

Have You Got the Seal of Approval?

An insight into the effectiveness and efficiency of the use of wound sealers

Authored by Duncan Griffiths

About 12 months ago I was honoured and privileged to teach a course for the AKCA's Koi Health Advisor (KHA) program on advanced Koi Treatments and diagnosis over the internet as I reside in the UK.

During this course, it became apparent that many of the students had not heard of the use of wound sealers that we in the UK use as a matter of course as part of our day to day treatments of bacterial ulcers and infections where the epidermis and Dermis has been breached and in some cases where it has not, but this will become apparent as we progress.

So let's establish why we would want to use a sealer, with the following question:

Q. What would you do if you cut yourself or had a severe abrasion?

A. we clean the wound, treat with an antiseptic and placed a Band-aid or bandage over the wound.

Q given that we have treated the wound why a Band-Aid or bandage?

A. to protect the wound by keeping it clean and sealing the treatment (antiseptic) in.

In truth, we cover a wound on a human or mammal until the wound in the healing process has sealed itself by a process called granulation, at which point generally the wound/infection has formed a scab; sealing the wound from the atmosphere and therefore further bacterial infection. At which point we can in certain circumstances now remove the temporary cover or seal (band-aid/sticking plaster) allowing the atmosphere to keep the wound dry.

So it can be seen, we would clean a wound exactly the same as we would with a bacterial ulcer or infection on a koi. We clean off any necrotic tissue which would hinder the healing process, treat it with an antiseptic to kill and keep killing the bacteria in the infection or wound for a period of time. We then seal the wound off with either a Band-aid or bandage.

Q. So do we seal a wound on a koi like we do with a human?

A. yes we do, for all the above reasons and one more very important reason, which we will come to shortly.

As Humans with cuts/infections, unless you have a job that places you in a particularly high risk dirty environment, a human with a cut, wound or infections, lives and moves in a relatively clean environment, even if for some reason we don't, we can by choice, quite easily avoid such filthy conditions to help keep any wounds clean, yet we still cover a wound with a Elastoplasts or bandage. Yet, it's still a fact that even with these careful precautions, wounds still degenerate into more serious conditions requiring more intrusive measures to combat the newly acquired more serious condition.

Koi live in a relatively hostile environment that presents certain problems with the healing process, the first of which is the fact koi live in a bacterial soup that contains both pathogenic

and none pathogenic bacteria, yet some still do not consider sealing a wound to protect it while granulation takes essential, saying you are sealing the bacteria in and around the wound. Lets make this perfectly clear if you have done your job right and cleaned the wound of debris, dirt, necrotic tissue and last of all bacteria you will not be sealing anything harmful in.

The healing process

Harmful Bacteria on the wound or ulcer have to feed but they have no mouths to eat so cannot take nutrients via the normal route; instead they absorb nutrients through the cell wall. They produce powerful enzymes that rot down their food into its component form so they can be absorbed through the cell wall

The first enzyme produced is called peptidase, these convert organics into short chain amino acids. Then a second enzyme called peptidase is produced that breaks down the short chain amino acids into individual amino acids, these can be absorbed into the bacterium. It's these enzymes produced by bacteria that create ulcers as they have a decaying effect on the tissue. In fact it's these same enzymes that are present in your bio washing powder that remove dried on stains like blood

At the same time as this is going on, a process called epithelial cell migration is trying to take place where by from the edges of the wound epithelial cells are flooding out to fill the void in the dermis as this process is tender and vulnerable the enzymes destroy the newly formed tissue as fast as they migrate.

Once we have treated the wound with an antiseptic topical treatment, and by that I mean cleansed the ulcer of all bacteria, not only the bacteria, but any dead and decaying tissue (necrosis) as you cannot cure what's already dead it will just lie there providing a place (haven) for newly migrating pathogenic bacteria to reform and colonise what ever your chosen topical is you can now seal with either a powder, liquid or paste sealer. This will seal the topical treatment in so it can carry on doing its job and put up a barrier to fresh alien pathogenic bacteria. (Remember koi live 24/7 with good and bad bacteria.)

At this point epithelial cell migration which is the koi's natural way of sealing the wound against attack from the bacteria can proceed unhindered. And that natural of all processes has a chance of being completed. When that happens that the wound will take on an opaque shiny white skin, this indicates that the wound is healing and is now sealed off from the surrounding environment. At this point you can discontinue your treatments

This epithelial migration process is very delicate and requires the wound to be disturbed as little as possible for this process to complete itself. And this will involve a sealer other wise you will be dragging the fish up repeatedly as it continues to be freshly infected by bacteria. This not only causes the fish undue stress, but this alone can hinder healing but you are likely to continue to disturb the cell migration from establishing itself

My own preference is for liquid sealers and powder sealers as paste tends to drop off in a lump I routinely apply a powder sealer to a topical while its still wet. This immediately dries the topical up and I can then cap it off with a liquid sealer, e.g., Friars Balsam (Benzoin compound tincture). This will stay in place for up to three days giving the wound half a decent chance of healing without prodding fingers.

Osmosis

I said earlier there was yet another reason for using a sealer and osmosis is the reason.

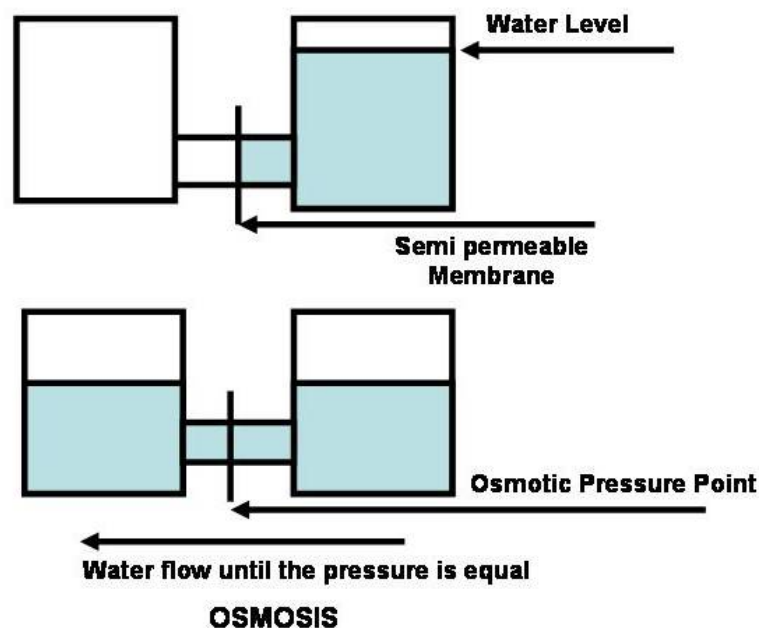
Under the scientific principles of diffusion and osmosis, a koi is gaining water and losing essential salts all day every day. If it was not for the koi's physiology which has evolved to counteract this process, it would simply bloat up with fluid and die. This is a condition called Dropsy (Ascites)

Before we can understand what dropsy is, we must first understand two natural occurring scientific processes namely, Osmosis and Diffusion.

Osmosis is the movement of a solvent through a semi or permeable membrane from a region of high pressure to a region of low pressure, this process will continue until the two pressures equalise. Water, being the solvent in question in our case.

Explanation of the above

Imagine two buckets joined at the bottom with a hollow tube and in one side we fill the bucket with water. The water will run through the tube until we have equal pressures on both sides (equal levels); then the flow stops. Similarly if we now put a semi permeable membrane across the centre of the tube in effect blocking the tube, because the membrane is semi permeable (not impermeable) If we then repeat the exercise, the same process will happen albeit at a greatly reduced rate because there is still passage for the water but the membrane offers a form of restriction, so when the two bodies of water equalise, the flow will stop. If we put an impermeable membrane in and repeat the process, the water will stay in one side as it cannot pass. This essentially is osmosis, a natural phenomenon that affects all things and can even be witnessed on fibre glass boats.



Diffusion

Diffusion is the movement or migration of a solute in a solvent, from an area of high concentration to lower concentration with or without a semi permeable membrane, the solute will always go from high to low concentration

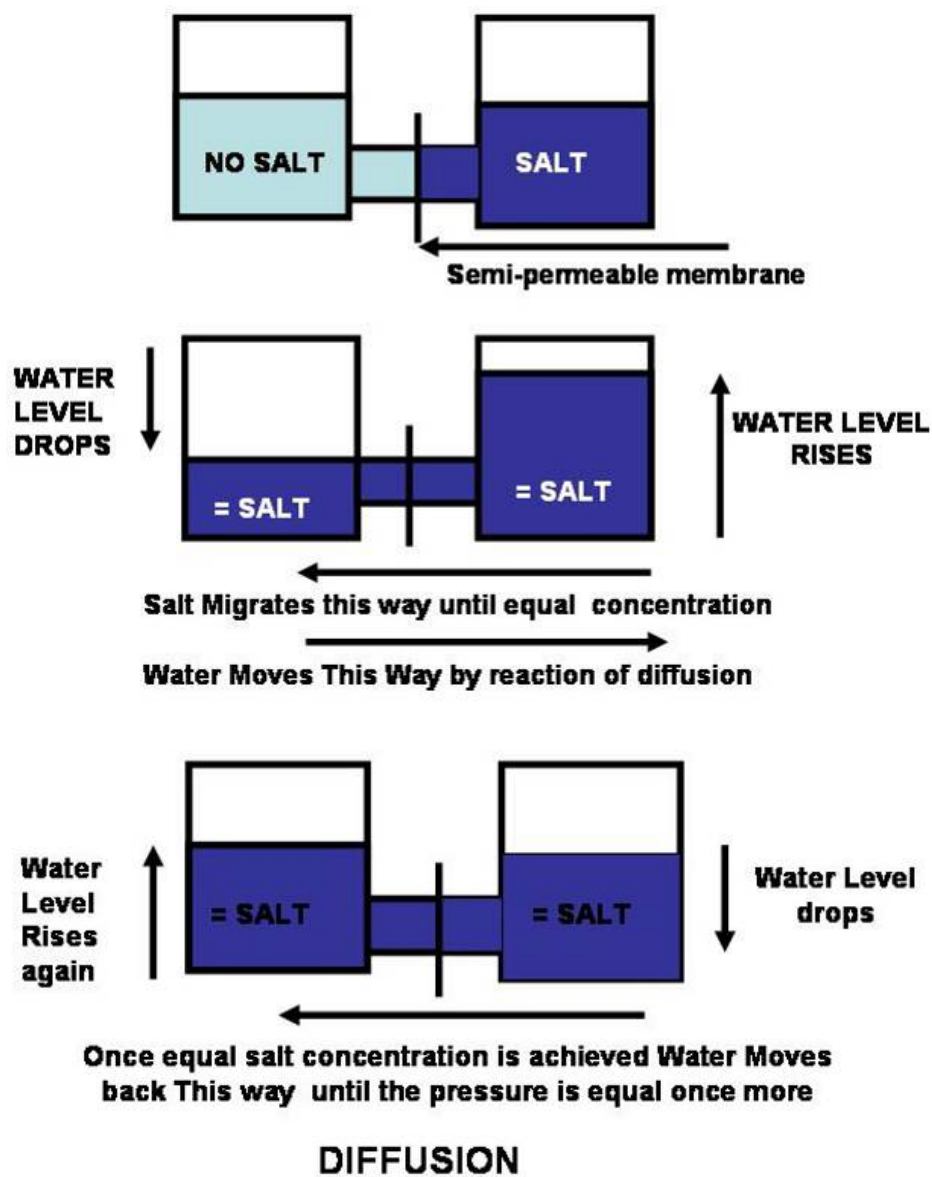
Explanation

Imagine a still pond with no movement at all, no pumps, no flow, no nothing. To one end we add a dye. Over a period of time we will see the dye spreading out without even so much as a stir in the water until the whole pond is evenly coloured at the same concentration. This process is called diffusion and is the dye molecules moving naturally from the area of high concentration to the areas of lower concentration till it all becomes equalised and all is of equal

saturation/concentration.

If we transfer the theory back to our bucket with the semi permeable membrane, if the water has equalised each side. If we now add salt to one side of the bucket but not the other, and provided the membrane holes are big enough to take the salt ions, salt will now begin to move across the membrane into the other side without any energy input until the concentration of salt is the same both sides. There is one draw back with this process that effects our koi immensely, and that is osmosis and diffusion can and do work hand in hand In other words as salt moves one way under diffusion, the water will move in the opposite direction.

If we go back to our bucket example where we added the salt to one side, what you will notice that as the salt begins to migrate to the lower concentration (the other side), it draws the water in the opposite direction, so the water level on the side the salt was added would rise slightly, until saturation was equal, then the water would by osmosis begin to go back to equalise the pressures again Under these processes the membrane is called the Osmotic pressure point



The more astute of you by now will have seen how this process can and does affect our koi

Fresh water teleost fishes have one major problem that's at the heart of most problems when things go astray and its this:

Your inside fluid salinity is 0.9% saline which is equal to 1.5 oz per imp gallon. So in other words if you could wring the water out of yourself out collect the water process all the other elements baring the salt you would have fluid left that's 0.9% in salinity.

It may surprise some to know that both fresh water fish and sea fish have the exact same salinity in their tissue. In the case of the sea fish, this presents a whole lot of problems that the fishes physiology has learned to deal with that are the exact opposite of fresh water fish.

The problem for freshwater fish is this:

While their inside salinity is 0.9%, their surrounding environment (water) is a lot lower usually around 0.05%, unless salt has been purposely added to the system. Therefore under the principals of diffusion the koi is constantly losing salts via diffusion, as the inside salt concentration is higher than the surrounding water. this happens 24/7 and is both involuntary and normal and requires no energy as it's a natural phenomena, but the koi has to maintain 0.9% other wise it goes as we do into shock, referred to as osmotic shock. These salts will be lost by process of diffusion mainly across the gut wall and gill. The gut has to be able to absorb ions for nutrition which makes that a semi permeable membrane, therefore what it can gain, it can also lose, and similarly with the gill, the uptake of oxygen for respiration and the release of carbon dioxide and ammonia makes that too semi permeable.

As we have already seen where salt moves in one direction, the water it's dissolved into will move in the other direction. So, the koi is constantly losing essential electrolytes and gaining hydration (water)

In all freshwater fish, they have a way to deal with this and it's as natural as breathing is to any living organism. It has in effect a bailing system that is constantly bailing the water out of the fish. A major player in this role is the kidney which produces huge amounts of urine which it again does 24/7 but as we are also losing salts the kidney being a filter has a trick up its sleeve. The kidney filters out all essential salts so avoiding further loss to an already total loss system and recycles these salts back into the koi's system. So the kidney produces copious amounts of **very** dilute urine and in effect this function performs two roles, it expels water that is being taken on board constantly and help minimise the loss of salts saving energy of the salts being pumped back to maintain 0.9% salinity in the tissue.

Salt is taken back into the koi or freshwater fish by special cells in the gill that pump salt ions against the natural lose concentration gradient, these are powered pumps and therefore require huge amounts of energy expenditure on the part of the koi so it makes sense to minimise any loss of essential salts as well.

So the koi has a very efficient bailing system just as in a boat with a leak but like all good bailing systems in order for them to work it depends on how powerful that bailing system is and how fast the water is being taken on board

In the case of our koi, the system works very well or we would all have fat bloated koi floating in our ponds, but there is very little in reserve. So if the kidney becomes dysfunctional, the koi cannot in effect bail itself out well enough and will start to fill with water and bloat. If the kidney is suffering from full renal failure, the system will flood even faster and will likely become unrecoverable. This is like the guy in our boat being unable to bail the boat out any more, the water still keeps coming but there is no one at home to bail it out, and just like our koi the guy in

the boat may be taking a break to recover or he may not be able to carry on at all, just as our koi's kidney it's either partially impaired or it's fully dysfunctional.

There is one more thing we must add to the above equation! What if the hole in the boat becomes bigger or the boat springs another leak? Would not the boat sink faster?

Yes and it's the same with our koi. Any breach in the dermis which exposes tissue on the fish is a further burden the koi can ill afford to have on an already over stretched system. Just like the boat it will fill faster and like the boat it can lose valuable cargo (salt) faster through the hole.

So with a full blown ulcer, the koi will both lose salts faster and gain water faster and it's essential we plug this hole.

In the case of the boat example, it will probably put to shore for repair and seal the holes and plug the leaks, in exactly the same way we must attend the koi's wounds by cleaning them and treating them and to seal the hole and plug it up, as well as sealing the medication in to work for that little while longer. And that, in a nut shell is the other reason for sealing and the reason it's so important to seal a wound.

Recap.

We clean the wound of dead or dying tissue and all bacteria apply your chosen topical. (If you have done your job right there will be nil or very little bacteria left and the fish's immune system will take care of any stray bugs) and then seal it off with a sealer your happy in using, if its a paste sealer like Orapaste, make sure its used sparingly or it will simply fall off. If its Orahesive powder apply while your chosen topical is still wet If it's a liquid sealer such as friars balsam, please allow to dry for a minute or so, most liquid sealers have a small amount of alcohol in them which makes for fast drying, I find liquid sealers not only stay in place longer(although they may appear to have vanished) but they are very flexible further adding longevity.



Below is a sequence showing the steps to cleaning, treating and sealing an ulcer in a koi.



Open ulcer exposed muscle cleaning agent applied (H₂O₂)



Topical applied



powder sealer applied



Top coat liquid sealer applied

Pictures from *Step By Step Advanced Koi Diagnosis And Treatments* by Duncan Griffiths

One last thought: if you subscribe to the theory of not sealing a wound and leave the hole unsealed, the ulcer/wound will be exposed to the elements with continual water ingress, into the tissue. And, what's in the surrounding water?

Yup you guessed it, probably the same bugs that started the whole mess off in the first place or much worse bugs, and if they are in the water and the water is entering the tissue what's also going into the tissue? Yes, again the same bugs. With this in mind, how long do you think it will be before these bugs do some real internal damage and we are dealing with septicemia?

Not long!



Lock 'N' Seal plus with added Bee Propolis, nature's healer and sticky glue
By Koikem by koi-unleashed

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