

UNDERSTANDING LAMENESS IN SHEEP



Causes of lameness in sheep

When investigating lameness in sheep it is important to consider that there are numerous causes, both infectious and non-infectious and a correct diagnosis is essential to ensure effective management and prevention. The common causes of lameness are listed below.

Infectious Causes

- ♣ **Strawberry footrot** (proliferative dermatitis): Bacterial infection (*Dermatophilus congolensis*) leading to scabs on the legs from the coronet to the knee or hock. Lesions below the fetlock are most common and sheep may become extremely lame if the coronary band is involved.
- ♣ **Orf (scabby mouth)**: Viral infection of the foot, scabs develop above the coronet with no involvement of the hoof. Hooves may slough with multiple lesions on the coronary band.
- ♣ **Arthritis**: Joint infection. May occur in young lambs following umbilical infection at birth or post marking/dipping lameness. May or may not have visibly swollen joints.
- ♣ **Foot abscess and septic arthritis**: Caused by bacterial infections entering through the interdigital skin, particularly if the skin is predisposed by sustained wet pasture conditions.
- ♣ **OID (Ovine Interdigital Dermatitis)**: Often precedes footrot and causes superficial inflammation (inflammation of the interdigital skin with no under-run).
- ♣ **Footrot**[^]: A highly contagious bacterial disease affecting the interdigital skin and horn of the hoof.
- ♣ **Bluetongue**[^]: An arthropod borne viral disease spread by *Culicoides* midges. May present as lameness with haemorrhaging at the coronary band, drooling, swelling of the lips, tongue and face and oral ulceration. Death can occur.

Exotic Causes of Lameness

- ♣ **Contagious Ovine Digital Dermatitis (CODD)**^{^*}: More severe infection than footrot commonly reported in the UK. It causes detachment of the hoof horn, and it associated with *Treponema* spp – a bacterial infection.
- ♣ **Foot and Mouth Disease**^{^*}: A highly contagious viral disease. Sheep may show lameness due to inflammation of the coronary band or interdigital skin, and erosions/ulcers on the dental pad and tongue.

Non-Infectious Causes

- ♣ **Trauma**: Cuts, bruises, or foreign bodies (e.g. grass seeds).
- ♣ **Oversgrown hooves**: Predispose to abnormal gait and secondary infections.
- ♣ **White Line Disease/Shelly Hoof**: Damage to the area where the sole meets the hoof wall. Limited studies have highlighted acidosis/laminitis, nutritional imbalances, the environment, and infectious causes (*Fusobacterium necrophorum* and *Dichelobacter nodosus*) as potential contributing factors to the disease.¹ There is also likely to be a genetic association. White Line Disease often leads to separation of the hoof wall from the sensitive tissues underneath resulting in formation of a cavity referred to as “Shelly Hoof”.
- ♣ **Laminitis**: inflammation of the sensitive laminae due to ingestion of excessive carbohydrates (either grain overload or pasture acidosis).

[^] Notifiable disease; * Emergency Animal Disease.

Report suspicion of a notifiable disease to the 24/7 Emergency Animal Disease Hotline 1800 675 888 or contact your local Animal Health Officer.

Figure 1: Causes of lameness in sheep:



Strawberry footrot (*Dermatophilus congolensis*)

- Scabs on the legs between the coronary band and knee/hock.
- Scabs break open to reveal red, bleeding tissue.



Scabby Mouth (Orf virus)

- Scabs on the feet, just above coronary band.
- May be typical scabby mouth lesions on other sheep.



Foot & Mouth Disease

- Blanching at coronary band.
- $\pm$ mild lameness.
- Virus exotic to Aust.



Bluetongue

- Swollen coronary band.
- $\pm$ mild lameness.
- Virus only in north-eastern Aust.



Contagious Ovine Digital Dermatitis (CODD)

- Similar appearance to footrot.
- $\pm$ severe lameness.
- Hoof wall & sole $\pm$ slough
- caused by bacteria *Treponema* spp.
- Exotic to Aust.



Arthritis

- Single or multi-limb lameness
- Joint swelling
- Reduced range of motion in joint.
- Often affects lambs but may see chronic cases in older sheep.



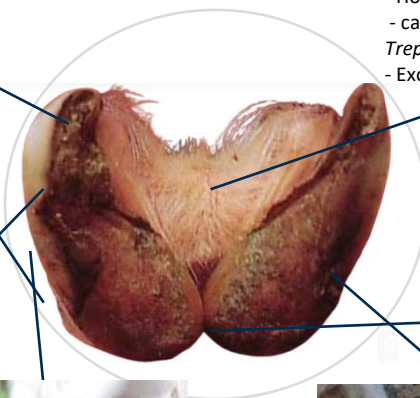
Foot abscess

- Sudden onset lameness
- Minimal weight bearing on foot.
- Often single limb affected.
- Swelling.
- May see pus from abscess.



Ovine Interdigital Dermatitis (OID)

- Interdigital skin hairless, red, moist.
- Thickening of interdigital skin.
- Colloquially referred to as 'Scald'.
- **No under-run**



Toe/Heel abscess

- Pain on pressure application to toe or heel bulb region.
- Pocket of pus/ black material often identified on trimming.
- Sudden onset pain.
- Often single limb.



White Line Disease (WLD)

- Damage and separation of the area where the sole meets the hoof wall.
- Often associated with acidosis/grain feeding.
- Often preludes Shelly Hoof.



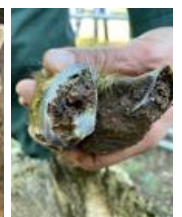
Shelly Hoof

- Separation of hoof wall from sensitive tissue underneath the wall.
- $\rightarrow$ cavity which often packs with dirt.
- Can lead to toe abscess.
- May or may not be lame.



Laminitis

- Multiple limb lameness.
- Feet may feel hot or there may be no obvious signs.
- May see changes to the white line, swelling at the coronary band or secondary abscessation.



Footrot

- Often multi-limb lameness.
- Affects interdigital skin and horn of hoof.
- Obvious smell.
- Often symmetrical.
- High percentage of lame sheep.

What is 'Scald'?

The term 'scald' or 'clover scald' is a common term used to describe a lameness condition associated with inflammation or infection of the interdigital skin. Its existence leads to confusion, complicating footrot diagnosis and giving producers the opportunity to "bury their head in the sand." It is in the opinion of the author and many other experts in the area that a farmer-diagnosis of scald, associated with significant lameness is footrot of some form². As scald refers to inflammation of the interdigital skin, a diagnosis of 'scald' may refer to ovine interdigital dermatitis (OID), benign footrot, or early virulent footrot. To differentiate between these conditions, do the following:

- Examine more sheep to detect under-run lesions.
- Check for disease progression by re-examining in 2-3 weeks.
- Swab feet to detect the presence of footrot bacteria.



Picture: Australian Wool Innovation Ltd, Footrot, A guide to identification and control in the field, 2020

Summary of lameness by cause

Bacterial	Viral	Parasitic	Other
Footrot [^]	Scabby Mouth	<i>Strongyloides</i>	Trauma
Foot abscess	FMD ^{^*}	Trombiculid mites	Hoof overgrown
Strawberry footrot	Bluetongue	Screen worm fly ^{^*}	White line disease
Post dipping lameness			Shelly hoof
Septic arthritis			Lameness
CODD ^{^*}			

[^] Notifiable disease

^{*} Exotic to Australia

Epidemiology of bacterial hoof infections

Disease	Tissue affected	Agents	Prevalence
Toe abscess (one digit)	Sensitive laminae (infection via cracks in horn)	Various	5%
Foot abscess (one digit, acute, swelling, pus)	Joint, ligament, tendon	<i>F. necrophorum</i> <i>A. pyogenes</i>	10-20%
OID (scald)	Interdigital skin	<i>F. necrophorum</i>	30%
Benign footrot [^]	Interdigital skin	<i>D. nodosus</i> (low virulence) ± <i>F. necrophorum</i>	20+%
Virulent footrot [^]	Interdigital skin & sensitive laminae of hoof wall & sole	<i>D. nodosus</i> (high virulence) ± <i>F. necrophorum</i>	1-5%

[^] Notifiable disease

Treatment options for foot conditions.

- Abscesses are best drained, but this is often impractical.
- Standing in a foot bath with 10% zinc sulphate and a wetting agent for 10 minutes will reduce surface contamination of the hoof but does not penetrate deeper layers.
- Antibiotics are the most effective choice but require at least a 5-day course to treat chronic infections. 2-3 treatments with long acting oxytetracycline or procaine penicillin are the most popular treatments, but chronic lesions may result in prolonged lameness due to scar tissue in hoof joints.

UNDERSTANDING FOOTROT



Environmental and nutritional factors often contribute to the development of lameness.

- ♣ **Wet, muddy conditions:** Soften hooves, promote bacterial survival, and spread. Prolonged wetting of the feet causes maceration and damage to the interdigital skin, allowing bacterial infection.
- ♣ **Rough ground:** Can cause sole bruising or penetration, predisposing to foot abscess. The heavier the sheep (e.g. rams and pregnant ewes) the greater the risk.
- ♣ **Stubble/grass seeds:** May damage the interdigital skin predisposing to infection and lameness.
- ♣ **Poor underfoot hygiene:** Increases exposure to pathogens.
- ♣ **Incorrect trimming:** Incorrect or excessive trimming exposes the sensitive structures of the foot, predisposing to abscess and granuloma formation.
- ♣ **Nutritional deficiencies:** Particularly zinc and biotin, can weaken hoof integrity. Selenium, copper and cobalt/B₁₂ are also important.
- ♣ **Acidosis:** Excess cereal grain or fermentable carbohydrate found in some pastures can cause inflammation of the feet.

Causes and transmission

Footrot is an infectious disease of sheep, cattle and goats caused by the bacterium *Dichelobacter nodosus*. It occurs throughout Australia but is most prevalent in the medium to high rainfall areas (> 500mm per annum).

The footrot bacteria need the feet of infected animals to survive. The bacteria can survive indefinitely in pockets of infection inside the feet of infected animals, even under dry conditions. The bacteria cannot survive for more than fourteen days in soil.

The basic principles to be aware of are:

- There are many strains of footrot ranging in their ability to cause disease.
- Footrot most commonly gets onto farms via the feet of infected sheep, goats or occasionally cattle. The disease can come from straying livestock or from recently purchased sheep or cattle. Rams should not be discounted as a potential source of introduction.
- Boots, tyres and wildlife are of lesser importance in the transmission of footrot but should still be considered a risk.
- Farms are not infected with footrot, the animals are.
- A paddock which has had no sheep, goats or cattle in it for fourteen days can be regarded as free from footrot. Clean (uninfected) sheep can be put in such a paddock with confidence that they will not contract footrot.
- Footrot bacteria can be found on healthy looking feet if the sheep have come from a footrot infected flock or in pockets left in partially healed feet. Don't assume your new sheep are free from footrot just because their feet look healthy.

The severity of footrot depends on three factors:

1. **Disease agent (Strain of footrot bacteria):** Benign strains can never cause severe disease at a flock level although a very small proportion of a flock may develop some underrunning of the hoof. In contrast, highly virulent strains will cause severe disease in a high proportion of the flock when the environment favours their spread and development in feet.

2. **Host (sheep factors):** Some breeds of sheep are more resistant to footrot than others. For example, British breed sheep are less likely than Merino sheep to develop severe underrunning even when infected with virulent strains of footrot. In contrast, Merinos and shedding breeds tend to be badly affected when infected with virulent strains. As an illustration, Figure 3 shows the results of footrot infection in five breeds of sheep run as a single flock on irrigated pasture for fourteen weeks. As well as differences between breeds there are substantial differences in footrot resistance between individual sheep within breeds.

3. **Environmental factors:** Moisture and temperature are important factors affecting the transmission and expression of footrot. Research shows that footrot outbreaks only occur after sustained periods of wet conditions and when the mean daily temperatures consistently exceed 10°C. If temperatures are too low in winter, footrot will not spread between sheep, even though moisture is not limiting. Footrot will not spread under hot, dry conditions. As a guide, outbreaks are unlikely to occur in spring unless preceded by winter rainfall exceeding an average of 50mm/month. In summer 125 mm/month is required and, in autumn, 60 mm/month⁴. This is why the main footrot spread period is during wet autumns, mild winters and spring.

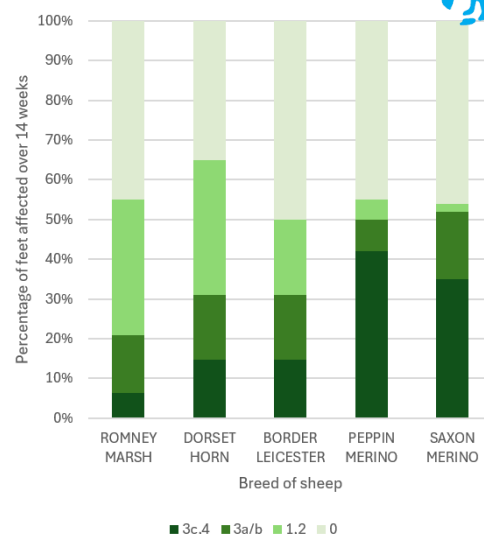
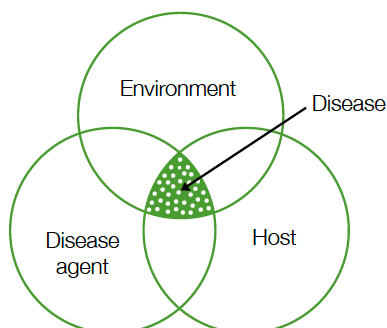


Figure 3: The distribution of footrot lesions in 5 breeds of sheep according to footscores over a transmission period of 14 weeks. 1984, Emery, D.L, Stewart, D.J & Clark, B.L. Adapted with permission.

Figure 4: Factors affecting disease expression:



Ref: awi-sheep-connect-sa-2020-footrot-a5-booklet.pdf

Take home message: Footrot expression is influenced by environmental, agent and host factors. Virulent strains of bacteria may be present but not cause disease if environmental conditions are unfavourable or the host has a high level of footrot resistance. Conversely, benign bacterial strains may still cause significant lameness if environmental conditions are optimal and host susceptibility is high.

Footrot Spread:

As conditions dry off in summer many animals will self-cure and the prevalence of lameness declines. Footrot bacteria will remain present in the feet of chronically infected animals, either in the interdigital skin or within pockets in the hoof. Upon suitable conditions the bacteria will become active, and infection may spread to other animals in the flock. Footrot spreads in moisture films on contaminated pasture or in muddy yards. If suitably predisposed by wet conditions a large proportion of a mob can be affected within one to two weeks of exposure to the bacteria. Spread within a mob is assisted by the natural flocking instinct of sheep, particularly when there is heavy contamination around common feeding and drinking areas. Yarding of sheep will accelerate spread and it is not uncommon to see an increase in lameness following routine yarding events such as lamb marking and weaning. Footrot can occur in sheep of all ages. Generally, the severity of lesions in ewes increases with age due to chronic infection. Lambs may develop severe under-run at a young age due to the softness of their feet. Prior natural infection does not provide immunity to subsequent challenges.

Economic and welfare impacts

Footrot can have a major impact on flock productivity and profitability. Lameness and pain in affected animals reduce their mobility and ability to graze efficiently. This results in poorer growth rates, longer finishing times, higher mortality rates, reduced wool production and quality (fibre diameter and tensile strength is affected) and lower ewe fertility. Footrot can be a major animal welfare issue for sheep. Infection and erosion of the sensitive tissues in the feet can cause extreme pain, and in severe cases the hard horn of the hoof may slough off. Often, animals cannot bear weight on affected feet and if more than one foot is affected, they may be unable to stand. Affected sheep limp, carry the affected leg and may graze on their knees. Reluctance to walk and graze lead to emaciation and increased risk of death due to under-nutrition or other conditions.

Lambing percentages and fleece weights are estimated to be reduced by 10% in sheep with at least one severely affected foot. The greater the severity of footrot in a flock, the greater the impact on productivity and profitability.

The following tables show the potential impact of footrot on a fat lamb and store lamb operation, assuming 80% of ewes are affected and have an average of two severely infected feet.

Production parameter	Cost (per ewe)	Assumptions
Direct Costs		
<i>Reduced pre-weaning lamb weight gain (-5kg)</i>	\$1.77	150% scanning, 123% lambs to sale, \$8/kg dressed
<i>Reduced post-weaning lamb weight gain (-7% during active footrot)</i>	\$4.32	100-day fattening period, average growth of 250g/head/day. Footrot active for 60/100-day period.
<i>Reduced conception rates (12 fewer lambs born per 100 ewes)</i>	\$9.98	150% scanning (clean) vs 138% (footrot affected), 7% loss in singles, 20% loss in twins, 2% marking to weaning loss.
<i>Reduced value of cull for age ewes.</i>	\$0.80	20% CFA ewes sold at 20% discount.
<i>Reduced wool production (-8%)</i>	\$1.27	Average wool production of \$19.90/ewe.
<i>Treatment cost of severely affected animals</i>	\$0.40	10% of affected ewes require antibiotics.
<i>Footbathing at yarding</i>	\$0.68	Labour and chemical costs for 5 yardings.
Indirect Costs		
<i>Feed costs to recover loss in ewe bodyweight.</i>	\$1.76	Feeding introduced 3 weeks earlier at \$350 per tonne and 0.3 kg per ewe per day.
<i>Increased mortality rates and associated replacement costs.</i>	\$1.60	Increased mortality from flystrike, pregnancy toxaemia, hypocalcaemia etc. Cost of replacement ewe= \$200/head.
<i>Increased labour associated with lameness</i>	\$0.32	One hour per 100 ewes per year.
Total	\$22.90/ewe	

Table 1: An estimate of the economic impact of footrot on a prime lamb operation selling lambs at approx. 58Kg LW and assuming 80% of ewes are affected with an average of 2 severely infected feet.

Production parameter	Cost (per ewe)	Assumptions
Direct Costs		
<i>Reduced pre-weaning lamb weight gain (-5kg)</i>	\$1.77	150% scanning, 123% lambs to sale, \$8/kg dressed
<i>Reduced conception rates (12 fewer lambs born per 100 ewes)</i>	\$5.18	150% scanning (clean) vs 138% (footrot affected), 7% loss in singles, 20% loss in twins, 2% marking to weaning loss.
<i>Reduced value of cull for age ewes.</i>	\$0.80	20% CFA ewes sold at 20% discount.
<i>Reduced wool production (-8%)</i>	\$1.27	Average wool production of \$19.90/ewe.
<i>Treatment cost of severely affected animals</i>	\$0.40	10% of affected ewes require antibiotics.
<i>Footbathing at yarding</i>	\$0.68	Labour and chemical costs for 5x yardings.
Indirect Costs		
<i>Feed costs to recover loss in ewe bodyweight.</i>	\$1.76	Feeding introduced 3 weeks earlier at \$350 per tonne and 0.3 kg per ewe per day.
<i>Increased mortality rates and associated replacement costs.</i>	\$1.60	Increased mortality from flystrike, pregnancy toxaemia, hypocalcaemia etc. Cost of replacement ewe= \$200/head.
<i>Increased labour associated with lameness</i>	\$0.32	One hour per 100 ewes per year.
<i>Loss of marketability</i>	\$9.30	Discount of \$0.7/kg for 30kg store lamb
Total	\$23.08/ewe	

Table 2: An estimate of the economic impact of footrot on a store lamb operation selling lambs at approx. 30Kg LW and assuming 80% of ewes are affected with an average of 2 severely infected feet.

In a prime lamb operation selling fat lambs the two biggest contributors affecting production are reduced fertility and depressed growth rates, both pre and post weaning. In a store lamb operation reduced fertility remains a major contributor, with loss of marketability another limitation to profitability. It has been suggested that in the current market footrot may depress a trade lambs value by up to a \$1/kg for lambs under 35kg and \$0.1-\$0.2/kg for lambs over 35kg liveweight.⁵

The cost of footrot will vary substantially between properties so these tables should be used as a guide only.

The AWI footrot tool was developed to help producers understand the financial cost of the disease on their farm and to evaluate the cost effectiveness of different strategies to control or eradicate the disease. Visit <https://www.wool.com/footrot>.

References:

1. Best, C.M., Roden, J., Phillips, K., Pyatt, A.Z. and Behnke, M.C. 2021. Prevalence and temporal dynamics of white line disease in sheep: an exploratory investigation into disease distribution and associated risk factors. *Veterinary Sciences*, 8(6).
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4. Graham, N.P.H & Egerton, J.R, Pathogenesis of ovine footrot: the role of some environmental factors, *Australian Veterinary Journal*, 1968, Vol. 44, pg. 235-240.
5. W. Nolan (personal communication July 3rd 2025).