Regenerative Medicine

Foregen was created for the desire to use regenerative medicine's amazing advances over the last fifteen years. Now, dermal replacement techniques can restore original tissue to those who have lost it.

Below is a brief explanation in layman's terms of the process of regeneration.

What is regeneration?

Regeneration is the ability of the body to regrow tissue when it is lost by trauma, disease, or other misadventure. The most famous example of this is the salamander, which can reproduce whole arms, legs, tails, and other body parts within days following their amputation. Salamanders are, however, not the only creatures with such powers humans have them naturally as well (at least for a time) while developing in the womb. If a developing baby loses a finger or another of its extremities, it simply grows it back without forming scar tissue. Indeed, very young neonatal babies can sometimes do the same if injured shortly after being born. Even in adults, kidneys and livers retain some of this regenerative capacity when they are damaged.

Aside from our kidneys and livers, why can't humans regenerate as adults?

While we don't know fully why we cannot regenerate after birth, existing theories may shed some light on the issue.

One theory is that stopping the regenerative process is critical to allow a much more powerful survival aid to take its place: scarring. A scar allows a wound to seal quickly, thus preventing death from infection or loss of blood. In evolutionary terms, the ability to scar helped our ancestors survive. Put simply, for primitive man there was little benefit in having a body that regenerated an amputated arm (which takes months) if, in the meantime, he bled to death. Survival by scarring was, therefore, a critical step forward in evolutionary terms, not just for man but for all mammals.

Scarring is not without costs, however. First, scar tissue prevents any new regrowth by regeneration; and secondly, scar tissue is different from the normal tissue that once was there (as anyone with a scar will know), both in appearance and in function. It stops us from dying when wounded, but isn't useful functionally.

How is it possible to regenerate now that we are adults?

That is the question to which biomedical research has been looking into for many years. Fortunately, we now have some answers. The first is the discovery that the unique DNA structure present in every cell represents (among other things) a blueprint or map of our *whole* body, not just information relevant to that cell. This blueprint organizes the body's growth in the womb by telling cells what comes next in the growth process. This body map is created in the very first cell we have and remains constant throughout our lives, unaltered even if our body becomes wounded, damaged, or amputated in some way. As such, when we are wounded, our

body still has a record of what should have been there, a record that regenerative medicine uses to have the body remake itself.
The second key is learning how to stop scarring from happening. When we are wounded, our body automatically instructs the cells at the wound site to form scar tissue. As stated above, this function was of importance to evolution but marked the end of natural regeneration in our body. Regenerative medical techniques have shown that it is possible to turn off that instruction from the brain and instead send a new instruction to wound site cells to *regrow* what was taken away, using the blueprint present in our DNA, just as if the body were still in the womb.

How do we induce regeneration from our DNA?

There are two important elements in regeneration: stem cells and the extra-cellular matrix or ECM. Recently, scientists discovered a *simple* method to revert adult skin cells back to embryonic stem cells. This discovery greatly helped the field of regeneration. An Extra-cellular matrix is also important. The ECM can be thought of as the skeleton for a tissue. It attaches cells together and gives them their structures. It also enables communication between cells. With an ECM stem cells know which structures to grow. It also provides the necessary vascularity to feed cells and remove waste. The ECM tells the surrounding cells to repair the tissue instead of creating scar tissue. It can be engineered, usually with a 3D printer, or obtained by stripping the cells of a donated tissue with specialized detergents. (To read more about the current progress of bioprinting in english, click here)
In regeneration, you obtain the ECM of the tissue you wish to regenerate and then seed it with the appropriate layers of cells. This method has been extremely successful in regenerating even the most difficult of organs, such as the heart, liver, and kidneys.

What has regenerative medicine accomplished so far?

Regenerative medicine has had amazing successes that were not possible a decade ago. Below is a brief list of significant accomplishments in the field:

- Regenerating bladders and printing kidney prototypes
- Cloning progress as of 4 years ago
- Implanting regenerated 3D printed tracheas
- Decellularizing then regenerating mice hearts
- Partially regenerating living human hearts
- Regenerating last joint of a human finger
- Partially regenerating breast tissue
- Implanting regenerated vaginal tissue
- Regenerating functional penises in rabbits
- Decellularizing animal foreskins for future regeneration

These successes convince even the people who doubt Foregen's mission to regenerate foreskins that reversing circumcision is possible. We know the technology exists. In fact, we have made tangible progress towards it and that is what Foregen will achieve.

Why focus on foreskin regeneration as opposed to other vital organs?

This is a wonderful question and one that Foregen takes very seriously. Foregen deeply respects the efforts of all the dedicated scientists in the biotech world and recognizes the importance of their work. There is no question that a patient needs working vital organs before fully functional sexual organs to survive, but there are real reasons to pursue foreskin regeneration that will benefit all aspects of the field of regenerative medicine.

First, the demand for a cure for circumcision is huge. The body part that is in highest demand for regenerative purposes in the US is the kidney. About 100,000 people are on the waiting list for one. There are approximately 1,000 times as many men (100 million) who are in need of an intact penis in the US alone! Although not all of these men are aware of Foregen's existence yet, or even of the damage imposed upon them, they soon will be as we make progress towards regeneration.

Foreskin regeneration will also bring the field of regenerative medicine attention. When we are successful, regenerative medicine will be brought into the public eye because of the effects our therapy will provide for millions of people. Lastly, we at Foregen believe there is a difference between surviving and truly living. To live, one needs to be physically, mentally, and spiritually healthy. A healthy sex life is an integral part of any person's overall well-being. Since circumcision amputates a significant amount of skin, nerves, and function from the male sexual organ, it is necessary to reverse this damage to regain a complete sex life and an emotional self.

Has anyone tried regenerative techniques on foreskin tissue?

Yes, both Foregen and Anthony Atala's lab (indirectly with his rabbit experiment), have made progress toward foreskin regeneration. However, no clinical trial has ever been done with the purpose of restoring a foreskin to a circumcised man, *yet*. However, small samples of foreskin tissue, have been successfully used in many medical experiments to generate new skin (it should, however, be stated that some of these experiments were, in Foregen's view, unethical as they involved foreskins taken non-consensually from healthy infants circumcised without their consent. Foregen is not, and will never be, involved with such experimentation). Foreskin has had great success so far and with your help will be able to regenerate the foreskin soon.

So when is Foregen going to regenerate a foreskin?

Very soon! We already have the ECM for regenerating animal foreskin and now working on obtaining the ECMs from donated human tissue. In the short term, we hope to fully regenerate human foreskins. Once we have accomplished that, our goal is to advance onto human clinical trials as soon as it is safe to do so.

Will the new tissue have full function?

We believe so. In other regenerative surgeries, the new tissue reintegrates itself into the body, which recognizes the tissue as its own and does not reject it via the immune system as it would for grafted skin or transplanted organs. Those who have already undergone regenerative therapies have had amazing success. For example, those who have received regenerated bladders or tracheas, as mentioned earlier, now have fully functioning organs! The nerve connections severed by the trauma of the surgery (in our case, circumcision) were reconnected to the body with the new implanted tissue. We expect Foregen to achieve similar results in our clinical trial.

What can I do to help?

Foregen appreciates your willingness to help us in our mission to reverse circumcision. We are moving as fast as we can, but to stay up to date with all of our advancements, please create an account with us in our main website. Also, we appreciate your tax deductible donations and we encourage you to become a Foregen Member! Lastly, please share Foregen with your friends and family and over social media to help spread the word. By helping Foregen, you bring foreskin regeneration one step closer to becoming a reality.