THE KANSAS ADAPTATION
TO THE DUTCH HOOF TRIMMING METHOD

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This article proposes an adaptation to the Dutch Method. In this Kansas adaptation the soles are trimmed to slope upward and inward. This differs from the conventional teaching of the Dutch Method where the soles are to be trimmed perpendicular to the cannon bone.[1]

Figures 1 and 2. Side-by-side comparison of two trimmed hooves which illustrates the adaptation.

Figure 1. Kansas Application

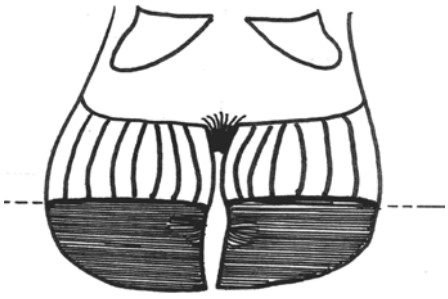

Figure 2. Conventional Dutch Method

Normal Sole Slope Definition
Sole slope defined - the plane of the distal surface of the trimmed toe is sloped proximally from abaxial to axial at an angle that is normally 3 to 4 degrees from a line perpendicular to the long axis of the cannon bone.

Objectives of This Article
For reasons that are given in the body of this article, I seldom use the Dutch Method. But when I do, the soles are sloped according to the Kansas Adaptation. This is done because a critical examination of the reasons given for trimming soles perpendicular reveals that there is no coherent justification for the use of this practice on free-stall cows. This will be explained in the article, and furthermore, it will be explained why trimming the soles sloped is beneficial, while trimming the soles perpendicular may actually do harm.

Other Useful Definitions

- Axial - the inner or medial aspect, example; the axial wall (inner wall, medial wall);
- Abaxial - the outer or lateral aspect, example; the abaxial wall (outer wall, lateral wall);
- Distal - remote, farther from any point of reference, example; the distal surface of the toe would be the sole surface as this is farther away from the main part of the cow than any other of the toe surfaces;
- Proximal - closer to any point of reference, example: the dew claws are proximal to the toes, i.e., the dew claws are closer to the main part of the cow than are the toes;

- Dorsal - meaning on top or above, example; the dorsal hoof wall is the top part of the hoof wall;
- Ventral - meaning bottom, below, or underneath, example: the sole is the ventral (bottom) surface of the hoof;
- Typical site - the area of the sole surface that is directly below the axial prominence on the heel of the coffin bone, this is the place where sole ulcers typically occur;
- Etiology - the sum of the causes of any disease, example; the etiology of the sole ulcer would refer to the chain of events that cause the development of an ulcer;
- Abaxial toe rotation - where the direction of long axis rotation is lateral (toward the outside of the hoof), axial toe rotation - where the direction of long axis rotation is medial (toward the inside of the hoof, an example of this type of toe rotation is the corkscrew claw);
- Axial tilt - a description used by Dr. Toussaint Raven for a toe that leans out (laterally) on its dorsal-ventral axis, on its long axis this would constitute an abaxial toe rotation.

Disclaimer

There are conclusions in this article that are based on logic and personal observations. In my opinion, these conclusions make sense, but in the strictest sense they have not been documented by research.

The main topic of this article is normal sole slope and while this has not been documented as being the normal state of the lifted hoof, it is, because by definition normal means the 'usual state' and sole slope is the usual state for the normal bovine hoof when it is lifted. The authenticity of this statement on normality should be self-evident to you from your own observations of normal hooves.

Normal Structure

A hindrance that is holding back a more practical understanding of how the bovine hoof should be trimmed are short-comings of a most fundamental nature: a lack of knowledge of basic normal structure and how this normal structure reacts to different environments. Two examples of this are normal sole slope and the self-shedding nature of the normal bovine sole. These are both very basic examples of normal structure. Normal sole slope would be evident to anyone who has trimmed a few thousand hooves, and the self-shedding sole, once explained, would be evident to any experienced hoof trimmer who trims cows housed in a variety of different environments. As hoof trimmers, we are charged with returning the overgrown hoof to normal. To do this first requires an understanding of what normal is. In conclusion, it is self-evident that to understand and deal with the abnormal, you must first know normal.

Toe Parameters

The normal structure of the epidermis of the bovine toe includes four parameters that are important for hoof trimming. These are: 1) sole thickness, 2) heel height, 3) wall length, and 4) sole slope.

The Importance of Recognizing What Normal Structure is for the Non-Weight Bearing Hoof

The normal weight bearing function of the hoof is dependent on its having a normal structure. The goal of hoof trimming is to return the hoof to its normal weight bearing function by restoring this normal structure.[2] However, the normal configuration of hoof structure changes when the hoof is lifted for trimming because doing this removes weight bearing. The most obvious component of this

change in normal is seen in the orientation of the surfaces of the soles. In the lifted non-weight bearing hoof the soles slope upward and inward. This slope is proximal from abaxial to axial at an angle that is normally 3 to 4 degrees from a line perpendicular to the cannon bone, as defined above. For the other three parameters of wall length, heel height, and sole thickness removing weight bearing has no effect on their normal magnitudes. However if, instead of being trimmed to normal slope, the soles are trimmed perpendicular to the cannon bone this will result in leaving the other parameters with abnormal magnitudes for length, height, and thickness, respectively. (This will be explained in more detail later in the article.) It is sensible that this will cause an abnormal distribution of weight bearing forces across the ground surfaces of the toes when the hoof again becomes weight bearing. While this has not been measured, common sense tells us that abnormally distributing weight bearing forces across the sole surfaces will likely result in increased sole contusion and disease. To summarize: *Since all hoof trimming is done while the hoof is in a non-weight bearing slate, i.e., when it is lifted, to attain the goal of returning the hoof to normal requires that we trim the hoof to the normal that actually exists during the time the hoof is lifted and we are working on it. This existing normal is the non-weight bearing normal and this includes normal sole slope.* The only way to negate the importance of recognizing and understanding the non-weight bearing normal structure would be to devise a technique to trim the hoof while the cow is standing on it. That way the existing normal would be the weight bearing normal. Since this is not likely to happen anytime soon, the realities that non-weight bearing normal structure have on the practice of hoof trimming will be explained further in the remainder of this article.

"What is Normal?" - The Problem of Normal Variation

In cattle there are normal variations in the magnitude of the toe parameters. This normal variation occurs between cattle groups that differ by age, breed, or sex, and between individuals who are of the same age, breed, and sex. Normal variation presents a problem during hoof trimming where the goal is to return the hoof to normal because what is 'normal' varies from animal to animal. Some examples will illustrate this:

Heel height - We have all seen adult Holsteins that are naturally shallow heeled and some that have naturally deeper heels. This is determined by inheritance and is an example of the normal range in heel heights. When trimming these cows, if we assume an average heel height of 1 1/2 inches[4] and trim all heels to this height, the bulbar sole thickness of a naturally shallow heeled cow will be under trimmed leaving it thicker than normal, and for a naturally deep heeled cow it will be over trimmed leaving it thinner than normal.

Dorsal wall length - The same can be said for dorsal wall length because some cows naturally have a longer toe, and some a shorter toe. If we assume an average dorsal wall length of 7.5 cm (3 in)[5], trimming all toes to this length, and then trim the soles to leave a 5 mm (1/4 in)[6] step at the toe end-cut; the result will be over-thinning of the apical sole in the naturally long toed cows and leaving it thicker than normal in the naturally short toed.

The problem of normal variation is made more severe when animals from different groups are included:

Age - Mature Holstein average values for dorsal wall length and heel height, for obvious reasons, will cause larger errors if applied to a group of Holsteins that are younger because that group as a

whole will have smaller feet, such as freshening or pre-freshening Holstein heifers.

Breed - Again, and for the same reasons, using average mature Holstein values for breeds that naturally have smaller feet, such as Jersey cows, is unworkable.

Normal variation can also cause differences between two toes on the same foot: We now know that the lateral epicondyle of the metatarsal bone is normally longer than the medial epicondyle.[7] This causes the lateral toe of the rear leg to protrude further distally than the medial toe. Because of this variation, if the lateral sole is trimmed down to the level of the medial sole, the usual result will be a lateral sole being thinned to less than its normal thickness, sometimes much less.[8]

Subjective and Objective Hoof Trimming Methods

There are two basic types of hoof trimming methods: subjective and objective.

The Dutch and White Line Methods[9] are subjective methods where the determination of normal sole thickness, from anterior to posterior, is based on using average values for dorsal wall length and heel height, respectively. Also, in the rear feet the practice of using the medial toe as a guide for trimming the lateral toe is advocated. As a result, both of these subjective hoof trimming methods are inherently weak at overcoming the problems posed by normal variation because average values cannot adequately define individual variation. Additionally, both methods teach that the correct plane of the trimmed soles is perpendicular to the cannon bone. An analysis of this teaching will show that this is also subjective.

The Kansas Method[10] is an objective method where the determination of normal sole thickness is based on using dehydrated (pith) and/or shedding overgrown sole horn as the depth of trimming guide for the sole. Since these types of sole horn can only occur *beyond the normal thickness,*[11] trimming the sole just short of their disappearance is an objective way to gauge when the sole has been returned to its normal thickness. Also, since pith and/or shedding sole horn occur across the entire extent of the sole, proper, from anterior to posterior and from medial to lateral, this yields normal dorsal wall length and heel height, respectively, when the entire distal surface of the toe is trimmed to the plane of the objectively gauged normal sole thickness. This also yields the normal plane of the trimmed soles in relationship to the cannon bone which is the proximally occurring abaxial to axial slope previously described. Since normal is determined objectively for all four hoof parameters, (sole thickness, dorsal wall length, heel height, and sole slope plane), the Kansas Method overcomes the problem of normal variation because each toe is trimmed to its own specific normality. Thus, this method can be used to return the overgrown bovine hoof to normal for any age, breed, or sex as long as sufficient sole drying is occurring to cause dehydrating and/or shedding sole horn.

The majority of the cattle I trim are free-stall cows with some access to dirt. In these housing environments, there is enough sole drying to allow the use of the Kansas Method on almost all to all of the cows. This varies a little depending on the amount of access to dirt, and/or sun dried concrete.

I also trim in some free-stall herds where the lactating cows are totally confined within the barn. In these totally housed environments sole drying is insufficient to allow the use of the Kansas Method on every animal. This varies from herd to herd. In most of these herds the Kansas Method can be

used on many to most of the cows, but in several a majority of the cows cannot be trimmed with this method.

I prefer the Kansas Method because it provides a more accurate way to determine where I am at in the hoof than is possible with the subjective methods. If insufficient sole drying requires the use of a subjective method my preference is the Dutch Method because it is less likely to result in over-thinning the apical sole than is the White Line Method.[13] When using the Dutch Method it is applied according to its teachings except for the practice of trimming the soles perpendicular to the cannon bone. Instead of this I substitute the adaptation from the Kansas Method to the Dutch Method where the surfaces of the soles are trimmed to the slope that is normal for a lifted bovine hoof.

Justifications for the Kansas Adaptation

Figure 3. Non-weight bearing normal

Fig 3 shows a normal bovine hoof that has been lifted for examination or treatment. There is no, or only slight overgrowth. As can be seen the soles slope proximally from abaxial to axial at a 3 to 4 degree slope from a line perpendicular to the long axis of the cannon bone, (this is best seen by looking at the heels from behind). This sole slope is normal because it is an overwhelmingly consistent finding when the normal bovine hoof is removed from weight bearing. For readers that have not noted this slope the next time you lift a normal hoof, or one that is very near-normal, look for it, it will be there.

As in all things biological, there is a range in normal. The 3 to 4 degree slope is my estimation of the average normal sole slope. Some hooves will slope more and some less, but what you will hardly ever see is a normal lifted hoof that has perpendicular soles, i.e., no sole slope.

In a toe that is 5 cm (2 in) in width, a slope of 4 degrees will result in the mid-abaxial margin of the sole surface protruding distally 3.5 mm further than its mid-axial margin. Considering that normal sole thickness is approximately 7 mm,[14] it would seem that 3.5 mm should be a significant quantity.

The cause of sole slope is not documented but it might be due to some elasticity in the cruciate ligaments. These ligaments criss-cross between the two phalangeal arrays and keep the toes from splaying excessively when the hoof is under a weight-bearing load. When the load is removed, by lifting the hoof, this elasticity could tend to pull the soles together resulting in sole slope. This would be analogous to the way an independent suspension cants the wheels of a car inwardly when it is raised on a lift.

The essential justification for trimming the soles to normal slope is: *it is normal*.

Normal is the end result of tens of thousands of years of evolution to the original design of the hoof. It is unwise to ignore this.

This discussion of the reasons for trimming to normal sole slope would be incomplete without an examination of the reasons given for not trimming to normal slope, in other words, the reasons given

for trimming the soles perpendicular to the cannon bone. This practice is always referenced back to the book, Cattle Footcare and Claw Trimming, authored by the late Dr. E. Toussaint Raven who developed the Dutch Method. This book, which well written and illustrated, is indeed a classic in the literature on hoof trimming. I am glad to have a copy of it in my library, and I honor the memory of Toussaint Raven with an appreciation for the amount of time, work, and research it took to compile and write this book. However, the fact remains that a critical reading of his reasons for trimming the soles perpendicular reveals that this practice should not be applied to all cattle, all the time, as is commonly suggested today. Toussaint Raven, himself, cautioned against this kind of a mind set, explaining that what is written in the book must be adjusted to local circumstances (different housing systems, climates, feeding regimes, etc.).[15] It is important to recognize that the majority of the Toussaint Raven's clinical experience was with the tie stall or stanchion cow. What might seem to be correct for the hooves of these cows cannot always be directly applied to the hoof of the free-stall cow. An example of this is the teaching that soles should be trimmed perpendicular to the cannon bone, it will be explained why this practice should not be applied to free-stall cows.

Toussaint Raven believed that toe instability was a primary cause of sole contusion and ulceration at the typical site. He defined instability *as a claw which tilts over axially and backwards*[16]. Another way to describe this would be to say that *the toe rotates abaxially.* He concluded that when this occurs the effect within the hoof is to focus an increased weight-bearing load on the axial prominence located on the ventral-axial aspect of the heel of the pedal bone. The result of this abnormal point load is bruising of the sole corium located directly below this prominence.[17] If this loading is severe and long standing the sole contusion progressed to an open lesion, a sole ulcer. Probably because sole ulcers are such serious lesions, Toussaint Raven devotes several pages in the book to discussions that pertain to their cause and prevention. Many of these discussions focus on the role that hoof overgrowth plays in the development of this lesion, specifically, *abaxial wall overgrowth.* As stated above, he believed that toe instability was a primary cause of the lesion. He also believed that the root cause of this instability was abaxial wall overgrowth because this type of overgrowth, when long enough, was the direct cause of the *axial tilt*[18] (abaxial rotation) which he believed is what starts the whole pathological process.

To say that Toussaint Raven had serious concerns about abaxial wall overgrowth would be an understatement. In addition to the pages of written text that deal with this subject there are numerous drawings. Most of these show posterior views of splayed out axially tilting (abaxially rotating) hooves caused by long abaxial wall overgrowth with cut-aways to illustrate the biomechanical effect this type of overgrowth has on the inner structures of the hoof. For all these reasons, I think he had a deeply held belief that no hoof should ever be trimmed in any way that left the sole surface protruding further distally along the abaxial margin than the axial. I think he felt this so strongly that it allowed him to ignore normal sole slope, because with this slope, the abaxial margin *does* protrude further distally than the axial. These are surmises, but they appear to be the most likely reasons why he advocated trimming soles perpendicular. In any event, this is mostly academic, because for all practical purposes, the type of long abaxial wall overgrowth that Toussaint Raven describes, *does not typically occur in free-stall cows.*

It must be remembered that the *defining component* of the type of hoof overgrowth described as typical by Toussaint Raven is that it causes an *abaxial rotation* of the toe and it is this that results in the instability and development of sole pathology. However, in free-stall hooves that have any

amount of abaxial wall overgrowth, almost always the toe rotation is in the opposite direction; *it is axial*, not abaxial as described by Toussaint Raven. (This is the situation for the rear outside toes and front inside toes of free-stall cows, these toes being the ones where most pathology occurs.)

The second essential component of the type of hoof overgrowth described by Toussaint Raven was an *axially under-developed heel*[19]. While not as significant as abaxial wall overgrowth, a low axial heel is described as being a very important contributing factor to the abaxial and backward rotation that characterizes toe instability and which leads to the increased pressure on the sole corium at the typical site. However, and again, in free-stall hooves that have any amount of abaxial wall overgrowth, the development of the axial aspect of the heel is typically just the opposite; *it is over-developed*, not underdeveloped as described by Toussaint Raven.

Since the essential features of the two anatomical components of the etiology of sole ulcer formation in the overgrown hoof, as described by Toussaint Raven, are completely dissimilar to the features of the same anatomical components in the overgrown free-stall hoof, a different etiology for the sole ulcer in free-stall cows with hoof overgrowth is needed:

In free-stall hooves with abaxial wall overgrowth the axial aspect of the heel horn is typically overgrown. When overgrowth is severe this is commonly seen as a ledge of combined overgrown heel and wall horn that protrudes distally and axially into the interdigital space. Often this extends over the typical site and it is not unusual to discover sole bruising and/or ulceration underneath this ledge. It would seem that the likely cause of this pathology would be the increased loading on this axially occurring overgrowth which in many instances extends distally beyond the remaining sole surface.[20] To counter this loading would require trimming the axial aspect of the sole surface lower than its abaxial aspect. This would leave the sole with a proximal abaxial to axial slope. It must be noted that this is the same as normal sole slope, so this should be considered a justification for trimming to normal sole slope in free-stall cows.

Since the type of abaxial wall overgrowth and its pathological effects as described by Toussaint Raven does not occur typically in the free-stall hoof, his reasons for trimming the soles perpendicular (to help nullify a backward and axial tilt), cannot plausibly be applied to free-stall cows.

Additional Reasons for Trimming to Normal Sole Slope

Sole slope is the existing normal for the lifted hoof, so when a sole is trimmed perpendicular the axial aspect will extend further distally than is normal while its abaxial aspect will extend distally less than normal. In other words, when trimmed perpendicular the sole will be left with more thickness along the axial margin than it has along its abaxial margin. When the hoof is again returned to weight bearing it seems sensible that this increased thickness would increase the axial loading of the sole beyond normal due to increased axial counter pressure from the floor surface. We should all be able to agree, considering the etiology of sole ulcer formation, that it is not good to increase the load on the axial sole. This should be considered another justification for trimming to normal slope which leaves the sole with a uniform axial to abaxial thickness, i.e., no increased axial thickness.

In free-stall cows significant abaxial wall overgrowth usually results in some degree of axial toe rotation. If this rotation is severe enough the result is a corkscrew claw. The complete etiology of the corkscrew claw is not documented but a hypothesis describing its growth and development is

accepted by many.[21] To paraphrase this hypothesis: it appears that the aberrant axially twisting growth of the corkscrew claw is instigated when the coffin joint slants abnormally. This slant is abaxial-ventral and it is severe enough to significantly increase the stretch and tension on the lateral collateral ligaments that cross the lateral side of this joint. This results in injury and tearing where the ligaments attach to the periosteum of the second phalanx and the coffin bone which causes an exotosis reaction that consists of the development of bone spicules at the sites of the tearing injuries. The next tissue layer out is the coronary corium located just underneath the hairline. This is the corium that secretes hoof wall. The sharp bone spicules irritate this corium and its response is an increased rate of hoof wall production. Meanwhile, on the medial side of the coffin joint there is no stretching of the medial collateral ligaments, and thus no bone spicules, so hoof wall production remains at its normal rate. In summary, the effect of this sequence of events is the situation where the growth rate of the abaxial wall is increased while that of the axial wall stays normal. The net effect of these unequal growth rates is the axially twisting lateral wall overgrowth that characterizes the corkscrew claw. The important thing to remember about this is that the immediate cause of the bone spicules is the increase in tension on the lateral collateral ligaments.

As explained previously, when a sole is trimmed perpendicular, its axial aspect will be left thicker than its abaxial aspect. When such a toe becomes weight bearing, this abnormal sole surface orientation will result in an increased distil displacement beyond normal of the lateral margin of the toe compared to its medial margin. It would seem inevitable that this will result in an increase in the tension on the lateral collateral ligaments. Since corkscrew claws are a common and debilitating hoof deformity, especially in free-stall cows, it would seem unwise to trim any hoof in a manner that would increase the tension on these ligaments. Furthermore, when trimming an existing corkscrew claw, where the ligaments are already under greatly increased tension, it would be adding insult to injury to facilitate this increase by trimming the soles perpendicular instead of sloped. Again, this is a justification for trimming to normal slope.

Normal Weight Distribution Across the Sole Surface

Classically, it had been theorized for many years that the abaxial wall was the main weight-bearing structure of the hoof. Considering the design of the hoof, this made sense because this wall is strong and anchored so well to the coffin bone by the extensive abaxial laminar corium. Scott (1988)[22] confirmed this theory by showing that the wall of the claw carried the most weight. Also, Westerfeld (2004)[23] in anatomical studies of the hoof under a weight-bearing load came to the functional conclusion that the main part offeree transformation is in the dorsal and apical third of the abaxial parietal area of the claw. This would tend to support the classical theory, mentioned above, that the abaxial wall, by design, is supposed to carry the main weight-bearing load. However, van der Tol (2002)[24] found that recently trimmed cows (Dutch Method) exert most of their weight on the sole and not on the wall when they are housed on a hard surface.

So, where does this leave us, what is normal weight-bearing? The Classical Theory, Scott, and Westerfeld teach that the abaxial wall is and should be, respectively, the main weight bearing structure, but in van der Tol's study it was actually the sole. However, he did qualify this by concluding that the hard flooring surface and/or the recent hoof trimming may have affected this finding. Since the reason we trim hooves is to redistribute weight-bearing, (hopefully back to normal), it seems reasonable that a recent hoof trimming would unavoidably affect measured load distributions across the ground surfaces of the hoof. In other words, it is possible that what van der

Tol (2002) actually discovered had more to do with the effect of the hoof trimming than what is necessarily normal weight distribution. As previously noted, the hooves in this study had been recently trimmed by the Dutch Method which leaves the soles perpendicular. Despite the conflicting research I think that the prevailing opinion is still with the theory that the wall would normally be the primary weight bearing structure.

So, now the question becomes: How do we trim the confined dairy cow's hoof to help insure that the abaxial wall bears most of the weight? This question is partially addressed in two recent studies. These trials were reported in 2004 and were on the effect that preventative trimming (Dutch Method) had on force and pressure distributions between the lateral and medial claws of the hind leg. One (Kehler, 2004)[25] concluded that functional trimming corrected, at least for a time, the unbalanced vertical loading of the hind claws. The other, (van der Tol, 2004),[26] concluded that the vertical loading of the hind claws remained unbalanced after trimming. Due to this result, and his previous trial (van der Tol, 2002) which showed that the main weight bearing force was on the softer parts of the claw capsule (sole, proper), van der Tol (2004) concluded *that force balance should not be the main focus of claw trimming. Instead the focus should be on finding a way to trim the hoof where the strongest part of the claw capsule, i.e., the wall, would be the primary weight-bearing structure.*

As I see it, a hoof trimmer might have a choice that could effect whether the sole, proper, or the wall, becomes the primary weight bearing structure. This choice is whether to trim the soles perpendicular or sloped. On this subject I am biased, having never agreed with the idea that by trimming perpendicular you are stabilizing the toe and that this creates a more normal weight-bearing distribution. My opinion is that when the sole is trimmed perpendicular to 'stabilize' the toe, the actual effect is to stabilize the main weight-bearing load on to the sole, proper, and I do not believe this is the type of stability that we are seeking.

I would suggest that trimming the soles to normal slope might result in shifting some of the weight-bearing load away from the sole and toward the abaxial wall. It will not be known for sure which is best, sole slope or perpendicular, until this is investigated. In the mean time I will continue to trim soles sloped for the reasons stated in this article, the most important of which is; *it is normal,* and normal should never be ignored.

I would invite your comments and criticisms, my email address is: laddsiebert@valleytel.net

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