Critically Appraised Topic (CAT): Evidence Base behind Foot Trimming in UK Dairy Cattle (2016)

Al Manning BVetMed MRCVS
Senior Clinical Training Scholar in Bovine Health and Production
The Royal Veterinary College

Dr Nick J. Bell MA VetMB PhD PG cert Vet. Ed. FHEA MRCVS
Senior lecturer in Veterinary Livestock Extension Services
The Royal Veterinary College

Full article https://www.magonlinelibrary.com/doi/pdf/10.12968/live.2016.21.1.6
For article on technicalities of Five Step Trimming see Mahendran and Bell 2015
https://inpractice.bmj.com/content/inpract/37/5/231.full.pdf

Foot Trimming Technique – Critical Appraisal of the Evidence

A search of the scientific literature revealed five peer review papers and one notable conference paper investigating claw trimming technique (Table 1).

Table 1 Summary of the five peer-reviewed papers and one conference abstract describing aspects of claw trimming technique in cattle.

Author, date and country	Study Population	Study Design	Outcomes	Key Results	Study Weaknesses
Phillips et al (2000), UK	36 distal limbs from nine heifers of mixed breeds at approximately 9 mo.	Cross-over intervention study comparing frictional characteristic of hooves before and after trimming.	Mean coefficient of static friction.	DFSM trimming increased claw grip: • Prior to trimming – 0.361µ • After trimming – 0.395µ P<0.001	Heifers selected were unrepresentative of the national dairy herd: • 6 different breeds • 9 months old • 78kg of load on each leg
Van der Tol et al (2004), the Netherlands	Hindlimbs from five Holstein-Friesian cows from the experimental farm at Utrecht University.	Clinical trial comparing claw balance before and after trimming intervention. Each cow used as its own control.	Weight balance between medial and lateral claws.	Corrective trimming using the Dutch Five Step Method (DFSM) improved balance across the medial and lateral claws: Before trimming – Lateral:Medial (80:20) After trimming – Lateral: Medial (70:30) Trimming increased claw floor contact area by 45%, reducing average pressure, but not maximum pressure	Small sample size. No follow up. Weight bearing from each leg measured at different times and added up to 110% of the animal's weight. All trims performed by a single trimmer, harder to extrapolate to the general population of trimmers
Nuss and Paulus (2006), UK	Hindfeet from 40 Simmental cows at an abattoir.	Cross-over intervention study before and after a DFSM trim.	Toe and sole depth	In step 2 of the Dutch Five Step, Nuss et al found that when both claws are trimmed to the same depth, the lateral claw horn is significantly thinner (2.71mm) than the medial (5mm). Strict adherence to step 2 could lead to over-trimming the lateral sole.	Beef cows are likely to have different trimming requirements to Holstein-Friesians. Lack of detail on how heel balance was judged.
Burgi and Cook (2008), USA	Personal experience.	Opinion based on field comparisons.	Proposed three adaptations to the Dutch Five Step.	1. Increasing the dorsal wall angle from 48° to 52° 2. Trimming the flat sole surface of the medial claw to the sum of the dorsal wall length and sole thickness (around 80mm) 3. A deeper model of the lateral claw sole in step 3.	Lack of evidence. Impractical to measure dorsal wall angle.
Ouweltjes et al (2009), the Netherlands	400 Holstein herd	Randomised positive control trial with 5 groups, 4 free stall Automatic Milking: 1. Tx slatted concrete 2. Tx slatted rubber 3. Cx slatted concrete 4. Cx slatted rubber 5. Conventional milking Tx Concave (Norwegian) trimming with 3-5mm of sole dug out over the claw bone. Cx Dutch 5step.	Lesion prevalence Claw dimensions Activity	No significant difference between trimming methods and lesions. Cows on rubber had significantly fewer sole haemorrhages at the 3 month inspection (22 vs 48% prevalence).	Cows from one farm, with a low incidence of lameness.

Archer et al (2015), UK	68 Holstein-Friesian dairy cows collected post mortem, 219 claws. From Scotland's Rural College Dairy Research Centre, Dumfries	Prospective cohort study. Medial and lateral claws of hindfeet were examined under computed tomography.	CT images of hindfeet used to measure dorsal wall length and sole thickness.	Strict application of steps one and two of the Dutch Five Step would cut 55% of claws too short. The authors propose that the minimum recommended claw length stated in training materials for all Holstein-Friesian cows should be increased to 90mm. Minimum dorsal wall length increases by 1mm per year of age.	When measuring the dorsal wall in step one, there is ambiguity over where the primary measurement should take place. This study measured from toe to the junction of perioplic horn and skin. There may also be confusion in interpreting landmarks from CT images in the live animal. All animals from the same farm. In vitro study, no evidence in the live animal. Lateral claws were included in the study which may be more variable in shape: 104 medial claws, 115 lateral. No account of dorsal wall curvature or disease.

Key:
Tx = Treatment
Cx = Control
Heifers = primiparous Cows

Foot Trimming Timing and Frequency– Critical Appraisal of the Evidence

With respect to foot trimming timing there were six peer review papers found on the timing of foot trimming in relation to lameness prevention (Table 2).

Table 2: Summary of the six peer-reviewed papers describing aspects of timing and frequency of foot trimming.

Author, date and country	Study Population	Study Design	Outcomes	Key Results	Study Weaknesses
Manson and Leaver (1988), UK	48 early to mid-lactation British Friesian cows.	Randomised matched control trial with four groups: 1. No trim, low protein diet 2. No trim, high protein diet 3. Pre-trial DFSM trim, low protein diet 4. Pre-trial DFSM trim, high protein diet Weekly locomotion scores (with prompt treatment), hoof measurements and production values were recorded.	Prevalence and incidence of lameness. Lesion incidence. Heel bulb hardness. Production values.	High protein level significantly increased ($p<0.001$) and trimming significantly reduced ($p<0.001$) the prevalence of lameness. Untrimmed cows had significantly higher locomotion scores, lameness incidence and sole ulcer incidence. Net hoof growth was significantly increased by trimming ($P<0.01$) Trimming significantly reduced the hardness of the heel bulb centre ($P<0.05$) but no other part of the foot. There were no significant differences in production values between groups.	Smaller cows than the current UK average, mean live weight was 550kg. Small sample size including 12 heifers.
Manske et al (2002), Sweden	A 2-year experiment on the effect of claw trimming on hoof health was performed in 77 Swedish dairy herds (3,444 dairy cattle). Swedish red or Swedish Holstein.	Randomised positive-control trial: Tx = Autumn and Spring trim Cx = Spring trim only.	Claw shape, presence of lameness and lesion type evaluated at the following spring trim. Lameness treatments between visits recorded.	At the Spring trim, the treatment group had reduced chance of: • Lameness (OR=0.66) • Sole Haemorrhage (OR=0.86) • Sole Ulcer (OR=0.59) • White Line Disease (OR=0.71) No significant difference in incidence of heel horn erosion and digital dermatitis. Between trims the control group had an increased chance of an acute episode of lameness (OR=2.02). No significant reduction in digital dermatitis incidence (OR=0.96) No significant difference between trimming success and stage of lactation.	Different trimmers being used, potential for inconsistent technique Different management systems to the UK. Not random, alternating allocation. More lame cows presented in the Tx group.
Hernandez et al (2007), USA	333 mid lactation (mean 204 days) Holstein cows from one farm in Florida.	Randomised negative control trial. Cows without apparent lameness were randomly allocated into: Tx = Foot inspection +/- trimming Cx = No examination All cows underwent routine foot trimming at drying off. Weekly locomotion scores to monitor lameness. Cows classified as lame in the first 200 days were excluded.	Incidence of lameness in late lactation. Cost benefit analysis.	No significant change in incidence of lameness in late lactation: Tx = 18% Cx = 24% P = 0.09 Costs based on 120 high yielding cows: Tx = $41,000 Cx = $48,000	Lame cows <200 days in milk were excluded from the study. Only one herd, too small a sample size to show a significant improvement. In the treatment group, only 11 cows (7%) had hoof lesions at intervention.
Leach et al (2012), UK	4 commercial farms in the UK. 1152 cows, 575 Cx, 577 Tx.	Randomised treatment vs negative control trial: Tx = Treating cows within 48 hours of being detected at fortnightly locomotion scorings Cx = Conventional approach was farm specific (eg regular foot trimmer)	Median time to trim in control group. Lameness prevalence Milk yield	In the control group the median time to trim after a case of lameness was 65d. Early intervention significantly reduced prevalence of lameness 4 weeks after treatment. At 2 and 6-10 weeks this difference was not significant. No effect of early treatment on milk yield	Only hindlimb lameness assessed.
Groenevelt et al (2014), UK	23,691 locomotion scores from 1,195 cows on 4 UK dairy farms	Randomised matched treatment control trial. At the start of the study animals were matched by parity and stage of lactation and randomly allocated to control or treatment. Cows were enrolled when fortnightly locomotion	Locomotion score	Trimming is linked to improved locomotion score within 2 weeks. 2 weeks after Lameness: 78% of the trimmed group were sound compared to 66% of the control.	Control group allowed for farmer treatment, which is inherently variable Only hindlimb lameness assessed.

		score showed they went lame from being sound. Tx = Trimming at 3-48 hours after lameness Cx = No intervention Farmers blinded to the study, but allowed to treat Cx and Tx groups as they saw fit.		18 weeks after lameness: 41% of the trimmed group were sound compared to 13% of the control. This suggests follow-up trimming interventions may be beneficial.	
Maxwell et al (2015), UK	282 heifers from 8 farms in the UK 305d yield >8,500L	Randomised treatment vs negative control trial. Tx = A single foot-trim in early lactation (50-80d). Cx = no intervention.	Milk yield Cost benefit analysis	No significant difference in 305d milk yield between treatment (7,727L) and control (7,646L). 81L difference (£10.53 – based on margin of 13ppL) compared to the cost of the intervention (£15). Although not cost effective in the whole group, a targeted trim of lame heifers may be beneficial. This is also encouraged in terms of improved welfare.	Single intervention only, no follow up trims. Only production values recorded, no data collected on lameness. Trimming at peak lactation is an unusual timing. Not random, alternating allocation. Different trimmers were used, potential for inconsistency.

Tx = Treatment

Cx = Control

OR = Odds Ratio

ppL = pence per Litre

WLD = White Line Disease

Conclusions

There is a lot of evidence to support the DFSM as a trimming technique although small modifications remain an area for further investigation. There are fewer papers that investigate regular routine foot trimming, but none that show a detrimental effect and one showing a beneficial effect. Routine claw trimming is likely to be cost-beneficial but targeted intervention with mobility scoring could be more cost-beneficial, particularly in low prevalence and low incidence herds. Therefore trimming protocols should be decided locally, and should be worked out in conjunction with trimmers and veterinarians. Early intervention in cases of lameness has been shown to produce good results, however follow up trims are recommended by many professionals. There are no published reports on efficacy of follow up inspections, and this recommendation is largely based on opinion.

Key Points

1. The majority of trimmers and studies are using a method based on the Dutch-5-Step.
2. When judging toe length clarity is needed on where to measure from in step one and when to deviate (show caution) due to disease.
3. Lame cows (mobility score 2 and 3) should be inspected immediately (within 48 hours) and treated with a block and NSAID with follow up after 2-5 weeks.
4. Lame cows should be targeted and prioritised over routine trims. Chronically lame animals non-responsive to corrective trims should be culled.
5. All cows in the herd should be inspected at a frequency determined by herd conditions, season and individual cow factors, ideally using mobility scores.
6. Routine foot checks are cost-beneficial for the herd with median levels of lesion incidence. More targeted intervention is likely to be more cost-beneficial for low incidence herds.

Key Words

Foot trimming Lameness Routine Dutch Mobility

New studies since this CAT was written:

Effect of hoof trimmer intervention in moderately lame
cows on lameness progression and milk yield

https://www.sciencedirect.com/science/article/pii/S0022030217308147

Lower odds of sole ulcers in the following lactation in dairy cows that received hoof trimming around drying off https://www.sciencedirect.com/science/article/pii/S1090023319301418

References

AHDB Dairy, 2015. http://dairy.ahdb.org.uk/technical-information/animal-health-welfare/lameness/husbandry-prevention/mobility-scoring/#.Vi5NtLfhBD8

Amory, J. R., Barker, Z. E., Wright, J. L., Mason, S. A., Blowey, R. W., & Green, L. E. (2008). Associations between sole ulcer, white line disease and digital dermatitis and the milk yield of 1824 dairy cows on 30 dairy cow farms in England and Wales from February 2003-November 2004. *Preventive Veterinary Medicine*, *83*(3-4), 381–91. http://doi.org/10.1016/j.prevetmed.2007.09.007

Archer, S., Bell, N., & Huxley, J. (2010). Lameness in UK dairy cows: a review of the current status. *In Practice*, *32*(10), 492–504. http://doi.org/10.1136/inp.c6672

Archer, S. C., Newsome, R., Dibble, H., Sturrock, C. J., Chagunda, M. G. G., Mason, C. S., & Huxley, J. N. (2015). Claw length recommendations for dairy cow foot trimming. *The Veterinary Record*, vetrec–2015–103197. http://doi.org/10.1136/vr.103197

Argáez-Rodríguez, F. J., Hird, D. W., Hernández de Anda, J., Read, D. H., & Rodríguez-Lainz, A. (1997). Papillomatous digital dermatitis on a commercial dairy farm in Mexicali, Mexico: incidence and effect on reproduction and milk production. *Preventive Veterinary Medicine*, *32*(3-4), 275–86. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9443334

Barker, Z. E. (2007, January 1). Epidemiology of lameness in dairy cows. Retrieved from http://wrap.warwick.ac.uk/1117/1/WRAP_THESIS_Barker_2007.pdf

Barker, Z. E., Leach, K. A., Whay, H. R., Bell, N. J., & Main, D. C. J. (2010). Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. *Journal of Dairy Science*, *93*(3), 932–41. http://doi.org/10.3168/jds.2009-2309

Bell, N. J., Potterton, S., Blowey, R., Whay, H. R., & Huxley, J. N. (2014). Disinfectant footbathing agents for the control of bovine digital dermatitis in dairy cattle. *Livestock*, *19*(1), 6–13. http://doi.org/10.12968/live.2014.19.1.6

Blowey, R. W. (1993). *Cattle Lameness and Hoofcare: An Illustrated Guide*. Farming Press. Retrieved from https://books.google.com/books?id=SXSNQgAACAAJ&pgis=1

Blowey, R. (2008). *Cattle Lameness and Hoofcare: An Illustrated Guide*. Old Pond. Retrieved from https://books.google.co.uk/books/about/Cattle_Lameness_and_Hoofcare.html?id=dseGGAAACAAJ&pgis=1

Burgi, K., Cook, N. (2008) 'Three Adaptations to the Functional Trimming Method' Lameness in Ruminants, Kuopio Finland

Collick, D., Ward, W., & Dobson, H. (1989). Associations between types of lameness and fertility. *Veterinary Record*, *125*(5), 103–106. http://doi.org/10.1136/vr.125.5.103

Divers, T. J., & Peek, S. F. (2008). *Rebhun's Diseases of Dairy Cattle*. Elsevier Health Sciences. Retrieved from https://books.google.com/books?id=PbEWJrEtECIC&pgis=1

Enting, H., Kooij, D., Dijkhuizen, A. A., Huirne, R. B. M., & Noordhuizen-Stassen, E. N. (1997). Economic losses due to clinical lameness in dairy cattle. *Livestock Production Science*, *49*(3), 259–267. http://doi.org/10.1016/S0301-6226(97)00051-1

Green, L. E., Hedges, V. J., Schukken, Y. H., Blowey, R. W., & Packington, A. J. (2002). The impact of clinical lameness on the milk yield of dairy cows. *Journal of Dairy Science*, *85*(9), 2250–6. http://doi.org/10.3168/jds.S0022-0302(02)74304-X

Groenevelt, M., Main, D. C. J., Tisdall, D., Knowles, T. G., & Bell, N. J. (2014). Measuring the response to therapeutic foot trimming in dairy cows with fortnightly lameness scoring. *Veterinary Journal (London, England : 1997)*, *201*(3), 283–8. http://doi.org/10.1016/j.tvjl.2014.05.017

Hedges, J., Blowey, R. W., Packington, A. J., O'Callaghan, C. J., & Green, L. E. (2001). A longitudinal field trial of the effect of biotin on lameness in dairy cows. *Journal of Dairy Science*, *84*(9), 1969–75. http://doi.org/10.3168/jds.S0022-0302(01)74639-5

Hernandez, J. A., Garbarino, E. J., Shearer, J. K., Risco, C. A., & Thatcher, W. W. (2007). Evaluation of the efficacy of prophylactic hoof health examination and trimming during midlactation in reducing the incidence of lameness during late lactation in dairy cows. *Journal of the American Veterinary Medical Association*, *230*(1), 89–93. http://doi.org/10.2460/javma.230.1.89

Hulsen, J. (2006). *Hooves: A Practical Guide for Hoof Health*. Roodbont. Retrieved from https://books.google.co.uk/books/about/Hooves.html?id=A0XLygAACAAJ&pgis=1

Kofler, J. (1999). Clinical study of toe ulcer and necrosis of the apex of the distal phalanx in 53 cattle. *Veterinary Journal (London, England : 1997)*, *157*(2), 139–47. http://doi.org/10.1053/tvjl.1998.0290Kossaibati, M. A., & Esslemont, R. J. (1997). The costs of production diseases in dairy herds in England. *The Veterinary Journal*, *154*(1), 41–51. http://doi.org/10.1016/S1090-0233(05)80007-3

Leach, K. A., Tisdall, D. A., Bell, N. J., Main, D. C. J., & Green, L. E. (2012). The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. *Veterinary Journal (London, England : 1997)*, *193*(3), 626–32. http://doi.org/10.1016/j.tvjl.2012.06.043

Lucey, S., Rowlands, G. J., & Russell, A. M. (1986). The association between lameness and fertility in dairy cows. *The Veterinary Record*, *118*(23), 628–31. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3739154

Mahendran, S., & Bell, N. (2015). Lameness in cattle 2. Managing claw health through appropriate trimming techniques. *In Practice*, *37*(5), 231–242. http://doi.org/10.1136/inp.h2011

Manske, T., Hultgren, J., & Bergsten, C. (2002). The effect of claw trimming on the hoof health of Swedish dairy cattle. *Preventive Veterinary Medicine*, *54*(2), 113–129. http://doi.org/10.1016/S0167-5877(02)00020-X

Manson, F. J., & Leaver, J. D. (2010). The effect of concentrate: silage ratio and of hoof trimming on lameness in dairy cattle. *Animal Production*, *49*(01), 15–22. http://doi.org/10.1017/S0003356100004207

Maxwell, O. J. R., Hudson, C. D., & Huxley, J. N. (2015). Effect of early lactation foot trimming in lame and non-lame dairy heifers: a randomised controlled trial. *The Veterinary Record*, *177*(4), 100. http://doi.org/10.1136/vr.103155

Murray, R. D., Downham, D. Y., Clarkson, M. J., Faull, W. B., Hughes, J. W., Manson, F. J., … Ward, W. R. (1996). Epidemiology of lameness in dairy cattle: description and analysis of foot lesions. *Veterinary Record*, *138*(24), 586–591. http://doi.org/10.1136/vr.138.24.586

Nuss, K., & Paulus, N. (2006). Measurements of claw dimensions in cows before and after functional trimming: a post-mortem study. *Veterinary Journal (London, England : 1997)*, *172*(2), 284–92. http://doi.org/10.1016/j.tvjl.2005.04.031

Ouweltjes, W., Holzhauer, M., van der Tol, P. P. J., & van der Werf, J. (2009). Effects of two trimming methods of dairy cattle on concrete or rubber-covered slatted floors. *Journal of Dairy Science*, *92*(3), 960–71. http://doi.org/10.3168/jds.2008-1559

Phillips, C. J. C., Chiy, P. C., Bucktrout, M. J., Collins, S. M., Gasson, C. J., Jenkins, A. C., & Paranhos da Costa, M. J. R. (2000). Frictional properties of cattle hooves and their conformation after trimming. *Veterinary Record*, *146*(21), 607–609. http://doi.org/10.1136/vr.146.21.607

Shearer, J. K., Amstel, S. R. Van, & Gonzalez, A. (2005). *Manual of Foot Care in Cattle*. Hoard's Dairyman Books. Retrieved from https://books.google.com/books?id=BvFeo6pFnXUC&pgis=1

Siebert, L., Eureka, S D.: "The Kansas adaptation to the Dutch hoof trimming method." *Hoof Health Conference Proceedings; Hoof Trimmers Association Inc*. 2005.

Sprecher, D. J., Hostetler, D. E., & Kaneene, J. B. (1997). A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. *Theriogenology*, *47*(6), 1179–1187. http://doi.org/10.1016/S0093-691X(97)00098-8

Thomas, H. J., Miguel-Pacheco, G. G., Bollard, N. J., Archer, S. C., Bell, N. J., Mason, C., … Huxley, J. N. (2015). Evaluation of treatments for claw horn lesions in dairy cows in a randomized controlled trial. *Journal of Dairy Science*, *98*(7), 4477–4486. http://doi.org/10.3168/jds.2014-8982

Thompson, P. N. (1998). Osteitis of the apex of the third phalanx following foot trimming in a dairy cow. *Journal of the South African Veterinary Association*, *69*(1), 23–6. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9646258

Toussaint Raven, E., 1985. Cattle footcare and claw trimming, 1st ed. Farming press Ltd, Suffolk, UK.

Tsuka, T., Ooshita, K., Sugiyama, A., Osaki, T., Okamoto, Y., Minami, S., & Imagawa, T. (2012). Quantitative evaluation of bone development of the distal phalanx of the cow hind limb using computed tomography. *Journal of Dairy Science*, *95*(1), 127–38. http://doi.org/10.3168/jds.2011-4316

Van der Tol, P. P. J., van der Beek, S. S., Metz, J. H. M., Noordhuizen-Stassen, E. N., Back, W., Braam, C. R., & Weijs, W. A. (2004). The effect of preventive trimming on weight bearing and force balance on the claws of dairy cattle. *Journal of Dairy Science*, *87*(6), 1732–8. http://doi.org/10.3168/jds.S0022-0302(04)73327-5

Vermunt, J. J., & Greenough, P. R. (1995). Structural characteristics of the bovine claw: Horn growth and wear, horn hardness and claw conformation. *British Veterinary Journal*, *151*(2), 157–180. http://doi.org/10.1016/S0007-1935(95)80007-7

Weaver, A. D., Jean, G. S., & Steiner, A. (2013). *Bovine Surgery and Lameness*. John Wiley & Sons. Retrieved from https://books.google.com/books?hl=en&lr=&id=ElMI6KE9t9EC&pgis=1

Willshire, J A., Bell N. (2009) 'An Economic Review Of Cattle Lameness' Cattle Practice 17 Nov 2009 Part 2

Willshire, J. A. (2012). The use of mobility score to predict dairy cow reproductive performance.