

## 7. Summary

### **Influence of the osteosynthesis-implant on the outcome of fracture healing in a tibial diastasis model**

#### **- Comparison of a medially mounted external fixator, an anteromedially mounted external fixator and an unreamed tibia nail - A biomechanical, radiological and histological study in the sheep.**

Fractures of the tibia are often caused by high energy-trauma (Markmiller et al., 2000) and are therefore more likely to affect young, active patients (Ong et al., 2002). This young group of patients nowadays demands fast rehabilitation without loss of function. These demands and the fact that up to 20 percent of fracture therapies still show healing complications legitimate an intensive research on the improvement of fracture healing (Haas, 2000). The most common osteosyntheses used to stabilise tibial fractures are intramedullary nails and external fixators (Haas et al., 1993; Höntzsch, 1997; Stürmer, 1996 a; Wu et al., 1984). Intramedullary nails were intended to be non load bearing implants (Küntschner, 1965; Markmiller et al., 2001). Nevertheless, today intramedullary nails are implanted to stabilise fractures with missing cortical support (Bhandari et al., 2001; Runkel, 1999; Schandelmaier et al., 1997 b). The consequences of the expansion of indication regarding the intramedullary unreamed nail are not known yet.

The external fixator allows great freedom in configuration, especially with regard to its mounting plane. The mounting plane is usually determined by anatomy (Anderson et al., 1996; Claes, 1990), but accompanying soft tissue trauma is also important (Anderson et al., 1996). Whether and how the mounting plane influences the healing process is still unclear. The presented study aimed to analyse the influence of external fixators mounting plane on fracture healing and additionally to compare external fixation with intramedullary nailing. An unreamed tibia nail (UTN), a medially mounted external fixator and a external fixator configured identically apart from its anteromedially mounting plane were compared with regard to their fracture healing potential.

The external fixators and the UTN were applied to a standardised diastasis-model (simulating bone loss) in the sheep and the callus tissue was analysed biomechanically, radiologically and histologically after nine weeks. Compared with the UTN, the external fixators were characterised by advanced healing results, but only a few differences were apparent between fixator mounting planes. Both fixator groups suggested they could be considered equal in supporting bone healing in this model. The callus tissue of the fixator groups was

stiffer than the that of theUTN-group, the radiologically documented healing outcome was significantly better for both fixator groups. The histological and histomorphometrical analysis of the tibiae stabilised by external fixators revealed a callus consisting predominantly of bone tissue, showing only a small amount of soft tissue and no cartilage tissue at all. The callus tissue had already entered the remodeling-phase of fracture healing. The callus formed by the UTN-stabilised tibiae consisted one half each of bone and soft tissue. Cartilage tissue was only found sporadically. The histological analysis revealed severe alterations and remodeling along the whole cortical bone and enlargement of the fracture gap. While both external fixators produced excellent healing results, the UTN did not seem to encourage bone healing in the chosen setting. Whether the failure of the UTN was caused by the design of the diastasis model or by the design of the implants could not be clarified. In any case, the external fixators provided significantly faster and better fracture healing.