

"Abscesses in Elephant's Feet"





The elephant foot abscess

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What we know about abscesses in elephant's feet

By Alan Roocroft

With a case study by Alan Littlehales,
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Introduction

Abscesses in captive elephant's feet are well known to the zoo and the circus community in the west but not well documented or efficiently treated to date. Our track record of curing or even understanding the reasons elephants develop abscesses is poor. The track record for preventing abscesses would appear to be nonexistent or, to put it another way, we are not completely ready to accept or acknowledge the reasons for abscess development in elephant's feet.

One of the leading causes of death in captive Asian elephants is foot related problems, actually out-of-control abscesses. Any old zoo documentation or medical records will lead you to believe that abscesses are the secondary cause of death and not a primary cause, arthritis being documented as the cause of death in some captive elephants. Many references can be found in old zoo records referring to arthritis, ulcerations of the feet, stiff joints, shuffling gaits, and so on. Diagnoses in many cases, in my opinion, have been and still are incorrect and misinterpreted, which had and still has a knock-on effect by setting the understanding and possible prevention of abscessed feet back for many years and I am sad to say, even today.

Over the last ten years I would say our understanding has greatly improved but the underlying environmental reasons for foot abscesses still exist in our zoos and we have a long way to go to building our understanding to a point when no more pressure related abscesses emerge or occur in our elephants.

An abscess in an elephant's foot is the symptom of the overall problem, not the problem itself.

Please take the above sentence as the leading statement in this article and for the young, enthusiastic, up and coming folks amongst us, remember it throughout your career. The elephant's environment will dictate its physical and mental condition.

Poor environment = poor elephant in many cases.

Use the elephant's own biology as your reference when creating its zoo habitat. An animal unable to enact its own natural history will ultimately end up with physical and mental deficits at some point later in life.

Historical Overview

Historically speaking, abscesses in elephant's feet have been documented many times in zoos, some in circuses and in many more instances in the timber camps of Asia happening at certain times of the year. In my opinion and in most cases, the condition has been misrepresented because of the lack of knowledge as to what is actually happening to the elephant. The treatments to date have been vague and misleading, as I said, they have been mostly reactive and not proactive. The

interpretation or translation of the situation has been vague but at the same time still gives us an insight into what was thought back then on the subject of occurring and reoccurring abscesses in elephant's feet.

Lieutenant Colonel G.H Evans makes reference to ulceration of the feet in elephants in the timber camps of Burma in his famous book, *Elephants and their Diseases*, 1910, and goes into local Burmese or tribal cures and remedies for the problems. For those who are interested visit pages 218-224 of this book. Interesting to read are the reasons why, in their opinions, elephants develop abscesses. Standing around for long periods in the wet seasons when the elephants cannot work is one reason. Because of the deep mud and hopeless footing in and around the camps during the monsoons, they would lay out tree trunks in a row under canopies where the working elephants stood for hours on end. The constant wet conditions and standing created uneven pressure to the nails and feet on the round sided logs causing pressure, so abscesses would develop in the working elephant's feet; I would imagine their front feet, although they do not state which feet developed abscesses. The feet of an elephant, in their natural condition, are totally different from what we are used to in our elephants, more about that later.

Other references are available in A.J. Ferrier's *The Care and Management of Elephants in Burma*, 1947, visit pages 153-156. Both Evans and Ferrier recognize that walking on paved roads wears the footpads abnormally, causing thinning of the sole to develop into other more serious conditions. Both authors mention the pressure aspect but do not go into much detail, as it appears that the word ulceration is the guiding factor and references to it overshadow any other possible reason for the abscesses. They do, in their writings, wisely and as we now clearly know, condemn continuous standing or walking on hard surfaces. They must have known that elephant's feet are not designed for the pressures of concrete or asphalt and do much better long term on soft, yielding substrates. There have been other not-so-famous elephant camp managers in Asia that have offered advice concerning working recommendations on the excellence of the working elephant, information that is all based on long years of knowledge handed down by the tribes, people and families out in the field who went before them. It's your responsibility as elephant caregivers to seek this information out, to put into practice, to alter and better our elephant's lives.

Interesting note: I was invited to an elephant compound during a trip to Sri Lanka in 1999, a place where elephants are kept and where European and American tourists can interact with them as part of an eco-tourism program. Elephants in Sri Lanka, interestingly enough, cannot be allowed to wander at night to feed as elephants are allowed to in Myanmar and in some remote parts of Thailand, because, I assume, of the size of the island and the proximity of human habitation.

The elephants in question were tethered front and back overnight as most elephants in Sri Lanka are, in a place near a tree where the legs would be attached. Because of urination and lack of run-off, the rear feet would sink in the mud that was generated by the urine. This in turn led the mahouts to lay wooden planks under the back feet of the elephant to keep them out of the mud, urine and feces. The pressure on the rear feet from the well-meant planks, along with the other fact that elephant was short chained and not carrying its weight 90 degrees under its body was causing pressure spots on areas of the rear foot soles ultimately causing abscesses. The mahouts of Sri Lanka didn't have many options or solutions to this issue; their cultural practices and history force them to contain the elephants in such a way and then deal with the

problems they created. We in the west are also forced to follow certain traditional methods and patterns handed down through our history of keeping elephants making us very good at solving the problems that our handling and housing creates. We became very good at normalizing the abnormalities we created. Foot abscesses are one of those abnormalities that are created by our practices.

Anatomy of an elephant's foot

During my consultations at zoos and circuses I try to teach the young elephant managers and keepers the importance that knowledge of anatomy of the foot is the key. Learn about the elephant's evolution and its natural history, why their feet are as they are and that there might be special conditions needed to keep them healthy throughout their long lives.

Asian elephants spend many hours walking on and interacting with soft substrates, amongst other things jungle flooring, mulch and grass. Of course there are times when they pass over hard surfaces, rocks, etc, but percentage wise, the majority of their time is spent on yielding surfaces even wet areas in monsoon seasons.

Africans with their browsing habits and completely different foot structure patterns have evolved to walk long distances growing the pad of the foot much more than their Asian relative.

In your zoo or circus, educate yourself how the elephant utilizes its feet in nature: create a picture in your mind of what an elephant is exposed to on a daily basis in its homelands and how the environment and an elephant's natural habit first of all benefits the feet and finally how what an elephant does impacts its feet positively and, of course, negatively. This exercise, hopefully, should change how you look at the feet from that point on. When I travel, I hear many times from captive elephant caregivers, *"But they are not in the wild, we will never create the wild in a zoo environment."* Yes, they are right, we will never create the wild in a zoo, circus or sanctuary; there is not the space first of all, but does that mean we should not try to create a physiologically embracing place, a complimenting environment that allows elephants to use their abilities that the evolution process has provided them with? I am constantly surprised how little we, as an animal welfare community, know about how our artificial environments impact our elephant's feet, how little we know about the anatomy of the elephant's foot, how the elephant uses its feet in nature, and more importantly, what is vital to maintain healthy feet under our care. I need to see elephants in their homeland as kind of a refresher course every few years or so and was recently in Asia, India and Sri Lanka to be specific. I need a trip to the wild, particularly concerning the Asian elephant every now and then to see elephant's feet under natural conditions. I specifically look at wrist flexibility, nail size and spaces between the nails, particularly in older animals. I saw feet in very good condition, generally speaking. I saw elephants into their fifties with near perfect feet. Of course, I saw some problems mostly in elephants that were kept in conditions similar to ours.



Look at the photo to the left and see how clean and soft the cuticles are in this 50 year old working elephant in India.

What do we know about the anatomy of an elephant's foot? How has the elephant evolved to become what we witness today?

Now, before we go any further, I am not a medical specialist or an animal doctor so most of my information is gained from hands-on experience, experience gained from treating elephant foot problems for many years in many parts of the world. I cannot base any of my findings on science and my information will not be peer reviewed as we seem to do with other bodies of information.

We know the African elephant must have evolved differently; after all they are from different locations in the world. African elephants appear to have evolved to be browsers; they have an extremely versatile trunk that has much more dexterity than its Asian counterpart. African elephant's tusks are unusual, both male and females have long tusks, used to strip bark from trees, break branches and also dig for water in times of drought.

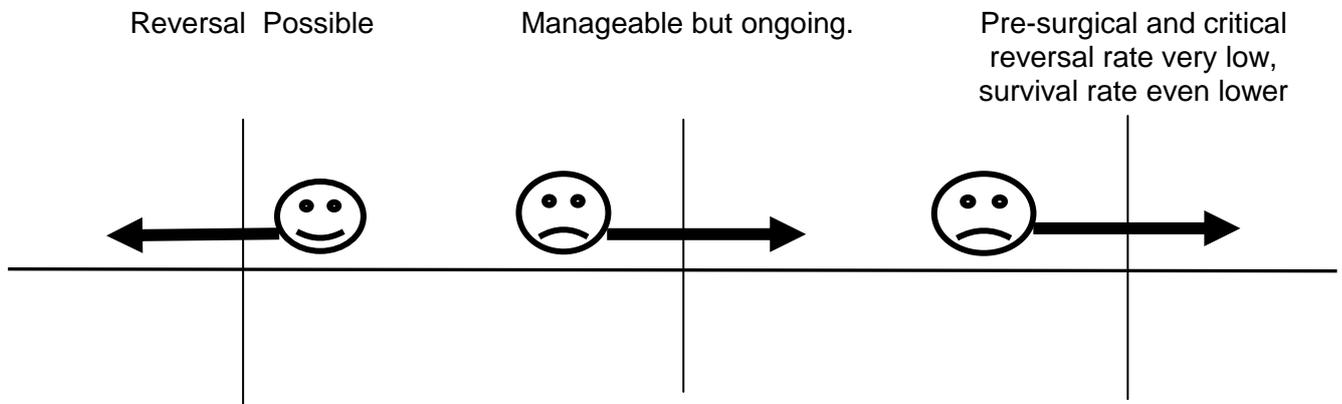
We know very little and discuss even less the differences between an African elephant's feet compared to the Asian elephant's feet. Why do African elephants need less attention to their feet in comparison to the Asian elephant? African elephant's feet are absolutely different as they have little to no cuticle growth until later in years; even then it doesn't come close to the cuticle growth in the Asian elephant. It appears the African elephant in the wild does not use its feet as the Asian elephant; years of evolution have molded and defined the feet in certain ways based on their usage throughout their evolution, which is not all that apparent today when you see African elephants performing some of the same behaviors as Asian elephants. For example, African elephants can be seen digging and doing most of what an Asian elephant does at present. If the African elephant has evolved to dig up roots and grasses, raking the ground with their softer and less massive nails, why do they have fewer nails on each foot? I have been searching to get an answer to all these questions for years but cannot find a constructive explanation in the literature. I can find no significant references that help me understand what environmental differences did the now three-species encounter in their evolution that would predetermine foot growth differences.

Why does the Asian elephant need much more foot care in our zoos? Why do the cuticles grow so fast and long on the Asian elephant and not at all on the African elephant? Why do only the foot pads grow on the African elephant and why does everything seem to grow on the Asian elephant's foot, even the skin that has no significance in some cases? I have heard people say we feed them too much, diets too high in protein and other less essential elements. Consequently their diets are just too rich, far richer than anything they would get in the wild.



Below is a quick analysis meter of how severe your abscesses really are.

The evaluation and management possibilities of an elephant foot abscess



Using the diagram above we get a better idea of what we need to do, can do and must do. There is a stage in abscess evolution when it is healable. Through experienced observation and recognition, careful trimming, and behavioral and facility alterations, one could resolve it at this stage as just a pressure sore on the foot.

However, without experienced monitoring of the elephants daily behavior, its housing and conditions, the abscess takes hold and becomes ingrained in the foot and from this point, irresolvable, only manageable, probably for the rest of the elephant's life. The last category is the scary area to enter; that of a pre-surgical situation. You know you are in this area when radiographs show bone involvement and the foot has been out of control for a long time.

Abscesses in elephant's feet, as we said earlier, are a symptom of a problem, not the underlying issue. Abscesses will not occur in a vacuum; there needs to be very definite disorders in the elephant's world for them to occur. Of course they become a problem for some elephants, even the cause of death. The problem is, of course, inappropriate captive conditions and husbandry for this type of animal, an issue we all have to identify and tackle before we can even perceive a cure. The elephant's foot is designed to move across soft substrate, not to stand on hard surfaces for long periods. The elephant has evolved to travel in search of food and water. Feeding patterns of the elephant in nature are diverse and wide ranging. The diet of the elephant as an herbivore is simple; their diet consists of grasses, roots, bushes and trees. The elephant is not a ruminant, so it does not spend hours chewing and re-chewing its food, it gets one shot at digestion, sometimes as we know, digesting only 45% of very rough and hard food items. This search for food by definition means they move, move, and move throughout their environment. But not just moving distances, the elephant has to reach, climb, dig, swim, wade, break, displace other elephants, and use its tusks, feet, legs, head, and weight to obtain food. What does your elephant do to obtain its food at your zoo?

So, these long absences of occupation are actually the problem, like I said earlier, the abscess is only a symptom. Issues like repetitive and anticipatory movement, hanging around waiting for the next thing to happen, even self-mutilation in extreme cases has been documented and sadly, even maternal aggression towards young animals are all consequences of their boring and non-stimulating surroundings. Back in the old days, long hours inside chained in place, elephants would



wear holes in the ground of their stalls with their stereotypical patterns, a behavior learned and ingrained from long hours of standing when they were chained. This has been reduced to date but there are still situations where elephants stand and rock out of habit, even when not restrained.

At this point if you already haven't, please read "Substrate in Elephants 2006" that was published in the AKF - *Animal Keeper Forum*.

Types of Abscesses

The abscess as mentioned earlier and only in my opinion, is caused by pressure, pressure from constant contact with hard surfaces, probably compounded by excessive weight, the lack of muscle condition and abnormal wear on the foot, which sometime occurs when an elephant is rocking or swaying for long periods, exhibiting stereotypical and anticipatory behaviors.

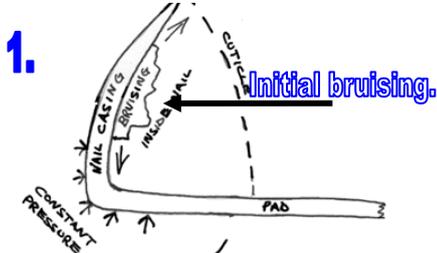
Contributing factors are also when elephants stand constantly not resting or lying down because they have given up trying to find a comfortable position on the concrete floors in our facilities.

Pacing should be mentioned here also; elephants walking in a figure eight pattern in a stall, exerting abnormal pressure as the animal turns at a wall or stall corner on its never ending stereotypical journey.

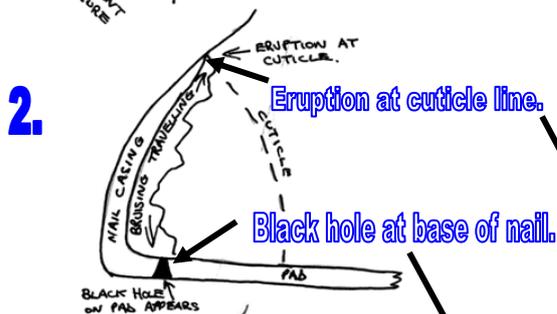
How the abscess begins

An abscess is quick to form and will take hold of an elephant's foot as fast you can blink.

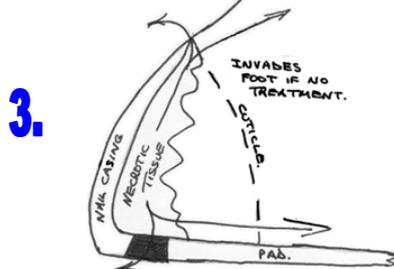
The initial onset of the abscess



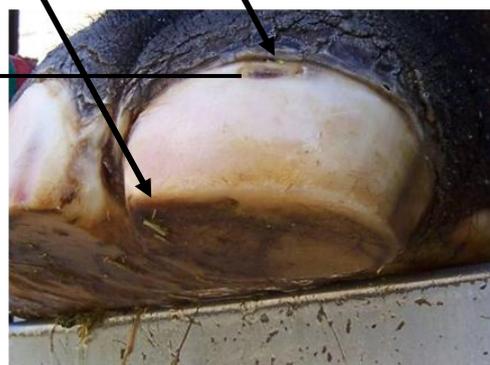
Stage 1 on the diagram to the left shows the development of a hematoma or bruising in the tissue in the lamina that sits behind the face of the nail. The bruising is caused by constant pressure from rocking on hard surfaces and abnormal wear on the foot.



Stage 2 on the diagram to the left shows the bruising or hematoma as it travels along the lamina, using the path of least resistance, and generally erupts at the cuticle line. At this point the tissue directly behind the nail is necrotic and will travel down, breaking through the base of the nail making a black hole. The abscess now behind the face of the nail is then connected at the top and bottom inside the nail at this point.



Stage 3 shows nail separation has started at this point as the necrosis spreads. The necrotic tissue inside the nail face will start to dry and new nail will start to grow in behind from the cuticle line.



Nail separation at the cuticle line can also occur. A typical nail separation after the inflammation inside the nail has journeyed through the lamina to the cuticle area is exposed in a very sensitive swelling, which at some stages resembles crabmeat after a while. Accompanying these scenarios is an occasional odor depending on how far the separation process has developed.

The Hourglass



The most common abscess starts behind the nail casing. It will separate at the bed of the nail at the cuticle line and break out at the bottom of the nail as mentioned earlier. As the abscess progresses, the inflammation will travel in the lamina directly behind the nail casing, a structure that is also found in horse hoofs. I guess it can be called, at this point, a kind of laminitis similar to what is found in horses. As the inflammation continues it engulfs more of the lamina, which in turn dies off and becomes

necrotic. Careful trimming of the area more than likely will create an hourglass-like shape, because tissue on either side of the channel is still living and viable. As the hourglass shape dries out new nail will start to grow back from the cuticle area down. This progress can be affected by the trimming and debriding regime. At this stage along with daily foot soaks in warm water and your choice of disinfectants, I have used Wonder Dust™, a charcoal based powder to help dry out the area faster.

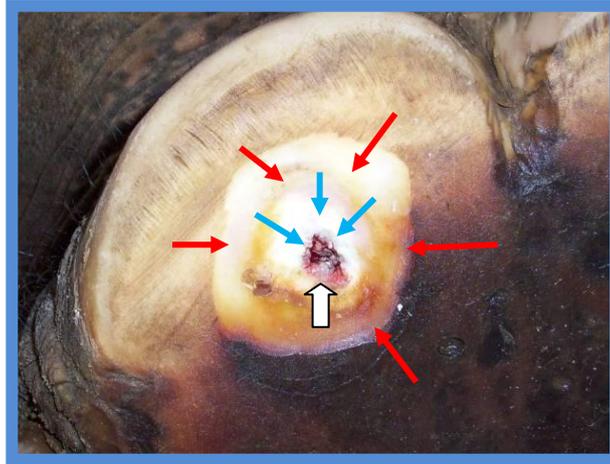


The photo to the left emphasizes in a more dramatic fashion, the eruption at the cuticle area and the back hole that occurs to join the inside face, by way of the lamina, after the necrosis has travelled the nail from top to bottom.

It is important at this point that the old nail be slowly removed when possible and the eruption site at the top of the nail joined with the black hole at the base. The trimming line will have an hourglass design if done correctly. But remember, the abscess is only the symptom of the overall problem; the elephant's behavior is what has to be changed before the abscess can be cured.



A word about granulation tissue



What I have found is that an abscess will granulate from two directions; number one is from the pad, red arrows, where the hole tries to heal over and wall itself off. The second is from within the hole itself, blue arrows, where it will try to fill in the hole from within the inside. It will leave an active area that is indicated by the white arrow, this is the place that always bleeds during trimmings. These areas of an abscess can only be identified when the abscess site is correctly trimmed and all areas are clean and distinguishable.

An elephant that was nearly lost

Let's talk about a success story about an elephant with a very difficult abscess.

The elephant in question had abscesses in both front feet but, by far the most serious was the site on the front right foot, nail three. The sequence of photos show how the abscess healed with a very specific treatment over the course of five months.



When I first approached this elephant she had a type of abscess that I had never encountered before. The granulation tissue on the inside of the abscess site had grown to the size of a mushroom and was blocking the area of the hole. In photo number two above, the dark, shiny area in the middle of the site was all overgrown granulation tissue. The photo after that, number three at the top right side was after I had removed the mushroom. All progress and healing started after it was taken out.

When we first started to treat this elephant, the owners were lost and had no idea which way to proceed; a treatment of corrective trimming, soakings and powders has now brought their level of understanding up to a very proficient level. The elephant is not out of the woods as the cause of the initial abscess is potentially still there, but we can now management it and keep it in a controllable state. There are many elephants, unfortunately, that would be euthanized for less in our modern institutions.

Rear sole abscesses



Sole abscesses in the rear feet are quite simply a consequence of abnormal weight distribution and pressure, possibly the result of painful arthritic joints and the inability to lie down to sleep.

Elephants with front wrist pain prefer to stand instead of lying down, or in some cases of arthritis or front joint disorder, the front feet are so sore or compromised that the elephant is shifting its body weight back to its rear feet to relieve the pain.

Leaning, instead of sleeping, as a resting option will also place abnormal pressure on parts of the rear feet resulting in sole abscesses caused by pressure.



Treatment for sole abscesses can be difficult because the elephant normally stands much of the day covering the site. In situations where elephants have stopped lying down or cannot lie down because of stalling restrictions or pain, standing is continuous so the abscess will receive no air or sunlight. Sunlight and fresh air are vital to the healing of an abscess. Percentages of dry and wet are usually unbalanced in our zoos and standing in their own feces and urine will not help the healing process.

Penetrations and pressures

Trimming around the abscess site so you leave a crater-like area will help to dry out the area as in [photo 2](#). Be sure

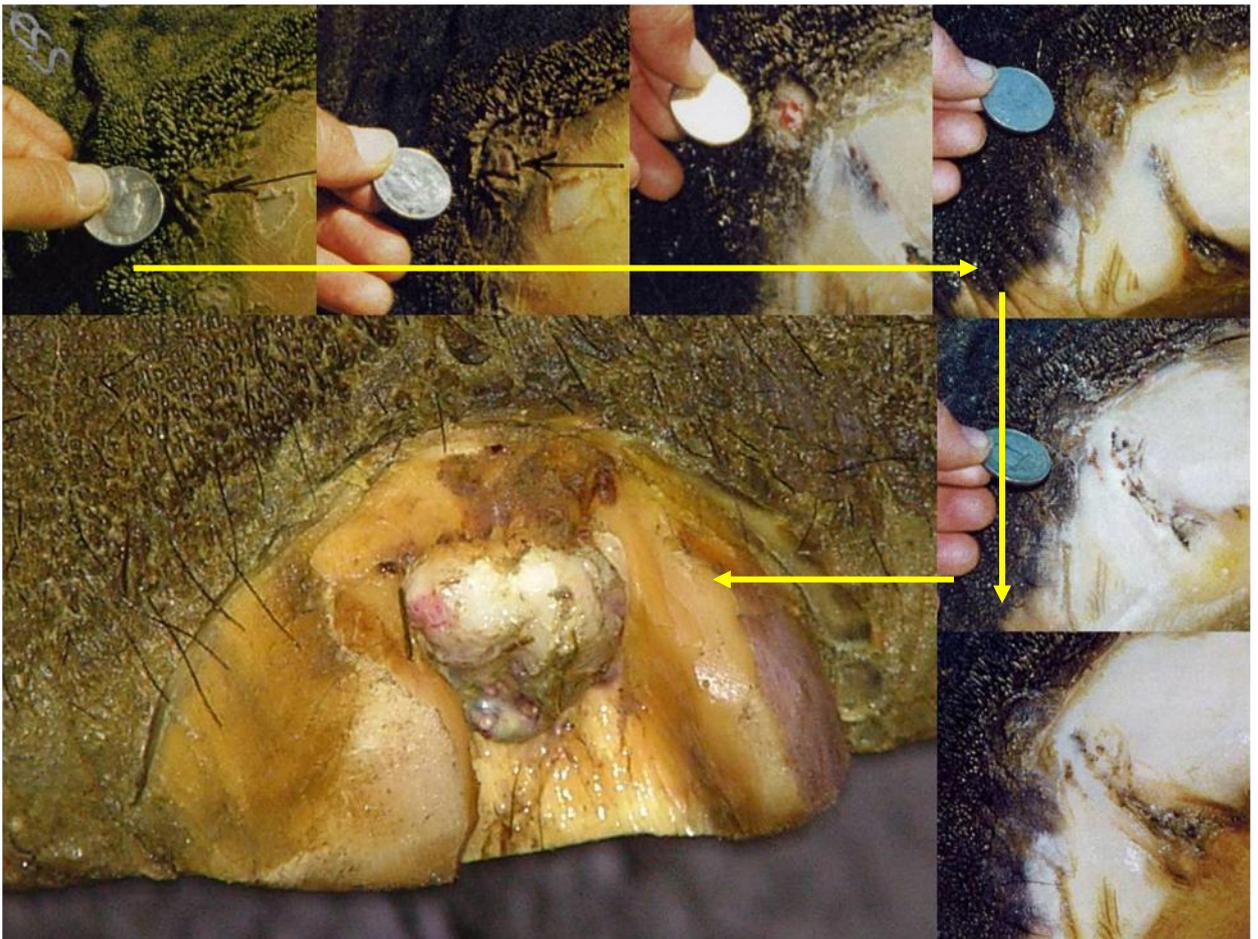
you leave no flaps of skin at the crater edge so small rocks and dirt cannot get trapped and cause discomfort. At the initial onset or recognition of the abscess, keep the area as clean as possible; it is advisable not to prolong the elephant's access to hard surfaces like standing on concrete, which generally the cause the problem in the first place. Soft, dry sand will help the healing process if available, the sand also helps debride the area. As part of the treatment and only after veterinary consultation, foot soaks might be necessary at the onset of recognition to help clean the area. Warming the soak water to as hot as the elephant will accept it will help to irrigate the area with blood, important in a non-active elephant. [Photo 1](#) above is a sole abscess in a front foot, this type of abscess can also be caused by pressure and generally happens when an elephant has a compromised front leg, wrist or foot; the elephant will distribute its front body weight onto one front leg or the other creating abnormal pressure in one foot. If this is thought to be arthritis, that should be



addressed and treated along with the issue of the abscess. There are some well known joint supplements available that seem to relieve the pain and discomfort providing the condition is not too advanced and ingrained.

There is another condition that will result in abnormal pad wear and potentially tissue damage in the sole of the foot. It is when an elephant has a locked front leg joint and while walking, swings its leg out hitting it on the ground with every step. A hot spot will occur and the tissue will break down, become a sore and then an open abscess.

The Beginnings



Just a note of interest

There will be readers that don't know the number of nails each species of elephant actually has. So----

The Asian elephant has five nails on the front and four on the back.

The African elephant has one less, four on the front and three on the back.

We count the nails on an elephant foot from the inside to the outside on the front feet, 1-5 on the front feet of the Asian and 2-5 on the front feet of the African.

Baby elephant's feet, transition from young to adult

This is a subject, it seems, I am always addressing in zoos breeding elephants. What should we trim on baby elephant's feet? Not much is my answer, but of course, people need more detail than that. As baby elephant's feet grow, they will go through a number of stages, nail cracks and pad flaking are the two most commonly seen issues.

Baby elephant's feet directly after birth are quite interesting. To protect the womb the nails on all four feet are soft and rounded with a texture similar to rubber. After a few hours they start to dry out and in a few days they are hard and worn on the bottom after the youngster has run around on different surfaces. Then from this point on the feet develop and grow but are still very sensitive to too much trimming and foot work.

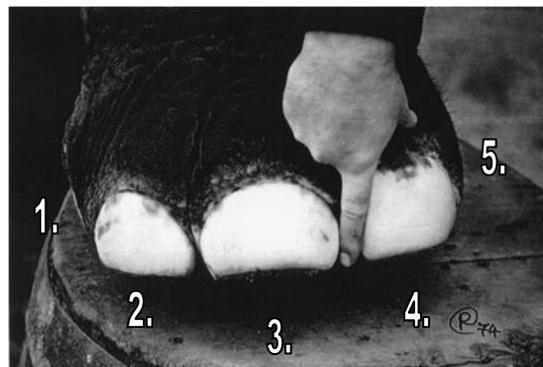
Our substrates play a big role in the condition and health of elephant's feet. There are sands and decomposed granite-like material that will suck the moisture out of a foot and leave it prone to cracks and other problems. The right amount of humidity delivered either by hosing down your sand or, like many institutions are doing now, the installation of an overhead drenching system that can be turned on and off as you need it, will create additional activity and help with the development of young feet.

Cracks develop for many reasons such as excessive pool time where the young feet are rubbing on the concrete as they play or wear from concrete floors as they get up and down on hard floors. The flaking of the pad is a normal growth and wear sequence and should not be viewed as a problem. The flakes however should not be allowed to grow so long as to collect sand, rocks and feces and should be checked on a regular basis during wash routines and foot presentations. Removal of these pad flakes is simply to just cut them off as need be with your hoof knife. The training of an elephant calf to accept foot access, at any age, is an important procedure in their development and life in our zoos. Along with the adults, they should be taught to accept the keepers inspecting the feet and, in some small way, for trimming to be performed. A rasp is a good desensitization tool when acclimating young elephants to foot care and foot manipulation in free and protected contact. It should only be introduced after the elephant has been trained and is holding its feet reliably in the foot port or a foot tub.

Inter-digital abscess

As part of your regular trimming techniques creating space between the nails of adult Asian elephants is very important to their health and welfare. One very good guide to judging this is to use your finger as a gauge.

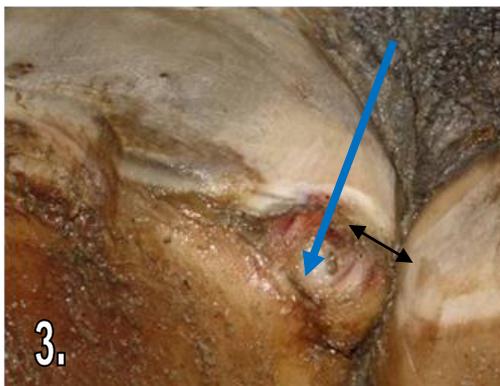
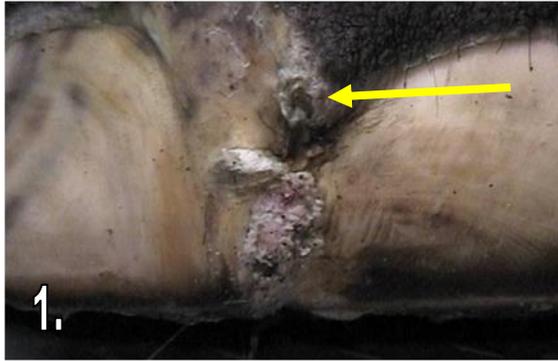
Now every foot is different so some nail spacing might not be as large as on other elephants, but by creating as much space as possible as the elephant walks and moves over the substrates you have provided, the sand, if deep enough and manicured, will massage and debride the nails and foot.



*For reference purposes I have numbered the nails on this front left foot of the elephant in the photo above.

The reason I mention space between the nails on nails on an adult Asian elephant is as they get older and less active they need all the help they can get from our experience and in the event that one of your elephants should develop inter-digital inflammation, you will wish there was more space between the nails.

The following photos will give you an idea of what an inter-digital abscess looks like. They come in different sizes and shapes but all have the same consequences to the elephant and generally happen after a certain age when the elephant is slowing down.



A short explanation of what is happening to the feet when your elephant gets an inter-digital inflammation that might turn into abscesses or sores.

From either stereotypical or anticipatory motion or, just sometime, form and confirmation issues, the elephant builds up pressure in a nail very similar to how an abscess will start in a nail, but this time the pressure is built up at the cuticle area, the spot becomes hot and the area will become inflamed. The lack of space then becomes a problem because as the inflammation builds so does the size of the area above the nail. Without a way out and usually fed by gravity downwards, the inflammation sits and gets worse.

Photo number 1 has been involved for a number weeks with the keepers trimming away some of the nail on either side of the inflammation but it wasn't enough and even too little too late. Water pockets have developed also (yellow arrow) making it even more sensitive to the touch when trimming or offering treatment. Photo number 2 is more advanced (red outline) as this elephant had some drifting of the nails causing crowding of the nails making it very hard to create productive space. In photo number 3 the inflammation has dropped through the nail and out the bottom because there was no space between the nails for the inflammation to spread.

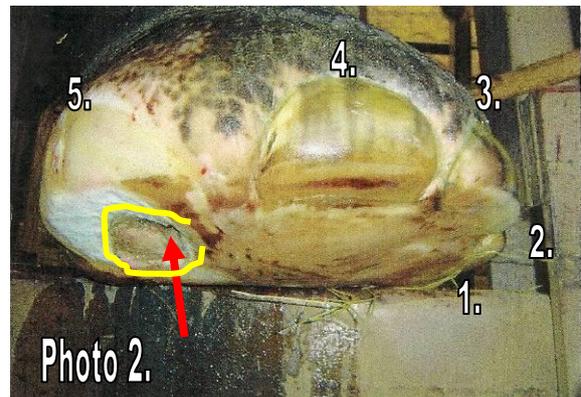
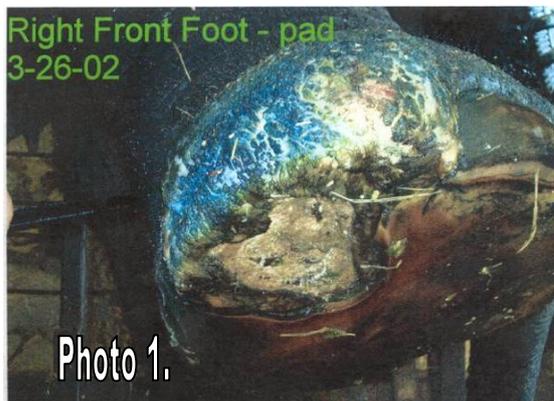
Nail number 5 abscesses, on Asians only

These types of abscesses rarely affect the African elephant. Although cracking of the nail might occur as the nail face is weakened by the rubbing of the foot as the

elephant sleeps on hard floors, the soft interior of the nail will be exposed as it's rubbed on the floor.

Side foot pressure is caused by the foot is twisting, directing the elephant's weight onto the outside nails and will create abscessing in nail 5. Also, an elephant lying down on a hard floor creates pressure in nail 5 by contact with the hard floor. The effects and pressure can be doubled if the elephant should position the upper foot on the down foot while lying down. Knowing your elephant's daily habits, like where they sleep, how long they sleep, what positions they choose when sleeping is highly recommended and can be achieved with night camera placement.

In severe cases, the conformation of your elephant will have a lot to do with the condition of the feet and wrists because some elephants, as they get older and more out of condition, the wrist starts to twist outward over a period of time. This twisting exerts enormous, continuous pressure on the number five nails and the soft structures of that part of the foot. The pressure build up is so bad it can and will sometimes engulf more than half of the foot. This is probably better explained by a veterinarian or someone with a better understanding of elephant physical conditions.



The two photos above are a graphic example of a number five nail that has been engulfed by inflammation and is at this point, in my opinion, not reversible because too much of the foot is now involved. As you can see in photo 1, on first contact much foot work had to be done. After months of corrective trimming and soakings, we were able to bring the foot back to a reasonable point to where we could see definition and nail five was again making an attempt to be back in business, unfortunately the foot had a necrotic track through the left side of the foot, which was the epicenter of her problems (yellow outline and red arrow), which whatever was attempted, would never heal. A catheter could be passed through the foot and out the top above the cuticle of nail five.

I have seen this condition a number of times in elephant's feet and in my opinion is the advanced stage of what I called earlier in the article the pre-surgical stage, where surgery has to be performed. This is one of the extreme cases I was brought in to consult on and the treatment I prescribed kept the elephant alive for two more years.

The two photos below are of nail 5 abscesses on an Asian elephant right at the moment when the first effects of deteriorating confirmation has set in and the building pressure on the outside of the foot is becoming apparent.

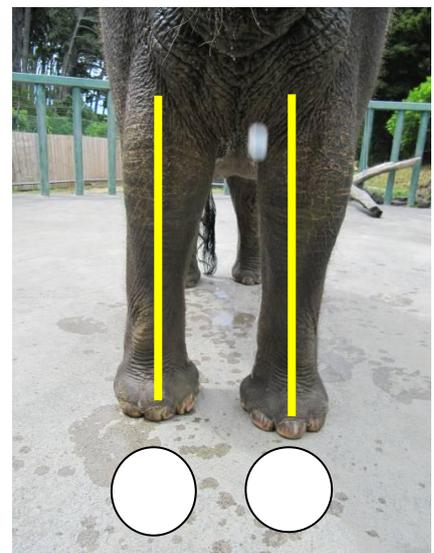


In the March photo, the necrosis has invaded pretty much all of the nail, and one can see with some attention and trimming by April the nail was slowly recovering. The confirmation of the elephant will determine how long it will take before this nail becomes as big a problem as the case we discussed before it.



One can clearly see in this photo how the feet are twisting outward distributing much of the foot pressure to the outside of the foot. There is, unfortunately, no magic recipe for treatment at this stage; it's all downhill from here as there is too much damage to the foot to reverse it. I have brought back a couple of cases to the point of noticeable change at the request of the owner or zoo, but at this point the elephant is in so much pain its future is very dim.

With aging, overweight elephants I always recommend that the owners or zoo try to plot the possible deterioration of their elephant's legs. Implement an exercise routine and daily activity that complements the shoulders, leg joints, knees, wrists, tendons, blood circulation, weight and flexibility of the elephants. After that, you can monitor the leg confirmation quite easily by monthly photos of the legs in a pre-determined position somewhere in the facility. We painted two circles on the concrete floor equal distant apart just slightly bigger than an elephant's foot. The elephant was trained to place its feet in the circles and stand while a photo was taken. After the photo was taken a line would be draw up from nail three. Over time one can see if the line is in the same place every time and see the movement of the foot on either side of the line. Not exactly science but it works to monitor elephants that have already entered the poor confirmation zone.



Abscesses in nail number 4, Asian elephants only

Abscesses in nail number 4 are the most common abscess and occurs only in Asian elephants. The reason for their development though, is the same, pressure on the foot caused by swaying, rocking and other not so obvious issues. The size and shape of the nail are of importance and are the guiding factor as to why this abscess is the most common.

If your elephant rocks, sways or even prefers a forward rocking motion as its stereotype, it's all dependent on the severity of the behavior as to how destructive it will be on the elephant's health and how intense the elephant demonstrates the behavior. The most common stereotypical patterns are rocking and swaying as they develop a wear pattern on the bottom of an elephant's foot that is easy to read and should promote you into stopping or at least reducing the rocking and swaying behavior because the health of your elephant will be in the balance. So here's my take on what happens.



In the photo to the left you see the right foot of an Asian elephant. I have numbered the nails for a clearer understanding. This elephant has a side-to-side rocking motion, which wears down the bottoms of nails 2 & 3. As you can see nail number 4 is barely touched. Consequently nail number 4 will grow very long in animals with this type of stereotypical movement. Now, other factors come into play here. I have found this type of abscess only occurs in animals of a certain age, meaning they have developed a certain

life pattern and are generally kept in less than comfortable conditions. As the elephant grows older it will develop behaviors that it obtains in its surroundings. For example, elephants get larger and less flexible, its neck is out of condition, leg joints are weak because it is not physically simulated, doesn't move much in the area it is given, it also is having a hard time finding a comfortable position on the flat concrete floors of its night stall, so what does it do? It stops lying down. Now the elephant has gone all in with its chips, it will still rock or sway out of habit but when the time comes for dosing or cat napping, the trunk lies flat on the ground or in its mouth or over the bars of the stall while the elephant sleeps. At this point all of its weight has gone to its feet as its leg muscles are not strong enough to be of any help in supporting it. It will even try to lean against a wall or bars. It is at this time when the foot is flat on the ground bearing the full weight of the elephant that the length of the nails are either a benefit or a problem, and as you saw in the photo above with no wear from the rocking to accidentally keep it short and, if the nail has not been identified during foot work and kept short out of knowledge, the de-vasculation of the nail through pressure will kick in.

Here's an easy exercise for you to see how fast a nail can be de-vascularized.



Take your thumb and second finger on either hand and gently apply pressure nail to nail, you will very quickly see how fast your nail turns white from pink as you press the blood out from under the nail. This is an easy demonstration of how de-vascularization through pressure works. Multiply that in the case of a heavy elephant with a longer than normal nail on a hard, created surface or for that matter DG “decomposed granite” and you will create a hematoma in the lamina, which then travels north and south blowing out at the cuticle and exiting through a small black hole on the bottom of the nail generally engulfing the whole nail and developing into an abscess if not treated. We mentioned this earlier in the article and have a diagram on how this might happen.

Many large, older males have developed this type of abscess after their surroundings became an issue to their comfort, do not lie down anymore and have basically run out of options.

Examples of nail number 4 abscesses in elephant feet



Nail number 2 abscesses in Asians



Number 2 nail abscesses (yellow arrows) are unusual to see in Asian elephant's feet because the conditions that cause them are more related to an individual elephant and are sometimes physical conformation based. They are like any of the other types of abscesses, hard to treat because unless you remove the behavior that is causing the pressure or the behavior that is a habitual part of the elephant's captive life the sore will continue to grow and be a problem.

African elephant front feet abscesses

African elephant feet, as we have said, are far softer than an Asian elephant's feet and more susceptible earlier in life to tissue damage in the number 2 nails on the front feet. Quite simply the tissue wears down, gets infected and if the rocking is not stopped and behavior changed abscesses can be with an elephant for the rest of its life.



The photos above are of movement patterns that can be seen in African elephants. Our care routines create expectations in the elephants so strong and to the point where animals will be waiting for the next thing to happen. Rocking out of anticipation, wearing divots in the sand with their feet and will actually wear away concrete from constant rubbing. The rubbing takes the tissue off from the foot and slowly the pad is removed. A small sore appears, getting larger and larger and very soon turns into an open abscess needing the same care as any other type of abscess.

It's all about behavior, folks.

There are other things that can spark off abnormal and physically detrimental behavior. For example, the arrival of a new elephant at the zoo will have an impact on the dynamics and the elephant will orientate itself differently in its stall, facing different ways down a slope or on topography in their environment that can have an effect on their feet. So don't underestimate stall and enclosure arrangements; it all matters to an elephant.

Below is a collection of number 2 nail abscesses in different elephants in different parts of the world with the same thing in common - unusual behavior.



Rear nail abscesses



Rear nail abscesses are a result of leaning, most likely associated with elephants that have stop lying down to rest and are exerting abnormal pressure because they are now leaning to rest. Another reason is because the front feet are so sore that the elephant has shifted its weight onto the back feet, abnormally distributing its body weight. This type of abscess is easier to cure than front foot abscesses unless, of course, the elephant's behavior has become chronic.

Imagine an elephant in a small inside area that has become arthritic in the front feet. The elephant starts lying down less because of the discomfort of the pain in getting down. The elephant decides to



lean on something from this point on; by leaning the elephant shifts its weight towards a wall or bars and by doing this, it places its feet, not flat on the ground, but at an angle distributing its weight abnormally on the sides of the feet and nails. The rest is history.



Cracks to abscesses, can that happen?

My feeling on this is it's a matter of coincidence if a crack turns into an abscess; you have two things going on at the same time. The crack is caused by certain

environmental variables such as rubbing on the floor and the abscess is caused by pressure. If the two defects occur at the same time it is no harder to treat both defects at the same time rather than just treating the abscess, which is the more serious condition of the two.

I saw this in an Asian female many years ago when my antenna was not completely up concerning these issues but was able to reduce the abscess to a manageable condition. The crack never came back.

The differences between African and Asian elephant's feet

We touch on this earlier in the article but I have not found to date any literature that clearly explains the evolution of these two elephant types guiding me to understand the enormous differences in their feet. As an example, the African elephant needs virtually no cuticle attention during regular foot care procedures, why? The cuticle on the African does not grow at the same rate as an Asian elephant. The answer, I believe, lies in the evolution and the environmental habits they have developed over many millennia. The African elephant, judging by its trunk versatility and its back formation, is better developed as a tree and bush browser; the Asian elephant seems to be more suited to grazing with a large powerful trunk tip and a back with far less flexibility than the African elephant. The large regenerating nails of the Asian are far better equipped to dig up grass sod and roots. Of course, now we can see both species doing almost the same things behaviorally in the wild, as their natural habitat is changing and reducing so how will their feet change in the future?

A Case Study

I have to this point been involved with a very high number of cases of abscesses in elephant's feet. Abscesses go through many stages of development and if incorrectly treated they will re-infect as the new nail tries to grow behind the old, dead nail and will reach points of no return with regards to treatments. Elephants can develop abscesses in both front and rear feet, and both African and Asian elephants are prone to the development although I have only ever witnessed mortalities related to abscesses in Asian elephants. Every abscess case in elephants is different, but there are a few similarities, mainly concerning the development of abscesses in the nails and the way they evolve.

Case Study 1: Long term abscess management in a female Asian Elephant
Author, Alan Littlehales Specialist Elephant Keeper Chester Zoo, England



History

The case study we have chosen is Sheba who, at the time of her recent death was 55 years old. This elephant had been at the zoo since 1965 having come over from Thailand as an eight year old. Because she had had continuous abscess care for the last fifteen years, this made her an interesting study subject. Sheba had a rare forward and back rocking stereotypy (instead of side-to-side.) This motion caused abscesses to occur in her front feet affecting toes #2, 3, 4 and 5. During her time at the zoo the substrate on which she was housed evolved. It changed from an inner area of concrete with unyielding clay on the paddock to a new house with 99% washed river sand inside and out. Sheba also changed management systems in 2008 moving from free contact to protected contact.

Abscess care team

To undertake the more complex footwork required to manage an elephant with abscesses you need a team of well trained foot care personnel. Sheba required twice weekly abscess trims and daily foot soaks. The team of three who undertook the foot care would liaise continually and if a new problem occurred it was flagged up immediately. Ideally we would get the elephant's foot up in the port and discuss the issue. This brainstorming not only makes a correct decision more likely it allows for a flow of information and experience. This is important for newer members of the team to learn and feel an equal part of the set up. The team was large enough to give Sheba's care total coverage when staff had holidays, etc.

Causes and maintenance of abscesses

As Sheba rocked she intermittently put pressure on to her front nails with mainly toes #2 and #4 taking the most impact. This on-off pressure interrupts the blood flow to the nail tissue and it dies off. This necrotic tissue if not dealt with will build up and migrate upwards towards the top of the nail. Eventually this will burst out at the cuticle. With Sheba, further complications occurred when she stopped lying down to sleep. She chose to lean on her right side against an area of wall. This put unnatural sideways pressure on her front right toe #5 and also caused an abscess to occur on her back left toe, #2. The trimming of the necrotic tissue of Sheba's abscess, in my opinion, was relatively simple. The real skill is in the evaluation of the abscess and trying to work out how it is evolving.

This is important as you need to decide whether to allow further evolution or start addressing the issue more intensively. This can entail removal of large areas of nail sometimes right up to the cuticle. We trimmed Sheba's abscesses twice weekly. This involved removing the tissue migrating down into the recess we created at the base of the nail to encourage this. We also had to keep open the epicenter (hole) in the base of the abscess. If this hole is allowed to close it encourages anaerobic bacteria to develop within the abscess. The foot care must be undertaken with preferably no blood draw. Trimming the epicenter is likely to cause some bleeding but reducing the necrotic tissue should never result in blood being drawn. Experience will teach you how much to trim without hitting the blood line. If this process is done continually the abscess will be encouraged to migrate downwards and is thus under control.



Pictures 1 & 2 show how the abscess has not been managed properly and has migrated up to the cuticle and blown out. Picture 3 is another example of an abscess "getting away." Not enough space for downward migration has resulted in the necrotic tissue moving within the nail. This can be seen in the exposed nail at the inter-digital gap between nails 3 & 4.



Pictures 4 & 5 are examples of heavy handed abscess care drawing too much blood. Picture 6 illustrates ill advised use of a power tool. I feel the lack of control that can be exerted is clearly visible in this example



Pictures 7, 8 & 9 show well maintained feet, correct inter-digital gaps, clean cuticles, correct nail lengths and shapes, all essential to monitor possible problems that may occur.



Picture 10 shows the abscess mid-trim, the recess for the abscess to grow into has been opened up and the epicenter (hole) still requires opening up. Pictures 11 & 12 show how the abscess has migrated over the years and sat partly in the foot.



Back foot abscess - Picture 13 shows first trim as the abscess is being pinched by the surrounding nail. Picture 14 shows the necrotic tissue released by nail removal. Picture 15 has the necrotic tissue trimmed back with minimal blood drawn. This process was repeated twice weekly until the abscess finished evolving.

Historic examples of Sheba's abscess care



Pictures 16 & 17 were taken in 2002



Pic 18

Pic 19

Pictures 18 & 19 were taken 2004



Pic 20

Pic 21

Pictures 20 & 21 were taken 2007



Pic 22

Pic 23

Pictures 22 & 23 were taken 2008



Pic 24

Pic 25

Pictures 24 & 25 are from 2009. Note application of wound powder (Wonder Dust™) to nail 4 abscesses



Pic 26

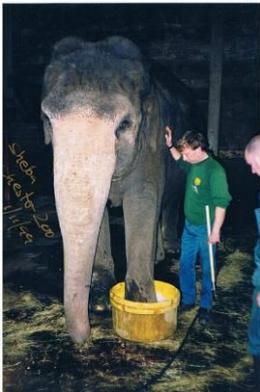


Pic 27

Pictures 26 & 27 were taken in 2010

Foot Soaks

As part of the abscesses care regime, Alan advised daily foot soaks. Sheba was trained to stand in two large tubs containing hot water and Hibiscrub™. The water was as hot as the elephant would allow as this encouraged blood flow into the feet and nails. The soaks were particularly important after the abscesses had been trimmed. Towards the end of Sheba's life she was standing in three soaks two front and one back. Sheba received, at a conservative estimate, over 5000 foot soaks during the period of her abscess care. This equates to about 1500 man hours.



Foot care tools

We use a selection of farrier tools. We use a Swiss hoof knife for pad trimming and commercial files for nail work. The main hoof knife we use is manufactured by Burdizzo. This company, sadly, has gone into liquidation so these knives are becoming increasingly rare. There are replacement knives on the market but all are of an inferior quality. Tool care is important. The tools are hand sharpened on stones as they require a very good edge. The knives are sharpened on the outside edge of the knife from the handle right around to the tip. Tools should be cleaned, sharpened and lightly oiled after use and correctly stored. I feel that the way a person cares for and stores their tools tends to reflect the way they approach foot care. These good habits should be encouraged in your foot care staff. Sharpening stones should be cleaned with oil after use to avoid clogging and should also be stored appropriately.



Training and philosophy

Obviously, to work on an abscess your elephant will need to be trained to give you access to its feet. Our elephants are all in PC and present front and back feet into a port within the PC wall. They will also side present the back feet for easier access. For routine work, the elephant should be trained to keep its foot in place for up to 45 minutes (with short rest periods). Abscess care tends to be of a shorter duration but can be longer if a problem is uncovered. *It is vital your staff remember there is an elephant at the other end of their hoof knife.* Compliance from your elephant is crucial and a holistic approach is preferable. With Alan's advice we allowed Sheba to drop her foot from the port during her sessions. Alan observed that the extra pressure on her standing foot caused her discomfort. Sheba would flex her standing foot and always returned her foot to the port. This approach gave Sheba maximum comfort during trimming and helped her to totally "buy into the process." This philosophy should also be undertaken in free contact. I have witnessed heavy handed and inappropriate foot care on elephants simply because they had no choice. Having a well-trained elephant and good staff is important but the elephant's physical and mental well-being is more important.

Conclusions

I firmly believe that only in extreme circumstances should an elephant die of foot related problems. Severely compromised conformity can cause impossible foot issues on occasion, usually affecting the back feet. Other than this, foot problems including abscesses are manageable if the holding institution is willing to invest in its elephant program. Sheba had incredibly severe abscess issues that required an immense investment in time and effort to manage. She would require two hours of foot care at least twice weekly and daily foot soaks of fifteen minutes. Although we recently lost Sheba we are proud that it wasn't foot related. No abscess is unmanageable and we accepted that as long as Sheba rocked, her feet would need attention. We now also have a strong team ethic and avoided allowing complex foot

care to naturally fall to one person on the team. This is an easy trap to fall into and needs avoiding. Training your team to manage abscesses takes extra effort, but in my opinion, it is essential to give your elephants consistent, ongoing foot care. All the photos in this article are of Sheba over the period of her foot management. The dedication of all the staff who has worked on Sheba over the years should not be underestimated.



Dedicated to Sheba, a special elephant, RIP

Case study 2: Yoyo, a female African elephant at the Barcelona Zoo in Spain.

Case study details: December, 2010 keepers found an area of necrosis on the right rear foot of Yoyo. The potential cause of the sore was determined to be pressure on the outside of foot from excessive leaning while standing in her night stall, possibly while sleeping.



The zoo staff first recognized the area on Yoyo's foot, above, December, 2010 and commenced trimming.



Trimming continued through December, 2010 and January, 2011 with consultation from me to zoo veterinarian Dr. Vanessa Almagro Delgado.





I arrived at the zoo February, 2011 on a site visit and continued the trimming, opening up the area so there was no pressure on the site but allowing the abscess to heal down and grow in.



Yoyo's housing at Barcelona Zoo changed for the better months after this abscess occurred. She is now walking and sleeping totally on sand, this has had dramatic results on her feet and the abscess healed quite quickly from that point.



Two other areas of treatment we introduced were daily soakings and the use of Wonder Dust™ as a drying agent. Both were extremely important to the healing of Yoyo's abscess.



The final point of importance is communication & correct trimming. We were very happy to have a competent veterinary department at the zoo so the foot was always well managed and under control. Dr. Hugo Fernandez, Chief Veterinarian, and Dr. Vanessa Almagro Delgado managed the observation and treatment and would keep me in the loop when needed. I must also compliment the elephant keeping staff for their husbandry training that made daily access to Yoyo's foot possible.

Accidental damage to the nail



Nail split caused by wear with the floor.



Cracks in nails are mostly caused by contact with a hard surface either when the elephant is sleeping flat on its side or, in the case of some young animals, playing in a pool or just extreme, rare stereotypical behavior. The casing of the nail is not thick and will wear down just from a few short movements of the foot on a hard surface.

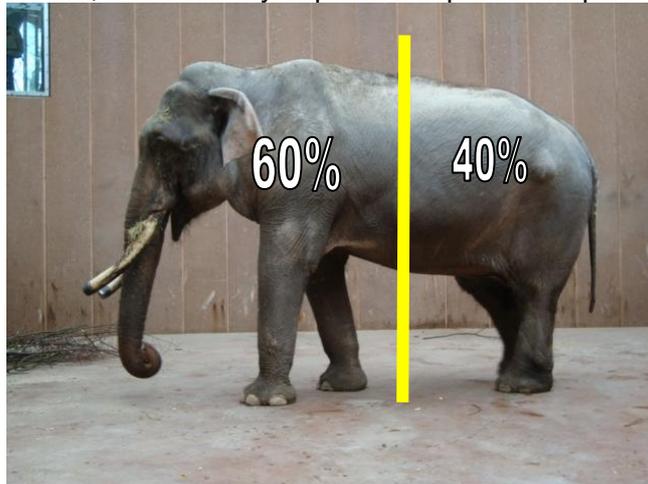
Healthy foot function

Sweating



Elephants will sweat above the nails in warm weather and is generally thought of as a sign of health.

Confirmation, an extremely important aspect to elephant health



Weight distribution in a full grown elephant is generally thought to be a 60% - 40% split. You can see below how this might become a problem to the animal if one or more feet should be compromised.



Weight distribution of an healthy elephant.

Elephant with compromised front foot.

Weight from the front foot is spread to the rear feet.





Weight distribution and body carriage is an important factor to such a large mammal and can have long term health consequences to an elephant, even death. The example above shows how dramatic a compromise can be to an elephant; the feet legs and joints are not able to carry uneven weight distribution over the long haul and the back legs will give out under such pressure.

Poor confirmation whether it is genetic, caused by an accident or the result of stereotypical and anticipatory behavior or, in some extreme cases, poor facility design can have an effect on an elephant's longevity and productivity.

Treatments and Preventions

Treatments vary from opinion to opinion and from experience to experience. Epsom salts to fairy dust have been used on elephant foot abscesses. I have even heard of therapeutically blowing smoke on the foot and one place even held séances and chanted around the elephant to heal abscesses; some zoos have tried to freeze the abscess in a hope of stopping the development. This is, of course, all only opinions that I hold, after attending abscesses for so long is all well and good but if it doesn't work, and the abscesses continue to develop, we the community, we the professionals should stop condoning it if we don't really know. First of all an abscess must heal from the inside out if the process is at all inhibited, it will not heal. An abscess in my experience heals at two locations one is from the outside where the hole will granulate, 1) and leave the appearance of being healed and 2) it granulates from the inside, trying to wall itself off. This type of granulation tissue is the hardest to detect because you cannot see it. The abscess wall will granulate in from one of the sides just below the surface of the abscess entrance. In doing so, it looks like the abscess is healing.

Treatments

- Antibiotics
- Pain relief & anti inflammation medications
- Glucosamine Chondroitin® complex
- Wait for the inflammation to subside and reduce before trimming
- Soaking of the foot, but at some point when granulation tissue has advanced and apparent healing has taken place, soakings will probably be less affective and no longer beneficial

What about the next generation of elephants born in our zoos?

The next generations of elephants in our zoos need careful review and consideration; we need to be adamant about how we allow our elephants to be portrayed under our care. Stereotypical motions need to be a thing of the past, our habitats and environments should be better designed and constructed, and natural surfaces should replace hard stand primary holding areas. We need to get better at

observation, using camera surveillance equipment to monitor our elephant's behavior twenty four hours per day. Know what they are doing all the time, watch our young closely, and be ready with solutions to step in the first time the baby shows signs of swaying or the slightest anticipatory behaviors.

Conclusion and knowledge spin offs

As long as traditional elephant keeping is encouraged and accepted as elephant welfare beneficial in the western zoos, we will always see foot abscesses.

Boredom, waiting and rocking in anticipation on substrates such as concrete and hard core, also carrying excessive unnatural body weight in poorly stimulated environments, abscesses will always occur.

The spinoff is the knowledge we gain and how that effects the changes in policy from the understanding of the issues of foot abscesses. For example, if an elephant has stopped lying down to rest we try to understand why the elephant has stopped lying down. With the introduction of sand or some other deep, soft bedding encourages the animal to give it another try. Feeding elephants, "no more food on the ground" makes the elephant work to obtain its food. Well, the list of spinoffs could be endless. What it means to me is that facility design is revisited. Are the facilities being built for elephants, elephant behavior friendly? Can the elephant enact natural behaviors 24/7? Have we stopped the swaying and rocking? Or are our young elephants that have been born in our zoos and related facilities in recent times still stereotypical?

My earliest memory of an elephant as a child, was visiting the Belle Vue Zoo in Manchester, England. That was just over fifty-four years ago. The elephants at that time did not have an outside enclosure and would spend all day inside unless they were chained outside, performing rides for the public or were walking on the zoo grounds for exercise involving television, newspaper pieces or other reasons.

The elephants I remember at Belle Vue would sway all the time compensating for the long hours of zero stimuli. This type of behavior, like other people in the zoo community, never did have much effect on me during my career; I saw it as normal for captive elephants, elephants were swaying all around me and I was even responsible for them swaying as the routines I implemented were the basis for the stereotypical behaviors, and even encouraged it at times. I guess looking back if they didn't sway I would have thought that something was wrong with them. What will be the spin off for you?

Personal note

As I said at the beginning of this article my association with elephants is not scientific, I am not a vet, but the information is based upon experience of more years than I like to mention. Use the enclosed information carefully; do not use it as a basis to knock elephant keeping in zoos, or anywhere else for that matter; use it better the lives of your elephants. We are in a long evolutionary process changing on a daily basis and if you are happy with where we are at with elephant keeping in our zoos, because you are still in denial, or feel like you have something to protect, be strong and resolute. The criticism we are receiving at this moment concerning our efforts as zoo professionals has only just begun. Believe me, the ride has just started and there are many more people outside of the zoo environment, worldwide, interested in elephant welfare, that "wait for it", that do not share our dream and certainly do not see the

importance of a zoo in a community and certainly don't share the notion of how we can conserve these animals for future generations in a zoo environment.

Hundreds of years ago many elephants were brought over to Europe from Asia. With those elephants came a mahout, generally an indigent person who had been working with elephants a long time. The elephants came by ship, kept sometimes on the deck in an open ended crate or just chained on the open deck. The mahout's soul task was to keep that elephant clean & satisfied during the long voyage. One of those mahouts I had the pleasure of meeting in Sri Lanka, back in the early 70's, was in Ceylon when I was there the first time.

The mahout I talked to back then had made many trips to Europe bringing elephants on behalf of animal dealers and even accompanied a couple of governmental gifts to zoos in the west.

He had also traveled Asia transporting elephants and seeing other elephant care methods. He had picked up some English on his travels so talking elephants with him was made easier.

One thing I did take away from our conversation, a point back then which meant very little to me as a novice, but now I get the point. "We in the West have adopted the worst handling methods of Asia only to make them our best practices in Europe and the USA." Now without being unfair to anyone and after seeing elephants in temples and royal housings, I understand exactly what he meant. They never brought over the best practices of some Asian countries because we didn't have the culture, the space or time to offer elephants the same as they would get in the places they are found.

But we are getting better.

Written as reference material and to make you think.