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**Faculty of Veterinary Medicine and Animal Science**

# Long term outcome and quality of life in cats and dogs suffering from pelvic fractures

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## SUMMARY

Pelvic fractures are a common injury in cats and dogs, mostly due to hit by car or falling from heights. There are several components that determine what treatment is the best in each case. Literature and leading surgeons suggest fractures of the weight bearing axis (iliosacral joint (SI joint), ilium body and acetabulum) should be treated surgically, but there are few studies comparing surgical and conservative treatment. Fractures of the pelvic floor (os pubis, pelvic symphysis and os ischium) and fractures of the ilium wing are rarely treated surgically. This study aims to describe what fractures were the most common, what treatment was chosen and to evaluate long term prognosis and quality of life in dogs and cats after suffering from a pelvic fracture.

The study consists of review of patient records, owner-based questionnaires and a clinical part with long term follow up of clinical outcome. A total of 196 cats and dogs suffering from pelvic fractures during the years 2007 to 2017 were treated at the University animal hospital of the Swedish University of Agricultural Sciences. Questionnaires used were the Feline Musculo-skeletal and Pain Index (FMPI) and the ACVS Canine Orthopedic Index (COI), the result of each questionnaire was calculated into a percentage that was comparable between the questionnaires. Twenty-one cat owners and 16 dog owners answered the questionnaire. Thirteen cats and 11 dogs participated in the clinical study and were subjected to a thorough orthopedic and neurological examination.

Review of patient records showed that the most common fractures in cats were fractures of the SI joint and amongst dogs the most common fractures were fractures of the pelvic floor. Multiple fractures occurred more often than fractures in one or two sites in both cats and dogs. Treatment of pelvic fractures differed between cats and dogs, cats were euthanized to a greater extent than dogs due to their pelvic fracture. Dogs were more commonly treated surgically compared to cats. In cats 46,4% were treated conservatively, 9,3% were treated surgically and 44,4% were euthanized. In dogs 41,3% were treated conservatively, 39,1% were treated surgically and 19,6% were euthanized.

The questionnaire showed with statistical significance, and 95% certainty, that cats recover better and have a better quality of life than dogs after suffering from a pelvic fracture. 57,1% of the cats recovered completely and 6,9% of the dogs recovered completely, according to the questionnaires. The clinical examination showed that the most common complication to pelvic fracture was decreased range of motion in the hip joint. Lameness in one or both of the hind limbs occurred in 25% of the cats and dogs. None of those who had neurological deficits reported on initial clinical presentation had remaining neurological deficits at follow up examination, although, 16,7% of the dogs had neurological deficits at follow up examination.

Unfortunately, the population was too small and heterogenous to make comparison and draw conclusions about whether surgical or conservative treatment is the ultimate treatment for the different types of pelvic fractures. Further studies are needed in the subject of treatment and long-term prognosis of pelvic fractures.

## CONTENT

# INTRODUCTION

Pelvic fractures are common injuries amongst dogs and cats, most often caused by hit by car accident, or falling from high heights. There are several ways to treat pelvic fractures described in veterinary literature, but there are few studies that describe long term follow up of patients after treatment.

The aim of this study was to estimate the quality of life, evaluate long term complications, describe the most common pelvic fracture types and how they were treated amongst cats and dogs. Moreover, the study compared treatment results between surgical- and conservative-treatment and compared the long term outcome between cats and dogs.

To achieve these goals the thesis consists of three parts - a review of patient records, an owner-based questionnaire and a clinical study. To better understand the treatment options described the thesis begins with a literature review on basic anatomy, healing processes, the typical patient and available treatment methods of pelvic fractures.

# LITERATURE REVIEW

## Healing process in skeleton and tendons

Fracture healing consists of three main phases: inflammation phase, regeneration phase and remodulation phase. Instantly after the injury a hematoma forms in the area of the fracture. The hematoma brings growth-factors and inflammatory cells. After 24 to 48 hours the regeneration phase starts with mesenchymal cells which later creates connective tissue, cartilage and, finally, bone. During this phase there is also a vascular growth, neovascularisation. After about 36 hours there is formation of woven bone, but there is no stability and it takes four to six weeks until callus forms and creates stability. The process of callus transforming into laminar bone takes several months to years (Zachary, 2012).

Tendons also heal in three phases: inflammation, cell- and matrix proliferation and remodeling with maturation. To avoid adhesions to surrounding tissue there should be some movement during the healing process. Movement during the healing process also increases the strength in the tendon. It takes a long time for a tendon to heal, and the phase of remodeling and maturation begins in approximately six to eight weeks past the injury (Zachary, 2012).

## Basics in orthopedic implants

Screws and plates are often used in orthopedic surgery, including pelvic fracture surgery. To understand the different surgical methods used as treatment of pelvic fractures there is a need to understand the basic principles of screws and plates.

### *Screws*

There are several types of screws depending on where they are used and what the purpose of the fixation is. There are screws used for cortical bone or cancellous bone. The screws used for cancellous bone have wider pitch, i.e. they are wider between the threads, than the screws used for cortical bone. Lag screws are used to create a pressure between two fracture fragments.

Different types of screws can work as a lag screw if inserted correctly. Some screws are self-tapping and some need manual tapping before inserting the screw. When the space is limited in the wound and there is a need to be certain that the screw is inserted correctly there is a screw with a hollow shaft within, where it is possible to use guiding instruments to insert the screw. These screws are called cannulated screws. A position screw is threaded all the way and prevents fragments from dislocating without creating pressure between the fragments. Position screws are often used in intraarticular fractures (Tobias & Johnston, 2012).

Screws can be used as the only fixation or together with a plate. When used together with a plate the screw can either create compression between the plate and bone due to lag, or lock onto the plate (Tobias & Johnston, 2012).

Depending on where the screw is placed and what type of movement it is supposed to prevent there is a large number of sizes of the screw, both in diameters and in length. Both screws and plates are made of 316L stainless steel or titanium (Tobias & Johnston, 2012).

### *Plates*

There are many shapes and sizes of plates, depending on the purpose with the plate and where it is used. The size of the plate is based on the screw used and the total amount of holes. The most common plate is a dynamic compression plate (DCP), which creates a pressure between the plate and the bone. There is a similar plate that is called limited contact dynamic compression plate which spreads the pressure all over the plate and prevents the pressure to center around the screws. There are cuttable plates that can be altered in length to optimize the fit, although these plates are weaker than non-cuttable plates. There are also plates that are softer than regular plates and can be shaped during surgery to fit the specific needs. These are called reconstructive plates and are preferred on bones like the pelvis, where perfect fit is difficult if the shape cannot be altered to match the contour of the bones. Locking compression plates (LCP) have a different configuration of the holes which makes it possible for the screws to lock into the plate. This makes the fixation more stable. One disadvantage of the LCP is that the screw has to be in 90 degrees angle to the long axis of the plate to lock to the plate, which can be difficult to achieve in the pelvic area due to the irregular shape of the bones (Tobias & Johnston, 2012). String of pearls (SOP) is another plate that is suitable for fixating pelvic fractures. SOPs is a locking plate that can be rotated and bent to create the best fit (Orthomed, 2017).

## Initial clinical presentation

The typical canine patient, with a pelvic fracture, shown in a previous study (Butterworth *et al.*, 1994) is male and younger than four years old. Another study (Denny, 1978) showed that 53% of the dogs injured were females and 60% of the dogs were younger than two years old, but the peak incidence was two to three years of age. The most common breeds injured were Jack Russel Terriers and crossbreeds. The typical feline patient is 2 years old, male and domestic shorthaired (Langley-Hobbs *et al*., 2009).

According to literature research the most common cause of all pelvic fractures is being hit by car or falling from high heights (Côté, 2015), which is confirmed in most of the clinical studies of pelvic fractures.

When arriving to the clinic the patient is usually presented with lameness or paralysis in one, or both, hind limbs (Côté, 2015). In some cases, the patient can support the hind limbs and it might be difficult to palpate an instability in the pelvis when the animal is awake. After sedation it might be easier to palpate an instability (Fossum Welch, 2013). Palpation of the pelvis can result in crepitation and pain. Manipulation of the hind limbs is often painful as well. Rectal exam can reveal a malalignment in the pelvic canal (Côté, 2015).

Most patients, as high as 76%, with a pelvic fracture suffer from multiple pelvic fractures, which means more than 3 fracture locations in the pelvis (Messmer & Montavon, 2004). In a study from 1978 (Denny, 1978) only 6% of the injured dogs suffered from soft tissue injuries related to their pelvic fractures previous to treatment, for example, sciatic nerve paralysis, ruptured urethra or urinary bladder, and abdominal hernia.

## Diagnostics

Diagnosis is determined by history, clinical exam and radiography or computed tomography (CT). Differential diagnoses are skeletal injuries in the spine and tail, injuries to the spinal cord, fractures in the hind legs or coxofemoral luxation (Côté, 2015).

A study performed 2015 in the United States (Stieger-Vanegas *et al.*, 2015) compared the accuracy of using radiography versus CT when evaluating pelvic fractures. The result showed that if the person interpreting the images was educated in CT evaluation the accuracy was 100%. If the person interpreting the CT images was not educated in CT evaluation it takes longer time to evaluate the fractures. There was better accuracy in evaluating fractures in the os pubis and os ischium in CT than in radiography. In other sites of the pelvis the accuracy was equal between CT and radiography.

## Initial treatment

Before beginning the treatment of the pelvic fracture, it is necessary to perform a neurological exam, and an evaluation of the urinary tract. Damage to the urinary bladder and to the urethra is associated with trauma to the pelvis (Fossum Welch, 2013).

Initial pain management is important. Avoid Non-Steroidal Anti-Inflammatory Drugs (NSAID) until the urinary tract and the status of the cardiovascular system are evaluated since NSAIDs are contraindicated when hypovolemia is present (Harasen, 2007).

## Choice of treatment

Many components matter in the choice of treatment. The whole situation must be taken into consideration. Even if the fracture is treatable there might be other injuries that the animal might not recover from. If everything is considered and the fracture is treatable the choice is between conservative or surgical treatment. Which treatment method is most suitable from a medical

view will be discussed below, but there are other components besides from the injuries that are important as well in the choice of treatment.

Factors that matter in treatment of pelvic fractures are the age of the animal, weight of the animal, area of use of the animal and future demands on function (Innes & Butterworth, 1996). If it is an elderly animal there is a risk there are elderly changes in, for example, the liver and kidneys that increase the risk of anesthesia. In the case where anesthesia is not recommended conservative treatment might be a better option. Obesity might result in increased loading of the limbs, and therefore the fracture, during a conservative treatment.

The time since the injury also matters in deciding what treatment to choose. Surgical treatment is recommended within seven to ten days since the injury (Innes & Butterworth, 1996) but the optimal time range for surgical treatment is within 48 to 72 hours (Harasen, 2007). If the fracture is intraarticular the surgical treatment should be completed as soon as the animal is stabilized to avoid complications (Tobias & Johnston, 2012). The animal owner's private economy is also a matter to be considered (Innes & Butterworth, 1996).

## Methods of treatment

### *Conservative treatment*

The pelvis is surrounded by large muscles that can stabilize eventual fractures which provides the option to treat these fractures conservatively (Harasen, 2007). Conservative treatment can be an option for cats or small dogs. Conservative treatment is not recommended for all pelvic fractures. Fractures that can successfully be treated conservatively are fractures in the os ischium, os pubis and os ilium cranially to the SI joint (Côté, 2015). The fracture must not be severely dislocated if conservative treatment is considered (Fossum Welch, 2013). A recent study (Meeson & Geddes, 2017) showed that only 26% of the cats with pelvic fractures were treated conservatively.

Initially conservative treatment consists of strict rest (cage rest) for three to four weeks. The initial strict rest is followed by controlled movement until four to eight weeks has passed since the injury (Côté, 2015; Fossum Welch, 2013). A resting period of four weeks was evaluated in a previous study (Denny, 1978) where they also compared fractures of the ilium, SI luxation fractures and fractures of the acetabulum, which were treated conservatively to the same fractures treated surgically. Function of the hind limbs were evaluated by the animal owner through a questionnaire. Of the patients with ilium fractures treated conservatively 14 of 17 regained full function of the hind limbs according to the owner. Of the patients with SI luxation fractures five of six regained full function of the hind limbs with conservative treatment. Of the patients with acetabular fractures 10 of 17 regained full function of the hind limbs according to the owner with conservative treatment. Although, a surgical treatment of the fracture in acetabulum shortens the period of convalescence and decreases the risk of chronic osteo-arthritis.

In the literature, fractures of the acetabulum require surgical treatment to heal properly. Nevertheless - a review (Butterworth *et al.*, 1994) of 34 patients with acetabular fractures

evaluated conservative treatment and 38% of these cases were treated conservatively. The result was evaluated by the owners in a questionnaire. All cases treated conservatively recovered successfully and 76% of those treated surgically recovered successfully. Successful treatment allowed mild intermittent lameness. There was a lack of information about recovery in some cases, which makes these figures uncertain.

### *Surgical treatment*

Surgical treatment is often necessary when fractures cause a dislocation in the acetabulum, os ilium, SI joint or sacrum (Côté, 2015). These structures are involved in the weight bearing axis. A dislocation of the pelvis cannot occur without bilateral SI joint luxation and/or fractures in at least three different sites of the pelvis, where SI joint luxation is counted as a fracture. Surgical treatment often results in shorter period of convalescence (Fossum Welch, 2013). When SI joint luxation occurs the most common direction of displacement of the ilium is craniodorsally (DeCamp *et al.*, 2016). In a previous study (Meeson & Geddes, 2017) 60% of the SI joint fractures, 82% of the ilial fractures, 58% of the acetabular fractures and 3% of the pubic fractures were treated surgically in cats.

#### *Fractures of the SI joint*

There are two open reduction approaches to the SI joint: dorsolateral approach or ventral approach. The dorsal approach can be used if there is a fracture of the acetabulum on the same side that also needs surgical fixation. The ventral approach can be used if there is a fracture in the ilium on the same side that needs surgical fixation. Fixation of the SI-joint is achieved by one or two lag screws through the body of ilium into the sacrum (DeCamp *et al.*, 2016).

In a review of six dogs that were treated surgically (Denny, 1978) the fracture was stabilized using lag screws and in two cases lag screws combined with pins. These patients regained full function in the fractured hind limb.

There is also a study reporting that closed reduction using lag screws is a considerable treatment option (Tomlinson *et al.*, 1999). The surgical technique was based on IM pins, Kirschner wires and intraoperative fluoroscopy to identify the correct insertion site for the lag screw and to temporary stabilize the fracture during lag screw insertion. A single lag screw was used and were anchored in the sacrum. The technique gives less soft tissue trauma than an open approach. Only one dog of 13 examined suffered from complications such as screw loosening and persistent ischiatic nerve damage, but, this dog did not follow the post-operative regime. This approach allows earlier use of the limb than an open approach. A more recent study evaluating closed reduction approach (Tonks *et al.*, 2008) shows the same result, but only radiographic follow-up was performed. Three of 24 dogs suffered from screw loosening, mostly as the result of osteomyelitis and were treated with antibiotics. All the 24 dogs had healed properly on follow up radiographs.

#### *Fractures of the ilium*

The open approach to the ilial body is the same as the ventrolateral approach to the SI joint. Fixation of the fracture can be achieved in several ways. The most common fixation is by plate.

What type of plate depends on the space available. Preferable is a six-holes straight plate, where one or several screws can be inserted into the sacrum to increase the strength of the fixation. If there is not enough space for two screws in the caudal segment a T-shaped, a L-shaped or a reconstruction plate might be used instead. To prevent narrowing of the pelvic canal due to the ilial fracture, the plate must be bent more concave than the usual shape of the pelvis (DeCamp *et al.*, 2016).

Locking T-plates were evaluated in cats and small dogs (Scrimgeour *et al.*, 2017) with the result of no case with screw loosening, compared to standard compression plate where 50% of the cases reported screw loosening.

DeCamp *et al.* (2016) describes two other techniques also used for ilial body fractures. The fracture can be fixated using lag screws. If the animal is too small and lag screws cannot be used, they can be substituted with pins and compression wire.

A study of cats with ilial fractures (Langley-Hobbs *et al.*, 2009) also described a dorsal approach to the ilium. In both the lateral approach and the dorsal approach, a plate was used for fixation. These two approaches were compared in the study. The authors concluded that dorsal plating might result in lower the risk of narrowing of the pelvic canal. Dorsal plating also resulted in fewer implant-associated complications.

### *Fractures of the acetabulum*

Open reduction and fixation are achieved by a dorsolateral approach to the hip joint. It might be necessary to perform an osteotomy of the greater trochanter to provide a proper view of the joint. Bone plates and screws tend to have the best result. Type of plate depends on the fracture, commonly used are straight-, reconstruction-, cuttable-, acetabular- and small fragment plates. Lag screws may also be used, depending on the type of fracture. If the animal is too small for a plate or lag screws, tension band wire in combination with pins and Kirschner wire can be used instead, but this is not as stable as lag screws or plates (DeCamp *et al*., 2016).

In a review of 14 dogs with fractures of the acetabulum (Denny, 1978) the fracture was reduced with two lag screws or a plate, depending on what part of the acetabulum that was injured. Lag screws were used if the fracture originated from the ilium and continued through the acetabulum.

If the acetabulum fracture cannot be reduced or fixated in a proper way and there is a high risk of osteoarthritis development, a femoral head and neck ostectomy can be considered. This is considered an acceptable treatment method for small dogs and cats. The surgery is performed through a craniolateral approach to the hip joint. Luxation of the hip joint is necessary to be able to proceed with the ostectomy of the femoral head and neck. After an ostectomy physical therapy should be started instantly to provide the best use of the limb and minimize post-surgical muscular atrophy. Known complications are persistent lameness, limb shortening, muscle atrophy, decreased range of motion and patellar luxation (Tobias & Johnston, 2012).

*Other fractures of the pelvis*

Fractures of the os ischium and os pubis are often stable without fixation if there are no other fractures, or if the other fracture involving the weight bearing axis is fixated and stable. These kinds of fractures rarely need surgical treatment (DeCamp *et al.*, 2016).

A study of 10 cats (Kipfer & Montavon, 2011) showed successful outcome in surgical reduction of pelvic floor fractures (fracture of pelvic symphysis, os pubis or os ischium). The study suggests that in cases where a SI joint luxation is difficult to reduce it might help to stabilize the pelvic floor before reducing the SI joint luxation. Fixation of these fractures also reduce pain during recovery. Fixation can also be used to prevent narrowing of the pelvic canal.

### *Postoperative care*

If the patient is non-ambulatory in the hind limbs post-surgery a schedule for turning the patient is necessary to prevent decubital ulcers (DeCamp *et al*., 2016).

After surgery the animal should be supported by abdominal support when moving and have restricted and controlled movement for one to two months (Côté, 2015; Fossum Welch, 2013), but other sources claim that the patient should have controlled movement which increases slowly during a period of three weeks (Fossum Welch, 2013). Early movement is better for healing, but to allow this the fracture must be completely stable and the exercise controlled. If the owner cannot follow the directions it is better to prevent the animal to use the injured side for one to two weeks initially, this can be achieved through using an Ehmer sling for example. If the patient has problem with adduction a sling to prevent abduction might be necessary for the first week (DeCamp *et al.*, 2016).

During this period pain management using NSAID can be used if indicated (Côté, 2015) (Fossum Welch, 2013). During this period, it is also important to monitor defecation and treat with laxative if the patient have problems with defecation (Fossum Welch, 2013).

## Complications and prognosis

There are complications associated with pelvic fractures overall, but there are also complications that are specific for where the fracture is located – these are described below.

Possible complications to a pelvic fracture can be an uneven healing of the fracture if the fracture fragments are not well aligned and have not been fixated correctly. A malaligned healing could result in narrowing of the pelvic canal which can cause obstipation or dystocia. There might also be damage to the urethra, therefore it is very important to monitor the patients urinating behavior (Côté, 2015). Problems with defecation could also result from narrowing of the pelvic canal, soft tissue swelling or pain.

A gait analysis using a pressure-sensing walkway in dogs with pelvic fractures treated conservatively was performed after a minimum of four months after injury (Vassalo *et al*., 2015). The study showed that 73,3% of the dogs had a visual lameness and 66,7% of the dogs had an abnormal weight distribution between the limbs or showed kinetic changes. Thirty-three

percent of the dogs showed signs of pain or restricted movement when passively extending the hip joint.

### *Fractures of the SI joint and the ilium*

The femoral nerve and the sciatic nerve are located near the SI joint and the nerves might be affected by a fracture (Fossum Welch, 2013). One study of peripheral nerve injuries in patients with pelvic fractures (Jacobson & Schrader, 1987) showed that the most common fractures associated with peripheral nerve injuries were ilial fractures with displacement of the fragments and luxation of the SI joint. Persistent neurological deficit in the caudal part of the body is a known complication, likewise, is persistent lameness in the hind limbs (Côté, 2015). Neurological deficits might occur when a fracture in the sacrum crosses the canalis vertebralis or crosses the sacral foramina (Fossum Welch, 2013).

In a review of 11 dogs with ilium fractures treated surgically (Denny, 1978), 10 dogs regained full function of the hind limbs. The 11$^{th}$ dog suffered from persistent peroneal nerve paralysis. In a study of 10 cats with ilial fractures (Langley-Hobbs *et al*., 2009) only one cat had persistent neurologic deficits. In a more recent study (Meeson & Geddes, 2017) 23% of the cats had neurological deficits at initial presentation, but 79% of these had regained full neurological function after six months.

### *Fractures of the acetabulum*

If the acetabulum is fractured there is a known risk of development of osteoarthritis due to incongruence in the joint. In a study from 2015 (Vassalo *et al*., 2015) all dogs with intraarticular fractures had radiological signs of osteoarthritis.

In a review of 14 dogs with acetabular fractures treated surgically (Denny, 1978), nine regained full function of the hind limbs. Those who did not regain full function suffered from intermittent lameness and persistent sciatic nerve paralysis.

### *Fractures of the os pubis and os ischium*

If os pubis is fractured there is a risk of abdominal hernia if the fragments are dislocated or due to an avulsion in the tendons attaching to os pubis (Côté, 2015).

### *Difference in recovery between surgical and conservative treatment*

In an old review by Denny (1978), 123 dogs with pelvic fractures were evaluated. There was a small difference in recovery in patients treated surgically compared to those treated conservatively. Seventy-eight percent of the patients treated surgically had a full recovery, versus 75% of the patients treated conservatively had a full recovery.

## MATERIAL AND METHODS

The thesis is based on three different parts: a review of patient records, owner questionnaires about pain and life quality after pelvic fracture and a clinical study. These three parts are described in detail below.

### Review of patient records

Review of patient records consists of a retrospective study of patients treated for pelvic fractures at the University animal hospital, Uppsala, between the years 2007 to 2017. Data was collected containing information on what type of fracture, the cause of the fractures, to what extent animals are euthanized because of the fractures, other injuries associated with pelvic fractures and the treatment method. Based on the journal studies patients were selected to participate in the questionnaires and the clinical study.

When collecting information about the type of fractures that occur the fractures were classified depending on the area of the pelvis that were fractured, but also if it was a unilateral fracture or a bilateral fracture. The areas were: ilium wing, ilium body, SI joint, acetabulum, os pubis, pelvic symphysis and os ischium. Fractures of the sacrum were not included in the study, but all fractures and soft tissue injuries in the patient presented with the pelvic fracture were reported as well.

**Inclusion criterium to participate in the questionnaire and the clinical study:**

- The patient is a dog or a cat.
- The patient suffered from pelvic fracture in the time between the years 2007 to 2017 and was treated at the University animal hospital in Uppsala.
- Diagnostic imaging of the pelvis was performed at the University animal hospital in Uppsala on the initial visit.
- The patient has not had any leg amputated and has not had a femoral head and neck ostectomy. These procedures change the normal pattern of movements, and the gait can therefore not be analyzed to determine if there is a change in movement because of the pelvic fracture.
- Cats younger than 15 years, small dogs younger than 13 years and large dogs younger than 10 years were included in the owner questionnaires and a clinical follow up study.
- Contact details to the owner of the animal are available and the owner does not have protected contact details.

Twenty-three dogs and 59 cats fulfilled the inclusion criteria. The owners were sent a letter including information about the study and were asked to answer the questionnaire and participate in the clinical study. The letters are found in Appendix 1. Out of 23 dogs 12 owners decided to participate in both the questionnaire and the clinical study, and four decided to only participate in the questionnaire. Out of 60 cats, 13 owners decided to participate in both the questionnaire and the clinical study. Eight cat owners only participated in the questionnaire and declined the invitation to the clinical study. Eight cat owners reported their cat dead or missing and could not answer the FMPI. These eight cat owners evaluated the result of the treatment outside the FMPI.

## Questionnaires

Part two of the thesis consists of owner-based questionnaires. To participate in this part of the study the patients needed to fulfill the inclusion criteria's stated above. The questionnaires provided information about the animal's quality of life after treatment of a pelvic fracture, based on the owner's experiences. The questionnaires also provided information about complications and how common these are in the long term. The questionnaires used are found in Appendix 2. Dogs and cats are different in their behavior, in their movement, and how they live. Therefore, there are two different questionnaires, one directed to dog owners and one directed to cat owners. Both the questionnaires are validated. The result of the questionnaires was translated into values which are comparable between the cats and dogs.

The American College of Veterinary Surgeons Canine Orthopedic Index has been validated by Brown as described, translated and validated in Swedish by Andersson and Bergström (2019). The questionnaire used for the cats is called Feline Musculoskeletal Pain Index (FMPI) and is created by Dr D. Lascelles as described and translated by Sarah Stadig in her doctoral thesis "Evaluation of physical dysfunction in cats with naturally occurring osteoarthritis" (2017).

### *Questionnaire feline*

Maximum score was 85, and the higher the score the poorer quality of life after the pelvic fracture. Total score of 17 means the patient recovered completely from the pelvic fracture and had the best quality of life possible. Quality of life (QOL) was scored outside the total score. Zero equals good quality of life. Maximum score in QOL is 3 and equals poor quality of life. If a question was not answered the total score was reduced with four points per question not answered. A relative score was calculated in percent, the lower score the better result. In the FMPI the relative score was the result of the total score and the QOL score combined. Relative score 20,0% equals normal life, these figures are comparable between the FMPI and the canine orthopedic index (COI) questionnaire. A score lower than 20,0% equals better than normal in some questions.

### *Questionnaire canine*

Maximum score was 80 and 16 was the lowest score possible if all questions were answered. If a question was not answered the total score was reduced with four points per question not answered. Low scores equal a life with low levels of stiffness, pain, problems with movement and in function, and a good quality of life. The lowest relative score was 20% and indicates that there was no stiffness, decreased function, impairment in movement and equals good quality of life.

## Clinical study

To proceed to clinical study the participant needed to fulfill the inclusion criteria's and answer the questionnaire. The clinical study consisted of a general health exam, orthopedic exam and neurological examination of the hind limbs. The examination sought to determine if the patient had regained full function in the hind limbs after treatment, or if the patient suffered from

orthopedic or neurological disabilities due to the injury. Description of the clinical examination is found in Appendix 3.

The patient received a grade from 0 to 3, where 0 equals normal, 1 equals mildly abnormal, 2 equals moderately abnormal and 3 equals severely abnormal in the areas examined (these areas are found in Appendix 3). The total score estimated how well the animal recovered after the pelvic fracture. The same grading system was used on both cats and dogs. If the patient suffered from other injuries or diseases, for example osteoarthritis, it was considered when interpreting the result.

### IT-security

According to GDPR the participants need to be informed about IT-security. In the survey the owners could choose to not share their phone number or email address, and they were informed about what the information was needed for. The information was collected to be able to contact the owners for a follow up examination. Before the follow up examination the owners received information about IT-security as follows in Swedish:

"Persondatan som samlats in syftar till att kunna länka patienten i fråga till rätt journal och för att kunna kalla patienten till ett återbesök. När studien är klar raderas all information berörande personuppgifter. Inga uppgifter kommer lämnas ut i den slutgiltiga rapporten som kan länka patienten till dess ägare".

## RESULTS

### Review of patient records

There were 196 cases diagnosed with pelvic fractures at the University animal hospital at the Swedish University of Agriculture Sciences between the years 2007 to 2017. Out of these 196 cases 150 were cats and 46 were dogs.

- 58 cats matched the inclusion criteria's for participating in the questionnaires.
- 92 cats did not match all the inclusion criteria's and were not offered to participate in the questionnaires and the clinical study.
- 23 dogs matched the inclusion criteria's to be participating in the questionnaires.
- 23 dogs did not match all the inclusion criteria's and were not offered to participate in the questionnaires and the clinical study.

#### *Causes to pelvic fractures*

The most common cause of pelvic fractures was the patient being hit by a motor vehicle, for example a car, a motorcycle or a train, and the cause in 97 patients out of 196. There was lack of information in many cases, for example cats disappeared and came back injured a couple of days later. The owners often thought the cause of the injury was hit by car on a nearby road. Other common reasons to pelvic fractures were falling from heights or injured by another animal (for example dog, horse or wild boar). See detailed proportions in Table 1.

Table 1. *Cause of pelvic fractures in cats and dogs*

| Cause of pelvic fracture | Cats (%) | Dogs (%) | Total (%) |
|---|---|---|---|
| Unknown | 74 (49,3) | 2 (4,3) | 76 (38,8) |
| Hit by motor vehicle | 63 (42,0) | 34 (73,4) | 97 (49,5) |
| Falling from height | 9 (6,0) | 2 (4,3) | 11 (5,6) |
| Injured by animal | 0 | 5 (10,9) | 5 (2,6) |
| Pathologic fracture | 3 (2,0) | 0 | 3 (1,5) |
| Jumped over fence | 0 | 1 (2,2) | 1 (0,5) |
| Item falling on the animal | 1 (0,7) | 1 (2,2) | 2 (1,0) |
| Traffic road accident | 0 | 1 (2,2) | 1 (0,5) |
| Total | 150 (100) | 46 (100) | 196 (100) |

#### *Age, sex and breed related to pelvic fractures*

Median age amongst the cats was two years of age and 51,3% of the cats injured were zero to two years of age. The most common age was one-year old cats. 32% of the cats were between three to six years old and only 6,7% were older than 10 years of age. The oldest cat presented with a pelvic fracture was 17 years of age.

Median age amongst the dogs was two years old and 60,9% of the dogs injured were zero to two years of age. 30,4% of the dogs were between three to six years old and only 4,3% were older than 10 years of age. The oldest dog presented with a pelvic fracture was 13 years of age. Detailed distribution is shown in Figure 1.

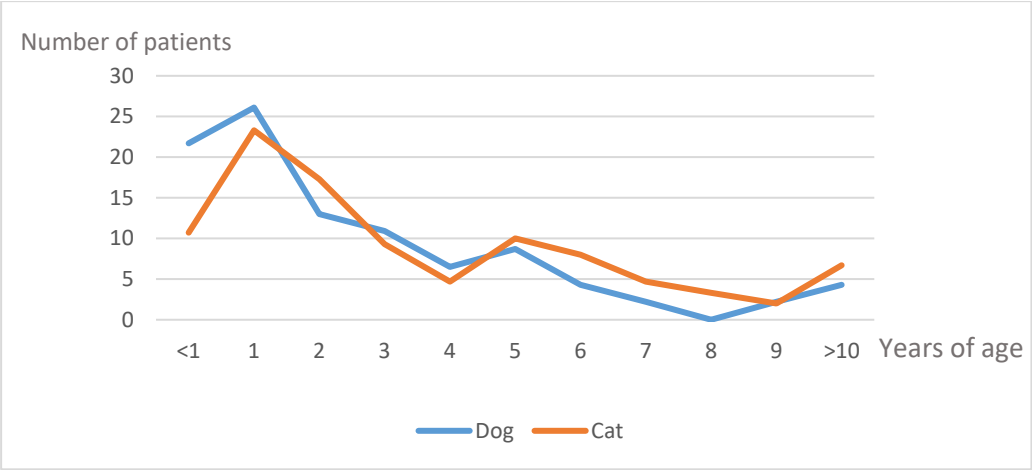


Figure 1. *Ages amongst cats and dogs presented with a pelvic fracture.*

Table 2 describes the distribution between the sexes.

Table 2. *Sex of the cats and dogs that suffered from pelvic fractures*

| Sex | Cats (%) | Dogs (%) | Total (%) |
|---|---|---|---|
| Female | 25 (16,7) | 27 (58,7) | 52 (26,5) |
| Neutered female | 49 (32,7) | 2 (4,3) | 51 (26,0) |
| Male | 19 (12,7) | 14 (30,4) | 33 (16,8) |
| Neutered male | 56 (37,3) | 3 (6,5) | 59 (30,1) |
| Not specified | 1 (0,7) | 0 | 1 (0,5) |
| Total | 150 (100) | 46 (100) | 196 (100) |

The most common cat breed with a pelvic fracture was the domestic shorthaired or longhaired cat (84,7%). Only 15,3% of the cats were pure bred and the most common breeds were Norwegian forest cat, Abessiner and Cornish Rex. Other injured breeds were Birma cat, Siamese, Maine Coon, Ocicat, Siberian cat, Sphynx, Bengal and Ragdoll.

The most common dog breed with pelvic fractures was the mixed breed (26,1%). Jack Russel Terrier was presented with 13,0%, followed by Dachshund (8,7%) and German shepherd (6,5%). Other injured breeds were Basset fauve de Bretagne, Golden retriever, Miniature poodle, Poodle, Cairn terrier, Norwegian moose dog, Danish-Swedish yard dog, Mittelspitz, Collie, Bichon frisé, Swedish white moose dog, Border collie, Australian kelpie, Vorsteh, Papillon, Basenji and Chihuahua.

### *Clinical presentation*

On arrival to the clinic a clinical examination was performed. Reported clinical signs were noted in the patient's record. Table 3 shows the clinical signs associated with initial arrival to the clinic of cats and dogs with pelvic fractures. The most commonly occurring clinical signs were decreased general condition and pain on palpation of the pelvis. Lameness in both hind limbs were slightly more common than lameness in one hind limb, although almost a quarter (23,5%) of the cats and dogs that did not show any signs of lameness.

Table 3. *Clinical signs of cats and dogs presented with pelvic fractures*

| Clinical sign | Number of cats (%) | Number of dogs (%) | Total (%) |
|---|---|---|---|
| Abnormal breathing pattern | 21 (14,0) | 2 (4,3) | 23 (11,7) |
| Shock | 13 (8,7) | 9 (19,6) | 22 (11,2) |
| Decreased general condition | 84 (56,0) | 29 (63,0) | 113 (57,7) |
| Pain | 46 (30,7) | 16 (34,8) | 62 (31,6) |
| Pain on pelvic palpation | 70 (46,7) | 14 (30,4) | 84 (42,9) |
| Pain on manipulation of the hind limbs | 35 (23,3) | 14 (30,4) | 49 (25,0) |
| Crepitation of the pelvis/hip joint | 33 (22,0) | 8 (17,4) | 41 (20,9) |
| Lameness one hind limb | 43 (28,7) | 22 (14,7) | 65 (33,2) |
| Lameness both hind limbs | 60 (40,0) | 12 (2,1) | 72 (36,7) |
| Paraparesis | 11 (7,3) | 2 (4,3) | 13 (6,6) |
| Decreased proprioception of the hind limbs | 9 (6,0) | 5 (10,9) | 14 (7,1) |
| Decreased reflexes of the hind limbs | 13 (8,7) | 5 (10,9) | 18 (9,1) |
| Decreased pain sensitivity in one or both hind limbs | 16 (10,7) | 3 (6,5) | 19 (9,7) |
| Decreased perineal reflex | 9 (6,0) | 1 (2,2) | 10 (5,1) |
| Decreased pain sensitivity or motility of the tail | 25 (16,7) | 2 (4,3) | 27 (13,8) |

Other orthopedic injuries presented at the same time as the pelvic fractures amongst cats were 26 cases of fractures of the hind limbs, 18 cases of fractures of the sacrum and 11 cases of fractured tails. Other less common orthopedic injuries presented at the same time as the pelvic fracture in cats were fractured ribs, fractures of the spine, ruptured cruciate ligament and fractured front limbs.

In dogs, common orthopedic injuries presented at the same time as the pelvic fracture were fractures of the spine, sacrum and hind limbs. Other concurrent injuries were fractures of the ribs and rupture of cruciate ligament or collateral ligaments.

Soft tissue injuries presented at the same time as the pelvic fracture were almost the same in cats and dogs. The most common soft tissue injuries were skin wounds, trauma to the thorax (i.e. pneumothorax or bleeding in the lung) and bleedings, both internal and external. Only three cats and two dogs were presented with abdominal wall hernia and one cat presented with a diaphragmatic hernia. Seven cats had either urinary incontinence or urinary bladder atony, but only two of these had suspicion of a ruptured urinary bladder. One cat and one dog also had nerve damage in one of the front limbs.

### *Type of fractures*

The most commonly occurring fractures amongst cats were SI joint luxation followed by fractures of the pelvic floor. Amongst dogs the most commonly occurring fracture were fractures of os pubis followed by fractures of the ischium. Amongst fractures involving weight-

bearing axis fractures of the ilium body was the most common type in dogs. In dogs 44,8% of the fractures were left sided and 31,2% were right sided. Cats had almost the same amounts of fractures in either side of the pelvis, 38,2% right sided and 32,9% left sided. Bilateral fractures were less common than unilateral fractures, 16,2% in cats and 19,2% in dogs. Two cats were diagnosed with pelvic fracture on clinical examination and then euthanized, therefore, no further information on fracture type was available. Detailed distribution is showed in Table 4.

Table 4. *Type of pelvic fractures in cats and dogs*

| Fractured area | Unilateral | | Sinister | | Dexter | | Bilateral | | Total (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cat | Dog | Cat | Dog | Cat | Dog | Cat | Dog | Cat | Dog |
| Os pubis | 76 | 29 | 32 | 17 | 36 | 12 | 24 | 10 | 100 (67,1) | 39 (84,8) |
| Os ischium | 90 | 27 | 42 | 17 | 40 | 10 | 12 | 9 | 102 (68,5) | 36 (78,3) |
| Pelvic symphysis | 28 | 4 | - | - | - | - | - | - | 28 (18,8) | 4 (8,7) |
| Ilium wing | 7 | 3 | 1 | 1 | 6 | 2 | 0 | 1 | 7 (4,7) | 4 (8,7) |
| Ilium body | 43 | 17 | 22 | 12 | 22 | 4 | 2 | 0 | 46 (30,9) | 17 (37,0) |
| SI joint | 75 | 9 | 32 | 3 | 40 | 5 | 30 | 4 | 107 (71,8) | 13 (28,3) |
| Acetabulum | 27 | 12 | 9 | 6 | 16 | 6 | 2 | 0 | 29 (19,5) | 12 (26,1) |

One cat was counted twice due to suffering from pelvic fractures twice and the two cats with no radiological diagnosis were excluded (149 cats in total).

In cats 75,8% had three or more fractures of the pelvis and in dogs 69,6% had three or more fractures of the pelvis.

SI joint luxation was recorded in 71,8% of the cats and 28,3% of the dogs (Table 5). The most commonly occurring direction of the luxation in cat was cranial luxation (81,6%). Other directions reported in cats were craniolateral (5,7%), craniomedial (2,3%), cranioventral (2,3%), caudal (2,3%), caudodorsal (1,1%), dorsal (1,1%), ventrolateral (1,1%), caudolateral (1,1%) and craniodorsal (1,1%). In dogs the most common direction of the luxation was, like in cats, cranial luxation (81,8%). Other directions of SI luxation in dogs were craniodorsal luxation (9,1%) and caudal luxation (9,1%).

### *Treatment of pelvic fractures*

Between 2007 and 2017, 150 cats were presented with pelvic fractures, one of these cats suffered from pelvic fractures twice and therefore the following numbers count 151 cats. Of these 151 cats 70 were treated conservatively and 14 were treated surgically. Some of the cats treated conservatively had surgery to the tail or limbs due to other concurrent injuries. Sixty-seven cats died or were euthanized due to their pelvic fracture. One cat had no medical record else than the radiological evaluation and therefore there was no information about treatment. In the same period 46 dogs were presented with pelvic fractures. Of these 46 dogs 19 dogs were treated conservatively and 18 dogs were treated surgically. Nine dogs were euthanized due to their pelvic fracture.

*Euthanasia related to pelvic fractures*

Seventy-six animals were euthanized or died due to their pelvic fractures. In 15 of the cases studied the reason for euthanasia was not stated in the patient record. The most common reason for euthanasia in both cats and dogs was related to poor prognosis for recovery. Figure 2 below describes the causes of euthanasia in patients with pelvic fractures.

Sixty-five cats of total 151 cats suffering from pelvic fractures were euthanized. The most common reason for euthanasia was poor prognosis (40,0%) and the second most commonly known reason for euthanasia due to pelvic fractures in cats was due to the owner's economy (15,4%). There were four reasons for euthanizing cats with a pelvic fracture that did not occur amongst the dog population: the owner declined surgery or amputation, due to factors concerning the owner's current living situation, due to animal welfare or due to concern that the animal was too old to undergo treatment. Two additional cats died during treatment and could not be saved.

In total there were nine dogs that were euthanized out of total 46 dogs suffering from pelvic fractures. The most common reasons for dogs to be euthanized were poor prognosis (33,3%) and that the dog could not go through rehabilitation and get back to its normal activities, such as hunting (22,2%). Only one dog was euthanized because of the owner's economy (11,1%). No dog died during treatment and none were euthanized because of animal welfare considerations.

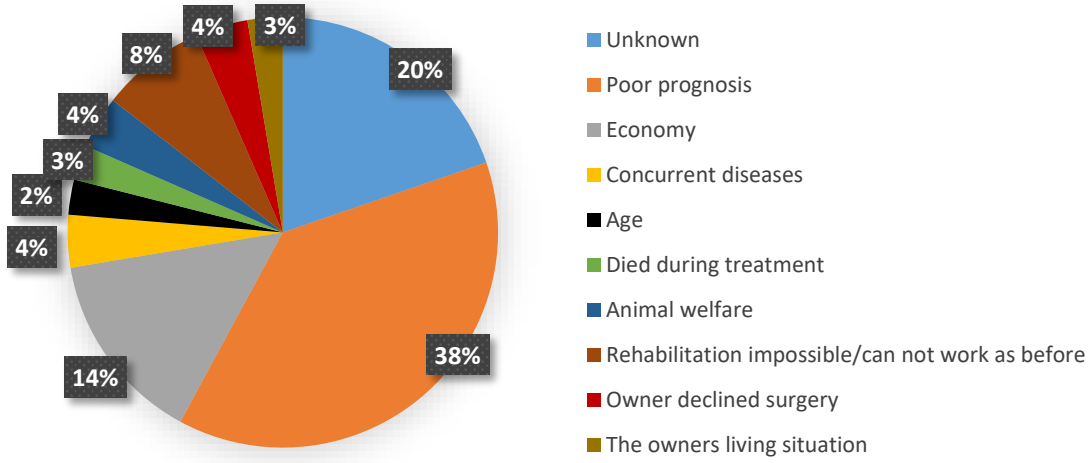


Figure 2. *Reasons for euthanasia due to pelvic fractures in cats and dogs.*

*Conservative treatment*

During the stated period of time 70 cats out of 151 were treated conservatively. Figure 3 combined with Table 5 describes the fracture combinations that were treated conservatively. In cats 100% of the ilial wing fractures were treated conservatively. Ilium body fractures were treated conservatively in 85,7% of the cases. SI joint luxation were treated conservatively in 93,2% of the cases. Acetabulum fractures were treated conservatively in 25,0% of the cases. Fractures of os pubis, the symphysis and os ischium were treated conservatively in 100% of the cases.

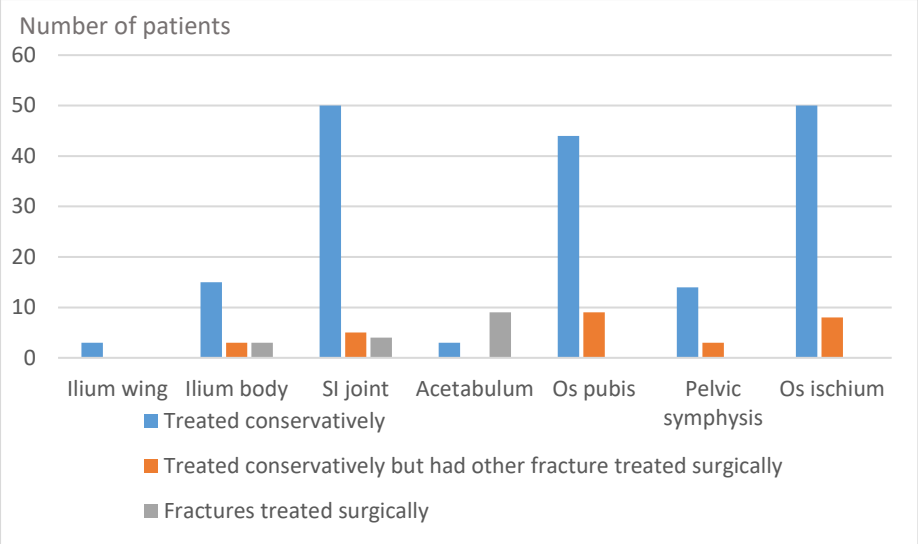


Figure 3. *Diagnosed fracture types treated conservatively in cats.*

During the same period of time 19 dogs out of 46 were treated conservatively. Figure 4 combined with Table 6 describes the fracture combinations that were treated conservatively. Fractures of the ilial wing were treated conservatively in 100% of the cases. Fractures of the ilium body were treated conservatively in 46,2% of the cases. Fractures of the SI joint were treated conservatively in 60,0% of the cases. Fractures of the acetabulum were treated conservatively in 20,0% of the cases. Fractures of the os pubis, symphysis and os ischium were treated conservatively in 100% of the cases.

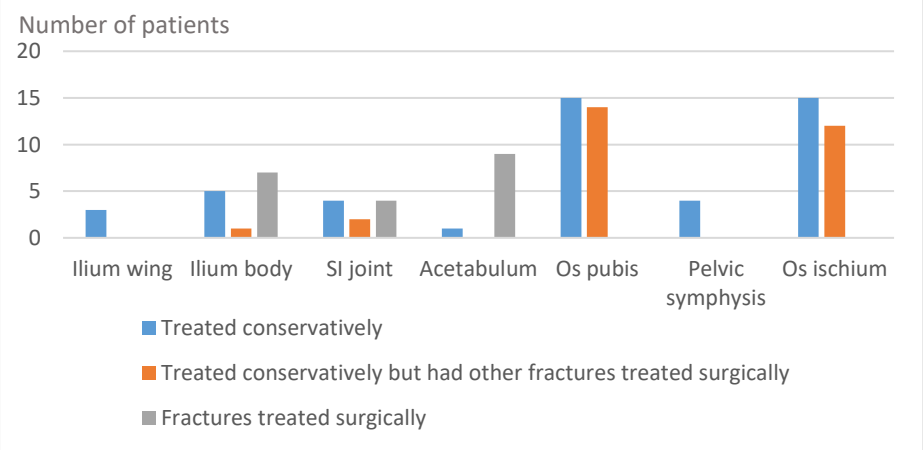


Figure 4. *Diagnosed fracture types treated conservatively in dogs.*

### *Surgical method used in the cases treated surgically*

During the stated period of time 14 of 151 (9,3%) cats had pelvic fractures that were treated surgically. Table 5 describes the fractures in cats and the surgical method used. During the same period of time 18 of 46 (39,1%) dogs had pelvic fractures that were treated surgically. Table 6 describes the fractures in dogs and what surgical method that was used. Fractures of the ilium wing, os pubis, pelvic symphysis and os ischium were not treated surgically in any case during this period.

Fractures of the ilium body were surgically treated in three cats and seven dogs, 14,3% of the ilium body fractures in cats and 53,8% of the ilium body fractures in dogs. Fractures of the ilium were surgically fixated with a plate in 100% of the cases in cats. In dogs three ilium fractures were fixated with a DCP, one fracture was fixated with a SOP, one fracture was fixated with a LCP, one fracture was fixated with a reconstruction plate and one fracture was fixated with a screw.

Fractures of the SI joint were surgically fixated in four cats and four dogs, 6,8% of the SI joint fractures in cats and 40,0% of the SI joint fractures in dogs. In cats two SI joint fractures were fixated with cortical screws, one fracture was fixated with a pin and a nylon line and one fracture was fixated with a lag screw. In dogs one fracture was fixated with a lag screw, one was fixated with a cancellous screw, one fracture was fixated with a cortical screw and one was fixated with a lag screw combined with a trans-ilial pin. Only in one case a bilateral fracture was surgically treated bilaterally.

Fractures of the acetabulum were surgically treated in nine cats and nine dogs, 75,0% of the fractures in cats and 90,0% of the fractures in dogs. In cats seven acetabular fractures were treated with femoral head and neck ostectomy. One was treated with a pin and cerclage, and one fracture was treated with only cerclage. In dogs three fractures were treated with a SOP. Three fractures were treated with a femoral head and neck ostectomy. One acetabular fracture was treated with a C plate and one fracture were treated with a LCP. One fracture was treated with a femoral head and neck ostectomy in combination with a cerclage.

Table 5. *Fracture type and surgical treatment of cats. "x" represents one sided fracture and. "xx" bilateral fracture. "**BOLD**" shows which fractures were treated surgically. Total C shows the total number of fractures treated conservatively and total S shows the total number of fractures treated surgically*

| Cat | Fracture | | | | | | | Surgical treatment |
|---|---|---|---|---|---|---|---|---|
| | Ilium wing | Ilium body | SI joint | Acet-abulum | Pub-is | Sym-physis | Isch-ium | |
| 126 | | | **XX** | | xx | | xx | Pin and nylon line |
| 130 | | **X** | | | x | | x | Plate |
| 131 | | | X | **X** | x | | x | Pin and a cerclage |
| 132. 2 | | **X** | | **X** | | x | | Ilium: plate. Acetabulum: cerclage |
| 137 | | x | | **X** | x | | | Femoral head and neck ostectomy |
| 138 | | **X** | X | **X** | xx | | xx | Femoral head and neck ostectomy. Ilium: plate |
| 139 | | | | **X** | xx | x | | Femoral head and neck ostectomy |
| 140 | | | | **X** | | | | Femoral head and neck ostectomy |
| 145 | | | x**X** | | x | | x | Lag screw |
| 154 | | | x**X** | | | | | Cortical screw |
| 158 | | | **X** | | | x | x | Pin and cortical screw |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 168 | | x | X | **X** | | | x | Femoral head and neck ostectomy |
| 169 | | x | X | **X** | x | | | Femoral head and neck ostectomy |
| 170 | | | X | **X** | x | | x | Femoral head and neck ostectomy |
| Total C | 0 | 3 | 5 | 0 | 9 | 3 | 8 | |
| Total S | 0 | 3 | 4 | 9 | 0 | 0 | 0 | |

Table 6. *Fracture type and surgical treatment of dogs. "x" represents one sided fracture and "xx" bilateral fracture. "**BOLD**" shows which fractures were treated surgically. Total C shows the total number of fractures treated conservatively and total S shows the total number of fractures treated surgically*

| Dog | Fracture | | | | | | | Surgical treatment |
|---|---|---|---|---|---|---|---|---|
| | Ilium wing | Ilium body | SI joint | Aceta-bulum | Pubis | Symp-hysis | Ischi-um | |
| 202 | | **X** | **X**x | | xx | | xx | Ilium: SOP. SI joint: pin and lag screw |
| 205 | | | | **X** | xx | | x | SOP |
| 206 | | **X** | x | | x | | xx | DCP |
| 207 | | **X** | | **X** | | | | LCP |
| 212 | | | **X** | | xx | | xx | Pin and cancellous screw |
| 214 | | **X** | **X** | | x | | x | SI joint: pin and cortical screw. Ilium: reconstruction plate |
| 215 | | | | **X** | x | | | Plate |
| 225 | | | **XX** | | x | | x | Lag screw and pin |
| 226 | | | | **X** | x | | x | Femoral head and neck ostectomy |
| 227 | | | x | **X** | x | | x | Femoral head and neck ostectomy |
| 228 | | | | **X** | | | | SOP. Femoral head and neck ostectomy later |
| 229 | | **X** | | | xx | | | Reoperation of old screw fixation. The screw was removed |
| 230 | | x | | **X** | x | | x | Femoral head and neck ostectomy and cerclage |
| 231 | | | | **X** | x | | x | SOP |
| 232 | | **X** | | | x | | x | DCP |
| 233 | | **X** | | | xx | | xx | DCP |
| 234 | | | | **X** | | | | Femoral head and neck ostectomy |
| Total C | 0 | 1 | 2 | 0 | 14 | 0 | 12 | |
| Total S | 0 | 7 | 4 | 9 | 0 | 0 | 0 | |

## Questionnaires

### *Feline Pain and Musculoskeletal Index (FMPI)*

Twenty-one cat owners answered the FMPI questionnaire. Eight cat owners described the time after the injury, outside the FMPI, because their cat was dead or missing and could therefore not answer the complete FMPI. Follow up time from injury varied between six months to 11 years, with a mean follow up time of 4,3 years, and the owners were asked questions about the past month. Table 7 shows the scores of the cats participating in the study.

Of all 21 cats, 12 cats had normal, or better than normal, activity and therefore, no indication of pain in their normal life. Nine cats had a higher relative score than 20,0%, which indicates some level of pain in their normal life. Only four owners thought their cat was in pain in their normal life, but none thought that this impacted on their cat's quality of life. Those who scored their cats with pain in their normal life had relative scores of 30,6%, 33,8%, 22,4% and 27,5%. These were not the highest relative scores, the highest relative scores were 33,8%, 30,6%, 28,2% and 27,5%. Median relative score was 20,0% which equals normal life with no pain. Mean relative score was 23,0%.

The most common questions to grade as "not normal" were the questions about normal gait, 28,6% did not have a normal gait, and being carried or petted, 28,6% could not be carried or petted normally. No cat had problems with urination or defecation. Jumping up and down was a problem for 23,8% of the cats. Walking downstairs was easier than walking upstairs, 85,7% of the cats walked upstairs normally and 90,5% of the cats walked downstairs normally.

The owners could leave a comment to the questionnaire. Two owners commented that their cat was lame, two owners commented that their cat was stiff in its hind limbs or back, one owner told their cat was asymmetric in its pelvis and one owner commented that their cat walked with stomping sounds with its hind limbs. Two owners also expressed that their cat did not like being petted or carried before the injury and did not like it after the injury either. Owner of cat 162 reported that the first years after the injury the cat did not show any pain, but when time had passed, they could see that their cat had changed its movement in a way that the owner perceived as a pain induced change.

Eight owners described their cats' time after the injury without answering the FMPI questionnaire due to death of their cat or that the cat was missing. Six of these cats recovered completely according to the owner and behaved the same way they did before the injury. One cat did not recover and the owner regrets that they did not euthanize the cat at the time of the injury. Another owner that participated in the clinical study expressed the same thing, although this cat did recover from the injury. They thought the treatment and the period after the injury were too tough. They expressed that they did not fully understand what the treatment meant and that if they were with the same choice again, they would not go through with treatment. The last cat almost recovered, it had a disturbance in movement, but it did not affect the cat in its normal life. The cat behaved the same as before the injury.

Table 7. *FMPI scores of cats that suffered from pelvic fractures. Conservative treatment = C, surgical treatment = S. Quality of life (QOL) is shown separately to better show the owners opinion on QOL. Relative score of ≤20,0% indicates normal function. Higher relative score indicates poorer function*

| Cat | Treatment | Total score | Relative score (%) | QOL score |
|---|---|---|---|---|
| 101 | C | 16/80 | 20,0 | 0 |
| 105 | C | 16/85 | 18,8 | 0 |
| 106 | C | 17/85 | 20,0 | 0 |
| 111 | C | 17/85 | 20,0 | 0 |
| 114 | C | 22/80 | 27,5 | 0 |
| 116 | C | 17/85 | 20,0 | 0 |
| 117 | C | 17/85 | 20,0 | 0 |
| 118 | C | 16/80 | 20,0 | 0 |
| 119 | C | 24/85 | 28,2 | 0 |
| 122 | C | 17/85 | 20,0 | 0 |
| 123 | C | 17/85 | 20,0 | 0 |
| 129 | C | 26/85 | 30,6 | 2 |
| 130 | S | 21/85 | 24,7 | 0 |
| 131 | S | 18/85 | 21,2 | 0 |
| 132 | S | 27/80 | 33,8 | 2 |
| 133 | C | 19/85 | 22,4 | 2 |
| 135 | C | 17/85 | 20,0 | 0 |
| 150 | C | 17/85 | 20,0 | 0 |
| 153 | C | 22/80 | 27,5 | 0 |
| 158 | S | 17/85 | 20,0 | 0 |
| 162 | C | 22/80 | 27,5 | 2 |

### *ACVS Canine Orthopedic Index (COI)*

Sixteen dog owners answered the COI questionnaire. Follow up time from injury varied between six months to 11 years, with a mean follow up time of 4,3 years, and the owners were asked about the past month. The result of the questionnaire is seen below in Table 8.

One dog had a relative score of 20%. Three dogs had a stiffness score of five, which indicates no stiffness in normal life. Seven dogs had a function score that indicates full function in their normal life. Four dogs had a gait score that indicates no lameness in their normal life. Six dogs had best quality of life possible, or the owners were not worried that the injury would affect the animal. Median relative score was 28,8% and mean relative score was 37,7%.

One female dog had problems with urinating and defecation. The dog had sometimes trouble getting in position and ended up urinating standing up. Twenty-five percent of the dogs never showed any kind of disturbance in movement due to the injury. The questionnaire asked directly about lameness in the movement part of the questionnaire, 43,9% of the dogs had varying degrees of lameness during light activity and 37,5% had varying degrees of lameness during moderate activity. The day after moderate activity 43,7% of the dogs had varying degrees of lameness.

The part of the questionnaire about stiffness showed that 31,3% of the dogs never showed any stiffness. 68,7% of the dogs had stiffness in the morning and 56,2% of the dogs had stiffness after 15 minutes rest, while 43,7% of the dogs had problems rise after 15 minutes rest. Although, it is important to note that 68,7% of the dogs had problems with their joints in general, not only the joints of the pelvis, according to their owner.

The part of the questionnaire about function showed that the most difficult movement was to jump up on something, 43,8% of the dogs had a normal jump. One dog could not jump up at all, this dog could not jump down either. Jumping down was easier, 62,5% of the dogs jumped down normal. Climbing was easier than jumping, 60% of the dogs could climb up and down.

The owners could comment the questionnaire and two owners thought that their dogs' stiffness and lameness were not correlated to the pelvic fracture, one of the dogs had been lame previous to the accident and both dogs showed lameness in their front limbs. One dog showed lameness when it had not had proper training, usually they exercise previous to the hunting season and the dog was fit, and then the dog did not show any lameness. Another dog showed lameness after a tough whole days hunting, but when it hunted only half days the dog was not lame. One owner could not tell if the dog did not want to walk or if it could not walk due to pain, because when they turned to go home the dog walked normal again. Several owners pointed out that when the questionnaire was answered the outside temperature was much higher than normal which impacted on the dogs' quality of life at the moment.

Table 8. *COI scores in dogs that suffered from pelvic fractures. Conservative treatment = C, surgical treatment = S. Relative score of ≤20,0% indicates normal function. Higher relative score indicates poorer function*

| Dog | Treatment | Total score | Relative score (%) | Stiffness score | Function score | Gait score | QOL score |
|---|---|---|---|---|---|---|---|
| 201 | C | 38/80 | 47,5 | 12/25 | 8/20 | 7/20 | 11/15 |
| 202 | S | 45/80 | 56,3 | 15/25 | 7/20 | 20/20 | 3/15 |
| 203 | C | 47/80 | 58,8 | 15/25 | 10/20 | 16/20 | 6/15 |
| 204 | C | 17/75 | 22,7 | 6/25 | 4/20 | 5/20 | 2/10 |
| 206 | S | 18/70 | 25,7 | 6/25 | 2/10 | 7/20 | 3/15 |
| 207 | S | 16/80 | 20,0 | 5/25 | 4/20 | 4/20 | 3/15 |
| 213 | C | 53/80 | 66,3 | 19/25 | 10/20 | 16/20 | 8/15 |
| 215 | S | 17/80 | 21,3 | 5/25 | 4/20 | 4/20 | 4/15 |
| 216 | C | 23/80 | 28,8 | 9/25 | 5/20 | 6/20 | 3/15 |
| 217 | C | 46/80 | 57,5 | 11/25 | 14/20 | 10/20 | 11/15 |
| 218 | C | 47/80 | 58,8 | 18/25 | 9/20 | 15/20 | 5/15 |
| 221 | C | 21/80 | 26,3 | 10/25 | 4/20 | 4/20 | 3/15 |
| 222 | C | 21/80 | 26,3 | 8/25 | 4/20 | 5/20 | 4/15 |
| 223 | C | 28/80 | 35,0 | 10/25 | 5/20 | 8/20 | 5/15 |
| 224 | C | 23/80 | 28,8 | 8/25 | 6/20 | 4/20 | 5/15 |
| 225 | S | 18/80 | 22,5 | 5/25 | 4/20 | 6/20 | 3/15 |

### *Comparison FMPI and COI*

The relative scores in the FMPI and the COI were comparable, and a Mann-Whitney test was performed to test if the difference in the relative scores in the FMPI and the COI were statistically significant. Median value of the relative score of cats was 20,0% and median value of the relative score of dogs was 28,8%. The Mann-Whitney test showed that with 95% certainty cats had less pain and a better quality of life than dogs after a pelvic fracture. Figure 5 shows the distribution of relative scores between cats treated conservatively, cats treated surgically, dogs treated conservatively, and dogs treated surgically.

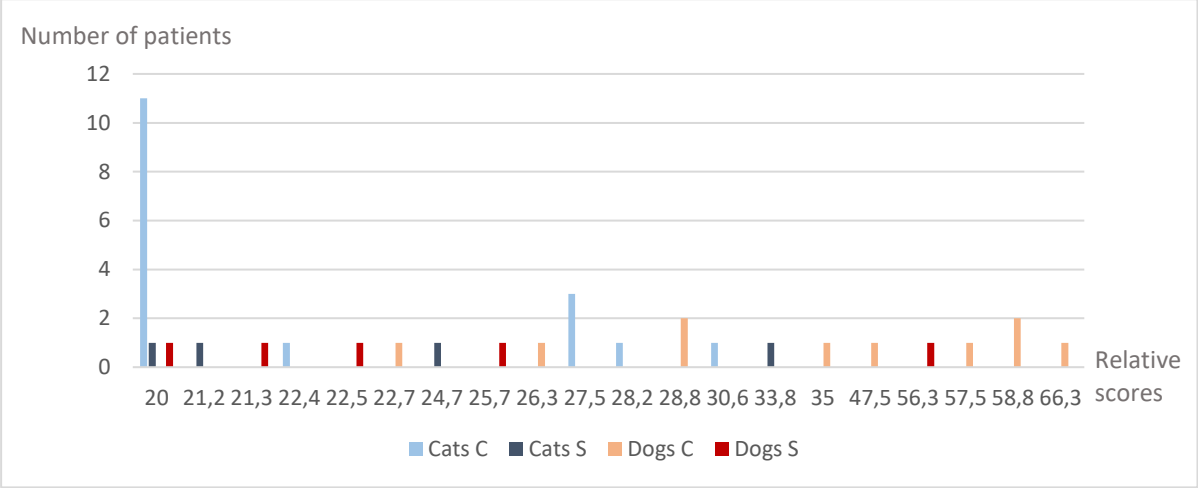


Figure 5. *Distribution of relative scores in cats and dogs. C = conservative treatment, S = surgical treatment.*

## Clinical study

The different parts examined and how they were graded is seen in Appendix 3. In Table 9 and 10 the result of the clinical examination is described. Thirteen cats and 11 dogs participated in the clinical study. Follow up time from injury varied between six months to 11 years, with a mean follow up time of 4,3 years.

Table 9. *Clinical signs on physical exam in cats that suffered from pelvic fractures*

| Cat | Treat-ment | Hind limb muscle | Lame-ness | Pain on palpa-tion | Pelvic symmetry | ROM hind limbs | Hind limb proprioception | Spinal reflex hind limbs | Function of the tail | Total score |
|---|---|---|---|---|---|---|---|---|---|---|
| 105 | C | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 111 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 116 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 117 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 119 | C | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| 123 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 129 | C | 1 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 6 |
| 130 | S | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 6 |
| 131 | S | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 132 | S | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 133 | C | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 150 | C | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 162 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tot-al (%) | 13 | 3 (23,1) | 2 (15,4) | 3 (23,1) | 5 (38,5) | 3 (23,1) | 0 | 0 | 0 | |

0 = normal, 1 = mild changes, 2 = moderate changes, 3 = severe changes. C = conservative treatment, S = surgical treatment.

Table 10. *Clinical signs on physical exam in dogs that suffered from pelvic fractures*

| Dog | Treat-ment | Hind limb muscle | Lame-ness | Pain on palpa-tion | Pelvic symme try | ROM hind limbs | Hind limb proprioceptio n | Spinal reflex hind limbs | Function of the tail | Total score |
|---|---|---|---|---|---|---|---|---|---|---|
| 201 | C | 1 | 0 | 2 | 1 | 1 | 2 | 1 | 0 | 8 |
| 202 | S | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| 204 | C | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| 213 | C | 1 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 5 |
| 215 | S | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| 216 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 218 | C | 1 | 0 | 0 | 1 | 3 | 0 | 1 | 0 | 6 |
| 221 | C | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 223 | C | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| 224 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 225 | S | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 6 |
| Total (%) | 11 | 5 (45,5) | 4 (36,4) | 3 (27,3) | 4 (36,4) | 8 (72,7) | 3 (27,3) | 2 (18,2) | 0 | |

0 = normal, 1 = mild changes, 2 = moderate changes, 3 = severe changes. C = conservative treatment, S = surgical treatment.

According to Tables 9 and 10 twice as many dogs had some degree of lameness compared to cats. One owner described that their dog started to ambler after the injury, the dog had normal gait before the injury. Five cats (38,5%) and four dogs (36,4%) had an asymmetry in their pelvis. Five of these were treated conservatively and two were treated surgically. Patient number 215 had puppies, normal delivery. No cat had neurological deficits, while four dogs had some degree of neurological deficit. According to patient records none of these dogs had known neurological deficits on initial presentation. Patient number 117, 129, 130, 202 and 225 had neurological deficits on initial clinical examination but did not show this on the follow up examination.

### *Comparison treatment method vs FMPI and COI vs clinical exam*

Table 11 describes the correlation between type of fracture, treatment method, the relative score of the questionnaire and the score of the clinical examination.

Table 11. *Presentation of fracture type, treatment method, the relative score of the FMPI/CI and the score of the clinical exam in cats and dogs with pelvic fractures. C = conservative treatment, S = surgical treatment. (s) shows which fracture that were treated surgically. Patient number starting with 1 = cat. Patient number starting with 2 = dog*

| Patient nr | Treatment | Weight bearing axis | Relative score FMPI/COI | Score clinical exam |
|---|---|---|---|---|
| 105 | C | SI joint | 18,8 | 1 |
| 111 | C | SI joint | 20,0 | 0 |
| 116 | C | SI joint | 20,0 | 0 |
| 117 | C | SI joint | 20,0 | 0 |
| 119 | C | SI joint | 28,2 | 4 |
| 123 | C | Acetabulum | 20,0 | 0 |
| 129 | C | SI joint | 30,6 | 6 |
| 130 | S | Ilium body (s) | 24,7 | 6 |
| 131 | S | Acetabulum (s), SI joint | 21,2 | 1 |
| 132 | S | Acetabulum, Ilium body (s) | 33,8 | 2 |
| 133 | C | SI joint | 22,4 | 1 |
| 150 | C | SI joint | 20,0 | 2 |
| 162 | C | SI joint | 27,5 | 0 |
| 201 | C | - | 47,5 | 8 |
| 202 | S | SI joint (s), ilium body (s) | 56,3 | 5 |
| 204 | C | Acetabulum | 22,7 | 2 |
| 213 | C | - | 66,3 | 5 |
| 215 | S | Acetabulum (s) | 21,3 | 2 |
| 216 | C | SI joint | 28,8 | 0 |
| 218 | C | Ilium body | 58,8 | 6 |
| 221 | C | Ilium body | 26,3 | 1 |
| 223 | C | - | 35,0 | 2 |
| 224 | C | Ilium body | 28,8 | 0 |
| 225 | S | SI joint (s) | 22,5 | 6 |

Fractures of the SI joint treated surgically resulted in a mean relative score at 32,9% and a mean clinical score at 5,5. Fractures of the SI joint treated conservatively resulted in a mean relative score 25,5% and a mean clinical score at 1,4. Of the patients treated conservatively 50% had normal life according to the FMPI or COI and 50% had no clinical findings on the clinical examination.

Fractures of the acetabulum were treated conservatively in three cases and mean relative score were 25,5% and mean clinical score were 1,3. Acetabulum fractures were treated surgically in two cases and mean relative score was 21,3% and mean clinical score was 1,5.

Fractures of the ilium body treated conservatively resulted in a mean relative score of 38,0% and a mean clinical score at 2,3. Fractures of the ilium body treated surgically resulted in a mean relative score at 38,3% and a mean clinical score at 4,3. Important to note is that two out of three ilium body fractures treated surgically were accompanied by other fractures involving weight bearing axis and it is uncertain which fracture that was causing the high scores.

There were three patients that did not have fractures involving weight bearing axis but all of them had high relative scores and clinical scores. Mean relative score were 49,6% and mean clinical score were 5,0.

Six of 24 patients had a FMPI or COI score at 20,0% or lower. Of these six patients two patients had a higher clinical score than normal. Three patients had a normal clinical score but a higher relative score than normal in the FMPI or COI.

## DISCUSSION

### Etiology to pelvic fractures and initial clinical presentation

Our case series, like literature (Côté, 2015), suggest the most common cause of pelvic fractures was hit by motor vehicle, followed by falling from heights. When it comes to age and sex different studies point in opposite directions. Denny (1978) showed that the typical canine patient was male and younger than four years of age, but Butterworth *et al.* (1994) showed that 53% of the injured dogs were female and 60% of the dogs were under two years of age. According to the data samples in this study the majority of both cats and dogs were younger than two years of age. Follow up time in our case study varied between six months to 11 years and mean follow up time at clinical study were 4,3 years.

Initial clinical examination showed that 23,5% of the cats and dogs did not show any lameness and 13% were presented with paraparesis. Nerve deficits occurred in about 15% of all cases, although these figures are uncertain due to the retrospective nature of the study. In some patient records there was no information about lameness or nerve function – it was impossible to say if the tests were normal or if nerves were not tested. It was also uncertain if all veterinarians knew the meaning of paraparesis and did therefore not use the term in cases that were described with signs of paraparesis. Important to note is that none of the cats and four dogs in the study had neurological deficits on follow up examination. These four dogs did not have neurological deficits according to their medical record on initial presentation. It would be interesting to determine when this neurological deficit appeared and how it progressed. To be able to do that there need to be standardized protocols for initial presentation and follow up examinations in the clinic in a retrospective manner. It is important to state if the nerve function was tested but normal in the medical record. A recent study (Meeson & Geddes, 2017) showed that a few cats developed neurological deficits post-surgery and one cat developed changed movement three months post the injury. This confirms the theory that these types of deficits can develop later and do not need to be present at initial presentation.

Messmer and Montavon (2004) showed that 76% of the patients with pelvic fractures suffer from multiple fractures. Multiple fractures were found to be more common than one or two fracture sites in both cats and dogs during this study, 75,8% of the cats suffered from multiple fractures and 69,6% of the dogs suffered from multiple fractures. Multiple fractures might be more common than one or two fracture sites because the fractures were often the result of a major trauma, for example traffic road accident. Other fractures that appear more often as singular fractures, for example radius or ulna fractures, are more common in tripping accidents and the force is directed to that specific limb and not to the whole body. Also, in the case of

one or two fracture sites, the pelvic will remain in correct alignment, with a reduced chance that the animal will be admitted for veterinary care.

In this study major soft tissue injuries associated with pelvic fractures were relatively rare, 6,6% of the cats and dogs in the study had either abdominal wall hernia, diaphragm hernia or damage to the urinary tract. This confirms a previous study (Denny, 1978) that showed that 6% of the injured dogs had these kinds of major soft tissue injuries.

### Treatment of pelvic fractures in cats and dogs

There was a difference observed in choice of treatment in cats versus dogs. When it comes to conservative treatment the result was almost the same in cats (46,4%) and dogs (41,3%). Surgical treatment was performed in 9,3% of the cats and in 39,1% of the dogs. A larger percentage of the cats were euthanized, 44,4%, compared to 19,6% of the dogs. These differences are interesting. One reason to the difference in surgical treatment and euthanasia could be that fewer cat owners accept surgical treatment, either because of private economy or because they do not want to put their cat through a big surgery. This was not confirmed during the review of patient records. A common expressed reason for euthanasia in cats were due to poor prognosis. This would indicate that cats are more severely injured than dogs. Although, this was not confirmed during the review of patient records either. Another explanation could be that veterinarians expect cats with pelvic fractures to have worse prognosis than dogs with pelvic fractures. When interpreting the prognosis another aspect could matter, the role of cats in the society. Cats have earlier had a lower position in the society than dogs, dogs were more valuable due to hunting, guarding and searching skills. Cats do not have this purpose and might therefore have a less worth. This might result in that both owners and veterinarians tend to put more resources in dogs than cats, and therefore do not value the life of the cat equal to the life of a dog. Although, these are only speculations and further studies on the subject is necessary.

When it comes to conservative or surgical treatment, the choice of conservative treatment was almost the same in cats and dogs. Fractures involving weight bearing axis were according to literature supposed to be treated surgically. In this study 85,7% of the ilium body fractures in cats were treated conservatively, 93,2% of the SI joint luxation in cats were treated conservatively and 25% of the fractures of the acetabulum in cats were treated conservatively. In dogs 46,2% of the ilium body fractures, 60,0% of the SI joint fractures and 20,0% of the acetabulum fractures were treated conservatively. Unfortunately, the population of patients treated surgically and conservatively in the study were not sufficient and therefore it was not possible to draw any conclusions whether surgical treatment was more successful than conservative treatment for that type of fracture.

These figures were compared with, and quite different from, the result from a recent article (Meeson & Geddes, 2017) where 18% of the ilial fractures, 40% of the SI joint fractures and 50% of the acetabular fractures were treated conservatively. This study could not compare surgical treatment to conservative treatment either but concluded that overall prognosis was good in both conservative and surgical treatment in cats.

## Quality of life and long-term prognosis

According to the FMPI 57,1% of the cats that suffered from pelvic fractures recovered completely, compared to the COI were 6,3% of the dogs recovered completely after a pelvic fracture. This difference showed to be statistically significant, cats recover better than dogs after a pelvic fracture according to their owner. What the difference in recovery depends on is uncertain. It might be because cats and dogs are different types of animals, dogs are pack animals, while cats do not rely on other individuals as much. This might result in dogs seeking comfort in their owners when in pain and it is therefore easier for dog owners to perceive signals of pain or discomfort than it is for cat owners. Cats are also known to hide away when in pain and do not want to show their pain to others. A study confirmed hiding as a behavior of cats in pain (Merola & Mills, 2016). There is also a difference in how the owners care for their animals. Dog owners walks their dogs outside several times every day, while cats often are outside voluntarily without their owner or live outside. This difference in care gives the dog owners an opportunity to perceive signals of pain or discomfort if the dog suddenly does not want to go outside or if it no longer can walk the usual distance. Cats are usually lighter in body weight than dogs and this might also contribute to better healing of the pelvic fractures due to less loading on the hind limbs. Whether the result of our study is true or not is debatable. There are many factors, including those stated above that would suggest that the cats are graded false low. Although, these results are consistent with the clinical examination performed where cats had a lower mean score (1,8) than dogs (3,4), which indicates that the result is true.

If the different fracture types are compared, fractures of only non-weight bearing structures had the highest scores on the FMPI and COI, with a mean relative score of 42,1%. Fractures involving the weight bearing axis had a mean relative score of 26,8%. The difference between the relative scores in patients with fractures not involving weight bearing structures and patients with fractures involving weight bearing axis is notable. This might be because the patients with fractures not involving weight bearing structures were not as well observed as the patients with fractures of the weight bearing structures because these fractures are not classified as serious as the fractures of the weight bearing structures. The difference might also depend on that these fractures are not surgically treated due to standard treatment procedures, this might result in an instability of the pelvis if there are multiple fractures, which could have a negative impact on the healing process. This instability could also result in an abnormal angle in the hips which could result in early progression of osteoarthritis. There are no studies available comparing surgical treatment to conservative treatment of fractures of non-weight bearing structures in the pelvis concerning long-term prognosis. To determine whether these patients would have a better quality of life if they were treated surgically such a study would need to be conducted. A study of short-time outcome was conducted in cats (Kipfer & Montavon, 2011) with the result that fixation of the pelvic floor significant reduced pain and lameness in six to eight weeks post-surgery.

According to the questionnaires combined with the clinical examination there does not seem to be a correlation between abnormal clinical findings and poor quality of life. Two of six patients with normal relative score had higher score at the clinical examination than normal. This indicates that the animal does not need to be clinically normal to function as a companion

animal. Perhaps the answers in the questionnaire would be different if the animals were used for hunting for example. It was important that the owners answered the questionnaire before the clinical examination was performed in case the examination revealed lameness for example and the owner then would change the opinion about how the animal behaves at home.

Four patients had persistent neurological deficits on follow up clinical examination. Three of these had fractures of the pelvic floor and one had a fracture of the ilium body combined with fractures of the pelvic floor. This result questions the statement in a previous study (Jacobson & Schrader, 1987) that showed that the most common fracture to cause persistent neurological deficits in peripheral nerves were displaced ilial fractures with luxation of the SI joint. But important to remember is that in the current clinical study there is not a big enough population to draw any certain conclusions.

Acetabulum fractures resulted in decreased range of motion during the clinical study in the hip joints in 60 of the cases, conservative treatment and surgical treatment combined. Although, of all the patients with decreased range of motion in the hip joints 27,3% had acetabular fractures, 27,3% had SI joint fractures, 27,3% had fractures of the pelvic floor and 18,2% had ilium fractures. The result that 60% of the patient with acetabular fractures had decreased range of motion in the hip joints could be due to development of osteoarthritis in the hip joint, but to confirm this a radiological evaluation of the hip joints would need to be performed. These figures are consistent with recent study (Vassalo *et al*., 2015) that showed that 100% of the patients with acetabular fractures developed radiological signs of osteoarthritis with a follow up time range between four months to seven years with a mean follow up time at 1,7 years. Osteoarthritis is a progressive disease and therefore more patients should have signs of osteoarthritis if the follow up time is prolonged.

In this study 25% of the cats and dogs showed visual lameness in one or both hind limbs during the clinical examination and 45,8% had decreased range of motion in the hip joints. Twice as many dogs had lameness compared to cats. There might be a false low result in cats because lameness is harder to detect in cats during a clinical examination than in dogs. Compared to another study (Vassalo *et al.*, 2015) this is a low number of lameness. In that study 73,3% of the dogs had visual lameness and 33% of the dogs had restricted movement in their hip joints. In the study from Vassalo *et al.* (2015) mean follow up time were 1,7 years compared to follow up time in our study at mean 4,3 years. Perhaps prolonged follow up time could result in less lameness and more decreased range of motion due to osteoarthritis, although it is known that 100% of the study population in the study from Vassalo *et al.* (2015) had radiological signs of osteoarthritis.

## Sources of error

Some problems appeared along the progression of the study. The first problem to appear were how some medical records were written. Some veterinarians wrote very short on initial presentation and it was hard to understand if for examples the nerve function were tested at all or if it was tested and were normal and therefore not written in the medical record. To simplify for later studies, it would be an idea to have a standardized form to fill out in the medical record

on these types of patients. Another problem with the medical record was that there often were information missing on which leg that was affected. Perhaps that is not a clinical problem when at the clinic, but when retrospectively reviewing the medical records it is difficult to understand the extent of the injuries. The same problem appeared in the surgical report. There was not always a description on what side of the animal the surgery was performed. A short headline including surgical procedure and left- or right side is recommended. This would provide a good overview for other veterinarians involved in the case and simplify for later studies and follow ups.

Another problem that occurred during the study of medical records was that the radiological diagnosis and description were incorrect in several cases. The fractures were described on the wrong side and in the wrong anatomical position. Radiographs were re-evaluated by the author when the medical record and radiological diagnosis were inconsistent, and all radiographs including an ilium fracture were re-evaluated in this study. The most common error in the record was reporting the fracture as a fracture of the ilium wing, when it was in fact a fracture of the ilium body.

During this study it was impossible to estimate the time to healing, which had been interesting to evaluate because abbreviated healing time is one of the most important reasons to choose surgical treatment. To be able to evaluate this there need to be scheduled follow up examinations with the same time range for both surgical and conservative patients.

Unfortunately, there was a big loss of study participants due to lack of contact information to the owners. To achieve a bigger population the study should be designed to follow the patients from initial presentation until the final follow up examination, preferably a year after the injury to evaluate healing and how the animal functions when it is back to its normal life.

It was also difficult to find good and recent studies on comparison between conservative and surgical methods. For example, old studies indicate that conservative treatment of acetabular fractures is equal to surgical treatment of acetabular fractures. There are no recent studies proving that surgical method is better than conservative because standardized treatment for intraarticular fractures is surgical today. Therefore, there are not enough animals treated conservatively to compare these two treatment methods.

### Future studies

In the future it would be interesting to perform a prospective study and follow patients from the initial clinical presentation, during treatment and include a standardized follow up examination. There would be a need to collect information about reasons to the choice of treatment. This would make it possible to evaluate time to recovery. If several animal hospitals were included (multicenter) there should be enough information to compare conservative treatment and surgical treatment. To strengthen the study a control group including animals without pelvic fractures would be ideal. It would also be interesting to evaluate the result of surgical treatment of fractures to non-weight bearing structures of the pelvis, since this study resulted in higher

sores on the FMPI and COI for the patients with fractures of non-weight bearing structures than for patients with fractures of the weight bearing axis.

## CONCLUSIONS

- Cats tend according to questionnaires to have a better quality of life than dogs after suffering from pelvic fractures. This is strengthened by the result of the clinical examination where cats had a lower score than dogs. Clinical findings did not always correlate with relative score of the questionnaire, which indicates that all clinical findings do not impact on the quality of life.
- Long-term complications noted during this study were lameness, persistent neurological deficits and decreased range of motion in the hip joints.
- The most commonly occurring fracture in cats were fractures of the SI joint and in dogs, fractures of os pubis and os ischium.
- To determine whether surgical treatment is a better method than conservative treatment could not be answered in this study since too few animals in the surgical group were included.

## POPULÄRVETENSKAPLIG SAMMANFATTNING

Bäckenfrakturer är en relativt vanlig skada hos våra hundar och katter. Främsta orsakerna är att hunden eller katten blir påkörd eller faller från hög höjd. Det finns flera vedertagna behandlingsmetoder för bäckenfrakturer och valet av metod beror på många olika faktorer. Viktigt är att ta hänsyn till djuret i fråga: hälsostatus i övrigt, ålder, hull och mentalitet. Andra faktorer som spelar in är användningsområde, t.ex. jakthund eller tävlingshund, och ägarens förväntningar efter tillfrisknande. Flera faktorer hos djurägaren är också avgörande, t.ex. levnadssituation, möjligheter till att rehabilitera djuret och ägarens ekonomi. Till sist kommer frakturen i fråga: vad för typ av fraktur, hur länge sedan uppstod frakturen, vilka samtidiga skador finns och vad är den beräknade prognosen.

Målsättningen med den här studien var att uppskatta livskvaliteten, utvärdera långtidsprognos och utvärdera komplikationer hos hundar och katter drabbade av bäckenfrakturer. Utöver dessa målsättningar syftar studien även till att beskriva vilka frakturtyper som var vanligast och hur dessa behandlades. Ytterligare frågeställningar var om det fanns någon skillnad mellan konservativ- och kirurgisk behandling och mellan hundar och katter avseende behandlingsresultat.

### Litteraturstudie

Flera studier har tittat på vilken den typiska patienten är som drabbas av en bäckenfraktur. Studierna är dock inte eniga. Vissa visar på att det är unga hondjur och andra studier visar på unga handjur. Vanligen har djuret en hälta på ett, eller båda, bakbenen och beröring av bakbenen och bäcken upplevs som smärtsamt. Dock visar inte alla djur tydliga symptom. De flesta som drabbas av bäckenfraktur har multipla frakturer, det vill säga fler än 3 frakturer i bäckenet. En studie visar att bara ca 6 % av hundarna och katterna med bäckenfraktur har samtidiga mjukdelsskador som involverar bukvägg, urinvägar och nerver. Diagnosen bäckenfraktur ställs genom djurägarens berättelse, klinisk undersökning och bilddiagnostik, t.ex. röntgenundersökning eller datortomografi. Det är viktigt att vid den första undersökningen utvärdera nervfunktion och om någon skada kommit till urinvägarna för att bedöma vidare prognos.

Behandling vid ankomst till kliniken består av smärtlindring och behandling av eventuell chock eftersom majoriteten av patienterna med bäckenfrakturer är påkörda och kan ha många skador. Därefter kommer valet av behandlingsmetod. Beroende på hur frakturen ser ut är olika behandlingar mer eller mindre lämpliga. Frakturer som drabbar viktbärande strukturer i bäckenet bör enligt rekommendationer behandlas kirurgiskt medan frakturer som ej drabbat viktbärande strukturer, och där benfragmenten inte ligger i fel läge, kan behandlas konservativt. Bäckenet är omgivet av stora muskelgrupper vilket ger en stabilitet i bäckenet som möjliggör en konservativ behandling. Konservativ behandling består av strikt vila i ca. sex till åtta veckor, men viss litteratur yrkar på en viloperiod på tre veckor innan långsam igångsättning sker. Vid kirurgisk behandling används olika typer av skruvar och plattor för att fixera frakturen. Olika komplikationer som kan uppstå efter en bäckenfraktur är hälta, stelhet, förstoppning, förlossningsproblem, nervdefekter och pålagringar i höftleden (osteoartrit).

## Material och metod

Studien bestod av tre delar: en journalstudie, en djurägarenkät och en klinisk studie. Journalstudien bestod av hundar och katter som diagnosticerats med bäckenfraktur vid Universitetsdjursjukhuset i Uppsala mellan åren 2007 till 2017. Totalt drabbades 196 hundar och katter av bäckenfrakturer under den tidsperioden. För att delta i kliniska studien fanns flertalet kriterier som behövde uppfyllas, bland annat fick inte patientens ålder överstiga en viss gräns, diagnos skulle vara ställd via bilddiagnostik och patienten fick inte ha amputerat något ben eller opererat bort höftleden då detta antogs påverka rörelsemönstret. Kriterierna uppfylldes av 23 hundar och 59 katter, vars ägare bjöds in till studien. Olika enkäter användes för hundar och katter, men en procentsats beräknades vilken var jämförbar mellan katterna och hundarna. För att delta i den kliniska studien krävdes att djurägaren svarat på enkäten.

## Resultat

### *Journalstudie*

Den mest förekommande orsaken till bäckenfraktur i den här studien var påkörd av motorfordon (49,5 %), men tyvärr var det många patienter där orsaken var okänd (38,8 %). Vad det gäller kön var det var ingen nämnvärd skillnad mellan honor och hanar. Medianålder var två år gammal hos både hundar och katter. Den äldsta katten med bäckenfraktur var 17 år gammal och den äldsta hunden var 13 år gammal. Huskatt var den mest förekommande kattrasen (84,7 %) medan blandras var den mest förekommande hundrasen (26,1 %) följt av Jack Russel Terrier (13 %).

Vid ankomst till kliniken hade 57,7 % av patienterna nedsatt allmäntillstånd, 42,9 % hade smärta vid beröring av bäckenet och 76,5 % hade hälta eller förlamning på ett eller båda bakbenen. Cirka 10 % av patienterna hade något form av neurologiskt bortfall. Andra skador som uppstått i samband med bäckenfrakturen var frakturer av bakben, frakturer av rygg, frakturer av svans, hudsår, blödningar, bukbråck och skador på urinvägarna.

Den vanligast förekommande frakturen hos katter var fraktur av iliosakralled följt av frakturer i blygdben och sittben. Hos hund var de vanligaste förekommande frakturerna frakturer i blygdben och sittben. Hos katter hade 75,8 % minst tre frakturer och hos hund hade 69,6 % minst tre frakturer i bäckenet. Det krävs i regel minst tre frakturer för att ett felläge ska kunna uppstå.

Mellan åren 2007 till 2017 diagnosticerades 150 katter och 46 hundar med bäckenfrakturer, men då en katt drabbades av bäckenfraktur två gånger räknas i detta stycket 151 katter. Av de 151 katterna behandlades 46,4 % konservativt, 9,3 % kirurgiskt och 44,4 % dog eller avlivades. Av de 46 hundarna behandlades 41,3 % konservativt, 39,1 % kirurgiskt och 19,6 % avlivades. Vanligaste orsaken till avlivning var på grund av dålig prognos, följt av ägarens ekonomi för katter och för hundar att hunden ej kan återgå till tidigare arbete, t.ex. jakt.

Som nämnt tidigare är det standard att behandla frakturer som involverar viktbärande strukturer kirurgiskt. Av de drabbade hundarna och katterna behandlades frakturer som involverade

viktbärande strukturer konservativt i 62,4 % av fallen och frakturer som ej involverar viktbärande struktur behandlades konservativt i 100 % av fallen.

### *Enkätstudie*

Tjugoen kattägare och 16 hundägare svarade på enkäten. Uppföljningstiden varierade från sex månader till 11 år sedan skadans inträffande och djurägarna frågades angående den senaste månaden. Av de 21 katterna hade 12 katter en relativ poäng på max 20,0 %, vilket motsvarar normalt liv. Medelvärde för relativ poäng var 23,0 %. Den högsta poängen hos katt var 33,8 % och indikerar smärta och stelhet i det normala livet. Enbart fyra djurägare ansåg att katten hade nedsatt livskvalitet.

Av de 16 hundarna hade bara en hund en relativ poäng på 20,0 % och medelvärdet för relativ poäng var 28,8 %. Det högsta poängen hos hund var 66,3 %. Sex hundägare ansåg att deras hund hade god livskvalitet. Dock påpekade flera hundägare att den senaste månaden varit extremt varm och att detta påverkat hundarnas livskvalitet negativt.

En jämförelse mellan resultaten för hundar och katter visar en statistiskt säkerställd skillnad att katter tillfrisknar bättre och har en bättre livskvalitet efter en bäckenfraktur än hundar.

### *Klinisk studie*

Totalt uppvisade 25 % av hundarna och katterna hälta vid den kliniska undersökningen och det var fördelat på fyra hundar och två katter. Vid undersökning av bäckenet uppvisade 38,5 % av katterna och 36,4 % av hundarna en sidoskillnad mellan höger och vänster bäckenhalva. Ingen av katterna hade någon neurologisk påverkan. Fyra hundar hade en neurologisk påverkan, dock hade ingen av dessa hundar uppvisat detta vid skadetillfället. Ingen av de som hade en neurologisk påverkan vid skadetillfället hade kvarstående problem. Tjugofem procent av hundarna och katterna uppvisade smärta vid beröring av bäckenet. Av de 24 hundarna och katterna uppvisade 45,8 % en nedsatt rörlighet i sina höftleder.

Jämförelse mellan enkäter och klinisk undersökning visade att det var sex patienter som hade en normal poäng på enkäten men som uppvisade förändring på den kliniska undersökningen.

## Slutsatser

- Enkäterna visade att det finns en statistiskt säkerställd skillnad mellan hundar och katter i återhämtning och livskvalitet. Katter återhämtar sig bättre och har en bättre livskvalitet efter en bäckenfraktur än hundar. Den kliniska undersökningen visar att kliniska fynd ej behöver påverka djuret i vardagen och behöver ej innebära en nedsatt livskvalitet.
- Förekommande kvarstående problem var hälta, smärta, nedsatt rörelseomfång i höftled och neurologisk påverkan.
- Den vanligaste förekommande frakturtypen hos katter var frakturer av SI leden och hos hund var frakturer av blygdben och sittben vanligast.
- Ingen slutsats kunde dras angående vilken behandlingsmetod som ger bäst resultat då det ingick för få kirurgiska patienter i studien.

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## APPENDIX 1

### Letter to the owner of the animal

”Hej,

Ni får det här brevet eftersom Din hund har vårdats för bäckenfraktur i Uppsala vid Universitetsdjursjukhuset. Mitt namn är Elin Orrenius och jag ska under höstterminen 2018 skriva mitt examensarbete inom veterinärprogrammet på ämnet bäckenfrakturer hos hund och katt. Målet med studien är att utvärdera resultatet av behandlingen och mäta livskvalitet hos det drabbade djuret.

Bifogat finns en webbaserad enkät som jag ber Er att fylla i. Om Ni har möjlighet är Ni även välkomna på återbesök hos mig på Universitetsdjursjukhuset under september månad 2018 där jag gör en hälsoundersökning och en utökad undersökning av rörelseapparat och neurologisk funktion. Hela besöket är självklart kostnadsfritt. Vi kontaktar Er för en tidsbokning.

Vi ber Er fylla i enkäten i webformuläret och på så sätt hjälpa oss att förbättra vården av hundar och katter med bäckenfrakturer i framtiden. Tveka inte att höra av Er om ni har några frågor!

Då vi inte har en uppdaterad mailadress till Er finns det två alternativ för att nå enkäten.

- Webbadress för enkät: https://goo.gl/forms/DwnZbuNWl7XYiwd43
- Om Ni hellre vill ha en länk via mailen – maila mig: enus0001@stud.slu.se

Tack för ert deltagande och trevlig sommar!

Med vänliga hälsningar,
Elin Orrenius, Veterinärprogrammet år 6
Sveriges Lantbruksuniversitet, Uppsala

enus0001@stud.slu.se
076-1095244

Handledare: Maria Dimopoulou, Specialist i kirurgi, Dipl ECVS och Annika Bergström, Specialist i kirurgi, Dipl ECVS, VMD.”

”Hej,

Ni får det här brevet eftersom Din katt har vårdats för bäckenfraktur i Uppsala vid Universitetsdjursjukhuset. Mitt namn är Elin Orrenius och jag ska under höstterminen 2018 skriva mitt examensarbete inom veterinärprogrammet på ämnet bäckenfrakturer hos hund och katt. Målet med studien är att utvärdera resultatet av behandlingen och mäta livskvalitet hos det drabbade djuret.

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Handledare: Maria Dimopoulou, Specialist i kirurgi, Dipl ECVS och Annika Bergström, Specialist i kirurgi, Dipl ECVS, VMD.”

Angående GDPR
Persondatan som samlats in syftar till att kunna länka patienten i fråga till rätt journal och för att kunna kalla patienten till ett återbesök. När studien är klar raderas all information berörande personuppgifter. Inga uppgifter kommer lämnas ut i den slutgiltiga rapporten som kan länka patienten till dess ägare.

## APPENDIX 2

## Questionnaire ”Livskvalitet hos katt efter bäckenfraktur”

Djurägarenkät angående livskvalitet hos katt efter konservativ eller kirurgisk behandling av bäckenfraktur. En del av ett examensarbete vid Sveriges lantbruksuniversitet av Elin Orrenius, veterinärstudent år 6.

**Basfrågor**

Namn (för- och efternamn) för eventuell senare kontakt med frågor eller undersökning*

E-post adress för eventuell senare kontakt med frågor eller undersökning*

Telefonnummer för eventuell senare kontakt med frågor eller undersökning*

Kattens namn*

Är katten vid liv idag?*

- Ja
- Nej

Har din katt drabbats av rörelsestörning efter bäckenfrakturen?*

- Ja
- Nej
- Vet ej

Om ja på tidigare fråga, vilken typ av rörelsestörning?

**Del 1. Frågor angående livskvalitet**

Den här delen av enkäten ställer frågor angående din katts möjlighet att genomföra olika aktiviteter i jämförelse med vad du tror att en normal katt i samma ålder skulle klara av. Alternativet ”Jag vet inte, eller det är inte relevant” finns med om påståendet inte gäller för din katt, t.ex. om ni inte har trappor i ert hem kan ni inte svara på en fråga om trappor. Kryssa i det som bäst beskriver hur din katt klarat av att göra följande under den senaste månaden:

1. Gå och/eller röra sig normalt utan besvär?*

- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

2. Springa?*

- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls

- Jag vet inte, eller det är inte relevant

3. Hoppa upp?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

4. Hoppa upp till en höjd motsvarande en köksbänk, i ett försök?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

5. Hoppa ned (hur väl och besvärsfritt)?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

6. Gå upp för trappor?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

7. Gå ned för trappor?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

8. Leka med leksaker och/eller jaga efter föremål?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

9. Leka och samverka med andra husdjur?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

10. Resa sig från viloposition?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

11. Ligga och/eller sitta ned?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls

- Jag vet inte, eller det är inte relevant

12. Sträcka på sig?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

13. Tvätta och trimma sig själv?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

14. Samverka med dig och övriga familjemedlemmar?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

15. Bli berörd, buren och/eller hållen?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

16. Äta?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

17. Gå på lådan (stiga i och ur, sitta på huk och täcka över avföringen)?*
- Bättre än normalt
- Normalt
- Inte helt normalt
- Lite sämre än normalt
- Knappt eller med stor ansträngning
- Inte alls
- Jag vet inte, eller det är inte relevant

Om svarat ej normalt – inte alls på fråga 17: Vilka moment har katten svårt att utföra?*
- Stiga ur och i lådan
- Sitta på huk
- Krysta ut avföring
- Täcka över avföring
- Annat

**Del 2**

Hur aktiv är din katt generellt sett?*
- Mer aktiv än normalt
- Normalt aktiv
- Inte helt normalt
- Lite mindre aktiv än normalt
- Knappast aktiv
- Inte aktiv alls

- Jag vet inte, eller det är inte relevant

Kryssa i den ruta som bäst beskriver din katts smärtnivå under den senaste månaden.*

- Ingen smärta
- Lite smärta
- Mild smärta
- Medelsvår (måttlig) smärta
- Mycket svår (allvarlig) smärta

Kryssa i den ruta som bäst beskriver din katts smärtnivå idag.*

- Ingen smärta
- Lite smärta
- Mild smärta
- Medelsvår (måttlig) smärta
- Mycket svår (allvarlig) smärta

Betygsätt din katts allmänna livskvalitet. (Hur väl katten kan utföra sina favoritaktiviteter, äta och röra sig i sin omgivning?)

- Utmärkt
- Bra
- Skapligt
- Dålig

Kommentar till enkätsvar, ange vilken fråga kommentaren/kommentarerna avser.

Om Nej på fråga ”Är katten vid liv idag”: Hur upplevde ni er katts livskvalitet efter behandling av bäckenfrakturen? Blev katten helt återställd? Fick katten problem att utföra vissa moment (t.ex. hoppa upp/ner, gå på lådan mm) efter att den friskförklarats? Upplevdes katten smärtpåverkad i sin vardag?

## Questionnaire ”Livskvalitet hos hund efter bäckenfraktur”

Djurägarenkät angående livskvalitet hos hund efter konservativ eller kirurgisk behandling av bäckenfraktur. En del av ett examensarbete vid Sveriges lantbruksuniversitet av Elin Orrenius, veterinärstudent år 6.

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E-post adress för eventuell senare kontakt med frågor eller undersökning

Telefonnummer för eventuell senare kontakt med frågor eller undersökning

Hundens namn*

Är hunden vid liv idag?*

- Ja
- Nej

Har din hund drabbats av rörelsestörning efter bäckenfrakturen?*

- Ja
- Nej
- Vet ej

Om Ja på föregående fråga: Vilken typ av rörelsestörning?

Har din hund haft svårt at bajsa och/eller kissa efter bäckenfrakturen?*

- Ja
- Nej
- Vet ej

Om Ja på föregående fråga: På vilket sätt har din hund haft svårt att bajsa och/eller kissa efter bäckenfrakturen?

**Frågor angående livskvalitet**

Avsnittet består av 16 frågor. Vänligen svara så noga som möjligt, välj ett alternativ. Frågorna avser den senaste månaden. Om Ni vill lämna en kommentar till frågan finns utrymma längs ned på denna sidan, vänligen skriv vilken fråga som kommentaren gäller.

1. Hur allvarlig bedömer du din hunds stelhet efter att hunden reser sig på morgonen?*

- Ingen stelhet
- Knappt synbar stelhet (man kan ana att det är ett problem, men det är svårt att se någon hälta/stelhet)
- Stel (kort stund med stelhet som snabbt försvinner efter ett par steg)
- Mycket stel (tydlig hälta som sitter i någon eller några minuter)

- Blockhalt/trebent (hunden går på tre ben efter vila och använder inte alls det sjuka benet)
- Vet ej

2. Senare under dagen, hur allvarlig bedömer du din hunds stelhet efter att hunden legat ner minst 15 min?*

- Ingen stelhet
- Knappt synbar stelhet (man kan ana att det är ett problem, men det är svårt att se någon hälta/stelhet)
- Stel (kort stund med stelhet som snabbt försvinner efter ett par steg)
- Mycket stel (tydlig hälta som sitter i någon eller några minuter)
- Blockhalt/trebent (hunden går på tre ben efter vila och använder inte alls det sjuka benet)
- Vet ej

3. Senare under dagen, hur svårt upplever du att din hund har att resa sig efter att ha legat ner under minst 15 min?*

- Utan problem
- Knappt synbar svårighet
- Viss svårighet
- Stor svårighet
- Kan ej resa sig utan hjälp
- Vet ej

4. Hur svårt bedömer du att din hund haft med sin led eller sina leder generellt sett under den senaste månaden?*

- Inga problem
- Knappt synbar svårighet
- Viss svårighet
- Stor svårighet
- Kan ej lägga sig utan hjälp
- Vet ej

5. Hur ofta uppvisar din hund ökad smärta och/eller stelhet dagen efter måttlig aktivitet enligt föregående frågor?*

- Aldrig
- Vid enstaka tillfällen
- Ibland
- Frekvent
- Konstant
- Ej applicerbart, hund under konvalescens

6. Hur svårt bedömer du att det varit för din hund den senaste månaden att hoppa upp (t.ex. in i bilen, upp i soffan eller upp på stock och sten ute i naturen)?*

- Inga svårigheter
- Viss tveksamhet ibland
- Tvekar alltid men hoppat själv
- Tvekar och behöver hjälp
- Kan ej utföra momentet
- Ej applicerbart, hund under konvalescens
- Vet ej

7. Hur svårt bedömer du att det varit för din hund den senaste månaden att hoppa ner (t.ex. ut ur bilen, ner från soffan eller stock och sten ute i naturen)?*

- Inga svårigheter
- Viss tveksamhet ibland
- Tvekar alltid men hoppat själv
- Tvekar och behöver hjälp
- Kan ej utföra momentet
- Ej applicerbart, hund under konvalescens
- Vet ej

8. Hur svårt bedömer du att det varit för din hund den senaste månaden att klättra upp (t.ex. för trappor, ramper)?*

- Inga svårigheter
- Viss tveksamhet ibland
- Tvekar alltid men klättrat själv
- Tvekar och behöver hjälp
- Kan ej utföra momentet
- Ej applicerbart, hund under konvalescens
- Vet ej

9. Hur svårt bedömer du att det varit för din hund den senaste månaden att klättra ner (t.ex. för trappor, ramper)?*

- Inga svårigheter
- Viss tveksamhet ibland
- Tvekar alltid men klättrat själv
- Tvekar och behöver hjälp
- Kan ej utföra momentet
- Ej applicerbart, hund under konvalescens
- Vet ej

10. Hur ofta haltar din hund under lättare aktivitet som t.ex. kortare promenader/rastning?*

- Aldrig
- Vid enstaka tillfällen
- Ibland
- Frekvent
- Konstant
- Ej applicerbart, hund under konvalescens
- Vet ej

11. Hur ofta haltar din hund under måttlig aktivitet såsom långa promenader där trav och galopp ingår?*

- Aldrig
- Vid enstaka tillfällen
- Ibland
- Frekvent
- Konstant
- Ej applicerbart, hund under konvalescens
- Vet ej

12. Hur ofta haltar din hund dagen efter måttlig aktivitet såsom långa promenader där trav och galopp ingår?*

- Aldrig
- Vid enstaka tillfällen
- Ibland
- Frekvent
- Konstant
- Ej applicerbart, hund under konvalescens
- Vet ej

13. Hur ofta lägger du märke till att din hund har en rörelsestörning p.g.a. den tidigare bäckenskadan?*

- Aldrig
- Vid enstaka tillfällen
- Ibland
- Frekvent
- Konstant
- Ej applicerbart, hund under konvalescens
- Vet ej

14. Hur upplever du att din hunds livskvalitet har varit under den senaste månaden?*

- Mycket bra
- Bra
- Lika många bra som dåliga dagar
- Ofta påverkad livskvalitet till det sämre, men hunden har stunder som verkar bra
- Kraftigt försämrad, har nästan alltid nedsatt livskvalitet
- Svårt att uttala sig: hundens liv temporärt begränsat p.g.a. konvalescensperiod
- Vet ej

15. Hur orolig har du varit den senaste månaden att din hund generellt saktat ner farten/trappat ned på sina olika aktiviteter?*

- Inte alls
- Har hänt vid något enstaka tillfälle
- Ca 1 gång i veckan
- Flera gånger i veckan
- Varje dag
- Svårt att uttala sig just nu eftersom hunden är under konvalescens: avvaktar resultat
- Vet ej

16. Hur orolig har du varit under den senaste månaden att din hunds tidigare bäckenskada ska förkorta hundens liv?*

- Inte alls
- Har hänt vid något enstaka tillfälle
- Ca en gång i veckan
- Flera gånger i veckan
- Varje dag
- Svårt att uttala sig just nu eftersom hunden är under konvalescens: avvaktar resultat
- Vet ej

Eventuella kommentarer till ovan frågor (obs börja med frågans nummer)

Om Nej på fråga ”Är hunden vid liv idag”: Hur upplevde ni er hunds livskvalitet efter behandling av bäckenfrakturen? Blev hunden helt återställd? Fick hunden problem att utföra vissa moment (t.ex. hoppa upp/ner, problem vid rastning mm) efter att den friskförklarats? Upplevdes hunden smärtpåverkad i sin vardag?

## APPENDIX 3

## Clinical examination

| **Löpnummer** _____ | **Värde** | **Enhet/skala** |
|---|---|---|
| **Anamnes** | | |
| **Andra sjukdomar** | | |
| **Vikt** | | kg |
| **Body condition score** | | 1-9/9 |
| **Muscle condition score** | | 1-9/9 |
| **Muskelansättning** | | 0-3 där 0 är normal och 3 är kraftig asymmetri |
| **Symmetri bäcken** | | 0-3 där 0 är normal och 3 är kraftig asymmetri |
| **Rörelse (hälta)** | | 0-3 där 0 är normal och 3 är kraftig hälta |
| **Smärta palpation bäcken** | | 0-3 där 0 är ingen smärta och 3 är kraftig smärta |
| **Smärta palpation bakben** | | 0-3 där 0 är ingen smärta och 3 är kraftig smärta |
| **Svullnad vid palpation bäcken/bakben** | | 0-3 där 0 är normal och 3 är kraftig svullnad |
| **Rörelseomfång bakben** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Positionsreaktion bakben** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Böjreflex** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Smärtsensibilitet bakben** (testas enbart om misstänkt bortfall) | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Patellarreflex** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Tibialis cranialis reflex** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Nervus ischias funktion** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Perinealreflex** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |
| **Svanshållning** | | 0-3 där 0 är normal och 3 är kraftigt nedsatt |