

6 Summary

Surgical treatment of diaphyseal long bone fracture of the cat: a biomechanical and clinical study

6.1 Biomechanical Study

The acrylic external skeletal fixator (ESF) is known to be a suitable osteosynthesis for feline diaphyseal fractures. The purpose of this study is to determine and compare the torsional rigidity of a newly developed paraosseous fixation device (PCCS) with that of two acrylic ESF (Type Ia and Type II). The biomechanical results should help to evaluate the clinical use of PCCS with comminuted diaphyseal fractures of the cat. Twenty four standardized feline tibia osteotomies with a 5mm gap were stabilized using both an acrylic ESF (Type Ia and Type II) and the PCCS. Medial, lateral and over-all stiffness were determined, as well as coefficient of variability, and correlated with additionally tested intact feline tibiae. A significantly higher torsional rigidity of the ESF Type II (0.114 Nm/°) was observed compared to the ESF Type Ia (0.045 Nm/°) and PCCS (0.049 Nm/°). The osteosynthesis achieved a torsional rigidity of 43.2% (ESF Type II) and about 18.0% (ESF Type Ia and PCCS) of the intact tested bones (0,264 Nm/°). The coefficient of variability of the PCCS was 0.52, while the ESF Type Ia and Type II values of 0.18 and 0.12 respectively. Clinical experience show the ESF Type Ia to be insufficient to stabilize comminuted diaphyseal fractures in cats. Commonly for this type of fracture a biplanar or bilinear configuration is required. As shown in this study, PCCS and the ESF Type Ia have equal torsional stiffnesses, while ESF Type II had significantly higher values. For this, PCCS seems to be unsuitable for bridging comminuted fractures in cats. Lower rigidity leads to higher interfragmentary strain, which is considered to be one of the fundamental mechanical factors involved in bone healing. Specially in the initial phase higher interfragmentary movements, maybe axial compression and bending more than shear forces seem to delay fracture healing. Furthermore a biomechanical study suggest faster bone healing under implants with a stiffness comparable to the intact bone, as shown above for ESF Type II, in contrast to weaker or stiffer stabilisations. Regarding the torsional rigidity PCCS, as ESF Type Ia as well, seems to be suitable to stabilize simple diaphyseal fractures of the cat sufficiently.

6.2 Clinical Study

In this clinical and prospective study the healing process of feline long bone fractures has been observed. Sixty-four fractures were stabilised by K-wire and cerclage, interlocking nail, bone plate, paraosseous fixation device and acrylic external fixator. The healing process of the patients was followed up age depending at 3, 6 and 12 (juvenile) as well as 6, 12 and 24 (adult) weeks after surgery.

For juvenile patients predominantly simple and wedged fractures have been encountered. The fractures healed within a short time and with few complications. K-wire and cerclage (6) with humeral (2/6), femoral (3/6) and tibial (1/6) fractures as well as the external fixator (4) with fractures of radius/ulna (1/4) and tibia/fibula (3/4) were successful in achieving good results in all cases reviewed (100%). Complications in 50% of the cases were determined for two bone plates (2/4) and one paraosseous fixation device (1/2) due to an implant failure and osteomyelitis by the plates and one delayed union of the paraosseous fixation device.

Cats older than one year of age, described as adult, had 79% (38/48) good (62,5%) or satisfactory (16,5%) results. In 21% of the cases the osteosynthesis failed. The paraosseous fixation device with 83% good (5/6) and 17% satisfactory (1/6) results turned out to be the most reliable method. Bone plates and external fixators, which had good or satisfactory results in 81 and 78% of the cases, were seen to be suitable for feline long bone fractures as well, although 19 resp. 22% of the osteosynthesis failed. Fractures stabilized by interlocking nails healed in only 60% of the cases. The treatment failures mostly were iatrogenic and not fracture related. Inadequate stability has been observed for two K-wires/cerclage constructs, leading to malunion and second surgical intervention. The fractures of the forearm of adult cats healed in all cases (15/15), while humeral (1/2, 50%), femoral (6/8, 75%) and tibial (16/23, 69%) fractures achieved less good results.