STEM CELLS FOR HAIR GROWTH AND HAIR TRANSPLANT

Is it possible to reverse hair loss?

BY EDWARD DICKERSON IV, MD

Dr. Edward E. Dickerson, IV is the owner and medical director for Cape Fear Aesthetics, Rejuvenating Med Spa, and Fayetteville Plastic Surgery. He is board certified by both the The American Board of Otolaryngology-Head & Neck Surgery and the The American Board of Facial Plastic & Reconstructive Surgery.

Thick healthy hair has historically been a sign of power and position, making hair loss a particularly sensitive subject. According to the International Society of Hair Restoration, in the United States alone, there are approximately 35 million men and 21 million women suffering with hair loss. The surgical correction of all types of hair loss is an almost two billion dollar industry worldwide. Traditional surgical procedures are often painful, slow to reach completion and expensive. The desire to have a healthy, full head of hair is compelling for many, making the development of new strategies for correcting all types of hair loss an important—and lucrative—endeavor. Turning to the use of stem cells to reverse hair loss is a new and exciting tactic being researched and tested across the world.

THE STRUCTURE OF THE HAIR FOLLICLE AND ITS CYCLE

The hair follicle is comprised of an outer root sheath (ORS) that is a part of the epidermis, an inner root sheath (IRS), and a hair shaft. Hair follicles have three distinct phases in the development and breakdown of hairs. The anagen phase is a time of activity and hair growth, while catagen is a time of apoptosis and hair destruction. The third phase is telogen, a period of rest.[1] Undifferentiated stem cells consistently develop into hair fibers, ensuring normal hair growth and regeneration.[2] Over time and with hormone malfunction and genetic mutations, these normally functioning follicles begin to produce thinner, shorter hairs, ultimately ending in alopecia.[3]

TYPES AND CAUSES OF HAIR LOSS

Alopecia is the blanket term for hair loss. This term can refer to the autoimmune disease alopecia areata, in which small, round sections of the scalp become bald, as well as the more common hormone-driven condition, androgenic alopecia. This androgen-dependent baldness is also referred to as male pattern baldness. Women are also affected, although not as frequently or as dramatically as men. There has been significantly more research conducted on male pattern baldness, but an increased incidence in female hair loss has triggered an increase in its study.[4]

In alopecia areata, small areas are typically affected and may even re-grow over time. The less common but more dramatic alopecia totalis and alopecia universalis result in total loss of scalp hair or hair loss over the entire body, respectively. According to the National Institutes of Health, there are no known cures for these autoimmune diseases or approved drugs for their treatment. Some sufferers will try corticosteroids or topical preparations, but due to the fact that additional hair loss can happen at any time, many of these efforts, even if successful, are temporary and largely in vain. Although many people with these autoimmune diseases do seek surgical treatments for correction of hair loss, the typical patients considering hair restoration intervention therapies are men and women fighting androgenic alopecia.

BOTTOM LINE

Several studies support the idea of regenerating or replacing hair follicles through stem cell therapies and point to mesenchymal stem cells and specifically dermal papilla cells as crucial players in stem cell-based treatments for hair loss. This is largely due to the DP cells' ability to induce hair follicle formation from epithelial stem cells.

SURGICAL INTERVENTION

Until recently, the most common approach to correcting androgenic alopecia was the surgical technique involving the harvesting of scalp tissue containing hair producing follicles. Follicular Unit Extraction (FUE) has become the gold standard for surgical repair. This method employs extracting one to four hair follicles at a time using 1mm or less harvesting tools, allowing for a more natural result. FUE replaces older strip methods. Newer surgical techniques are repairing much of these older missteps, yet the process is still arduous.[5]

STEM CELLS: A NEW APPROACH

There are two main types of stem cells that can be used for a variety of medical interventions: embryonic stem cells (ESC) and adult mesenchymal stem cells (MSC). There is great promise in using ESC, as they are capable of differentiating into any type of cell in the body. This could lead to cures for diseases and other highly beneficial outcomes. Regardless of their medical potential, there are myriad ethical and regulatory hurdles surrounding the use of embryonic stem cells, making the option of using MSC attractive.[6]

Below the hair follicle is a pocket of specialized mesenchymal cells, called the dermal papilla (DP). These DP are essential to follicle formation.[7] When DP are dissected and combined with hair follicle fragments containing bulge cells, they can reconstitute a viable hair follicle.[8] The hair follicle bulge is an excellent source of pluripotent adult stem cells.[9] Bulge stem cells have demonstrated the ability to be multipotent, a capability that can lead to the regeneration of sebaceous glands, epidermis, and hair follicles. Because of the copious quantity of hair follicles in human skin, each containing stem cells, the skin provides a massive and easily accessible storehouse of MSC and DP in the body.[10]

In addition to the follicular bulge, MSC can be harvested from a variety of other sources, primarily bone marrow and adipose tissue. Harvesting adult stem cells from bone marrow typically requires drilling into the bone, making it a more dramatic and potentially painful procedure. Adipose tissue removal can be achieved using a typical liposuction technique. The White Adipose Tissue (WAT) resides slightly above the subcutaneous adipose layer and appears to be inextricably connected to hair follicle cycling and health.[11] The mature fat cells are a rich source of epidermal growth factors that play a key role in slowing the follicle from entering the catagen stage, therefore lengthening the anagen stage.[12] These fat cells also provide copious long chain free fatty acids that are known to influence many metabolic reactions, potentially that of the skin and hair follicles.[13] The ease of collection along with the growth factor and free fatty acid availability make white adipose tissue and attractive option for fighting hair loss.

Several studies support the idea of regenerating or replacing hair follicles through stem cell therapies, and point to MSC and specifically DP cells as crucial players in stem cell-based treatments for hair loss. This is largely due to the DP cells' ability to induce hair follicle formation from epithelial stem cells.[14] Once this hair producing capacity is reduced or lost, restoration can be achieved through the use of DP cells from the affected individuals. These stem cells are then incubated and expanded in a laboratory, forming spherical droplets that are transplanted back into the skin of the individual. Studies have shown that after transplantation there was an accelerated growth of new, fully functional hair follicles.[15]

THE FUTURE IS NOW

Stem cells offer us untold numbers of therapies moving into the future. The science and art of safely and ethically harvesting and storing stem cells is a rapidly growing field. The pool of science currently available on the use of stem cells to restore healthy, full heads of hair without surgery is compelling. This field will continue to expand and be perfected, and will most likely become the gold standard of treatment in the decades to come. ■

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