Fertility and Breeding Evaluation of Bulls

Joel Yelich
Associate Professor, UF/IFAS, Department of Animal Sciences, Gainesville, FL

A breeding soundness Exam (BSE) is a relative inexpensive procedure that can be utilized by producers to determine if a bull is fertile and has the potential to naturally service females. There are typically three times that a BSE is conducted including 1) *Pre-purchase sale*, 2) *Pre-breeding season exam: 30 to 60 days prior to start of breeding season*, and/or 3) *Post-breeding season exam: if the owner suspects fertility problems*. The purpose of this paper is to provide producers a brief explanation of the components of the BSE and to assist in developing a better understanding of what to expect when a BSE is performed. There are four major components to the BSE including the *physical exam*, *genital exam*, *scrotal measurement*, and *semen evaluation*. For the semen evaluation, semen is usually collected using electroejaculation, which consists of a special probe inserted into the rectum of a bull restrained in a squeeze chute followed by short electrical pulses directed through the probe. The electrical pulses stimulate the muscles/nerves associated with the reproductive tract and aids in movement of semen (containing sperm) out of the reproductive tract to be collected. The semen is evaluated for sperm motility and morphology.

A. Physical examination

1. Health
   - ■ The bull should be in general good health including a full mouth of teeth and his eyes should be clear of any lesions such as pinkeye and squamous cell carcinomas.
2. Body Condition
   - ■ Excessively fat bulls lack vigor and excess fat can negatively affect sperm production.
   - ■ Extremely thin bulls may not have the stamina to service cows during breeding season. Therefore, bulls must carry some extra condition at the start of the breeding season.
3. Conformation and Body Structure
   - ■ Rear leg conformation is very important since they are the load bearing structures during mounting and breeding and are necessary for proper mobility during breeding. Hooves should be in good shape and require no trimming.
   - ■ There are desirable conformations (Figures 1a, 2b) and undesirable conformations (Figures 1b, 1c, 2a, 2c, 2d) such as sickle-hocked, post-legged, camped behind. Bulls with extremely undesirable conformations should be culled, since conformation is a highly heritable trait.

B. Genital examination

1. Prepuce
   - ■ The prepuce should be palpated and absent of adhesions, inflammation, and abscesses.
   - ■ Cattle of *Bos indicus* and *Bos indicus x Bos taurus* breeding are predisposed to preputial injury or prolaspe due to very loose and pendulous sheath development.
2. Penis
   - ■ Penile frenulums are developmental characteristics where the tip of the penis grows back on the tip of the penis and are typically observed in virgin bulls. Other abnormalities such as rings of hair around the penis, scar tissue, growths, hematomas, and coiling of the end of the penis should be checked for and bulls with abnormalities should be dealt with accordingly.
3. Scrotum
   - ■ There are variations in both normal (Figure 3.1) and abnormal scrotal conformations (Figure 3.2). The testes and epididymis should be palpated for size, tone, and symmetry and to make sure that there are no lesions on the epididymides. The testes should be firm but they should not be too soft or too hard. A symmetrical testes shape is normal and preferred. Any deviation in size, shape, and

Table 1. Age comparison of average scrotal circumference (cm) of beef breeds.

	Months							
Breed	<14	14-17	18-20	21-23	24-26	27-30	31-36	>36
Angus	34.8	35.9	36.6	36.9	36.7	36.3	36.6	38.2
Charolais	32.6	35.4	34.5	34.9	34.6	36.2	37.1	38.1
Horned Hereford	33.0	32.2	34.1	36.2	33.4	33.8	35.2	34.0
Simmental	33.4	36.5	—	—	36.0	—	—	37.2
Limousin	30.6	31.7	32.0	33.9	—	—	—	35.5
Santa Gertrudis	34.0	35.3	35.5	36.7	36.5	36.4	38.3	40.5
Brahman	21.9	27.4	29.4	31.4	31.7	33.5	34.7	36.7

(or) position should be viewed with suspicion.

■ Cryptorchidism is failure of one or more testis to descend into scrotum. It is a highly heritable trait and all breeding bulls with this condition should be culled. A unilateral cryptorchid has one testicle retained and bulls are generally fertile. A bilateral cryptorchid has both testicles retained and bulls are infertile, but still maintain a male phenotype.

4. Accessory Sex Glands

■ The vesicular and prostate glands, pelvic urethral muscle, and ampullae should be examined by rectal palpation to make sure there is no swelling and (or) other abnormalities.

■ Seminal vesiculitis is a common problem in bulls and more common in bulls on high energy diets. The condition is characterized by firm vesicular glands accompanied by inflammation of the vas deferens, ampullae, epididymides, or testes with increased white blood cells in the semen leading to puss in the ejaculate. During rectal palpation and (or) electroejaculation there is an acute pain followed by excessive vocalization by the bull.

C. Scrotal Circumference

1. Largest Diameter of Scrotum (Figure 4).

■ The measurement is taken with scrotal tape and is a highly repeatable measurement.

■ The scrotal tape is cheap and easy to use, which allows producers the ability to determine if scrotal size is correct for the age and breed on the bull.

2. Importance and Value of Scrotal Measurements

■ Scrotal circumference is a highly heritable trait (0.5) and is one of the most accurate indicators of puberty in bulls. Puberty typically occurs at an average scrotal circumference of 28 cm (range 25 to 30 cm).

■ Scrotal circumference in young bulls (12 to 15 months) is an accurate predictor of sperm output, future sperm producing characteristics of the testes, and it is also favorably related to semen traits. When scrotal circumference is increased, sperm motility and normal sperm numbers increase, while abnormal sperm numbers decrease.

■ Since scrotal circumference is a highly heritable trait, selection pressure should be placed on this trait whenever possible. Bulls with large scrotal circumference also tend to sire heifers that attain puberty at younger ages.

3. Factors Affecting Scrotal Circumference

■ **Age:** Scrotal circumference increases rapidly in young bulls but only gradually in older bulls (> 3 years) as testicular growth and development slows.

■ **Breed:** *Bos indicus* and later maturing *Bos taurus* breeds tends to have smaller scrotal circumference as yearlings (Table 1). However, there is considerable variation in scrotal circumference both between and within breeds.

■ **Environment**: In young bulls, scrotal

circumference can be negatively affected by severely restricting nutrition. Anabolic-like steroids (i.e., Ralgro) also decrease scrotal circumference and retard sexual development. Other factors such as heat/cold stress, systemic infections, trauma, and inadequate nutrition can all have a negative effect on scrotal circumference, which can result in a decrease in semen quality.

4. Reference Table for Scrotal Circumference

■ In Table 2 (below) are the ***minimum recommended scrotal circumference categorized per age group*** that a bull must have to pass a BSE.

Age (months)	*Bos taurus* (cm)	*Bos indicus* (cm)
≤ 15	30	26
> 15 ≤ 18	31	28
> 18 ≤ 21	32	30
> 21 ≤ 24	33	31
> 24	34	32

Minimum recommended scrotal circumference to pass the BSE.

D. Semen Examination

1. Visual Exam of Ejaculate.

■ The volume of an ejaculate ranges from 1 to 6 mL with a sperm concentration of 800 to 2,000 million sperm/mL or 5 to 15 billion sperm/ejaculate.

■ The gross appearance of the ejaculate is evaluated and it should be creamy white, which is indicative of high sperm concentration. The ejaculate should also be free from contaminants including blood, urine, dirt, or pus. It is important to keep urine and water out of the ejaculate since they are toxic to sperm cells.

2. Motility

■ Two types of motility are evaluated including gross and individual motility. *Gross motility* is the mass swirling movement of semen and *individual motility* is a strong forward progressive movement of individual sperm as a percentage of the sample. Numerous factors can influence motility including fractionation of semen sample, presence of urine, environmental insults, inadequate dilution techniques, and ambient temperature.

■ Because numerous factors can influence motility, it is the least predictable part of a semen evaluation. Therefore, it carries less influence on the final outcome of the BSE.

■ In Table 3 (below) are the different categories of gross and individual motility. The ***minimum recommended motility to pass a BSE is ≥ 30% or Fair.***

Gross motility	Rating	Individual
Rapid swirling	Very good	> 70%
Slower swirling	Good	50 - 69%
Generalized oscillation	Fair	30 - 49%
Sporadic oscillation	Poor	< 30%

Minimum recommended motility is 30% or Fair for BSE.

3. Morphology

■ After collection of the ejaculate a smear is made of the semen sample using a special stain (eosin-nigrosin is most common). The smears are viewed with a microscope to determine the presence and number of normal and abnormal sperm in the ejaculate.

■ There are two types of abnormalities including primary and secondary (Figures 5, 6). *Primary abnormalities* usually occur inside the testes due to faulty spermatogenesis and include all head defects, most tail defects, and proximal droplets. *Secondary abnormalities* typically occur as sperm move through duct system outside the testes and include distal droplets and detached heads. A bull with increased number of detached heads is indicative of a sexually inactive bull and the number of detached heads usually decreases with increased sexual activity.

■ There are numerous factors that can affect sperm morphology including increased heat in testes (0.5 to 1.0°C) for a day or two, which causes abnormal spermatogenesis through lack of oxygen and a decrease in testosterone concentrations. Other stressors such as an illness, injury, prolonged low ambient temperature, and pain can also have a negative effect on semen quality and cause an increase

in abnormal sperm cell morphology.

- A high prevalence of abnormal sperm can reduce the fertility of the male. Therefore, the ***Minimum recommended normal sperm in an ejaculate is 70% to pass a BSE***.

F. Final BSE classifications

The individual conducting the BSE, whether it be a veterinarian or other qualified individual, will provide the final evaluation and (or) certification of each bull's BSE. Bulls are classified into one of three categories:

Satisfactory potential breeder

- Bull is categorized to breed cows.
- The bull must pass a physical examination and meet the minimum values for:

Scrotal circumference: correct for bull's age (Table 2).
Motility: > 30% (Table 3).
Morphology: > 70% normal.

Unsatisfactory potential breeder

- Bull does not meet either one or several of the minimum BSE values.
- Bulls in this category are typically not sold as breeding bulls.
- Bulls in this category are expected to cause poor fertility during the breeding season.

Classification deferred

- Bull does not meet either one or several of the minimum BSE values.
- Classification is deferred at evaluator's discretion and bull can undergo a re-examination at a later date to determine if the bull can be placed in Satisfactory Potential Breeder category.
- Typically used for pubertal bulls or mature bulls that may have had an insult in spermatogenesis and from which recovery is expected.

Summary

There are numerous other management practices in addition to the BSE exam that producers could implement to ensure maximal reproductive efficiency of their breeding bulls.

A. BSE recommendations: The BSE is a highly recommended reproductive management practice that should be conducted annually since an infertile bull can't get cows pregnant. This is particularly important for producers that use single sire mating systems or mating systems that utilize a small number of bulls (2 to 3). A bull that is infertile can have devastating effects on cowherd fertility.

B. Libido and mating ability: Although not evaluated during a BSE, it is important that a bull has good libido and mating ability.

1. Libido is defined as the willingness and enthusiasm of the bull to mount and attempt to service the female. It is also known as sex drive.
2. Mating ability is the bull's ability to complete the service and breed the female.
3. Therefore, it would serve producers well to observe their bulls in the act of mating females in estrus at the start of the breeding season. The bull should be able to mount the female, extend his penis, and penetrate the vagina with his penis resulting in successful breeding. The mating process should be a quick and natural process. Bulls that cannot complete the breeding process should be replaced immediately and culled from the herd.
4. Remember, just because he looks like a bull, acts like a bull, smells like a bull, and thinks he is a breeding bull, doesn't necessarily mean he can breed females and get them pregnant.

C. Nutrition: It is important ***not to overfeed bulls*** so they become excessively fat. Excess fat can lead to poor libido, potential structural problems, and decreased semen quality due to fat deposition in the scrotum. During the non-breeding season, young bulls' ≤ 3 years old should be fed to maintain growth requirements and maintain adequate body condition with a condition score of approximately a 5 (Scale 1-9); whereas, mature bulls > 3 years old should be fed to meet maintenance requirements and to maintain body condition of approximately a 5. Nutrition should be increased approximately 60 days prior to the start of the breeding season to ensure adequate body condition by the start of breeding. This is particularly

true if bulls are extremely thin with a condition score of 4. If supplementing bulls with cottonseed type products either during the breeding season or off season, it is important to monitor intake. Cottonseed contains gossypol and excess gossypol can temporarily reduce semen quality. The following guidelines should be followed:

1. Whole cottonseed: < 10% of young bulls diet and 10 to 20% of mature bulls diet.
2. Solvent extracted cottonseed: < 5% of total diet.
3. Mechanical extracted cottonseed: < 15% of total diet.

D. Fertility Associated Antigen (FAA): Producers can also test bulls for FAA while conducting a BSE exam. FAA is a protein that is produced by the accessory sex glands and its chemical fraction binds to the sperm membrane. The degree of FAA attachment varies between bulls and research has shown that FAA positive bulls have 15 to 20% greater pregnancy rates than FAA negative bulls. The test is simple to conduct and can be performed either chute side or the collected semen can be frozen and the test can be performed later. Additional literature on FAA and information on ordering the test can be accessed at the ReproTec web page (http://www.reprotec.us).

E. Breeding season management: Producers should also evaluate their bull to cow ratios prior to the breeding season. Traditionally, producers have used a 1:25 ratio, which is probably wasteful in highly fertile bulls. Depending on the pasture size, pasture topography, and bull age, a 1:40 ratio is adequate in older bulls (≥ 3 years) and 1:15 to 30 in young bulls ≤ 2 years of age. Bulls should also be sorted by age and weight to prevent any injuries and (or) dominance issues with older bulls. Attention should be paid to older dominant bulls in multiple sire mating systems. Older bulls can become dominant and aggressive and prevent other bulls from servicing females, which is a problem when the dominant bull is infertile.

F. It should be noted that the minimum acceptable BSE guidelines for scrotal circumference, motility and morphology presented in this paper were developed by veterinarians who are members of the Society of Theriogenology, an association comprised of veterinarians that are dedicated to the study of reproduction.

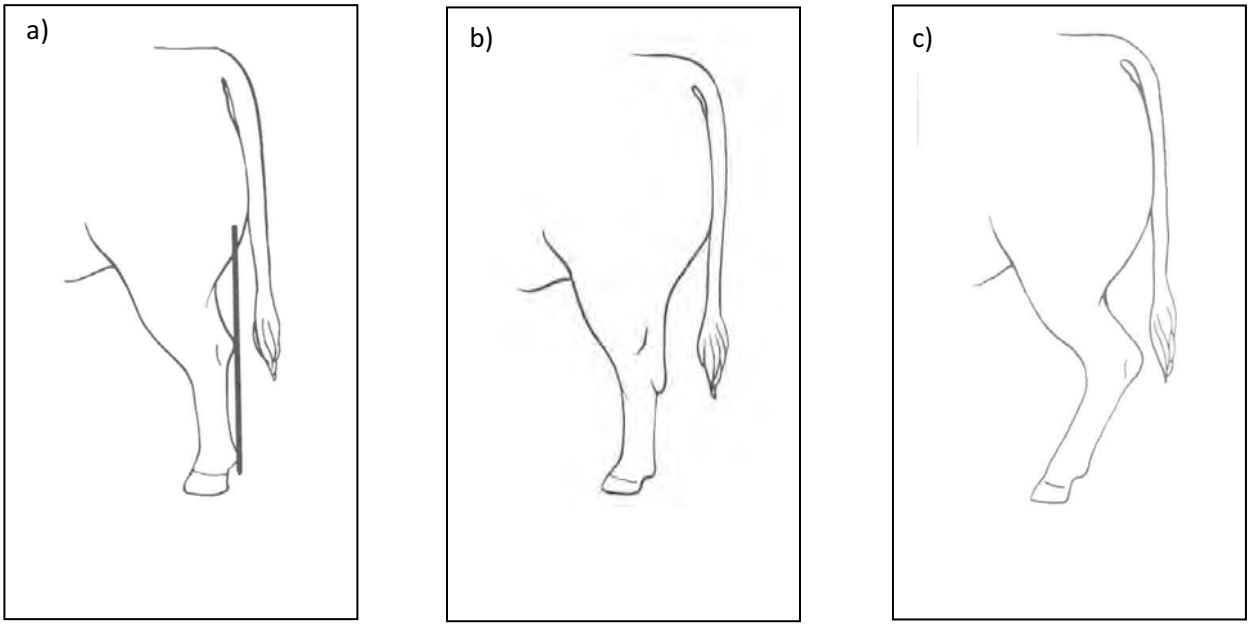

Figure 1. **a) *Desirable*** conformation of the rear legs as seen from the side. **b) *Postlegged***. Bulls with this fault lack proper angulation of the hock and stifle joint. These animals may "stifle" and their pasterns may be noticeably weakened. **c) *Sickle-hock*** conformation. This fault can lead to swollen hocks and lameness.

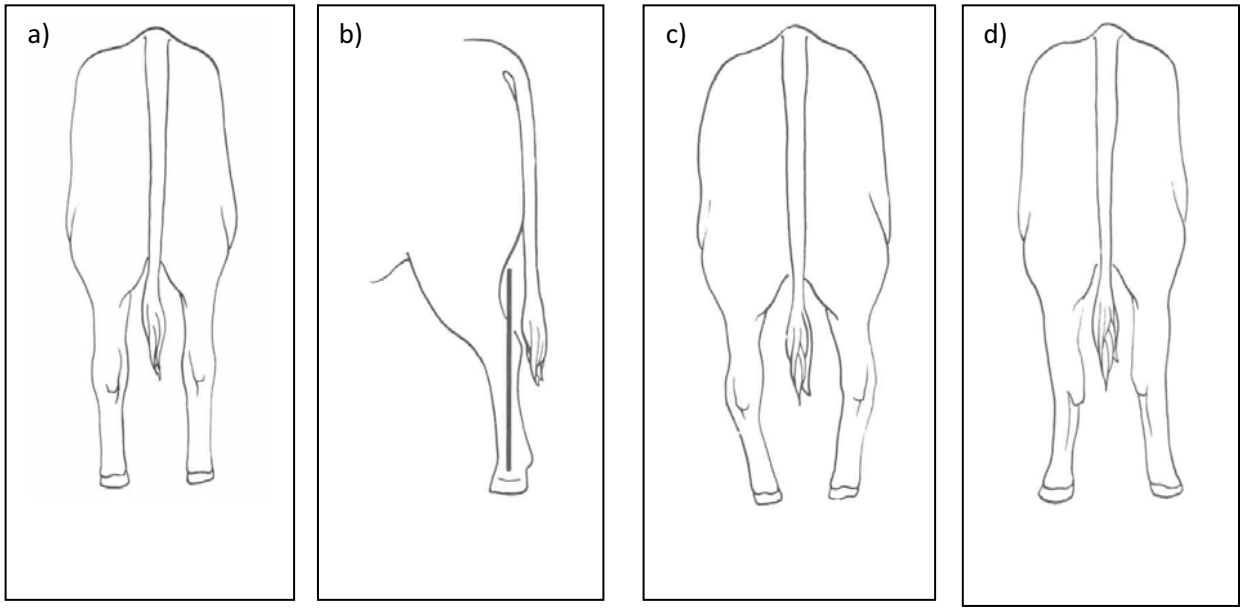

Figure 2. **a)** ***Desirable*** conformation of the hind legs as seen from the rear. **b)** ***Camped behind.*** With this defect, bulls shift their rear legs frequently in an effort to find a comfortable stance. They are usually swayback. **c)** ***Bowleggedness*** (base narrow). The outside wall of the hoof is compressed. The outer toe may curl upward, growing over the inside toe and requiring frequent trimming. Bulls with this fault show various degrees of lameness. **d)** ***Toed-out stance*** (base wide). Fault is usually seen in conjunction with the sickle-hock conformation.

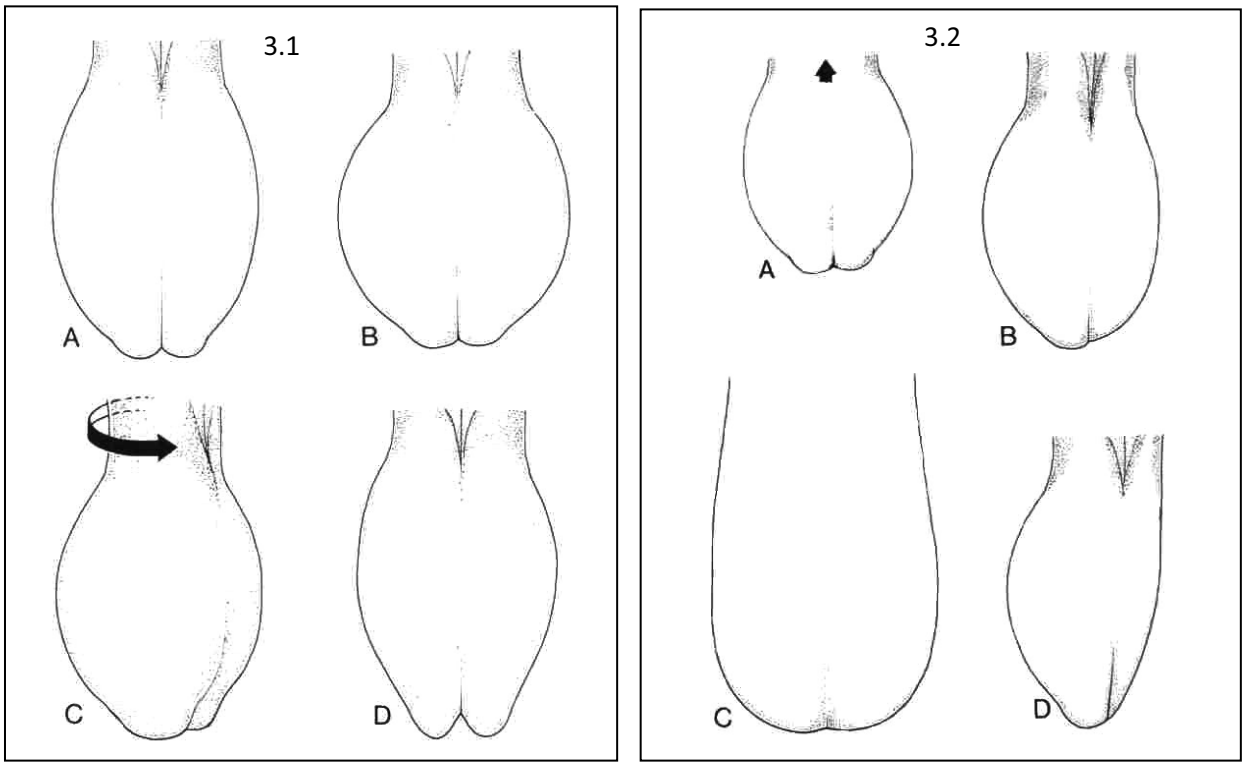

Figure 3.1. Variations of scrotal conformation. **A)** Normal scrotal conformation with elongated testes; **B)** Normal scrotal conformation with rounded testes; **C)** Scrotum may be rotated in some bulls with no apparent ill-effects; **D)** Cleavage between the epididymides is sometimes very distinct. The bottle shaped scrotum is most desirable because it allows for optimum thermoregulation.

Figure 3.2. Any deviation from normal scrotal conformation usually leads to a poor prognosis. **A)** Testes held close to body wall or wedge shaped are usually small or hypoplastic and produce sperm of decreased quality; **B)** Unilateral hypoplasia; **C)** Scrotal hernia; **D)** Incomplete descent of right testis. Straight-sided scrotums usually have excessive fat depots, which impair thermoregulation and decreases sperm quality.

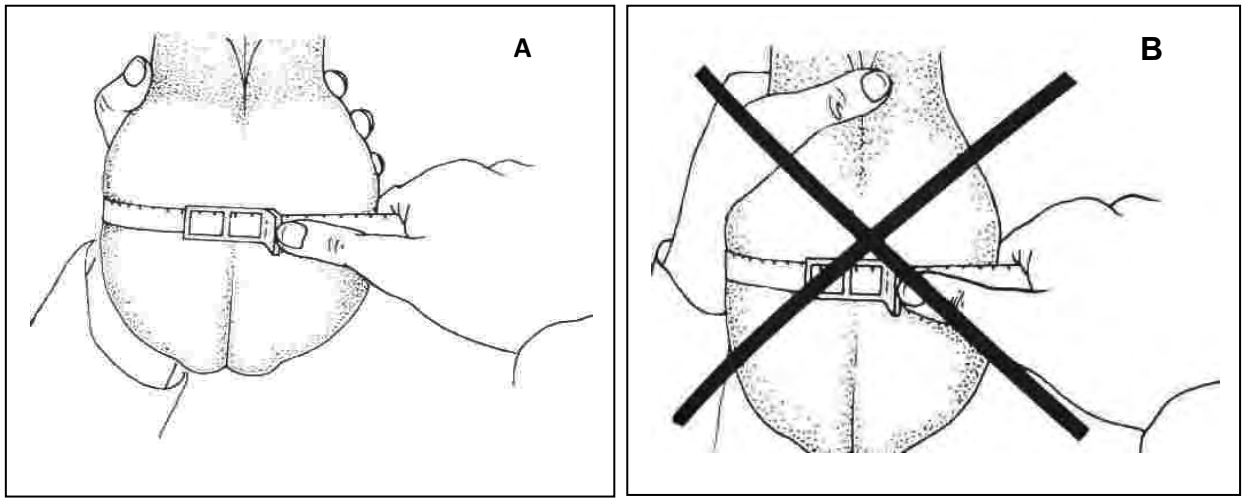

Figure 4. Correct method for measurement of scrotal circumference. The testes are pulled firmly into the lower part of the scrotum by encircling its base with the hand and pulling down on the testes. **(A)** The scrotal tape is formed into a loop and slipped over the scrotum and pulled up snugly around the ***greatest diameter*** of the scrotal contents. The thumbs and fingers should be located on the side of the scrotum rather than between the testes **(B)** to prevent separation of the testes and inaccurate measurement.

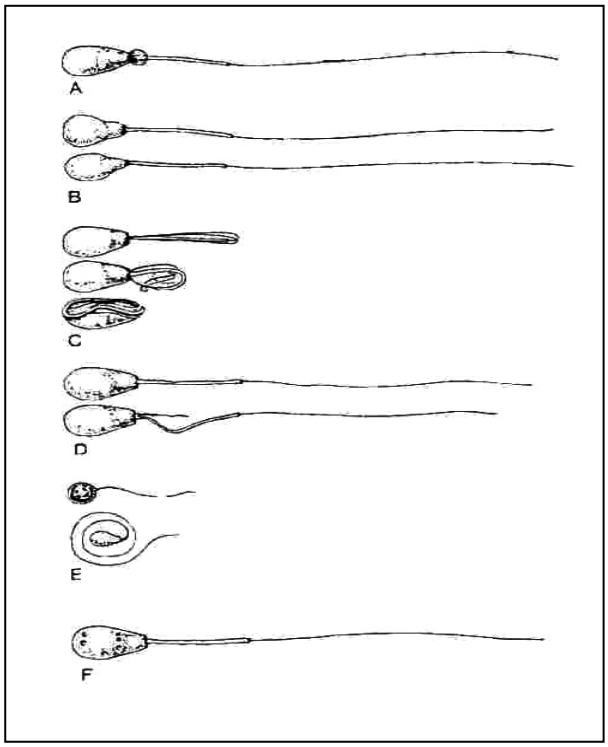

Figure 5. Primary sperm abnormalities. **A.** Proximal cytoplasmic droplets; **B.** Pyriform heads; **C.** Strongly folded or coiled tails, tails coiled around the head; **D.** Middle piece defects; **E.** Under developed; **F.** Craters.

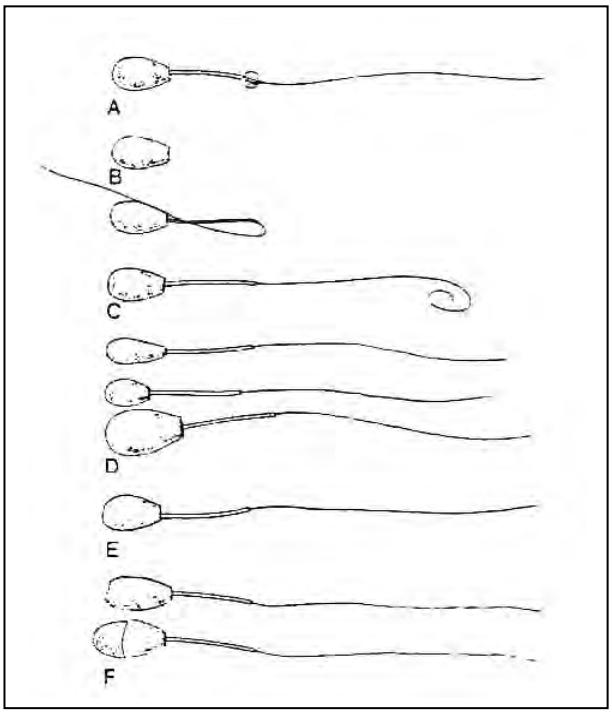

Figure 6. Secondary sperm abnormalities. **A.** Distal cytoplasmic droplets; **B.** Tailless normal heads; **C.** Simple bend or terminally coiled tails; **D.** Narrow, small, or giant heads; **E.** Abaxial implantation; **F.** Abnormal acrosomes (ruffled, detatched).

Notes: