



Thoracoscopic-assisted surgical stabilisation with a locking compression plate for pectus excavatum in a Maine Coon kitten

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Abstract

Case summary A 4-month-old Maine Coon kitten was presented for the surgical correction of pectus excavatum (PE). Originally presenting with progressive respiratory distress, the cat underwent video-assisted thoracoscopic surgery (VATS) for stabilisation using a locking compression plate. Postoperative complications included two separate episodes of infection, which ultimately resolved after implant removal. The cat showed gradual improvement and exhibited no clinical signs related to PE at the 12-month follow-up.

Relevance and novel information The VATS approach may provide a useful technique to help reduce intraoperative risk during PE correction in cats.

Keywords: Minimally invasive; pectus excavatum; thoracic surgery; video-assisted thoracoscopic surgery

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Introduction

Pectus excavatum (PE) is a thoracic wall anomaly characterised by inward deviation of the sternum and costal cartilage, resulting in a reduced dorsoventral diameter of the thorax.¹ This condition is generally considered uncommon.²

The aetiology remains poorly understood; however, a genetic component is suggested by cases where multiple animals within the same litter are affected.^{3–6} In cats, a breed predisposition has been reported in Burmese⁴ and Bengal cats.^{7,8}

The recommended treatment for young animals (aged <4 months) with a compliant thorax typically involves surgical correction using external splinting techniques.⁹ In older cats with a non-compliant sternum, external splinting is discouraged.⁸ Correction aims to remodel the chest and achieve downward traction on the costochondral junctions and ribs.^{10–12} To achieve this, the preferred technique involves placing circumsternal sutures.¹³ While specific guidelines for suture placement are lacking, the primary focus must be on exercising caution to avoid vital structures, as the risk of injury to the

heart, lungs and major vessels is significant, especially in a small sized patient.

Thoracoscopy is associated with faster recovery and shorter hospitalisation times compared with open surgery.¹⁴ Despite limited working space in the feline thoracic cavity, video-assisted thoracoscopic surgery (VATS) is a viable alternative and is increasingly used in a variety of procedures.^{15–18} We used VATS to provide comprehensive intraoperative visualisation of the thoracic cavity and to minimise the risk of iatrogenic injury.

This report presents the successful treatment of a 4-month-old cat using a sternum realignment technique under VATS.

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Case description

A 4-month-old Maine Coon cat weighing 1.85 kg was referred with a history of progressive exercise intolerance and acute respiratory distress. Despite the clinical signs, the kitten's weight was comparable to that of a littermate in the same household. On physical examination, the kitten exhibited mixed dyspnoea characterised by increased respiratory effort and open-mouth breathing. Auscultation revealed mild diffuse respiratory stridor and heart sounds were muffled on the right hemithorax. Palpation identified a dorsal concave deviation of the caudal portion of the sternum along the longitudinal axis. To confirm the chest wall malformation, standard lateral and ventrodorsal (VD) thoracic radiographs were taken (Figure 1).

The radiographs confirmed the caudal deviation of the sternum, displaying a typical PE⁶ with short thoracic depression.¹⁹ The cardiac silhouette appeared entirely displaced to the left on the VD view. The degree of the PE was assessed using the frontosagittal index (FSI) and the vertebral index (VI).^{9,20} A VI of 9.1 (reference interval [RI] 12.6–18.8) and an FSI of 2.1 (RI 0.7–1.3) indicated a moderate degree of PE. To further evaluate the deformity, a CT scan was performed. The VI was calculated as previously described,¹⁹ yielding a value of 8.7, consistent with the radiographic findings. The correction index (CI) was estimated at 13.8 and the PE was asymmetric.¹⁹ Focal interstitial parenchymal pulmonary lesions were identified at the ventral portion of the middle right lobe and right cranial lobe.

Surgical correction was scheduled 24 h after diagnosis, with both written and verbal consent obtained from the owner. Premedication included diazepam (0.2 mg/kg IV) and morphine (0.1 mg/kg IV), followed by induction with propofol (2 mg/kg IV). Anaesthesia was maintained with isoflurane under assisted ventilation. Perioperatively, the cat received meloxicam (0.05 mg/kg IV) and amoxicillin–clavulanic acid (20 mg/kg IV). A 3.5 mm cannula with an open valve was inserted intercostally at the fifth left intercostal space (Figure 2) and was used to enable airflow into the thoracic cavity, inducing pneumothorax at atmospheric pressure. There was no CO₂ injection needed; instead, air was allowed to enter from the outside, collapsing the pleural space and allowing a satisfactory view of the thoracic cavity. A rigid 2.7 mm, 30° telescope was inserted, thereby providing visualisation of lung collapse and chest wall deformation (Figure 3a). Two small skin incisions were made at the level of the xyphoid process and manubrium to facilitate subcutaneous placement of a 12-hole 2.4 mm locking compression plate (LCP) on the ventral surface of the sternum. The plate served as an anchor for two circumsternal non-absorbable polyamide sutures (Ethilon II; Ethicon), placed to engage the xyphoid process and caudal sternebrae. An additional non-absorbable suture was placed proximally, passing through the first hole in the plate to stabilise it. Intraoperative monitoring with thoracoscopy allowed direct visualisation of thoracic compliance, facilitating precise adjustments to suture placement and traction. The caudal sutures were

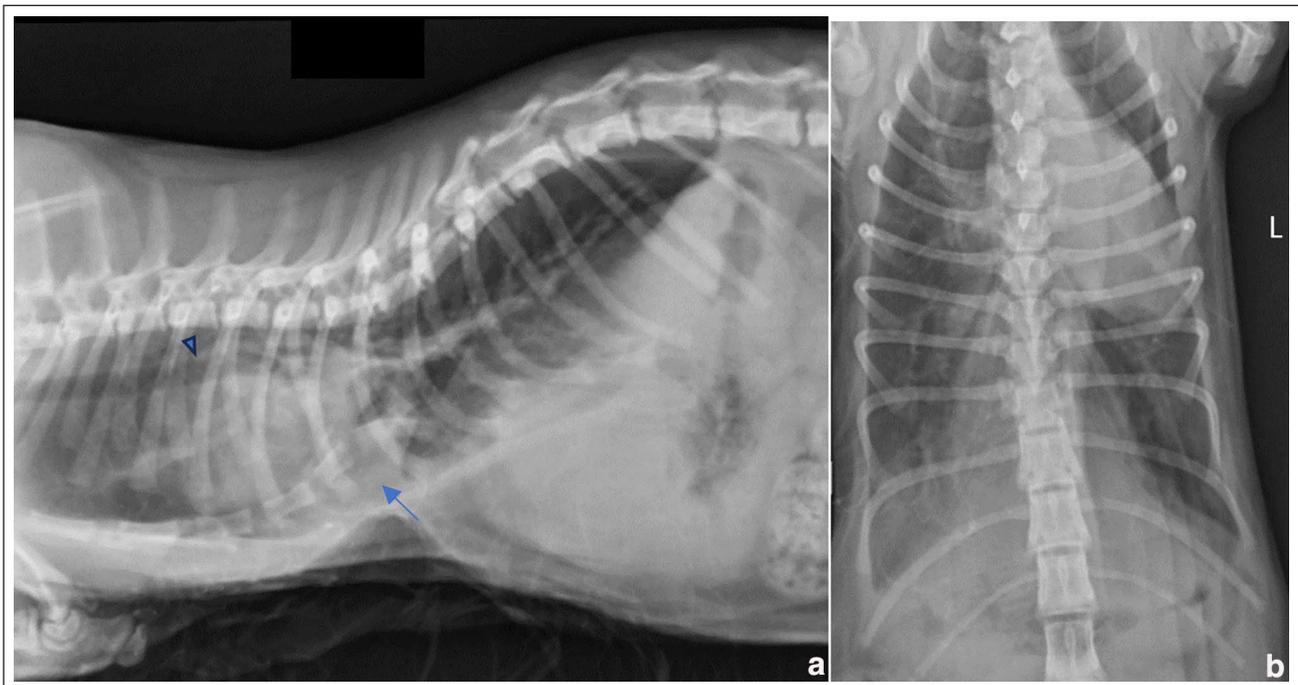


Figure 1 (a) Right lateral and (b) dorsoventral thoracic preoperative radiographs showing dorsal deviation of the caudal portion of the sternum (arrow) and dorsal displacement of the thoracic portion of the trachea (arrowhead)

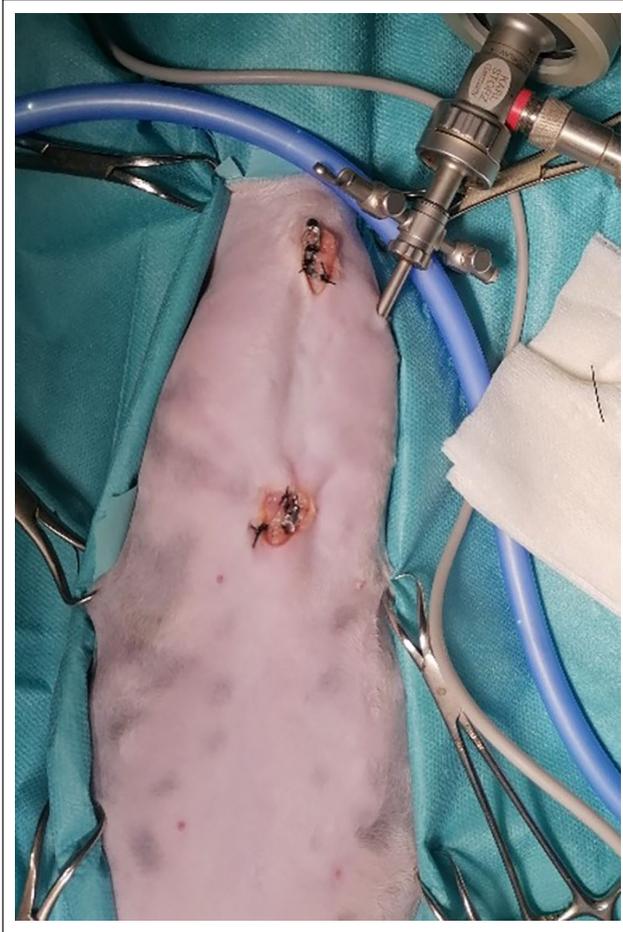


Figure 2 Image showing the placement of the scope to allow thoracic cavity visualisation after minimally invasive placement of the locking compression plate. The head of the kitten, placed in dorsal recumbency, is at the top of the image

used to apply ventral traction on the sternbrae. Tension was applied with a Backhaus towel clamp to the sternbrae and was carefully monitored under camera guidance to adjust traction and the position of the sutures to achieve optimal chest wall alignment (Figure 3b). An intravenous catheter was temporarily used as a chest drain to resolve iatrogenic pneumothorax, which was removed after muscle layer closure. Postoperative orthogonal thoracic radiographs (Figure 4) and CT scans showed improvement in the thoracic deformity, correct implant positioning and no residual pneumothorax. The VI on CT images was 11 and the CI was 10.9.

The kitten recovered for 12h in an oxygen tent and received morphine (0.1mg/kg IV q6h). Pain was assessed every 4h using the Glasgow Feline Composite Measure Pain Scale (CMPS-F),²¹ in accordance with the hospital’s standard protocol (mean value 0.4, range 0–1). The kitten showed remarkable clinical improvement the day after surgery, appearing bright and alert, eating well and displaying good energy levels without any signs of respiratory distress. As a result, discharge was arranged 24h postoperatively with a 5-day course of non-steroidal anti-inflammatory drugs (meloxicam 0.05mg/kg PO q24h), along with instructions for strict exercise restriction and indoor supervision for 14 days. Use of a crate whenever direct supervision of the pet was not possible was also advised.

Five days postoperatively, however, the cat presented at the practice with mild lethargy and hyperthermia (40.1°C). Erythema and mild sero-hemorrhagic discharge were observed at the cranial surgical site. Broad-spectrum antibiotics (amoxicillin and clavulanic acid 15mg/kg PO q12h) were administered, and clinical signs resolved after 5 days of treatment. Orthogonal thoracic radiographs

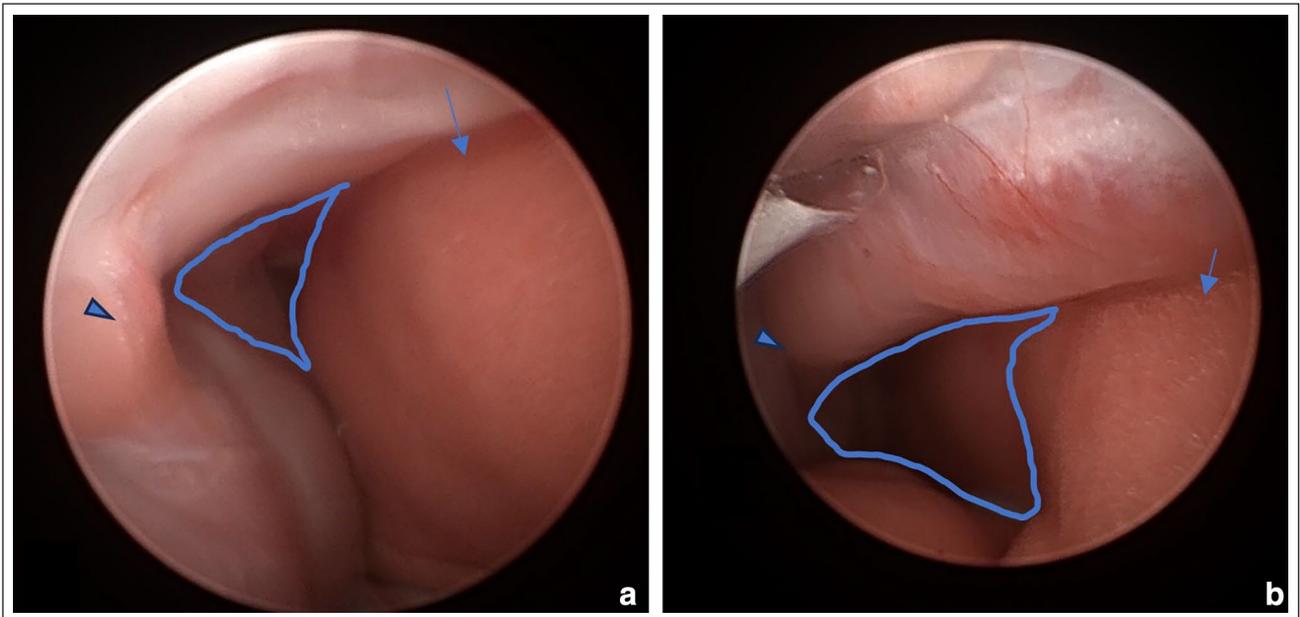


Figure 3 Intraoperative thoracoscopic image showing visualisation of (a) the thoracic cavity and (b) progressive improvement of the thoracic compliance during surgical correction. Thoracic wall (arrowheads) and left cranial pulmonary lobe (arrows) increased thoracic compliance objectivated during the procedure (continuous blue lines)

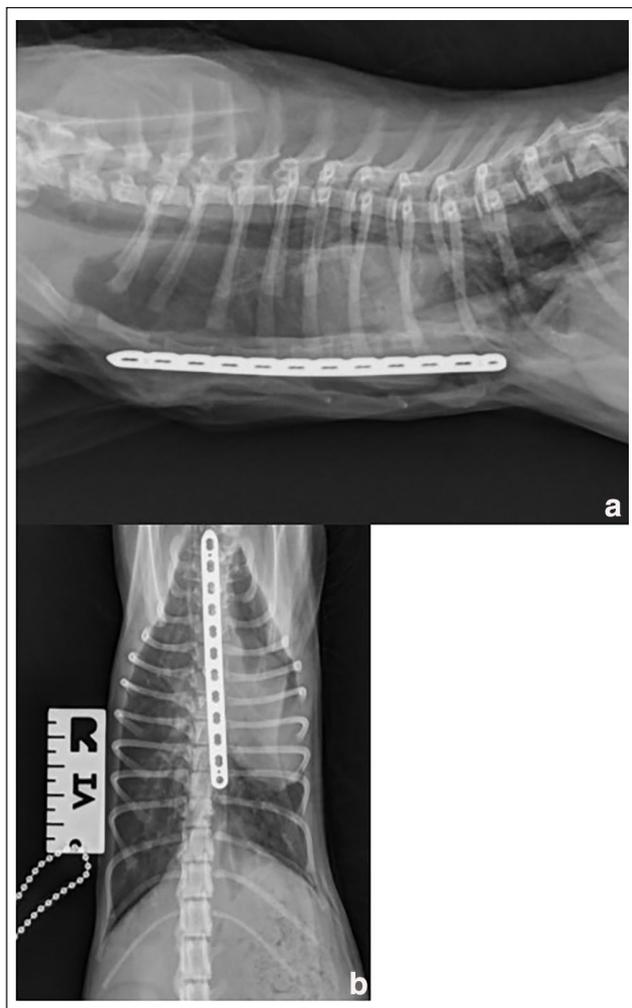


Figure 4 (a) Right lateral and (b) dorsoventral thoracic postoperative radiographs where thoracic deformities were reduced to a more normal configuration. Pulmonary compliance improvement can be appreciated compared with the preoperative radiographic images

were taken every 4 weeks to monitor pulmonary lesion and atelectasis progression, revealing gradual improvement. Two months postoperatively, the cat presented with a second episode of wound infection (Figure 5), showing signs of hyperthermia (39.8°C), lethargy and dysorexia. Both surgical sites exhibited mild purulent discharge and wound dehiscence with exposure of the implant, suggesting an implant-associated infection. This prompted a second 3-week course of antibiotics (amoxicillin and clavulanic acid 15 mg/kg PO q12h). By the end of the antibiotic treatment, wound healing was nearly complete, but a small area of a few millimetres remained open, possibly indicating a reaction to the implant. Because of persistent signs of infection, the implants were removed 3 months postoperatively, with the plan to perform a bacteriological swab if surgical site infection (SSI) persisted. At the final follow-up, 12 months postoperatively, there were no clinical



Figure 5 Surgical site infection 2 months postoperatively. Wound dehiscence is present on both surgical sites. Mild purulent discharge was present associated with mild erythema. The kitten's head is at the top of the image and the kitten is in dorsal recumbency

cal signs associated with PE and the owner reported a normal quality of life for the cat.

Discussion

The VATS technique has been already described successfully in one dog;²² the aim of this report was to demonstrate the same feasibility in a kitten. The use of an LCP to correct PE, with VATS, proved to be a safe and successful procedure. This case highlights the accessibility of the feline thoracic cavity via thoracoscopy, even in cats with varying thoracic conformations. The severity of PE can vary widely, often with minimal impact on health. Surgical intervention becomes necessary when the anomaly compromises respiratory or cardiac function to a moderate to severe degree.¹³ Standard surgical treatment typically involves prosthetic devices to reshape and support the chest wall,^{10,20,23} with various techniques described, including internal splinting for cats aged over 5 months,¹⁰ temporary external coaptation with circumsternal sutures,²⁴ hybrid techniques¹¹

and patient-specific 3D-printed external devices.²⁵ Using VATS, we achieved a minimally invasive approach to the thoracic cavity with just three small incisions, avoiding the need for large external devices. This approach minimises the risk of dermatitis and offers better comfort for the animal. The LCP effectively reshaped the thorax by applying permanent traction to the sternum. While external coaptation was considered, using a plate allowed for precise traction suture placement under thoracoscopic guidance.

Given the small size of the patient, the risk of iatrogenic injury was a primary concern. We believe that VATS significantly enhances care by minimising intraoperative complications. If an iatrogenic injury were to occur (eg, lung or vessel damage), VATS also enables a quicker response and the option to convert to open surgery, a benefit not available with non-visualisation techniques. Direct visualisation enabled optimal adjustment of suture tension to achieve the best possible chest wall conformation. Alternative methods, such as fluoroscopy, could have been considered to assist with intraoperative guidance, but fluoroscopy lacks the direct visual feedback of VATS, does not prevent iatrogenic injury and poses radiation exposure risks to surgical staff. VATS provided a level of precision in suture adjustment and visualisation that fluoroscopy could not match.

One major postoperative complication we encountered was SSI. This complication was not related to the surgical technique itself but is commonly associated with PE correction procedures, given the high volume of foreign material typically used.^{10,26} The implant's size relative to the patient may have contributed to an excessive inflammatory response, with secondary infection potentially due to mechanical friction. In addition, nosocomial contamination cannot be ruled out. While we chose not to perform a culture and sensitivity test at the first presentation of the SSI owing to concerns about potential external contamination, we recognise that this decision may not align with optimal clinical practice. In hindsight, performing a culture and sensitivity test would have been prudent to guide antimicrobial therapy more effectively. However, had the SSI persisted after implant removal, a bacteriological swab would have been warranted. Tension applied by the sutures may also have compromised vascular supply, predisposing the site to infection. Ultimately, implant removal was necessary, which we regard as part of the standard postoperative care for PE repair. A shorter duration before implant removal may have been adequate in this case. The authors support the use of VATS for its advantages in controlling potential bleeding or organ injury due to suture placement, as previously suggested.²²

The main limitations of this technique are the requirement for specialised equipment and extensive training in thoracoscopic procedures. The surgeon must also be

prepared for thoracotomy if conversion is needed, and additional anaesthetic equipment, including mechanical ventilation and trained personnel, are essential.

Conclusions

The primary advantage presented is the feasibility of using VATS to provide the surgeon with precise guidance in adjusting suture tension. VATS can be integrated with various established techniques for addressing PE, enhancing surgical accuracy. To the best of our knowledge, this is the first documented use of VATS to correct PE in a kitten, as it has previously only been reported in a dog.²²

Conflict of interest The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical approval The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained it is stated in the manuscript.

Informed consent Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers, tissues or samples) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

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