

A longitudinal study of the clinical course of udder cleft dermatitis

On 5 dairy farms in the Netherlands

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Abstract

Udder cleft dermatitis (UCD) is an inflammation of the skin between the two forequarters of the udder and the ventral abdominal wall, or from the skin between the frontquarters. Previous studies gave insight in prevalence and appearance of the condition at a single time point, but do not give information about development of UCD in the time. Therefore in this study we performed a longitudinal study to describe the clinical course of UCD. UCD lesions in 5 herds were followed up for a period of 23 weeks by photographing the lesions. A score system was developed to give every photo a score and turn information from the photos into analyzable data. UCD lesions appeared with and without breached skin; cases could therefore consist of 'severe' and 'mild' episodes. Mild episodes were characterized as covered with smear/sebum/fat and erythema can be present. Severe episodes are covered with transudate/exsudate/hairs or crusts. It appeared that mild lesions can convert into severe lesions. The average prevalence in the 5 herds was 37,2%. Especially the long duration contributed to this percentage, because the incidence was low: 1,76 episodes/100 cows/week. 36% of the episodes had a duration ≥ 23 weeks and only 36% of all episodes recovered during the testing period. From severe episodes only 7% recovered.

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2 Introduction

Udder cleft dermatitis (UCD) is an inflammation from the skin between the two forequarters of the udder and the ventral bodywall, or from the skin between the frontquarters. The appearance of the affected skin differs widely: red irritated areas, but also deep wounds can occur (Boyer & Singleton, 1998; Amersfort, 2013; Olde Riekerink et al., 2014; Waller et al., 2014). Recent studies revealed that the prevalence of UCD in Dutch dairy herds is 80% and within herd prevalences of 0-39% in randomly selected herds (Riekerink et al., 2014; Waller et al., 2014). The aetiology of the disease is unknown, but high milk yield (Beattie & Taylor, 2000; Amersfort, 2013; Riekerink et al., 2014), congestion and oedema of the udder (Blowey and Edmondson, 1995) skin folds at the front of the udder (Blowey, 1995; Waller et al., 2014) and a small angle between the udder and abdominal wall or loose fore udder attachment (Riekerink et al., 2014; Waller et al., 2014) may be risk factors. In previous reports a relationship between UCD and digital dermatitis was suggested (Boyer, 1998; Stamm, 2009; Evans, 2010). Researchers isolated *Treponema spp* that are associated with digital dermatitis from UCD wounds (Stamm, 2009; Evans 2010), but to this day the causal agent of UCD is unknown. Riekerink et al. (2014) and Waller et al. (2014) performed observational studies which gave insight in prevalence and appearance of the condition at a cross section, but do not give information about development of UCD in the time. Therefore we performed a longitudinal study to define the clinical course of UCD.

3 Materials & methods

We investigated udder cleft dermatitis on 5 Dutch farms with Holstein-Friesian cattle, serviced by veterinarians of the Universitaire Landbouwhuisdieren Praktijk (ULP) in Harmelen. The 5 farms were selected by ULP veterinarians based on an estimated prevalence of UCD that exceeded 6%, a feeding rack with headlocks for fixation, a production level exceeding 7500 kg of milk/cow/year, herd size of 60 to 100 animals and an accurate animal disease-administration. Further characteristics of the farms are in table 1 (see attachment 1, table 1).

The farms were visited from the 25th of January 2013 till the 7th of June 2013 every week and from the 8th of June 2013 till the 12th of July 2013 once every two weeks.

Farm visits took place in the morning, when cows were fixed in the feeding rack after milking. At each visit, all lactating and non-lactating cows and heifers were checked for UCD with a lamp and a hand mirror and checked for signs of UCD, such as erythema, smear/sebum/fat, scar tissue, transudate/exudate/hairs and/or an open wound. Cows with signs of UCD were called a case and were marked and recorded on a list. For the recording of all observations of each case, one photo was made with a camera and a mirror assembled to a stick. An assistant manipulated the udder in a way the whole lesion was reflected in the mirror and the research technician took the photos via the mirror. Cows with UCD sometimes had several episodes of UCD, which were defined as periods of at least two consecutive observations with UCD in between two healthy observations. Some cows had several UCD episodes. A card with the identification of the cow fixed on a ruler was photographed together with the lesion. Cows without lesions were declared.

In order to obtain analyzable data from all the observations, we used at first the system described by Lam & Riekerink (2011) to score photos. This did not suffice well because the scoring of one picture by different people resulted in different categories. Probably because the characteristics of one photo could be captured by more than one category, because one category held several different characteristics.

Also we considered a classification based on the course of the disease, as was discovered for digital dermatitis (Holzhauer et al., 2008), with a subclinical, acute, healing and chronic phase, that display the clinical course of digital dermatitis. This could not be discovered in the photos in our database. After viewing a lot of photos we decided to score single characteristics from the lesion.

Photos were scored for the characteristics coverage, granulation tissue, scar tissue, erythema, length of lesion, length of wound and location and scores were noted in a database (see attachment 1, figure 1 and 2). Four types of coverage were scored: no coverage, crusts, transudate/exudate/hairs or smear/sebum/fat. For erythema, scar tissue and granulation tissue it was determined whether it was observed (i.e., present) or not. The exact location of the lesion could be anywhere on the Y that is formed from a long axis, between the two forequarters of the udder and two short axis, formed by folds in the skin of the ventral abdominal wall. The place where the long and short axis meet is the core (see attachment 1, figure 3 and 4). All photographs were scored by two persons, who trained to obtain a good level of agreement.

Data were analyzed with simple calculations. Prevalence and incidence of UCD was calculated and characteristics of lesions were determined. Differentiating on the start and end of UCD or in some

cases the first or the last photo that was taken, duration of UCD was determined. Based on the most distinctive characteristic of a lesion, the presence or absence of a wound, simple calculations were made. Episodes with a wound were called severe episodes and episodes without a wound were called mild episodes. From representative cases that start UCD during our testing period the characteristics of the start of lesions was studied.

4 Results

During the testing period, farms were visited 20 or 21 times. We observed 383 cows on 5 farms with herd size between 54 and 91 cows. A total of 3077 photos was taken from 220 animals that were affected at the start or developed UCD during our testing period. A total of 239 episodes are in our database, with 19 cases experiencing 2 episodes of UCD.

In total, 83 cows had UCD lesions throughout the study period of 23 weeks(long duration). The average duration of UCD in animals that became affected and recovered during our study (n=66) is 9 weeks (short duration) with a range of 2-21 weeks.

From the episodes with short duration 22,8% were classified as severe episodes, whereas 73,5% of the episodes with a long duration were severe. At many observations in this group in a wound was covered with transudate/exudate/hairs (75%). In addition, all wounds from cases with a short duration frequently covered with crusts. Mild lesions were covered with smear/sebum/fat in the majority of the observations. Erythema was present in every mild lesion that had no coverage (see attachment 1, graph 1).

	Duration	
	Long	Short
Cases	83	66
Severe	61 (73,5%)	15 (22,8%)
Coverage:		
Transudate/exudate/hairs	46 (75%)	0 (0%)
Crust	15 (25%)	15 (100%)

Table 1 Coverage of severe episodes in cases with long and short duration

In the majority of the observations a lesion had a length of 5-15 cm (87,4%). In 2,4% of the observations the lesion was longer than 15 cm. The length of wounds was <5 cm (54,4%) or 5-10 cm (41,1%) and in 4,5% of the observations the length exceeded 10 cm. For all observations the predominant location was the core (see attachment 1, graph 2-4).

The estimated average within herd prevalence of UCD per month is 37,2% with a range of 31,4-45,1% (see attachment 1 table 2). In 43% of the episodes a wound is developed. 36% of all episodes recovered during our study, 7% of episodes that recovered were severe episodes.

Episodes	Severe	Mild	Total
Recovery			
Unknown	86 (36%)	67 (28%)	153 (64%)
Known	17 (7%)	69 (29%)	86 (36%)
Total	103 (43%)	136 (57%)	239

Table 2 Severe and mild episodes with known of unknown recovery

The incidence of UCD in our study is 1,76/100 cows/week (see attachment 1, table 4 & 5, fig 5).

48 episodes that start during the testing period and that did not recover during the testing period were used to get insight in the development of UCD and the transition from an episode from mild to severe.

At end testing period:	No wound	Wound	Total
At start UCD			
No wound	22 (46%)	13 (37%)	35
Wound	2 (4,2%)	11 (23%)	13
Total	24	24	48

Table 3 Start of UCD of 48 episodes that do not recover during the testing period

In 35 episodes UCD starts without a wound and with erythema and/or sebum coverage for an average duration of 10,2 weeks with a range of 1-21 weeks. From these episodes, 13 episodes develop a wound, after an average duration of 4,9 weeks with a range of 1-18 weeks (Tabel 3).

In 13 episodes UCD is started with a wound. In 11 from these episodes the wound existed till the end of the testing period, with an average duration of 9,1 weeks, with a range of 1-20 weeks. The other 2 episodes recover from the wound during the testing period, after respectively 4 and 6 weeks (Tabel 3).

5 Discussion

The prevalence of UCD in our study is much higher than expected beforehand by the farmers and their veterinarians. This could be the result of the anatomical position of the lesion; at normal inspection of a cow by the farmer it is unobservable. It is also higher than the prevalence found in previous studies by Amersfort et al. (2013) and Waller et al. (2014). This is probably due to the fact that they studied UCD in randomly selected herds, while we selected herds with and estimated a prevalence of UCD of more than 6%.

With a low incidence of 1,76/100 cows at risk/week, the duration is the major contributor to the high prevalence. Only 36% of all episodes recovered during our study. Up to 35% of the episodes had a duration ≥ 23 weeks. From these episodes 73,5% developed a wound, which points out the great influence a wound has on the duration; only 7% of severe episodes recover during our study.

The wounds from severe episodes with a long duration are in the majority of the observations covered with transudate/exudate/hairs (75%), while all wounds from episodes with a short duration (start and recovery known) are in the majority of the observations covered with crusts. Because these wounds recover during our study, we can hypothesize that a wound covered with crusts has started healing, while transudate/exudate/hairs seems to cover a wound that tends to exist for a longer time. This is in line with what is known from the process of wound healing; the discharge or fluid from a wound that is not acute may inhibit or delay wound healing (Vowden & Vowden, 2003), while formation of a crust has a positive effect on wound healing (Marinho et al., 2013).

The long duration of a severe episode may be the result of infection. From human medicine is known that an ulcer can become deeper as a result of infection (Shai & Maibach, 2005) and therefore tends to exist longer. This hypothesis is in accordance with previous studies in which pathogens were isolated from UCD lesions (Boyer & Singleton, 1998; Beattie & Taylor, 2000; Warnick et al., 2002; Stamm et al., 2009; Evans et al., 2010). Infection and therefore duration may be influenced by environmental challenge of micro-organisms. Otherwise, the impossibility of the cow to overcome the dermatitis may be due to several factors such as the attachment of the udder, parity, high milk yield mentioned in previous studies (Beattie & Taylor, 2000; Amersfort, 2013; Riekerling et al., 2014; Waller et al., 2014) and other local or systemic causes that need further investigation. To determine possible associations between cow- and environment factors and origination and development of UCD lesions more information needs to be collected and analyzed.

The episodes that start during our testing period and were not recovered at the end of the study are the most representative episodes to study the clinical course of UCD. From these 37% (13/48) of episodes that start with mild observations become severe. It is unknown if the episodes that start with severe observations were preceded by a mild episode in the 7-14 days between two farm visits. Attention needs to be paid to mild episodes. Cases with mild episodes can probably be prevented from severe episodes by treatment or other preventive measures. It is unknown what triggers the transition from mild to severe, but from human medicine we know simple injuries may become secondarily infected with bacteria (Shai & Maibach, 2005).

In this study we analyzed photos to collect data. We did not take into account the factors on cow- and farm level. It would be interesting to relate such factors with the episodes, or even with single

observations, to study influence of these factors on change of lesion or transition from mild to severe episodes and the other way around.

Because we did not use statistical models to analyze the data, it is unknown if the results are significant. Although a significant outcome plausible is with vast differences are found. Statistic testing with this database can give more insights and significant outcomes.

6 Conclusion

The clinical course of udder cleft dermatitis cannot be determined by a score system with categories that combine a set of signs. Because UCD appears with and without breached skin cases could be divided in respectively severe and mild cases. Mild episodes are covered with smear/sebum/fat and erythema can be present. Severe episodes are covered with transudate/exsudate/hairs or crusts. Mild lesions can convert into severe lesions, so attention needs to be payed to both forms. Prevalence in herds can be high, despite a low incidence of 1,76 episodes/100 cows at risk/week, because UCD has a long duration, especially in severe episodes. To determine aetiology and risk factors more research is needed.

Literature

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Attachment 1

Table 1 Characteristics of the farms and their herds that were involved in the investigation

	<i>Herd A</i>	<i>Herd B</i>	<i>Herd C</i>	<i>Herd D</i>	<i>Herd E</i>
<u>Mean herdsize*</u>	54	82	67	89	91
<u>Mean 305-daily production*</u>	9101 kg	9223 kg	10385 kg	8890 kg	9225 kg
<u>Stable type</u>	Cubicle stable	Cubicle stable	Cubicle stable	Cubicle stable	Cubicle stable (Stable 1/Stable 2)
<u>Floor type</u>	Slatted	Slatted	Slatted	Slatted	Slatted/Concrete blocks with a slit every meter
<u>Cubicles</u>					
- Rubber mats	Yes	--	--	Yes	Yes/No
- Soft green mattress	--	--	Yes	--	--
- Water mattress	--	--	--	--	No/Yes
- Sawdust	Yes	--	Yes	Yes	--
- Ground straw	--	Yes, thick layer	--	--	Yes/Yes
- Lime	Yes	--	--	--	Yes/Yes
<u>Cleaning floor</u>				No manure slider	
- Manure Robot	--	--	Yes	--	Yes/Yes
- Automatic manure slider	--	Yes	--	--	--
- Manure slide machine	Yes, 2/daily	--	--	--	--
<u>Milking</u>					
- Robot	--	--	--	--	Yes
- Side by Side	2x5	--	--	--	--
- Herringbone	--	2x6	2x5	2x6	--
- Times daily:	2x	2x	2x	2x	--
<u>Non-lactating cows</u>					
- Floor type	Slatted	Slatted	Slatted	Slatted	Slatted
- Manure slider	--	--	Robot	--	--
<u>Cubicles</u>					
- Rubber mats	Yes	Yes	--	Yes	Yes
- Soft green mattress	--	--	Yes	--	--
- Sawdust	Yes	--	Yes	Yes (not every day)	--
*Hygiene level	2	2	1	1	1
Grazing since:	22 June '13	No grazing	6 June'13	10 June'13	No grazing

* The term "mean" means the average value taken over the period of six months (January-July '13)

**Hygiene level is a comparison between the five herds.

Cownumber	Herd	Scoredate	Coverage	1 = Present; 0 = Absent			Length of unbroken skin	Length of broken skin	Location
				Granulation tissue	Scar tissue	Erythema			
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

Fig. 1 Score-diagram

Aspect of coverage	Length of lesion	Length of wound	Location
0 = No coverage	1 < 5 cm	1 < 5 cm	1 Pit
1 = Healing crust	2 > 5 < 15 cm	2 > 5 < 10 cm	2 Short arm
2 = Exudate/transudate/hairs	3 > 15 cm	3 > 10 cm	3 Long arm
3 = Smear/sebum/fat			4 Whole Y/half Y
			5 Long arm+pit
			6 Short arm+pit

Fig. 2 Descriptive characteristics



Fig. 3 Y-shaped lesion

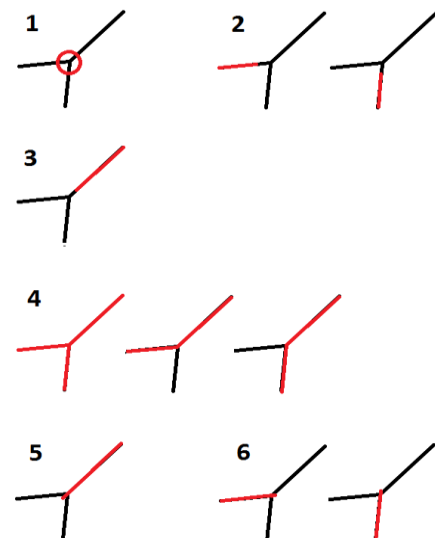
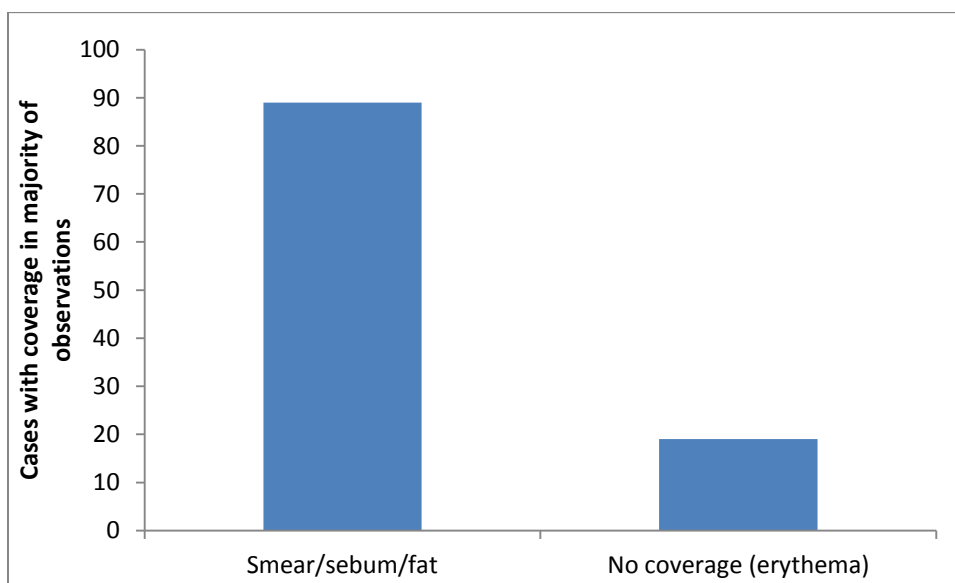
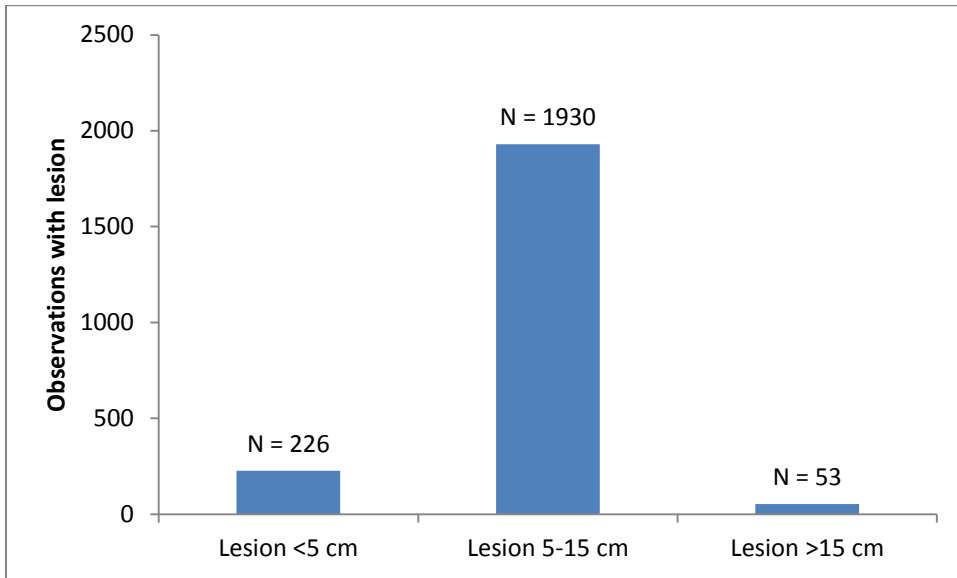


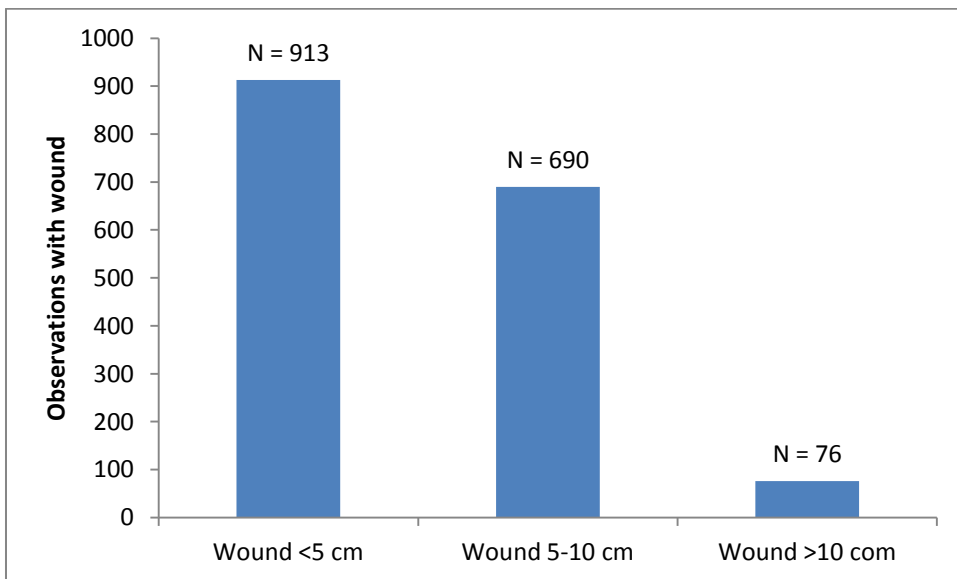
Fig. 4 locations



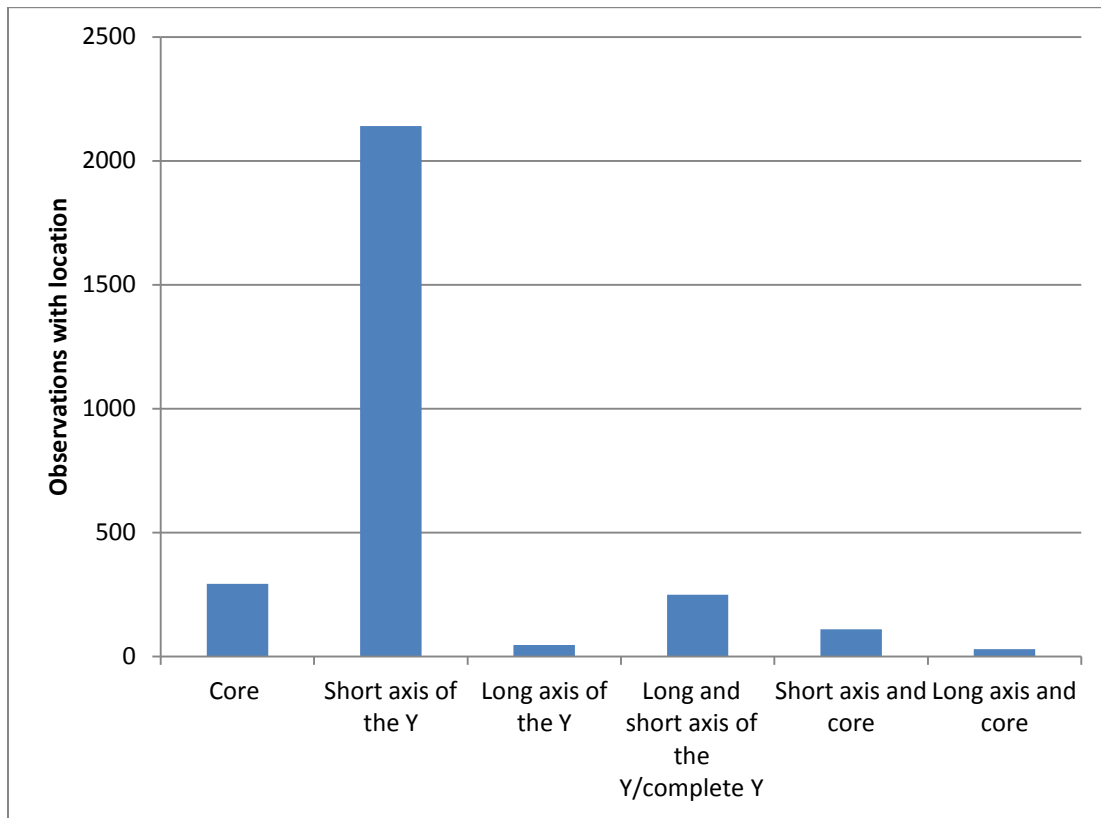
Graph 1 coverag of mild lesions



Graph 2 Observations with lesion (N = 2209) - Distribution of length of lesion.



Graph 3 Observations with wound (N = 1679) - Distribution of length of wound.



Graph 4 Observations with location

Table 2 Prevalence per month, per farm and average prevalence

	Min. prevalence	Max. prevalence	Average prevalence
Farm A	27,5	39,7	34,5
Farm B	39,4	50,7	45,1
Farm C	35,2	44,0	40,2
Farm D	20,2	40,9	23,4
Farm E	34,6	50,0	42,6
All farms	31,4	45,1	37,2

Table 3 Cases with start and recovery known/unknown

Recovery \ Start	Start		Total
	Unknown	Known	
Unknown	83	71	154
Known	0	66	66
Total	83	137	220

Table 4 Healthy cows at risk

	Healthy cows at risk
Cases that are healthy at the start of the study	300 (383-83)
Cases that recover during study	66
Cases that have 2 episodes	19
Total	385

Table 5 Affected cases

	Affected cases
Cases that start during study	71
Cases that start and recover during study	66
Cases that start a second episode	19
Total	156

Fig. 5 Formula to calculate incidence

Affected cases / Healthy cows at risk

Testing period

$$156/385 = 0,405195$$

$$0,405195/23 \text{ weeks} * 100 \text{ animals} = 1,761717/100 \text{ cows at risk/week}$$