Reproductive Soundness in Beef Bulls

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Veterinarians are called upon to examine bulls for breeding soundness either before purchase or before the breeding season. There are many workers who believe that the reproductive capacity of beef bulls is generally less than that of bulls of dairy breeds. The purpose of this review is to present some comparisons of measures of reproductive capacity in bulls of beef and dairy breed in the United States and to discuss the clinical evaluation of the bull's reproductive system.

Purpose of Examinations for Reproductive Soundness

Adequate examination of bulls for breeding soundness requires systematic evaluation of general health, detailed examination of the reproductive system, detection of reproductive disease and appraisal of libido. The areas of general health and an inclusive survey of genital diseases are beyond the scope of this discussion. This review will be concerned primarily with examination of the reproductive system.

The intended use of the bull must be considered in giving a prognosis from the results of an examination. Heavier demands are placed on a bull in an artificial insemination center as compared to a bull serving a few cows in a pasture. For successful use in artificial insemination, a bull must produce large volumes of high quality semen. American Breeders Service considers that the incidence of abnormal sperm cells should not exceed 9% primary abnormalities or 25% total abnormalities, and initial motility should be 60% with a minimum of 20% post-freeze survival.[31] For use in light natural service, where expectations of breeding capacity and the ability to evaluate fertility levels are reduced, bulls with deficiencies in seminal quality are frequently used and seem to perform adequately. Many of these observations, especially with pasture mating using multiple sires, are open to question. A system for evaluating seminal quality has been described and widely used in examining bulls for breeding soundness in the United States.[21] Bulls with a higher incidence of sperm cell abnormalities than that acceptable to American Breeders Service are classified as satisfactory prospective breeders, but the actual breeding efficiency of bulls classified by these standards has not been determined.

Comparison Of Bulls Of Beef and Dairy Breeds

Most of the research on reproductive function in bulls in the United States has utilized dairy bulls, and Holstein bulls in artificial insemination centers have been the predominant experimental animals. As more bulls of beef breeds have entered service in artificial insemination, an increasing number of workers have the opinion that there are important differences in reproductive capacity among beef and dairy bulls. Conclusive evidence from controlled experiments to support these views is not available, but there is an increasing number of convincing observations. The proportion of yearling beef bulls acceptable for use at American Breeders Service was significantly less than that of yearling dairy bulls (Table 1).[31] These findings are probably representative of bulls which are genetically capable, on the basis of today's selection criteria, of improving cattle production. It appears that we are dealing with different populations in beef and dairy bulls, and the factors involved are unquestionably numerous.

TABLE 1

SUITABILITY OF YEARLING BULLS FOR USE IN ARTIFICIAL INSEMINATION

	Holstein	Beef
Accepted	396	328
Rejected	32	105

There is far less than 1 chance in 100 that so many beef bulls would be rejected for use in artificial insemination as a result of fortuity ($P < 0.01$ by chi square analysis).

(Data furnished by Lester L. Larson, D.V.M., Ph.D.)

Elliott believes that performance testing of young beef bulls on a high feeding level is at least partially responsible for the fact that they produce semen of poorer quality than do young Holstein bulls.[23] According to observations from his laboratory, some beef bulls are capable of producing semen of sufficient quantity and quality for use in artificial insemination. However, most beef bulls do not produce semen as efficiently as dairy bulls, and there is more variation in the beef bull population.

Among 10,940 bulls examined for breeding soundness in Colorado, 9.5% were classified as unsatisfactory prospective breeders.[21] This compares with the 26.5% rejection rate for beef bulls examined for potential use in artificial insemination and reflects differing standards for breeding capacity.[31] Only 7.5% of the Holstein bulls examined by American Breeders Service veterinarians were unsuited for use in artificial insemination.

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There have been no data presented in recent years on the results of reproductive soundness examinations of dairy bulls intended for natural service.

There appears to be more variation in reproductive capacity among beef bulls than among dairy bulls. Particular attention should be focused on the most commonly reported abnormalities on the reproductive system in beef bulls.

Abnormalities of the Testicle

The frequency of testicular defects among bulls examined in Colorado was recorded (Table 2).[21]

TABLE 2

OCCURRENCE OF TESTICULAR DEFECTS FOUND IN 10,940 BULLS

Condition	Number Affected	Condition	Number Affected
Reduced size	814	Abnormal shape	104
Soft	806	Fibrosis	47
Hypoplastic	146	Cryptorchid	14

(Data from Carroll, E. J., et al., *J.A.V.M.A. 142:1105, 1963.)*

These diagnoses were the impressions of the examiner; no quantitative methods were used.

Small size was the most frequent observation and indicates the need for more precision in the clinical examination of the testicles. Several investigators have reported that testicular circumference is positively correlated with number of sperm collected by frequent ejaculation.[2, 3, 4, 5, 15, 27, 39] Testicular circumference can be measured easily with a flexible cloth or plastic tape around the greatest diameter of the testes and scrotum.[24] Other testicular measurements can be obtained, but circumference is preferred because it is highly correlated with other testicular measurements, is highly repeatable and is the simplest measurement to obtain. Testicular size is highly correlated to sperm output in young bulls and provides a valuable method for predicting sperm output and subsequent testicular development.[27] However, it appears to be of little value in bulls more than five to six years of age, where other testicular characteristics apparently mask the relationship of testicular size to total spermatogenic potential. Testicular fibrosis and neoplasms are common in older bulls.[33]

TABLE 3

SCROTAL CIRCUMFERENCE MEASUREMENTS AT DIFFERENT AGES OF HOLSTEIN BULLS IN AN ARTIFICIAL INSEMINATION CENTER

Age in Months	Number of Bulls	Scrotal Circumference (in centimeters) Mean	Standard Deviation
7-12	32	28.4	3.4
13-18	59	34.9	2.0
19-24	54	37.1	2.2
25-30	52	38.7	2.1
31-36	54	39.3	1.8
37-42	49	40.6	2.4
43-48	43	41.2	1.9
49-54	32	41.2	2.0
55-60	29	42.0	2.2
61-72	51	42.8	2.3
73-84	26	42.2	2.4
85-96	20	42.0	2.4
97-168	50	42.9	2.2

(Data from Hahn, J., Foote, R. H. and Seidel, G. E., J. Animal Science, 29:41, 1969.)

Scientists at Cornell University have measured a large number of Holstein bulls in different age groups, and these data should indicate standards for this breed (Table 3).[27] Similar data for the beef breeds, particularly in the younger age groups, would be useful to clinicians performing reproductive soundness examinations.

In the Colorado survey (Table 2), the diagnosis of hypoplasia was limited to bulls with unusually small testicles and unsatisfactory seminal quality. In a recent study the clinical diagnosis of hypoplasia was confirmed by histologic studies of testes from bulls in one herd included in the 1963 survey.[19] Testicular hypoplasia occurs more frequently in certain genetic lines of cattle, but no clear-cut pattern of heritability has been determined. On the basis of histologic evidence, at least some of the cases differ from the gonadal hypoplasia described in the Swedish Highland breed.[30]

Soft consistency of the testis as determined by manual palpation is often related to poor seminal quality and low fertility.[1, 21, 28, 35] Because manual palpation techniques are too subjective to classify gradations in firmness, Hahn and coworkers developed a testicular tonometer for objective measurement of testicular consistency.[26] Their results indicate that the tonometer provides a simple, quantitative means of predicting seminal quality and potential fertility in dairy bulls. Investigations of improved tonometer instruments for evaluating breeding potential of young beef bulls are in progress and should prove useful.

Cryptorchism is the arrest of testicular descent. The affected testicle(s) may be abdominal, in the inguinal canal, or located ectopically in the subcutaneous tissue lateral to the prepuce. Fourteen cases of cryptorchism were reported in the Colorado survey,[21] and Blom and Christensen found seven affected bulls among 2,000 examined.[12] Proof of inheritance of this condition in the bull is lacking, but most authors assume by analogy with other species that it is likely to be hereditary. Four cases of unilateral cryptorchism in purebred Here-

ford bulls from one herd have been described.[38] A genetic basis for the incidence was indicated, but the evidence was not adequate to permit determination of the mode of inheritance. Some cases have been observed in a Colorado Experiment Station herd, where no indication for a genetic cause was found.

Epididymis

Epididymal abnormalities are less common or more difficult to diagnose than testicular defects; only 112 abnormalities were detected in the clinical evaluation of 10,940 bulls.[21] Epididymal lesions, even if small and localized, often have profound effects, since any occlusion of the epididymal duct totally restricts the movement of spermatozoa.

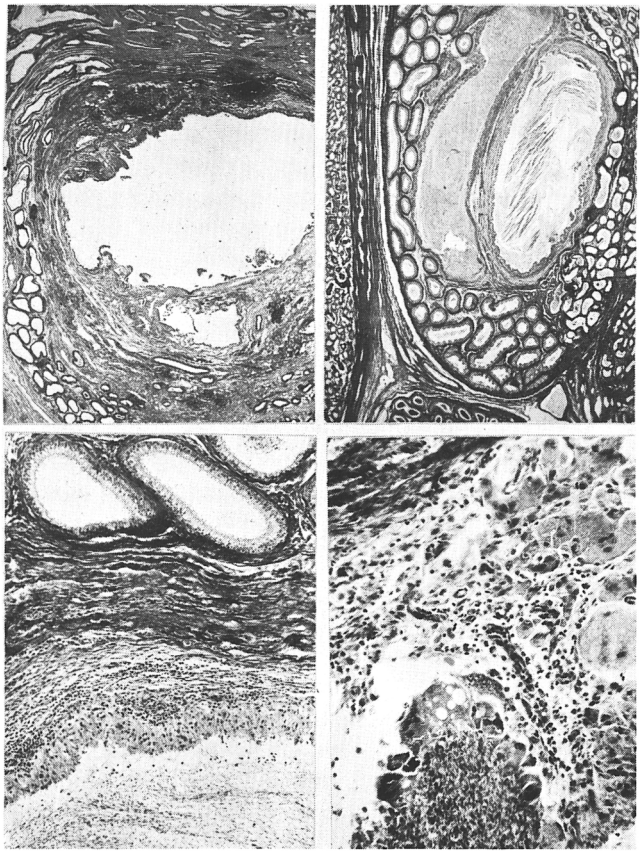

Figure 1. (upper left; 4.75X) Spermatic granuloma in the head of the epididymis. The contents of the cavity were lost in the processing of the tissue.

(upper right; 4.75X) Spermatic granuloma in the head of the epididymis. The lumen is filled with a dense aggregation of spermatozoa.

(lower left; 60X. lower right; 120X) Wall of epididymal spermatic granuloma consisting of a layer of dense connective tissue, a region of fibrocytes and mononuclear cells, and an innermost layer of epithelioid cells and phagocytic giant cells.

Segmental aplasia, usually of the cauda, of one or both epididymides was diagnosed in 20 bulls in the Colorado survey. The cases were too few and widely scattered to determine any genetic basis for the condition. Segmental aplasia of the Wolffian duct has been intensively studied in Denmark, and there is evidence for a genetic cause.[13]

The remainder of the epididymal defects was diagnosed as epididymitis, tumors or abscesses.[21] Most likely a substantial number of these was spermatic granulomas, at least this has been so in a few bulls that could be examined post mortem. Lesions of this type have been reported among bulls in Denmark, and some evidence supports a genetic predisposition to the condition.[14]

In a study of pathologic changes of the testicle among 123 yearling Hereford bulls, unilateral spermatic granuloma in the head of the epididymis was diagnosed in three unrelated bulls at necropsy (Figure 1).[18] The condition was not diagnosed at ante mortem clinical examination, and the quality of semen was within normal ranges, but the lesions totally obstructed the movement of spermatozoa on the affected side. Pathologic changes in the testes of the three bulls and their herd mates suggest that inflammatory changes, rather than genetically controlled developmental defects, were responsible for the granulomatous lesions. Focal areas of destruction of epithelial integrity in the efferent duct or epididymal tubule were observed and could provide a means for spermatozoa to enter the interstitial tissue and elicit granulomatous response. A high frequency of interstitial epididymitis has been observed in bulls from the same herd for several years, but no specific etiologic agent has been determined.[10]

Seminal Vesicle

Seminal vesiculitis has been a common finding in beef bulls in Colorado (Table 4). Clinical signs and gross pathologic changes vary in bulls affected with

TABLE 4

FINDINGS ON RECTAL EXAMINATION OF 7,359 BULLS

Condition	Number of Affected Bulls
Enlarged seminal vesicles	338
Seminal vesiculitis	181
Scrotal hernia	17
Enlarged inguinal rings	11

(From Carroll, E. J., Ball, L. and Scott, J. A., J. Am. Vet. Med. Ass., 142:1105, 1963.)

seminal vesiculitis.[9, 11, 25] Normal glands are relatively symmetical, but asymmetry occurs in normal glands and may be confused with unilateral

inflammation (Figure 2). Affected glands (Figures 3, 4, 5) may be enlarged, indurated, and lack

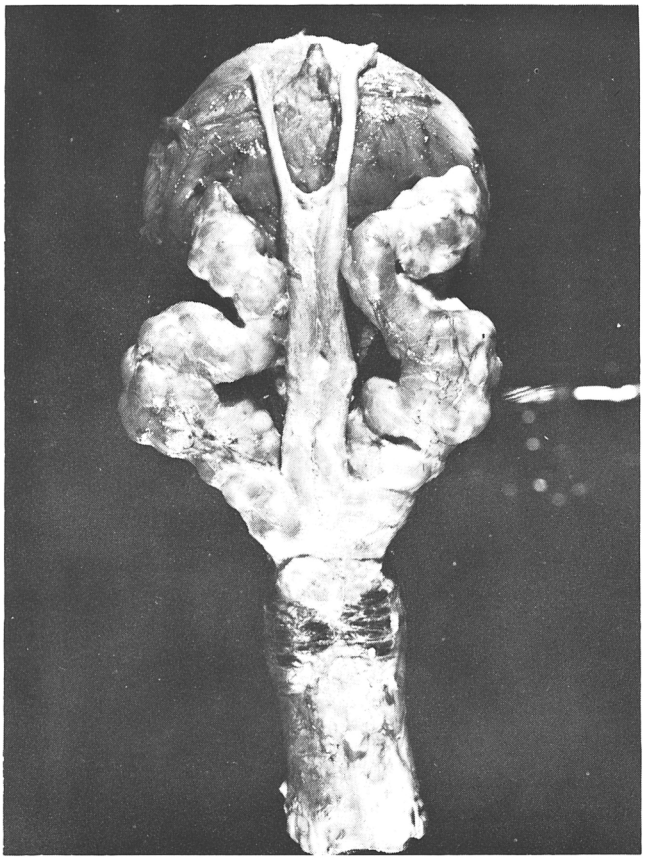

Figure 2. Normal pelvic genitalia of the bull. Lobulation of the seminal vesicle is distinct.

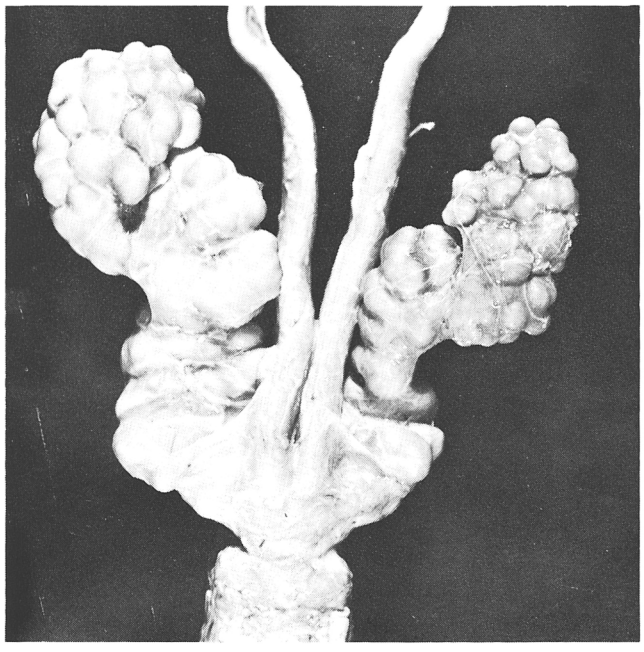

Figure 3. Bull with subacute seminal vesiculitis. Lobulations are still distinct, but the glands were very firm on rectal palpation.

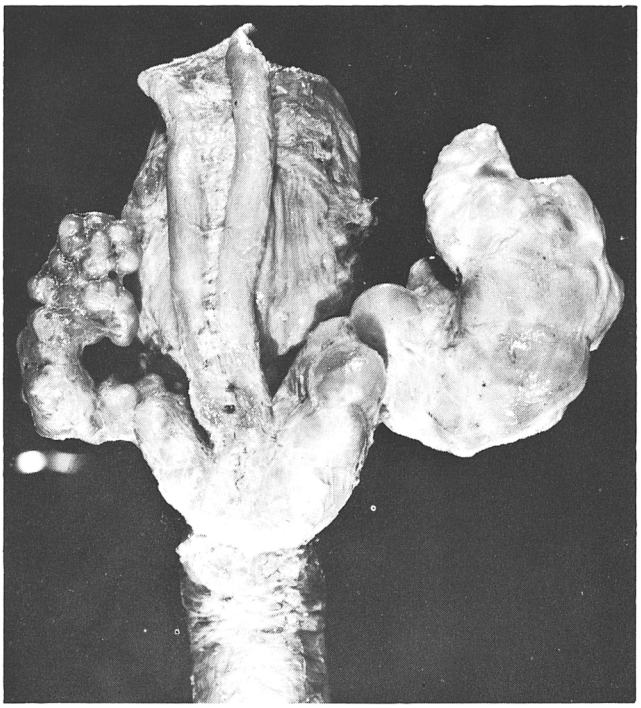

Figure 4. Pelvic genitalia from bull with chronic bilateral seminal vesiculitis. Lobulation in right seminal vesicle is indistinct and fibrosis is extensive.

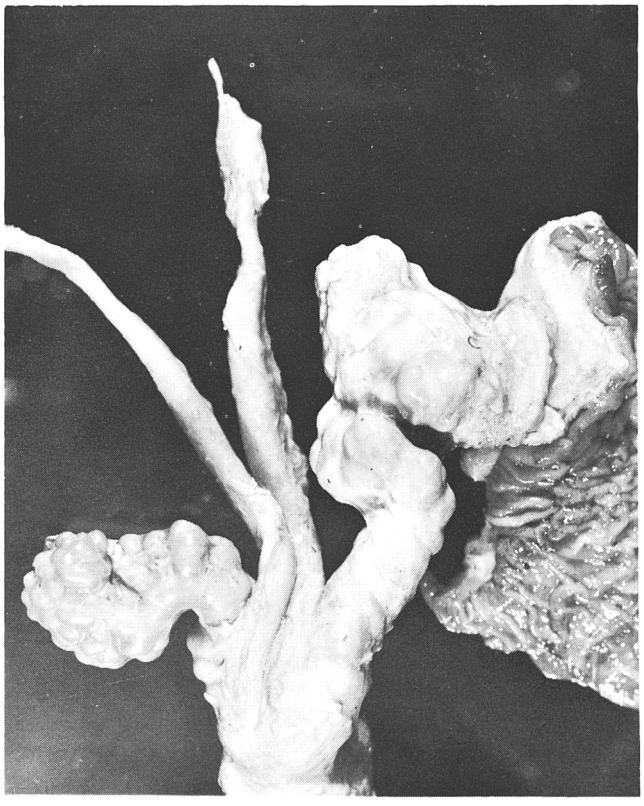

Figure 5. Chronic bilateral seminal vesiculitis with adhesions between the right seminal vesicle and rectum; a draining sinus tract extended from the vesicle into the lumen of the rectum.

well-defined lobulations. The extent of the involvement of affected glands can be quite variable. In some cases glandular size would be considered normal, but the glands are firm, and there may be leukocytes in ejaculated semen. By contrast, both glands may become abscessed, grossly enlarged, and affected with extensive visceral adhesions. Most bulls do not show signs of pain, except that stimulation with an electroejaculator elicits a pain response in many affected bulls. General clinical signs, such as arched back, fever, reduced appetite, depressed ruminal function and pain on defecation have not been observed in young beef bulls affected with seminal vesiculitis.[22] Routine rectal examination of seminal vesicles is essential in breeding soundness examinations, or seminal vesiculitis may be overlooked.

Young beef bulls were most often affected prior to use for breeding. There was a high rate of infection among bulls nine years and older, but there were relatively few cases, since this age group represented a small segment of the population (Table 5).[9] A significant difference in herd incidence has been recognized, and the incidence of affected bulls varied widely from year to year in the same herd (Table 6). These variations suggest that a specific infectious agent may have been responsible.

TABLE 5

AGE INCIDENCE OF BOVINE SEMINAL VESICULITIS

Age	Total Examined	Number Affected	Percent Affected
1	1,202	71	5.9
2	2,344	47	2.0
3	1,199	15	1.3
4	819	8	1.0
5	720	7	1.0
6	462	6	1.3
7	213	4	1.9
8	101	0	0
9	42	2	4.8
10 and over	76	5	6.6
Total	7,178	165	

(From Ball, L., Griner, L., and Carroll, E. J., Am. J. Vet. Res., 25:291, 1964.)

Many bacterial pathogens have been isolated from affected seminal vesicles, but specific causes have not been identified. *Corynebacterium pyogenes* is the organism most frequently reported to be associated with seminal vesiculitis,[11] but the disease has never been reproduced under experimental conditions by the inoculation of this or any other bacterial organism except *Brucella abortus*. In fact, excepting *Brucella abortus*, experimental reproduction of seminal vesiculitis has been achieved only with viral agents that have not yet been isolated in the United States.[16, 17, 32] A psittacoid agent (Chlamydia) was isolated from samples of semen or epididymal tissue from six to ten bulls in which the seminal vesiculitis syndrome was common.[37] The agent was related to a strain originally recovered from the kidney of a calf aborted by a cow with epizootic bovine abortion (EBA). The significance of the agents in bulls has not been determined.

TABLE 6

ANNUAL INCIDENCE OF CLINICALLY DIAGNOSED SEMINAL VESICULITIS IN 12 MONTH OLD BULLS FROM ONE HERD

Year	Number Examined	Affected Number	Affected Percent
1958	81	5	6.2
1959	103	8	7.8
1960	106	12	11.3
1961	102	14	13.7
1962	136	5	3.7
1963	143	11	7.7
1964	154	7	4.5
1965	153	5	3.3
Total	978	67	6.9

(From Carroll, E. J., Ball, L., and Young, S., J. Amer. Vet. Med. Ass., 152:1749, 1968.)

In handling cases of seminal vesiculitis, the problem for the attending veterinarian is one of making a prognosis. Certain bulls may recover spontaneously without involvement of other genital organs. Disappearance of the clinical signs of seminal vesiculitis has also been associated with systemic antibiotic therapy.[11, 29] Such responses must be evaluated rather critically in view of the number of spontaneous recoveries. Some bulls may remain chronically affected for an indefinite period; in other bulls the disease process may extend to (or be an extension of lesions in) other genitalia, notably the epididymis and periorchium.

Penis

Penile abnormalities are frequently encountered in examinations for breeding soundness. The most common defects encountered among beef bulls in Colorado were deviations, neoplasms and persistent frenulums (Table 7).[21]

Spiral deviation, or "corkscrew penis," has been cited as a cause for inability to serve. Surgical methods have been described to correct the condition, and some explanations for the occurrence of the deviation have been advanced. There is substantial evidence accumulating that it may be only a premature occurrence of a normal response. Normal bulls often show spiral deviation on with-

TABLE 7

DEFECTS OF PENIS FOUND IN 10,940 BULLS

Deviation	190
Neoplasms	73
Persistent fibrous raphe	57
Lacerations	26
Urethral fistula (hypospadia)	19
Balanitis	17
Ulceration	6

(From Carroll, E. J., Ball, L., and Scott, J. A., J. Am. Vet. Med. Ass., 142:1108, 1963.)

drawal,[6] and the deviation was seen frequently among bulls collected with a transparent artificial vagina.[36] Since the bull's penis does not dilate during erection, spiralling may significantly increase the vaginal stimulus in the female during intromission.[8] Anatomical studies support the natural existence of structures contributing to the corkscrew.[6, 7, 8] Spiral deviations of the penis occur frequently in bulls subjected to stimulation with an electroejaculator.[21] Diagnosis of spiral deviation of the penis should be restricted to those bulls which repeatedly fail to achieve intromission; under these circumstances, the incidence and successful surgical correction of this condition would probably be substantially reduced.

Penile fibropapillomas are common in beef bulls (Table 7). The habit of young bulls to mount penmates and to abrade the glans penis during the process is apparently highly conducive to invasion of the penile epithelium by wart virus. Housing in individual pens could be effective in preventing this disease. In most cases, surgical removal of penile fibropapillomas is easily accomplished. There may be a regrowth, but the chance of recurrence is decreased when surgical removal is delayed from 10 to 30 days after the initial observation of the lesion. Occasional cases are difficult to treat, and the bull may be lost from service in complicated cases. When the disease exists as a herd problem, there is an indication for prophylactic vaccination with formalin-treated bovine wart tissue vaccine.[34]

Persistent penile frenulum causes a marked deviation of the erect penis and prevents normal protrusion (Figure 6). The persistent frenulum extends from the ventral median raphe of the penis to the prepuce and varies from a small, cordlike attachment to a wide band of tissue extending the full length of the median raphe (Figure 7). A significantly higher incidence was found in Beef Shorthorn and Angus bulls in Colorado (Table 8).[20] Surgical correction is simple, and most bulls make a satisfactory recovery. The high incidence in certain herds suggests some genetic basis for the abnormality, and it may be an error to use affected bulls in purebred herds.

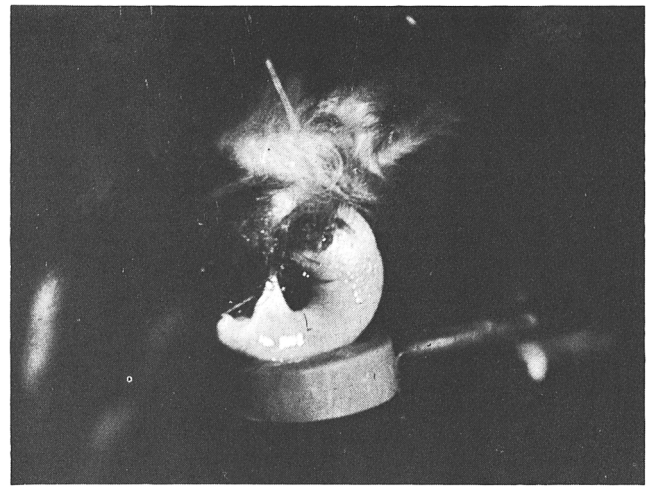

Figure 6. Deviation of penis caused by persistent penile frenulum in a bull being stimulated with an electroejaculator.

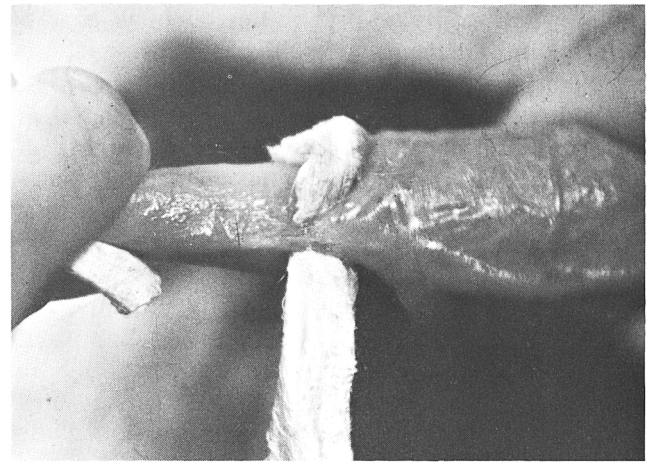

Figure 7. Penile and preputial attachment of frenulum shown in Figure 6. The piece of gauze is between the frenulum and the penis.

TABLE 8

BREED INCIDENCE OF PERSISTENT PENILE FRENULUM IN BULLS

Breed	Total Bulls Examined	Number Affected
Hereford	6,836	8
Aberdeen Angus	2,611	22
Polled Hereford	570	1
Beef Shorthorn	174	6
Santa Gertrudis	71	2
Other Breeds*	678	1

*Included Charolais, Charbray, Red Angus, Beefmaster and a few dairy bulls; the single affected bull was a Scottish Highlander.

(Data from Carroll, E. J., Ball, L., and Aanes, W. A., J. Amer. Vet. Med. Assn., 144:747, 1964.)

(Continued on page 74)

THE ROLE OF THE FEEDLOT VETERINARIAN

(Continued from page 54)

professional veterinary medicine and once their results become the goal of the industry, the demand for veterinarians will again rock the profession. With over half the industry's multimillion dollar loss from death and chronic poor health following treatment directly attributable to laryngo-pharyngeal trauma, peritonitis, abscesses and foreign body pneumonia produced by inexpert techniques or grossly careless sanitation, there may even be a realization of the need for at least close professional supervision at the treatment chutes. A very real danger lies in the inadequacy of the profession to meet this challenge again, without deliberate anticipation and action.

REPRODUCTIVE SOUNDNESS IN BEEF BULLS

(Continued from page 25)

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