

VAGINOSCOPIC IDENTIFICATION OF A VERTICAL VAGINAL SEPTUM IN ONE PRIMIPAROUS AND THREE NULLIPAROUS SOUTHERN WHITE RHINOCEROS (*CERATOTHERIUM SIMUM SIMUM*)

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Abstract: Vaginostomy using a 10-mm, 30° forward viewing rigid endoscope was used to evaluate the caudal reproductive tract of four subadult southern white rhinoceros (*Ceratotherium simum simum*). A vertical vaginal septum was documented in all four animals, including a primiparous cow that gave birth to a stillborn calf 14 months before vaginostomy. Vaginostomy using a 57-cm-long, 10-mm, 30° forward viewing endoscope provides adequate visualization of the caudal reproductive track in the southern white rhinoceros, and a detailed description of the vertical vaginal septum is presented. Additionally, the presence of a vertical vaginal septum in a primiparous southern white rhinoceros suggests the presence of this anatomic structure cannot be used as a proxy of nulliparity for captive southern white rhinoceros.

Key words: *Ceratotherium simum simum*, Cervix, Endoscope, Hymen, Southern white rhinoceros, Vertical vaginal septum.

BRIEF COMMUNICATION

The female rhinoceros reproductive tract has been described using live animal visualization and palpation, transcutaneous and transrectal ultrasonography, and necropsy evaluation using gross and histologic techniques and is an important starting point to establish anatomic landmarks during reproductive evaluations and assisted reproductive technique development. The cranial vestibule, hymen, and vagina have been described on postmortem evaluations of southern white rhinoceros (*Ceratotherium simum simum*).^{1,7} The hymen varied in appearance and extent in a 21-yr-old nulliparous and 27-yr-old primiparous animal, with the nulliparous animal having a palpable hymen during vaginal palpation. The primiparous animal was reported to have a remnant of a hymen

with tissue running longitudinally in the vagina, dividing the vagina into two channels.¹ Similarly, a midline vertical septum extending into the cranial vagina and supporting a transverse hymen was reported in three nonbred rhinoceros.⁶ Aside from providing structural support to the transverse hymen, the purpose of this vertical vaginal septum has not been reported, but it has been suggested that, to penetrate the complex rhinoceros cervix, the transverse and vertical septum must be transected.⁶

Vaginostomy can greatly enhance the visualization of the caudal reproductive tract in a variety of species by using a rigid endoscope and high-powered light source to illuminate difficult to access anatomic structures with magnification and obtain video and still images. This increases the ability to properly describe the in vivo position and color of anatomic structures. This report describes vaginostomy techniques used to evaluate the caudal reproductive tract of four (estimated 6–9 yr old) southern white rhinoceros and unequivocally photodocuments the presence of a vertical vaginal septum in a primiparous cow that gave birth to a full-term calf 14 months prior to vaginostomy.

Under standing sedation using a butorphanol (27–36 µg/kg) and medetomidine (2 µg/kg) intramuscular-based protocol, vaginostomy was performed on four southern white rhinoceros (*C. simum simum*). Following natural breeding, one rhino (#19) had given birth to a full-term,

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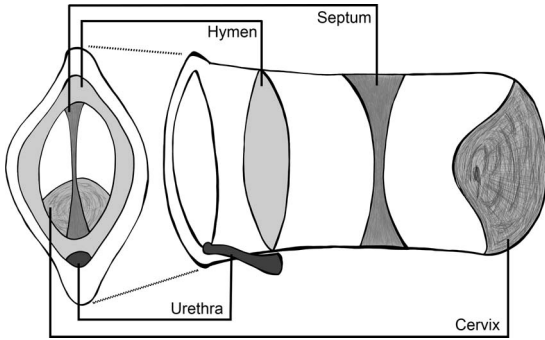


Figure 1. Schematic representation of the caudal reproductive tract of a southern white rhinoceros. In this schematic, the hymen is partially removed to allow for visualization of the vertical vaginal septum. The dotted lines represent 90° rotation to allow schematic representation in a cranial to caudal and sagittal projection.

stillborn calf 14 months prior to vaginoscopy. This cow passed a stillborn calf in posterior longitudinal, dorsal-sacral, rear legs extended position, posture, and presentation. The remaining three rhinoceros (#16, #20, and #21) were nulliparous. A well-lubricated gloved hand was used to cover the tip of a 10-mm, 30° forward viewing rigid endoscope contained in a 57-cm-long cannula with an insufflation valve (Karl Storz Veterinary Endoscopy, Goleta, CA 93117, USA), and gentle advancement and simultaneous digital palpation were used to evaluate anatomic structures. Room air was infused to achieve a pneumovestibule or pneumovagina for endoscopic visualization. A transverse hymen was encountered in two animals and was manually ruptured with gentle digital pressure. In all animals, a vertical vaginal septum was encountered and photo or video documented.

The vaginal vault, cervix with an indistinct external cervical os, and vertical vaginal septum were identified in all animals. Clear visualization of these structures was incomplete in two animals with a transverse hymen, as digital palpation resulted in rupture of the transverse hymen and moderate hemorrhage that obscured the endoscope lens and subsequently limited image quality. The vertical vaginal septum was located directly on midline in all four animals and extended from the dorsal to the ventral aspect of vagina (Fig. 1). The attachment of the vertical vaginal septum on the dorsal aspect of the vagina increased in size in the caudal to cranial direction at the dorsal attachment point (Fig. 1). Along the entire length of the vertical vaginal septum, the

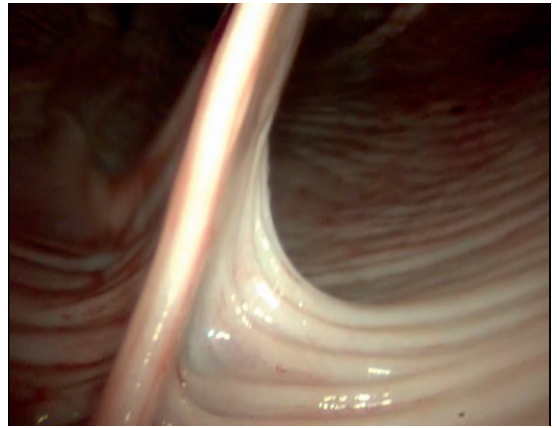


Figure 2. Vaginoscopic image of the ventral attachment of the vertical vaginal septum in a nulliparous southern white rhinoceros.

caudal-most aspect was thickened, and the tissue narrowed in the cranial direction. The vertical vaginal septum attachment to the floor of the vagina extended slightly off midline to the right and left in semidiscrete lateral tissue bands (Figs. 1, 2). The ventral attachment of the vertical vaginal septum was caudal to the cervix in all animals (Fig. 1). The location, size, distensibility, and color of the vertical vaginal septum was similar in the nulliparous and primiparous rhinoceros (Fig. 3).

The vertical vaginal septum was transected in three animals (#16, #20, and #21) using digital palpation and mayo scissors. The distensibility of the vertical vaginal septum allowed for direct visualization at the vulva opening of the vertical vaginal septum with caudal traction. In one animal, the vertical vaginal septum was transected slightly away from the midpoint of the dorsal to ventral location, and a section of tissue measuring $4.6 \times 1.7 \times 0.6$ cm was collected, placed in formalin, and submitted for histopathologic evaluation. In all instances, minimal bleeding occurred following transection, and the sedated animals did not react to tissue transection. Histopathology revealed dense fibrous connective tissue partially or completely lined superficially by squamous mucosa. A few small glands lined by pseudostratified columnar epithelium were present in the submucosa, and there were occasional small lymphoid aggregates in the superficial submucosa/propria. Multifocal lymphatic dilation and swelling of superficial squamous epithelial cells were observed.

Rigid endoscopy is a useful diagnostic and therapeutic modality in megavertebrate medicine

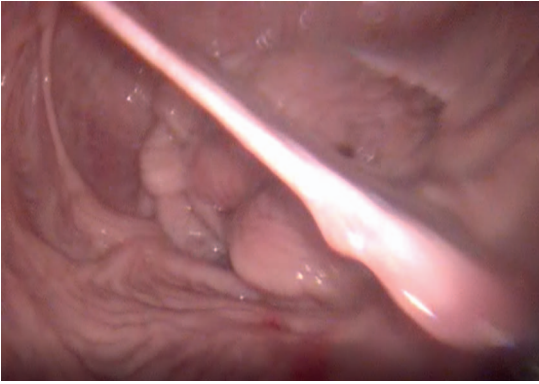


Figure 3. Vaginoscopic image of the vertical vaginal septum and external cervical os in a nulliparous southern white rhinoceros.

and surgery and has been used for laparoscopic evaluation of the dorsal aspect of the abdomen of a female African elephant (*Loxodonta africana*), vasectomy in the free-ranging African elephant, and uterine biopsy, liver biopsy, and ovariectomy in rhinoceros.^{5,8,9} Vaginoscopy can be performed in southern white rhinoceros using standing sedation and a 10-mm, 30° forward viewing endoscope. Vaginoscopy in the southern white rhinoceros provides an in vivo depiction of the size, location, color, and relationship of anatomical structures to each other in standing animals and can provide valuable insight for the development of the specialized equipment needed for assisted reproductive techniques.

The hymen of the elephant is positioned at the cranial-most aspect of the vestibule with a single 0.4- × 0.2-cm opening into the vagina and is purported to remain intact during mating as the penis does not penetrate the vagina, but it does rupture during the first delivery.⁴ In contrast, the rhinoceros hymen is suspected to rupture during mating, with only vestiges of the hymen remaining after intromission. The persistence of a hymen was a common finding in mature white rhinoceros with reproductive failure. More specifically, 76% of 54 nonreproductive animals demonstrated a persistent hymen.³ In addition to suggesting nullparity, the presence of a fibrous persistent hymen was identified as a likely mechanical impediment to successful intromission in older females. To remove this mechanical barrier, transection has been recommended.⁶

The purpose of the vertical vaginal septum can only be speculated. The large size of the southern white rhinoceros vaginal vault may suggest an underlying mechanical purpose. The transverse

hymen documented in some individuals appeared to be partially supported by the vertical vaginal septum, suggesting this structure provides some assistance in maintaining the integrity of the thinner and easily torn transverse hymen. Alternatively, the vertical vaginal septum may serve a secondary mechanical purpose during copulation. The vertical vaginal septum was persevered in one animal that was naturally bred and gave birth to a stillborn calf, suggesting this structure is durable and can be present in the postpartum southern white rhinoceros. The tip of the rhinoceros penis has flared annular skin folds at the distal tip, and lateral projections are present between the tip and middle of the penis in the white, black (*Diceros bicornis*), and Asian rhinoceros (*Ceratotherium simum*) with pronounced lateral protrusion when erect.⁶ The unique flaring of the distal tip and lateral projections of the rhinoceros penis may serve to engage the vertical vaginal septum in the female, resulting in stabilization or repositioning of the distal urethra directly against the cervix during copulation. It has been previously speculated that the lateral protrusions and the presence of a mushroom-shaped process glandis on the distal most aspect of the penis results in cervical insemination directly into the cervical folds.^{2,6,10} Alternatively, it is possible that the vertical vaginal septum of the southern white rhinoceros is a vestigial structure or an embryonic remnant.

Increasing the number of vaginoscopic evaluations in southern white rhinoceros with emphasis on animals of various ages, housing (captive versus free-ranging), reproductive cycle timing, and parity will be of value moving forward. Anatomic evaluation of the proposed relationship between the cranial vaginal vault and erect penis may provide valuable insight into the underlying purpose of the vertical vaginal septum and how it relates anatomically to the penis during copulation. Importantly, documentation of the persistence of this structure in a naturally bred rhinoceros that delivered a full-term, stillborn calf poses the question of whether the vertical vaginal septum needs to be removed to facilitate intromission and calf delivery. Vaginoscopic evaluation of multiparous rhinoceros will help determine whether the vertical vaginal septum requires removal for delivery of a live calf.

This report documents the presence of a vertical vaginal septum in four female rhinoceros including a primiparous animal that had previously given birth to a full-term stillborn offspring 14 months prior to vaginoscopy. The presence of a vertical vaginal septum may have management

implications, as its presence cannot be used as a proxy of nulliparity in the southern white.

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