU (12). In our case SSRF was performed 10 days after the traumatic event, longer than widely accepted. This was due to several factors: first, when the patient was admitted at the Emergency Department, physical examination did not clearly identify any paradoxical motion of the chest and the patient was not subjectively

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in severe dyspnea. A thoracic surgeon consultation was requested only 3 days after admission, upon evidence of clinical flail chest, worsening respiratory conditions and after execution of CT scan, which demonstrated the precise pattern of fractures. We might assume that the fractured ribs underwent a further displacement during the first days following the trauma, a phenomenon that has already been described and that may account for the late identification of potential surgical candidates (2). In addition, even after confirming the presence of the flail chest, we tried to manage the situation conservatively with chest drainage and NIV, leading to a further delay of about 2–3 days to surgical stabilization. Eventually, the employed surgical kit was not available at our institution at case presentation, and, once the indication was posed, we had to wait to receive it to schedule the intervention.

Strengths and limitations

Apart from these points of debate, there are still some considerations to be made regarding the extent of indications for employing this technique. Indeed, in a non-negligible proportion of cases, victims of chest trauma may present with bilateral costal fractures and/or lung contusions. While to our knowledge no study investigated yet this topic, the bilateral involvement may represent a potential contraindication for an intrathoracic procedure: contralateral lung contusion may pose a serious challenge for supporting the patient with one-lung ventilation, and positioning the patient on the injured side may aggravate the anatomical pattern and cause further acute complications, such as lung perforation and haemothorax, which are difficult to address during the surgical phase. Another point of concern is represented by fracture involving the anterior costal cartilage or the sternocostal joints, which may be troublesome to stabilize due to the weaker composition of the cartilage and the proximity with the heart. In this latter case the employment of an extrathoracic plating technique might be more indicated since it does not pose concerns regarding potential heart injuries and allows a more reliable fixation of the fractured rib with the compact surface of the sternum.

Concerning the surgical approach, it should be noted that even though the procedure is widely described as "VATS", the necessity of additional incisions above the fracture points better configures the procedure more as hybrid than purely thoracoscopic. However, due to the small size of such surgical accesses and the preservation of the muscular tissue, which is just bluntly dissected to reach the rib surface, we believe that the surgical invasiveness is definitely lower than in case of traditional open procedures, which often require a wide exposure of the rib cage through muscle division and detachment from the rib surface. Eventually, albeit the smooth surface of the implant, which inevitably gets in contact with the lung surface, demonstrated to prevent from lung damage and related complications, no data are currently available regarding its safety in the long term. Indeed, the contact between the implant and the visceral pleura might potentially lead to long term effects such as pleural irritation and development of adhesions. The nature of our case description and its short follow-up time cannot provide an answer to this issue, and extended follow-up data from large series are awaited to eventually confirm its security even in the long term.

Comparison with other surgical techniques and researches

While the comparison between surgical stabilization and conservative treatment for patients with chest instability is well-supported by several studies with high level of evidence (3,5,6), to our knowledge no prospective trial compared the outcomes of extrathoracic versus intrathoracic rib plating. The currently available evidence, to our knowledge, is derived by retrospective series: Qian and coauthors reported the results of a comparison between open and VATS SSRF, demonstrating similar outcomes in terms of operative time and length of admission, whereas patients undergoing open stabilization experienced higher post-operative pain and higher incidence of post-operative pleural effusion (11). In a similar design study Tay-Lasso and colleagues described how VATS rib plating was characterized by shorter operative times and length of admission (18). However, while the efficacy and reliability of open SSRF is confirmed even in the long term (19), the relatively recent introduction of the VATS approach system does not consent to draw firm conclusions on its safety over time. Mature data, possibly from large prospective studies are therefore required to confirm its security in the middle-long term.

Beyond the clinical outcomes of a novel procedure, a point of reflection is posed by the assessment of the overall costs related to it. While a straight comparison of the direct implants' costs between the extrathoracic and intrathoracic approach seems difficult due to the wide heterogeneity of the kind of plates and screws employed in the former technique, further uncertainties raise when considering the impact of the two techniques on the overall expenses.

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Indeed, the assumed positive outcomes of the intrathoracic stabilization may translate into reduced ICU and overall in-hospital length of stay, and consumption of analgesics, factors that may contribute to a decrease in overall admission costs. However, we deem this procedure-related costs evaluation extremely premature, and separated *ad hoc* studies should be performed to respond to this point.

Implications and actions recommended

The apparent advantages of internal rib plating are likely to generate an expansion in its application for the treatment of flail chest. However, the level of evidence supporting this practice is still immature, and prospective randomized controlled trials are necessary to definitely confirm its advantage from a clinical point of view.

Conclusions

VATS SSRF is a viable option for the treatment of post-traumatic chest instability. Due to the lower extent of surgical incisions and the reduced need for thoracic muscles division, it appears as a less invasive alternative to open stabilization. These results should be confirmed by large prospective trials.

Acknowledgments

We thank Zimmer Biomet for granting permission to use the device images in this paper.

Footnote

Reporting Checklist: The authors have completed the SUPER reporting checklist. Available at https://jovs.amegroups.com/article/view/10.21037/jovs-2026-0015/rc

Peer Review File: Available at https://jovs.amegroups.com/article/view/10.21037/jovs-2026-0015/prf

Funding: None.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jovs.amegroups.com/article/view/10.21037/jovs-2026-0015/coif). The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from the patient for the publication of this study, accompanying images and the video. A copy of the written consent is available for review by the editorial office of this journal.

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doi: 10.21037/jovs-2026-0015
Cite this article as: Londero F, Cinel J, Grossi W, De Franceschi E, Melan L, Masullo G, Copetti E, Raffaelli B, Zuin A. Video-assisted thoracoscopic surgery surgical stabilization of rib fractures: surgical technique and case report. J Vis Surg 2026;12:32.

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