PELVIC FRACTURES: MANAGEMENT, TREATMENT AND COMPLICATIONS

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look at the surgical options available when confronted with this type of fracture, focusing on conservative management and internal fixation

PELVIS fractures are very common in small animal practice and they can be a challenge to manage. Conservative treatment can often work well, but early patient mobilisation and comfort are often much improved by timely surgical intervention.

Surgical treatment is desirable if:

- the weight-bearing axis is compromised, especially if this is bilateral;
- acetabular fracture(s) are present involving the weight-bearing part of the acetabulum. Injuries involving the cranial and the dorsal parts of the acetabulum are more significant than those involving the caudal and ventral parts;
- pelvic dimensions are significantly compromised, with risks of future obstipation or dystocia; or
- pain management and convalescent nursing care are otherwise problematic.

Most pelvis fractures occur after high-energy trauma sustained during road traffic accidents and accompanying injuries are common.

The patient may have other problems that can greatly affect the treatment plan and the prognosis, including:

- shock and/or hypovolaemia;
- thoracic injuries, including ruptured diaphragm and pneumothorax;
- CNS trauma, with implications for prognosis, anaesthesia and opiate use;
- spinal injuries;
- sacrococcygeal fracture/luxations;
- urinary dysfunction; and
- cranial/maxillary/mandibular injuries affecting the normal ingestion of food through altered mentation, olfaction or mechanical ability to ingest normally.

Diaphragmatic rupture is not uncommon after a road traffic accident. This can be clinically silent at presentation. Similarly, signs of peritonitis following biliary trauma can be delayed and insidious.

Sacrococcygeal fracture/luxations – "tail pull" injuries – may seriously compromise pelvic nerve function, but these fracture/luxations may not be obvious in one radiographic plane and orthogonal pelvic radiographs are required.

Urinary dysfunction may still be present in the absence of radiographic evidence of vertebral displacement. Return of urinary function may not occur at all after spinal/sacrococcygeal injuries. If function does return, it may take weeks – long after the opportunity for internal fixation of fractures has passed. It may be desirable to fix pelvic fractures before urinary function has returned for reasons of patient comfort, mobility and before the fractures become too problematic to reduce.

In this case, the owner must be counselled that, in the event that urinary function does not return, they may end up considering euthanasia a few weeks down the line. The caudal rectal/pudendal nerve supply to the anus and the pelvic nerve supply to the bladder/urethra both involve the S1 to S3 nerve roots. The continued absence of an intact anal reflex and the absence of tail sensation within a couple of weeks of the injury are poor prognostic indicators for the ultimate return of urinary function.

Nerve damage during pelvic trauma and limb disuse in the convalescent phase can both lead to dramatic hamstring muscular atrophy in the weeks following pelvic trauma. Owners should be counselled to expect this atrophy, as it can be a shock for them, even if the eventual outcome is good.

The lumbosacral nerve trunk, running medial to the iliac wing, can be impinged if the caudal part of the ilium displaces craniomedially (Figure 1). Fractures of the ischium often rotate distally under the pull of the hamstring muscles that originate from the ischial fragment. There may be sciatic nerve impingement by sharp craniodorsal features of the caudal fragment (Figure 2). Sacral nerve roots can be impinged by sacral fracture/luxations, which often pass through one or more of the sacral foramina.

Preoperative assessment should include as full a neurological examination as possible. This should include assessment of the anal reflex and tone, and assessment of tail sensation and movement. The sensation of the hind feet must be assessed. Digit two has femoral innervation and digit five has innervation derived from the sciatic nerve. Check for the presence of voluntary movement of the hindlimbs. In a recumbent, frightened, painful, potentially aggressive animal, subtle neurological deficits are easily overlooked.

The pelvis is a ring-shaped, rigid structure. A break in this ring structure implies interruption in at least two places – in the same way that a mug handle never breaks in just one place.

Pelvic fractures commonly involve combinations of:

- iliac wing;
- sacroiliac joint with or without sacral fragments;
- acetabulum; and
- ischium/pubis/pelvic symphysis.

Common management of various pelvic fractures:

- sacroiliac separations are typically treated conservatively or fixed with screws;
- iliac wing fractures are typically plated;
- acetabular fractures are typically plated, or occasionally managed conservatively – with or without delayed femoral head and neck excision;
- ischial fractures are typically treated conservatively or plated; and
- pubis fractures are almost always treated conservatively.

Conservative management

Conservative management of pelvic fractures involves analgesia, urinary management, cage rest, assisted lifting and physiotherapy. Conservative management is often appropriate when pelvic dimensions aren't seriously compromised, or when general anaesthesia is a problem for medical or financial reasons.

The pubis and the pelvic symphysis are commonly fractured in association with other pelvic injuries. They are typically not repaired, as they are not part of the weight-bearing axis, but simply provide for muscular attachments. Even if the whole floor of the pelvis is displaced, this can usually be managed conservatively. Occasionally, pubis and symphyseal fragments can cause serious lacerations to the urethra, necessitating reduction and fixation with wire sutures. Sometimes, a pubic fragment might be repaired as part of an abdominal rupture repair. Care needs to be taken to spare the obturator nerve that passes through the obturator foramen craniolaterally.

Sacroiliac luxations are often managed conservatively. If there is marked displacement, fixation may be considered. Sacral fracture/luxations often involve nerve impingement and require internal fixation with screws, transilial pins/bolts or locking plates.

Sacrococcygeal luxations are managed conservatively, as they

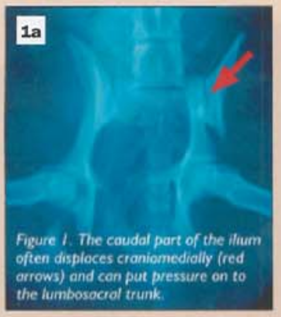

Figure 1. The caudal part of the ilium often displaces craniomedially (red arrows) and can put pressure on to the lumbosacral trunk.

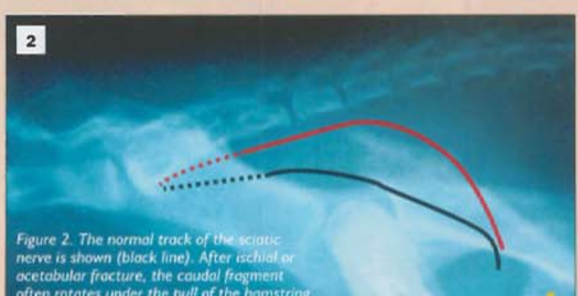

Figure 2. The normal track of the sciatic nerve is shown (black line). After ischial or acetabular fracture, the caudal fragment often rotates under the pull of the hamstring muscles (yellow arrow). The sciatic nerve can be displaced by the displaced caudal fragment (red line). This puts pressure on the sciatic nerve, resulting in pain and neural dysfunction.

Figures 3a and 3b. Concurrent bilateral sacroiliac luxations, ventrally displaced symphyseal fracture and sacrococcygeal luxation (red arrows) in a young cat. All were successfully managed conservatively.

Figures 4a and 4b. The avulsed left ischial tuberosity (red arrows) is obvious in the lateral view, but is almost obscured by the metallic marker in the ventrodorsal view.

are not amenable to surgical stabilisation. Tail amputation may be necessary to prevent a paralysed tail from getting caught on objects in the environment in the future, but this is best delayed for a few weeks until inflammation has settled down. Cage confinement until such time as tail function returns or the tail is amputated is wise to prevent further "tail-pull" injuries.

Concurrent bilateral sacroiliac luxations, ventrally displaced symphyseal fracture and sacrococcygeal luxation can all be managed conservatively (**Figure 3**).

Fractures of the caudal third of the acetabulum and of the medioventral part of the acetabulum can often be managed conservatively, whereas dorsal and cranial acetabular fractures require internal fixation with plates for best functional outcome.

Conservative management can be appropriate for ischial fractures, but internal fixation with plates may be indicated if there is pain from sciatic nerve impingment or if there is significant involvement of the acetabulum (**Figure 2**). Ischial tuberosity growth plate fractures are managed conservatively (**Figure 4**).

Conservative management is not usually recommended for fractures of the ilium and the craniodorsal acetabulum if surgery is an option. Plating relieves any nerve impingement and anatomical reduction allows rapid mobilisation and the best hope for return of good function.

Internal fixation

Sacroiliac luxations are typically treated conservatively or they are reduced and lag-screwed. Where significant compromise of pelvic dimensions results from sacroiliac luxation(s) with concurrent pelvic floor fractures, the pelvic shape can often be very satisfyingly restored with nothing more than one or two well-placed sacroiliac screws.

The approach to sacroiliac luxations is easy. Division of the muscle dorsal and medial to the iliac crest exposes the luxation gap between the sacrum and the iliac wing. However, the target area for screws in the lateral sacrum is small. The lateral face of the sacrum is not in the sagittal plane. Yet this is the surgical reference plane. If the drill is positioned perpendicular to the lateral sacral face, there is a high chance of inadvertently drilling into the L7-S1 intervertebral space. So the drill needs to be aimed off caudally by 10 degrees or so.

Care also needs to be taken to judge the drilling position between the dorsal and ventral borders of the sacrum to avoid drilling too far dorsally into the neural canal, and to avoid drilling too far ventrally into poor bone stock. To avoid inadvertently drilling too deep, use a sharp drill bit that can be controlled without the addition of much pressure. Consider seating the drill bit deeply in the chuck to limit the length of drill bit that is exposed beyond the chuck. Consider cutting a length of sterile drip tube to create a made-to-measure drill sleeve that allows the depth to be more accurately assessed during drilling.

Also, consider drilling with a pin rather than with a drill bit, with just a short amount of pin exposed beyond the chuck. Although the trochar tip of the pin generates more heat than a drill bit does, using a pin has two advantages over a drill bit. Firstly, breakage is far less likely. Secondly, in the extremely undesirable event of the pin penetrating the neural canal, a pin is less likely to "grab" delicate soft tissues.

Probe the depth of the drilled hole with a thinner pin – there should be a "bottom" to the hole. Assess the depth of the hole and choose a screw that won't quite reach the bottom. If a screw did hit the bottom, continued turning of the screw would then strip the threads. When bilateral luxations are fixed, there is the further potential problem of implant conflict if either of the screws crosses the midline (**Figure 5**).

Fracture/luxations of the sacroiliac junction often involve the sacral foramina and accurate reconstruction is challenging. The cancellous bone, especially if comminuted, can appear horribly unfamiliar and confusing. The target area for screws can be just a few square millimetres. The sacral nerve roots are waiting to be trapped between bone fragments or to be impinged by drills and implants. Traditional fixation with screws or transilial pins/bolts requires accurate reduction and introduces compressive forces at the fracture site.

The availability of affordable locking plates in recent years has greatly facilitated the fixation of many challenging pelvic fractures, including sacral, iliac and acetabular fractures. Screws "lock" into threads engineered into the locking plate, as well as gripping in threads cut into the underlying bone. Locking plates

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