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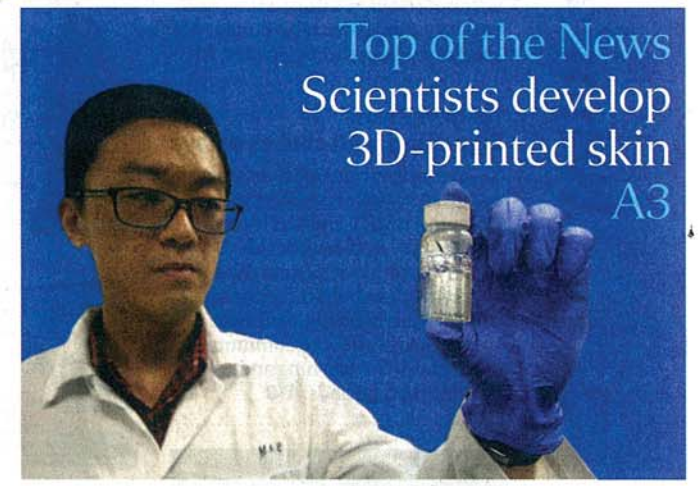

NTU scientists print human skin that matches natural pigment

Breakthrough could potentially replace animal testing and help burn and diabetic patients

Linette Lai
Health Correspondent

Scientists from Nanyang Technological University (NTU) have managed to print tiny 2cm patches of human skin that look like the real thing.

They are the first in the world to be able to match the colours found naturally on the human body – and researchers have told The Straits Times that they believe their breakthrough has the potential to change science and medicine.

For example, it could give companies a more ethical way of testing drugs or cosmetics, instead of using animals.

Being able to produce pigmented skin is also important. "Take suntanning lotion or whitening products, for example," said research fellow Ng Wei Long of NTU's Singapore Centre for 3D Printing. "Without pigmentation, how are you going to verify that it works?"

But the "ultimate dream" is to be able to print skin for medical purposes, according to Dr Yeong Wai Yee, who is assistant chair (students) at NTU's school of mechanical and aerospace engineering.

This could include skin grafts for burn victims or diabetics.

"People with diabetes sometimes get wounds that are very difficult to heal," said Dr Yeong.

The bioprinting project is a collaboration between NTU's Singapore Centre for 3D Printing and the Singapore Institute of Manufacturing Technology at the Agency for Science, Technology and Research.

The process works by feeding "ink" made of three types of skin cells – keratinocytes, melanocytes and fibroblasts – into a special printer along with a soft collagen gel. Over several days, the raw materials are laid down in precisely patterned layers that result in the natural colouring of human skin. In comparison, doing the same thing by hand would result in blotchy and uneven pigmentation, Dr Yeong said.

The skin construct is then cultured for four weeks before it is ready to be harvested. The entire process takes around two months.

Unlike growing skin in a laboratory, bioprinting gives scientists much more control over the entire process.

In fact, said Dr Yeong, it could even allow them to mimic the skin of people of different age groups.

"With the manual method, the technicians cannot decide the design of the construct," she added. "They can only define the process."

The project, which took four years, was a proof-of-concept to demonstrate that 3D printing skin is feasible.

The team behind it is now working with a company called Denova Sciences to help them refine and commercialise their work. They hope to add more features of real skin, such as stem cells, fat cells, blood vessels and hair follicles.

"It is like learning how to paint," Dr Yeong added. "In future, with more research, we should be able to use the same technique to get different colour pigmentations, like painting with different colours."

The laboratory is also looking into printing other body parts, such as retinas, which could be used to test drugs.

Doctors say the skin-printing technology holds promise, especially for patients with burns or illnesses that cause their skin to lose pigment. However, much more work needs to be done before it can be used routinely.

For example, medical treatment will not be as simple as printing a layer of skin to graft onto a burn patient's wounds.

"Skin pre-grown from human donors will be liable to rejection by the patient's immune system," said Dr Tey Hong Liang, a senior consultant at the National Skin Centre.

"(But) the harvesting and growing of patients' own skin cells to a sufficient quantity requires much time currently."

Dr Alvin Chua, deputy head of the Singapore General Hospital's skin bank unit, added that in order to treat major burns, there must be enough "cell ink" for printing.

However, this can take time that burn patients cannot afford.

"A large amount of skin cells must be grown to provide the necessary ingredients to produce big enough areas of printed skin to cover extensive burns," he said.

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WORK IN PROGRESS

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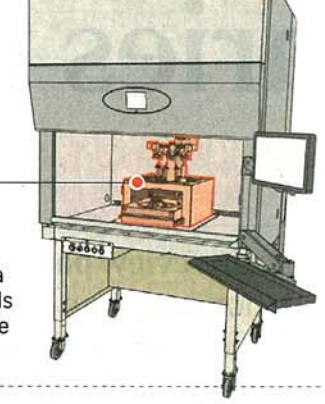
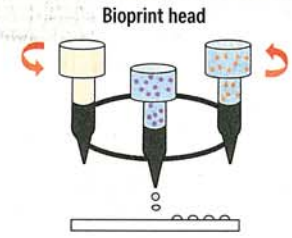
DR YEONG WAI YEE, assistant chair (students) at NTU's school of mechanical and aerospace engineering.

How does skin printing work?

Scientists at the Nanyang Technological University have managed to print human skin in different colours, which can be used for testing cosmetics and drugs, or even medical treatment.

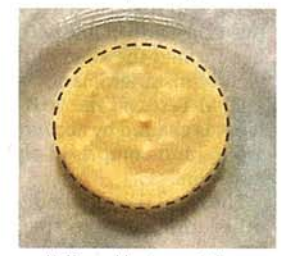
1 The 3D bioprinter is loaded with a mixture of three types of skin cells and a collagen gel, on which these cells will grow.





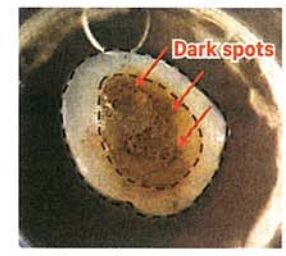
2 Over several days, the different cells are printed in a very precise pattern. Doing this by hand would result in blotchy and uneven pigmentation.

Bioprinting



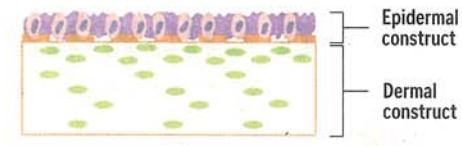
Uniform skin pigmentation

Manual casting

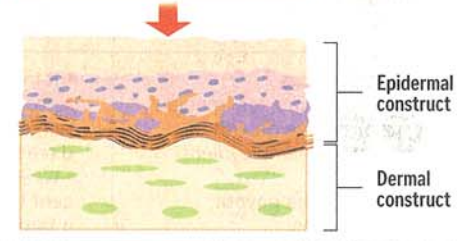


Uneven pigmentation and presence of dark spots

3 The entire construct is cultured for four weeks.



4 The printed skin construct is ready for harvesting.



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