Fracture Healing

Dr. rer. nat. Katharina Schmidt-Bleek

In order to understand better and to unravel the complexity of the bone regeneration process, we focus on the analysis and comparison of the healing cascade of impaired and uneventful healing scenarios.

Fracture healing phases

Bone is a unique tissue as it is capable of complete regeneration after an injury. In the case of fracture this capacity leads to an "restitutio ad integrum", meaning a scarless healing restoring form and function.

The formation of a hematoma after fracture is one prerequisite for successful bone regeneration. A hematoma is formed due to the disruption of the blood vessel network in the fracture zone. This early fracture hematoma is accompanied by an inflammatory reaction. First, a pro-inflammatory state is present initiating the healing cascade. For successful progression of bone regeneration, the pro-inflammation has to switch into an anti-inflammatory state. This switch is further indispensable for the revascularization of the fracture zone, another prerequisite for successful bone healing. After the hematoma phase, granulation tissue refills the fracture gap, which further develops into fibrocartilage stabilizing the fracture area by a soft callus. Subsequently, the soft callus is replaced by newly formed woven bone (hard callus formation) which is finally remodeled depend on the mechanical strains the bone is exposed to.

The early fracture healing phase

Our research focusses on the early fracture healing phase. In order to deeper analyze bone regeneration; the cellular and molecular composition of a scar forming muscle hematoma was compared to a regenerating bone hematoma. In the bone hematoma, the switch from the pro- into the anti-inflammatory state was earlier initiated and terminated in comparison to the muscle hematoma. This finding was accompanied by an earlier starting of the important revascularization of the hematoma region in the bone. Thus, our findings demonstrate, that a well-regulated and orchestrated inflammatory phase in the early healing cascade is an indispensable step for successful bone regeneration.

Bone consists of extracellular matrix and specific cells, which are embedded in the matrix. This matrix consists next to water, of collagen fibers and minerals. Collagen I is the dominant collagen in bony tissue. It is predominantly produced by bone forming osteoblasts. In our own studies, we showed that a well-regulated collagen I deposition is highly dependent on the correct functioning of T cells, a subpopulation of the adaptive immunity. In the absence of T cells, the bony tissue appears as a holy and honeycombed structure due to a dysregulated collagen I deposition. Thus, immune cells highly influence the structure and therefore also the biomechanical competence of the bone.

Contact

Dr. rer. nat. Katharina Schmidt-Bleek
Principal Investigator

Contact us
CharitéCentrum für Unfall- und Wiederherstellungschirurgie (CC 9)

Julius Wolff Institut für Biomechanik und Muskuloskeletale Regeneration
Charité Campus Virchow-Klinikum
Augustenburger Platz 1, D-13353 Berlin