

TRAUMATIC COXOFEMORAL LUXATION IN CATS TREATED WITH HIP-TOGGLE STABILIZATION USING THE MINI TIGHTROPE® FIXATION SYSTEM

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The aim of this retrospective study was to evaluate the clinical and radiographic outcomes of 21 cats that underwent coxofemoral toggle stabilization using the Mini TightRope® Fixation System (mTR®). Data were compiled from client-owned cats with traumatic hip luxation. Each cat underwent the same protocol including orthopedic assessment, preoperative radiographic evaluation, surgical procedure, postoperative management and clinical re-examination at 14 days, 8 weeks and 12 months following surgery. Age, body weight, implants and osteoarthritis progression were recorded. A lameness score 0-4 was assigned to each cat. Pain upon hip extension was not quantified but as pain reaction or no pain reaction. Major complications and osteoarthritic (OA) changes were recorded. Osteoarthritic changes were classified on a 0-4 scale. Twenty-one cats were included in the study. Coxofemoral luxations were stabilized using a mTR®. At 8 weeks, weight bearing was considered normal (grade 0) in all cats and no pain reaction was elicited during hip extension. One year after surgery, orthopedic examination was within the normal limits and according to the owners, all animals exhibited a normal physical activity. No complications were recorded. Evidence of slight OA changes were observed in 5 out of 21 cats. The final outcome was considered excellent in 16/21 patients and good in 5/21 cats. The application of the mTR® system can be considered a suitable surgical treatment in cats affected by traumatic hip luxation.

Key words: toggle pin, hip, luxation, tightrope, cat

INTRODUCTION

Traumatic coxofemoral luxation is a common joint lesion in small animal practice [1-3]. The most common luxation occurs in the craniodorsal direction, most likely due to the contraction of gluteal muscles [2]. The dislocation of the femoral head, associated

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with round ligament and joint capsule injuries, is responsible for pain and lameness of the affected limb. Clinical evaluation and radiographic examination are required to confirm the diagnosis. Closed reduction is typically attempted within the therapeutic window of 48-72 h, although a relaxation rate of 50–70% has been described [1-3]. An Ehmer sling can be used following closed reduction but is often poorly tolerated by feline patients and can be responsible for vascular injury, severe muscle atrophy and joint stiffness [4]. In patients with longer standing coxofemoral luxation or residual hip instability following closed reduction, surgery has been indicated. Several open surgical techniques for the treatment of hip luxation in dogs and cats have been described in the veterinary literature [2,5-13]. The variety of techniques and materials suggests that no single method is superior to others [10]. In cats, trans-articular pinning, toggle pin fixation, femoral head and neck ostectomy and extra-articular stabilization have been proposed [4,14-17].

The mTR® system is a braided polyblend toggle construct that was proposed in 2010 by Cooks to stabilize the stifle joint in dogs affected by cranial cruciate ligament disease [18].

The mTR® system was also used to treat craniodorsal coxofemoral luxation in 17 dogs [2]. In feline surgery, two papers, describing four cats and one patient, respectively, reported the successful outcome of coxofemoral luxation stabilized with mTR® [19,20]. Both papers reported further evaluation in terms of larger study population and longer follow-up period to better evaluate outcomes and complications [19,20].

For this reason, the aim of this retrospective study was to evaluate the long-term clinical and radiographic outcome of craniodorsal coxofemoral luxation in cats stabilized with the mTR® system.

MATERIALS AND METHODS

Inclusion criteria were records of cats referred with a diagnosis of traumatic coxofemoral luxation between 2016 and 2019 and treated at the Veterinary Teaching Hospital of the University of Teramo by intra-articular stabilization using the mTR® system.

The study protocol was executed following the institutional guidelines for clinical studies on client-owned animals; owners were fully informed of the procedures and a written informed consent was obtained.

Each cat underwent the same protocolled procedures including orthopedic assessment, preoperative radiographic evaluation, surgical procedure, postoperative management and clinical examination at 8 weeks and 12 months following surgery. Age, body weight, implants and osteoarthritis progression were recorded. A lameness score of 0-4 was assigned to each cat as follow: grade 0 no lameness; grade 1 intermittent lameness; grade 2 consistent weight-bearing lameness, grade 3 intermittent non-weight bearing lameness; grade 4 consistently non weight-bearing lameness [2]. Pain upon

hip extension was classified as pain reaction or no pain reaction [21]. Radiographic assessment was performed under general anesthesia during the preoperative evaluation to evaluate the femoral displacement, hip conformation and OA evaluation. Cats were premedicated with acepromazine (0.03 mg/kg *i.m.*) and ketamine (2 mg/kg *i.m.*), induced with propofol (4 mg/kg *i.v.*) endotracheally intubated and general anaesthesia was maintained with isoflurane in 100% oxygen. The hip joint was exposed via a standard craniolateral approach. Soft tissues dissections and hemostasis were performed using the Air plasma device [22]. Caudal retraction of the femur, via pointed bone holding forceps attached to the greater trochanter, allowed inspection of the acetabulum and removal of any soft tissue debris. The femoral head was reduced and a mTR® implant was applied using the technique by Ash and colleagues [19]. Post-operative radiographic examination confirmed the reduction of the joint with seated position of the toggle. No bandage was applied. Immediate postoperative radiographic assessment including ventrodorsal and mediolateral views were performed to check the implant position and joint congruity. All cats were given cefazolin perioperatively (22 mg/kg IV) every 90 minutes during surgery then every six hours for 10 days. Immediate postoperative pain control included methadone (0.1 mg/kg IV) q4 and Meloxicam (0,1 mg/kg IV) q24. Patients were discharged one day after surgery with Meloxicam (0.1 mg/kg PO) q24 for 14 days and Tramadol (3mg/kg PO) q8 for 5 days. Owners were instructed to limit the physical activity of their pets to indoor exercise for two weeks. No cage rest was required. Clinical follow-up evaluations were performed 14 days, 8 weeks and one year after surgery. Radiographic assessment of the pelvis was performed under sedation eight weeks and one year after surgery. Evidence of osteoarthritic changes were recorded and classified as absent, slight, mild moderate [23]. Complications were recorded as major if additional surgery was required, and minor in cases of conservative management. According to clinical and radiographic findings 1 year after surgery, outcomes were classified as follow: excellent (absence of any clinical and radiographic signs; good: OA signs radiographically without functional signs, and poor: not applicable because there was no poor outcome.

RESULTS

Twenty-one domestic short hair cats met the inclusion criteria (Table 1). The study included fourteen male and seven female cats. The median age was 3.4-year-old (range 1–8-year-old). Median body weight was 3.6 kg (range 2.6- 5.1 kg). Median duration of luxation prior to surgery was 9.71 days (range 4-21 days). All cats in this study had unilateral craniodorsal coxofemoral luxation and no further orthopaedic injuries were diagnosed. All luxations were stabilized using a mini Thigh-Rope® system, Arthrex®, Naples, FL, USA.

At 14 days after surgery, all cats showed slight lameness (grade = 1). Manipulation of the operated hip did not reveal any crepitus and extension of the hip elicited only slight pain in all cats. No lameness was detected at 8 weeks, nor pain reaction was

appreciated during hip extension. Furthermore, radiographic examination showed no difference as compared with the immediate post-op view. The femoral tunnel was evident, and the hip joint surfaces were congruent. At the 12 months re-examination, orthopaedic evaluation revealed no lameness and, according to the owners, patients showed a normal physical activity. No complications were observed. Radiographic evidence of slight remodeling of the femoral head without accompanied pain was observed in 5 out of 21 cats. Final outcomes were considered excellent in 16/21 cats and good in 5/21 (Fig.1).

Table 1. Summary of signalment and outcome

| Case | Breed | Body weight | Sex | Age (yr) | Luxation duration (days) | Lameness score (0/4) 1 yr PO | OA changes 1yr PO | Pain upon hip extension 1 yr PO | Final outcome 1 yr PO |
|------|-------|-------------|-----|----------|--------------------------|------------------------------|-------------------|---------------------------------|-----------------------|
| 1 | Dsh | 3.2 | F | 4 | 7 | | no | no | excellent |
| 2 | Dsh | 2.9 | M | 3 | 10 | 0 | slight | no | good |
| 3 | Dsh | 3.4 | M | 2 | 11 | 0 | no | no | excellent |
| 4 | Dsh | 3.6 | M | 8 | 4 | 0 | no | no | excellent |
| 5 | Dsh | 4.2 | M | 1 | 6 | 0 | no | no | excellent |
| 6 | Dsh | 4.8 | F | 5 | 8 | 0 | slight | no | good |
| 7 | Dsh | 2.9 | M | 1 | 10 | 0 | slight | no | good |
| 8 | Dsh | 3.3 | F | 4 | 15 | 0 | no | no | excellent |
| 9 | Dsh | 4.1 | M | 3 | 21 | 0 | no | no | excellent |
| 10 | Dsh | 5 | F | 2 | 12 | 0 | no | no | excellent |
| 11 | Dsh | 4.3 | M | 5 | 6 | 0 | slight | no | good |
| 12 | Dsh | 2.8 | M | 4 | 9 | 0 | no | no | excellent |
| 13 | Dsh | 3.3 | M | 5 | 11 | 0 | no | no | excellent |
| 14 | Dsh | 3.8 | M | 1 | 11 | 0 | no | no | excellent |
| 15 | Dsh | 3.7 | F | 5 | 14 | 0 | no | no | excellent |
| 16 | Dsh | 4.1 | F | 3 | 6 | 0 | no | no | good |
| 17 | Dsh | 2.6 | M | 2 | 8 | 0 | slight | no | good |
| 18 | Dsh | 3.9 | M | 4 | 9 | 0 | no | no | excellent |
| 19 | Dsh | 2.8 | M | 3 | 10 | 0 | no | no | excellent |
| 20 | Dsh | 3.5 | F | 3 | 13 | 0 | no | no | excellent |
| 21 | Dsh | 3.7 | M | 2 | 11 | 0 | no | no | excellent |
| Mean | | 3.61 | | 3.42 | 10.1 | | | | |
| SD | | 0.65 | | 1.63 | 3.75 | | | | |

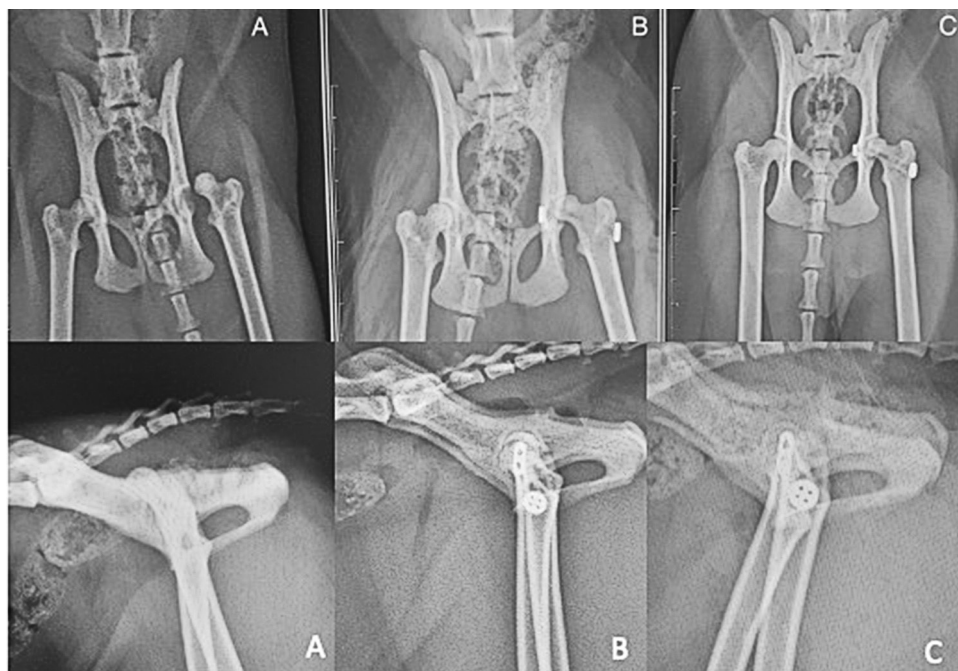


Figure 1. Cat male dsh 1 year old body weight 2.9kg. Preoperative (A), post-operative (B) and one year (C) hip VD and ML radiographs. One year after surgery there was no relaxation, evidence of slight OA changes can be observed. The femoral tunnel is still evident

DISCUSSION

Trans-articular pinning is a common surgical technique for stabilizing coxofemoral luxation in cats. In 2009 Sissener and others reported an overall success rate of 77% with evidence of good to excellent long-term functional outcome of surgical stabilization by trans-articular pinning in 20 cats [4]. However, the following complications may be observed: damage of the articular cartilage subluxation of the femoral head, rectal perforation, toggle pin breakage and/or migration, and bone resorption around the pin [24]. In 2012 Pratesi reported the outcome of 14 unilateral coxofemoral luxations in cats treated with toggle pin stabilization. The success rate was 86% with evidence of relaxation in two cats with multiple orthopaedic injuries [15]. In 2021 Rupérez compared the complication rate and outcome of cats treated with toggle pin stabilization using ultrahigh-molecular-weight-polyethylene or nylon. Hip toggle stabilization was associated with a low rate of intraoperative complications or relaxation and excellent long-term outcomes in most cats [17].

The mTR® system consists of a single strand of FiberWire® looped twice through the toggle and titanium button [18]. In 2012 Ash and colleagues described a novel method of craniodorsal coxofemoral luxation in four cats and five small breed dogs using

a modified Knowles technique with the braided polyblend mTR® system [19]. The clinical outcome of this report was very encouraging confirming coxofemoral joint congruity six weeks postoperatively and the patients returned to their previous level of activity. Median lameness score at six weeks after surgery was 0/5 while radiographic examination confirmed hip stability with no displacement of the toggle pin and absence of signs of OA. Follow-up by telephone performed at 16 weeks revealed that all patients returned to their previous level of activity. Only minimal complications, with no requirement of surgical revision, were observed during the recovery period. A paper published in 2014 reported the outcome of 17 dogs successfully treated by hip toggle pin stabilization using the mTR® system [2]. Gait analysis showed symmetric pelvic limb use in the six re-evaluated dogs. Radiographs showed no progression of osteoarthritis in comparison to immediate postoperative radiographs. All owners of living dogs reported limb function as being good to excellent and perceived that their dogs were pain free [2].

In this study population of 21 cats, clinical examination showed a satisfactory outcome just 14 days after surgery. Furthermore, at 8 weeks and 12 months after surgery weight bearing was evaluated to be normal; the orthopedic examination was within the normal limit, and radiographic re-examination showed no signs of relaxation. In addition, the muscles were symmetrical compared to the contralateral limb. Radiographs confirmed hip reduction and maintained toggle position. Slight progression of OA signs was observed in 5 out of 21 cats. Progression of OA is likely due to the traumatic event, although there is a possibility that the presence of the implant may enhance osteoarthritic changes over time.

It was observed that the tunnel into the femoral head and neck was slightly enlarged in the 12 months follow-up radiographs. This may be due to the integrity of the fiberwire, which causes a mechanical remodeling of the tunnel. It is unknown if this remodeling increases in the long term and whether this may lead to further complications.

According to clinical and radiographic findings, outcome was considered excellent in 16 out of 21 patients. No complications were reported during the recovery from surgery. In this case series, all cats with coxofemoral luxation had no other orthopedic conditions. Further studies are required to rate potential complications in cases in which additional traumatic injuries involving the hip such as pelvic fractures and/or sacroiliac luxations may have occurred. As any prosthetic implant, mTR can be susceptible of infection or failure.

Main shortcomings of this study include its retrospective nature, the absence of the objectively evaluate lameness assessment and the lack of owner evaluation forms.

In conclusion, we found that application of the mTR® system can be considered a suitable surgical treatment in cats affected by traumatic hip luxation.

Authors' contributions

RT participated in the conceptualization and original draft preparation. RT, AP_r, FC_a and AP used methodology. IF, ADB and MV did an investigation. AB made data curation. RT, AP_a and MV participated in manuscript writing, review and editing. All authors read and approved the final manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of Informed Consent

The owner understood procedure and agrees that results related to investigation or treatment of their companion animals, could be published in Scientific Journal *Acta Veterinaria-Beograd*.

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STABILIZACIJA KUKA UZ UPOTREBU MINI TIGHTROPE® FIXATION SISTEMA KOD MAČAKA SA TRAUMATSKOM KOKSOFEMORALNOM LUKSACIJOM

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Cilj ove retrospektivne studije je bio da se obavi evaluacija kliničkih i radiografskih ishoda kod 21 mačke kod kojih je primenjena stabilizacija kuka upotrebom Mini TightRope® Fixation System (mTR®). U okviru studije, obavljena je kompilacija podataka od vlasničkih mačaka kod kojih je dijagnostikovana traumatska luksacija kuka. Svaka je mačka podvrgnuta istom protokolu koji je obuhvatao ortopedijsku procenu, preoperativnu radiografsku evaluaciju, hirurški zahvat, postoperativnu proceduru i kliničko naknadno ispitivanje, 14 dana, 8 nedelja i 12 meseci posle hirurškog zahvata. Beleženi su podaci kao što je to uzrast, težina telesne mase, stanje implanta i uznapredovalost osteoartritis. Svako je mački procenjivan skor hromosti u rasponu od 0 do 4. Bol koji nastaje prilikom istezanja kuka nije bio kvantifikovan već je okarakterisan kao prisustvo ili odsustvo bola. Beležene su značajne komplikacije kao i osteoartritis (OA). Osteoartritis su klasifikovani u odnosu na skalu od 0 do 4. Studijom je bila obuhvaćena 21 mačka. Koksofemoralna luksacija je stabilizovana upotrebom mTR®. Osam nedelja posle tretmana, opterećenje težinom je bilo normalno kod svih mačaka (nulti stupanj), nije bilo bolne reakcije tokom ekstenzije kuka. Godinu dana posle operacije, ortopedijsko ispitivanje je ukazivalo na normalne vrednosti, a prema iskazima vlasnika mačaka, sve su mačke imale normalnu fizičku aktivnost. Nisu uočene nikakve komplikacije. Neznatne OA promene su uočene kod 5 od ukupno ispitanih 21 mačaka. Konačni ishod tretmana je bio odličan kod 16 od ukupno 21 mačke kao i dobar kod 5 mačaka od ukupno 21 mačke. Smatra se da je primena mTR® sistema odgovarajući i adekvatan hirurški tretman kod mačaka kod kojih je dijagnostikovana traumatska luksacija kuka.