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TREATMENT OF SALTER-HARRIS FRACTURES OF THE DISTAL FEMUR IN DOGS AND CATS: A COMPARISON OF CROSS-PIN AND ARROW-PIN OSTEOSYNTHESIS

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Abstract: Salter-Harris fractures of the distal femur are among the most frequent orthopedic injuries of growing dogs and cats, and their treatment remains challenging because the distal epiphyseal fragment is small and the growth plate must be preserved. This study compared two internal fixation techniques for Salter-Harris type I and II fractures of the distal femoral physis: the conventional cross-pin construct, in which two or more pins are inserted in an X configuration, and an alternative technique (arrow-pin) based on a single modified Kirschner wire. Over a three-year period, 24 patients (14 cats, 10 dogs) were enrolled from two veterinary clinics; 12 were treated with the cross-pin technique and 12 with the arrow-pin technique. Bone healing was achieved in 91% (11/12) of cross-pin patients and in 100% (12/12) of arrow-pin patients. Complications occurred in 41% (5/12) of cross-pin cases, including one major complication that required limb amputation, and in 33% (4/12) of arrow-pin cases, all classified as minor or moderate. At the 4 to 6 week clinical evaluation, lameness had resolved in 7/12 cross-pin patients and 8/12 arrow-pin patients. The overall orthopedic outcome was rated very good in 9 cases of each group, satisfactory in 2 cross-pin and 3 arrow-pin cases, and unsatisfactory in 1 cross-pin case. Both techniques achieved good bone healing. The cross-pin construct provided the highest stability and remains the standard method, but requires more experience and specialized equipment. The arrow-pin technique is technically simpler, requires basic instrumentation, achieved 100% healing without implant migration, and represents a valid alternative for Salter-Harris type I and II fractures in patients under 10 kg.

• Introduction

Salter-Harris fractures located in the distal portion of the femur are among the most frequent orthopedic injuries encountered in animals during the growth period. In the dog, distal femoral physeal fractures account for approximately 37% of all growth plate fractures [3], while in the cat this anatomical region is involved in approximately 50% of Salter-Harris fractures; of these, types I and II are the most frequently diagnosed in both species [2] The objective of fracture treatment is the restoration of bone anatomy and the re-establishment of normal patient functionality. The surgeon must select a fixation method able to neutralize the torsion, compression and bending forces applied to the bone; in young patients these principles carry additional importance because of the presence of the growth plate, and precise anatomical reduction, construct stability and preservation of the local vascularization are of major importance for a favorable prognosis [4, 6, 26].

• Material and method

The study was carried out over a period of three years and was based on a group of 24 young patients, dogs and cats, with variable characteristics in terms of age, breed and sex. The 24 patients with distal femoral physeal fractures were allocated into two numerically equal groups of 12 individuals. Patients in the first group were treated with the cross-pin surgical technique, which involves convergent insertion of pins in an X configuration, as described by Fossum (2019), Slatter (2003) and Zaera Polo (2015); in a few particular situations this technique was adapted to intraoperative needs. Patients in the second group were treated with an alternative surgical technique, named arrow-pin, a method of osteosynthesis mentioned only sporadically in the literature [4, 3, 6, 22, 23].

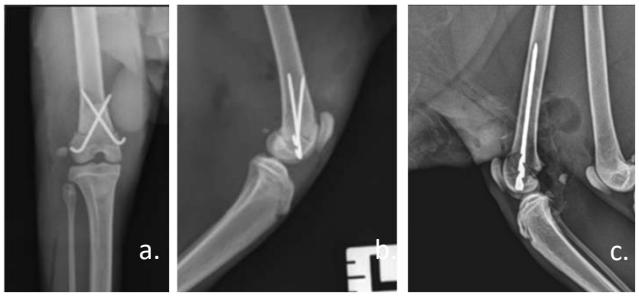


Figure 1. Postoperative radiographic evaluation of Salter–Harris fracture fixation: cross-pin technique (a.;b.); modified Kirschner wire - "Arrow-pin" inserted in a normograde fashion through the intercondylar fossa (c.)

• Results and discussions

In group 1, the bone healing rate was 91%, achieved in 11 of the 12 patients. Complications were recorded in 41% of cases (5/12), of which four were classified as minor or moderate complications and one as a major complication. At the clinical evaluation performed at 4 to 6 weeks, favorable healing was clinically confirmed by the disappearance of lameness in 7 of the 12 patients. The other 5 patients presented some degree of lameness: mild in 3, moderate in 1 and severe in 1.
In group 2, treated with the single-pin arrow-pin technique, the bone healing rate was 100%, achieved in all 12 patients. Complications were recorded in 33% of cases (4/12), all classified as minor or moderate complications. At the clinical evaluation performed at 4 to 6 weeks, favorable healing was clinically confirmed by the disappearance of lameness in 8 of the 12 patients. The other 4 patients presented some degree of lameness: mild in 1 and moderate in 3.
For the cross-pin technique, the clinical results, the postoperative complication rate and the rate of therapeutic failure are similar to the data obtained in several recent studies [2, 21]. The study by Rubinos and Meeson (2021) included 36 feline patients with Salter-Harris fractures, of which 17 (47%) were located at the distal femoral physis and treated by the cross-pin technique; complications were reported in approximately 25% of cases: minor or moderate complications in 3/17 cases (patellar luxation, superficial dehiscence, limb shortening) and severe complications in 1/17 case (implant migration with surgical failure) [2].
The arrow-pin osteosynthesis technique is an unconventional fixation method for Salter-Harris fractures described in a few scientific journal articles; nevertheless, the capacity of a single pin to provide sufficient stability is regarded with skepticism.

• Conclusions

Salter-Harris type I fractures of the distal femur occur with higher frequency in felines, while type II fractures predominated in canines. Salter-Harris type II fractures are associated with a higher risk of complications. Due to the location and small size of the distal fragment, the surgical treatment of these fractures is difficult and is frequently associated with an increased rate of complications.
The comparative evaluation of the two surgical methods demonstrated that the arrow-pin technique has a very good efficiency, a degree of healing similar to the cross-pin technique, and requires minimal surgical experience and basic surgical instrumentation.

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