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Severity of foot lesions in relation to calving in Sahiwal-HF crossbred cattle

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Lameness is one of the three costliest diseases of the dairy industry including mastitis and fertility problems (Hernandez *et al*. 2000). The pain and distress caused to the animals make it an important issue of animal welfare (O' Callaghan 2002). About 90–99% of lameness incidents in cattle all over the world occur due to claw lesions, irrespective of breed, use or housing (Hernandez *et al*. 2002, Van Amstel and Shearer 2006). The time around calving is critical in the initiation of claw lesions but the physiological reasons for this are not known (Peterse 1980, Bradley *et al*. 1989). Calving and onset of lactation causes non-inflammatory changes in the connective tissue of the corium that impair resilience of the claws to external stresses, mediated through activation of certain gelatinoproteases (Knott *et al*. 2007). The combined effects of calving, housing and the introduction of lactation diets result in insults to the claw corium (Chaplin *et al*. 2000, Tarlton *et al*. 2002). The occurrence of claw lesions in one lactation is likely to affect the claw health in subsequent years (Peterse 1980) and first calving heifers are more prone to claw lesions than cows in third or fourth lactation (Webster 2001). Studies in relation to calving were undertaken in pure Holstein Friesian cows (Capion *et al.* 2009) but hardly any information is available on how parturition changes affect claw lesions in crossbred cattle. So the present study was undertaken to evaluate the affect of calving on the severity of foot lesions in 3 groups of Sahiwal-Holstein Friesian crossbred cows. The study was conducted at Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) dairy farm located at Ludhiana. Herd consisted of 200 Sahiwal- HF crossbred cows and 250 Murrah buffaloes both maintained independently by segregating according to different age groups. Hoof trimming was not a routine practice at the farm and was done only in animals showing clinical lameness. The study was conducted during July 2009 to April 2010 and involved randomly selected 9 Sahiwal-HF crossbred heifers (group 1), 9 second calf Sahiwal- HF crossbred cows (group 2), and 9 mature Sahiwal- HF crossbred cows (group 3).

Animals and their management: All the 3 groups were managed intensively. They were given concentrate @ 400g/ kg of milk produced, in addition to 2 kg for maintenance as well as 35–40 kg of green fodder daily. Body weight of about 275 kg was used as criteria for the time of breeding. The pregnant heifers, second calf cows and mature cows were moved to calving pens 2 months before expected date of calving. After parturition heifers were kept with other parturated (second calf cows and mature) animals.

Lameness scoring and rear leg view index: Gait of each animal was examined on 4 occasions, viz. 4 months before calving (–4), 2 months before calving (–2), at calving (0) and 2 months after calving (+2) by allowing it to walk on the flat surface up to 30 m and rated on a 5– point scale (Wells *et al*. 1993). Rear leg view index of each animal was also recorded (Randhawa *et al.* 2008).

Hoof examination: After locomotion scoring each animal was properly restrained in trimming chute and each foot was examined one by one for any gross lesions before and after paring a layer of approximately 1 mm of horn from the weight bearing surface. Different types of foot lesions were categorised and scored for severity (Randhawa *et al.* 2008) on hoof maps.

Statistical analysis: The data were analysed using Kruskal Wallis test of analysis of variance or H-test (Steel and Torrie 1980) to evaluate the differences in severity of lesions and locomotion score within groups and between 3 groups of crossbred cows by using statistical package for social sciences (SPSS for windows version 11–0–1). Observations (864: 27 animals × 8 claws × 4 examinations) were recorded from the claws of 3 groups of animals over a period of 6 months. Within group comparison in heifers revealed a significant difference in the locomotion score and rear leg view index (Table 1) with an increase in per cent locomotion score and

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Table 1. Locomotion score and rear leg view index in heifers, second calf cows and mature cows (within group comparisons)

	Heifers		Second calf cows		Mature cows	
	Test statistic	P-value	Test statistic	P-value	Test statistic	P-value
Locomotion score	16.179*	0.001	9.9458	0.019	2.994	0.393
Rear leg view index	9.545*	0.023	4.375	0.224	6.562	0.087

*Significant at $P \leq 0.05$

lesions by within group and between group comparisons are presented in Tables 3 and 4. The within group comparison of different hoof lesions of all 3 groups revealed a significant difference in heel erosions and sole avulsions in heifers. In mature cows, a significant difference was observed in sole avulsions. However, rest of the lesions differed nonsignificantly. The difference was nonsignificant within second calf cows (Table 3). The between group comparison depicted a significant difference in heel erosions, sole avulsions and interdigital hyperplasia between the 3 groups of cattle at 4 months before calving and also a significant

Table 2. Locomotion score and rear leg view index in heifers, second calf cows and mature cows (between group comparisons)

	Observation time							
	–4		–2		0		2	
	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value
Locomotion score	3.483	0.175	3.224	0.199	0.083	0.96	1.688	0.43
Rear leg view index	0	1	0	1	1.238	0.538	3.309	0.191

–4, 4 months before calving; –2, 2 months before calving; 0, at calving; 2, 2 months after calving

rear leg view index at the time of calving as compared to 4 months and 2 months before calving and 2 months after calving whereas a nonsignificant change in per cent locomotion score and rear leg view index was appreciated in second calf cows and mature cows. However, analysis of locomotion score and rear leg view index revealed no significant difference between 3 groups (Table 2). One interesting finding was that in heifers and second calf cows, the locomotion score shifted towards lower side after calving but no such recovery was evident in mature cows which is in agreement with Webster (2002). The increased occurrence of lameness score and rear leg view index in heifers at the time of calving could be directly related to increase in the total number of claw lesions at the time of calving and thereafter (Fig 1).

Statistically significant differences between different hoof

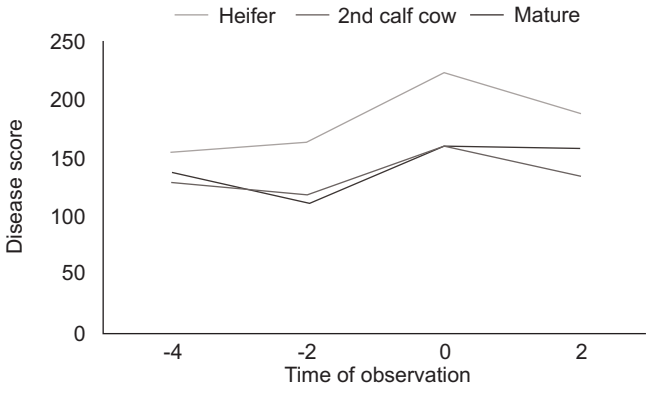

Fig. 1. Cumulative weighted lesion score in heifers, second calf cows and mature cows.

Table 3. Hoof lesions in heifers, second calf cows and mature cows (within group comparison)

Lesions	Heifers		Second calf cows		Mature cows	
	Test statistic	P-value	Test statistic	P-value	Test statistic	P-value
HE	9.031*	0.029	2.061	0.56	3.19	0.363
SH	3.671	0.299	1.419	0.701	1.591	0.662
WLH	3.806	0.283	6.826	0.078	4.385	0.223
WLF	1.899	0.594	2.719	0.437	1.394	0.707
SA	10.183*	0.017	3.958	0.266	11.313*	0.01
US	6.839	0.077	3.981	0.264	0.807	0.848
OS	3.806	0.283	2.141	0.544	2.864	0.413
OH	0	1	0	1	6.176	0.103
IDH	0	1	3	0.392	2.33	0.507

*Significant at $P \leq 0.05$; HE, heel erosion; SH, sole haemorrhage; WLH, white line haemorrhage; WLF, white line fissure; SA, sole avulsion; US, under run sole; OS, overgrown sole; OH, overgrown hoof; IDH, interdigital hyperplasia.

difference was observed in under run soles and overgrown soles at 2 months after calving between the 3 groups of cattle (Table 4).

The significant difference in heel erosions between 3 groups (Table 3) was mainly due to significant difference in the incidence of heel erosions at 4 months before calving than at any other time (Table 4). This could be due to the reason that heifers have encountered very few haemorrhagic events associated with subclinical laminitis (Greenough and Vermunt 1991) being in first gestation as compared to second calf cows and mature cows. It seems that successive haemorrhagic events in the corium are required before the

Table 4. Hoof lesions in heifers, second calf cows and mature cows (between group comparison)

Lesions	-4 Test statistic	-2 Test statistic	0 Test statistic	2 Test statistic
HE	5.955*	1.097	1.771	0.966
SH	1.429	0.164	0.251	0.138
WLH	0	2	0.431	1.929
WLF	0.388	5.108	0.946	2.213
SA	8.568*	2.758	4.282	1.481
US	0.461	3.598	0.838	6.185*
OS	0.431	4.549	1.34	6.08*
OH	4.16	0	0	0
IDH	6.48*	2	1.043	2

*Significant at P≤0.05; –4, 4 months before calving; –2, 2 months before calving; 0, at calving; 2, 2 months after calving; HE, heel erosion; SH, sole haemorrhage; WLH, white line haemorrhage; WLF, white line fissure; SA, sole avulsion; US, under run sole; OS, overgrown sole; OH, overgrown hoof; IDH, interdigital hyperplasia.

heel horn becomes so weak to get eroded. The increase in the severity of heel erosions at or after calving in heifers as compared to before calving could also be related to the change they observed on entering the milch life from a heifer status. This milch status could cause an apparently more drainage of calcium and trace minerals like copper, zinc, manganese and cobalt for synthesis of milk. The repartitioning of energy towards mammary gland development and milk production could have compromised the genesis of healthy hoof tissue. Within group comparison of heel erosions over the entire period showed nonsignificant difference in second calf cows and mature cows (Table 3). This could be due to their adaptation to these changes which they had encountered during previous lactations.

The within group comparison of sole avulsions in different groups revealed a significant difference between different timings of examination in heifers and mature cows (Table 3). It might be due to the fact that during pregnancy the increased body weight may have overloaded the feet or claws already compromised by episodes of sub clinical laminitis and shifting of resources towards mammary gland development and maintenance of pregnancy. Due to increased ground reaction forces on the sole, the soles might have avulsed easily that is why the incidence of sole avulsions decreased in all the 3 groups at and after calving due to abrupt relieving of animals of the body weight. A significantly high incidence of sole avulsions was observed 4 months before calving in heifers as compared to second calf cows and mature cows (Table 4). The difference of sole avulsions between different groups at 4 months before calving was related to their significantly higher incidence in heifers in comparison to second calf cows and mature cows (Tables 5, 6). High incidence of sole avulsions in heifers at this time could be due to increase in body weight which they experienced for the first time.

The increased severity of sole haemorrhages towards calving and thereafter (Table 4) could be related to the physiological and hormonal changes occurring around calving in all the 3 groups of animals. Further it could be due to recurrent episodes of subclinical laminitis due to rumen acidic fluctuations which might be more during late pregnancy and early calving period because of sufficient concentrate feeding during this period. The present findings were in agreement with those of Leach *et al*. (1997) who observed that 90% of heifers were affected with less severe sole lesions before calving. Offer *et al*. (2000) also observed peaks in the severity and incidence of haemorrhages at and around 2 to 4 months after calving. Repeated observations of the feet of cattle throughout lactation revealed that nearly all animals develop haemorrhages in the first few weeks post-calving (Tarlton *et al*. 2002).

Table 5. Hoof lesions in heifers and second calf cows (between group comparison)

Lesions	Observation time							
	–4		–2		0		2	
	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value
HE	5.177*	0.023	0.103	0.749	0.868	0.352	0.953	0.329
SH	0.384	0.535	0.2	0.655	0.002	0.962	0.002	0.961
WLH	0	1	1	0.317	0.296	0.586	1.964	0.161
WLF	0.384	0.535	0.007	0.936	0.734	0.392	0.559	0.455
SA	5.556*	0.018	0.882	0.348	1.757	0.185	0.113	0.737
US	0.209	0.648	0.113	0.737	0.863	0.353	5.909*	0.015
OS	0.015	0.903	4.781	0.029	1.214	0.27	1	0.317
OH	0	1	0	1	0	1	0	1
IDH	0	1	0	1	1	0.317	0	1

*Significant at P≤0.05; –4, 4 months before calving; –2, 2 months before calving; 0, at calving; 2, 2 months after calving; HE, heel erosion; SH, sole haemorrhage; WLH, white line haemorrhage; WLF, white line fissure; SA, sole avulsion; US, under run sole; OS, overgrown sole; OH, overgrown hoof; IDH, interdigital hyperplasia.

Table 6. Hoof lesions in heifers and mature cows (between group comparison)

Lesions	Observation time							
	–4		–2		0		2	
	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value
HE	3.723	0.054	0.717	0.397	0.002	0.964	0.237	0.626
SH	1.358	0.244	0.025	0.875	0.181	0.67	0.034	0.853
WLH	0	1	1	0.317	0.015	0.903	0.559	0.455
WLF	0.015	0.903	2.738	0.098	0.308	0.579	2.118	0.146
SA	6.393*	0.011	1.257	0.262	3.612	0.057	0.559	0.455
US	0.054	0.816	2.311	0.128	0.008	0.927	2.371	0.124
OS	0.296	0.586	0.551	0.458	0.296	0.586	4.772*	0.029
OH	2.125	0.145	0	1	0	1	0	1
IDH	3.375	0.066	1	0.317	1	0.317	1	0.317

*Significant at P≤0.05; –4, 4 months before calving; –2, 2 months before calving; 0, at calving; 2, 2 months after calving; HE, heel erosion; SH, sole haemorrhage; WLH, white line haemorrhage; WLF, white line fissure; SA, sole avulsion; US, under run sole; OS, overgrown sole; OH, overgrown hoof; IDH, interdigital hyperplasia.

Table 7. Hoof lesions in second calf cows and mature cows (between group comparison)

Lesions	Observation time							
	–4		–2		0		2	
	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value	Test statistic	P- value
HE	0.097	0.755	0.717	0.397	1.78	0.182	0.237	0.626
SH	0.369	0.544	0.025	0.875	0.191	0.662	0.175	0.676
WLH	0	1	1	0.317	0.378	0.539	0.337	0.562
WLF	0.154	0.695	2.738	0.098	0.403	0.526	0.543	0.461
SA	1.18	0.277	1.257	0.262	0.992	0.319	1.624	0.203
US	0.422	0.516	2.311	0.128	0.426	0.514	0.651	0.42
OS	0.378	0.539	0.551	0.458	0.457	0.499	2.291	0.13
OH	2.125	0.145	0	1	0	1	0	1
IDH	3.375	0.066	1	0.317	0.007	0.936	1	0.317

–4, 4 months before calving; –2, 2 months before calving; 0, at calving; 2, 2 months after calving; HE, heel erosion; SH, sole haemorrhage; WLH, white line haemorrhage; WLF, white line fissure; SA, sole avulsion; US, under run sole; OS, overgrown sole; OH, overgrown hoof; IDH, interdigital hyperplasia.

In all the 3 groups white line haemorrhages were not present at 4 months before calving (Table 4). They appeared 2 months before calving in second calf cows while as in heifers and mature cows they appeared at calving (Tables 5–7). At calving the white line haemorrhages tended to be more in heifers and mature cows than second calf cows. However, they tended to disappear rapidly from claws of heifers after calving whereas in second calf cows and mature cows no such rapid recovery was evident. In all the 3 groups, the occurrence of white line fissures tended to peak at calving than at 2 months before or 2 months after calving. The fissures disappeared rapidly from the claws of heifers and second calf cows after calving but no such rapid recovery was evident in mature cows. The scarring of the corium could be a reason for the slow recovery of white line area in older cows as compared to heifers (Peterse 1980). White line disease typically starts to develop around the time of parturition and tends to be most severe in early weeks of lactation (Offer *et al*. 2000). It seems that white line haemorrhages appear first which further softens the white line and then lead to formation of white line fissures. Once softened, small fragments of dirt or even quite large stones might get impacted in the white line.

The high incidence of under run soles (Tables 4–7) in the heifers 2 months after calving could be attributed to the fact that under run soles has similar pathogenesis as the sole haemorrhages because in present study the severity of sole haemorrhages increased from 2 months before calving up to 2 months after calving. Sole haemorrhages might have caused degeneration of the hoof horn at specific points which may have rendered the underfoot slurry to enter the sole causing under-running of the sole.

The high incidence of overgrown soles in mature cows as compared to the other groups may be attributed to frequent irritation due to recurrent insults of subclinical laminitis might have rendered the sole hyperkeratotic. The overgrown

hooves were observed only in the mature cows at the start i.e. 4 months before calving while in other 2 groups they were not observed during the entire period of 6 months. The overgrown hooves were reported as a major problem of mature animals though rarely it affects recently calved heifers (Bradley *et al*. 1989).

From the present study, it was concluded that the changes associated with calving put lot of impact on the pattern of lesions in heifers as compared to second calf cows and mature cows. So heifers need more nutritional and managemental care as compared to other groups in the herd especially at and around calving.

SUMMARY

Sahiwal-HF crossbred dairy cows (27) maintained under similar managemental and nutritional practices were randomly selected for this study. The animals were examined on four occasions, viz. 4 months before calving (–4), 2 months before calving (–2), at calving (0) and 2 months after calving (+2). On the day of examination, each animal was evaluated for locomotion score, rear leg view index and for various foot lesions. Observations (864: 27 animals × 8 claws × 4 examinations) were recorded from the claws of 3 groups (group 1: 9 heifers, group 2: 9 second calf cows and group 3: 9 mature cows). Locomotion score was more severe at calving and decreased after that in heifers and second calf cows whereas no improvement was seen in mature cows. The incidence of heel erosions was low in heifers 4 months before calving as compared to other 2 groups but increased at the time of calving and 2 months after in all the 3 groups. The incidence of sole avulsions was high before calving but tended to decrease at and after calving. The incidence of under run soles and overgrown soles 2 months after calving was more in heifers and second calf cows respectively. The incidence of sole haemorrhages, white line haemorrhages and white line fissures increased at calving in all the 3 groups. It was concluded that the physiological changes approaching calving could be responsible for increased cumulative lesions score at the time of calving especially in heifers.

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