

# Case Series Presenting a Modified Approach for Permanent Perineal Urethrostomy in Horses

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## Abstract

Permanent perineal urethrostomy (PPU) may be performed in horses with severe preputial or penile trauma, in which surgical repair of extensive urethral damage is too complex or even impossible. We hypothesized that a modified PPU approach would abolish the use of postoperative indwelling urinary catheters (PIUC) and that the complication rate would be low. Therefore, the main objective of this report is to share our experience performing a modified approach for PPU in horses. Four geldings were referred after a history of severe urogenital laceration, and PPU was performed by removing a skin flap incision forming an inverted triangle (2.5 cm base and 5 cm sides) on the perineal raphe. None of the horses were submitted to the placement of PIUC. Short-term complications were restricted to partial PPU wound dehiscence in one horse, but this did not impede complete healing. Complications encountered after hospital discharge comprised urine staining of the hind legs in two (50%) horses. Urethral stoma retraction was a common sequel in all horses, but it did not impair urinary patency. The main limitations of this study were the small sample size and reliance on owner recall for outcome information. Overall, the complication rate was considered low, and owner satisfaction with the post-operative result was high. In conclusion, the modified approach for PPU using the inverted triangle-shaped incision adapted from the Williams technique of partial phallectomy proved to be a suitable alternative in the described horses, abolishing the use of PIUC. Furthermore, the urethral stoma remained patent in all horses even 75 months after surgery.

## Keywords

Inverted triangle incision; gelding; urine staining; urethral trauma; urinary system; Williams technique

## 1. Introduction

Disorders of the male equine urinary tract that may require surgery of the urethra include congenital anomalies (rectourethral fistulas), and acquired disorders. Urolithiasis, soft tissue obstructions (neoplasms or strictures), hematomas, and lacerations are the most common acquired disorders [1]. Trauma-induced injuries to the stallion's distal penis and urethra have been related to direct injury during copulation and fights with other horses [2]. Nevertheless, colts and geldings are also at risk of traumatic lacerations of the urogenital tract [3]. These lesions are accompanied by severe blood loss, especially when the *corpus spongiosum* is

compromised [4]. Urination may exacerbate blood loss and might not be confused with hematuria. The most common causes of hematuria include renal, ureteral, vesicular, or urethral calculi; renal, and vesicular neoplasia; and pyelonephritis [1]. Therefore, detailed clinical evaluation and ancillary diagnostic methods, such as ultrasonography, may play an important role in achieving a correct diagnosis [3].

Severe preputial or penile trauma in horses is most commonly treated with amputation due to concerns about postoperative urethral stricture and occlusion [5]. Among the treatment options, permanent perineal urethrostomy (PPU) may be

performed in horses with extensive urethral damage, in which surgical repair is too complex or even impossible [1,6].

We hypothesized that the modified PPU approach would abolish the use of postoperative indwelling urinary catheters (PIUC) and that the complication rate would be low. Therefore, the main objective of the present report is to share our experiences performing a modified approach for PPU in four horses. This case series presents clinical and laboratory features of horses with severe urethral laceration, as well as the outcomes following surgical intervention, including short and long-term follow-up. Data were collected retrospectively over 7 years without randomization or a control group.

## 2. Cases Details

### 2.1. History and Clinical Evaluation

Four geldings were referred after a history of severe urogenital laceration. Epidemiological and long-term follow-up data are summarized in **Table 1**. Upon physical examination, all horses were apparently calm, tachycardic (48-53 beats per minute), and dehydrated (capillary refill time equal to/greater than 3 seconds). Pale mucous membranes were present in two (50%) horses. Rectal temperature was within reference values for horses. Intestinal motility was assessed by auscultation and considered within normal parameters in all horses [7]. In Horse 3, the owner sutured the skin laceration causing subcutaneous urine accumulation (**Figure 1A**). Three (75%) horses (Horses 1-3) presented deep lacerations located on the inner thighs reaching the urethra. Penile urethral catheterization revealed the lacerations located at the subischial arch in these horses. One (25%) horse was a wandering animal and no clinical history was available. This horse presented an extensive scar on the ventral abdomen, and the preputial skin fold and glans penis were not detected. There was a fistula on the right side draining urine and fibrin clots (**Figure 1B**).

### 2.2. Laboratory Findings

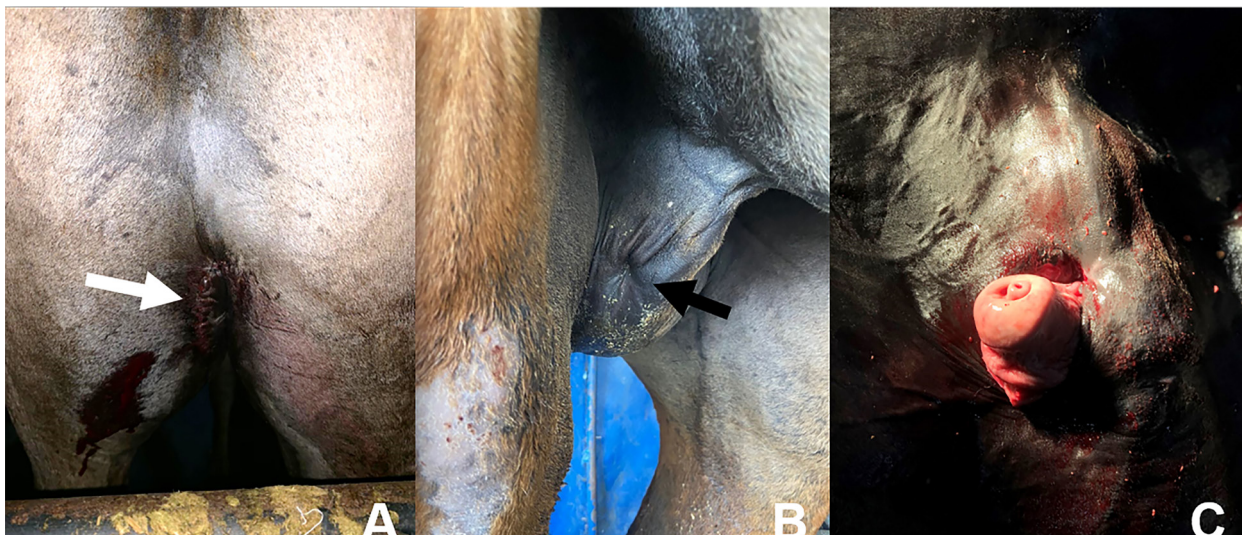
Laboratory data at hospital admission are presented in **Table 2**. Hematology revealed low hematocrit, red blood cells, and

hemoglobin values in all horses, probably due to acute blood loss from the muscular and urethral lacerations or due to chronic inflammatory processes (Horse 4). Horse 1 presented discrete leukopenia. No hemoparasites were visualized on the blood smears [8]. Serum biochemistry assay presented hypoalbuminemia in all horses and hypoproteinemia in Horse 3. Urea and creatinine levels were within reference values in all horses [9], since there was no urinary obstruction and the horses could urinate through the lacerations sites. Fecal egg count using McMaster's technique [10] was negative in all horses.

Urinalysis was performed on one horse (Horse 4) revealing abnormalities in physical (yellowish coloration, fetid odor, and cloudy aspect) and chemical evaluation (proteinuria and occult blood). Examination of urinary sediments presents countless leukocytes, bacteria (cocci and bacilli), and few red blood cells.

### 2.3. Surgery

After clinical evaluation, PPU was chosen due to the extensive urethral laceration. Two horses (Horses 1 and 3) were submitted to standing PPU after sedation (intravenous continuous infusion rate of detomidine [0.01 mg/kg] and butorphanol [0.02 mg/kg]), epidural anesthesia and pudendal local blockade (bupivacaine: 0.06 mg/kg). Two horses (Horse 2 and 4) underwent general anesthesia for proper surgical debridement on the laceration sites and fistula, respectively. After pre-medication with 10% xylazine hydrochloride (1 mg/kg, intravenously [IV]) and morphine (0.05 mg/kg, intramuscularly [IM]), induction was obtained with ketamine (2 mg/kg, IV) and midazolam (0.05 mg/kg, IV). Orotracheal intubation was performed, and general anesthesia was maintained using isoflurane and oxygen flow in a closed circuit. Horse 4 was initially submitted to fistula exploration by an elliptical incision, and the glans penis was detected on the subcutaneous tissue on the right inguinal region, along with fibrin clots and purulent material (**Figure 1C**).



**Figure 1:** (A) Horse 3. Skin laceration sutured by the owner (white arrow). Note drainage of urine from the suture causing urine staining. (B) Horse 4. Urine and fibrin clots accumulate in the subcutaneous tissue and drain from a fistula (black arrow). (C) Horse 4. After fistula exploration, the glans penis was within the subcutaneous tissue on the right inguinal region.

**Table 1:** Epidemiological and long-term follow-up data of four horses submitted to permanent perineal urethrostomy.

| Horse | Breed     | Age (years) | Weight (kg) | Clinical evolution (days) | Anesthesia          | Month/year of surgery | Hospital discharge (days) | Complications  | Follow-up period (months) |
|-------|-----------|-------------|-------------|---------------------------|---------------------|-----------------------|---------------------------|----------------|---------------------------|
| 1     | MM        | 10          | 360         | 15                        | Sedation + epidural | July/2016             | 28                        | None           | 75                        |
| 2     | Crossbred | 1½          | 120         | 3                         | General             | September/2019        | 39                        | Urine staining | 37                        |
| 3     | Crossbred | 4           | 320         | 1                         | Sedation + epidural | December/2019         | 17                        | Urine staining | 34                        |
| 4     | Crossbred | 6           | 230         | NAD                       | General             | February/2022         | 44                        | None           | 8                         |

MM: Mangalarga Machador; NAD: No available data.

All horses were submitted to urethral catheterization through the urethral laceration (Horse 1-3) or penile urethra (Horse 4), reaching the urinary bladder. After surgical preparation, PPU was performed by removing a skin flap incision forming an inverted triangle (2.5 cm base and 5 cm sides) 6-15 cm ventral to the anus on the perineal raphe (Figure 2A). Then, divulsion was propagated through the subcutaneous tissues, bulbospongiosus muscles, and *corpus spongiosum*, using a Metzenbaum scissor and/or scalpel, taking care not to enter the urethral lumen. The bulbospongiosus and the retractor penis muscles were sutured along their cut edges with simple interrupted sutures using 2-0 polyglactin or 2-0 polyglecaprone sutures. The urethra was identified and stabilized by palpation of the urinary catheter. To create the urethral stoma, the exposed urethra was incised on its midline from the base to the apex of the triangle, and the incised edges of the urethra and the triangle's epithelial border were apposed with simple interrupted 2-0 polyglactin or 2-0 polyglecaprone sutures (Figure 2B-D). None of the horses were submitted to the placement of PIUC. Postoperatively, drug therapy consisted of anti-inflammatory drugs (flunixin meglumine: 1.1 mg/kg, IV, q24h, three days), antibiotics (potassium penicillin: 30,000 UI/kg, IV, q6h, three days), and antitetanic serum (5,000 IU; IM). Both surgical wounds were dressed twice daily with diluted (1:100) iodopovidone solution, followed by healing

ointment. PPU surgical site completely healed in 12 to 17 days after surgery (Figure 3A-B). The wounds from the lacerations and surgical debridement sites varied from 17 to 44 days for complete secondary intention healing.

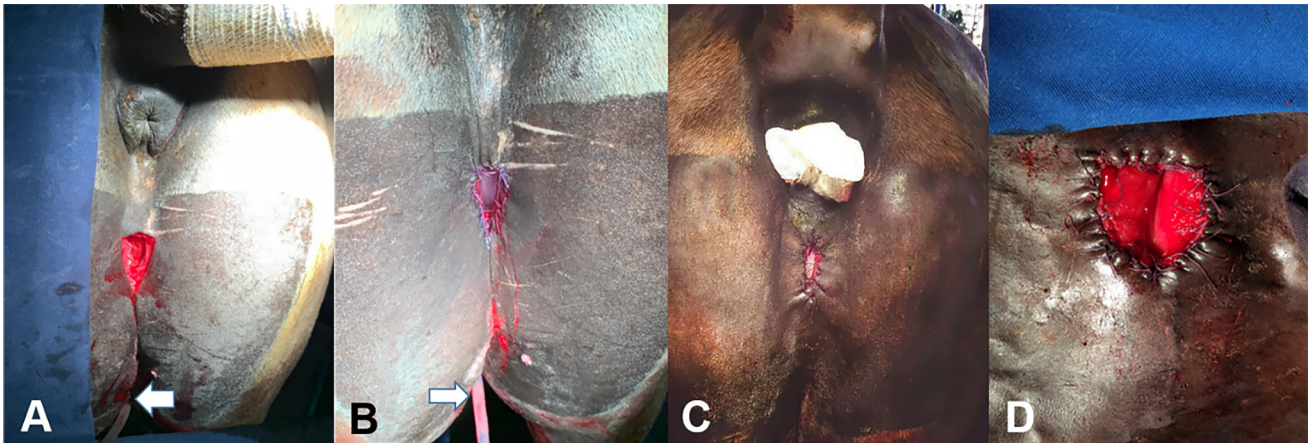
#### 2.4. Short and Long-Term Complications

Short-term complications (defined as the time from surgery until hospital discharge) included partial dehiscence of the PPU (three suture stitches) on Horse 3 but did not impede complete healing. Horse 4 was adopted at the end of the treatment. At the time of manuscript preparation, long-term follow-up (defined as  $\geq 8$  months) was conducted by telephone contact with the owners (Table 1). Owners were asked about complications at the PPU and adaptation of posturing to urinate, and they were asked to send a photograph of the surgical site. All owners reported that the horses adapted their posture to urinate by lifting the tail in approximately 2-6 months. Urethral stoma retraction was a common sequel in all horses, but urinary patency remained unaltered (Figures 3C-F), and urination occurred only through the PPU. Even after adaptation, Horses 2 and 3 presented persistent urine staining of the hind limbs (Figures 3C and F). The owners were advised to manage the staining by regularly washing the area and protecting the skin with baby oil.

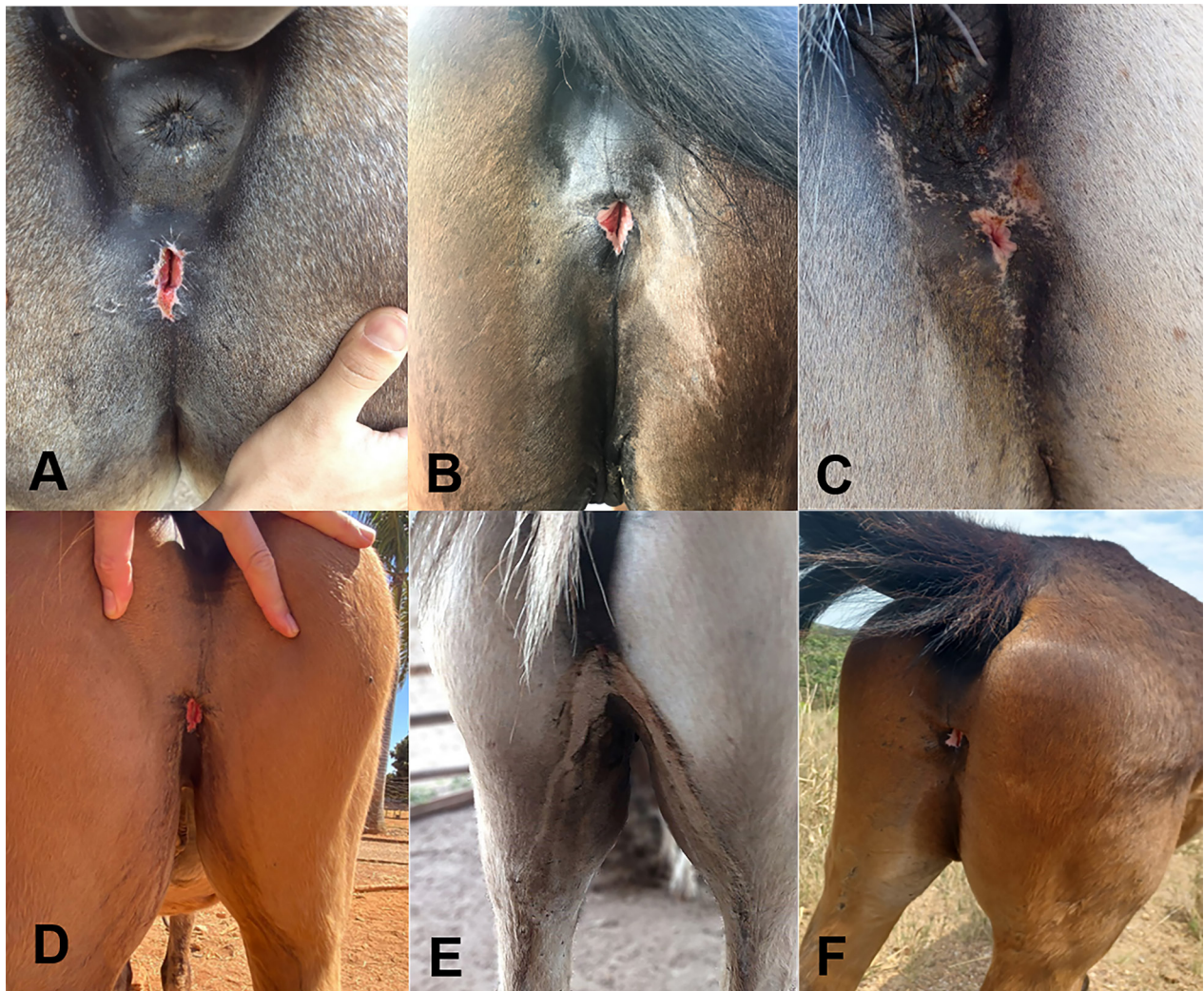
**Table 2:** Hematological and biochemical findings at hospital admission in four horses with a urethral laceration.

| Parameter                                     | Horse 1 | Horse 2 | Horse 3 | Horse 4 | X $\pm$ SD         | Reference values* |
|---|---------|---------|---------|---------|--------------------|-------------------|
| Hematocrit (%)                                | 16      | 21      | 19      | 23      | 19.75 $\pm$ 2.98   | 24-44             |
| Red blood cells (x 10 <sup>6</sup> / $\mu$ L) | 3.16    | 4.13    | 4.57    | 4.37    | 4.05 $\pm$ 0.62    | 5.5-9.5           |
| Hemoglobin (g/dL)                             | 5.5     | 7.3     | 6.6     | 8       | 6.85 $\pm$ 1.06    | 8-14              |
| TPP (g/dL)                                    | 6.7     | 5.4     | 5       | 6.6     | 5.92 $\pm$ 0.85    | 5.2-7.9           |
| Albumin (g/dL)                                | 1.9     | 1.53    | 2.1     | 1.14    | 1.66 $\pm$ 0.42    | 2.6-3.7           |
| Fibrinogen (mg/dL)                            | 200     | 400     | 600     | 400     | 400 $\pm$ 163.29   | 100-400           |
| Total leukocytes(/ $\mu$ L)                   | 5,100   | 10,500  | 10,400  | 7,300   | 8,320 $\pm$ 2,610  | 6,000-12,000      |
| AST (U/L)                                     | 150     | 354     | 288     | 183     | 243.75 $\pm$ 94.15 | 226-366           |
| GGT (U/L)                                     | 4       | 12      | 6       | 7       | 7.25 $\pm$ 3.04    | 6.1-17.4          |
| Creatinine (mg/dL)                            | 1.5     | 1.8     | 1.3     | 1.2     | 1.45 $\pm$ 0.26    | 1.2-1.9           |
| Urea (mg/dL)                                  | 34      | 48      | 26      | 45      | 38.25 $\pm$ 10.14  | 21.4-51.3         |

TPP: total plasma protein; AST: aspartate aminotransferase; GGT: gamma-glutamyltransferase. \*Kaneko *et al.* [9], Freeman *et al.* [8].



**Figure 2:** Surgical procedure. (A) A triangular skin flap forming an inverted triangle (2.5 cm base and 5 cm sides) 6-15 cm ventral to the anus on the perineal raphe is removed. Note that urethral catheterization was performed through the laceration site (white arrows). (B-D) The appearance of the permanent perineal urethrostomy immediately after surgery on Horse 3 (B), Horse 1 (C), and Horse 4 (D – closer view).



**Figure 3:** Short and long-term follow-up. (A-B) The appearance of the permanent perineal urethrostomy (PPU) of Horse 1 (A), and Horse 4 (B) at hospital discharge at 28 and 44 days' post-surgery. (C-F) The appearance of the PPU of Horse 1 (C), Horse 2 (D), Horse 3 (E), and Horse 4 (F) at 75, 37, 34, and 8 months' post-surgery, respectively. Note the urine staining on the inner thighs of Horse 2 (D) and Horse 3 (E).

### 3. Discussion

Perineal urethrotomy at the ischial arch is most commonly performed to provide access to small cystic calculi, to treat hemospermia or hematuria, and to divert the flow of urine from the penile urethra for such conditions as urethral laceration or urethrolithiasis in horses [1]. This technique is often associated with the placement of PIUC aiming to prevent urethral stricture, and associated short-term complications may achieve 75% [11]. Placement of PIUC is also performed in horses submitted to PPU [5,12,13], and seemed to be related to the development of postoperative complications [11].

Herein, we adapted the Williams technique of partial phallectomy [14] to be performed as a PPU. The intention of the inverted triangle incision with a 2.5 cm base was to assure urethral patency, eliminating the use of PIUC and decreasing the chance for urethral stoma stricture. None of the horses demonstrated short-term complications reported in horses with PIUC, that includes colic, stranguria, severe cystitis, urethral stricture, and ruptured bladder [11]. Long-term follow-up was performed at 8 to 75 months post-surgery proving maintenance of urethral patency, even in cases where some urethral stoma retraction occurred (Horse 1).

Caution must be taken when performing a PPU in order to make the incision on the perineal raphe and that multiple planes of dissection are not made through the tissues, preventing excessive edema and increasing suture tension [1]. Suturing of the bulbospongiosus and the retractor penis muscles along their cut edges is important to ensure accurate and tensionless apposition, facilitating the subsequent apposition of the perineal skin and urethral mucosa. These preventive measures also decrease the occurrence of hemorrhage from the surgical site at the end of urination, that may occur up to two weeks, since the bulbospongiosus muscle contracts at the end of urination, and this increases the pressure in the *corpus spongiosum* [6,11]. Additionally, prior urethral catheterization is crucial to prevent midline incision deviation and cranial urethral wall penetration [1,6,12]. All these cares were taken on the horses submitted to PPU in this case series, reducing the incidence of short-term complications, which was restricted to partial surgical wound dehiscence in one case (Horse 3).

Severe preputial or penile trauma in horses is most commonly treated with amputation [5]. Although, PPU may be an interesting surgical option in geldings with extensive urethral laceration since it can be performed in a standing position in sedated subjects, which mitigates against additional costs and risks associated with general anesthesia [4,6]. Recently, a temporary perineal urethrostomy was performed to divert urine from the urethral reconstruction site in a stallion submitted to fistulectomy and urethral resection and anastomosis, that caused distortion of the urethral lumen at the fistulectomy site. This complication was managed by urethral dilatation for 5 minutes every 12 hours for 3 days [5]. In our cases, PPU seemed the best approach regarding the acute nature of the injury in three horses (Horse 1-3) associated with the owner's financial constraints.

Long-term complications in this study were restricted to urine staining of the hind legs in 50% of the horses (in 2/4 cases) following PPU. In these cases, persistent urine staining

of variable degrees made regular cleaning of the hind legs necessary on a long-term basis. This complication is frequently reported and may vary from 11% [15] to 71% [4] of the cases. In more severe cases, urine staining may evolve into scalding and/or urine-induced dermatitis [4]. Herein, probably the variation in the distance from the PPU incision to the anus (6-15 cm) may have influenced the occurrence of urine staining since some authors advocate the subischial approach [1,13]. A recent study on 14 horses submitted to PPU reports that some horses never adapt the posture to urinate or learn to lift the tail while urinating, and others horses present urine staining despite lifting their tail and adapting the posture to urinate [4]. Owners must be made aware of this possible complication prior to surgery and that this may demand a more involved long-term post-operative management, such as daily cleaning of the affected area [4,11,15]. Other complications include ascending cystitis, urethral stricture [11], and myiasis [12].

The limitations of the present study included its retrospective nature; the small sample size, and reliance on owner recall for long-term complications and outcome information. However, the overall complication rate was considered low, and owner satisfaction with the post-operative result was high, including cases with persistent urine staining.

### 4. Conclusion

In conclusion, the modified approach for PPU using the inverted triangle-shaped incision adapted from the Williams technique of partial phallectomy proved to be a suitable alternative in the described horses, abolishing the use of PIUC. Furthermore, the urethral stoma remained patent in all horses even 75 months after PPU.

### Authors' Contributions

A.C.L.C, H.A.L.A., F.H.B.X. and R.C.C. conducted the clinical examination, laboratorial analysis. and surgical procedures. A.C.L.C and H.A.L.A. wrote the manuscript, and F.H.B.X. and R.C.C. revised it. All authors read and approved the manuscript.

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### Conflicts of Interest

The authors declare that there are no conflicts of interest.

### Ethical Approval

The horses presented herein were attended as patients at the Large Animal Veterinary Teaching Hospital, Universidade de Brasília, Brasília-DF, Brazil. The owners signed a consent form to permit hospitalization, surgery, and treatment. Additional consent was obtained for using the images for research purposes. The authors also confirm that the study has followed the guidelines of the Declaration of Helsinki.

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