Opis przypadku *Case report*

Tarsocrural arthrodesis using K-wires and crosspinning technique in a cat: a case report

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Summary

Tarsocrural arthrodesis was performed in a cat using Kirschner pins in the crosspinning technique with an additional tension band. Short term radiological and clinical outcomes, arthrodesis progression were assessed. 10 weeks after surgery the clinical examination showed no lameness and the patient's condition was described as „very good", radiographically there was a new callus formation bridging the tarsocrural joint with bone remodeling. The functional score was favorable indicating very good postoperative outcomes in terms of the possibility of the cat to perform normal feline activities with no pain.

Keywords: talocrural luxation, tarsus, feline, Kirschner pin

Injuries of the tarsal joint occur commonly in cats and often are associated with car accidents or traumatic impact. The tarsal joint is a compound anatomic structure, with the tarsocrural joint providing the main range of motion (14). Pantarsal and tarsocrural arthrodesis has been reported in cats (2, 21). Tarsal arthrodesis is a salvage procedure engaging fusion of the tarsocrural joint. The English-language publications addressing surgical technique and clinical outcomes following feline pantarsal arthrodesis is limited to 32 cats (5, 11, 12).

A common reason for visits to the veterinarian is injuries to the cat's tarsus. They can be divided into fractures of bone elements, ruptures of ligaments stabilizing the joint, and dislocation of individual components of the joint (16). Some of these injuries can be successfully treated surgically with osteosynthesis of bone fragments, external fixation or ligament repair (16, 17, 22, 23). An ankle joint dislocation is a difficult and complex tarsal injury for which use of one of the aforementioned techniques fails to achieve the desired outcomes (13). This mainly occurs as a result of traffic accidents (8, 11, 13). The consequence of these types of accidents is damage to the collateral ligaments, which can result in instability and dislocation of the ankle joint (1, 9, 11). Dislocations of the ankle include subluxation and complete dislocation, with complete dislocations being rare compared to subluxations (6). Luxations may concern the tarsocrural joint, proximal intertarsal or distal intertarsal joints, or tarsal-metatarsal articulations. Tarsocrural luxations are associated, in the majority of cases, with medial or lateral collateral ligament rupture or with a damage of the distal tibiofibular ligament (13).

A complete ankle dislocation is considered a severe condition and in most cases requires ankle arthrodesis to relieve pain, prevent ankle instability, and allow functional use of the limb (11). Among the methods of arthrodesis of the ankle joint, we distinguish external stabilization, medial or dorsal plating stabilization, orthogonal plating and arthrodesis with the use of Kirchner pins and a tension band. Partial and pantarsal arthodesis are reported in cats (21). As an alternative method of repairing an ankle joint, manual reduction with prosthetics of damaged ligaments have been described (18). The plate method is well described in the literature (11, 14, 19); however, to our knowledge there is no thoroughly described technique of arthrodesis of the ankle joint using the crosspining method in a cat. The purpose of this study is to present the arthrodesis technique using Kirschner pins and a tension band and the functional outcome following surgical stabilization of cat's tarsocrural dislocation.

Case history

A 15-month-old European Shorthair cat was referred to the Department of Surgery and X-rays in the Clinic in order to assess the lameness of the right pelvic limb. Anatomical

irregularities in the location of the bone in the distal part of the lower leg were palpable, and an orthopedic examination revealed fifth-degree lameness on a scale of five, significant edema, and elevated warmth in the area of the right ankle joint. In addition, characteristic crepitations could be felt during the flexion and extension of the ankle joint. The diagnosis of right ankle sprain was made based on a complete orthopedic examination and diagnostic imaging. Radiographs were studied beforehand to determine the precise surgical technique (Fig. 1).

The patient was premedicated with a mixture of dexmedetomidine and butorphanol. Midazolam and ketamine were used to induce anesthesia. Anesthesia was continued with isoflurane 3-5% in oxygen and fentanyl in the infusion pump. The patient was taken to the operating room and placed in the lateral position. The affected limb was suspended in a hoist and then prepared aseptically.

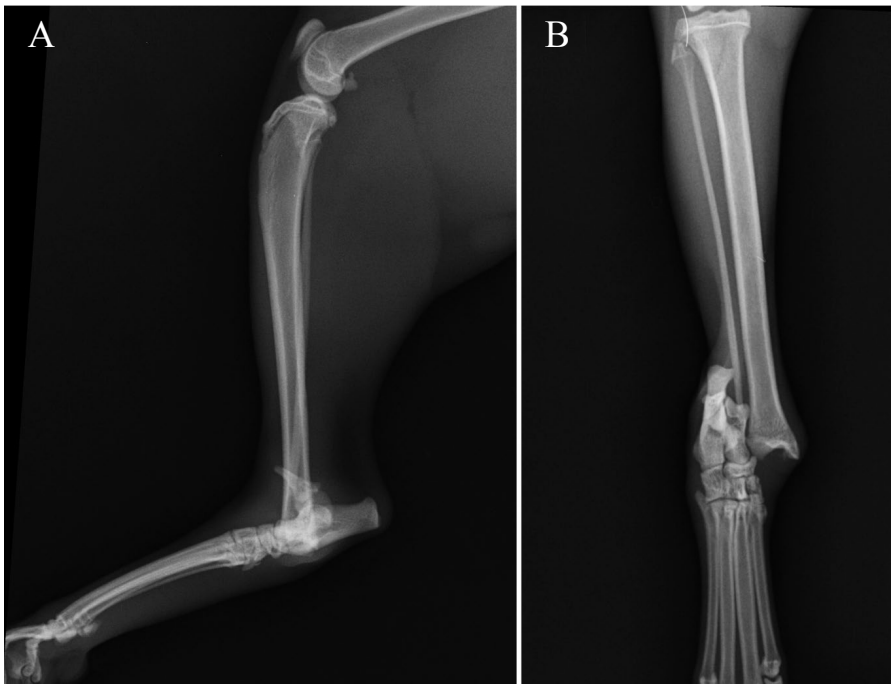

Fig. 1. A. Lateral and B. Antero-posterior preoperative radiographs of tarsocrural luxation

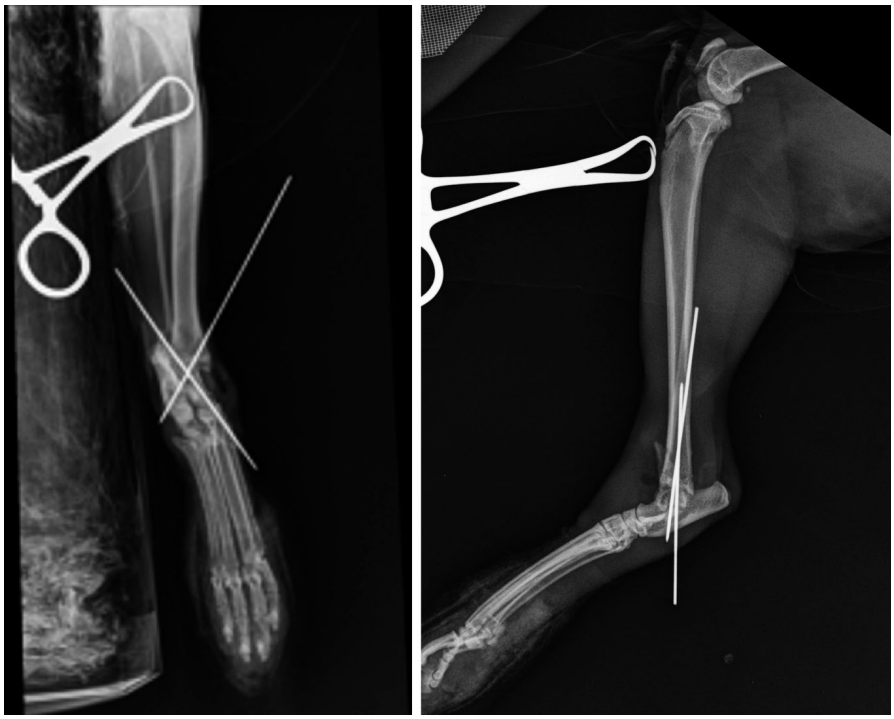

Fig. 2. Intraoperative radiographic view of two crosspinning Kirschner pins

As a surgical method, arthrodesis of the tibia-talar joint with the use of Kirschner pins and tension band was chosen, the so-called crosspinning. The procedure was started from the medial approach. A linear skin incision of approximately 4 cm was made, starting 2 cm above the medial malleolus of the tibia and ending at the central tarsus. Next, the subcutaneous tissues were dissected, and the soft tissues were cleaned of numerous clots and damaged elements of the fascia. The next stage was the removal of cartilage elements from the distal epiphysis of the tibia and the tarsal bone using a surgical cutter and drilling of vascular access channels in the distal epiphysis of the tibia, after which the manual reduction of the ankle joint dislocation was performed. The area was then dissected to expose the Kirschner pin attachment points, paying special attention to the tibial nerve, peroneal arteries and vein, and branches of the saphenous vein. The tendon of the tibialis caudal muscle was gently moved to the caudal side, and the tibialis muscle was moved cranially along with the remaining fascial elements using Hohmann retractors. Another step of the procedure was the insertion of two Kirschner pins with a diameter of 1.4 mm crossing the ankle joint, which were introduced at an angle of 135 degrees to each other. The first pin started its course 0.5 cm above the medial malleolus of the tibia, then passed through the talus and ended its course in the fourth tarsal bone. The second had its beginning in the central tarsal bone, then crossed with the first in the talus, to end its course in the region of the lateral malleolus of the fibula. Intraoperative control radiographic images were then taken to ensure that the K-wires were inserted correctly (Fig. 2).

After the first intraoperative radiographs, the surgeon decided to insert an additional Kirschner pin 0.5 cm higher and parallel to the first one to provide additional stabilization. The final element of the arthrodesis was the shortening of all metal elements and the bending of all Kirschner wires on the medial side. To create the compression force at the joint level, a tension band was applied to the Kirschner pins. For the tension band an 0.7 mm cerclage wire was used. Finally, the subcutaneous tissues were sutured with intradermal sutures and the skin with surgical staples. Immediately

Fig. 3. Postoperative radiography of tarsocrural stabilization with the use of three K-wires in crosspinning technique and tension band

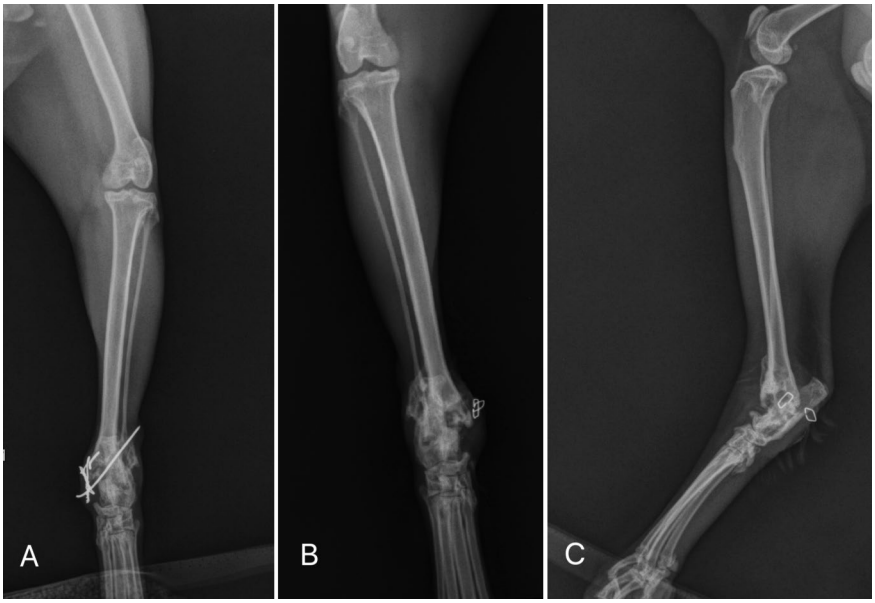

Fig. 4. Follow-up radiographs after eight weeks, before Kirschner pin and tension band were removed (A). Moderate callus formation seen on dorsoplantar (B) and medial view (C)

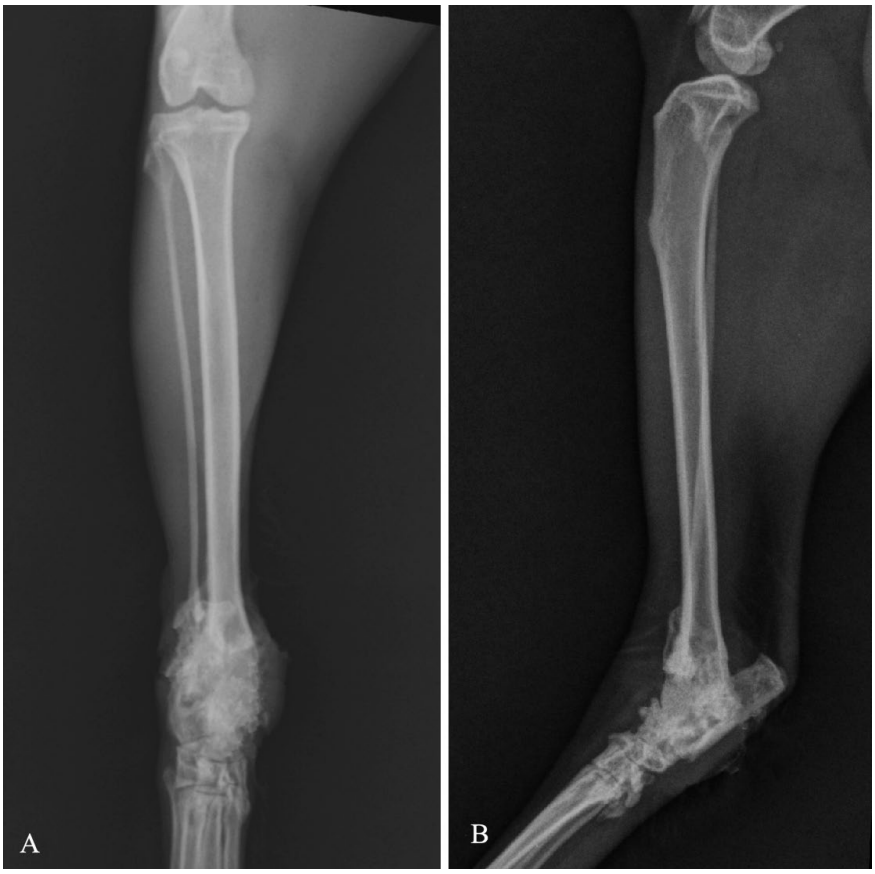

Fig. 5. Control radiographs 4 months after surgery. (A) anterior-posterior position (B) lateral position

postoperative radiographs confirmed the correct performance of the procedure (Fig. 3).

The cat was given an analgesic after the procedure. The owner was advised to restrict the animal's movement for 6 weeks after surgery. A kennel cage was found to be the preferred method of limiting movement. A follow-up visit was scheduled for 2 days after the surgery, during which the cat put weight bearing on the limb, and the lameness was rated at three points on a five-point scale. The owner and cat returned for another follow-up examination after 8 weeks. The general condition of the animal was classified as „good", and lameness was not found. Despite this, it was possible to palpate a protruding metal element, penetrating through the skin of the operated limb. During the visit, control radiographs were taken, which showed that one Kirschner pin and a part of the other were missing in the joint, and a fragment of the remaining element protruded beyond the soft tissues (Fig. 4).

Nevertheless, there was an evidently callus formation (Fig. 5). During the visit, the animal was premedicated and the implants were removed. After two weeks, the patient returned for a follow-up appointment, at this time the sutures were taken out and an orthopedic evaluation was done. According to the surgeon's expectations, lack of mobility in the tarsocrural joint was present. But mobility in the distal intertarsal and tarsal-metatarsal joints was present. In addition, the examination showed no lameness and the patient's condition was described as „very good".

Discussion

The ankle joint in cats has a complicated anatomy and function. The tarsus consists of fourteen bones and twenty different articular surfaces. Each component must be undamaged for the animal to have the full range of motion in the aforementioned structures (3). Due to the topographical proximity and the small size of the adjacent elements, cat ankle joint injures are often combined with other musculoskeletal damages. This disease entity is often accompanied by fractures of the fibula, damage to the surrounding tendons, fractures of the medial or lateral malleolus (13). In most pathological cases it is impossible to treat single components of the musculoskeletal system. Arthrodesis of the tarsus, which immobilizes all the ankle joint's elements, is the necessary surgical procedure (14). Among the tarsus arthrodesis techniques, we distinguish the use of arthrodesis plates, external fixation and arthrodesis with the use of Kirschner pins and tension band (22).

Manual reduction of the dislocation with the implantation of materials in lieu of the naturally occurring ligaments is one of the alternative surgical care techniques for feline ankle dislocations that allows the ankle joint to be preserved in function. This technique consists in creating bone tunnels at the point of insertion of the ligament attachments and placing in them the suture material, thanks to which the course of the ligaments is reconstructed. According to the authors, this method ensures stabilization of the ankle joint while maintaining almost the original range of motion. After using this technique, ankle biomechanics measurements showed a slightly reduced external rotation during ankle flexion. However, the authors tested this technique on cadavers, there are no data on the effectiveness of the therapy on live animals. Nevertheless, this method may be a promising alternative for the treatment of ankle dislocations (18, 24, 25).

Plate arthrodesis includes dorsal, medial and ventral plate arthrodesis (13). Despite its widespread use, this method carries a high frequency of complications such as ischemic necrosis or periarticular nerve paralysis (10, 12, 15, 20). Although minimally invasive plate arthrodesis is performed to reduce the aforementioned negative effects since tissue traumatization is still a significant problem (11, 19). Another complication is the insufficient resistance of the implant to the bending forces of the ankle joint and the loosening of the screws securing the implant (5, 17). This is most frequently seen with the use of isolated arthrodesis of the tarsal and tibial bones. Short plate surface in comparison to periarticular pressures is the cause of implants' incapacity (10, 12, 15). Changing the technique to pantarsal arthrodesis, using a plate covering the entire ankle joint, distributes the forces acting on the joint and protects the implant from damage (5, 17). Less frequently, the plate is placed in the lateral and ventral position. These methods can cause, among other things, necrosis of the sole of the foot (20). In addition to postoperative complications, the authors also point out the high frequency of intraoperative complications, such as fractures of drills or metatarsal bones (19). Irrespective of the placement of the plate, only in 50 to 70% of treated cases can be expected the success healing (15, 17).

The tarsocrural arthrodesis using Kirschner pins and a tension band may be a promising solution for dislocation of ankle joint in cats. Bone pins stabilize the elements of the ankle joint in each position, and their cross arrangement prevents rotational forces acting on the joint. The tension band acts as a compression force, thanks to which bone connections are created between the individual elements of the tarsocrural joint. In addition, the tension band wire prevents rotational forces acting on the ankle joint (23). Compared to plate arthrodesis, arthrodesis using Kirschner pins and tension band does not require such wide surgical access, thanks to which there is a lower risk of damage to the surrounding soft tissues (14). This may be the method of choice for small and light animals, including cats, where plate arthrodesis poses a risk of iatrogenic talus fractures with plate and screws fixation (15). Bone pins will also be effective in this group of patients since they have reduced periarticular stresses and the implantation material can withstand the forces acting on the joint. However, this method has some drawbacks. It should not be used in chronic cases where massive fibrosis develops around the injury (10, 11, 17).

In the clinical case described above, the Kirschner implant was partially spontaneously slipped out during convalescence. This may have been due to the owners not rigorously adhering to the movement restriction. Nevertheless, the implant was effective in causing ankle joint arthroidesis. The greatest advantage of using the above technique was the small surgical access and low traumatization of soft tissues during preparation, which made the recovery time faster compared to the classic (pancarpal) plate arthrodesis.

The structure of the ankle joint in cats and dogs are very different from one another, particularly in the way the ligaments are arranged. Therefore, surgical techniques in dogs may not be appropriate for cats (24, 25). Because of this, veterinary orthopedic surgeons must find novel methods to treating cats.

A promising alternative may be arthrodesis of the ankle joint using Kirschner pins and a tension band. The bone pins and tension band can be used alone for small or young animals where rapid growth potential is expected (4, 7, 26). In addition, the procedure can be performed in poorer regions due to the lower cost of the implant material. However, this method requires testing on a larger group of animals.

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