PEER REVIEWED

# Effects of Frequent Functional Foot Trimming on the Incidence of Lameness in Lactating Dairy Cattle

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***Dedication***

*This paper is dedicated to the memory of Steve Mason (1957-2007).*

**Abstract**

A 36-month field trial was conducted to determine the effect of frequent functional foot trimming on lameness. Six hundred and thirty-eight (638) lactating dairy cattle in a southwestern Pennsylvania commercial herd were subjected to functional foot trimming either once a year (control group - CG) or three times a year (foot treatment group - FTG). FTG cattle were trimmed as a group in May, September and January; CG cattle were trimmed at dry-off. All cattle were managed the same during the trial period. The overall reduction in all foot lameness by treatment was 27% when controlling for a previous history of lameness and lactation number, but results were not significant ($P$=0.15).

Cows in the FTG group were 52% less likely to develop a sole ulcer compared to CG cows ($P$=0.05). Overall, cows with a previous history of lameness were 6.4 times more likely to become lame and 3.1 times more likely to develop a sole ulcer. There was no difference in risk of being culled between FTG and CG cows. In addition, there was no difference in lameness for first-lactation heifers (prospective heifers) assigned to either the FTG or CG after the study began, suggesting that more research is needed to establish the benefit of a single functional foot trimming compared to an untreated control group in first-lactation heifers. Although results from this study and others suggest a reduction in lameness for cows trimmed more frequently than once a year, further studies with larger numbers of cows from multiple herds are needed to make definitive conclusions regarding the overall benefit of frequent functional foot trimming.

**Keywords**: bovine, frequent functional foot trimming, sole ulcer, lameness

**Résumé**

Un essai sur le terrain de 36 mois a été mené pour déterminer l'effet du parage fonctionnel fréquent des onglons sur la boiterie. Un total de 638 vaches laitières en lactation dans une ferme laitière commerciale du sud ouest de la Pennsylvanie ont reçu soit un parage fonctionnel des onglons une fois par année (groupe témoin) ou soit un parage fonctionnel des onglons trois fois par année (groupe traité). Le parage des onglons chez toutes les vaches traitées se faisait en mai, en septembre et en janvier alors que le parage prenait place au tarissement chez les vaches témoins. Toutes les vaches étaient régies de la même façon pendant la durée de l'essai. La réduction générale de tous les cas de boiterie par le traitement était de 27% tenant en ligne de compte les antécédents de boiterie et le numéro de lactation mais cette différence n'était pas significative (p = 0.15).

Les vaches avec parage plus fréquent avaient 52% moins de chances de développer un ulcère de la sole que les vaches témoins (p = 0.05). Les vaches avec un antécédent de boiterie avaient généralement 6.4 fois plus de chances de boiter et 3.1 fois plus de chances d'avoir un ulcère de la sole. Il n'y avait pas de différence entre les deux groupes au niveau du risque d'élimination. De plus, il n'y avait pas de différence au niveau de la boiterie chez les primipares (taures prospectives) allouées soit au groupe témoin ou soit au groupe avec parage plus fréquent après le début de l'étude. Ce résultat suggère qu'il faudrait plus de travaux pour déterminer si le parage fonctionnel unique, comparé à un groupe témoin non-traité, serait plus bénéfique chez les primipares. Bien que les résultats de cet essai et d'autres études suggèrent que la boiterie soit moins fréquente chez les vaches avec parage plus d'une fois par année, une con-

clusion plus ferme sur les bénéfices du parage fonctionnel fréquent des onglons devrait être établie avec des travaux incluant un plus grand nombre de vaches provenant de plusieurs troupeaux.

## Introduction

Dairy cattle lameness is a concern to the dairy industry because of its high prevalence,[9] negative economic impact[15,23] and effect on animal stress due to pain.[50] The pain caused by lameness in dairy cattle makes it a serious animal welfare issue. The overall incidence of dairy cattle lameness ranges from five to 70 cases per 100 cows per year.[2,9,13,21,22] The high variability in reported incidence is likely due to difficulty in defining a clinical case of lameness, misclassification of cases, different skills of personnel responsible for recording cases, different farm facilities and differing management styles.[2,18,22,37] Economically, dairy cattle lameness has a negative impact on dairy herd productivity by reducing milk production,[18,24,26,40,49] decreasing fertility[10,17,23,25,29] and increasing the risk of culling. Culled animals may have decreased salvage value.[6,10,16,43]

Lameness related to foot lesions can be categorized into infectious causes such as hairy heel wart (*digital dermatitis*), heel erosion (*interdigital dermatitis*) and foot rot (*interdigital phlegmon*), and non-infectious causes such as laminitis, sole ulcers and white line disease.[35] Laminitis usually results in various claw lesions such as sole hemorrhage, sole ulcer (*pododermatitis circumscripta*), double sole, white line disease (hemorrhage, fissure and abscess (*pododermatitis septica*)), and vertical/horizontal wall cracks or heel fissure.[7,8,20]

Regular foot care and claw trimming are necessary procedures used to prevent lameness in dairy cattle.[22,31] The preventative effects of foot trimming on clinical lameness are not clear. Many factors influence the occurrence of lameness, such as infectious disease agents,[4] excessive wear and trauma,[48] stall comfort,[11,30] confinement housing,[5] rumen acidosis[34,36] and over-trimming.[28,45] Numerous foot trimming techniques are used to perform routine foot maintenance on dairy cattle. Today, the most recognized method of foot trimming used in dairy cattle is functional foot trimming.[42] The objective of functional foot trimming in dairy cattle is to re-establish appropriate weight bearing without causing harm to the foot.[44]

The frequency of trimming dairy cattle varies,[32] and the benefits of trimming are the subject of frequent debate.[27,31,32] Risks associated with trimming include both injuring cattle from equipment needed to handle them and injuring the foot due to over-trimming. More research is needed to establish the efficacy of more frequent prophylactic trimming as a management tool to prevent lameness.

The objective of this study was to evaluate the effects of functional foot trimming three times per year compared to trimming only at dry-off.

## Materials and Methods

*Animals and management system*

A high-producing Holstein dairy herd serviced by the University of Pennsylvania Field Service Section was chosen for the study due to a high prevalence of lameness, being free of digital dermatitis, excellent management practices and the owner's willingness to participate. The owner/manager was extremely meticulous about record keeping and animal health management and had over 20 years' experience in identification and treatment of lame cows. The foot trimmer used in this study had received a certificate of successful completion of the Master Hoof Care Program. All cows were managed under equal conditions in multiple groups. Cows were housed in free stalls with sand bedding and sprinklers, as well as fans for heat stress abatement. Cows were milked and fed a total mixed ration twice daily. Rolling herd average at time of the study was 27,940 lb (12,700 kg). All pertinent data related to production was based on monthly Dairy Herd Improvement Association (DHIA) testing.

*Allocation to treatment group*

Six hundred and thirty-eight (638) dairy cows were studied from May 1999 to May 2002 and blocked by lactation number (primiparous versus multiparous). At the beginning of the study, all non-lame lactating cows in the herd were randomly allocated to a foot treatment group (FTG) or control group (CG) using a random numbers table. Cows were not scored for locomotion. History of lameness prior to onset of the study was obtained at the end of the trial from the cows' individual records and not considered prior to formation of the two study groups. New heifers calving for the first time after May 1999 (prospective heifers) were added to the FTG or CG every four months. A total of 348 prospective heifers was added during the three-year period.

All cattle in the FTG were first trimmed in May 1999 and were subsequently trimmed every four months until May 2002. All FTG cattle were trimmed in May, September and January, irrespective of stage of lactation or gestation. All CG group cows were trimmed approximately once a year at dry-off. Cows in both the FTG and CG were trimmed by the same hoof trimmer. For routine hoof trimming, cows were placed on a tilt table and trimmed by the functional hoof trimming method described by Toussaint-Raven.[44] Cattle with hoof disorders could have been diagnosed and treated during routine trimming.

All acutely lame cows in either FTG or CG identified outside of the routine trim dates were diagnosed, treated and recorded as lame by the herd owner. The herd owner was specifically trained by the investigators to correctly diagnose and manage lame study cows identified outside of the regularly scheduled trimmings.

*Statistical analysis*

Two survival regression models were developed to evaluate the relationship between treatment group and time to development of foot lameness. The first survival model evaluated the relationship between treatment group and any foot lameness, including white line abscess (*pododermatitis septica*), sole ulcer (*pododermatitis circumscripta*), foot rot (*interdigital phlegmon*), sole bruise (*sole hemorrhage*), heel erosion (*interdigital dermatitis*) and fibroma (*interdigital hyperplasia*) as a group. The second survival model evaluated the relationship between treatment group and development of a sole ulcer as the lameness outcome. Outcome of lameness was defined as number of days until the cow presented lame after assignment to the study. Outcome of the sole ulcer was defined as number of days until the cow first developed a sole ulcer and presented lame after assignment to the study. The comparison was performed using survival analysis, a regression technique applicable to event history studies that uses time as an outcome variable.[1] The advantage of using survival analysis is that data from cows that either become lame or remain sound can be analyzed simultaneously. In this study, cows that remained sound by the end of the study or were culled from the study before becoming lame were considered "censored." For these cows, the outcome time variable was calculated as the day from assignment to the study to the end of the study, or date culled. Cows that became lame were coded as having experienced the event of lameness, and their outcome time variable was defined as the number of days until the cow first became lame after assignment to the study.

A Chi-square ($\chi^2$) test was used to test the hypothesis that there was an equal distribution of previously lame cows in the FTG and CG, and also to test that there was an equal distribution of previously lame cows in the cows identified as lame in the FTG and CG.

In this study, the primary outcome variable of interest was the treatment group. Cows were classified as exposed to the FTG or CG. The analysis was adjusted for lactation number (primiparous versus multiparous) and previous lameness condition prior to the beginning of the study. A Cox proportional hazards regression model of the following form was used to model the data:

$$h_i(t)=h_o(t)\exp\{\text{treatment} + \text{lactation} + \text{prior lameness}\}.$$

The hazard function, $h_i(t)$, was the probability of observation $i$ of a cow becoming lame at $t$ days after assignment to the study. For the ulcer model, the hazard function, $h_i(t)$, was the probability of observation $i$ of a cow becoming lame and developing an ulcer at $t$ days after assignment to the study.

A hazard ratio was estimated for each independent variable in the model. The hazard ratios were obtained by exponentiating the coefficients ($\beta$) (raising $e$(2.718) to the $\beta$ power). The hazard ratio estimates the rate of lameness (number of lameness per time) for exposure to the FTG or CG. A hazard ratio of 1 indicates that the FTG and CG group cows had the same lameness rate.

Parameters for the model were estimated using a partial likelihood method. All second order interactions were evaluated and found to be non-significant. The likelihood ratio test was used for statistical significance. Statistical significance was $P<0.1$ (two sided).

A third survival regression model was developed to evaluate the relationship between treatment group and probability of culling. In this model the hazard function, $h_i(t)$, was the probability of observation $i$ of a cow being culled at $t$ days after assignment to the study. Cows that were not culled by the end of the study were considered "censored." For these cows the outcome time variable was calculated as the day from assignment to the study to the end of the study. Cows that were culled were coded as having experienced the cull event, and their time variable was calculated as the day from assignment to the study to the date culled.

A fourth survival regression model was developed to evaluate the relationship between treatment group and time to development of foot lameness in prospective heifers. The model evaluated the relationship between treatment group and any foot lameness, including white line abscess (*pododermatitis septica*), sole ulcer (*pododermatitis circumscripta*), foot rot (*interdigital phlegmon*), sole bruise (*sole hemorrhage*), heel erosion (*interdigital dermatitis*) and fibroma (*interdigital hyperplasia*).

## Results

There were 318 FTG cows and 320 CG cows used in the data analysis. Table 1 presents descriptive statistics of the frequency of lameness events by lameness condition over time for the treatment groups. Thirty-six (11%) FTG cows and 51 (16%) CG cows became lame during the study. Nine (3%) of the FTG cows and 19 (6%) of the CG cows developed sole ulcers, and 17 (5%) of the FTG cows and 19 (6%) of the CG cows developed white line abscesses over the study. Ten FTG cows and 13 CG cows developed a foot lesion other than a sole ulcer or white line abscess during the study. Digital dermatitis was not diagnosed in any of the study cows.

**Table 1.** Descriptive statistics of lameness counts by lameness condition over time for the functional foot trimming (FTG) treatment group and the group trimmed once each year at dry-off (CG).

| | FTG | | | | CG | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Lame | Sole Ulcer | White Line Abscess | Other[1] | Lame | Sole Ulcer | White Line Abscess | Other[1] |
| 1999-2000 | 17 | 4 | 7 | 6 | 20 | 6 | 8 | 6 |
| 2000-2001 | 15 | 4 | 8 | 3 | 20 | 9 | 6 | 5 |
| 2001-2002 | 4 | 1 | 2 | 1 | 11 | 4 | 5 | 2 |
| Total | 36 | 9 | 17 | 10 | 51 | 19 | 19 | 13 |

[1]Foot lameness other than ulcer, abscess or digital dermatitis

At the end of the study, 164 censored FTG cows were still in the herd, and 118 that had remained sound had been sold. In the CG group, 170 censored cows that had remained sound remained in the herd at the end of the study, and 99 censored CG cows that remained sound had been sold. FTG cows received an average of 4.6 foot trimmings per cow during the three-year study period, compared to 1.8 trimmings per cow for the CG cows.

Cows in the FTG group were 27% less likely to develop any foot lameness compared to CG cows ($P$=0.15; Table 2). Cows with a history of lameness before the study were 6.4 times ($P$<0.001) more likely to develop lameness than cows without a history of lameness. Twenty-two of 318 (7%) cows in the FTG and 24 of 320 (7.5%) cows in the control group were identified in the records as lame at some time prior to enrollment in the study, and there was no difference in distribution of previously lame cows in the FTG or CG at the beginning of the trial ($\chi^2$ test $P$=0.79). Ten of 36 FTG lame cows and 13 of 51 CG lame cows were identified with a previous lameness, and there was no difference in distribution of previously lame cows in the cows identified as lame in the FTG or CG during the study ($\chi^2$ test $P$=0.85). Three of nine FTG and four of 19 CG cows that developed ulcers were identified as lame prior to enrollment in the study, and there was no difference in distribution of previously lame cows identified with ulcers in the FTG or CG groups during the study ($\chi^2$ test $P$=0.59).

Cows in the FTG group were 52% less likely to develop a sole ulcer compared to CG cows ($P$=0.05; Table 2). Lactation number ($P$<0.003) and history of previous lameness ($P$<0.02) before the start of the study were highly significant variables in the final regression model. Cows with a history of foot lameness before the study were 3.1 times more likely to develop a sole ulcer than cows without a history of lameness.

There was no difference in probability of culling for any reason between the FTG and CG cows (Table 2).

Five of 173 (3%) prospective heifers in the FTG and six of 175 (3%) prospective heifers in the CG became lame during the trial. There was no difference in the probability of developing foot lameness in prospective heifers between the FTG and CG (Table 2).

## Discussion

This study was conducted to determine the efficacy of frequent foot trimming (functional foot trimming) three times a year at four-month intervals compared to trimming once a year at dry-off for reducing the incidence of foot lameness in Holstein dairy cows. Historically, the dairy herd used for this study had experienced a high lameness rate (greater than 35% incidence annually), but the incidence had been decreasing for a few years prior to the study coincident with a change to sand-bedded free stalls. Once the study began, there were no significant management changes made to address lameness in the herd.

Incidence of all foot lameness during the study was 16% in the CG cows compared to 11% in the FTG cows. After controlling for previous lameness history and lactation number, the overall reduction in all foot lameness due to frequent functional foot trimming was 27%, which was not statistically significant ($P$=0.15). Because overall incidence of lameness in this herd was low (13.6%) during the study, a larger sample size would have been necessary to show statistical significance at $P$=0.05. In this study, an additional 230 dairy cows in each group would have been required for the results to be significant at $P$=0.05, assuming the incidence of lameness had remained the same.

We are unaware of other published reports on the efficacy of frequent functional foot trimming three times a year to reduce the incidence of lameness in dairy herds. Because of differences in study design, results from this study are difficult to compare to other studies[27,32] that examined increased frequency of foot trimming. The 27% reduction in all foot lameness in this study is in general agreement with results found in two other studies that reported 25%[27] and 33%[32] decreases in the inci-

**Table 2.** Number (%) of cows and control variables for outcome variable groups among 638 Holstein cows allocated to a treatment FTG (n=318) or control CG (n=320) group.

| Outcome Variable | Control Group (CG) | Treatment Group (FTG) | *P* |
|---|---|---|---|
| Foot Lameness | | | |
| Lame Cows | | | 0.15 |
| Yes | 51 (16) | 36 (11) | |
| No | 269 (84) | 282 (89) | |
| Control Variables | | | |
| Lactation | | | 0.17 |
| Previously lame | | | <0.001 |
| Foot Ulcer | | | |
| Sole Ulcer Cows | | | 0.05 |
| Yes | 19 (6) | 9 (3) | |
| No | 301 (94) | 309 (97) | |
| Control Variables | | | |
| Lactation | | | 0.003 |
| Previously lame | | | 0.02 |
| Culled | | | |
| Culled Cows | | | 0.58 |
| Yes | 99 (31) | 118 (37) | |
| No | 221 (69) | 200 (63) | |
| Control Variables | | | |
| Lactation | | | 0.37 |
| Previously lame | | | <0.001 |
| Prospective Heifers | 175 total | 173 total | |
| Lame Cows | | | 0.93 |
| Yes | 6 (3) | 5 (3) | |
| No | 169 (96) | 168 (97) | |

dence of all foot lameness by trimming dairy cattle twice a year. The Swedish study[32] reported a statistically significant 33% decrease in incidence of all foot lesions by increasing the frequency of foot trimmings from every 12 months to six months. However, there were 4,295 cows from multiple herds in the Swedish study,[32] resulting in greater statistical power than the current study, which included 638 total cows from one herd. In the Florida study,[27] additional trimming during mid-lactation decreased the incidence of lameness by 25% ($P$=0.09). As in the current study, the Florida study[27] lacked sufficient statistical power to show statistical significance at $P$=0.05, as there were only 333 cows in the study. Although results from these studies suggest a benefit in reduction of lameness for cows trimmed more frequently than once a year, further studies with large numbers of cows from multiple herds are still needed to make definitive conclusions regarding the overall benefit from frequent functional foot trimming.

Average cost of maintenance foot trims on dairy cows varies. However, the estimated cost for each lameness case is $400 based on lower milk yield ($200) and longer calving-to-conception interval ($200).[27] Using $400 as the cost of lameness, Florida researchers reported an economic benefit of $7,000 for a herd of 500 cows when cows were trimmed twice a year, compared to annual trimming, assuming $10/cow as the cost for foot trimming. In the current study, the reduction in lameness would save a dairyman with 500 cows $10,000 (assuming $400/lameness and a reduction of lameness from 16% to 11%) per year, but would cost $10,000 (at $10/cow) for two additional prophylactic foot trimmings per year. If the same results were obtained by twice-a-year prophylactic trimming, the economic benefit would be $5,000. Although the economic benefit appears small, fewer cows would suffer pain associated with lameness, enhancing animal welfare.

Noteworthy in this study was that more frequent functional foot trimming protected against development of sole ulcers when compared to functional foot trimming once a year. After controlling for lactation number and previous lameness, FTG cows were 52% ($P$=0.05) less likely to develop a sole ulcer than CG cows (Table 2). Nine (25%) of 36 FTG lame cows had a sole ulcer, compared to 19 (37%) of 51 CG lame cows. Cows with a previous history of lameness were 3.1 times more likely to develop an ulcer, and older-lactation cows were more at risk for sole ulcers than first-lactation heifers. Presence of a sole ulcer in one lactation has been reported to increase the risk of a sole ulcer developing in a subse-

quent lactation.[14] Sole ulcers cause severe pain and discomfort to dairy cattle, resulting in both animal welfare and production-related economic issues.[27] Although low numbers of cattle diagnosed with sole ulcers in this study preclude justifying prophylactic foot trimming three times a year on an economic basis in this herd, a 52% reduction in sole ulcers could be economically significant in dairy herds with a high incidence of sole ulcers. Reducing lameness caused by sole ulcers would improve animal welfare.

Sole ulcers result from prolonged damage to the corium. Cattle with long toes due to sole and hoof wall overgrowth have abnormal weight-bearing within the foot.[44,46] The weight-bearing axis is shifted toward the heel, exerting more pressure on the corium, leading to hemorrhage.[44,46] If left untreated, the corium will continue to be damaged, leading to failure of horn production and development of a full-thickness horn defect known as a sole ulcer.[19] The functional foot trimming method restores appropriate weight-bearing within each claw, corrects hoof overgrowth, balances weight-bearing between the claws of each foot and allows for identification and correction of claw lesions.[42] Frequent readjustment of the weight-bearing axis of the foot of dairy cattle may help reduce the degree of damage to the corium. In this study, there was a significant difference in the reduction of sole ulcers in the FTG versus the CG. In addition, the number of cows diagnosed with a white line abscess (*pododermatitis septica*) was similar in the FTG and CG at the end of the trial. Even though there was a total reduction in incidence of white line abscesses in both FTG and CG from the beginning to the end of the trial, there was no significant difference in the incidence of white line abscesses between the two groups. It is possible that frequent functional foot trimming influences the type of foot lameness seen in dairy cows, and that certain foot lesions respond better to this method of foot trimming.

A history of previous lameness was a significant variable for the incidence of all foot lameness and sole ulcers. These findings are consistent with other reports indicating that mature cows that developed claw disorders are more prone to future occurrences of these claw problems,[14,38,39] and that cattle diagnosed with sole ulcers are generally prone to poor recovery from that lesion and an increase in subsequent development of sole ulcers.[14] In this study, dairy cattle with a previous history of foot lameness were 6.4 times more likely to develop foot lameness and 3.1 times more likely to develop a sole ulcer, and frequent functional foot trimming compared to trimming at dry-off did not significantly prevent future foot lameness or sole ulcers in dairy cattle with a previous history of lameness.

The design of this study allowed for analysis of a subset of first-lactation heifers (prospective heifer trial included 173 in the FTG and 175 in the CG) assigned to the study after the original cows were enrolled in May 1999. None of the first-lactation heifers had been trimmed or reported to be lame prior to their first parturition. There was no difference between the FTG and CG in the incidence of any foot lameness in prospective heifers. Because an untreated control group was not included in this study, one could conclude that functional foot trimming first-calf heifers once a year was as protective as functionally foot trimming three times a year.

Research on foot trimming dairy heifers prior to parturition is limited. Permanent damage to the feet of dairy cattle can occur during the early growing stages, and has been reported in heifers as young as six months of age.[47] Drendel *et al* reported that 12-month-old heifers identified with claw lesions were 27.7 times more likely to subsequently develop claw lesions in early lactation when compared to heifers with no prior claw lesions.[12] Scharko *et al* showed that instituting one time preventive foot care by professional foot trimmers in dairy heifers between six and 16 months of age results in a significant increase in mean first-lactation 305-day milk production when compared to an untrimmed control group.[41] This difference was seen in the fall-trimmed heifer subgroup, but not in the spring-trimmed subgroup.[41] Results from our study and others suggest that more research is needed to establish the benefit of a single functional foot trimming compared to not trimming first-lactation heifers.

In this study, no difference was found in risk of being culled for lameness for any reason between FTG and CG cows (Table 2). Two cows in each treatment group were culled for lameness. Even though lameness is a considerable problem in the dairy industry, the effect of lameness on culling is unclear. Beaudeau *et al* reported little or no increase in culling due to lameness.[3] In contrast, others report an increase in culling of dairy cattle due to lameness.[10,16,33] Lameness, one of the most common reasons for culling dairy cows, is reported to affect as many as 15% of dairy cows sent to slaughter.[33] The effect of lameness on culling depends on a number of variables including the specific diagnosis, time of diagnosis and time of culling.[6]

## Conclusions

This study was conducted to determine the efficacy of frequent functional foot trimming three times a year at set dates, compared to once a year at dry-off, for reducing incidence of foot lameness in 638 Holstein dairy cows. There was 27% less foot lameness ($P$=0.15) in cows trimmed three times a year compared to those trimmed only at dry-off. Notably, frequent functional foot trimming in this study reduced the risk of sole ulcer by 52%. Although the economic benefit of frequent

functional foot trimming for this herd appeared small, fewer cows would suffer pain associated with lameness, which would be positive for animal welfare. There was, however, no difference in risk of being culled for lameness or any reason between cows that were frequently foot trimmed compared to once a year. In addition, there was no difference in lameness for first-lactation heifers assigned to either the treatment (FTG) or control group (CG), suggesting that more research is needed to establish the benefit of a single functional foot trimming compared to an untreated control group in first-lactation heifers.

Although results from this study and others suggest a reduction in lameness for cows trimmed more frequently than once a year, further studies with larger numbers of cows from multiple herds are needed to make definitive conclusions regarding the overall benefit of frequent functional foot trimming.

If more frequent foot trimming is implemented in a herd, it is critical that foot trimmers avoid over-trimming cattle, thereby creating overly thin soles.

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# Abstracts

## Field technique for the resection of the distal interphalangeal joint and proximal resection of the deep digital flexor tendon in cows

R.C. Bicalho, S.H. Cheong, C.L. Guard
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A modified technique for the resection of the distal interphalangeal joint and the proximal resection of the deep digital flexor tendon in cows is described. Septic arthritis of the joint was diagnosed in eight Holstein cows and treated in the field. Four of the cows were diagnosed with ascending tendonitis during the resection of the joint and their tendons were also resected. All the animals remained moderately to severely lame for two weeks postoperatively but quickly recovered and were sound within five months. Eight months after the last surgery only one cow had been culled, 321 days after its surgery, for reproductive failure. The other seven cows had survived for a mean period of 308 days, with a range from 235 to 392 days.

## Effect of the administration of flunixin meglumine on pregnancy rates in Holstein heifers

A. Guzeloglu, H. Erdem, M.K. Saribay, W.W. Thatcher, T. Tekeli
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Fifty-two 15-month-old Holstein heifers were synchronized with single or double injections of prostaglandin $F_{2\alpha}$, followed by an injection of gonadotrophin-releasing hormone (GnRH) 48 hours later, and inseminated 12 to 14 hours after the injection of GnRH (day 0). Half of them were then injected twice intramuscularly with 1·1 mg/kg flunixin meglumine 12 hours apart, on the evening of day 15 and the morning of day 16, and the other 26 were not treated. Pregnancy was diagnosed by ultrasound 29 and 65 days after they were inseminated. On day 29, 20 of the treated heifers were pregnant compared with 13 of the control heifers ($P<0.05$); on day 65, 18 of the treated heifers were still pregnant compared with 12 of the control heifers ($P<0.10$).