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Surgical management of traumatic stifle luxation in cats with the use of fabelotibial and fibulopatellar sutures

MAGDALENA MORAWSKA-KOZŁOWSKA, YAUHENI ZHALNIAROVICH

Department of Surgery and Radiology with Clinic, Faculty of Veterinary Medicine,
University of Warmia and Mazury in Olsztyn, Oczapowskiego 14, 10-719 Olsztyn, Poland

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Morawska-Kozłowska M., Zhalniarovich Y.

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Summary

Cats' ligaments in the stifle joint may become damaged because of several accident kinds. Effective treatment of this condition requires surgical intervention. The objective of this article is to outline the most precise diagnostic process, surgical treatment, as well as investigate the outcomes and potential complications in the surgical treatment of stifle disruption in cats without a temporary transarticular pin. Five cats of various breeds, ranging in age from 1 to 5 years, were used in the study. Each animal has both cruciate ligaments damaged. As a therapeutic therapy, two stabilizing sutures (fabellotibial and fibulopatellar) were applied to the cats. At one, three, five, seven-, and nine-weeks following surgery, each patient underwent control and clinical gait evaluation. A phone call with the owners was conducted 4 months following the surgery to gauge their satisfaction with treatment results and find out whether the cat had fully recovered. After treatment, all patients regained their mobility. No one cat had major complications and required reoperation. Few patients were exposed to minor complications, including swelling, bacteril infection and rupture of sutures. Each owner was satisfied with the results of the therapy and their animal's recovery. To preserve the entire functionality of the limb, the lateral fabellotibial and fibulopatellar suture technique can be effective in young animals. If the cruciate ligaments are the primary area of damage, the suture technique may be helpful.

Keywords: polytrauma, knee luxation, cranial cruciate rupture, fabellotibial suture, fibolopatellar suture

Multiligamentous injuries of the stifle joint in cats are relatively infrequent (3, 19). The most damage follows severe traumas, such as road traffic accidents, falls from a height and building collapses (5). Multiligamentous injuries most frequently involve the disruption of the medial and lateral collateral ligaments as well as the cranial and caudal cruciate ligaments (1, 13). Additionally, damaged simultaneously are the menisci and joint capsule (3, 4). High torsional and bending forces applied to the knee may result in total stifle luxation (5, 13). The diagnosis of knee instability is based on gait assessment, palpation, but most of all, on imaging diagnostics. A thorough clinical examination can typically identify the specific ligamentous injuries (11).

With a stifle luxation, most cats will exhibit severe or non weight bearing lameness and noticeable soft tissue edema around the stifle joint. The orthopedic examination also reveals the rotation of the limb, usually to the lateral side, and pain when the stifle is touched or when the joint is tried to be moved (1).

Goals of surgical treatment of stifle disruption are to prevent further articular surface damage and remaining soft tissues, restore limb alignment and joint stability, and maintain a normal range of motion (12). In cats, surgical management of the cranial cruciate ligament rupture is usually attained with an extracapsular lateral fabellotibial suture, while stabilization of a caudal cruciate ligament rupture can be achieved by the fibulopatellar suture (22).

Effective treatment of this condition requires surgical intervention. There are two main types of repair for these injuries. If sufficient tissues are present, primary restoration of all joint supports is typically the recommended strategy to regain joint stability. But in severe soft tissue injuries, primary repair might not be a possibility (15). Currently, transarticular external skeletal fixation, stifle arthrodesis and ligament recon-

struction or replacement (with or without temporary transarticular pin fixation) are available treatments for multiligamentous injuries of the total knee luxation in cats (8, 22).

Transarticular external skeletal stabilisation provide additional joint stabilization; however, it has a number of negative effects on the joint, such as reduction of cartilage stiffness and thickness, decreased synovial fluid production, reduce range of motion, leads to the development of degenerative joint disease, elongated immobilization also leads to muscles atrophy (12).

Complications related to the surgical treatment of stifle disruption are various and include the following: infections; a loss of range of motion; persistent instability; fibula or tibial fracture through pin holes; pin loosening, bending or breakage; lameness; and finally degenerative joint disease (17). Most complications are related more to the severe joint instability than to complications of surgical treatment. Nevertheless, outcomes are described to be satisfactory to good in most cats (9, 17).

The objective of this article is to outline the most precise diagnostic process, surgical treatment, as well as investigate the outcomes and potential complications in the surgical treatment of stifle disruption in cats without a temporary transarticular pin.

Material and methods

Medical records from 2013 to 2022 from Department of Surgery and Radiology with Clinic, University of Warmia and Mazury were reviewed. Five cats with a median age of 3 years and a range of 1 to 5 years were admitted due to total knee luxation (with ruptures of both cruciate ligaments and grade I lateral or medial collateral ligament injury). Median weight of the cats was 2.5 kg and a range of 1.6 to 3.4 kg. Every animal had either been involved in a car accident or had jumped from quite high. Cats in which only the cranial cruciate ligament was ruptured and animals with simultaneous bilateral stifle disruption were excluded from the study. A final diagnosis was based on clinical, radiographic and intraoperative results. All animals were treated surgically.

Cat 1 was referred from another animal care facility for the removal of the left pelvic limb. The orthopedic examination revealed grade 5 lameness on a 5-point scale, marked lateral rotation of the limb, significant pain manifestation, and soft tissue edema. In addition, the cranial drawer, caudal drawer, and tibial compression tests were positive. X-rays showed a change in position of the vertical line tangential to the caudal femoral condyles, relative to the caudal margin of the tibial plateau (Fig. 1).

Cat 2 jumped from a building's third floor and showed non-weight bearing lameness of the right pelvic limb. The clinical and radiological findings and symptoms during the first orthopedic evaluation were identical to the cat 1. Right stifle luxation was diagnosed. Cat 3 had a car accident in which the left femur was fractured, and the right knee was luxated. The animal was completely immobile, the soft tissues were greatly swollen, and the pain expression was intense. An osteosynthesis plate and an intramedullary pin were used to stabilize the femoral fracture, and on the opposite side stifle disruption was treated. Cat 4 jumped from a building's second floor and had lameness of the left pelvic limb. The orthopedic examination (using X-rays and orthopedics tests) showed total knee luxation in the left pelvic limb. Cat 5 had a car accident. The orthopedic examination showed lameness of the left pelvic limb and medial rotation of the left pelvic limb. The above-described technique was performed on each animal to treat a total knee luxation.

Surgical technique. The patient was premedicated with a mixture of dexmedetomidine and butorphanol. Midazolam and ketamine were used to induce anesthesia. Anesthesia was continued with 3-5% isoflurane solution in a stream of oxygen and fentanyl in the infusion pump. The procedure started from the lateral parapatellar approach. A 5-cm-long linear incision was created, beginning laterally 2 cm above the upper border of the patella and extending to the foot. The skin and subcutaneous tissues were removed, and the structures of the knee joint were investigated. After intraoperative examination, it was determined that the cruciate ligaments were torn, and the lateral collateral ligament suffered grade I injury (on a scale from I to III). There was

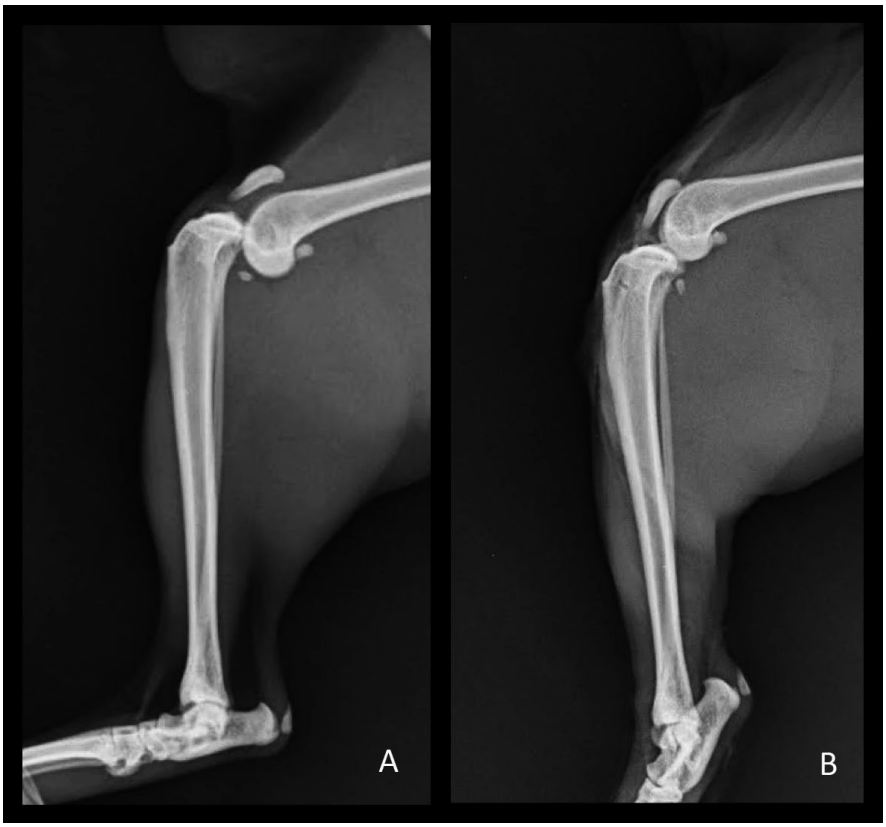

Fig. 1. Mediolateral radiograph of the left stifle. (A) Preoperative X-Ray of stifle luxation. The tibia has clearly moved cranially with reference to the femur; (B) Immediately post-operative X-Ray. The stifle joint is stabilized

no menisci injury. The stumps of the anterior and posterior cruciate ligaments were removed. Next, two sutures were placed to stabilize the stifle joint, both sutures on the lateral side of the knee joint.

The technique of application of a lateral fabellotibial suture. The fabella was palpable after the fascia lata had been raised and incised. A non-absorbable suture with a nominal value of 2 was selected as the implant material. To protect the peroneal nerve, the suture was applied circumferentially around the fabella (Fig. 2A). A K-wire measuring 1.2 to 1.5 mm was then used to create a hole in the cranioproximal aspect of the tibial tuberosity at the point where the patellar ligament inserts (Fig. 2B). Under the patellar ligament and through a drill hole, the suture was passed in a lateral, medial, and lateral manner. While the assistant stabilized the limb in the caudal drawer position, the surgeon tied the suture (Fig. 2C).

The technique of the application of a fibulopatellar suture. While fascia lata was raised, the fibular head was palpated. In the peroneus longus muscle, close to the fibular head, a little cut was created. Blunt dissection was done using curved scissors until the bone could be touched and seen. The opening created in the peroneus longus muscle was used to insert the suture (a non-absorbable suture with a nominal of 2) around the fibular head and medially between the fibula and tibia. The assistant oversaw visualizing and retracting the peroneal nerve at that moment. The suture was then distributed around the patella in the patellar ligament. While the assistant stabilized the limb in the cranial drawer position, the surgeon tied the suture in such a way that the axis of the limb and the patellar ligament are parallel.

During surgery, the knee joint's mobility was evaluated, and it was determined that the correct biomechanics of the limb had been restored. The loose in the stifle joint was checked by drawer test and tibial compression test during postoperative check-up. Additionally, radiographs were taken, which demonstrated the pelvic limb's preserved axis.

Postoperative management. The limb was not covered with a cast or another bracing dressing. After the procedure, the patient was analgesic for the first 4 days with meloxicam.

On the same day, cats were released to their owners. A complete restriction on movement was also advised for the first two weeks following the treatment (by kennel cage), then minimal activity was introduced for two weeks. Furthermore, no physiotherapy techniques were applied.

Follow-up. Cats were examined by the same person before surgery, one week after surgery

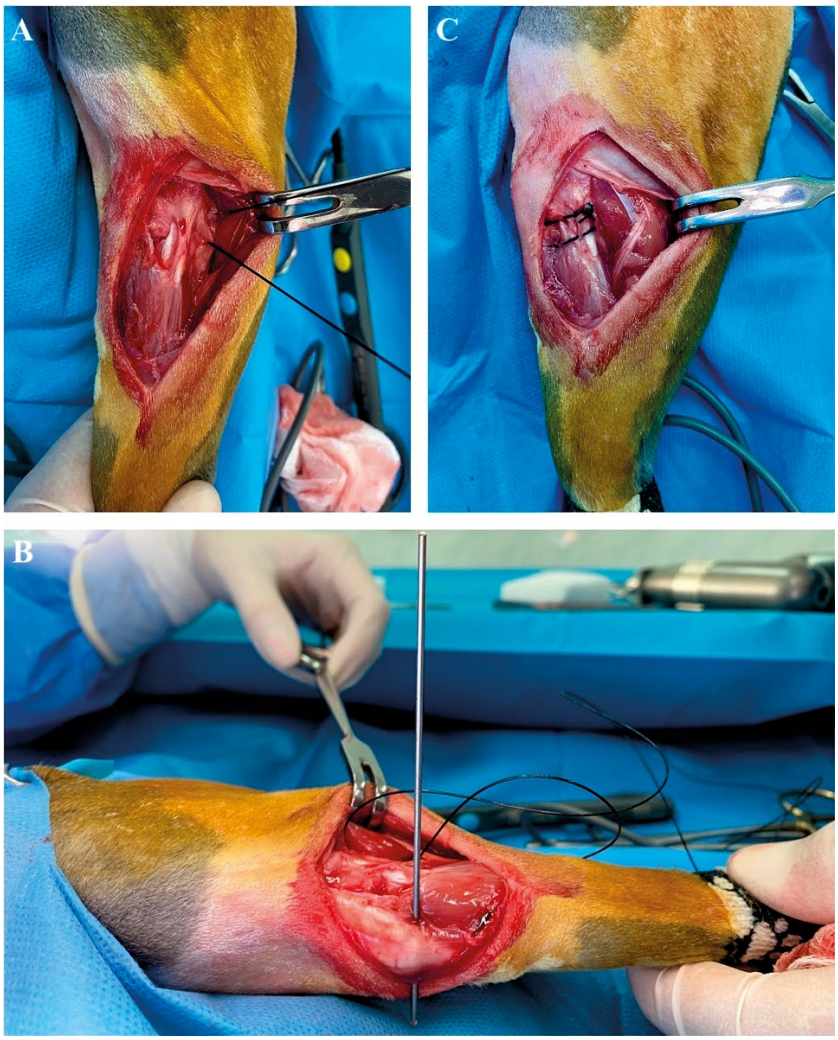

Fig. 2. The procedure of application of lateral fabellotibial suture
Explanation: A, B, C – lateral view

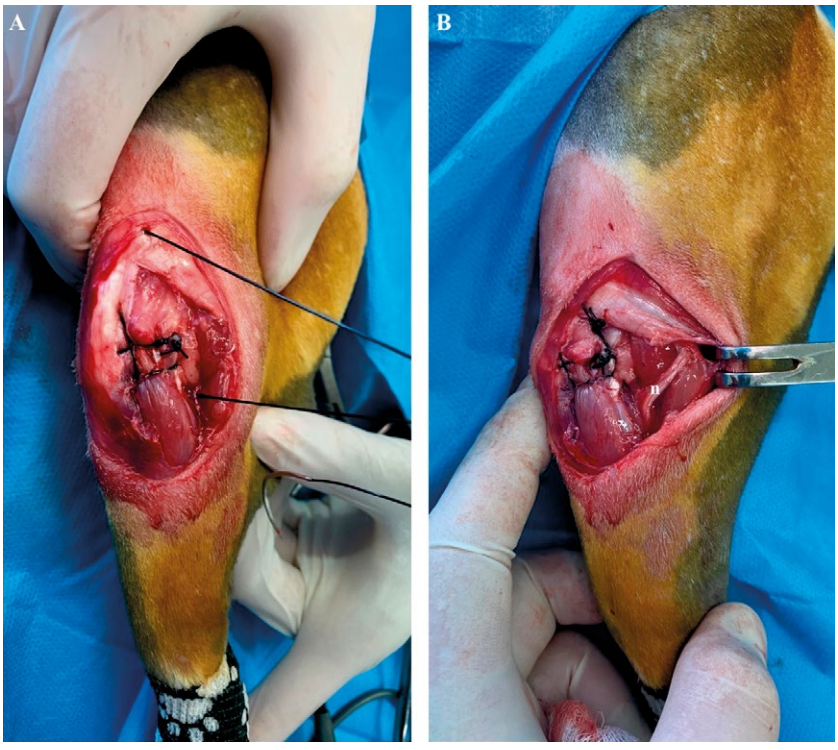

Fig. 3. The procedure of the application of fibulopatellar suture
Explanation: n – the peroneal nerve

Tab. 1. Lameness assessment criteria in postoperative examinations at 1, 3, 5, 7 and 9 weeks after surgery

Score	Criteria
1	normal weight bearing at rest and while moving
2	normal weight bearing at rest; partial weight bearing while moving
3	normal weight bearing at rest; intermittent weight bearing while moving
4	partial weight bearing at rest and while moving
5	no weight bearing at rest and while moving

and then every 2 weeks. The lameness scoring system below was used to record the lameness scores for each cat at each postoperative period till 9 weeks (14) (Tab. 1). The occurrence and nature of complications were noted. Follow-up information about results was acquired by telephone interview of owners four months after surgery.

Results and discussion

The results are presented in the form of a table (Tab. 2). In cat 1 the orthopedic assessment one week after surgery detected grade 3 lameness. After an additional two weeks, there were no noticeable gait issues. Furthermore, throughout the entire treatment process, no procedure-related complications were observed, and the owner reported being really satisfied.

In cat 2 the orthopedic examination one week after surgery detected grade 3 lameness and rupture of sutures. Three weeks after the procedure, the patient's gait had gotten worse. It was determined that the owner had ignored the veterinarian's advice to restrict the animal's movement, and the cat during play jumped up onto a ledge. Orthopedic examination showed high soft tissue swelling and severe pain in the tensor fascia lata. An X-ray examination was also conducted during the appointment, and the results revealed no abnormalities in the axis of the limb. The soft tissues injury was diagnosed, and therefore analgesic and anti-inflammatory treatment were ordered for 3 days. Additionally, it was advised to prolong the restriction of movement for another 7 days. The last orthopedic examination nine weeks after surgery showed grade 2 lameness of right pelvic limb, but four months following the operation, the owner declared over the phone that the lameness was no longer present.

In cat 3 orthopedic examination performed one week and three weeks after surgery showed grade 4 lameness. However, in the fifth and seventh week after the procedure, the symptoms subsided to give the effect of grade 2 lameness at the nineth week. The following side effects were noted during convalescence: a small amount of soft tissue edema and a bacterial infection, both of which went away with antibiotic therapy. Four months following the treatment, the owner declared over the phone that the right pelvic limb's lameness had subsided. Only after intense play did the animal exhibit lameness in the left pelvic limb (after stabilization of the fracture).

Tab. 2. Tabulated patient's information and gait assessment results

Cat	Patient data	Injury	Lamenessscores						Complications	Owner evaluation
			Preoperative	Postoperaative (weeks)						
				1	3	5	7	9		
1	European Shorthair, 2 y, 2,5 kg	– car accident – referred for removal of the left pelvic limb – lameness of the left pelvic limb – total luxation of the left knee joint (rupture of both cruciate ligaments with grade I lateral collateral ligament injury)	5	3	2	1	1	1	– none	– very satisfied – no lameness
2	Bengal, 3 y, 2,6 kg	– jumped from a building's third floor – lameness of the right pelvic limb – total luxation of the right knee joint (rupture of both cruciate ligaments with grade I lateral collateral ligament injury)	5	3	4	4	3	2	– rupture of sutures – high soft tissue swelling – severe pain in the tensor fascia lata	– very satisfied – no lameness
3	European Shorthair, 5 y, 3,4 kg	– car accident – lameness of both pelvic limbs – fracture of the left femur – total luxation of the right knee joint (rupture of both cruciate ligaments with grade I lateral collateral ligament injury)	5	4	4	3	3	2	– slight soft tissue swelling – bacterial infection easily treated with antibiotic therapy	– very satisfied – temporary lameness of the left pelvic limb (with femur fracture)
4	European Shorthair, 3 y, 2,9 kg	– a jump from a building's second floor – lameness of the left pelvic limb – total luxation of the left knee joint (rupture of both cruciate ligaments with grade I lateral collateral ligament injury)	5	3	3	2	2	1	– none	– very satisfied – no lameness
5	Siamese, 1 y, 1,6 kg	– car accident – lameness of the left pelvic limb – total luxation of the left knee joint (rupture of both cruciate ligaments with grade I medial collateral ligament injury)	5	3	3	2	1	1	– none	– very satisfied – no lameness

In the cases of cats 4 and 5 an orthopedic assessment one week following surgery revealed grade 3 lameness in both animals. There were no postoperative complications in these patients. The owners of each of the cats rated the level of satisfaction with the performed procedure as: „very satisfied".

Traumatic stifle luxation in cats is an infrequent injury associated with the traumatic injury of multiple ligaments resulting significant instability of the joint (14, 21). The diagnosis of knee disruption is based on a complete orthopedic examination and radiograph analysis (1). In our study, each patient's clinical signs of a total knee luxation were consistent across the board and matched cases previously reported in the literature. The animals' gait disturbances and a severe display of discomfort, which included vocalization, rapid and shallow breathing, lethargy, tachycardia, and heightened aggression toward humans were distinguishing features. Typically, the animal did not bear weight with the injured leg when it was at rest or moving, which rotated to the lateral side (1, 6).

The first step in diagnosis process is a comprehensive physical examination and assessment of the joint. While performing stress palpation, all ligaments should be examined closely because a ligament may appear to be largely intact despite having significantly decreased its capacity to support loads (15). It is possible to identify which structures have been affected by carefully palpating the stifle joint in a cat that has been sedated or under anesthesia. When the cruciate ligaments are ruptured, there will be a noticeable cranial displacement of the tibia in reference to the femur (anterior and posterior drawer and tibial compression tests). Whenever the collateral ligaments are injured, significant medio-lateral instability is anticipated (4, 8). In addition to orthopedic examination and palpation, an ultrasonographical modality can be performed, allowing the determination of the continuity of ligaments (2). An important role in the diagnosis is also played by the intraoperative expertise of the structures forming the joint, including careful examination of the menisci before performing any necessary ligament reconstruction (11).

Animals whose stifle joints have suffered severe, irreversible impairment due to ligament damage, osteoarthritis, articular fractures, or septic arthritis may recover from stifle arthrodesis (16). When amputation is not an option and total stifle replacement is not possible because of clinical or economical constraints, the goal of an arthrodesis is to reduce pain and provide satisfactory joint function (3).

Stifle arthrodesis is performed by using numerous implants such as plates and screws, compression screws, and external skeletal fixation (7). It is a technically challenging surgical technique. It is recommended to apply several of the common arthrodesis principles to the stifle joint, including removing all articular cartilage, performing arthrodesis at a weight-bearing angle, and using autogenous cancellous bone graft (16). As a result, to successfully perform the procedure a high degree of manual skills and a huge array of instruments are needed, which raises the procedure's cost.

There is conflicting information available regarding the ideal stifle joint arthrodesis angle, with recommended angles for cats falling between 110 and 125 degrees (16, 22). The healthy limb radiographic images are used while planning the surgery to assess where the implant for arthrodesis should be placed. For the mediolateral radiograph, the contralateral limb is placed in the cat's standard standing angle. As a result, the plate may be properly shaped before surgery by using the opposing limb radiography as a template (3). These suggestions do not seem to be based on the outcome of studies for clinical cases of stifle arthrodesis, but rather on the typical standing angle of the stifle joint (2, 3), which appears very subjective and susceptible to complications.

Stifle arthrodesis helps with lameness brought on by pain, but mechanical lameness is still predicted (20-22). This is due to a problem with the gait biomechanics of the cats (3). The pre-injury type of movement is never fully recovered and a gait abnormality with considerable circumduction of the afflicted limb and difficulties getting out of a prone position are common post-operative symptoms (19). Additionally, according to some reports, long-term abnormal movement patterns in the arthrodesed stifle joint result in lesions in the ipsilateral coxofemoral joint (6, 17).

Belch et al. described arthrodesis of the knee joint in a cat using a plate, Kirschner nails and a positioning screw. Two weeks post-operatively no signs of pain were showed, the cat had a mild weight bearing lameness, the limb was externally rotated, the digits were constantly scratching the floor and the ipsilateral hock joint tended to be hyperflexed. At six weeks after surgery, the weight bearing lameness was considered slight and the cat had a more marked inclination to stand in a plantigrade position. Only six months after surgery was the patient able to engage in normal activities, such as climbing and jumping. In addition, the cat was walking normally, albeit with an altered stride, on the limb that had undergone arthrodesis. The example of this patient can suggest a protracted recovery process when employing the plate arthrodesis technique. The use of arthrodesis plate does not guarantee the limb will regain full functionality in comparison to the method mentioned above.

An external sceletal fixator is hardly recommended in the treatment of a knee joint dislocation. It necessitates an intracapsular approach, tiny skin incisions, and dull soft tissue preparation (5). The affected cruciate ligament remaining tissue needs to be removed, and the joint needs to be flushed. Primary restoration of the damaged ligaments must be accomplished whenever it is possible. At the conclusion of the procedure, a transarticular external skeletal fixator is placed across the

stifle joints, while the stifle is held at a functional standing angle (5). As with the bone plate stifle arthrodesis, this angle is also estimated using radiographs of the healthy limb (1). Compared to plate arthrodesis, this method is easier to perform, but it is marked in many complications. The most typical postoperative side effects are as follows: loss of pins, osteolysis of the bone around the pin, femoral or tibial fractures, displacement of the external fixator, and pin fracture (1, 5, 10). By employing positive threaded pins, which have greater pull-out resistance than smooth pins, complications can be kept to a minimum. It is also important to insert pins slowly to reduce heat production, bone necrosis, and due for that pin loosening. However, by using the near-far-far-near concept and inserting the most proximal pin in the proximal third of the femur and the most distal pin in the distal third of the tibia, the risk of iatrogenic fracture can be decreased (5). Nevertheless, despite the use of these prevention measures, treatment is prolonged, and treatment effects are not fully of satisfactory (1, 5, 10).

A treatment that shows promise in complete knee dislocation in cats is the insertion of lateral fabellotibial and fibulopatellar sutures. It is a technique that guarantees the cruciate ligaments' functional recovery (1). In contrast to arthrodesis of the knee joint, this allows the biomechanics of the limb to be preserved (including flexion and extension movements) (3, 18). The employment of physical therapy techniques is made possible by this method because it doesn't require for the use of metal components, which rules out the use of even electrostimulation (2), which may result in less muscle atrophy. Other advantages of this method are less bone traumatization, short recovery period, the need for a smaller amount of surgical instruments, and thus lower costs of the procedure. However, it is a method that will be used in case of a knee luxation with rupture of both cruciate ligaments, joint capsule damage and I degree collateral ligaments damage.

In some circumstances, severe ligament, meniscal, and joint capsule damage may prevent primary restoration. In 2012 a case was reported of an obese cat in whom extracapsular sutures were used to stabilize a knee luxation, in which external skeletal fixation or transarticular coaptation were not used postoperatively. An orthopedic examination performed two weeks after the surgery showed severe lameness and instability of the knee joint. The interview revealed that the owners disregarded the doctor's advice, and the cat's range of motion was unrestricted (2). The failure of the treatment is attributed by the study's authors to the surgical approach taken. Additionally, it is unclear what structures the main injury caused damage as well as how the surgeon put the stabilizing sutures. This case might merely imply that the use of joint stabilizing sutures in obese animals should be restricted.

All patients' clinical outcomes were satisfactory. Each owner was really satisfied with the outcome of the treatment. In order to preserve the entire functionality of the limb, the lateral fabellotibial and fibulopatellar suture technique can be effective in young animals. If the cruciate ligaments are the primary area of damage, the suture technique may be helpful. In cases of damaged collateral ligaments, doctors might even consider utilizing them with bone anchors, although this would necessitate a distinct clinical investigation.

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Corresponding author: Magdalena Morawska-Kozłowska, DVM, ul. Oczapowskiego 14, 10-719 Olsztyn, Poland; e-mail: magdalena.m.morawska@gmail.com