

Modified partial posthectomy surgery for chronic preputial prolapse in a *Bos indicus* bull

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Abstract

Preputial prolapses in bulls are frequently encountered by bovine reproductive practitioners and are common physical conditions impairing a bull's ability to copulate. Marked chronicity or unsuccessful medical management warrant surgical correction. Preputial resection/circumcision (also known as 'reefing procedure') or preputial amputation are 2 well-documented procedures performed to restore penile function. It is widely believed that preputial resection is considered superior to amputation, as with the latter procedure, strictures and wound contracture stenosis are common reported sequelae. Therefore, surgery should aim at preserving tissue and resolving the prolapse without interference to complete penile extension. We adapted novel surgical features in a bull with a chronically prolapsed prepuce: an updated preputial amputation technique (i.e. modified posthectomy) and used a single-layer closure pattern with rapidly absorbable suture (not reported for bulls). There was total resolution and bull returned to service. This case illustrated that severe and chronically prolapsed prepuces can be successfully repaired using this updated modification of a historical technique.

Keywords: Beef bull, chronic preputial prolapse, preputial amputation, modified posthectomy

Background

Injuries to the prepuce of breeding beef bulls are common, particularly those of *Bos indicus* influence as a result of certain anatomical arrangements.^{1,2} Although the etiology of this condition may appear straightforward, a variety of factors have been linked to preputial prolapse occurrence in bulls: genotype,^{3,4} breed,⁵⁻⁷ innate sheath conformation,⁸⁻¹⁰ bovine herpes virus (BHV-1) associated balanoposthitis,⁹ and potentially bulls that may preferentially evert preputial skin when relaxed (remains speculative).^{11,12} In general, however, trauma usually occurs to prepuce during breeding^{1,3,13} or when tissue is not maintained within the sheath and therefore exposed to noncoital injury such as incidental lacerations and inadvertent self-injury.³ *Bos indicus* subspecies bulls are renowned for sustaining injuries to the prepuce at breeding due to anatomical traits such as pendulous sheaths and substantial preputial skin.^{1,4} Some Angus bulls may also have similar problems, with a horizontal sheath opening being another additional association.¹⁴⁻¹⁶ Certain *Bos taurus* breeds of the polled phenotype have also been historically linked to a higher predisposition of preputial injuries possibly due to incompletely developed

caudal retractor preputial muscles.^{6,7} These anatomical associations may be unduly represented as the original paper that cited this association misinterpreted preputial eversion as preputial prolapse.^{16,17} Since then, it has prevailed in literature. For instance, there is no completely conclusive evidence that preputial eversion is directly related to prolapses in *Bos taurus* bulls specifically, despite seeming a plausible cause to practitioners and producers.^{14,16,18} Also, it is generally considered that minor lacerations or injury to the prepuce in *Bos taurus* breeds seldom leads to fulminant preputial prolapse as in *Bos indicus* type.¹³ Depending on the chronicity and extent of injury, either medical management or surgical correction may be attempted.^{4,19} A scale initially developed by Wolfe & Carson²⁰ has been updated in recent texts¹ to classify and predict the prognosis for resolution of preputial injuries in bulls¹ (Table 1).

Additionally, there are variations on anatomical terminology for the prepuce in large animals,^{6,21,22} and it is paramount that examining veterinarians understand preputial anatomy of bulls, particularly during circumstances of injury where confusion can occur. Authors' recommend

Table 1. Preputial injuries categories: description, treatment, and prognosis¹

| Category | Description | Treatment and prognosis |
|----------|---|--|
| I | Simple preputial prolapse with slight to moderate edema without laceration, necrosis, or fibrosis | Either conservative or surgical treatment with good prognosis |
| II | The prolapsed prepuce has moderate to severe edema, may have superficial lacerations or slight necrosis, but has no evidence of fibrosis | Surgery is the usual course of therapy with a good to guarded prognosis |
| III | There is severe edema of the prolapsed prepuce with deep lacerations, moderate necrosis, and slight fibrosis | Surgery is indicated and the prognosis is guarded |
| IV | The prolapsed prepuce has been exposed for quite some time and has severe edema, deep lacerations, deep necrosis, fibrosis, and often abscess | Surgery and salvage by slaughter are the only options, and a guarded to poor prognosis follows surgery |

and prefer to use that described by Ashdown et al.^{6,22} when considering the definitions of portions of the preputial tissue involved in injury so to avoid confusion or inadvertent incorrect anatomical descriptions. Further, it is also important to highlight that although the preputial tissue is continuous with that of the penile integument, and may resemble that of a mucous membrane, it is in fact lined with stratified squamous epithelium and the preputial wall contains inner and outer concentric fibrous layers that are organized differently to penile mucosa.^{6,22}

Regardless of the technique for medical management, core principles of nonsurgical treatment involve managing edema, improving lymphatic drainage, reducing inflammation, and preventing further injury. This may include topical hydrotherapy with daily cold water hosing in acute stages, bandaging the prolapsed tissue around a placed urinary egress tube, applying topical emollients, placing a sling, and treating with nonsteroidal antiinflammatories and antimicrobials systemically.^{1,5,9} Failing successful medical management, or for cases of chronic prolapse, either surgery or salvage slaughter is generally indicated.⁴ Known surgical repair techniques include either simple laceration repair, preputial resection (i.e. ‘reefing’ procedure) or preputial amputation.^{4,5,13} Due to the advent of farm animal insurance in some countries outside of US, bulls with prolapses that are not amenable to medical management are often culled or claimed for reproductive loss of use. Additionally, due to financial limitations and concerns over use of prolonged general anesthesia in ruminants,²³ surgical procedures may be limited to certain institutions or simply not elected by owners. This may result in either salvage slaughter, or potentially even the adoption of salvage procedures such as ring amputation that are not completely restorative.²⁴ Ultimately, this may dissuade producers from electing for fully corrective surgical procedures in future, and therefore exploring and/or revisiting alternate procedures are of value to bovine practitioners. Detailed pre-surgical (assessment, medical management, restraint, and anesthesia) and surgical descriptions are provided in this report.

Case presentation

An 8 year, ~ 900 kg Brahman bull, was presented for surgical management of a Grade III²⁰ prolapsed prepuce of ~ 6 months duration. Bull was identified with this condition by the owner

after deployment in a large paddock for breeding of ~ 40 heifers. Bull had previously sired calves successfully in previous seasons with no evidence of prior injuries. Owner pursued treatment and surgery due to amiable and calm temperament of the bull despite the severity of injury.

Treatment

Examination

Bull was initially examined while restrained in a crush to determine the extent of injury. Bull was bright, alert and responsive, and in good body condition (BCS 4/5). Careful inspection and palpation of the prepuce revealed prolapse severity (Figure 1). Attempts to exteriorize the penis were not initially successful that was attributed to narrowing of the preputial lumen by the swollen prolapsed tissue and/or retraction of retractor penis muscles. Prolapse was palpated and internal channel of prolapse was also examined to determine if there was evidence of strictures or if penis could be exteriorized. Other incidental findings included overgrown claws (possibly due to reduced sexual activity as a result of preputial injury). Prolapsed tissue was cleaned, cold water hosed and bandaged around a ~ 40 cm urine egress tube made from plastic garden tubing. A sling using shade-cloth material was also placed to aid in rectifying the remaining edematous tissue prior to surgery (Figure 2). Treatment with a broad-spectrum antimicrobial (intramuscular oxytetracycline 10 mg/kg once a day, Alamylin®, Norbrook) and a nonsteroidal antiinflammatory (subcutaneous meloxicam (Metacam®, Boehringer) 0.5 mg/kg once every 3 days) was initiated. Bull was not fed for 36 hours prior to surgery and had water restriction for 12 hours.

Anesthesia and restraint

Bull was initially restrained in a tip-table crush. Intravenous sedation (via caudal coccygeal vein) consisted of 0.02 mg/kg xylazine hydrochloride (Xylazil-100, Ilium) and 0.02 mg/kg butorphanol tartare (Butorgesic, Ilium); caudal coccygeal epidural anesthesia was induced (4.5 ml of 2% lignocaine hydrochloride [Lignocaine 20, Ilium]). Bull was then tipped into right lateral recumbency on the tip table and pudendal nerve block was induced.^{25,26} Ischiorectal fossa region was clipped and surgically prepared on both tail sides. After creating 3-4 ml



Figure 1. Close examination of prolapsed prepuce; note edema and sunburnt preputial skin.



Figure 2. A. edematous prepuce tightly bandaged against a urine egress tube made from rubber tubing; B. placement of sling (rubber Esmarch's tourniquet straps and shade-cloth material).

bleb of 2% lignocaine hydrochloride (Lignocaine 20, Ilium), a spinal needle (18 gauge, 4 inch) was inserted through a hypodermic needle (14 gauge 1.5 inch) that was used as a cannula and guide. Point of the spinal needle was directed (while palpating transectally) toward the lesser sacro-sciatic foramen, 30 ml of 2% lignocaine hydrochloride (Lignocaine 20, Ilium) was deposited immediately cranial and caudal to the lesser sciatic foramen A cannula (20 gauge, 32 inch) was placed in the left auricular vein (pulse rate, respiratory rate, mucous membrane color, and rectal temperature were monitored during the procedure). Immobilization was achieved with 3 mg/kg intravenous ketamine hydrochloride (Ketamil, Ilium); butorphanol, ketamine, and xylazine boluses were given during the procedure. Nasal oxygen (12 liters/minute) was given and bull was blindfolded during recumbency. After pudendal nerve block, 50 ml of lidocaine infiltrated at the proximal prepuce, further sedation allowed good surgical condition. Penis was fully extended from prepuce and the entire preputial tissue was examined to plan for surgical incisions (Figure 3). Sheath skin was clipped, skin and preputial and penile mucosa were scrubbed with dilute chlorhexidine and sterile water routinely. Distal portion of the prolapsed preputial tissue was tied with a long gauze for immobilization. A disposable plastic drape was then placed over the surgical field.

Surgery

First, 2 stay sutures were placed on cranial and caudal aspects of prolapsed skin proximal to planned amputation site to ensure correct anatomical tissue apposition after amputation. Using a size 22 scalpel blade, a transversely positioned oblique circumferential incision was created on the exposed tissue, ~ 2 cm distal to the junction of the sheath and prepuce (Figure 5). Using Metzenbaum scissors, careful blunt and sharp dissection were alternately used to transect the subcutaneous tissue. Large vessels were ligated with USP 2-0 rapidly absorbable monofilament suture (Glycomer™631 [Biosyn™], Covidien) while bleeding caused by transection of minor vessels was contained with a handheld electrocautery unit (Kautolux, DLC). Using a scalpel, preputial subcutaneous tissue was transected, and additional stay sutures were placed to ensure that the internal channel of tissue was correctly reattached to the preputial skin in its previous anatomical position. Apposition of edges of transected skin was then completed using USP 2-0 rapidly absorbable monofilament suture (Glycomer™631 [Biosyn™], Covidien) in a simple continuous pattern interrupted at cranial and caudal aspects of the preputial circumference. While closing, internal (visceral) preputial skin was meticulously included in each bite to ensure correct apposition to parietal preputial tissue. Stay sutures were



Figure 3. Fully extended penis after pudendal nerve block; note the extent of preputial skin damage and tissue to be removed.

removed and as prepuce was released, surgical site was immediately retracted inwards. Surgical site and entire preputial tissue were covered with 1% silver sulphadiazine (Flamazine™, Smith & Nephew), a shortened sterilized nasogastric tube was placed into prepuce, and prepuce was then bandaged. Bull's feet were trimmed to correct the overgrown claws. Diagrammatic (Figure 4 [A-F]) and visual representation of surgical events are provided (Figure 5 [A-D]).

Aftercare

After recovery from sedation/anesthesia, the shade-cloth material sling was replaced and bull was examined twice daily. Three days postoperatively, the bandage was removed, and surgical site was inspected. Transrectal palpation of accessory sex glands was also performed to facilitate penile relaxation, but was unsuccessful on first attempt. Topical ointment (1% Silver sulfadiazine, Flamazine™, Smith & Nephew) was applied and the tube and bandage were replaced. Four days after surgery, the sling, bandage and tube were removed, along with the sling. Daily observation for urination and penile extension was employed and it was apparent that the bull was able to protrude the penis beyond the hair line at the external orifice of the prepuce by the 5th day postsurgery. Bull's claws were also trimmed for a second time during hospitalisation.

Outcome

After 10 days of hospitalization, bull was discharged, owner was instructed to give complete sexual rest (at least 2 months) for the bull. No evidence of stricture or tubal contraction was noted, and inspection of apposed tissues revealed no evidence dehiscence or infection. Approximately 6 months later, a follow up with the owner revealed that successful intromission had been observed and a number of females were successfully bred, supported by positive pregnancy diagnosis.

Discussion

Successful treatment of a severe and chronic preputial prolapse in a mature *Bos indicus* Brahman bull using an updated version of the preputial amputation (posthectomy) technique

is reported for the first time. Lay terminologies for surgical descriptions have been used interchangeably;^{13,19} however, we prefer to categorize 'reefing' with preputial resection and anastomosis, and 'circumcision' with preputial amputation (or posthectomy), as indicated.²⁷ To authors' knowledge, there are no published reports of using a rapidly absorbable suture (such as Biosyn™) to close the internal to external preputial integument during a preputial amputation in bulls, despite being recently published in stallions.²⁸ Preputial prolapse repair, particularly in North America, are often performed in specialist referral hospitals under controlled theatre conditions and with meticulous hospital aftercare. It is therefore clinically relevant to explore alternate techniques that can be performed in field conditions and reduce postoperative handling. In a case series of 51 surgical repairs⁵ it was identified that success rates of preputial injuries were higher if a preputial resection could be performed compared to amputation (90 versus 43% success). Surgical success rate was also reported to be higher when the procedure was conducted under full general anesthesia in an operating theatre, as expected, compared to injectable or local anesthesia. Generally, preputial amputation is reserved for chronic prolapse cases where complete extension of the penis is not possible, and the preputial resection/reefing technique is often considered to yield more favourable outcomes than amputation.^{19,29} Higher incidence of wound contracture stenosis was reported¹³ for preputial amputation (or posthectomy). However, in a different case series, preputial circumcision (i.e. amputation) indeed resulted in somewhat favourable outcomes, with 76% of bulls reproductively sound for ≥ 1 year after surgery.³⁰ Reefing procedure may not always be feasible in scenarios where sterile theatre conditions are not available or replicable, particularly in animals of high anesthetic risk, those with behavioral limitations or for clients with cost constraints. Additionally, other factors such as location of injury, ability to exteriorise the penis, and breed/subspecies may further influence decision making on surgical technique.²⁷ For instance, bulls of the British *Bos taurus* subspecies may not have enough preputial skin to facilitate amputation or posthectomy.^{13,27} Nonetheless, it is indeed valuable to reconsider alternate procedures that can provide similar success rates to those reported in texts,¹³ along with shortening surgical time and minimizing postprocedural handling. Although complete penile extension was achieved in this case, it was decided to perform a preputial amputation (circumcision) technique similar to that described earlier³¹ and later³² using rapidly absorbable suture material for the apposition of the preputial skin on closure. Suture material (2-0 Biosyn™) used may lose up to 50% of tensile strength at 2-3 weeks and is completely absorbed at ~ 3 months,³³ as opposed to other suture materials such as polydioxanone (PDS) suture that has minimal absorption within this same time frame.³⁴ Previous reports on surgical prolapse have suggested using absorbable suture materials such as polydioxanone,³⁵ and even nonabsorbable sutures such as Supramid® and wound staples.¹³ However, given that the internal visceral layer of skin in the prepuce is delicate, there is a possibility of irritation when using longer absorbing sutures that may result in undesirable sequelae such as further inflammation and wound breakdown. Other key aspects of this technique is that the amputation line is oblique, rather than straight/transverse which results in a postamputation orifice that is oval as opposed to circular.³¹ This may mitigate the need for an additional 'V' incision to be incorporated into the closure that has been advocated by some practitioners, but lacks substantial evidence.^{19,36} Additionally, horizontal mattress sutures were not placed proximal to the line of amputation as described,^{27,31} and may not be necessary for most cases. Distal amputated



Figure 4. Sequence of events during surgery: A. incised and dissected preputial skin down to the internal (visceral lamina); note the bleeding despite attempts at meticulous hemostasis, B. proximal aspect of prepuce after prolapsed section removal; note exposed tissue that had to be joined by placing sutures from internal to external preputial tissue, C. closure of the surgery incision using 2/0 Biosyn™ absorbable suture material in a simple continuous fashion; semi-circular half of the ovoid orifice was closed at a time, D. finished closure of the surgery site prior to prepuce retraction into sheath, and E and F. application of compressive bandage to assist with postoperative swelling.

portion was also removed in its entirety without staged incision and closure in 'thirds'.¹³ Both these modifications reduced surgical time considerably as closure was performed in halves as described.²⁷ However, substantial hemorrhage was encountered during the procedure. Therefore, without appropriate hemostasis, it is possible for incorrect anatomical apposition of tissues and excessive postoperative swelling. Nevertheless, minimal postoperative swelling was reported and spontaneous full penile extension was achieved within 1 week post-surgery, eliminating the need to perform daily bandage

changes or considerable ongoing intervention. Specific steps of the procedure are outlined in Figure 5. A key aspect worth mentioning by the surgeons in this case report is that the internal linings of the prolapsed portion of the prepuce were spared by bluntly dissecting distally to the initial incision site (Figure 5B) which may have preserved more skin that is less likely to be involved in the inflammatory process and hence avoided removing too much tissue to prevent full penile extension in future.^{19,27} Postoperative complications such as incisional dehiscence, suture abscesses and focal incisional hernias were

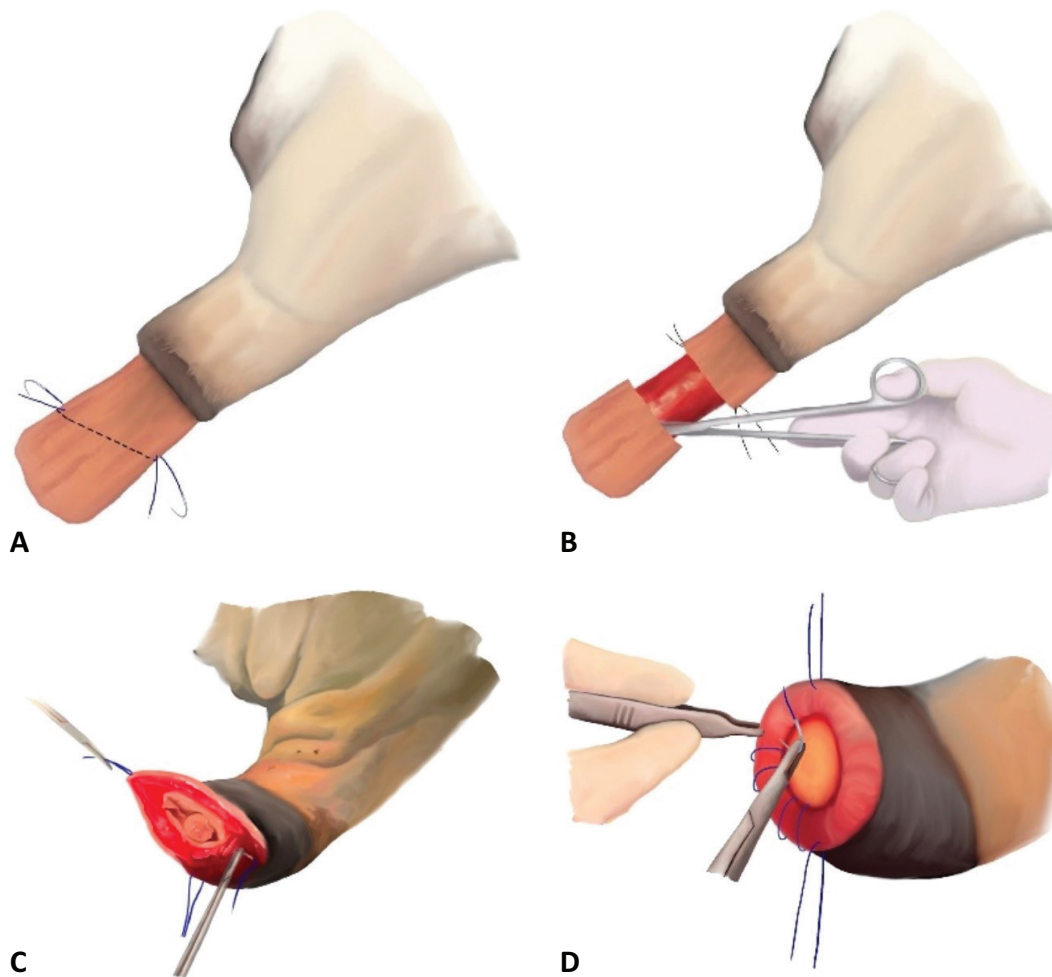


Figure 5. A. intended incision (dotted line) site and location (cranial and caudal aspect of the section to be removed) of stay sutures, B. circumferential incision (using a scalpel blade) in an angled plane and removal of tissue using Metzenbaum scissors and dissected distally to the closure site to allow more skin within the internal channel of the prolapse to be apposed during the closure, C. after amputation, recognize tissues to be reapposed in correct anatomical plane; note it is crucial that any bleeding vessels are dealt with using appropriate haemostatic techniques (electrocautery or ligation), and D. closure is achieved using rapidly absorbable 2-0 Glycomer™631 [Biosyn™] suture in a continuous fashion semicircularly from the distal stay suture to the cranial stay suture. Bites should be taken from the inside of the preputial skin to the outside, so to 'roll' the tissue outwardly. After one-half of the closure is completed, the same is done for the other semicircle of the closure.

not encountered as mentioned.^{27,30} Further, no evidence of wound contracture stenosis was apparent throughout hospitalization and neither was there any impediment to full penile extension, erection, and intromission as visually confirmed by the owner during paddock service. Other benefits to performing amputation as opposed to resection (i.e. 'reefing') are that it negates the need for full penile extension, and could minimize trauma to penis which needs to be fully exteriorized to perform the latter technique. Interestingly, alternatives to resection and anastomosis technique have just been recently described^{28,36} further suggesting this updated technique as a viable option. This amputation technique has only received limited mention in some salient texts on reproductive surgery,³² despite others reporting reasonable outcomes.^{27,30} Besides minimizing surgical trauma, surgeons' commitment to key components of Halstead's principles such as aseptic technique, attention to hemostasis, minimization of dead-space, and use of rapidly absorbed small diameter monofilament suture may have contributed to the positive outcome. Further, reported sequelae (wound contracture and stenosis)

to amputation technique can be overcome by employing the aforementioned techniques. This case served as an example for successful resolution of a Grade III chronic preputial prolapse through a slightly modified approach to the typical preputial amputation techniques.^{13,20,31,35}

Learning points

- Preputial amputation is a reasonable alternative to preputial resection ('reefing') for surgical repair of chronic preputial prolapses.
- Use of rapidly absorbable suture may assist in reducing ongoing irritation and facilitate rapid healing; some steps in previous procedures may be bypassed to reduce surgical time.
- Modifications to historical techniques for preputial amputation may allow for surgery to be performed

without the need for general anesthesia or a sterile surgical suite.

- Meticulous hemostasis, conservative resection, gentle tissue handling, and accurate anatomical apposition of tissues are key to ensuring surgical success.

Acknowledgement

Authors thank Dr. Cassandra MacDonald for surgical illustrations.

Conflict of interest

None to report and no funding is associated.

Author contributions

RN conceived the idea, RN wrote majority of manuscript, ML, CQ and HL reviewed it, and all authors approved submission.

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