

## Postoperative evaluation of the surgical treatment of accessory teat and gland cistern complexes in dairy cows

Kathleen A. Schmit, Mimi Arighi, Howard Dobson

### Abstract

The purpose of this study was the long-term evaluation of a method of surgically repairing the abnormal condition of accessory teat and gland cistern complexes in dairy cattle. A prospective evaluation of three cows that had undergone the procedure was done. These cows were evaluated from four months to one year, postoperatively. A thorough history, physical examination, contrast radiography, and ultrasonic examination were done on each cow. A retrospective evaluation of an additional 13 cows that had also undergone the procedure was obtained four months to three years following the surgery, via owner communication.

The prospective portion of this study demonstrated patency of the communication between main and accessory teat cisterns. Postoperative complications included initial slow milking and mild swelling of the involved teat. These problems resolved in all cows one to two months postoperatively. None of the 16 cows that had undergone the surgery either developed or was treated for mastitis. Likewise, none of these cows was sold or slaughtered as a result of postoperative teat problems or unsatisfactory milk production.

Our study demonstrated that this particular method of surgical correction of accessory teat and gland cistern complexes is effective, is esthetically acceptable, produces minimal associated complications, and preserves the milk production capacity of the gland.

### Résumé

**Évaluation postopératoire de la chirurgie pour correction de trayons surnuméraires et de la citerne de la glande mammaire chez la vache**  
 Cette étude a pour objet l'évaluation à long terme d'une technique chirurgicale pour la correction d'anomalies reliées au complexe du trayon sur-

numéraire-citerne de la glande mammaire chez la vache laitière. Trois animaux ont été évalués de façon prospective pour une période de quatre mois à un an postintervention. Les données recueillies incluent l'anamnèse, l'examen physique, l'évaluation radiologique avec milieu de contraste et l'échographie. Une étude rétrospective a aussi été effectuée à partir des dossiers de 13 vaches ayant subi l'intervention dans les trois dernières années. Pour ces animaux, le résultat de la chirurgie a été déterminé en communiquant avec les propriétaires.

L'étude prospective a démontré que la communication entre la citerne principale et celle du trayon accessoire était fonctionnelle. Les complications postchirurgicales ont été au début un ralentissement de la vitesse de traite et une enflure légère du trayon impliqué. Ces problèmes se sont résolus sur une période de un à deux mois. Aucune des 16 vaches traitées chirurgicalement a développé une mastite. De plus, aucune des vaches n'a été vendue ou envoyée à l'abattoir en raison de problèmes postopératoires reliés au trayon ou pour une production de lait non satisfaisante. La présente étude démontre que cette chirurgie corrective est à la fois efficace, esthétique, présente un taux minimal de complications et n'interfère pas avec la production de lait.

(Traduit par Dr Thérèse Lanthier)

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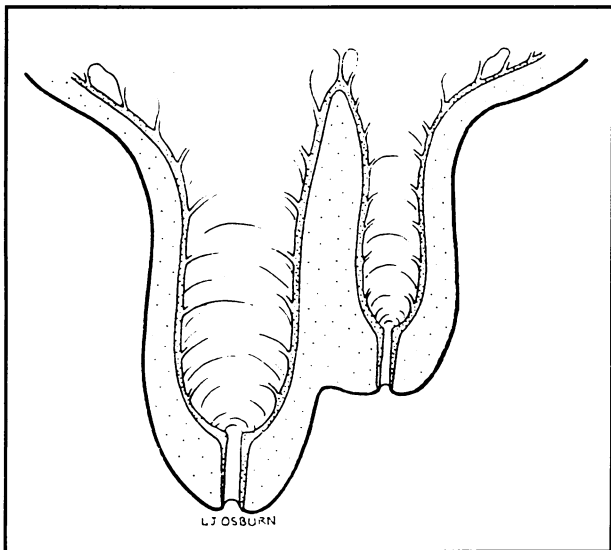
### Introduction

An accessory teat is an extra teat attached to the side of a main teat. When an accessory teat possesses a teat and gland cistern complex separate from the main teat complex, it is referred to as a webbed teat. A webbed teat is an uncommon congenital abnormality of dairy cattle. It may or may not have a separate teat sphincter (Figures 1-4). A webbed teat that does not possess a teat sphincter will constantly drip milk. A webbed teat needs to be differentiated from a teat fistula or a supernumerary teat since treatment of these entities differs. A teat fistula is an accessory opening on a teat that communicates with the main teat cistern and gland complex. A teat fistula can be congenital but is usually the result of traumatic injury to the teat. It does not

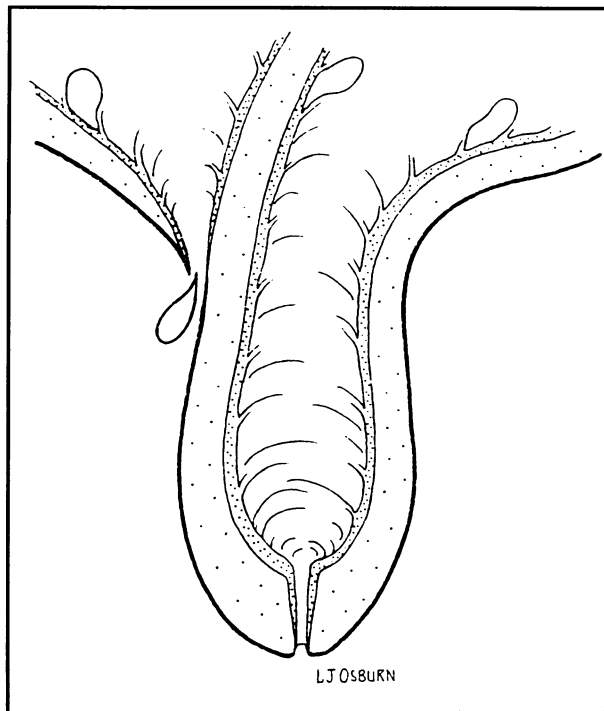
Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1.

Reprint requests to: Dr. Kathleen Schmit, Ilderton Equine Clinic, Box 774, Station B, London, Ontario N6A 4Y8.

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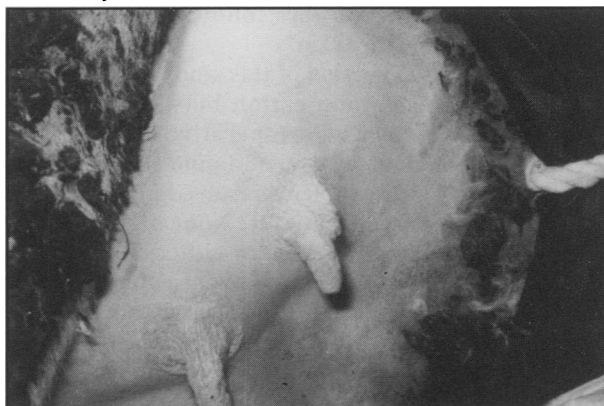
**Figure 1.** Schematic of a webbed teat in which adjacent glands share a common wall but their lumens do not communicate. Note that this type of accessory teat and gland cistern complex does possess a separate teat canal (streak canal) and sphincter. (Reproduced from Ducharme *et al*, Can Vet J 1987; 28: 757-762 with the permission of the Canadian Veterinary Medical Association.)



**Figure 3.** Schematic of an accessory teat and gland cistern complex that does not possess its own teat canal (streak canal) and sphincter. (Reproduced from Ducharme *et al*, Can Vet J 1987; 28: 757-762 with the permission of the Canadian Veterinary Medical Association.)



**Figure 2.** Right hind teat of a cow showing an accessory teat and gland cistern complex that possesses a teat canal (streak canal) and sphincter.



**Figure 4.** Left fore teat of a cow showing an accessory teat and gland cistern complex that does not possess its own teat canal (streak canal) and sphincter.

possess a separate teat canal or teat sphincter. A supernumerary teat is a congenital condition in which an extra teat may be present but is not attached to a main teat. A supernumerary teat will possess its own teat canal (streak canal) and sphincter but does not possess an associated gland cistern complex. In repairing a teat fistula, the borders of the fistula are excised to expose unscarred teat wall. The teat wall is then closed in three layers similar to the procedure for a thelotomy (1-7). Supernumerary teats are easily removed shortly after birth or at the time of vaccination. Small supernumerary teats can be removed with scissors. Larger ones may require use of an emasculator at the base of the teat for hemostasis before removal with a scalpel (1-7). The surgical repair of a teat fistula or supernumerary teat is quite simple whereas surgical correction of a webbed teat is more involved (1,2,8).

The purpose of the study reported herein was the long-term evaluation of the surgical repair of accessory-teat complexes in dairy cattle where a window is cre-

ated between the main and accessory teat cisterns with mucosal apposition of the adjacent teat cistern walls (8).

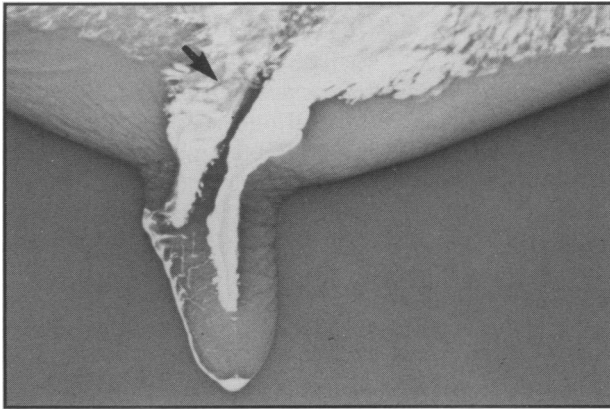
## Materials and methods

### Animals

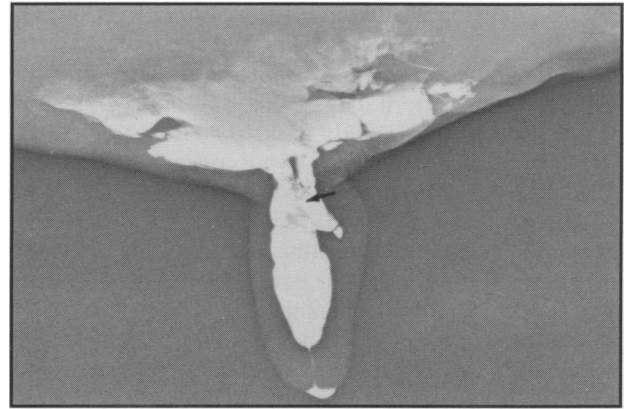
The 16 dairy cows chosen for this study were of milk production age and had been presented to the Ontario Veterinary College between June 1984 and April 1991 for evaluation and surgical correction of an accessory teat and gland cistern complex. Three, cows 1, 2 and 3, were operated on and followed prospectively, 13 had been operated on some time before and were evaluated retrospectively via owner communication.

### Cow One

Cow 1 was presented on September 25, 1990. She was a three-year-old Holstein that had just completed her first



**Figure 5.** Lateral to medial contrast xeroradiograph of the udder of a cow after injection of contrast material into both the main and accessory teat openings. Note the large portion of glandular tissue that is associated with the accessory teat (arrow) and separated from the main gland by a thin sheet of tissue.



**Figure 6.** Postoperative lateral to medial contrast xeroradiograph of the right fore teat of a cow after injection of contrast material into the normal teat canal demonstrating patency of the communication created surgically between main and accessory teat cisterns (arrow).

lactation. An opening was present on the lateral side of the left fore teat, and the cow had dribbled milk from the accessory opening during the entire lactation. It had been noted that some milk would come out of the normal teat canal but most of it came out of the accessory opening. There had been no history of trauma or mastitis. She had been treated with novobiocin (Albadry, The Upjohn Company, Orangeville, Ontario) three weeks prior to presentation.

On physical examination, the left fore teat was thickened at its base and the thickening extended approximately half way down the teat. A small opening from which milk could be expressed was present on the lateral aspect of the teat. Contrast xeroradiography revealed an accessory teat cistern and a large glandular complex associated with the accessory teat opening. There was no communication between the accessory teat and its gland cistern and the main teat cistern and gland complex. A thin sheet of tissue appeared to separate the accessory and main teat cisterns (Figure 5).

#### *Cow Two*

Cow 2 was presented on April 3, 1991. She was a mature Holstein in her second lactation. An opening on the caudal aspect of the right fore teat had been noted during her first lactation. There was no history of trauma or mastitis in any quarter. The cow was used primarily for show and was milking 47 kg per day at the time of presentation. On physical examination, a small opening was noted on the caudal aspect of the right fore teat, 2 cm proximal to the teat end. Milk could be expressed easily from the opening. A California mastitis test was negative. Contrast xeroradiography revealed an accessory teat cistern and gland complex separate from the main teat cistern and gland complex. Substantial glandular tissue was associated with the accessory teat complex.

#### *Cow Three*

Cow 3 was presented on April 24, 1991. She was a three-year-old Holstein and had calved two weeks previously. She had been milking well. However, an accessory teat on the cranial aspect of the right hind teat dribbled milk during milking of the main teat. There had

been no history of trauma. *Escherichia coli* had been cultured from the right hind teat at the time of calving, but the quarter had been treated, and the somatic cell count in the quarter was normal at presentation.

On physical examination, milk could be expressed easily from the opening of the accessory teat. A California mastitis test reading was trace to 1+ on the right hind and left fore quarters. Contrast xeroradiography on the right hind teat and accessory complex revealed that the accessory teat cistern and gland complex were separate from the main teat cistern and gland complex.

#### *Surgical procedure*

Surgery was performed under general anesthesia with the cow in dorsal recumbency. Cows routinely received broad-spectrum systemic antibiotics preoperatively: cow 1 received intravenous trimethoprim-potentiated sulphadoxine (Trivetin, Agropharm Inc., Ajax, Ontario) at a combined dose of 15 mg/kg body weight (BW) and intravenous sodium penicillin (Crystapen, Glaxo Canada Inc., Toronto, Ontario) at a dose of 20,000 IU/kg BW. Cow 2 received intramuscular procaine penicillin G (Ethacillin, rogar/STB Inc., London, Ontario) at a dose of 20,000 IU/kg BW and cow 3 received intravenous sodium penicillin (Crystapen, Glaxo Canada Inc.) at a dose of 20,000 IU/kg BW. Intramammary infusion of antibiotics was done the evening prior to surgery in 9 of the 16 cases. The other seven cows were not infused preoperatively due to individual surgeon preference.

The surgical procedure involved creating a window between the accessory and main teat cisterns to allow milk to flow from the accessory glandular tissue into the main teat cistern. An elliptical incision was made around the opening of the accessory teat and the tissue excised (3,4). A sterile teat cannula was then inserted into the opening and directed proximally. The incision was extended one to two centimeters into the accessory teat cistern along the teat cannula. A second teat cannula was then inserted into the normal teat canal. The wall between the accessory and main teat cisterns was then incised to create an opening (2–3 cm diameter) as far proximad as possible without entering the annular fold between the teat and gland cisterns. Hemorrhage was

controlled using electrocautery and vessel ligation. The mucosal layer of the accessory and main teat cisterns were then apposed with a simple continuous or interrupted suture pattern using 3-0 or 4-0 polydioxanone (PDS, Ethicon Inc., Peterborough, Ontario), polyglactan 910 (Vicryl, Ethicon Inc.), or polypropylene (Prolene, Ethicon Inc.). The mucosal layer of the remainder of the accessory teat and the normal teat cistern were then reapposed with a simple continuous pattern with 4-0 polydioxanone or polyglactan 910, and the fibrous layer was closed with a simple continuous pattern with 3-0 polydioxanone or polyglactan 910. The skin was then reapposed with 3-0 polypropylene in a simple interrupted pattern. A four-layer closure, as apposed to a three-layer closure, which involved apposition of the mucosa, muscularis, subcutaneous tissue, and skin, respectively, was performed in one case.

Cephapirin sodium (Cefa-lak, Ayerst Laboratories, Montreal, Quebec) or cloxacillin benzathine (Orbenin, Ayerst Laboratories) was administered into the teat cistern following closure. In all lactating cows, intramammary infusion of antibiotics was continued postoperatively for one to three days. All cows were machine milked within 12 hours of surgery. One cow received 500 mg of flunixin meglumine (Banamine, Schering Plough Animal Health, Schering Canada Inc., Pointe Claire, Quebec), IV, postoperatively. Systemic antibiotic therapy was generally continued for 24 hours postoperatively.

#### *Follow-up examination*

In the three cases that were looked at prospectively, a complete physical examination, contrast radiography, and ultrasonic examination of the affected teat were done at the time of follow-up (which ranged from four months to three years). A thorough postoperative history from the time of surgery until the time of followup was also obtained; this included questions regarding the occurrence and character of postoperative complications, ease of milking, milk production, and esthetic appearance of the teat.

The physical examination included palpation of the affected teat canal, teat cistern, and gland for any abnormalities related to the surgery. Survey and positive contrast radiography or xeroradiography (9) were compared with preoperative films. Cassettes were placed in the intermammary sulci and craniocaudal and lateromedial survey films were taken. Twenty to thirty milliliters of an iodine based contrast material (Hypaque-M 75%, Sodium and Meglumine Diatrizoates, Winthrop Laboratories, Aurora, Ontario) diluted with sterile water to an iodine concentration of 200 mg/mL was then injected aseptically into the main teat canal, whereupon the radiographic views were repeated. The ultrasonic examination of the teat was performed using a 10 MHz sector scanner (Ultramark 8, Advanced Technologies Laboratory, The Squibb Company, Montreal, Quebec).

Follow-up examination of the 13 cows evaluated retrospectively was conducted via telephone conversation with the owners. Questions included the occurrence and character of postoperative complications, ease of milking, milk production, esthetic appearance of the teat and the occurrence of webbed teats in offspring of the affected cow.

## Results

### *Cow One*

The surgery was done as described and a follow-up examination was performed one year later. The cow had milked well from the affected quarter during her second lactation. There had been no significant swelling or mastitis associated with the quarter, and the ease of milking and quantity of milk obtained from the affected quarter were the same as for the other three quarters. She had delivered a normal calf six months previously, was again pregnant, and was milking 48 kg per day at the time of the follow-up examination. On physical examination of the left fore teat, a slight lateral out-pouching of skin was evident at the site of the previous accessory teat opening. On palpation, the teat base was normal, but the teat cistern lumen was enlarged. Milk was easily expressed from the teat canal.

Contrast radiography and xeroradiography revealed the interthecal stoma to be patent. A small reduction in diameter of the teat canal at the teat base was evident. This was thought to be due to fibrosis. An ultrasonic examination showed that the stoma (approximately 1.5 cm in diameter) was patent, and a slight increase in echogenicity was noted at the teat base corresponding to the stricture noted radiographically.

### *Cow Two*

Contrast xeroradiography was repeated on this cow the day following surgery to assess patency of the opening in the immediate postoperative period. The opening between accessory and main teat cisterns could not be clearly identified, presumably due to postoperative inflammation and swelling.

A follow-up examination was done four months following the surgery. The history was that the cow had been slow to milk from the affected quarter for the first two months following the surgery. Initially, some degree of swelling and inflammation was noted. At the time of the follow-up examination, the ease of milking and the quantity of milk obtained from the affected quarter were equal to those of the other quarters. There had been no problems with mastitis and she was milking 42 kg per day. She was pregnant and had been classified as very good based on milk production and conformation.

On physical examination of the right fore teat, a slight out-pouching of skin was evident caudally at the site of the previous accessory teat opening. A slightly enlarged teat cistern and a small amount of fibrous tissue was palpable at the teat base. Milk was expressed easily from the teat canal. Contrast radiography and xeroradiography revealed the interthecal stoma to be patent (Figure 6). An ultrasonic examination confirmed the patency of the stoma. The diameter of the opening was approximately 1.0 cm.

### *Cow Three*

A follow-up examination was performed on this cow ten months following the surgery. The history was that the cow had been slow to milk from the affected quarter for the first two to three weeks following surgery. She had just calved at the time of the follow-up examination and was currently milking equally well from all four quarters. There had been no problems with mastitis.

On physical examination of the right hind teat, a slight out-pouching of skin was evident cranially at the site of the previous accessory teat opening. A slightly enlarged teat cistern was palpable. Milk was easily expressed from the teat canal. Contrast radiography demonstrated patency of the communication created surgically.

Postoperative complications reported by the owners of the 13 cows in the retrospective study included slow milking (5/16) and mild swelling of the involved teat (3/16). These problems had resolved in all cases within two to three weeks. None of the 16 cows that had undergone surgery had developed mastitis subsequent to the procedure or had been sold or slaughtered as a result of teat problems or unsatisfactory milk production.

## Discussion

We were able to demonstrate that the communication between accessory and main teat cisterns remained patent in the three dairy cows with webbed teats that were surgically corrected and examined four months to one year postoperatively.

There are several indications for surgical repair of a webbed teat. First, the normal teat canal is the primary defense barrier against udder pathogens (10–12). Mechanical barriers such as the teat canal, teat sphincter, and Furstenburg's rosette may not be present in the accessory teat and gland complexes (11). In addition, keratin production from epithelial cells lining a normal teat canal reduces bacterial penetration into the gland. Keratin production may be diminished or absent in an accessory complex (13). Intermittent drainage from the accessory complex after machine milking increases the risk of bacterial colonization in the glandular tissue of the accessory teat, which in some cases may comprise 50% or more of the total glandular tissue of the quarter (3,11,13). Quarters with leaky teat canals have high infection rates (11). For these reasons, failure to correct a webbed teat may predispose the affected quarters to mastitis. In addition, the location of the accessory teat in some cases prevents machine milking. Esthetic considerations may also warrant removal of an accessory teat. Webbed teat is a congenital abnormality, but it has not been shown to be hereditary.

Methods used in the past for surgical correction of webbed teats have usually involved removing the accessory teat and closing off the accessory opening without creating a communication between accessory and main teat cisterns. In these cases, however, milk from the accessory gland cannot be collected to add to the total milk production of the cow. Gland complexes associated with accessory teats are sometimes quite extensive, as can be seen from Figure 5, and connecting the accessory and main teat cisterns enables milk from the accessory gland system to be collected via the main teat cistern, whereas the accessory gland system simply atrophies when the opening of the accessory teat is closed off. Preserving the total milking capacity of the gland in high producing dairy cows can be an important economic consideration.

Disadvantages of the procedure include expense and postoperative complications. The postoperative complications encountered in the three cows that we evaluated directly consisted of mild swelling and slow milk-

ing initially. This resolved in all cases one to two months postoperatively. Previously reported postoperative complications associated with the procedure include the development of mastitis in the immediate postoperative period, slow milking, blood clots occluding outflow of milk, and occlusion of the communication created surgically with inflammatory tissue (5,8).

Though a cow with a webbed teat would seem to be at a higher risk of developing mastitis, a much larger number of cows need to be evaluated, in a controlled study, in order to make any statements regarding the effectiveness of this procedure in reducing the risk of mastitis. In the survey of our cases, one of the 16 cows had experienced mastitis prior to surgery. There were, however, no reports of mastitis postoperatively. The fact that a problem such as a webbed teat is usually first noticed at the beginning of a cow's first lactation, when either it is corrected or the cow is culled, makes evaluation of the risk of mastitis difficult.

Many of these cows had an accessory teat in a location that prevented effective machine milking. If machine milking could be performed, the accessory opening would drip milk constantly during milking. In some cases owners reported that they felt that more milk was coming out of the accessory teat than the main teat during milking. If the accessory teat was the type with no teat sphincter, it would also drip milk at other times. This procedure obviously greatly improved the ease of milking; however, a procedure involving closing off the accessory teat opening without creating a window between the accessory and main teat cisterns would have had the same effect.

Since several of the cows that had this procedure performed were potential show cows, esthetic appearance of the teat was an important consideration. The esthetic result in all cases was satisfactory and several cows were classified very good to excellent by show standards following the surgical procedure. Again, a procedure involving removal of the accessory teat without creating a window between the accessory and main teat cisterns would have had the same effect with regard to the appearance of the teat cistern, but the gland itself may be smaller than the other three glands due to atrophy of accessory glandular tissue.

In all cows, owners reported good milk production postoperatively. We had no means, however, of objectively quantifying milk production and determining if the cows were producing more milk from the quarter than they would have done if no communication had been created between main and accessory teat cisterns. All owners reported the affected quarter to be equal in milk production to the other three quarters; but, again, this was not measured objectively. In the three cows that we followed-up directly, we were able to document that the communication created surgically between main and accessory teat and gland complexes did remain patent. Although we were unable to directly quantify this, intuitively we would expect greater milk production in these cows, since the milk from the accessory glandular tissue could be collected.

Since this procedure involves delicate surgery and requires considerable surgical time, general anesthesia is preferable. This increases the expense of the procedure, which can be an important consideration in

dealing with food producing animals. In high producing dairy cattle or cattle of superior genetic potential, however, this procedure may be economically justified.

Since the heritability of webbed teats is a concern with regard to the ethical consideration of surgical repair, we also surveyed owners on incidence of the condition in female offspring of affected animals. From the 16 affected cows, 24 heifers (of which the owners had direct knowledge) had been produced and had reached milking age at the time of the investigation, and none was affected. A large scale project would be necessary, however, to properly determine the heritability of this condition.

In conclusion, the surgical correction of a webbed teat by creating a communication between accessory and main teat cisterns was effective and had few associated complications in our study. In addition to potentially reducing the risk of mastitis in the affected gland and improving the ease of milking and esthetic appearance of the teat, the surgical procedure described herein offered a means of preserving the total milking capacity of the gland, which could be economically justifiable in high producing dairy cattle. CVJ

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