Medical Xpress

Laboratory study paves way for new approach to treating hair loss in humans

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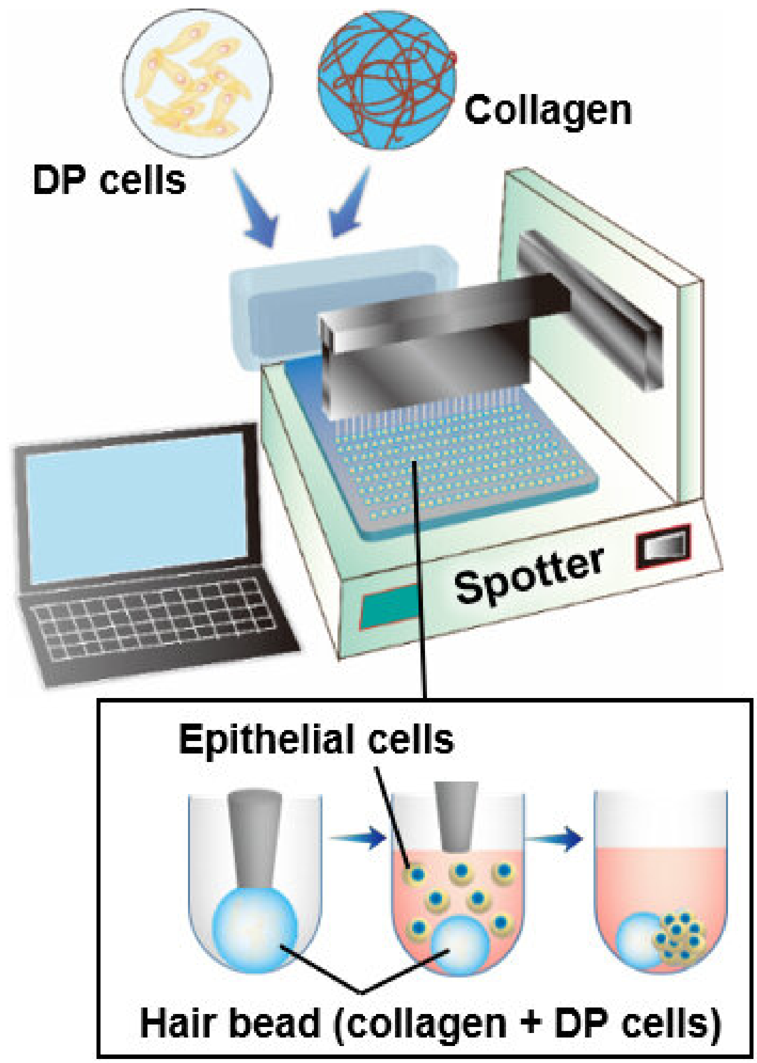


Japanese scientists have developed an efficient method of successfully generating hair growth in nude mice. The new method can be scaled up and therefore shows great potential for clinical applications in human hair regenerative therapy. Credit: Yokohama National University

Japanese scientists have developed an efficient method of successfully generating hair growth in nude mice. The new method can be scaled up and therefore shows great potential for clinical applications in human hair regenerative therapy.

Their findings were published on May 9, 2019 in *Biomaterials*.

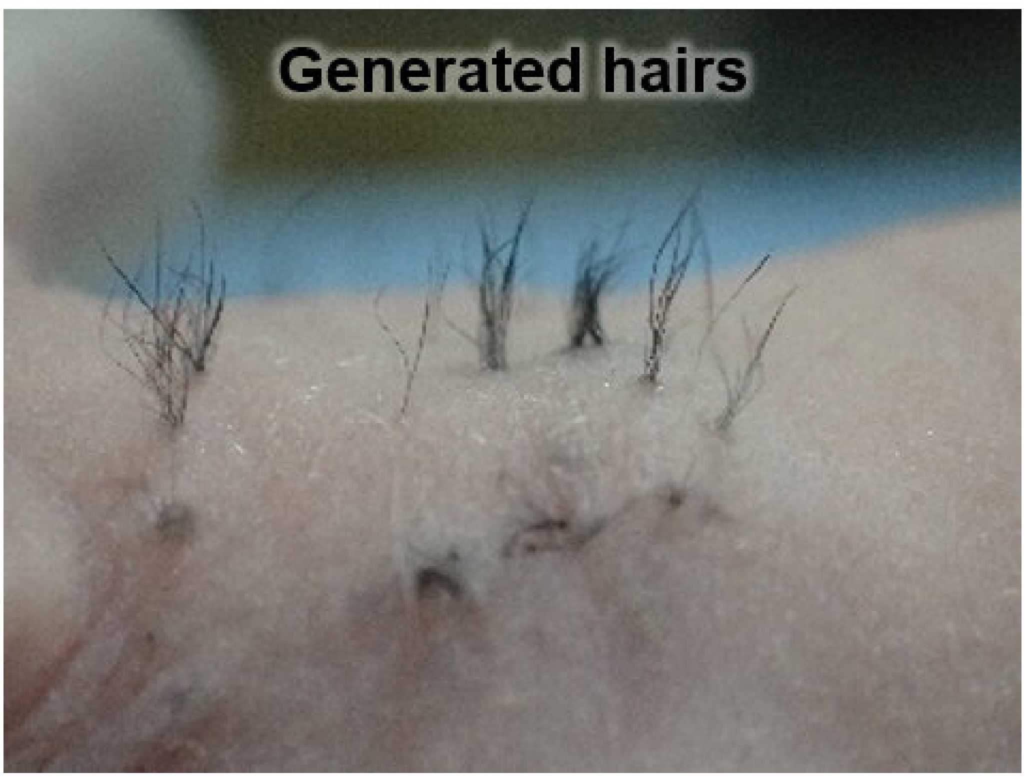
Several factors contribute to human hair loss: It can be hereditary, or it can occur as a result of aging, hormonal imbalances or treatment with cancer fighting medications, all of which can lead to the loss of stem cells responsible for hair formation during development and the replacement of hairs that are shed during normal hair cycling.

Hair loss is currently treated with drugs and hair transplantation—where hair follicles are removed from one part of the body (ex. the back of the head) to the site of hair loss. However, these treatment methods have their limitations; drugs are inefficient at stimulating hair regrowth to the extent necessary to counteract hair loss and hair transplantation doesn't increase hair numbers in the scalp.

Previous studies have shown improved results by transplanting, onto the backs of mice, a three-dimensional tissue culture called hair follicle germ (HFG). HFG is composed of hair follicle stem cells derived from both epithelial (outer layer of the skin) and mesenchymal tissue (connective tissue derived from the mesoderm). However, this approach requires manually merging the stem cells derived from these two different origins under a microscope, making it a challenge to produce the 5,000 or more hair follicle germs (HFGs) required per transplant patient.

To make the method scalable and therefore clinically viable, a team of scientists led by Dr. Tatsuto Kageyama and Prof. Junji Fukuda from Yokohama National University in Japan proposed a new approach to regenerate hair using mouse and human hair follicle stem cells.

The team fabricated hair beads (HBs) in u-shaped wells in a plate array using hair follicle stem cells encapsulated in collagen, a structural protein in skin believed to play an important role in hair follicle generation during embryonic development and hair regrowth throughout life. A suspension of mouse epithelial cells was then added into the wells containing the gel encapsulated hair beads. After 24 hours, the epithelial cells clumped together in a ball and adhered to the collagen gel. The collagen gel then contracted to form a "bead-based hair follicle germ" (bbHFG).



The new approach showed a higher rate of hair generation compared with other methods. Credit: Yokohama National University

To test the efficiency of the hair bead approach, the scientists transplanted HBs and bbHFGs onto the backs of mice.

The team also transplanted hair follicle cell aggregates fabricated with two other methods onto the backs of nude mice as comparisons. In the first of these methods, mesenchymal and epithelial cells were mixed before being seeded in the wells. These cells initially aggregated, but spatially separated out from each after three days of culture to form a hair follicle germ (ssHFG), as reported by the same team. For the second method, they prepared a collagen solution containing a mixture of epithelial and mesenchymal cells and prepared droplets from this mixture. The microgel containing the cell aggregate contracted similar to that of the hair beads, but they did not separate and remained randomly mixed.

The results showed that compared to the other methods, the collagen-enriched hair bead (bbHFG) approach produced a high rate of hair generation four weeks after being transplanted onto the skin of the mice. After comparing gene expression of hair-producing gene markers in the three different methods, they found that gene expression for almost all the hair producing gene markers was greater in the bbHFGs, suggesting that collagen enrichment and cell aggregation play an important role in promoting hair follicle stem cell development.

The researchers also investigated whether this method could be automated to mass produce hair follicle germs on the scale needed to be clinically feasible for hair regenerative treatment of patients suffering hair loss.

"Using an automated spotter, this approach was scalable to prepare a large number of hair follicle germs, which is important for human treatment because thousands of tissue grafts are necessary for a single patient," said Prof. Fukuda.

As the ultimate goal of this research is to develop an efficient method of hair regenerative therapy that can be upscaled to make it clinically viable, the researchers next step "is to find a way to expand the number of hair follicle stem cells," said Prof Fukuda. "In this study, we worked on how to prepare tissue grafts. However, to deliver this approach to hair loss patients, we need a proper approach to obtain a sufficient number of hair follicle stem cells before preparing tissue grafts."

According to the authors, further studies that use hair follicle stem cells derived from patients suffering from hair loss are also required.

More information: Tatsuto Kageyama et al, Preparation of hair beads and hair follicle germs for regenerative medicine, *Biomaterials* (2019). DOI: 10.1016/j.biomaterials.2019.05.003

Provided by Yokohama National University