The Natural Process of Wound Healing

Phases, Barriers & **Regenerative Therapy** as a Treatment Option

When getting injured, the innate response of the body is to close the wound and repair the damaged tissue. Wound healing without complications is crucial to prevent infection, dehydration or other consequential harm. As a natural process, it is a very complex and well-orchestrated series of events,[1] which can be divided in 4 distinct phases.[2]

1 Hemostasis

Usually, when skin is cut, scraped or punctured, the wound will start to bleed. Within minutes or even less, the blood cells clump together and clot to stop the bleeding. The blood clots are initiated by platelets. As the clots dry, they turn into a scab. They contain a protein called fibrin, which forms a net to hold them in place. At the same time, the platelets also release various mediators of wound healing.

2 Inflammation

Once the wound is closed with a clot and the scab forms, the body's immune system starts to protect the wound from infection. Blood vessels open, so the blood can bring nutrients and oxygen to the wound. Blood-borne oxygen is essential for wound healing. At the same time, chemical messengers — or growth factors — are produced, which help to repair the wound.

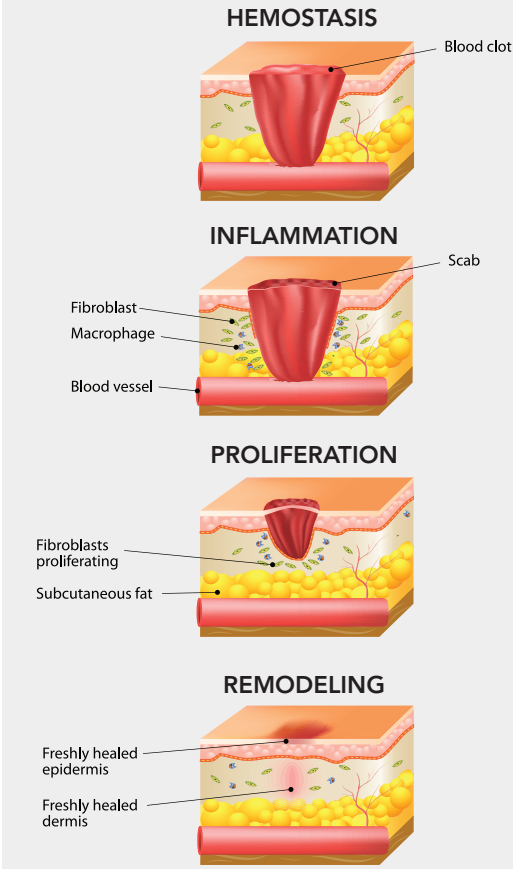
3 Proliferation

During the proliferative phase of healing the wound is rebuilt with new tissue made up of extracellular matrix. Growth of new tissue is induced by blood cells, including oxygen-rich red blood cells. The injured area starts to fill in with new tissues and new skin begins to form over this tissue. As a result, the wound gets smaller.

4 Remodeling

At this stage, the wound fully closes. Collagen remodeling starts, which serves as a scaffolding. As healing continues, the new tissue gets stronger. This process typically lasts 6-24 months from the time of injury.

[1] Thiruvoth FM, Mohapatra DP, Kumar D, Chittoria SRK, Nandhagopal V. Current concepts in the physiology of adult wound healing. *Plast Aesthet Res* 2015;2:250-6. http://dx.doi.org/10.4103/2347-9264.158851



In healthy individuals and when cared for properly, most wounds heal well, leaving only a small scar or none at all. The larger or deeper the wound, the longer it takes to heal and the more likely is a scar. Careful wound care can speed up the stages of wound healing by keeping the affected area moist, clean and protected from reinjury and infection. However, certain conditions and factors can slow down or even prevent the healing entirely.

When wound healing is interrupted

When the healing process is delayed, a chronic wound may develop. This is more likely to occur in patients with underlying medical disorders.

[2] For a description of the 4 phases see: Johns Hopkins Medicine: How wounds heal, https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/how-wounds-heal

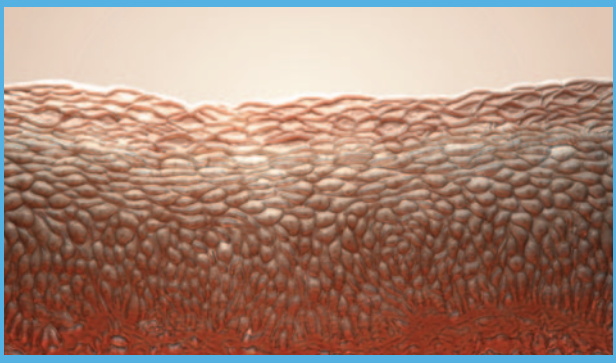
Medical disorders & other factors that may hinder the healing process include[3]:

- Chronic diseases such as diabetes, metabolic disorders, anemia, and some vascular diseases restrict the blood supply to the area. Reduced blood supply is one of the most dramatic factors as oxygen and nutrients that the new blood delivers to the wound are essential to successful healing.
- Age: In elderly people, wounds tend to heal more slowly. The formation of new cells and blood vessels is delayed and the tear resistance of fresh scar tissue is often impaired.
- Obesity may lead to slower wound healing due to poor blood supply to adipose tissue. In addition, some obese patients have protein malnutrition, which further impedes healing.
- Poor diet may deprive the body of the nutrients it needs to heal, such as vitamin C, zinc, and proteins.
- Smoking harms healing and increases the risk of complications.
- Some medications or treatments can restrain the formation of new cells.

Wound healing can also be slowed down by factors local to the wound, such as desiccation (loss of moisture), infection or abnormal bacterial presence, maceration due to urinary and fecal incontinence, and dead skin (necrosis). In addition, wounds heal slowly or may not heal at all when they are repeatedly traumatized or deprived of local blood supply by edema.

In the case of a "chronic wound," no final improvement is apparent despite careful treatment. In such a case, special wound treatment must be initiated instantly, otherwise there is a risk of more serious complications.

[3] https://journals.lww.com/aswcjournal/fulltext/2011/04000/checklist_for_factors_affecting_wound_healing.10.aspx and https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/wounds-how-to-care-for-them



Regenerative Therapy may support the repair of injured tissue in a natural way

Regenerative Therapies are reconstructive treatment options with the potential to accelerate the regeneration, repair or replacement of damaged tissue. They are intended to reduce pain as well as healing times and may be able to provide extensive, long-lasting coverage for wounds.

In the process of wound healing, Regenerative Therapy may support the repair and self-renewal by

- Providing building blocks for scaffolds to support reconstruction,
- Retaining moisture needed for healing,
- Creating a barrier to protect the regenerative process,
- Stimulating the repair of damaged and injured tissues.

Interested in learning more about regenerative technology for supporting natural wound healing? Please ask your Medical Provider.

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Always direct medical questions to a licensed healthcare professional.

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