# Breeding soundness evaluation focusing on penis examination in a bull – methodology and a case report

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**Abstract**

The aim of the study was to point out a rare congenital reproductive defect in a bull, namely a short penis. The case report is focused on examination methods usable for inducing penile prolapse in a bull and the presentation of a specific bull with a high libido accompanied by a low pregnancy rates within a beef cow herd. The bull was completely andrologically examined by methods of breeding soundness evaluation, which include examination of the libido and ejaculate, and a basic clinical examination of the male reproductive organs. Since penis examination in a bull can pose a problem, it is advisable to use one of the variety of methods of inducing its prolapse, as presented in this clinical case. The anamnesis showed that the patient's libido was very good. Semen was examined using flow cytometry and subjective microscopicals methods, showing very good quality. The results of the general clinical and laboratory examination did not show any pathological changes. Special attention was paid to the examination of the external and internal reproductive organs which were without pathological findings except for an insufficient penis length proven after artificial penile prolapse using bilateral anaesthesia of the pudental nerves. The diagnosis was established as a congenitally short penis. Breeding soundness evaluation is a complex examination system that evaluates several criteria and a failure in just one criterion can cause the bull to be removed from a breeding programme, as seen in the presented case.

*Cattle, congenital deformity, pudendal nerve, reproduction*

Bull breeding soundness evaluation (BBSE) is a procedure that reduces risk and improves strategic bull use and herd fertility. It is a method of evaluating the bull's potential to be used as the herd sire (Lone et al. 2017) and is important for eliminating sub-fertile sires from breeding programmes. Although the use of artificial insemination (AI) is widespread, natural service is commonly used in beef cattle herds and for breeding empty cows after a period of AI in dairy herds (Chapwania et al. 2008).

The true measure of bull breeding soundness is their ability to get cows pregnant and the production of live calves. Performing a BBSE prior to the breeding season, under the guidelines set forth by the Society for Theriogenology, will provide practitioners with a uniform method for assessment and selection of sires that could potentially impregnate 25–30 cows in a 65–70-day breeding season. The BBSE does not guarantee that a bull will be highly fertile and does not ensure that the bull's semen is free of viral or other infectious agents (Armstrong and Koziol 2022).

Freedom from sexually transmissible diseases is usually not but can be included in the BBSE. In locations where campylobacteriosis and trichomoniasis are prevalent, testing for these diseases may be performed at least partially in conjunction with BBSEs. There is some variability in the way bulls are evaluated for breeding soundness in different parts of the world, however, three cardinal principles of breeding soundness are acknowledged in all systems. A BBSE considers the bull's physical characteristics and libido that are necessary for his mobility in the pasture, detection of cows in oestrus, and his ability to

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service them. These are also used to evaluate his overall and reproductive development, the size and health of his testes (scrotal circumference), and the quality of his semen (Barth 2018).

## Examination of the bull's prepuce and penis

The penis and prepuce are usually examined during semen collection. The sheath should be inspected and palpated. Examination of preputial hairs on the end of the sheath for accumulation of blood or exudates might indicate penile or preputial injury. The presence of sandy or gritty material on preputial hairs may indicate the presence of urolithiasis. Problems here might include inflammatory exudates, trauma, fibrosis, abscessation and scarring (Armstrong and Koziol 2022).

Initial examination of the penis can be carried out during the physical examination by palpation through the sheath. Lesions such as penile haematomata or large papillomata may be detected at this stage, however, proper examination requires protrusion of the penis. Some bulls can be stimulated for partial protrusion of the penis during rectal palpation, which provides an option to inspect the tip of the penis. In some cases, the free end of the penis can be carefully grasped with a gauze swab and pulled forward to allow further examination, if required (Aiello and Moses 2016).

Manual protrusion of the penis from the prepuce can be very difficult and in some cases impossible. This is due to the considerable strength within the paired penis retractors (mm. retractores penis). The innervation of the penis and its muscles is provided by the pudendal nerves and the pelvic plexus of the sympathetic system. Several methods exist for inducing prolapse of the penis from the preputial sac and for its subsequent examination, including epidural anaesthesia, application of tranquilizers or sedatives, general anaesthesia or local anaesthesia of the pudendal nerves. The method chosen depends on each case and required intervention. A simple and quick clinical examination can be performed during semen collection while the penis is erect. However, when a more thorough examination or treatment is required, it is necessary to consider the application of one of the anaesthesia methods. A disadvantage of epidural anaesthesia may be the disruption of motor function of the pelvic limbs due to excessive anaesthetic administration. During general anaesthesia, there is a risk of developing tympany and respiratory problems in ruminants. Both methods can affect the animal's general condition. For this reason, local anaesthesia of the pudendal nerves is probably the most appropriate method (Ahmed et al. 2011).

Bilateral anaesthesia of the internal pudendal nerves in the fossa ischiorectalis was first described by Larson (1953) as a method of inducing penile prolapse in the bull without disruption of locomotor functions. Internal anaesthesia of the pudendal nerves can be performed on a standing bull to induce penile prolapse, provide analgesia distal to the sigmoid flexure, and allow for subsequent examination or minor surgical procedures such as removal of papillomas. This procedure involves anaesthesia of the internal pudendal nerves and the anastomotic branch of the middle haemorrhoidal nerves using an ischiorectal approach (Sidelinger 2021). The internal pudendal nerve consists of fibres originating from the ventral branches of the 2$^{nd}$, 3$^{rd}$, and 4$^{th}$ sacral nerves and the pelvic splanchnic nerves. It runs ventrocaudally on the medial surface of the sacrosciatic ligament, and provides innervation of the perineum and external genitalia, including the mm. retractores penis (El-Kammar and Alsafy 2006).

Several methods of pudendal nerve blocks have been described in ruminants in order to achieve artificial penile prolapse (McFarlane 1963; Skarda 1996; Fazili et al. 2016).

The penis does not always protrude spontaneously from the prepuce with all techniques. In some cases, the relaxed penis remains near the preputial orifice. In order to achieve a complete prolapse, manual removal of the penis is needed. Use of a a piece of moistened gauze to grasp and fixate the penis outside the prepuce is necessary (Ahmed et al. 2011).

After successful induction of anaesthesia, examination of the penis and foreskin or therapy, the consequences of the procedure and the fact that penile prolapse may persist for some time need to be considered. In order to prevent injury, it is necessary to isolate the bull from other animals. Bandaging the prepuce may also be considered after repositioning the penis inside (Edwards 2001).

### Bilateral anaesthesia of the internal pudendal nerves using the Larson method

The point of needle insertion is at the lowest point of fossa ischiorectalis, which is a triangular depression bound ventrally by ischial tuberosity, laterally by the posterior border of the sacrosciatic ligament, and medially by the rectum and tail head. The hairs at the site of injection are clipped and the skin is disinfected. Infiltration anaesthesia is performed with approximately 2 ml of procaine. Subsequently, the skin is perforated with a thicker needle, through which a long injection needle (10–15 cm) is introduced slightly cranioventrally to the foramen ischiadicum minus. The method can be modified by incision of a skin with scalpel and subsequently, only long injected needles are introduced on the position of the nerves (Edwards 2001) (Plate II, Fig. 1).

The needle is directed under hand control through the rectum. The needle is not palpable until it is inserted approximately 5–7 cm deep, which is due to the presence of m. coccygeus, which lies between the wall of the rectum and the needle. With right-sided anaesthesia, the operator's left hand is inserted into the rectum approximately up to the wrist and with the fingers it is possible to identify the foramen ischiadicum minus laterally on the right as a soft delimited depression in the ligamentum sacrotuberale latum. To more easily identify the opening, it is also possible to use a. iliaca interna, the pulsation of which can be detected on the medial surface of ligamentum sacrotuberale latum until it enters foramen ischiadicum minus.

The site of the first application of local anaesthetic is within the foramen ischiadicum minus. The amount of substance applied is 20–25 ml. Subsequently, the needle is partially pulled out and redirected 2–3 cm caudodorsally above the opening where further 10 ml are applied for anaesthesia of n. haemorrhoidalis (Plate III, Fig. 2). After the local anaesthetic is administered and the needle is removed, the solution is dispersed by massaging the application site. This procedure is then repeated on the opposite side of the pelvis. The onset of the effect varies between 20–40 min and its duration is 2–4 h.

## Case report

### Case history

A breeding bull (2.5 years old) of the Limousin breed was admitted to the clinic. According to the information provided by the owner, the newly purchased bull was introduced to the herd where he showed a high libido. Despite this, pregnancy rates within the herd were low. As a result, the owner requested an examination of the bull.

### Clinical examination

The bull was examined by standard methods of BBSE. The bull's libido was evaluated using information provided by the owner who reported that the bull manifested good interest in the females and also a high libido. The patient's general condition was evaluated based on the results of laboratory blood analysis and clinical examination. The laboratory examination was focused on protein profile for detecting the presence of inflammatory changes. Hovewer, the results showed no significant changes, which was reflected in the clinical examination. Special attention was paid to the examination of the external (testicles, epididymis, spermatic cord) and internal (prostate and vesicular glands) reproductive organs which were also examined by ultrasonography. Again, no pathological

changes were detected. Scrotal circumference was measured by tape and it was 34 cm. Subsequently, semen was collected by electroejaculation, however, the results did not demonstrate any fertility concerns in the sperm sample. The ejaculate showed excellent quality in all the investigated indicators (spermatozoa concentration, motility, presence of morphologically malformed spermatozoa, viability). Semen was examined in the laboratory using flow cytometry and subjective microscopic methods. Flow cytometry was used for sperm count determination by use of counting beads, 123 count eBeads™ (eBioscience, ThermoFisher Scientific, Carlsbad, USA) and sperm viability was determined by combined staining with propidium iodide (PI; Sigma Aldrich, St. Louis, MO, USA) and carboxyl fluorescein diacetate (cFDA; Sigma Aldrich) as described by Dolník et al. (2023). Subjective methods were used for examination of sperm motility under light microscope and for evaluation of morphological malformed spermatozoa Farelly stain (Minitübe, Germany, available online: https://www.minitube.com/catalog/en/farelly-stain-for-morphology-p1749/).

It was not possible to examine the penis during routine clinical examination or during semen collection as only a temporary, mild erection was observed. Therefore, artificial prolapse of the penis was subsequently induced through bilateral anaesthesia of the pudendal nerves using a modified method according to Larson. The release of the penis occurred after 10 min. No efflorescences or neoplasms were present on the mucous membrane of the penis. However, even with manual help, it was not possible to remove more than 15 cm of the penis from the prepuce (Plate III, Fig. 3). An extension of the flexura sigmoidei was palpated, which would not be possible in the case of another abnormality, short mm. retractores penis. A diagnosis of congenitally short penis was made. As this is a hereditary disease, the bull had to be removed from the breeding programme.

## Discussion

Impotence caused by a congenitally short penis is rarely a cause of infertility in bulls. The diagnosis of this disorder can be problematic as the anamnestic data often indicates a good libido of the bull. It is also often possible to collect the ejaculate and the results of sperm examination may show suitable quality. There have also been cases where young bulls with a congenitally short penis could fertilize heifers. However, with increasing age and mainly growing body size, they become less agile and the length of the penis does not allow them to reach the vulva (Gilbert 1989).

Full penis extension from the prepuce is made possible by multiple interdigitating layers of elastic tissue between the preputial epithelium and penile tunica albuginea. There is wide variation among bulls, such that the penis protrudes 25 to 60 cm beyond the preputial orifice during full erection (Beckett and Wolfe 1998).

In bulls with congenitally short penis, the erect penis does not protrude more than 10 to 15 cm from the opening of the foreskin, despite the retractor penis muscles being normally developed and no adhesions preventing the erect penis protruding from the foreskin. Short retractor penis muscles have been reported as a probable recessive hereditary disease in Friesian bulls (Roberts 1986). The presentation of such cases is very similar to congenitally short penis disease, except that when the rectractor penis muscles are short, the sigmoid flexure is normally developed but cannot be straightened during copulation or electroejaculation. Myotomy of the m. retractores penis to correct the defect is not recommended and is illegal in some countries because there is evidence that these conditions are hereditary. Therefore, the affected bulls should be excluded from breeding programmes (Gledhill 1973).

Another cause that can prevent complete penile extension and needs to be excluded, is incomplete separation of the epithelium of the penis and prepuce. The surface epithelium

of the free part of the penis is firmly attached to the epithelium of the prepuce at birth. These tissues begin to separate at 4 weeks of age and progress caudally until complete separation occurs from 8 to 11 months of age. Incomplete separation of the epithelium of the penis and prepuce can be diagnosed during clinical examination by palpation. Manual traction of the free part of the penis can complete the separation from prepuce, but excessive force can cause tearing or bleeding of the tightly adherent tissues. This condition may be associated with later maturity and may have an undesirable hereditary component. Acquired causes, such as laceration and inflammation of prepuce also exist, which can cause a stenosis, or penile haematoma. All of these pathological changes may cause phimosis and eventually prevent a bull from extending the penis sufficiently to achieve coitus (Wolfe 2018).

The defect of congenitally short penis is a problem that should be recognized by the staff of insemination and breeding centres, as the semen of affected bulls is often collected using an artificial vagina, but commonly the defect itself remains undetected. In addition, a penile examination of bulls used in natural breeding is complicated by the complexity of the procedure, therefore the penis is often only examined during a spontaneous erection or during the collection of ejaculate by electroejaculation. In both cases, the penis may not be completely extended, and thus an accurate evaluation of its length is not possible. A presumptive diagnosis is possible if the protrusion of the penis appears insufficient when collecting the ejaculate. The length of the penis is important during mounting and copulation, for effective intromission and fertilization. According to Gilbert (1989), the length of the penis in an adult healthy bull, from the foreskin opening to the tip of the penis should not be less than 25 cm. For this reason, in case of doubt, it is necessary to perform a pudendal nerve block or general anaesthesia, before thoroughly examining the bull to confirm or refute the diagnosis.

## Conclusion

BBSE is a complex examination system that evaluates several criteria, and a failure in just one criterion can cause the bull to be removed from breeding programme, as can be seen in the presented case, where the established diagnosis was a congenitally short penis. The penis examination is one of the criteria that the bull must satisfy before his selection for a breeding programme. Considering the importance and difficulty of a penile examination, inducing artificial prolapse of the penis is considered an essential method for both examination and therapeutic intervention. The method of bilateral nervus pudendus anaesthesia still appears to be the best choice. The main advantage is the ability to perform the procedure on a standing animal with a reduced risk of impairing the locomotor functions and of problems associated with general anaesthesia.

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Fig. 1. Needle insertion site on the left side in the ischiorectal fossa
Source: own

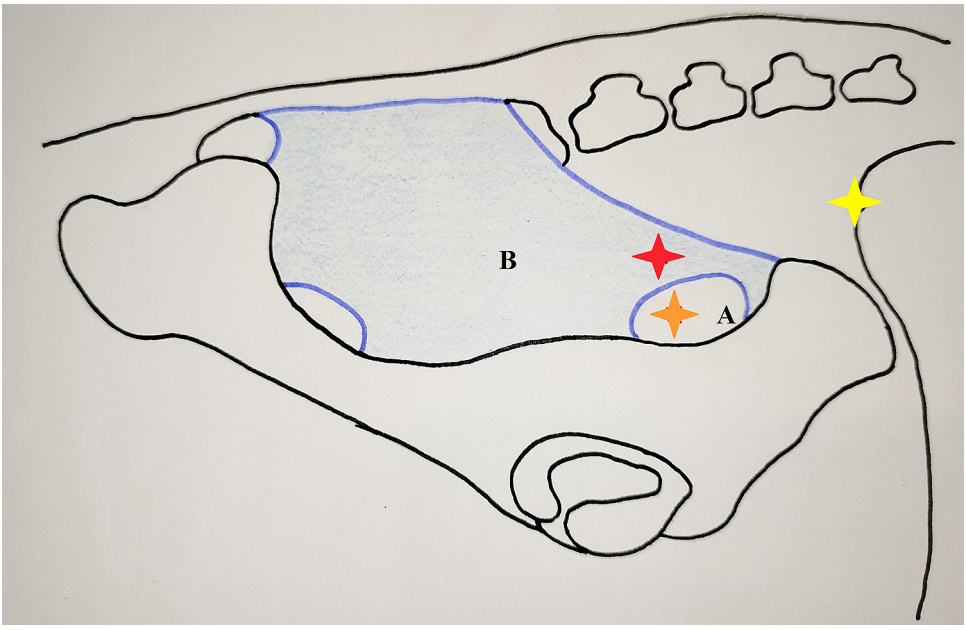


Fig. 2. Schematic illustration of the sites of local anaesthetic application. A - foramen ischiadicum minus; B - ligamentum sacrotuberale latum; yellow star - site of needle introduction; orange star - site of anaesthesia of the n. pudendus; red star - site of anaesthesia of the n. haemorrhoidalis

Source: own

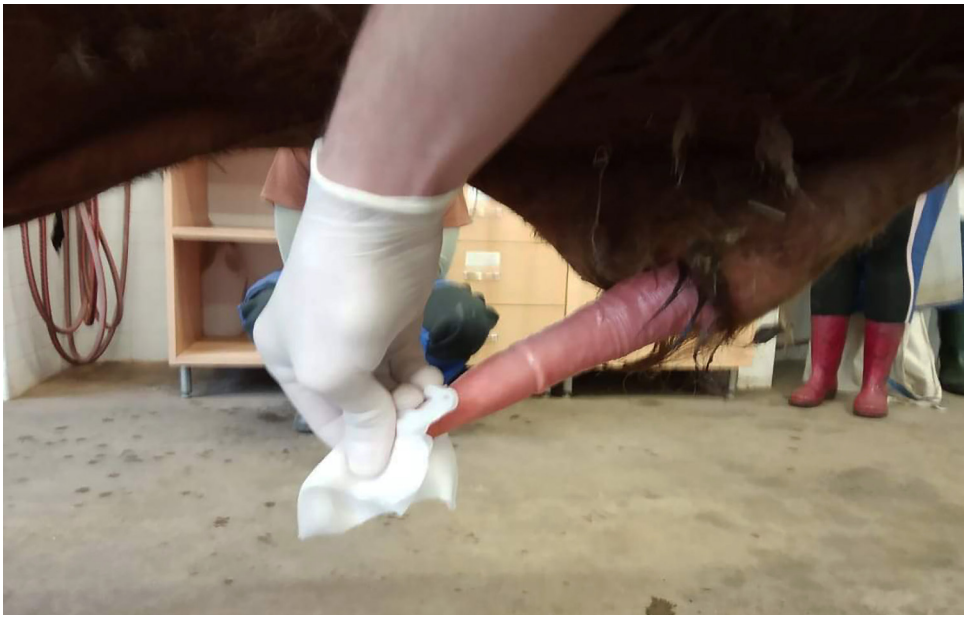

Fig. 3. Bull's penis after local anaesthesia of the pudendal nerves.

Source: own