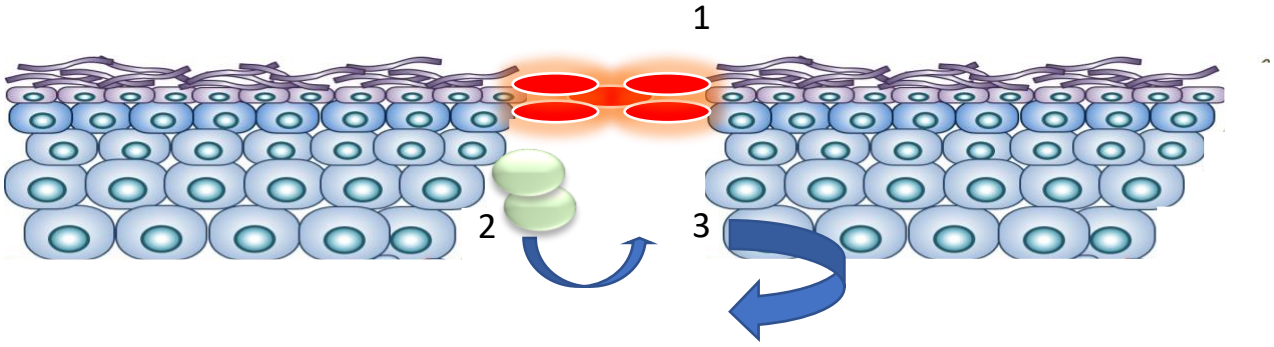
Stem Cells and Wound Healing: Your Body's Band-Aid

By Tyler Davis

Wound healing is a necessary process that everyone has gone through during their lifetime. Whether large or small, everyone at some point has cut themselves, but have you ever wondered how we heal? Wound healing is a complex system of signals and cellular interactions, with stem cells being some of the premier contributors. Stem cells often carry a negative connotation; however, this simply need not be the case. Stem cells occur naturally in the body and are involved in a number of functions. Even beyond their natural roles within the system, science has discovered roles for stem cells within the clinical setting. The purpose of this blog is to not only shed some light on stem cells natural roles, but also how researchers in the field are manipulating these cells to provide innovative medical treatments.

There are multiple populations of stem cells, which have distinct functions during wound healing. While the skin is in normal state, otherwise known as homeostasis, these populations help maintain separate tissues in the skin. During a wound, all these cells drop their normal function to aid in repair. The host response is immediate, with stem cells sending signals and migrating toward the wound site.

During hemostasis, a blood clot forms and secretes a signal cascade to multiple cell types, initiating inflammation, cell migration and cell proliferation by the local stem cell populations. Stem cells located in the bulge of the hair follicle migrate toward the wound edge to construct a scab and begin the process of rebuilding the hair follicle. Stem cells from the sebaceous gland, typically responsible for oil production and the replenishment of sebocytes during a wound produce growth factors key to wound healing. During these stages of wound healing it is not only the stem cells of the epithelia that contribute, but stem cells found throughout the body.



1. Hemostasis: Blood clot formation, sealing of the wound
2. Inflammatory: Immune cells respond, inflammation of the tissue
3. Proliferative: Fibroblasts begin proliferation, and tissue remodeling

Bone marrow derived stem cells (BM-MSC) perform several critical functions during wound healing. BM-MSC have been shown to migrate to the wound edge, and there produce granular structures which lead to re-epithelization (new skin formation). These cells also secrete cytokines (chemical signals) in order to recruit other healing factors to the wound site. Along with direct wound healing, BM-MSC also stimulate angiogenesis (blood vessel generation) in the wound bed, leading to further healing. Because of the multitude of functions BM-MSC's, clinical applications have investigated whether these cells can be added exogenously to increase healing. Researchers have been investigating the efficacy of adding BM-MSC's into the wound microenvironment. Multiple studies have shown that by adding BM-MSC "cocktails" as treatment has helped heal wounds through increased epithelization.

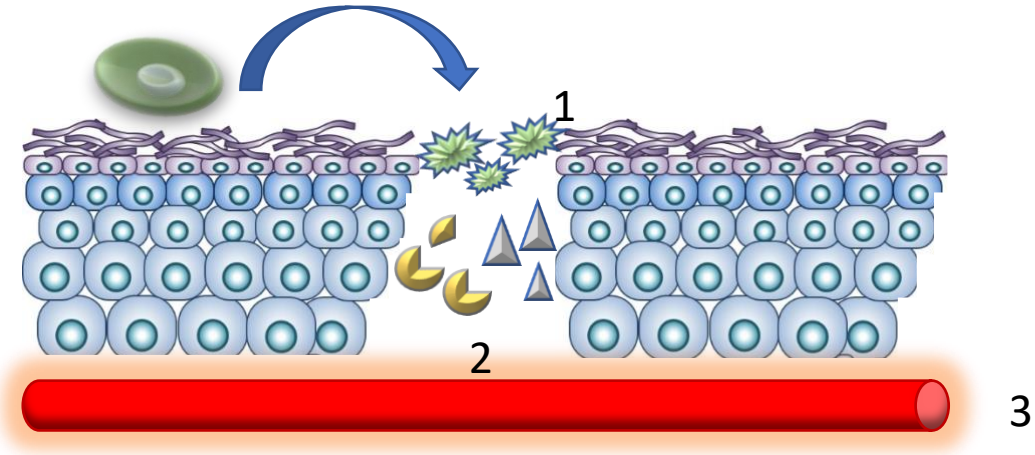


Figure 2: Illustration of the benefits of exogenous treatment with BM-MSC's. BM-MSC's produce granular structures (1) leading to re-epithelialization along the wound edge. They also produce cytokines (2) to recruit healing factors to the site of the wound, including anti-inflammatory signals. Finally, BM-MSC's lead to increased angiogenesis (3) further speeding the wound healing process.

Wound healing is a complex process that involves multiple cell types of the host. While many interactions are responsible for the healing of a wound, stem cells may be the most important. From cells that reside in the epithelia, to cells that migrate from throughout the body, stem cells are true workhorses as it pertains to wound healing.