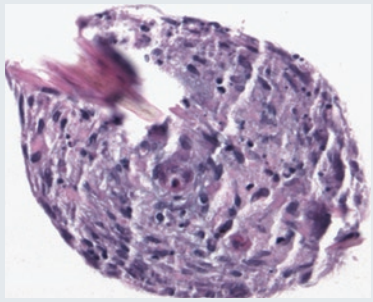
For the article: http://dx.doi.org/10.1038/jid.2009.322

The Multipotent Nature of Hair Bulge Cells

Ronald Sulewski[1] and Robert S. Kirsner[1]

Journal of Investigative Dermatology (2010) **130**, 1198. doi:10.1038/jid.2010.81



Stem cells are hot, both in the media and in recent research. Although embryonic stem cells have been a focus of attention because of their near totipotent nature, ethical and practical concerns have limited their use. The bulge region, where arrector pili muscles insert into hair follicles, is a segment of the outer root sheath that contains stem cells and develops into epithelial cells and melanocytes (Akiyama *et al*., 1995; Yu *et al*., 2006). Yu and colleagues (2010, this issue) at the University of Pennsylvania further characterized stem cells from the bulge region and report a more accessible source of human stem cells: neural crest–like stem cells that are derived from human fetal and adult hair follicles. These cells were shown to be multipotent, as they differentiated into many neural crest cell types, including neurons. They were also found to be functional, and when placed in mouse brains they remained viable. This work represents an important step toward regenerating essential adult tissues in a safe and accessible manner.

Earlier studies have demonstrated stem cells' potential for nerve regrowth. Amoh *et al*. (2008) improved motor function in mice transplanted with follicle-derived stem cells following transecting spinal cord injury. Furthermore, peripheral nerves have been repaired with stem cell grafts (Lin *et al*., 2009), and implantation of skin-derived precursor cells adjacent to crushed sciatic nerves has resulted in remyelination (McKenzie *et al*., 2006). In addition to the potential of skin-derived stem cells to assist in nerve regeneration, these cells have potential in other areas, such as wound healing (Ito *et al*., 2005).

Through the following questions, we examine this paper—and neural crest–like stem cells—in greater detail. For brief answers, please refer to the supplementary material online <http://www.nature.com/jid/journal/v130/n5/suppinfo/jid201081s1.html>

REFERENCES

Akiyama M, Dale BA, Sun TT *et al*. (1995) Characterization of hair follicle bulge in human fetal skin: the human fetal bulge is a pool of undifferentiated keratinocytes. *J Invest Dermatol* 105:844–50

Amoh Y, Li L, Katsuoka K *et al*. (2008) Multipotent hair follicle stem cells promote repair of spinal cord injury and recovery of walking function. *Cell Cycle* 7:1865–9

Ito M, Liu Y, Yang Z *et al*. (2005) Stem cells in the hair follicle bulge contribute to wound repair but not to homeostasis of the epidermis. *Nat Med* 11:1351–4

Lin H, Liu F, Zhang C *et al*. (2009) Pluripotent hair follicle neural crest stem-cell-derived neurons and Schwann cells functionally repair sciatic nerves in rats. *Mol Neurobiol* 40:216–23

McKenzie IA, Biernaskie J, Toma JG *et al*. (2006) Skin-derived precursors generate myelinating Schwann cells for the injured and dysmyelinated nervous system. *J Neurosci* 26:6651–60

Yu H, Fang D, Kumar SM *et al*. (2006) Isolation of a novel population of multipotent adult stem cells from human hair follicles. *Am J Pathol* 168:1879–88

Yu H, Kumar SM, Kossenkov AV *et al*. (2010) Stem cells with neural crest characteristics derived from the bulge region of cultured human hair follicles. *J Invest Dermatol* 130:1227–36

QUESTIONS

1. Describe the embryonic formation of the skin and hair.
2. Describe the differences between stem cells and pluripotent cells.
3. Describe the hypothesis and rationale for this study.
4. What methods were employed, and what were the results?
5. What were the conclusions and clinical implications of the study, and what further studies might be performed?

[1]*Department of Dermatology and Cutaneous Surgery, University of Miami Miller School of Medicine, Miami, Florida, USA*