Why Can’t Humans Regenerate?

When I was three years old I caught my thumb in a folding chair. I cannot remember this episode, filled as it must have been with blood and pain, but my mother does. She packed the amputated tip of the thumb on ice and rushed me to the Emergency Department, where a surgeon sewed it back on again. I still have the scar on my thumb now, running parallel to the base of my nail.

What my mother didn’t know, and what most doctors still don’t, is that my thumb would almost certainly have grown back perfectly without any treatment. It would have regenerated in the same way as many lizards can grow back their tails or legs. Bone, nail, nerves, blood vessels, the whole lot. All it needed was a gentle, clean, non-adherent dressing, and a lollipop to soothe my frayed three-year-old nerves.

It turns out humans can regenerate, but only the very tips of their fingers and only children who still have strong Qi (we’ll come to this). In the 1970s a Sheffield paediatrician even published a paper on this effect in the *Journal of Paediatric Surgery.* Her results were unequivocal: amputations above the last joint in children under six left to heal naturally would regrow, the entire finger, without a scar or deformity!

It is somewhat amazing that this fact is so little known in the medical community. Having worked in the Emergency Department for ten years I have only ever met one colleague who was aware of this fact, despite the implications it has for patient care. The reason for this to me is clear: it strikes at the core of
what we think we know about medicine. If people can regenerate fingers then how do they do so, and what else can they regenerate? Medical schools would have to open up a new department.

The research into regeneration in humans is so slim that I have only ever seen one book on it, yet it is at the heart of the healing principle. An orthopaedic surgeon in America, R.O. Becker, spent decades looking into the ability of salamanders to regenerate. His interest was in non-union of fractures, literally a crippling problem that can occur for no clear reason. His findings led to medically approved devices for using electricity to cure bone ‘non-unions’, but it was these findings themselves that were most amazing.

Becker chose salamanders to experiment on because of their ability to regrow limbs, but he could have used any number of primitive animals who regenerate. Salamanders never suffer from non-union of broken bones for, even if they have no limb left to reunite, they can just grow a new one. Although salamanders are amphibians, their legs are functionally very similar to ours. They have bones, joints, nerves, blood vessels, and muscles, tendons and ligaments. In fact, they have everything we have in our legs, just smaller and covered in green skin.

A salamander that has had its leg removed will make a stumpy blood clot at the end and then over the course of the next few weeks it will grow a shiny new green leg. It’s amphibian magic!

Becker was intrigued by this power. After some research, he started to measure the electrical currents that would occur at the site of injury after amputating his salamanders’ legs. He had already noticed that there was a tiny electrical gradient from the salamander’s head to fingers (if that is what a salamander has). He noticed that this current was so small that it was almost unmeasurable. It was in micro-amperes, but was consistent and was consistently more negative at the head. What he found was that after he amputated the limb there was a reversal in the polarity of the normal electrical current and that this reversal would cause the limb regeneration.

Most students of medicine will not find anything unusual about animals generating electricity. Nerves are constantly able
to produce this and some animals can even generate large electric
shocks. What was unusual about this electricity was that it was a
DC current. Nerve electricity is AC – it has an up and down like
the power from the mains. The current Becker was measuring was
constant, like that from a battery.

Now, it would be nice to say at this point that no animals
were harmed in these experiments, but that is clearly not true…
What is incredible, though, is that at the end of the experiments
it appeared that no animals had been harmed! Regeneration is a
truly miraculous event.

What Becker found is that this reversal of electrical current
would cause changes in the salamanders’ blood cells in the region
of injury. They would de-differentiate (differentiation is the process
of stem cells turning into specialised cells like muscles). In other
words, the red blood cells would wind back the embryological
clock, unlocking their DNA until they were primitive stem cells
again. Then they would start rebuilding the limb from scratch,
differentiating into bone, nerve, muscle, whatever was needed.
Within a few weeks the job was done and the salamander was
back on four legs again. So long as the salamander had enough
food, this could be repeated many times.

Any student of medicine may have spotted a deliberate mistake
in the above: red blood cells don’t have DNA in them, they have no
nucleus. Indeed, this is true, red cells have no nucleus in humans,
but in more primitive animals red cells are nucleated. They have all
the genetic code present: large parts have been turned off to enable
the cell to function as a red blood cell, but it is still all there. What’s
more, with the right messaging it can still create any cell in the
body! It is this process that was used to clone Dolly the sheep and
this, my friends, is one reason why more primitive animals than us
can regenerate limbs: they have stronger blood.

Becker went further. He messed around with electricity in
salamanders and other animals and made them grow extra limbs
and even heads. Using tiny electrodes he re-reversed the polarity
at injured limbs and stopped them regenerating. Then he showed
that higher animals, like rats, can sometimes regenerate limbs,
especially if he provided the injury site with an extra boost of electricity. He noticed that this power diminishes as the rat gets older and the injury gets more severe. As he worked with more evolved animals, he noticed that this regeneration reduced, along with the ability to generate a strong DC regenerative current and nucleated red cells.

Finally, he came to the conclusion that the more energy a species has spent on creating a big brain, the less ability it has to regenerate. Humans, with the largest brain per size of any large animal, have been left with the regenerative short straw.

Regeneration is a fact of life, but what is remarkable about people is the fact that we cannot do it in our limbs more readily. Regeneration is just embryology and the processes involved are the same. It is the same DNA, using the same pathways, and the same messaging system. We regenerate every time we heal a cut or broken bones and, on a micro-level, we do this all the time in our body, a million times a day. Cells in our gut are constantly regenerating and forming a new gut lining, our bone marrow is constantly regenerating our blood and immune system, and our internal organs are certainly engaged in ongoing repair and replacement as cells wear out.

There are certain tissues that cannot regenerate, and the most devastatingly injurious of these are the brain and spinal cord. Injury here can result in a stroke or paralysis with no hope of regeneration – the cells are too specialised to wind back their embryological clock.

As I have said, the electricity that Becker showed in injured limbs wasn’t the same as nerve impulses. It was constant, a DC current rather than the up and down AC current of nerves. Becker was unsure where it came from but a visiting doctor from the military wondered if it was the same mechanism as worked in acupuncture – was this what the Chinese called Qi?