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Randomised controlled trial to evaluate the effect of foot trimming before and after first calving on subsequent lameness episodes and productivity in dairy heifers

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ABSTRACT

The objective of this study was to assess both independent and combined effects of routine foot trimming of heifers at 3 weeks pre-calving and 100 days post calving on the first lactation lameness and lactation productivity. A total of 419 pre-calving dairy heifers were recruited from one heifer rearing operation over a 10-month period. Heifers were randomly allocated into one of four foot trimming regimens; pre-calving foot trim and post-calving lameness score (Group TL), pre-calving lameness score and post-calving foot trim (Group LT), pre-calving foot trim and post-calving foot trim (Group TT), and pre-calving lameness score and post-calving lameness score (Group LL, control group). All heifers were scored for lameness at 24 biweekly time points for 1 year following calving, and first lactation milk production data were collected.

Following calving, 172/419 (41.1%) of heifers became lame during the study (period prevalence), with lameness prevalence at each time-point following calving ranging from 48/392 (12.2%) at 29–42 days post-calving to 4/379 (1.1%) between 295 and 383 days after calving. The effects of the four treatment groups were not significantly different from each other for overall lameness period prevalence, biweekly lameness point prevalence, time to first lameness event, type of foot lesion identified at dry off claw trimming, or the 4% fat corrected 305-day milk yield. However, increased odds lameness was significantly associated with a pre-calving trim alone ($P = 0.044$) compared to the reference group LL. The odds of heifer lameness were highest between 0 and 6 weeks post-partum, and heifer farm destination was significantly associated with lameness (OR 2.24), suggesting that even at high standard facilities, environment and management systems have more effect on heifer foot health than trimming.

Introduction

Lameness and deterioration in claw health observed during the first lactation (Offer et al., 2000) is likely to contribute to poor longevity, high recurrence of foot lesions between lactations (Hirst et al., 2002), reduced milk yield, poor fertility (Hernandez et al., 2005) and increased likelihood of culling (Sogstad et al., 2007). Claw horn lesion development in dairy heifers can occur pre-calving (Livesey et al., 1998), with concurrent high levels of claw horn pathology present in early lactation (Webster, 2001) and lameness at 50–100 days post-partum is common (Ettema and Ostergaard, 2006; Maxwell et al., 2015). Since lameness occurs frequently in heifers, pre-calving foot inspection might reduce subsequent lameness around in the periparturient period.

The main cause of bovine lameness is foot lesions (Murray et al., 1996), and one proposed method of managing foot health is routine foot trimming, aiming to maintain correct weight bearing for optimal function, and to minimise and prevent lesion development (Manske et al., 2001). However, the evidence-base for the regimens used is sparse (Manning et al., 2016).

Locomotion scoring is the main method used to detect lameness, and previous work has demonstrated the low prevalence of proximal limb lameness (Murray et al., 1996). Lesions causing lameness on subsequent foot examination have been reported in lactating dairy cows with a locomotion score of 2 (Groenevelt et al., 2014). These lesions respond best to treatment with non-steroidal

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anti-inflammatory drugs and the application of a block to a sound claw (Thomas et al., 2014). These reports support the assumption that most lameness detected using mobility scoring is foot lesion-related and potentially manageable using claw trimming methods.

The primary objective of the study was to assess both the independent and combined effects of routine foot trimming in heifers at 3 weeks pre-calving and 100 days post calving on the first lactation lameness and lactation productivity. The hypothesis was that there would be a significant difference between the control group (biweekly lameness score only) and groups containing heifers that received foot trimming either pre-calving and/or post-calving with respect to lameness prevalence, 305-day first lactation milk yield, and/or time to conception.

Materials and methods

Study design

A negatively controlled randomised clinical trial (RCT) was used to compare the effect of pre- and post-calving foot trimming regimens on subsequent lameness events and production during the first lactation. The trial protocol was reviewed and approved by the Ethical Review Committee of the Royal Veterinary College (Approval number, URN 2013 1255; January 2014). Sample size calculations based on detecting a 25% difference in lameness prevalence at 80% power and 5% significance yielded a group size of 43 heifers per group (PS power and sample size calculations, Version 3, 2009).

Herd selection

One dairy farm business (Dorset, UK), comprising two dairy herds, was used for the study, and Holstein dairy heifers calved between November 2013 and September 2014. A heifer was defined as a female bovine that was due to calve for the first time during the study period; the animal ceased being a heifer at dry off, culling or death during first lactation. Before first calving, heifers were reared at grass during the summer and housed in winter in sand bedded cubicles. At 3 weeks pre-calving, heifers were moved into a transition group at the calving unit, housed in sand bedded cubicles together with multiparous cows, and calved in a loose housed straw yard. Heifers joined one of two milking herds post-partum, located at two different sites. Both dairies operated a continuous housing system for lactating cows with deep sand beds in Super Comfort Sand Stall cow cubicles (IAE, UK). Cows were milked 3 times a day through a rotary parlour, and fed on a total mixed ration. Farm 1 was a high yielding (11,500 L) dairy, with high foot wear due to large walking distances and a lot of concrete flooring, and was where all heifers calved. Farm 2 was a new build, high yielding (10,000 L) dairy, with very high foot wear due to newly laid concrete, and was located approximately 7 km from Farm 1. The destination of heifers was determined at calving by the owner and herd manager who were masked to treatment group allocations and made location selection without animal inspection.

Allocation to treatment group

The study interventions were conducted at the individual animal level, with each heifer treated as an independent unit. Heifers were excluded from enrolment if they had previously been lame or were lame at the time of enrolment (3 weeks pre-calving). Heifers were randomly allocated to one of the four treatment groups using random sequences generated by computer software (Excel 2007, Microsoft). The groups were as follows: pre-calving foot trim and post-calving lameness score (Group TL), pre-calving lameness score and post-calving foot trim (Group LT), pre-calving foot trim and post-calving foot trim (Group TT) and pre-calving lameness score and post-calving lameness score (Group LL, control group; Fig. 1).

Heifers not present in the transition group at the pre-calving foot trimming were randomly re-allocated to either Group LT or Group LL, a modification introduced during the trial. Randomisation was performed using random sequences generated by computer software (Excel 2007, Microsoft). Reasons for heifers not being present in the transition group included overstocking of the shed or a change in the day that heifers were moved into the transition group to a day that the foot trimmer was unavailable.

Foot trimming and locomotion scoring

Foot trimming visits were carried out every 2 weeks from 1 November 2013 until 30 November 2014. Heifers in a treatment group that were due to receive a foot trim (Groups TL, LT, TT) had all four feet examined in a hydraulic upright foot crush (HTL Hydraulic Crush, Hooftrimming). Heifers allocated to Group LL did not have their feet lifted or examined. The foot trimming was carried out by one professional foot trimmer (Dutch Diploma Holder) following the Dutch Five Step method (Toussaint Raven, 1985), with deep and wide dishing out at the sole ulcer site consistent with a modification proposed by Burgi and Cook (2008). A conservative trimming method

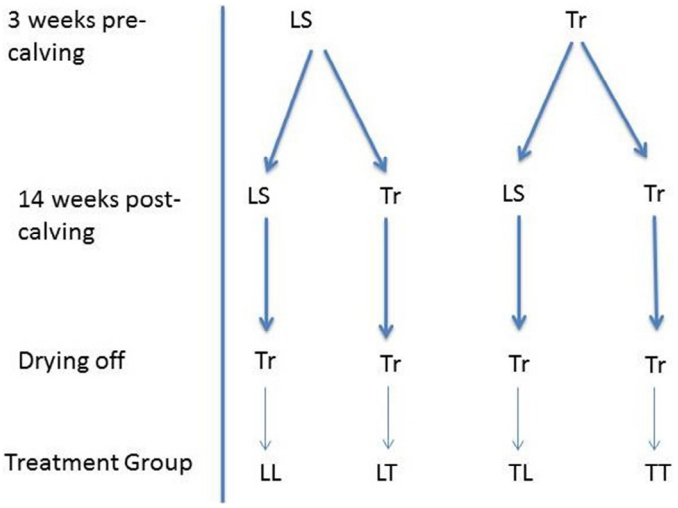

Fig. 1. Flow chart representing events for each treatment groups at specified intervention times. LS, locomotion score; Tr, foot trim; TL, pre-calving foot trim and post-calving locomotion score; LT, pre-calving locomotion score and post-calving foot trim; TT, pre-calving foot trim and post-calving foot trim; LL, pre-calving locomotion score and post-calving locomotion score (control).

was used which preserved sole depth and walls, and no trimming was carried out unless detectable overgrowth required correction, thereby avoiding overtrimming.

Any heifers identified as lame before entering the trimming crush was treated using a standardised protocol, irrespective of study group allocation. Any digital dermatitis lesions identified was treated with chlortetracycline spray (Cyclo spray, Dechra Veterinary Products). Claw horn lesions were treated with wooden blocks applied to the sound claw with an adhesive bond to the sole (Mini Moo Gloo, Moogloo), and corrective trimming with loose and under-run horn removed according to Mahendran and Bell (2015). Non-steroidal anti-inflammatory drugs were not administered.

Locomotion was assessed in all heifers at 3 weeks pre-calving, and then biweekly every 14 ± 3 days for 1 year post-calving (producing 24 biweekly locomotion scores). Scoring was conducted using a modified version of the Agriculture and Horticulture Development Board (AHDB) Dairy mobility score (locomotion scores of 0, 1, 2a, 2b, 3a, or 3b; Thomas et al., 2015). Briefly, heifers with score 0 walked with a normal gait; heifers with score 1 had uneven steps but the leg was not immediately identifiable; heifers with score 2a had mild asymmetry with a decreased stride length; heifers with score 2b had moderate asymmetry with a raised back; heifers with score 3a had severe asymmetry with reduced walking velocity so they were unable to keep up with the healthy herd; and heifers with score 3b were minimally weight-bearing and reluctant to walk. Locomotion scoring was carried out by a single trained observer (SAM) who was effectively masked to the treatment group by virtue of the small number of heifers joining large milking groups. When a heifer was identified as lame (locomotion score 2a, 2b, 3a or 3b), the farmer was informed and any further treatments were conducted at the farmer's discretion, while heifers remained in the study.

Productivity data

Milk yield and fertility data were extracted from monthly milk recordings collected by a single company (National Milk Records) and by using on-farm management software (Dairy Comp 305, Valley Agricultural Software). A 4% fat corrected 305-day milk yield was calculated using the formula reported by Gaines and Davidson (1923).

Outcome measures of lameness

Never vs. ever lame

The 48-week period prevalence was defined as the proportion of heifers that went lame during the 48-week time period, using the number of heifers present at the beginning of the study period as the denominator.

Proportion of time lame during the study period

This proportion was defined as the number of locomotion scores (>1) during the 24 biweekly locomotion scores following parturition, divided by the total number of locomotion score observations recorded during the study period for each heifer. Heifers exiting the study received biweekly locomotion scoring until their removal from the farm.