

7 Summary

The influence of shear fixation stability on the histology and histomorphometry during fracture healing

Interfragmentary movements influence the pattern of fracture healing. The aim of this study was to investigate the effect of interfragmentary shear movements on the healing mechanism. For that reason two external fixators were created that differed only in their shear stiffness.

In a standardized sheep-model the healing pattern after rigid fixation or semi-rigid fixation were determined. Therefore 64 sheep underwent a standardized mid-shaft osteotomy of the right tibia (gap = 3 mm). The osteotomy of 32 sheep were stabilized with the rigid fixator, the osteotomy of the other 32 sheep with the semi-rigid one. Groups of 8 sheep were allowed different healing periods (two, three, six or nine weeks). After sacrifice, x-rays were taken and the tibiae were tested biomechanically. Histological examination of the osteotomy area followed. The callus tissue quality and quantity were examined using a computerized image analysis system.

No difference in fracture healing between the rigid and semi-rigid fixation group were found after two weeks. However, by three weeks some difference had begun to emerge. In the rigid group, the maximum total callus area was reached at three weeks, while in the semi-rigid group a maximum was not reached until 6 weeks. The fibrous tissue content was also higher in the semi-rigid group at six weeks, such that in the rigid group at six weeks a higher content of bone was present. At nine weeks a greater mineralized callus width and total callus area was determined in the semi-rigid group. The quality of the callus tissue at nine weeks was similar for both groups which correlated well with the results of torsional testing indicating similar mechanical competence of the calluses in both the rigid and semi-rigid fixation groups.

The present study demonstrated that higher shear movements have no negative effect on the early phase of fracture healing. However the callus formation and differentiation were delayed in the third and sixth week. Six weeks after surgery, the larger callus was of inferior quality in the group with soft fixation. After nine weeks, the sheep of both groups had healed without complications and had reestablished mechanical competence to pre-osteotomy levels.