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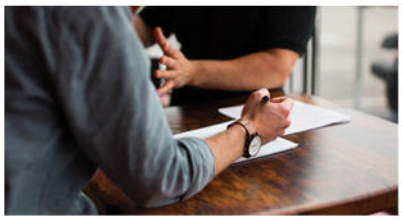

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ORIGINAL ARTICLE - CLINICAL

WILEY

Single-stage reconstruction of third-degree perineal lacerations in horses under general anesthesia: Utrecht repair method

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Abstract

Objective: To describe perioperative management, surgical procedure, and outcome in mares with third-degree perineal lacerations (TDPL) treated with a single-stage repair, the Utrecht repair method (URM).

Study design: Retrospective study.

Animals: Twenty mares with TDPL.

Methods: Medical records of mares with TDPL reconstructed with a URM were reviewed for perioperative management; surgical outcome; and postoperative fertility, athletic performance, and complications.

Results: Mares ranged in age from 3.5 to 11 years. Long-term follow-up was available for 13 mares. Mean duration of follow-up was 9 years (median, 9.5; range, 2–215 months (17.9 years)). Standardized perioperative fasting and postoperative refeeding protocols were used. Only five mares received supportive gastric medication. Reconstruction of the rectovestibular shelf was successful in 18 of 20 mares. Two of 20 mares developed a small rectovestibular fistula after the initial repair, which was successfully repaired with a second surgery. Other postoperative complications were observed in 13 mares and consisted of mild postanesthetic myositis, facial nerve paralysis, esophageal obstruction, rectal obstipation, partial perineal dehiscence, and rectal or vestibular wind-sucking. Six of seven mares that were subsequently bred became pregnant. One mare was successfully used for embryo recovery, and five of six mares foaled without recurrence of a TDPL. Nine of 13 mares were used for riding at various levels.

Conclusion: The alternative single-stage reconstruction for TDPL was successful in 18 of 20 mares after a single surgery. No major complications related directly to the technique were noted.

Clinical significance: The URM is a valid alternative surgical technique for repairing TDPL in mares.

1 | INTRODUCTION

Lacerations of the perineal region occur commonly in mares at the time of foaling.[1] These lacerations are generally divided into three different types, depending on the perineal tissues involved.[2-5] Simple, first-degree lacerations involve the skin and vestibular mucosa of the dorsal commissure only. Second-degree lacerations involve the skin, mucosa, and

submucosa of the dorsal commissure and extend to include some of the musculature of the perineal body. In these cases, there is no involvement of the rectal mucosa. More serious lacerations of the perineal region include tears that extend to involve the perineal septum, anal sphincter, rectal submucosa, and rectal mucosa; these are referred to as third-degree perineal lacerations (TDPL). Third-degree perineal lacerations most commonly occur in primiparous mares during an unattended foaling.[5,6] The damage is thought to result from rapid or powerful expulsion of a fetus in an abnormal posture or position. The foal's foot or muzzle gets lodged in the constriction at the level of the vaginal-vestibular fold and is forced through the dorsal vestibular wall into the rectum.[5,6] If manual repositioning of the foal occurs, damage may be restricted to a rectovestibular fistula (RVF). However, if the malposture is not corrected and parturition proceeds, the lesion will progress to a TDPL.[3] Because TDPL most commonly involve the dorsal vestibular wall and less frequently extend cranially to include a significant part of the dorsal vaginal wall,[4] the authors prefer to use the term vestibular rather than vaginal when referring to the damaged region. The goal of surgical repair is to create a new division between vestibulum and rectum along with functional reconstruction of the perineal body to return the mare to breeding soundness, improve the general well-being of the mare, and restore competence for future athletic performance.[5,7]

Successful reconstruction of a TDPL remains challenging because of the surgical complexity, bacterial contamination, continuing rectal peristalsis and fecal passage.[8] Presence of additional mechanical trauma characterized by severe edema, tissue inflammation, haemorrhage, and tissue necrosis makes immediate surgical repair highly susceptible to failure.[9-12] Delayed surgical repair of TDPL is therefore strongly recommended.[4,5,13,14] In the literature, delayed surgical repair methods are divided into single-stage and two-stage procedures.[3-5,7,15] The single-stage procedure was originally described by Goetz and was later documented by Straub and Fowler (1961).[16] The Goetz modification of the single-stage repair uses a six-bite suture pattern for rectovestibular shelf reconstruction.[5] Most single-stage repair methods currently recommend the use of a multiple (six)-bite purse-string suture pattern, a side-by-side continuous apposition suture pattern, or a simple continuous apposing suture pattern to separate the rectal lumen from the vaginal and vestibular cavities.[3] In following decennia, multiple modifications of the original technique have been reported.[1,6,9,17,18] Most single-stage repair methods are performed on the restrained, standing, sedated mare because this avoids risks related to general anesthesia (GA), lowers costs, and preserves the anatomic relationships.[19,20] Repair in the standing mare, however, can be challenging, especially during extended surgical procedures.

The first objective of this study was to describe the perioperative management and surgical procedure of an alternative single-stage TDPL repair, the Utrecht repair method (URM), in 20 mares. The second objective was to report the surgical outcome, common postoperative complications, subsequent fertility, and athletic performance. Based on our clinical experience, our hypothesis was that the URM would have a high surgical success rate and that complications related to the perioperative management and surgical technique would minimal. Furthermore, we hypothesized that postoperative fertility and athletic performance after repair with the URM would be favourable.

2 | MATERIALS AND METHODS

Medical records of 20 mares that presented between 2000 and 2019 at two separate equine referral centers were retrospectively reviewed. All mares were referred for the surgical reconstruction of a TDPL with the URM. Mares diagnosed with first- and second- degree perineal lacerations or RVF were excluded from this study. Breed, age, perioperative management, preoperative and postoperative complications, postoperative breeding details, subsequent fertility (ie, successfully became pregnant and foaled), and return to athletic performance were recorded. Preoperative, perioperative, and postoperative information until discharge was available from the hospital's databases. All mares were reexamined by the surgeon who had performed the repair at 4 to 6 weeks postoperatively (ie, short-term follow up). Long-term follow-up was performed via a telephone questionnaire at the end of the study period and was available for 13 of 20 mares. For all but one of these mares, long-term follow-up was performed ≥1 year postoperatively.

3 | SURGICAL TECHNIQUE

3.1 | Preoperative planning

Surgery was postponed in all cases until foals were weaned and/or second intention healing of the laceration had occurred (ie, when the epithelium had completely covered all the granulation tissue on the wound surface, usually at a minimum of 12 weeks postpartum).

All mares were fasted for 10 days prior to surgery and were hospitalized in a stable with or without bedding. Mares that were placed in stables with bedding were muzzled. Water uptake was unrestricted. During the 10-day fasting period, omeprazole (4 mg/kg, Gastroguard; Boehringer Ingelheim Animal Health, Alkmaar, the Netherlands) was administered orally once daily to five mares.

The vaccination status was determined prior to surgery. Tetanus serum (7500 IU subcutaneously; Intervet, De Bilt,

the Netherlands) was administered if required. All mares were sedated with a combination of detomidine hydrochloride (10 µg/kg intravenously [IV]) and morphine hydrochloride (0.1 mg/kg IV) or butorphanol (0.1 mg/kg IV). After sedation, mares were premedicated with sodium benzyl penicillin (40 000 IU/kg IV), gentamicin sulphate (6.6 mg/kg IV), and flunixin meglumine (1.1 mg/kg IV). General anesthesia was induced with a combination of midazolam hydrochloride (0.1 mg/kg IV) and ketamine hydrochloride (2 mg/kg IV).

After they had been anesthetized and intubated, mares were positioned in dorsal recumbency and placed caudally on the operating table to optimize surgical access. The surgical table remained in a horizontal, untilted position during the entire anesthetic period. Anesthesia was maintained via intermittent positive-pressure ventilation with isoflurane in oxygen. After positioning, the mare's rectum was manually evacuated, followed by a first lavage with tap water. If significant amounts of feces were present, a betadine-soaked gauze wad was placed cranially to the lesion in the rectum to prevent fecal passage into the surgical field. Subsequently, a second lavage with a diluted povidone-iodine solution was performed. Finally, the surrounding perineal region was aseptically prepared and draped for surgery in a routine fashion.

3.2 | Surgical technique

To maintain surgical overview, a first marker incision was made bilaterally at the level of the planned new dorsal vulval commissure (Figure 1A), followed by a second marker incision at the planned new distal margin of the external anal sphincter (Figure 1B). Surgical exposure of the defect was facilitated by retraction of each vulval labium with a large stay suture (Vicryl 6, polyglactin 910; Johnson & Johnson Medical NV, Zaventem, Belgium). An Allis tissue forceps

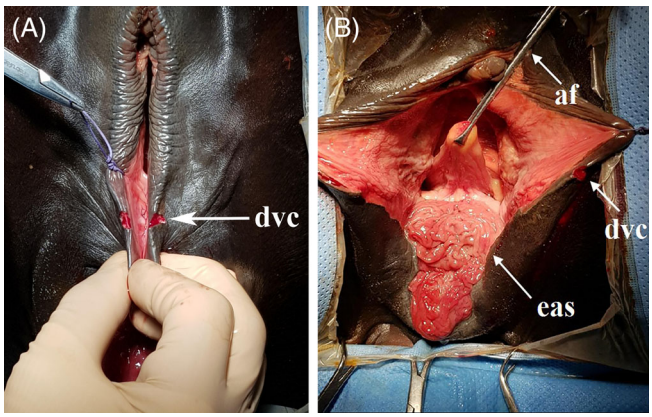

FIGURE 1 A,B, Marker incisions at the planned new dorsal vulval commissure (dvc), the planned new distal margin of the external anal sphincter (eas), and placement of the first stay suture. Allis tissue forceps (af) were used to elevate the vestibular plica

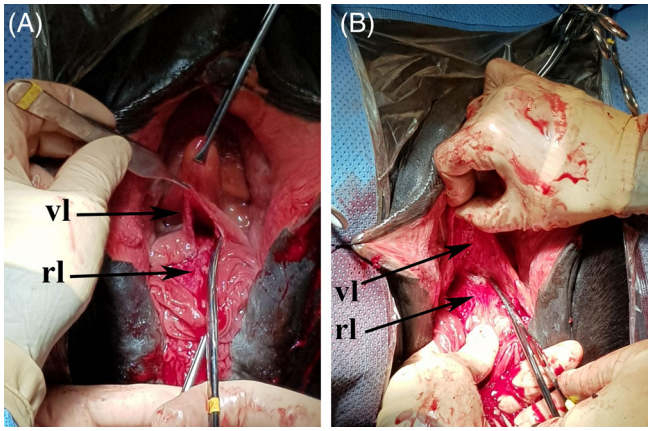

FIGURE 2 A,B, Dissection of a thick perirectal layer (rl) and a thinner vestibular layer (vl)

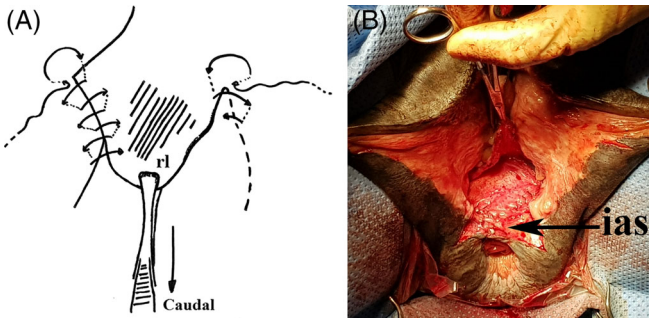

FIGURE 3 A, Caudal mobilization of the perirectal layer (rl) with a thumb or Allis forceps while applying the Utrecht suture pattern from both cranial "corners" in an alternating fashion. B, Reconstruction of the internal anal sphincter (ias)

was placed in the midline on the vestibular plica to aid surgical exposure of the cranial margin of the defect (Figure 1B).

First, the incision was started at the cranial margin of the defect and extended laterally and caudally along this line of demarcation on each side of the defect to the anal sphincter marker incisions in the perineal skin with a No. 10 (F.t.B.) or No. 15 (T.A.E.S., F.H.J.) scalpel blade. Next, the vestibular mucosa and submucosa were dissected from the underlying rectal tissue with Metzenbaum scissors to mobilize enough tissue to allow creation of the new shelf with as little tension as possible on the opposing rectal layers (Figure 2A,B). A well-performed dissection should result in a thick, firm, and intact rectal layer and comparatively thin vestibular layer (Figure 2B).

After caudal retraction of the mobilized perirectal tissue, a Utrecht suture pattern[21] (USP; also referred to as a *modified Cushing's suture pattern*; Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV) was used to appose the lateral parts of the dissected perirectal tissue with the central part. The USP is best described as a Cushing pattern but with the bites running obliquely toward the incision line.

The USP is, in essence, an inverting suture pattern that opposes the rectal submucosa and inverts the rectal mucosal edge into the rectal lumen.[21] Apposition was continued caudally to the level of the internal anal sphincter, beginning separately from the left and right cranial sides of the dissected rectal tissue and performing first one side and then the other. Special attention was given to obtaining a fairly symmetrical V or Y shaped closure during the procedure, depending on the severity of the laceration (Figure 3A). The USP was subsequently continued to reconstruct the internal anal sphincter by juxtaposing the palpable ends of the ruptured sphincter muscle (Figure 3B). In cases in which the anal sphincter was torn at a position other than 6 o'clock, additional simple interrupted sutures (Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV) were used to appose and reconstruct the internal anal sphincter in an attempt to recreate the normal anatomical appearance. After the internal anal sphincter had been reconstructed, a horizontal mattress tension suture (Surgipro 2, polypropylene; Medtronic, Minneapolis, Minnesota) was preplaced at the level of the external anal sphincter (Figure 4A), followed by complete reconstruction of the external anal sphincter with single interrupted sutures (Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV; Figure 4B). An optimally repaired anal sphincter should allow passage of two average sized fingers.

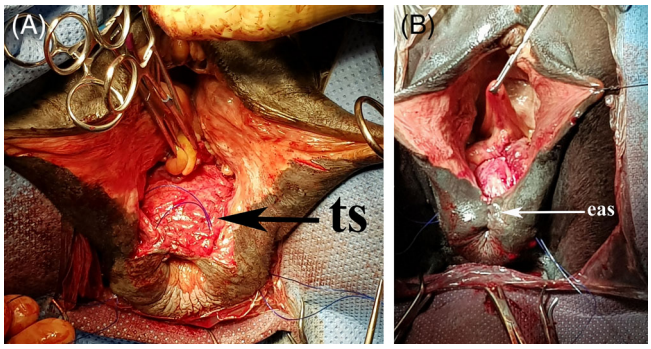

FIGURE 4 A, Preplacement of the tension suture (ts). B, Reconstruction of the external anal sphincter (eas)

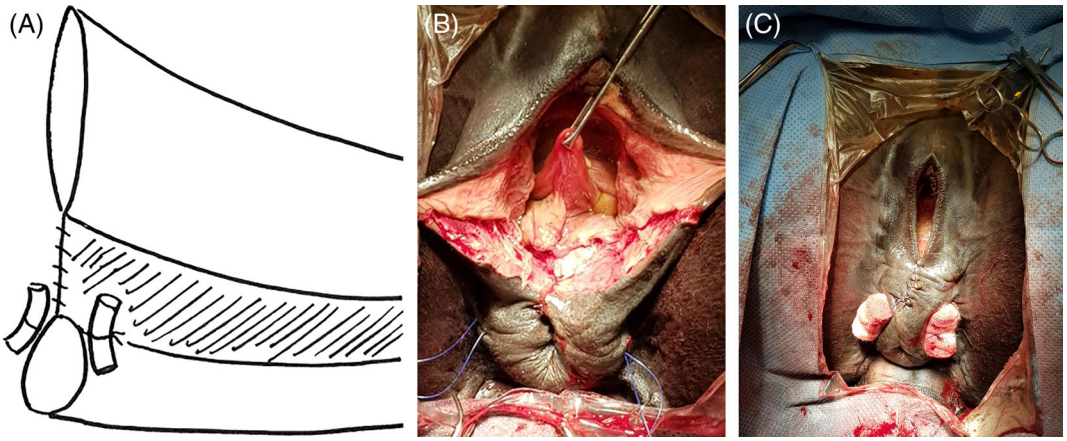

FIGURE 5 A,B,C, Modified episioplasty technique to reconstruct the perineal body. Povidone–iodine-soaked cotton rolls are positioned and the preplaced tension suture is tightened

TABLE 1 Postoperative feed reintroduction protocol for a 500-kg adult mare

PO day	Quantity soaked hay, g	Freq/day	Total soaked hay, g	Quantity concentrates, g	Freq/day	Total concentrates, g
0–4	0	0	0	0	0	0
5	100–200	1	100–200	0	0	0
6	100–200	3	300–600	0	0	0
7	200–400	3	600–1200	150	3	500
8	400–800	3	1200–2400	333	3	1000
		4[a]	1600-3200			
9	800–1600	3	2400–4800	666	3	2000
		4[a]	3200-6400			

Abbreviations: Freq, frequency; PO, postoperative.
[a]If appetite is good, an additional portion may be given.

TABLE 2A Short and long-term outcomes of TDPL repair in 20 mares

Horse No.	Breed	Age, y	Omp	POH, d	STF	STC	LTF	LTC
1	WB	7	No	9	Yes	None	Yes	None
2	AH	7	No	12	Yes	None	No	…
3	FJ	5	No	20	Yes	ppd, ro	No	…
4	WB	4.5	No	13	Yes	None	No	…
5	WB	6	No	12	Yes	None	No	…
6	WB	5	No	20	Yes	None	Yes	ws
7	WB	6.5	No	15	Yes	None	Yes	ws
8	WB	5.5	No	15	Yes	None	Yes	none
9	AP	3.5	No	14	Yes	None	Yes	ws
10	WB	6	No	15	Yes	ro	Yes	ws
11	WB	5	No	10	Yes	None	No	…
12	WB	6	No	16	Yes	None	Yes	ws
13	WB	4	Yes	16	Yes	ppd	No	…
14	WB	5	Yes	12	Yes	ppd	Yes	ws
15	WB	3.5	No	13	Yes	rvf	Yes	ws
16	WB	4	No	10	Yes	rvf, ppd, oo	Yes	ws
17	WB	6	No	13	Yes	None	No	…
18	WB	4.5	Yes	18	Yes	None	Yes	ws
19	WB	4	Yes	9	Yes	None	Yes	ws
20[a]	WB	5	Yes	19	Yes	ppd, my, fnp	Yes[b]	ws

Abbreviations: AH, Arabian horse; AP, American paint horse; FJ, Fjord; fnp, facial nerve paralysis; LTC, long-term complications; LTF, long-term follow-up; my, myositis; Omp, omeprazole; oo, oesophageal obstruction; POH, postoperative hospitalization; ppd, partial perineal dehiscence; ro, rectal obstipation; rvf, rectovestibular fistula; STF, short-term follow-up; STC, short-term complications; TDPL, third-degree perineal lacerations; WB, warmblood; ws, wind-sucking.

[a]Had two previous repair attempts.

[b]Long-term follow-up <1 year.

After the perirectal shelf and anal sphincter were reconstructed, a second and third layer of continuous USP fashion sutures (Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV) were placed directly over the left and right first layer suture lines to give the rectal shelf greater holding strength. Reconstruction of the perineal body was completed by using a modified episioplasty technique. Two triangular-shaped pieces of vestibular mucosa were created and dissected away from the vestibular wall to allow apposition and closure of the vestibular roof with simple interrupted or horizontal mattress sutures (Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV; Figure 5A-C). During closing, the left and right vestibular mucosa were apposed from cranial to caudal with simple interrupted or horizontal mattress sutures (Vicryl 2–0, polyglactin 910; Johnson & Johnson Medical NV). The perineal skin was apposed with simple interrupted sutures. Finally, povidone–iodine-soaked rolls of gauze were placed on both sides of the anal sphincter within the loops of the preplaced tension suture, which was pulled tight and knotted (Figure 5C).

3.3 | Postoperative care

Antibiotics were continued for 36 to 48 hours postoperatively and consisted of a combination of gentamicin sulphate (6.6 mg/kg IV) and procaine penicillin (20 000 IU/kg intramuscularly). The use of postoperative anti-inflammatory drugs was not standard.

All mares were fasted for an additional 4 days postoperatively. On the fifth day, a precisely weighed amount of soaked hay (100–200 g, depending on the size of the mare) was offered. Over the next 4 days, the quantity of feed was gradually increased according to a strict feed reintroduction protocol (Table 1). Normal stable bedding was reintroduced after completion of the feed reintroduction protocol.

The tension suture was removed on the fifth day (ie, soon after the reintroduction of feed), and perineal suture removal was performed on postoperative day 14. After surgical repair, mares were confined to a stall for 4 weeks. After perineal suture removal, mares were hand-walked twice daily for 10 minutes. Mares underwent a routine clinical and rectal examination 4 to 6 weeks postoperatively by the veterinary

TABLE 2B Postoperative breeding results and athletic performance outcome after TDPL repair in 20 mares

Horse No.	AI	Pregnant	Foaled	TDPL recurrence	Riding
1	+	−	−		+
2					
3					
4					
5					
6	+	+	+	−	−
7	−				+
8	−				+
9	−				+
10	+	+	+	−	−
11					
12	+	+	+	−	+
13					
14	−				+
15	+	+	+	−	+
16	−				+
17					
18	+	+[a]		−	+
19	+	+	+	−	−
20					

Abbreviations: -, No; +, Yes; AI, artificially inseminated; TDPL, third-degree perineal lacerations.
[a]Successfully used for embryo recovery.

surgeon who had performed the perineal reconstruction. A gradual return to routine exercise was initiated in the absence of any complications. Breeding was postponed until at least 8 weeks or 3 months postoperatively in the case of artificial insemination or natural mating, respectively.

4 | RESULTS

Twenty mares with a mean age of 5.6 years (median, 5; range, 3.5–11) that presented between 2000 and 2019 were included in this survey (Table 2A). These included 17 warmbloods, one Arabian, one Fjord, and one American paint horse. Information regarding foaling details were available for 14 of 20 mares. Twelve of 14 were primiparous mares and two of 14 were multiparous (TDPL occurred during the second foaling in one mare and the third foaling in another mare). All mares but one were referred for surgical repair for the first time. One warmblood mare (No. 20) had a history of two previous reconstruction attempts with a modified Goetz technique.

Surgical repair was delayed until complete second intention healing had occurred and any foal had been weaned, usually at least three months after parturition. Surgical reconstruction was performed after a 10-day preoperative fasting period. Five of the 20 mares received supportive oral gastric medication (4 mg/kg omeprazole, Gastroguard; Boehringer Ingelheim Animal Health). Data concerning surgery time, anesthesia time, and recovery quality were available for 14 mares. Total anesthesia time ranged from 185 to 310 minutes (median, 241), and total surgery time ranged from 140 to 273 minutes (median, 195). Surgeries were performed by three separate surgeons, and cases were divided almost equally between surgeons (F.t.B., 7; T.A.E.S., 7; F.H.J., 6). Recovery after anesthesia was reported as good in 12 mares, reasonable in one mare, and poor in the final mare. The poor recovery was characterized by multiple frantic attempts to stand between exhausted recumbent periods together with signs of mild postoperative myopathy.

Information until discharge and short-term follow-up (ie, until the reexamination at 4–6 weeks postoperatively) were obtained by reviewing all medical records (Table 2A). Healing of the rectovestibular shelf occurred in 18 of 20 of the mares, and all mares were discharged from the hospital between 9 and 20 days (mean, 12.8) after surgery.

A small RVF remained in two mares (Nos. 15 and 16). Both RVF were located just cranial to the internal anal sphincter in the midline of the rectal floor. This location corresponded well with the point of the V or Y suture closure, where three edges of rectal mucosa were apposed. The RVF were successfully closed in the standing, sedated, and

restrained mare with a transrectal approach (No. 15, T.A.E.S.) or under GA with a transvestibular approach (No. 16, F.t.B.), depending on the treating veterinary surgeon's preference. Preoperative fasting, surgical technique (3-layer USP), perioperative/postoperative management, and feed reintroduction were similar to the TDPL reconstruction method previously described in this article.

Mild rectal obstipation occurred about the fifth postoperative day in two mares. Removal of the tension suture, careful manual evacuation, and repeated nasogastric tubing with paraffin oil resulted in a rapid resolution of the obstruction. None of these mares developed an RVF.

Perineal dehiscence (ie, partial dehiscence of the apposed perineal skin between the newly reconstructed anus and dorsal vulval commissure) occurred 7 to 10 days postoperatively in five mares. In each case, the perineum was reconstructed in the standing, sedated, and restrained mare with local anesthetic infiltration one or two days prior to discharge.

Other reported minor complications were abnormal behavior in one mare (ie, that it chewed and consumed its tail-hairs as a result of boredom and hunger), mild postanaesthetic myositis together with transient facial nerve paralysis in another, and oesophageal obstruction after food reintroduction in one mare.

Long-term follow-up obtained via a telephone questionnaire was available for 13 mares (Table 2B). Mean duration of follow-up was 9 years (median, 9.5; range, 17.8). Seven of the 13 mares were used for artificial breeding. All but one mare (No. 10) were bred in the next or the next-but-one breeding seasons. Pregnancy, defined as a conceptus identified at 16 days after ovulation, was reported in six of seven mares. Successful pregnancy after TDPL reconstruction was realized at the first attempt in three of six mares. The other three of six mares became pregnant within two or more attempts during the same breeding season. One of the inseminated mares (No. 18) was instead used for embryo recovery with success. All pregnant mares foaled without recurrence of a TDPL or significant perineal damage. Mare No. 15 was formatted in multiple breeding seasons and successfully gave birth to four foals with no major complications.

In total, nine of 13 mares were used for riding. Riding purposes were diverse and ranged from pleasure riding to high-level athletic performances. Four mares were used for both breeding and riding purposes. Signs of slight anal or vaginal wind-sucking occurred in seven of nine of the mares used for riding and in six of seven mares used for breeding.

5 | DISCUSSION

Successful surgical repair of TDPL remains challenging because of the complexity of the procedure and the many intrinsic factors likely to impede adequate healing. In this article, we report successful reconstruction of the rectovestibular shelf in 18 of 20 (90%) mares by using the URM. This result compares favorably to previously described single-stage repair methods (12/16 [75%] in O'Rielly et al[2] and 14/17 [82%] in Belknap and Nickels[1]). Comparable results have been reported by others but have been based on small numbers of mares (9/10 [90%] in Stickel et al[9]) and (7/7 [100%] in Kazemi et al[22]). Only two mares developed a small rectovestibular fistula that required a second surgical repair with the URM in the study reported here. In the authors' opinion, the high success rate of the URM is dependent on a combination of the extended preoperative fasting period, a precise surgical technique performed under GA involving the creation of large mucosal tissue flaps for both the rectal and vestibular mucosa (which diminishes the tension on the suture lines), and a 3-layer USP apposition of the rectal mucosa and submucosa, followed by a strict feed reintroduction protocol.

The time period after parturition at which surgical correction is advised varies considerably among reports. A minimum of 3 weeks was proposed by Trotter,[23] 4 weeks by McKinnon and Jalim,[3] 6 weeks by Turner and McIlwraith,[24] and 8 weeks by Mosbah.[11] The moment of TDPL repair is also influenced by the preferred time of breeding (ie, in the current or the subsequent breeding seasons). In general, we prefer surgical correction after second intention healing has occurred and, if there is a surviving foal, the foal has been weaned; this is usually from 3 to 4 months after parturition.

Good perioperative management of fecal consistency is considered essential for surgical success. The high bacterial load, persistent fecal passage, and absence of any method for immobilization (eg, casting or bandaging of a distal limb) impairs wound healing and facilitates suture-line dehiscence. Most reconstruction techniques include a perioperative diet that seeks to soften fecal consistency and prevent accumulation of hard fecal balls at the anal sphincter, thereby minimizing physical stretch and stress on the healing wound. Conversely, overly soft (ie, almost liquid feces) may leak through the suture line and trigger dehiscence.[18,25] We used a fasting period extending from preoperative day 10 to postoperative day 4 to reduce gastrointestinal content and fecal passage. A decrease in intestinal motility was reported after 3 days of fasting and coincided with a significant reduction in fecal passage.[26] Selection of the 10-day preoperative fasting duration was based on personal experience of continued passage of significant amounts of feces even after 7 to 8 days of fasting. Extended fasting might be expected to carry a heightened risk of hyperlipaemia, dysbacteriosis, electrolyte disturbances, and energy imbalances. A report of a study on the effect of a 14-day perioperative fasting period on mares undergoing surgery of the perineal region did not describe any dramatic changes in the general condition of the mares.[26] The gastrointestinal tract and metabolism of

mares appeared to be well adapted to withstand extended periods of fasting.[26] It is important to note that none of the mares received any nonsteroidal anti-inflammatory drugs (NSAID) or antibiotics during the preoperative fasting period. Nonsteroidal anti-inflammatory drugs may predispose to gastrointestinal disease such as large colon impaction, right dorsal colitis, and diarrhea.[27] Colitis caused by bacterial overgrowth of nosocomial organisms is also a risk in adult horses that have been treated with antibiotics.[28] Therefore, judicious use of NSAID and antibiotics is warranted when extended fasting is used. Similarly to Hospes and Bleul,[26] we did not observe any clinical side effects such as enteritis or typhlocolitis. The authors believe that strict adherence to the feed reintroduction protocol together with the limited perioperative and postoperative use of systemic NSAID and antibiotics contribute to the absence of significant gastrointestinal complications.

The URM differs considerably from previously reported single-stage TDPL repair methods. First, the procedure is performed under GA in dorsal recumbency. Repair of TDPL under GA has been questioned by some authors not only because it may distort the anatomy of the perineal area, but, more importantly, because it carries the risk of anesthesia related complications.[19,20] Therefore, most repair methods are currently performed on the standing, sedated mare with epidural anesthesia. However, complications such as inadequate analgesia, variable degrees of hindlimb weakness, and ataxia leading to recumbency have also been documented.[29] Despite the previously discussed potential disadvantages, we prefer repair under GA because it eliminates undesired movements of the mare, improves surgical access and overview, requires a transvestibular rather than transrectal approach, and, therefore, allows meticulous dissection and reconstruction of a thick perirectal tube. Moreover, by applying a 3-layer USP in dorsal recumbency, the suture line remains buried within the perirectal tissue while the mucosa everts into the rectal lumen. Effective apposition and tightening of the perirectal layers results in the creation of a watertight seal.

Second, sufficient undermining of the lateral sides of the thick triangular perirectal tissue flaps facilitates caudal mobilization and apposition at the midline and subsequently results in a considerable reduction in tension at the suture lines. Excessive tension is believed to predispose to suture breakdown, subsequently leading to dehiscence and fistula formation.[1,9,30-32] The USP redistributes tension along each suture line of the V or Y reconstruction and leaves fewer knots in the surgical wound. Furthermore, we prefer the use of a synthetic absorbable braided multifilament (polyglactin 910; Johnson & Johnson Medical NV) because of its excellent handling properties and good knot security because accessibility to and visualization of the most cranial aspects of the wound is often limited. Finally, the reconstructed anal sphincter was supported by using a monofilament polypropylene horizontal mattress suture for 5 days.

Mild rectal obstipation occurred in two mares postoperatively. Moderate to severe constipation and straining to pass feces could potentially lead to rectovestibular shelf breakdown or RVF formation.[31,33] We therefore recommend careful manual evacuation of fecal pellets if signs of slight obstipation occur. Mares with partial perineal suture-line dehiscence were subjected to a standing revision episioplasty under local anesthesia. One mare developed esophageal obstruction after reintroduction of hay on the fifth day postsurgery that was probably caused by rapid ingestion resulting from to hunger. Soaking hay for the first 2 days of the feed reintroduction protocol may help prevent obstructions.

A small RVF developed in two of the 20 mares. Both RVF healed successfully after a second reconstruction procedure by using either a similar fasting protocol and surgical technique or a transrectal approach with only 36-hour fasting and dietary management. Slight to mild anal or vaginal wind-sucking occurred in 11 of the 13 mares and was only reported as an esthetic remark. A Caslick procedure or a second surgical reconstruction of the perineal body including narrowing the anal sphincter could resolve this problem.[5]

Long-term follow-up was available from only 13 horses, which is a limitation of this study. Artificial insemination was delayed for a minimum of 8 weeks after complete healing of the rectovestibular shelf. We usually recommend postponing surgery until late in the season and breeding the next season to allow optimal healing of the wound. Schumacher et al[34] reported successful artificial insemination within 2 weeks after TDPL repair and natural breeding within 6 weeks. Data for fertility and breeding follow-up were available for only seven of 13 mares. Comparison of the breeding results with other reports was not possible because of the low numbers of mares included. Six of the mares were bred successfully (ie, five became and remained pregnant and one yielded an embryo for transfer). Pregnancy was realized within one or multiple attempts in the same breeding season in all inseminated mares. All mares subsequently foaled uneventfully and without recurrence of either a TDPL or even a more minor or first- or second-degree perineal laceration. One mare was bred for multiple seasons and successfully gave birth to four foals. Nine of the 13 mares were used for riding at various levels.

In conclusion, the study reported here describes a new single-stage repair, URM, for the reconstruction of TDPL in mares. The authors believe that the high surgical success rate, 90% (18 of 20) repair at the first attempt, was the result of a meticulous surgical technique with a 3-layer USP together with strict perioperative management. The minimal incidence of complications related to the extended fasting period and the prolonged anesthetic time help to justify the

repair of TDPL under GA. Postoperative fertility and breeding results, although available only for a limited number of mares, were promising. Therefore, the authors believe that the URM is a promising and valid surgical method for the reconstruction of TDPL, especially when circumstances exclude repair in the standing mare. Recently, to avoid GA-related risks, one of the authors (T.A.E.S.) performed the described URM successfully in the standing, sedated mare; finding it to be possible but more difficult. Additional clinical studies are required to assess the feasibility and outcome of the URM in the standing mare and the requirement of the reported extended fasting protocol.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this report.

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