

# Invasive Teat Surgery in Dairy Cattle

## II. Long-term Follow-up and Complications

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### Abstract

A prospective study was performed on 52 teats that were operated upon at the Ontario Veterinary College over a three year period for various problems. Long-term postsurgical follow-ups were obtained to assess milking ability. Sixty-three percent of all the cows that had surgery were classified by the Canadian Holstein Association as "good" or better. The implantation of a prosthesis was required in 32 teats and was found to be associated with: a higher prevalence of chronic mastitis, a lower long-term milking success rate, and an increased prevalence of abnormal milking times. Of the five types of teat lesions encountered, Type I (<30% of teat cistern involved) and Type V (lacerations, webbed teats, fistulae) had the best short and long-term prognosis for lactation. Overall, 60% of the operated teats were milking one month after surgery, and 41% at the end of the lactation.

*Can Vet J 1987; 28: 763-767*

### Introduction

Many authors have reported successful results following teat surgery (1-10). Success is generally defined as milk production at the time of the animal's discharge from the

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### Résumé

#### Chirurgie profonde du trayon, chez la vache laitière II. Suivi prolongé et complications

Les auteurs ont réalisé une étude prospective relative à 52 trayons qui avaient subi une intervention chirurgicale pour divers problèmes, au Collège Vétérinaire de l'Ontario, sur une période de trois ans. Ils effectuèrent un suivi post-opératoire prolongé de leurs patientes, afin d'en évaluer l'habilité à donner du lait. L'association Holstein canadienne classifia comme "bonnes" ou "bonnes plus" 63% de celles qui avaient subi une intervention chirurgicale. L'implantation d'une prothèse s'avéra nécessaire dans 32 trayons et elle s'accompagna des complications suivantes: une prévalence plus élevée de mammite chronique, un taux plus faible de production lactée durable et une prévalence accrue d'un temps de traite anormal. Parmi les cinq types de lésions qui affectaient les trayons, le type I, où moins de 30% des citernes des trayons se trouvaient impliquées, et le type V, qui impliquait des fistules, des lacérations et des trayons membraneux, affichèrent le meilleur pronostic, à court ou à long terme, pour la lactation. En tout, 60% des trayons opérés étaient fonctionnels, un mois après la chirurgie, et 41%, à la fin de la lactation.

hospital, and there is little mention of the duration of the follow-up period (1-10).

Generally, it is felt that most lacerations into the teat cistern, and fistu-

lae that are closed by first intention healing, will return to normal milking, but intraluminal teat obstructions have had a much worse prognosis (2). Recently, Donawick has modified the surgical technique and improved the success rate in the management of teat obstruction (3). Other authors have also subsequently reported successful treatments apparently for intraluminal obstruction, success again being defined as milking at the time of discharge from the hospital (4, 5, 7). However, meaningful assessments of surgical results are more accurately made in long-term follow-ups of milk production or level of classification obtained.

Herein we describe the long-term complications following thelatomies, and also describe the success rate in keeping an obstructed teat at full milking capacity, both one month post-operatively, and after one lactation.

### Materials and Methods

Sixty cattle were presented to the Large Animal Clinic of the Ontario Veterinary College (OVC) between September 1983 and June 1986 with mammary gland or teat abnormalities. Fifty-one cows (52 teats) were surgically treated.

The surgical procedure has been described previously; teat lesions were classified into five types (11). These types were: Type I — focal teat cistern lesions that involved less than 30% of the mucosal surface of the teat cistern (13/52); Type II — diffuse teat cistern lesions that involved greater than 30% of the mucosal surface of the teat cistern (4/52); Type III — membranous or fibrous structures separating the gland cistern from the teat cistern, or the lactiferous ducts from the gland cistern (13/52); Type

IV — lesions that involved both the gland and teat cisterns (10/52); and Type V — teat lesions leading to loss of milk through abnormal routes such as fistulae, webbed teats, or lacerations (12/52).

A standard follow-up protocol sheet was used for each cow. Information recorded included: time of lactation, milking time in relation to other quarters, whether mastitis was present or not, and, if present, how frequently. The cosmetic appearance of the surgical incision and teat were also determined. Owners were called for information concerning their cows both one month after surgery and again after the end of the corresponding lactation period, which generally was 10-11 months after surgery. In June 1986, all owners were called to assess the present status of the cows. Success was defined in three ways: 1) milk had to be present in the affected quarter one month after surgery; 2) milk production in the affected quarter had to cease at the end of lactation at the same time as the other quarters; and 3) the cow had to have the capacity to be milked by machine out of all four quarters at the time of classification. Classification in this case is defined by the Canadian Holstein Association and is based on a numerical score that is derived from body capacity, dairiness, general appearance, and the mammary system.

Several variables were assessed to identify statistically significant associations with surgical success as previously described. These variables were: surgical experience, presence or absence of an intraluminal prosthesis, classification of lesions, and the number of surgical procedures on one teat. The outcome of surgery in the first 26 cows was compared to the second 25 cows, to determine if surgical expertise improved, and thus concurrently improved the success rate. We also assessed effect of the implantation of the prosthesis on milking time, cosmetic appearance, and occurrence of postoperative mastitis as reported by the owners during telephone communication. Chi-square, one-tailed Fisher's exact test, and normal deviate Z for proportional data were used to assess statistical significance as indicated by  $p < 0.05$ .

## Results

### A. Surgical Success/Failure

Of the 52 teats operated upon, 32

eventually had an intraluminal prosthesis placed. Twenty-seven were implanted at the initial surgery, one within two weeks, three between one and four months, and one at one year after the initial surgery. A single surgical procedure was performed in 41 of 52 (79%) teats, and two or more surgical procedures were required in the 11 (21%) others. Four of these 11 teats (36%) were milking until the end of the lactation. This compares with 17 of 40 (43%) teats where only one surgical procedure was performed. Overall, 60% of the teats were being successfully milked one month after surgery, while 41% could be milked until the end of the lactation. There was no statistical difference between these two percentages ( $p > 0.05$ ).

For 48 of 51 cows, follow-up information on classification postoperatively was received. Seventeen percent (8/48) classified good, 29% (14/48) classified good +, and 17% (8/48) classified very good. Only 4% (2/48) classified fair, and 33% (16/48) did not classify at all (Figure 1). The two cows that classified fair were no longer milking out of the affected teat which is why they did not classify higher when evaluated. None of the cows that classified good or better (8/30) dropped from their preoperative classification. Fourteen of 30 were unclassified before surgery but classified good or better after surgery.

Thirty-one percent (13/42) of the cows in their second lactation were

still milking out of the affected teat during their second lactation. Ten other cows, at the last follow-up, were due to calve soon and had been milking well out of the affected teat when they were dried-off two months earlier. The overall success rate for the operated teats to continue to milk in the second lactation could range from 25 to 44% depending on how many of those ten cows milk normally after calving.

Seventy-two percent of the cows were classified following the first 26 surgeries, and 61% of the cows classified after the second 25 surgeries. The percentage of cows milking out of the affected teat one month after the first and the second set of surgeries was 69% and 52%, respectively. The percentage of cows that completed their lactation out of affected teats was 44% and 39%. Statistically, surgical experience did not appear to influence the percentage of cows classifying, the percentage of cows milking out one month after surgery, or the percentage of cows completing their lactation ( $p > 0.05$ ).

Seventy percent of the cows (14/20) without prostheses classified fair or better, whereas 65.5% (19/29) of the cows (in three cows classification information was not available) with a prosthesis classified fair or better. When looking at classification, the presence of a prosthesis did not significantly affect the outcome ( $p > 0.05$ ). Of the 32 teats with a prosthesis, 17

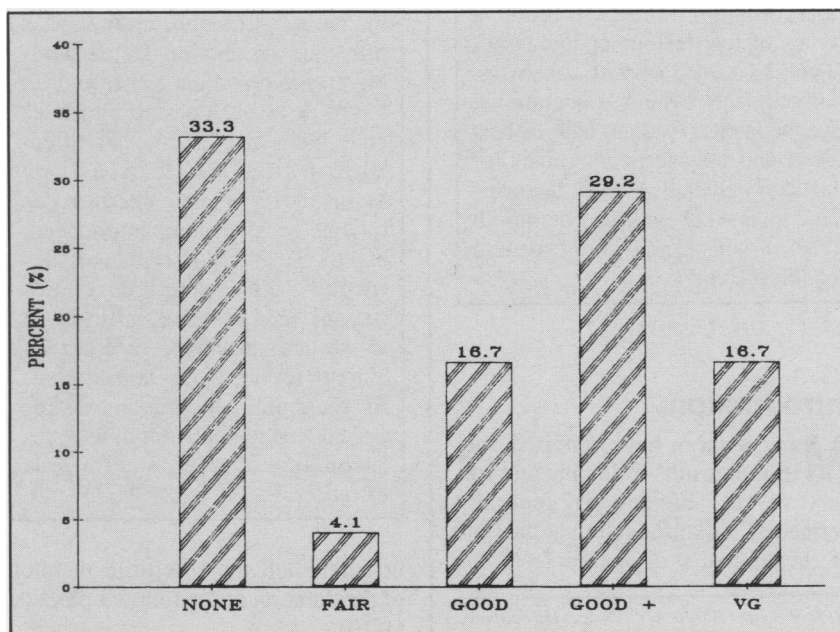


Figure 1. Outcome of teat surgery in terms of classification by the Canadian Holstein Association (vg = very good).

(53%) could be milked after one month while 14 of 20 (70%) of the cows without any prosthesis were milking. After one month of milking, again the presence or absence of a prosthesis did not affect the outcome ( $p > 0.05$ ). Nine (28%) of the 32 teats with a prosthesis completed the lactation while 12 (60%) of the 20 teats without a prosthesis completed lactation. At the end of one lactation, the presence of a prosthesis was associated with a decrease in success rate ( $p < 0.05$ ) (Figure 2).

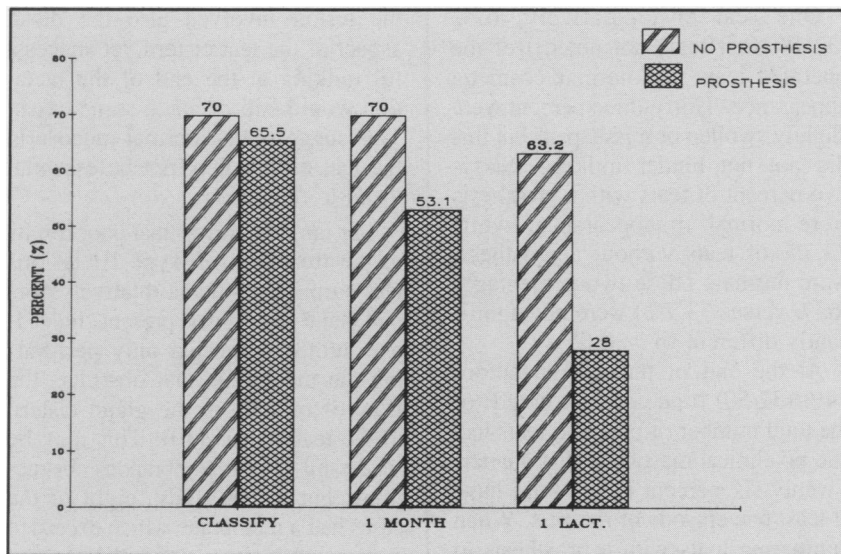
A higher proportion of cows with teat lesions of Type I were classified fair or better than were cows with other teat lesions. One month after surgery, Types I and V lesions had a significantly ( $p < 0.05$ ) better prognosis for success (77% and 83%, respectively) than Types III and IV (39% and 30%, respectively). At the end of the one lactation, Types I and V again had significantly better success rates (62% and 82%, respectively) than Types III and IV (8% and 10% respectively) ( $p < 0.05$ ) (Figure 3).

There were four complications of teat surgery (thelotomies). At least one episode of mastitis was seen postoperatively in 13 of 52 (25%) quarters. In addition, five cases (10%) had implant failures. Sixteen of 52 (30%) teats were not cosmetically acceptable and dehiscence was observed in three incisions (6%) (Figure 4).

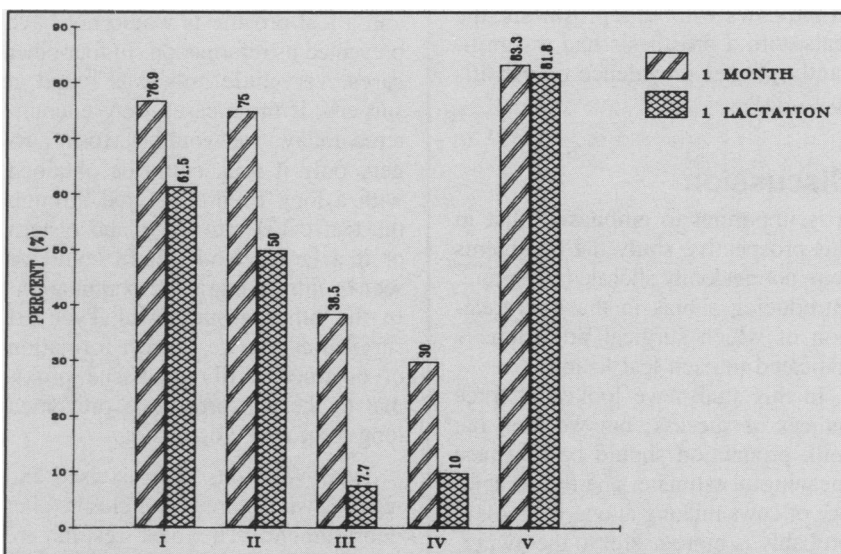
### B. Teat Prosthesis vs. Simple Reconstructive Surgery

Thirty-two teat prostheses were eventually placed in 32 cows in this study. Six (18%) technical problems were encountered with this procedure. The prosthesis broke and had to be replaced in two cases. In two other cases, a longer prosthesis had to be placed before milk outflow would occur. In one case, the prosthesis became loose three weeks after surgery and needed to be resutured in place; and lastly, the prosthesis came out through the teat incision in one case, when dehiscence of the incision occurred.

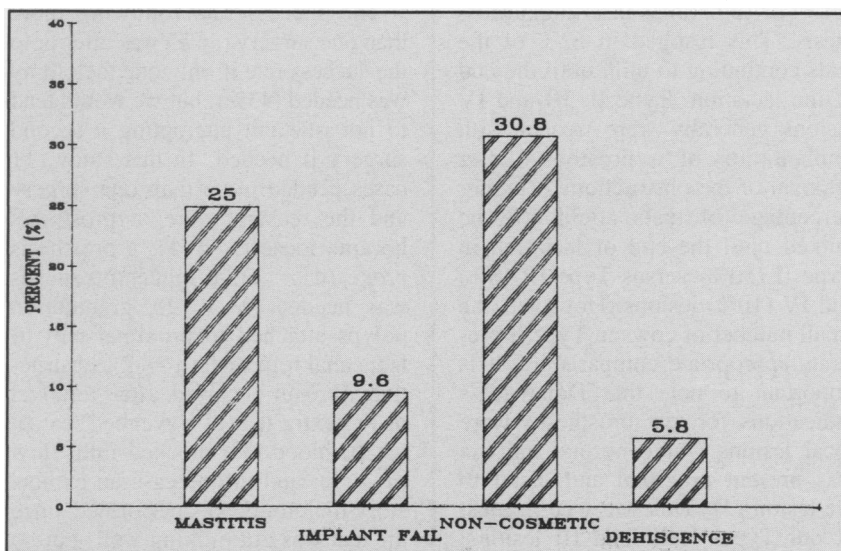
Of the 31 teats that were able to be milked one month postoperatively, the owners felt they could comment on milking time in 26 of these teats. Forty-six percent (12/26) milked normally, whereas 54% had a longer milking time with less milk received than from other quarters, or a shorter milking time, again, with less milk.



**Figure 2.** Association between presence of a teat prosthesis and surgical success defined as the percentage of cows that were classified, the percentage of teats able to be milked at one month, and those that could be milked until the end of the lactation.



**Figure 3.** Association between the teat lesion and the surgical success defined as the percentage of teats able to be milked at one month, or those that could be milked until the end of the lactation.



**Figure 4.** Rates of major complications of teat surgery.

One year postoperatively, 67% (32/48 [four teats not noted]) of the operated teats had normal cosmetic appearance. Thirty-three percent were slightly swollen or misshapen, but this did not hinder milking. Sixty-two percent of teats with a prosthesis were normal in appearance, while 73.7% of teats without a prosthesis were normal. These two percentages (62% versus 73.7%) were not significantly different ( $p > 0.05$ ).

At the end of the first lactation, 74% (37/50) (one cow not noted) of the total number of operated teats had had no clinical mastitis in that quarter. Twenty-six percent (13/50) did have at least one episode of mastitis. When comparing teats with a prosthesis to those without, 37.5% of the teats with a prosthesis had had one or more episodes of mastitis, compared to 5.6% of the cows without a prosthesis; the teats with a prosthesis had a significantly greater prevalence of mastitis ( $p < 0.05$ ).

## Discussion

It is important to emphasize that in this prospective study the treatments were not randomly allocated, therefore, introducing a bias in the interpretation of which surgical procedure is indicated in each teal lesion.

In this study, we looked at three indices of success, but we feel that milk production should be the most meaningful estimate, and the percentage of cows milking at one year (41%) probably is more useful to the owner.

Type I lesions were treated by excision of the granulation tissue, and then either sliding mucosa over the defect or sometimes inserting a prosthesis. This resulted in 62% of the teats continuing to milk until the end of the lactation. Type II, III and IV lesions generally were treated with implantation of a prosthesis after removal of the obstruction. A higher percentage of teats could still be milked until the end of lactation in Type II (50%) versus Type III (8%) and IV (10%) lesions. However, the small number of cows in Type II prevents appropriate comparisons. It is important to note that Donawick's indications for teat prostheses were focal lesions where normal mucosa was present proximal and distal to the lesion (3). This was true in most of our Types I, II, and III lesions. However, in some teats in Type I,

the lesion involved also the distal aspect of the teat cistern yet successful milking at the end of the lactation would still occur in some cases. This suggests that normal mucosa in the teat cistern may not be essential distal to the lesion.

Our impression was that poor results in the treatment of Type III lesions was surprising since a relatively normal gland cistern was present. Indeed, one author suggested only perforating the membrane that obstructs the flow of milk from the gland cistern to the teat cistern (10). This may be successful in thin membranous obstructions, but in our study, eight of the cases had a membrane which exceeded 5 mm in thickness and therefore a prosthesis was implanted. One case had a thin membrane separating the lactiferous duct from the gland cistern and a teat prosthesis would not have prevented its reformation. In four other cases, very little milk was found at surgery. If these cases were encountered today, we would perform surgery only if milk could be obtained with a long needle inserted through the teat canal into the gland cistern or if a large gland cistern could be seen by ultrasonographic examination. In the other unsuccessful Type III surgical cases, we suspect formation of obstructive fibrous tissue proximal to the teat prosthesis prevented long-term milk outflow.

Type V lesions were excised and repaired with a three-layer closure after debridement. The best results are observed in this group probably because they were anatomically and morphologically closest to normal.

The success rate following more than one surgery (36%) was inferior to the success rate if only one thelotomy was needed (43%), but we would tend to not rule out attempting a second surgery if needed. In this study, 11 cases needed more than one surgery and the reasons were: a prosthesis became loose ( $n = 1$ ), a prosthesis broke ( $n = 1$ ), a longer prosthesis was needed ( $n = 2$ ), granulation polyps attached to proximal part of teat canal reformed ( $n = 2$ ), obstructive fibrosis occurred after removal of the extra teat of a webbed teat ( $n = 3$ ), blood clot blocked milk flow ( $n = 1$ ), and in one case an exploratory thelotomy was performed since the teat was not milking well, but no abnormality was found leading us to

suspect a lack of normal glandular function.

Overall, there was a 60% success rate in keeping affected teats milking for a month after surgery; a 41% success rate after one lactation; and a 25-44% success rate at the start of the second lactation. The classifications suggested should help decide treatment and estimate the prognosis.

There was no difference in success rate between the first 26 surgeries and the second 25, thus improvement of surgical skill and shortening of surgical time did not seem to be important factors in determining the final outcome. Perhaps more difficult cases were attempted as the surgeons became more experienced or confident. This may have led to a biased lower success rate due to more severe lesions being operated upon.

Many authors have reported the importance of performing thelotomies for repair of fistulae during dry periods to minimize incisional complications (2). In all but one cow in this study, the surgical procedure was performed during the lactation and only three (5.7%) incisional dehiscences occurred (11). One was corrected surgically and the other two healed by second intention. This low rate of incisional dehiscence (5.7%) (although it needs to be compared to a dehiscence rate in the dry period), does not justify, in our opinion, delaying a surgical procedure until the lactation ceases.

Implantation of a prosthesis was not found to have a significant association with the cosmetic appearance of the teat. It was, however, associated with a significantly higher prevalence of postoperative chronic mastitis, a lower long-term milking success rate, and an increased prevalence of abnormal milking times. Whether these results were due to the presence of the foreign implant, or because the teat lesions were more severe (and therefore required implantation of a prosthesis) is open to conjecture.

Removal of the teat prosthesis was recommended by Donawick when he introduced this surgical technique (3). In our study we did not remove the prosthesis. The occurrence of mastitis was greater in our study when a teat prosthesis was placed compared to those cases without a prosthesis. Seven of 13 cows with mastitis were chronically affected, while the other six cows had only one or two epi-

sodes of mild clinical mastitis. We believe more information is needed to assess whether the lesion or the prosthesis is responsible for the occurrence of mastitis. Presently we do not believe that the cost, inconvenience, and surgical risks dictate the routine removal of implants. We would suggest removal of implants in cows with chronic or frequent episodes of mastitis.

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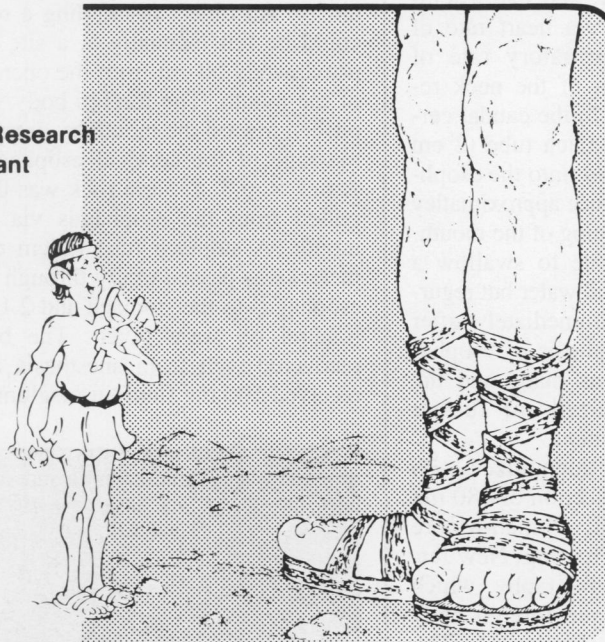
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