Interview with Dr. Fiona Wood

Interview with Dr. Fiona Wood from The Institute for Research into Tissue Regeneration, Repair and Reconstruction. This interview took place on the 28th of October, 1996 in her office at 44 Churchill Av. Subiaco. Western Australia. This text was reformatted from the original Tissue Culture and Art Website (http://www.tca.uwa.edu.au/project/interviews/inter_main.html)

Oron

I am currently doing my honours degree in design, looking at ways in which biotechnology, and in particular tissue engineering can be used to produce products which are not of medical or agricultural nature. I identified the work that is being done regarding to skin growth in vitro, as having the greatest potential for such products.
So I am very interested in your work. Are you dealing with skin culture?

Fiona Wood

Yes, we grow the epidermis.

Oron

So you are not growing a multi-layered culture?

Fiona Wood

No, we are not growing composites. People have tried growing composites around the world. But still without clinical success. They haven't actually got it to work. There is the Conco group, they have tried, but from a burn point of view. They are trying to incorporate the dermal and the allograft, and trying to introduce the cells to it. Clinically it has not been used successfully, yet.

Oron

What about tissue engineering, using biopolymers scaffolding?

Fiona Wood

The current state of the art is Integra. That is a colagene metrics with a synthetic coating, and you put that in place and allow couple of weeks for it to vascularise and then you resurface it with epidermis. So its a dermal template, but its a two stage procedure. That is the state of the art at the moment, to get consistent results. In the experimental setting, there is a lot of work done in taking it back a step, from a two stage surgical procedure, where you put the dermis first and then you put the epidermis on, to try and seed the dermal template with the epidermis. There are number of ways in which it was tried: centrefusion in which the seeding is from the outside sticking fibrin glue, and things like that. But nothing is useable yet.

Oron

For my purposes, this ëskin' is not going to be transplanted, and by that eliminating some of surgical problems.

Fiona Wood

Yes. That is right, the work is there, so there may be an opening there. Our limitation is how actually to apply it to patients.

Oron

In this stage, I am looking at these subjects from the design point of view. To provide a fresh perspective, and attack this subject from different angles. To try and find solutions to other problems. Do you think that there is a possibility of growing skin in a non sterile condition, using the skin itself as a barrier against contamination?

Fiona Wood

In non sterile conditions it will be difficult. It depends on how you maintain the vascular supply, that is the nutrition. What do you have in mind?

Oron

I was thinking about a way in which the skin engulfs the object, this object will have a mechanism that will provide the nutrients from the inside out, and I assume will also have to maintain a constant temperature.

Fiona Wood

We grow our skin in CO2, at 35ºC and 5% CO2, that is the optimal condition. If the object could deliver neutrinos then there is a potential that it would work. You have to provide a surface that is favourable for adhesion. A lot of our work is about adhesion, and how to make it stick and keep stuck. Because we can get it to stick and its floats off again. This is one of the big problems with that, because it is no good if it blisters, changes in that way. So from that point of view there is a potential, depends on the object and what information you need to extract from that object. It certainly has to get away from the flat flask, change it to a sphere. But then you have the problem of how to hold this sphere. If you feed it from underneath, you may be in a position to allow it to spread over the surface, but you will have to trial the surface if it is susceptible to adhesion. Currently we are looking at various ways in which we can have the skin on the top and feed it from underneath, by actually putting it on a mesh, with some liquid, that allows air interface, and that triggers differentiation, because if you have a liquid interface it does not differentiate, the cells stay just of the one kind. So, for the sake of the argument, if you apply it to a sphere, and you suspend that sphere, you will have to coat the external with the right kind of plastic for adhesion, (aratiat fibroblast, that allows it to adhere) and you have to seed it (with the right kind of cells). And then you will have to feed it from inside, it will have to be porous. So there are a whole lot of issues to transfer the current state of technology to this kind of thing.

Oron

Are you still speaking about one layer of cells?

Fiona Wood

Well, if you have it in an air interface, it does differentiate. It become a non single cellular layer, and even with the current methods we can get up to ten layers before its thickness prevents the defusion of nutrients. If you put it into an air liquid interface and feed it with the liquid underneath, then what you get is a situation where its begins to differentiate and then it does thicken up. So to actually get to engulf an objcet it will have to go to a liquid feeding system, that present its difficulties; if, say, you have a blob with mesh over and then have the liquid flow thorough the mesh. The liquid then will be collected by a dish. That presents problems with the input and the output.

Oron

Vacanti clams that in the near future we will be able to grow a whole limb in in vitro conditions.

Fiona Wood

That is really ambitious. You are pushing to get the composite elements, first there is the problem with the nerves. Basically we have a single cell with all of the information, but we don't have the key... and you can stimulate it in different ways to get different composites. But to say that we can grow a limb in the next ten years... I think it is ambitious, if it will happen in my medical lifetime I will be surprised. But things accelerate, on the time scale of technology the development rate is expeditional. Even allowing for that, there are significant drawbacks for actual composite organs. If you look at the work that is being done with artificial livers, with artificial pancreas, which are of a relatively simple geometrical structure and cellular structure and then transfer it to all embryological derivatives, its a big step.

Oron

I am looking at ways in which we can use this technology for non-medical uses. The first attempts will probably be of an artistic or ornamental nature, and by that avoiding some of the problems you mentioned. So do you think we will be able to have half living half artificial objects?

Fiona Wood

You could definitely grow skin on an inert object, that is exactly that. If you grow skin on the inside of that surface and collected what it produced, like cells' factories in which the cells grow on rods and we collecting the proteins the cells produce.

Oron

Costwise, how much does it cost to grow, using the current methods, 1002cm of skin?

Fiona Wood

Its about a $100. That can be even cheaper, depends on what you want to do with it. You can harvest it and let it grow again. If you freeze it down, its more expensive.

Oron

How long does it takes to grow?

Fiona Wood

We can get cell suspension by five days, and a sheet at ten days. That is the minimum time.

Oron

What size?

Fiona Wood

Any size, depends on how many cells you have seed into it, to begin with.

Oron

Can I see the how you grow the skin?

Fiona Wood

Yes, that is in the Spine Lab at PMH. It easier if you actually go there and see the lab set-up. Then you can appreciate the stability concept as well.

Oron

Do you know of any similar work that has been done on animal skin?

Fiona Wood

I really don't know.

Oron

I asked about that because I think that growing reptilian skin may be easier to grow as an independent tissue.

Fiona Wood

Possibly, but I do not know. What we do know from our work is that the skin retains its characteristics from the site it was growing. If we grow the palm of the hand we will take that

skin from the sole. If we grow skin to match the face we take the skin from behind the ear, because the colour is the same. So, the keratin and the proteins that they produce and their forms are different, they retain their site specific nature. So if you put skin of the sole of the foot on the face it will not match and will look different.

Oron

Back to these half living structures, is there any future there?

Fiona Wood

Yes, obviously you will have do identify a potential useful source, and make the steps back to what we have currently, and work out if you can actually make the link between these two. If you can not, why not? what else would you need to make it work?

Oron

Thank you for time.