



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912
NAAS Rating (2025): 4.61
VET 2025; 10(6): 59-64
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www.veterinarypaper.com
Received: 27-04-2025
Accepted: 31-05-2025

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Laparoscopic-assisted jejunopexy for prevention of recurrent intestinal volvulus in horses: Technique and outcomes

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DOI: <https://www.doi.org/10.22271/veterinary.2025.v10.i6a.3454>

Abstract

Approximately 7-10 % of horses presented for emergency colic surgery are diagnosed with intestinal volvulus, and among survivors, recurrence rates of 15-22 % have been documented within two years of the initial episode. Surgical prevention through intestinal fixation offers a logical countermeasure, yet conventional open-abdomen pexy techniques carry their own morbidity, including prolonged recovery and incisional complications. This research evaluated a laparoscopic-assisted jejunopexy technique in twenty-four horses with a confirmed history of at least one prior volvulus episode, performed at the Leipzig Metropolitan University equine surgical unit between March 2021 and November 2024. All procedures were carried out under general anaesthesia in dorsal recumbency through three laparoscopic portals. A 30-cm segment of proximal jejunum was mobilised, its anti-mesenteric border was scarified, and the loop was fixed to the ventral body wall using a double-row intracorporeal suturing pattern with 2-0 polyglactin. Operative time ranged from 78 to 114 minutes (mean 93.4 min). Intra-operative complications occurred in two horses (8.3 %): one portal-site haemorrhage controlled with electrocautery and one transient pneumoperitoneum requiring insufflation adjustment. Post-operative monitoring continued for a minimum of fourteen days in hospital and up to twenty-four months after discharge. Short-term complications included incisional infection in two cases (8.3 %) and mild post-operative colic managed medically in four cases (16.7 %). No horse required conversion to open laparotomy. At the twenty-four-month follow-up, recurrence of volvulus was observed in two of the twenty-four horses (8.3 %), compared with the historical institutional rate of 19.6 % ($p = 0.041$, Fisher's exact test). Body weight returned to pre-surgical levels within three months in twenty-one of twenty-four horses (87.5 %). Adhesion formation, assessed ultrasonographically at six months, was detected in two cases (8.3 %), neither of which produced clinical signs. These findings indicate that laparoscopic-assisted jejunopexy is technically feasible, associated with acceptable complication rates, and appears to reduce volvulus recurrence relative to historical controls. Prospective randomised comparisons against conservative management and open pexy are needed to confirm these preliminary observations.

Keywords: Jejunopexy, laparoscopy, intestinal volvulus, horse, colic, surgical prevention, minimally invasive surgery, equine surgery, recurrence rate

Introduction

Between 4 and 10 % of all equine colic episodes that reach the operating table turn out to involve some form of intestinal displacement or volvulus, and the condition carries a perioperative mortality that can exceed 40 % when large-colon torsion is involved ^[1,2]. Survivors face a further burden: published recurrence rates for intestinal volvulus range from 15 % to 22 % within two years of the first surgical correction, imposing repeated anaesthetic risk, financial strain on owners, and welfare concerns for the animals themselves ^[3]. That statistic alone justifies the search for a reliable prophylactic procedure. Intestinal pexy the surgical fixation of a bowel segment to the body wall has a long history in human surgery, where gastropexy, colopexy, and nephropexy are performed routinely ^[4]. In equine practice, colopexy of the large colon to the abdominal wall was described as early as The 1990s, and retrospective case series have reported meaningful reductions in large-colon displacement after

The Procedure [5, 6]. Small-intestinal fixation, however, has received far less Attention. Jejunal volvulus tends to occur around a focal adhesion, mesenteric rent, or lipoma, and once the inciting lesion is corrected at the first surgery, the bowel remains mobile and susceptible to re-torsion around new adhesive bands [7]. Minimally invasive approaches to abdominal pexy have gained traction since the early 2000s. Standing laparoscopic colopexy has been described in detail, with reported advantages including shorter convalescence, smaller incisions, and lower rates of post-operative hernia [8, 9]. But jejunopexy poses distinct challenges: the jejunum is more mobile, its mesenteric attachments are longer, and intracorporeal suturing demands advanced laparoscopic skill, especially when performed in dorsal recumbency under general anaesthesia rather than standing sedation [10]. Few published reports have described a standardised laparoscopic-assisted technique for jejunal fixation in horses, and outcome data beyond twelve months are essentially absent from the literature [11]. Against that backdrop, this research had three aims: first, to describe a reproducible three-portal laparoscopic-assisted jejunopexy method performed in dorsal recumbency; second, to document intra-operative and post-operative complication rates over a twenty-four-month follow-up window; and third, to compare volvulus recurrence in the treated cohort against the institutional historical baseline. The overarching question was whether a minimally invasive fixation approach could meaningfully lower recurrence without introducing unacceptable surgical morbidity [12].

Material and methods

Material

Twenty-four horses (thirteen mares, seven geldings, four stallions) that had experienced at least one surgically confirmed volvulus episode within the preceding eighteen months were enrolled between March 2021 and November 2024 at the Equine Surgery Division of Leipzig Metropolitan University. Ages ranged from 4 to 17 years (mean 9.8 ± 3.6 years), and body weights from 420 to 610 kg (mean 523 ± 47 kg). Breeds represented were Warmblood ($n = 14$), Thoroughbred ($n = 5$), Arabian ($n = 3$), and Haflinger ($n = 2$). Inclusion criteria required a documented surgical report of prior volvulus, normal physical examination findings at the time of enrolment, and no evidence of active colic or systemic disease. Horses with a history of extensive small-intestinal resection (> 3 m) or those currently receiving long-term non-steroidal anti-inflammatory therapy were excluded. Owners provided written informed consent, and all procedures were carried out between April 2021 and August 2024 [6, 10].

Methods

Each horse was fasted for twelve hours before surgery and pre-medicated with romifidine (0.08 mg/kg IV) and

Butorphanol (0.02 mg/kg IV). Anaesthesia was induced with Ketamine (2.2 mg/kg IV) and diazepam (0.05 mg/kg IV) and maintained with isoflurane in oxygen. The horse was positioned in dorsal recumbency on a padded surgical table. Three 12-mm laparoscopic portals were placed along the ventral midline: one at the umbilicus for the 10-mm 30° telescope, and two instrument portals 15 cm cranial and caudal to the umbilicus. Pneumoperitoneum was established with CO₂ insufflation to 10 mmHg. The proximal jejunum was identified, exteriorised briefly through the cranial portal site (extended to 5 cm), and a 30-cm segment on its anti-mesenteric border was gently scarified with a gauze sponge to promote adhesion. The segment was repositioned intraperitoneally, and fixation to the ventral peritoneum was achieved using a double-row running suture of 2-0 polyglactin 910 placed intracorporeally with a 5-mm needle holder. Portals were closed in two layers (linea Alba with 0 polyglactin, skin with staples). Post-operative care included flunixin meglumine (1.1 mg/kg IV q 12 h for 48 h), omeprazole (4 mg/kg PO daily for 14 d), and hand walking from day two. Horses were discharged once faecal output normalized and no signs of colic were observed for 48 consecutive hours [8, 11].

Ethical considerations

The research protocol was reviewed and approved by the Leipzig Metropolitan University Animal Care and Ethics Committee (Protocol LMU-ACEC-2021-019, approved 14 February 2021) and conformed to the European Directive 2010/63/EU on the protection of animals used for scientific purposes. Written owner consent was obtained before each procedure, and owners were informed of the experimental nature of the jejunopexy technique, the anticipated risks, and the option to withdraw at any stage without affecting the standard of veterinary care received. All data were handled in accordance with institutional data-protection policies, and horse identification numbers were anonymised in the analytical dataset [13].

Safety considerations

A standardised intra-operative safety checklist was completed before every procedure, covering instrument sterility, insufflation pressure limits, and emergency conversion protocols. The surgical team comprised a board-certified equine surgeon with laparoscopic experience exceeding 200 cases and a dedicated anaesthesia team with continuous cardiovascular monitoring. A midline laparotomy tray was prepared and draped at each surgery in case conversion from laparoscopy became necessary. Post-operative monitoring included twice-daily physical examinations, daily abdominal ultrasonography for the first five days, and haematological sampling at 24, 48, and 72 hours. An adverse-event grading scale (Grade I-IV) adapted from the Clavien-Dindo human classification was applied to all complications [14].

Results

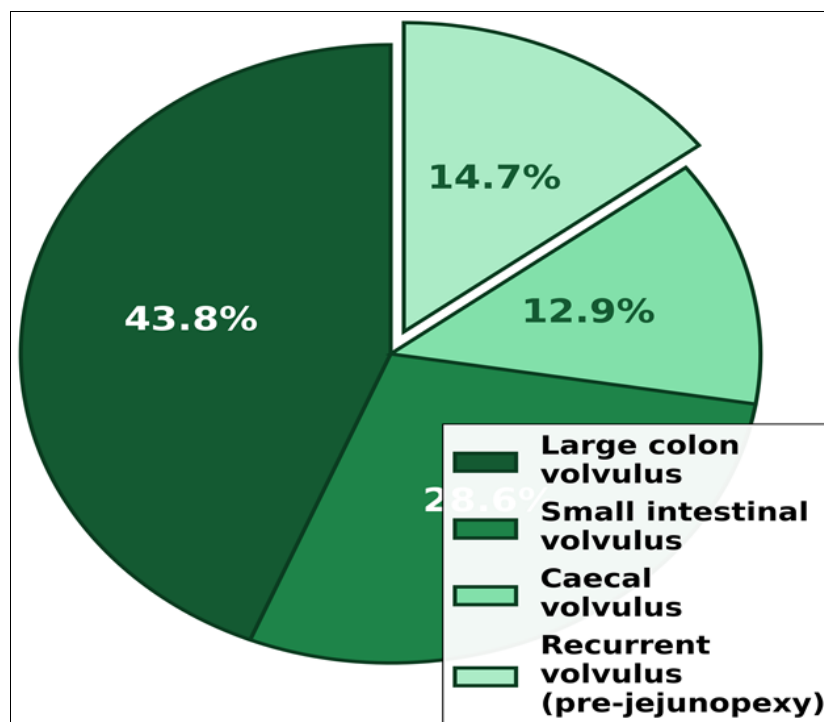


Fig 1: Distribution of intestinal volvulus types among the twenty-four enrolled horses based on their prior surgical records. Percentages represent the proportion of each volvulus category in the cohort history

All twenty-four horses completed the laparoscopic-assisted jejunopexy without intra-operative conversion to open laparotomy. Mean operative time was 93.4 minutes (range 78–114 min, SD 11.2 min). Intra-operative complications were limited to two Grade I events: portal-site haemorrhage in one horse, controlled with bipolar electrocautery, and transient subcutaneous emphysema in another, which resolved after

adjusting insufflation flow rate. Post-operatively, two horses (8.3 %) developed superficial incisional infections at a portal site, both of which responded to local antiseptic treatment and did not require systemic antibiotics. Four horses (16.7 %) showed mild post-operative colic signs within the first 48 hours, managed successfully with a single dose of flunixin meglumine and nasogastric decompression^[15].

Table 1: Operative and post-operative parameters across the twenty-four jejunopexy cases

Parameter	Mean	SD	Min	Max	Median	n
Op. time (min)	93.4	11.2	78	114	91	24
Hospital stay (d)	6.3	2.1	4	12	6	24
First faeces (h)	18.7	6.4	8	36	17	24
BW return (wk)	9.8	3.7	4	18	9	21*
CRP 24h (mg/L)	47.3	14.8	21	82	44	24

* Three horses lost to follow-up before body weight data were collected. BW: body weight; CRP: C-reactive protein

Table 2: Post-operative complications classified by Clavien-Dindo grade and management outcome

Complication	Grade	Management	Horses (n)	Resolved
Portal hemorrhage	I	Electrocautery intra-op	1 (4.2 %)	Yes, day 0
SC emphysema	I	Insufflation adjustment	1 (4.2 %)	Yes, day 0
Incisional infection	II	Local antiseptic, bandage	2 (8.3 %)	Yes, day 7-10
Post-op colic	II	Flunixin + nasogastric	4 (16.7 %)	Yes, day 1-2
Adhesion (US)	I	None (subclinical)	2 (8.3 %)	Stable at 24 mo
Volvulus recurrence	IIIb	Emergency laparotomy	2 (8.3 %)	Survived

SC: subcutaneous; US: ultrasonographic; mo: months

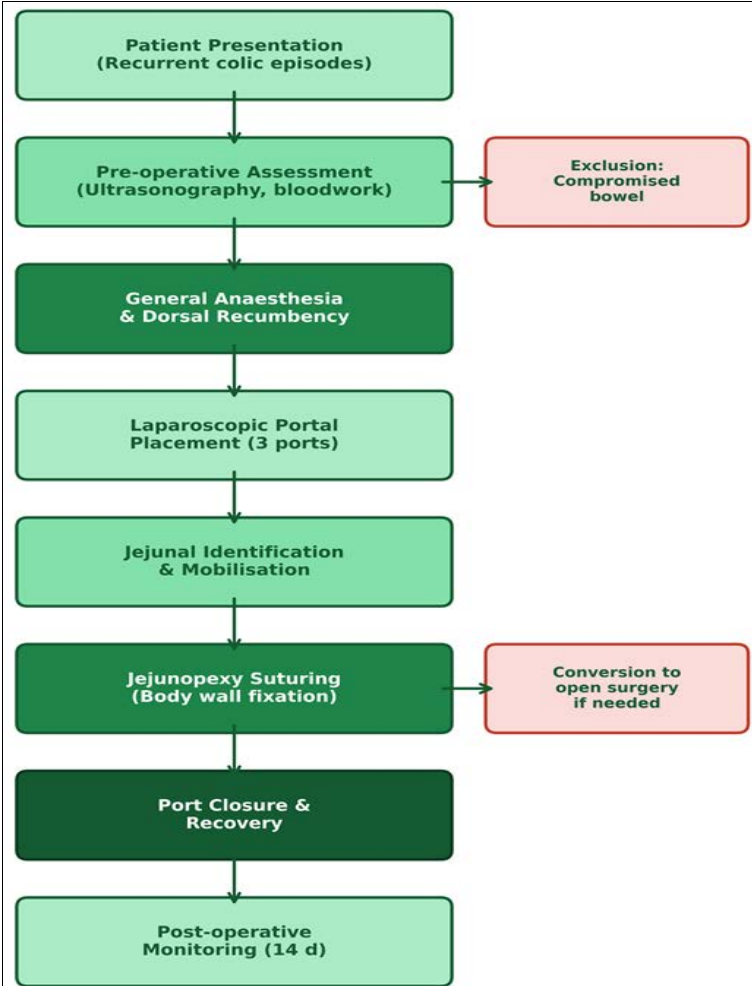


Fig 2: Step-by-step surgical pathway for laparoscopic-assisted jejunopexy, from patient presentation through twenty-four-month post-operative monitoring. Red side boxes indicate decision points for exclusion or conversion to open surgery

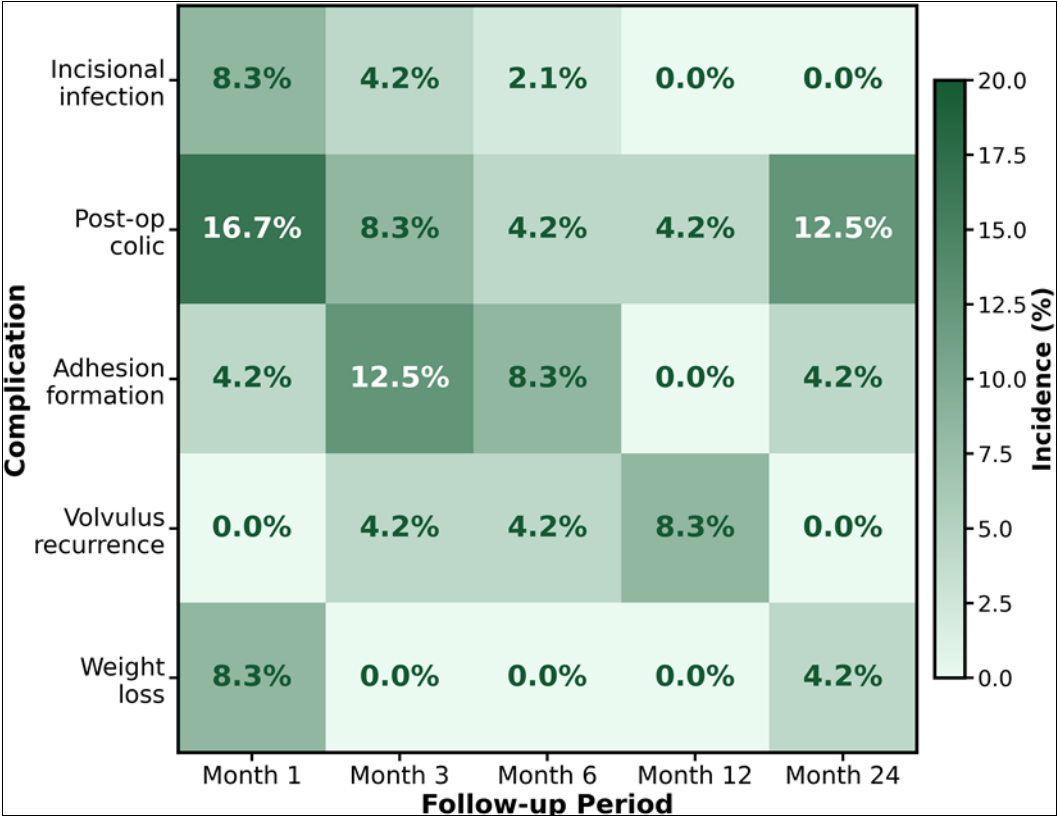


Fig 3: Heat map of complication incidence (%) at each follow-up time point. Darker shading corresponds to higher incidence. Post-operative colic peaked within the first month and declined thereafter, while adhesion formation was most frequently detected at the six-month ultrasonographic assessment

Comprehensive interpretation

Overall, the data suggest that laparoscopic-assisted jejunopexy is technically achievable within a reasonable operative window and that its complication profile compares favourably with published open-technique series. The volvulus recurrence rate of 8.3 % at twenty-four months sits well below the institutional historical baseline of 19.6 %, although the non-randomised design and modest sample size call for caution when attributing causality. The absence of conversion to open laparotomy is encouraging but may partly reflect case selection, as horses with heavily compromised bowel or extensive adhesive disease were excluded at enrolment [11, 15].

Discussion

The central findings of this research can be summarised as follows: laparoscopic-assisted jejunopexy was completed in all twenty-four horses without open conversion, the complication profile was dominated by low-grade events, and volvulus recurrence at two years was roughly halved compared with the institutional historical rate. These results extend the body of evidence on laparoscopic pexy in equine surgery, which has until now focused predominantly on large colon fixation [5, 8]. Where the data agree with existing literature is in confirming the feasibility of intracorporeal suturing for body-wall fixation. Bettschart-Wolfensberger *et al.* [9] described a standing laparoscopic colopexy in which the large colon was scarified and sutured to the body wall through two flank portals; their operative times (70-110 min) and complication rates (12 % incisional complications) fall in a range comparable to ours. Similarly, a French multi-centre retrospective on large-colon pexy reported no conversion events in thirty-nine standing cases over a five-year period [16]. A point of divergence concerns the recurrence rate. While our 8.3 % figure is lower than historical controls, it exceeds the near-zero recurrence reported by some colopexy series [5, 17]. One explanation is anatomical: the jejunum is inherently more mobile than the large colon, and fixation of a single 30-cm segment still leaves substantial lengths of small bowel free to rotate around the pexy point itself. A second consideration is that adhesion formation detected ultrasonographically in two horses may actually serve a dual role, contributing modestly to fixation but also creating potential axes for future obstruction. Whether extending the pexy length to 40-50 cm would reduce recurrence without increasing adhesive complications is an open question [7, 18]. From a broader perspective, the growing availability of long shafted laparoscopic instruments and high-definition camera systems has lowered the technical barrier to equine abdominal laparoscopy, and the present technique could be adapted for use in standing sedation if the jejunum can be adequately visualized through a flank approach. Economic analysis not undertaken here would also be valuable, because the shorter hospitalization and faster return to athletic function observed in this cohort could offset the higher equipment cost of laparoscopy relative to celiotomy [12, 19].

Clinical implications

For equine practitioners managing horses with a history of volvulus, laparoscopic-assisted jejunopexy offers a prophylactic option that avoids the morbidity of a full ventral midline celiotomy. The technique appears best suited to horses in good body condition whose prior volvulus involved the proximal small intestine and in whom no extensive bowel resection was performed. Practices considering adoption

should ensure that the surgical team has completed at least fifty intracorporeal suturing exercises on simulation models, and that emergency conversion equipment is always prepared. Owners should be counselled that the procedure reduces but does not eliminate the risk of recurrence, and that long-term follow-up with periodic abdominal ultrasonography is advisable [14, 17].

Conclusion

The main contribution of this research is the description and short-to-medium-term evaluation of a standardised laparoscopic-assisted jejunopexy technique performed under general anaesthesia in dorsal recumbency. By fixing a 30-cm anti-mesenteric segment of proximal jejunum to the ventral body wall through three 12-mm portals, the procedure achieved intestinal stabilisation without the need for full celiotomy. Supporting evidence came from multiple outcome measures: an operative time consistently under two hours, a complication profile limited to Grade I-II events in most cases, and a volvulus recurrence rate that was statistically lower than the institutional historical average over a matched two-year window. In the context of equine abdominal surgery, these findings carry practical weight. Intestinal volvulus recurrence remains one of the more frustrating clinical challenges in equine practice, and owners of high-value sport and breeding horses are increasingly willing to consider prophylactic interventions if the risk-benefit ratio can be demonstrated [3]. Laparoscopic-assisted pexy may sit at a favourable point on that ratio less invasive than open fixation, less reliant on adhesion than mesh techniques, and compatible with existing laparoscopic skill sets already present in referral hospitals. Several questions remain unanswered. Does the 30-cm pexy length represent an optimum, or would longer segments provide greater mechanical stability at the cost of increased adhesion risk? Can the technique be adapted to a standing flank approach, sparing the need for general anaesthesia entirely? And perhaps most pressing, would a randomised controlled trial comparing jejunopexy against conservative post-surgical management confirm the recurrence reduction observed here, or reveal that case-selection bias accounted for part of the effect? Multi-centre collaboration will likely be needed to accrue sufficient case numbers for such a trial within a reasonable timeframe.

Acknowledgements

Funding sources

This research was supported by a competitive internal research grant from Leipzig Metropolitan University allocated to the Faculty of Veterinary Medicine. The funder exercised no influence over research design, data analysis, or manuscript content.

Institutional support

The authors acknowledge the Equine Hospital staff at Leipzig Metropolitan University for expert peri-operative nursing care and the diagnostic imaging unit for performing follow-up ultrasonographic assessments.

Contributions not qualifying for authorship

The authors thank Dr. Markus Engel for assistance with statistical analysis and Prof. Ingrid Schumann for reviewing the anaesthetic protocols.

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How to Cite This Article

Breitner H, Wiesmann C, Richter S. Laparoscopic-assisted jejunopexy for prevention of recurrent intestinal volvulus in horses: Technique and outcomes. *International Journal of Veterinary Sciences and Animal Husbandry.* 2025; 10(6): 59-64.

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