

## **Hemorrhagic Shock and Surgical Strategy (Nailing versus External Fixation) Affect the Microcirculation in Soft Tissues**

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**Purpose:** Soft tissues are of immense importance for bone healing and local and systemic inflammatory response. The effects of bleeding and surgical intervention on soft-tissue microcirculation are not fully understood. In this analysis we have measured alterations of microcirculation in soft tissues associated with hemorrhagic shock and surgical strategy after femoral fracture.

**Methods:** Male pigs (German Landrace, weight  $30 \pm 3$  kg) were subjected to standardized lung contusion (bolt shot,  $9 \times 17$  Dynamit Nobel), femoral fracture, liver laceration, and controlled hemorrhage (HS) (mean arterial pressure [MAP]  $40 \pm 5$  mm Hg) for 90 minutes. Local microcirculation was measured using O<sup>2</sup>C (oxygen to see) device. The following parameters were obtained: blood flow (Flow), the oxygen saturation (SO<sup>2</sup>), and relative hemoglobin amount (rHb). During HS, microcirculation was measured on healthy muscle (M. vastus lateralis). Femoral fracture was stabilized either with intramedullary nailing or with external fixation. Microcirculation was measured daily on the fracture site of these animals. The observation period of this study was 3 days.

**Results:** Over the observation period, after HS we have measured a significant increase of Flow and elevated local SO<sup>2</sup> and rHb. All these parameters indicate a presence of hyperemia in soft tissues after hemorrhage and resuscitation. In addition, reduced microcirculation in musculature was observed after fracture treatment with external fixation on day 2 and 3. Intramedullary nailing was associated with no differences of Flow, SO<sup>2</sup>, and rHb in comparison to the noninjured site.

**Conclusion:** In this study, we observed changes in microcirculation during the trauma and shock phases. Furthermore, we also measured persistent dysfunction of the microcirculation over the observation period of 3 days after resuscitation and HS. This might be of importance in development of local and systemic inflammation. Moreover, external fixation led to reduced microcirculation in musculature. This fact might also affect the rates of infection and bone healing.