https://doi.org/10.17221/173/2020-VETMED

External fixator for the treatment of narrowed pelvic canal in a cat

Stefania Pinna, Chiara Tassani, Melissa Rossini, Francesco Lanzi*

Department of Veterinary Medical Sciences, Alma Mater Studiorum, University of Bologna, Ozzano E. (Bologna), Italy
**Corresponding author: stefania.pinna@unibo.it*

Citation: Pinna S, Tassani C, Rossini M, Lanzi F (2021): External fixator for the treatment of narrowed pelvic canal in a cat. Vet Med-Czech 66, 356–362.

Abstract: The aim of this study was to report the outcome of the use of an external fixator to treat a pelvic canal stenosis in a 5-month-old female cat. The cat was referred with a history of 3 weeks of intermittent signs of constipation refractory to the medical management, occurring after surgical treatment for a bilateral sacroiliac luxation and sacral fracture. The clinical examination revealed instability of the pelvis and a radiograph showed a pelvic canal stenosis and megacolon. External fixator was the method of choice to be used in this case. The manually applied tension on an external fixator resulted in a widening of the pelvic canal. At 45 days after surgery, there were no signs of constipation, and the radiological examination showed progressive bone healing. At 18 months post-op, the cat had no abnormalities both on the clinical examination and on the radiography. In conclusion, the use of an external fixator led to the widening of the pelvic canal using a minimally invasive procedure. To the authors' knowledge, this case report represents the first surgical description and clinical outcome of the widening of the pelvic canal in cats using an external skeletal fixator.

Keywords: constipation; minimally invasive procedure; sacral index; stenosis

Pelvic fractures account for 22–32% of all feline fractures (Grierson 2019). Concurrent non-orthopaedic injuries are seen in 59–72% of cases (Bookbinder and Flanders 1992; Lanz 2002; Meeson and Geddes 2017). The most common long-term gastrointestinal complication of pelvic fractures is a megacolon (Lanz 2002). A megacolon is the result of obstructive or pseudo-obstructive conditions which cause constipation (Bertoy 2002). Stenosis of the pelvic canal following pelvic fractures is the second most common cause of megacolons and accounts for approximately 25% of all cases (White 2002; Colopy-Poulsen et al. 2005; Trevail et al. 2011). When fractures are managed conservatively, the risk of malunion and the consequent stenosis of the pelvic canal increases (Lanz 2002). Even the unexpected failure of an orthopaedic implant following a surgical treatment could cause the displacement of fragments and the consequent narrowing of the canal (Hamilton et al. 2009; Schmierer et al. 2015).

Previous studies have recommended a surgical procedure to widen the pelvic canal when the clinical signs of constipation secondary to pelvic fracture malunion lasted for 6 months or less in duration (Matthiesen et al. 1991; Schrader 1992). When the constipation lasted for more than 6 months, a subtotal colectomy is suggested (Matthiesen et al. 1991; Schrader 1992; Colopy-Poulsen et al. 2005; DeGroot et al. 2016). Several surgical techniques have been described to resolve a pelvic canal stenosis (Leighton 1969; Evans 1980; Ferguson 1996; Liptak 1998; Prassinos et al. 2007; Kramer et al. 2008; DeGroot et al. 2016; Cinti et al. 2020). To the authors' knowledge, the application of an external skeletal fixator (ESF) to resolve pelvic fractures and/or a pelvic stenosis in cats has not yet been reported.

https://doi.org/10.17221/173/2020-VETMED

This case described the use of an ESF to treat a pelvic canal stenosis due to the failure of the previous orthopaedic surgery in a 5-month-old cat.

Case description

CLINICAL EVALUATION

A 5-month-old female domestic shorthair cat was referred to the University Hospital of the Department of Veterinary Medical Sciences, University of Bologna, Ozzano dell'Emilia (Bologna) for evaluation of chronic 3-week constipation. The cat had surgery 25 days earlier to treat a bilateral sacroiliac luxation and a sacral fracture concomitant to the luxation on the right sacral wing as a result of a motor vehicle accident. In addition, the failure of the medical and dietary therapy was reported.

The cat showed moderate right pelvic limb lameness and slight pain when the right hip was manipulated. The other limbs were considered normal. There was instability during palpation of the pelvis. A neurological examination revealed the perineal and hind limb withdrawal reflexes to be decreased.

An abdominal palpation was painful and detected a distended colon. It was impossible to perform a finger exploration; the opening was sufficient to pass a 14 Fr gastroduodenal feeding tube which was used to carry out enemas to soften the stools.

RADIOGRAPHIC EVALUATION

A right lateral radiograph of the abdomen revealed a severe colonic dilation superimposed on a faecal impaction; the ratio of the colonic diameter (31.4 mm) to the L5 length (19.3 mm) was 1.63 (Figure 1). A ratio > 1.48 is suggestive of a megacolon (Trevail et al. 2011).

The ventrodorsal radiograph of the pelvis showed an orthopaedic implant migration and an axial dislocation of the right coxal bone. The width between the axial cortices of the two acetabular bones was 11.6 mm (Figure 2). The sacral index (SI) was calculated as the ratio of the width of the sacrum at the cranial border to the width of the pelvic canal measured between the axial cortices of the acetabular bones (Hamilton et al. 2009), resulting in an SI of 1.72. This value was suggestive of a severe narrowing of the canal when compared with the normal SI value for cats (defined as 0.97 ± 0.025) (Hamilton et al. 2009).

The owner signed an "informed consent" in order to proceed with the anaesthesia and the surgical procedures.

SURGICAL TECHNIQUE

The cat was premedicated with ketamine chlorhydrate (Nimatek 100 mg/ml; Dechra, Eurovet

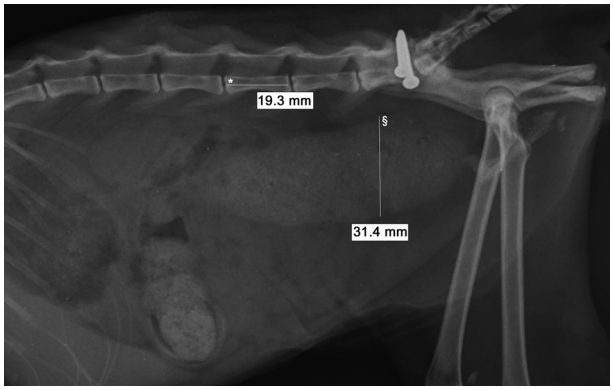


Figure 1. Right lateral abdominal radiograph
The colonic diameter (§) and L5 length (*) are measured upon the cat's admission. Two screws are identified between the L7 and the sacral bone. Fragments of the pubic bone are moved in a ventral direction

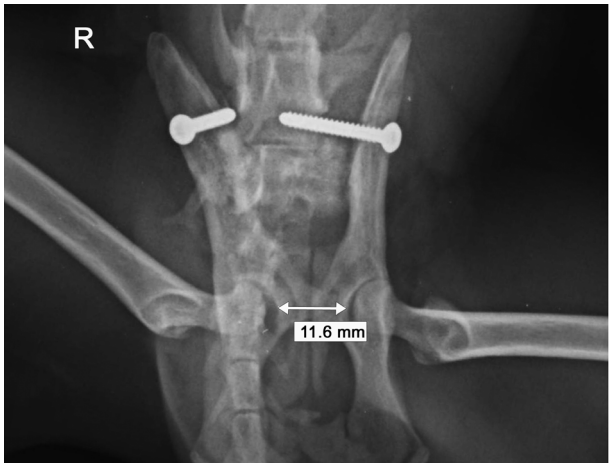


Figure 2. Ventrodorsal pelvic radiograph
The collapse of the right coxal bone to the median axis of the pelvis is noted. The double arrow line reveals the pelvic canal diameter. The position of the two screws suggests that the screws either tore out or were never stable in the sacrum. This is suggestive of a previous surgery failure. Fracture lines are visible in the pubic bone and ischiatic table, and a sacroiliac luxation is evident on the left side, but not clearly identifiable on the right side (R = right)

https://doi.org/10.17221/173/2020-VETMED

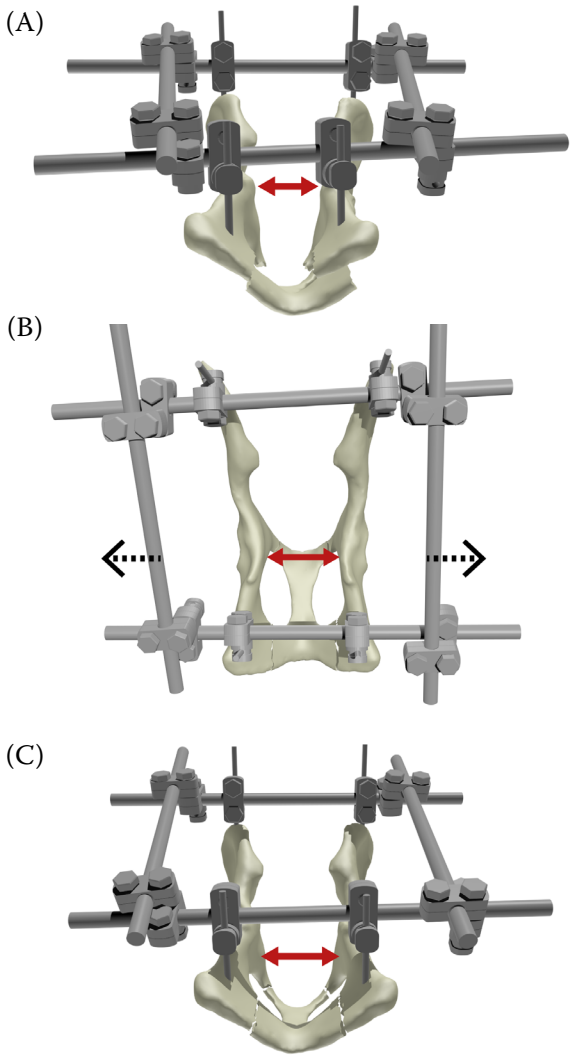
Animal Health b.v., AE Bladel, The Netherlands) (5 mg/kg) intramuscularly (i.m.) and dexmedetomidine chlorhydrate (Dextroquillan® 0.5 mg/ml; Fatro SpA, Ozzano E., Bologna, Italy) (5 mcg/kg i.m.). Anaesthesia was induced with propofol (Proposure; Boehringer Ingelheim, Milano, Italy) (0.5 mg/kg) intravenously and was maintained with isoflurane (Iso-Vet®; Piramal Critical Care Limited, West Drayton, UK) and oxygen during the procedure.

The cat was positioned in ventral recumbency. First, a lateral open approach to the ilium was used and, under fluoroscopic control, both the screws were removed using a stab incision. A closed approach to the pelvis was then carried out. An EFS (Imex Veterinary Inc., Texas, USA) was applied under fluoroscopic control. Two 1.6 mm positive-profile threaded pins were inserted perpendicularly into the dorsal surface of both wings of the ilium and two 2.0 mm positive-profile threaded pins were inserted perpendicularly into the dorsal surface of both ischiatic tables through the minimal stab incision. The pins were then connected to clamps, and the clamps were connected to connecting rods (diameter: 3.2 mm) to form a uniplanar configuration in a rectangular shape of the EFS (Figure 3A).

While the surgeon was applying a manual traction on the pins, an external operator performed a digital rectal exploration to perceive the pelvis dilation. When the widening was confirmed by the fluoroscopic control, the clamps were then locked to the connecting rods (Figure 3B–C).

Postoperative pelvic radiographs were taken. The width of the pelvic canal was measured and was 18.2 mm (Figure 3D). A padded bandage was applied over the ESF for protection and comfort.

The postoperative analgesia was provided with one dose of methadone chlorhydrate (Eptadone® 10 mg/ml; Molteni Farmaceutici, Firenze, Italy) (0.1 mg/kg i.m.) every 4 h for the initial 12 h, and subsequently with tramadol chlorhydrate (Altadol®



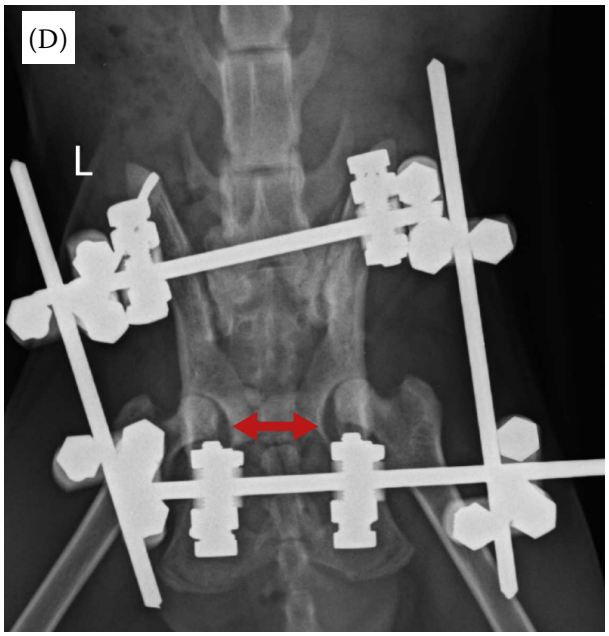


Figure 3. Illustration of the steps of the surgical procedure
The caudocranial view of the external skeletal fixator applied to the cat pelvis before the distraction. The stenosis of the pelvic canal due to the dislocation of the right coxal bone towards the median axis is noted (A). Dorsoventral (B) and caudocranial (C) views of the external fixator after the traction. The dotted arrow reveals the distraction applied to the implant. The widening of the pelvic canal is noted. The dorsoventral radiograph taken after surgery confirmed the correct distraction (18.2 mm) (D). The radiographic image (D) is represented in illustration B. All the red double-sided arrows show the width of the pelvic canal (L = left)

https://doi.org/10.17221/173/2020-VETMED

50 mg/ml; Formvet S.r.l., Milano, Italy) orally (2 mg/kg).

The cat voluntarily defecated without dyschezia 48 h after the surgery, and the rectal exploration was normal. The cat showed no signs of pain/discomfort toward the ESF (Figure 4), and it was discharged with a 5-day course of cefazoline (Cefazolina Teva 1 g/4 ml; Teva Italia S.r.l., Milano, Italy) (30 mg/kg) and tramadol. Exercise restriction was recommended at discharge.

Figure 4. Postoperative image of the cat with the external fixator in the dorsal view

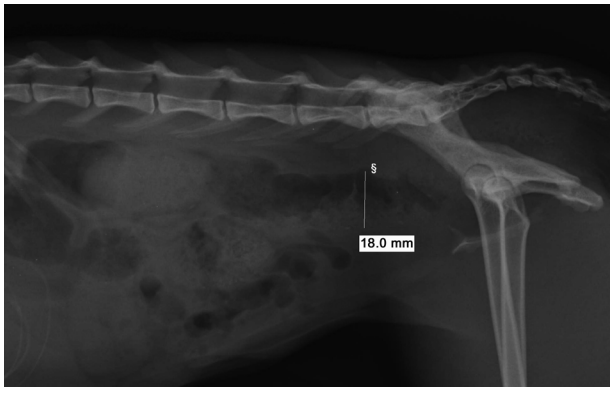


Figure 6. Right lateral abdominal radiograph taken 18 months after surgery

The colonic diameter (§) decreased to 25.3 mm when compared with Figure 1

After positioning the ESF, the manually applied tension on the pins achieved the widening of the pelvic canal. The accuracy of the surgical procedure was confirmed both by measuring the pelvic canal (18.2 mm) and the SI (1.09), and by the radiographs.

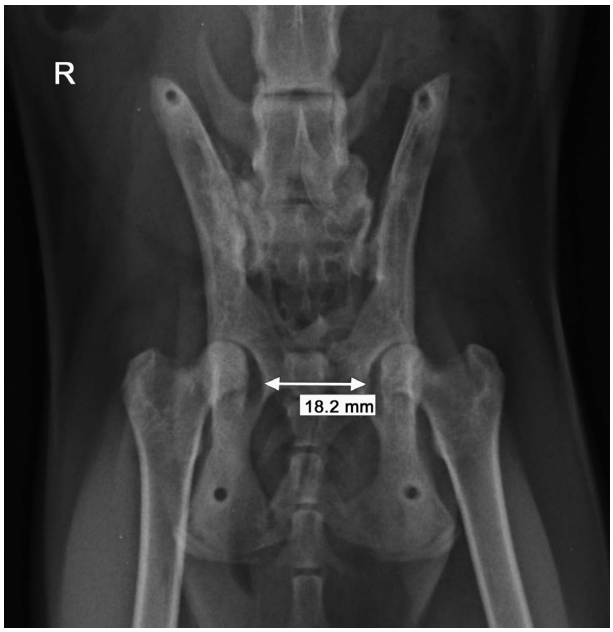


Figure 5. Ventrodorsal pelvic radiograph at the time of the implant removal, 45 days after the surgery

The double-sided arrow line reveals the widening of the pelvic canal (18.2 mm) (R = right)

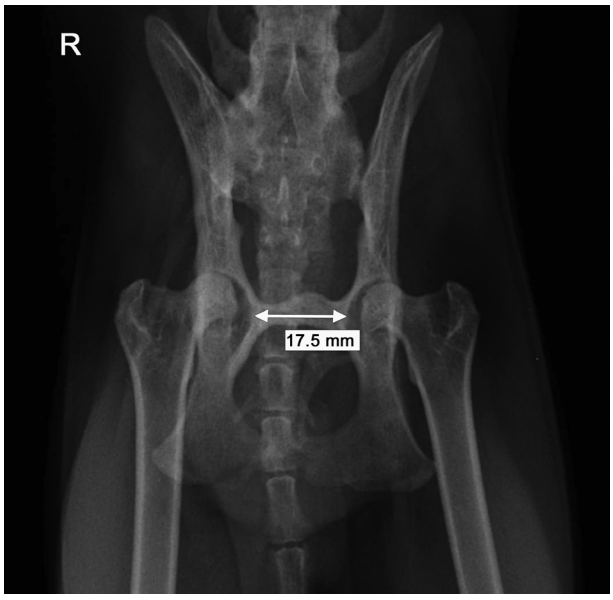


Figure 7. Ventrodorsal pelvic radiograph taken at the 18-month follow-up

The double-sided arrow line reveals the widening of the pelvic canal, only slightly diminished (17.5 mm) when compared with Figure 5 (R = right)

https://doi.org/10.17221/173/2020-VETMED

Table 1. The data obtained from the measurements on both the lateral radiograph of the abdomen and the ventrodorsal radiograph of the pelvis are listed

Follow-up	Cranial border of the sacrum (mm)	Pelvic canal (mm)	Sacral index SI = S/C	SI increasing to normal value (%)	Colonic diameter (mm)	L5 length (mm)	Ratio D/L (cut-off 1.48)
T(–)1	19.9	11.6	1.72	77.3	31.4	19.3	1.63
T0	19.9	18.2	1.09	12.4	NA	NA	NA
T1	19.9	18.2	1.09	12.4	19.9	19.3	1.03
T2	19.9	17.5	1.14	17.5	18	19.3	0.93

C = pelvic canal; D = colonic diameter; L = L5 length; NA = not applicable; S = cranial border of the sacrum; SI = sacral index; T(–)1 = pre-operative time; T0 = post-operative time; T1 = 45 days after surgery; T2 = 18 months after surgery
Sacral index normal value is 0.97

FOLLOW-UP

The cat was rechecked 45 days after surgery; the owner reported no signs of constipation. The cat walked normally, the radiographs showed progressive bone healing, and the widening of the pelvis was maintained when compared with the immediate postoperative time (Figure 5). No complication due to the ESF was recorded, and it was removed. The owner was contacted by telephone several times during the year after the implant's removal. No walking and defecation problems were reported.

At 18 months post-op, the cat had a follow-up examination. The physical examination was normal. Neither lameness nor signs of discomfort were observed. A finger rectal exploration was possible and suggested that there was no pelvic canal stenosis. A neurological examination showed the perineal and hind limb withdrawal reflexes to be normal. A lateral radiograph of the abdomen showed no faecal impaction, the diameter of the colon was 18.0 mm and the ratio of the width to the L5 length was 0.93 (Figure 6). The width of the pelvic canal shown in the ventrodorsal radiograph was 17.5 mm and the SI was 1.14 (Figure 7). All the data are listed in Table 1.

DISCUSSION AND CONCLUSIONS

This case report describes the use of an ESF for the treatment of a pelvic canal stenosis concomitant with a megacolon. The authors were unaware of the approach used to treat the first stabilisation. The radiographic evaluation of the pelvis, carried out at the time the cat was presented, showed that the screws had a craniodorsal direction toward L7, and not to the body of the sacrum, in both the ventrodorsal and lateral projections (Figures 1 and 2). A previous study regarding the stabilisation of sacroiliac dislocation in cats (Shales et al. 2010) recommended the screw placement in the body of the sacrum or exiting ventrally, with a depth of at least 60% of the width of the feline sacrum. In the present case report, owing to the misdirection of the screws, it was impossible to assess the percentage of the screw inserted into the sacrum. According to this study (Shales et al. 2010), the malposition of a screw and/or it not being inserted deep enough could have been cause of the loosening of the implant with the consequent dislocation of the coxal bone. The loosening of the orthopaedic implant was probably the cause of the narrowing of the pelvis with the consequent constipation. Previous studies have shown that pelvic canal widening is likely to be effective when the constipation is of less than 6 months duration. After this period, the colon is unlikely to return to normal function due to the excessive dilation and subsequent neurological damage (Colopy-Poulsen et al. 2005). For that reason, when signs of constipation have been present for more than 6 months, a subtotal colectomy is performed (Matthiesen et al. 1991; Schrader 1992; Colopy-Poulsen et al. 2005). Since the cat had only 3 weeks of constipation, the pelvic canal narrowing was surgically corrected with a good prognosis.

The choice of surgical treatment was rather limited and conditioned by the persistent pelvic instability. Some authors have described a triple pelvic osteotomy as treatment for obstipation in cats with stenosis of the pelvic canal (Schrader 1992; Ferguson 1996; Cinti et al. 2020). This procedure was discarded because the authors considered that the instability of the entire right coxal bone could have created problems in carrying out the surgery,

https://doi.org/10.17221/173/2020-VETMED

with a consequent uncertain efficacy. Moreover, pelvic osteotomies (Ferguson 1996; Prassinos et al. 2007; DeGroot et al. 2016) are very invasive procedures with potentially serious complications (Colopy-Poulsen et al. 2005; Kramer et al. 2008; Chou et al. 2013). However, a recent paper (Cinti et al. 2020) described a triple pelvic osteotomy procedure using a single lag screw, in place of a thermoplastic polyolefin (TPO) plate, resulting in a fast and effective technique without major complications.

A symphysiotomy with the use of an allogenic or heterologous bone graft, or metal spacers, as described in various studies (Evans 1980; Prassinos et al. 2007), could also not be used in this case since the pelvic floor was fractured and the use of spacers could have caused additional instability with the likely failure of the procedure.

In all these reports, the fractures had healed completely and the pelvic bone was stable. In the present study, the use of an ESF was advised in order to take advantage of the pelvic mobility still present, and to apply and maintain the widening of the pelvic canal. The SI was calculated to obtain an objective measurement of the pelvic canal narrowing and of the postoperative widening. This was used to assess the degree of the pelvic canal stenosis as a percentage of the normal SI of cats (Hamilton et al. 2009). When the cat was presented, the SI was 77.3% greater than the normal SI (a percentage ≥ 30% was described as severe narrowing) (Hamilton et al. 2009). After the application of the ESF, the SI was 12.4% over a normal SI (Hamilton et al. 2009) and, therefore, less than the 45% which has been reported to be the cut-off point for a higher risk of constipation (Hamilton et al. 2009; Meeson and Geddes 2017).

At 18 months post-op, the width of the pelvic canal slightly decreased to 17.5 mm and the SI value increased (from 12.4% to 17.5%) when compared to the immediate postoperative time. The decrease in the diameter of the pelvic canal was due to bone rearrangement during healing. However, the change in the SI value could have been due to an incorrect reading of the radiograph owing to a slightly different position of the pelvis in the follow-up. However, the clinical outcomes confirmed the success of the widening. Although there was a narrowing of the pelvic canal when compared to its dimensions at the time of implant removal, the measurement of the colonic diameter and the corresponding ratio indicated the resolution of the megacolon which was confirmed by the lack of constipation in the cat.

To the authors' knowledge, the use of an ESF for the stabilisation of pelvic fractures, especially for pelvic canal widening in cats, has not yet been reported. The ESF was applied using a minimally invasive approach, and no complications or discomfort were recorded.

Based on a study regarding a surgical procedure on a dog's pelvis, the caudal pins of the ESF should be inserted into the ischial tuberosity in order to achieve more stability (Fitzpatrick et al. 2008). However, due to the young age of the cat in which the physis was still open, the authors decided to insert the pins cranially to the ischial tuberosities on the ischial table.

In the present report, the application of an ESF was demonstrated to be a successful choice for treating pelvic canal narrowing in a cat and could be a valid alternative to other surgical options described in the literature as long as there is still bone mobility.

An evaluation involving a larger cohort of cats managed with an ESF for pelvic canal widening is required in order to acquire more data, determine the repeatability of the procedure and perhaps evaluate the use of the ESF as a primary synthesis implant, alone and/or associated with other implants, such as plates or lag screws.

Acknowledgement

We thank to Mrs. Barbara Pinna for her generous contribution regarding the drawings included in this manuscript.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

Bertoy RW. Megacolon in the cat. Vet Clin North Am Small Anim Pract. 2002 Jul;32(4):901-15.

Bookbinder PF, Flanders JA. Characteristics of pelvic fracture in the cat. Vet Comp Orthop Traumatol. 1992;5(3): 122-7.

https://doi.org/10.17221/173/2020-VETMED

Chou P, Runyon C, Bailey T, Beraud R. Use of Y-shaped TPLO plates for the stabilization of supracondylar ilial fractures in four dogs and one cat. Vet Comp Orthop Traumatol. 2013 Mar;26(3):226-32.

Cinti F, Cavaliere L, Tommasini Degna M, Rossi F, Pisani G. Triple pelvic osteotomy fixed with lag screw for the treatment of pelvic canal stenosis in five cats. Vet Comp Orthop Traumatol. 2020 Sep;33(5):363-9.

Colopy-Poulsen SA, Danova NA, Hardie RJ, Muir P. Managing feline obstipation secondary to pelvic fracture. Comp Cont Educ Pract. 2005 Sep;27(9):662-9.

DeGroot W, Gibson TW, Reynolds D, Murphy KA. Internal hemipelvectomy for treatment of obstipation secondary to pelvic malunion in 3 cats. Can Vet J. 2016 Sep;57(9): 955-60.

Evans I. Use of an allogeneic bone graft to enlarge the pelvic outlet in a cat. Vet Med Small Anim Clin. 1980 Feb; 75(2):218-20.

Ferguson JF. Triple pelvic osteotomy for the treatment of pelvic canal stenosis in a cat. J Small Anim Pract. 1996 Oct;37(10):495-8.

Fitzpatrick N, Lewis D, Cross A. A biomechanical comparison of external skeletal fixation and plating for the stabilization of ilial osteotomies in dogs. Vet Comp Orthop Traumatol. 2008 Feb;21(4):349-57.

Grierson J. Dealing with pelvic fractures in cats. In Pract. 2019 Apr;41(3):106-14.

Hamilton MH, Evans DA, Langley-Hobbs SJ. Feline ilial fractures: Assessment of screw loosening and pelvic canal narrowing after lateral plating. Vet Surg. 2009 Apr;38(3): 326-33.

Kramer A, Walsh PJ, Seguin B. Hemipelvectomy in dogs and cats: Technique overview, variations, and description. Vet Surg. 2008 July;37(5):413-9.

Lanz OI. Lumbosacral and pelvic injuries. Vet Clin North Am Small Anim Pract. 2002 Jul;32(4):949-62.

Leighton RL. Symphysectomy in the cat and use of a steel insert to increase pelvic diameter. J Small Anim Pract. 1969 June;10(6):355-6.

Liptak JM. Hemipelvectomy for the treatment of obstipation secondary to narrowing of the pelvic canal in a cat. Aust Vet Practit. 1998 Mar;28(1):2-6.

Matthiesen DT, Scavelli TD, Whitney WO. Subtotal colectomy for the treatment of obstipation secondary to pelvic fracture malunion in cats. Vet Surg. 1991 Mar;20(2):113-7.

Meeson RL, Geddes AT. Management and long-term outcome of pelvic fractures: A retrospective study of 43 cats. J Feline Med Surg. 2017 Oct;19(1):36-41.

Prassinos NN, Adamama-Moraitou KK, Gouletsou PG, Rallis TS. Symphyseal distraction-osteotomy using a novel spacer of spirally fashioned orthopaedic wire for the management of obstipation. J Feline Med Surg. 2007 Feb;9 (1):23-8.

Schrader SC. Pelvic osteotomy as a treatment for obstipation in cats with acquired stenosis of the pelvic canal: Six cases (1978–1989). J Am Vet Med Assoc. 1992 Jan;200(2): 208-13.

Shales C, Moores A, Kulendra E, White C, Toscano M, Langley-Hobbs S. Stabilization of sacroiliac luxation in 40 cats using screws inserted in lag fashion. Vet Surg. 2010 Aug;39(6):696-700.

Schmierer PA, Kircher PR, Hartnack S, Knell SC. Screw loosening and pelvic canal narrowing after lateral plating of feline ilial fractures with locking and nonlocking plates. Vet Surg. 2015 Oct;44(7):900-4.

Trevail T, Gunn-Moore D, Carrera I, Courcier E, Sullivan M. Radiographic diameter of the colon in normal and constipated cats and in cats with megacolon. Vet Radiol Ultrasound. 2011 May;52(5):516-20.

White RN. Surgical management of constipation. J Feline Med Surg. 2002 Sep;4(3):129-38.

Received: September 1, 2020
Accepted: February 22, 2021