Numerous small non-weight-bearing bones in dogs and cats may be sufficiently traumatized to result in fracture. A majority are sesamoids, bones that are located within a tendon or ligament. Another group of small bones do not occupy tendinous locations; they include the ribs, os penis, hyoid bones, and sternebrae. Another small bone, the clavicle, is present in cats and occasionally in dogs. It is located within the brachiocephalicus muscle.

FRACTURE OF SESAMOID BONES
PATELLAR FRACTURES

Patellar fractures are uncommon. Most occur as a result of direct trauma. Very rarely, the patellae may fracture bilaterally.

The patella usually fractures transversely; however, it may also fracture longitudinally, it may comminute, or it may simply avulse the proximal or distal pole. Almost all fracture types are intra-articular (Figs. 33-1 and 33-2).

FIG. 33-1 Cranial-caudal (A) and medial-lateral (B) radiographs demonstrate transverse fracture of a canine patella.

FIG. 33-2 Medial-lateral radiograph demonstrates a comminuted fracture of a canine patella.

Physical examination generally demonstrates crepitus on palpation of the knee. The crepitus will be more prevalent with direct pressure over the patella. In avulsions or complete fractures that include quadriceps tearing, the patellar ligament may be lax; however, most patellar fractures do not include complete quadriceps tearing. Radiographs are needed to arrive at a definitive diagnosis.
Closed reduction is impossible owing to the constant pull of the quadriceps; distraction will be maintained, and nonunion will result. As a result of the nonunion and irregular articulating surface, degenerative arthritis of the knee can be anticipated.

Open reduction and fixation is accomplished by a lateral or medial parapatellar arthrotomy incision. This will allow for complete visualization of the fracture fragments as well as of the articular surface. Reduction is accomplished by placing the knee in extension, thus relaxing the quadriceps.

Small fragments or multiple small comminuted fragments must be removed. Only large pieces possessing articular cartilage need to be reduced. If necessary, up to one half of the patella can be resected.

**METHODS OF FIXATION**

Many methods of internal fixation have been used over the years. Because numerous simple wiring techniques failed, the biomechanics of the knee were studied. Such studies demonstrated that like weight-bearing long bones, the patella has a compression side and a tension band side. The tension band surface is cranial; therefore, successful repair depends on the fixative being placed cranial to the midline or preferably on the cranial surface (Fig. 33-3).

Fixation is achieved best using a classic tension band wire or any solid wiring technique that firmly aligns the fragments and is tied over the cranial surface of the patella. The better methods require that some portion of the fixative penetrate the patella. Whereas circumferential wiring, which takes purchase in the surrounding tendinous and ligamentous insertions and origins, may be adequate, failure is common owing to wire slippage.

Simple interfragmentary screw fixation may be used in patellar fractures but is best suited to longitudinal fractures. If used for a transverse fracture, a tension band wire should also be applied to prevent the screw from bending and failing.

If in doubt as to patellar stability, an additional tension band wire may be used to protect the fracture site. This wire should relieve all tension in the patellar ligament; therefore, it is looped over the patella proximally and is anchored distally through a transverse hole in the tibial crest. This latter wire will undoubtedly break in 6 to 10 weeks of weight bearing; however, it will release the tension long enough to allow for patellar union (Fig. 33-4).

**AFTERCARE AND COMPLICATIONS**

Dogs or cats should be allowed full weight-bearing activity. If additional external fixation is added, loss of joint range of motion will result. Normal activity will also tend to smooth the intra-articular callus and hopefully will minimize secondary degenerative joint disease.

The most common complication is fixation failure due to inadequate technique. If the fixative is placed caudal to the central patellar axis and falls on the compression surface, it will bend, fatigue, and fail. The second most common problem is secondary degenerative joint disease. This can be minimized by prompt, adequate internal fixation. Nonunion may occur but is rare.
MEDIAL AND LATERAL FABELLAE OR POPLITEAL SESAMOID FRACTURES
The medial and lateral fabellas and popliteal sesamoid reside in muscular tendons of origin or insertion around the knee. Fractures of these bones are very rare and are usually caused by direct trauma. As a result of their position in tendons of large muscles, these fractures are always under tension and thus provide a source of pain. Diagnosis determined following careful palpation over the bone location. Deep palpation will produce pain, but only rarely crepitus. Radiography will provide a positive diagnosis.

Due to the small size of these fractures, reduction is not feasible. Surgical excision of one or both of the bony fragments is the method of treatment that most commonly results in success. Care must be taken when excising the fragments not to damage the associated tendinous attachment. Postoperative care should include normal activity. If these fractures are untreated, nonunion will result and may or may not cause pain.(8)

PALMAR AND PLANTAR SESAMOID FRACTURES Fracture of the palmar and plantar sesamoids is primarily a problem of racing greyhounds; however, one author has described the problem in the rottweiler, the boxer, and the St. Bernard.(1)

Nonworking dogs with sesamoid fractures present with acute lameness of the paw. Palpation of the affected area will demonstrate mild to moderate swelling and pain. Thumb pressure over the fractured bone with dorsiflexion of the affected digit will result in apparent pain and possibly crepitus. Sesamoids two and seven are fractured most frequently. Animals with acute injuries have pronounced lameness, whereas chronic fracture produces a variable amount of lameness. Radiography will help to confirm the diagnosis. Proper positioning to separate the digits is critical.

Acute fractures are rarely treated successfully by external immobilization. If pain continues or nonunion develops, surgical resection of the bony fragments is required. Chronic lameness caused by chronic fracture nonunion requires surgical intervention (Fig. 33-5) The following technique is quoted from Berg. (1)

The surgical site should be prepared in the standard manner and the dog positioned so that the palmar or plantar aspect of the foot is presented to the surgeon. In most dogs, the involved sesamoid will be associated with either the second or fifth digit. In these dogs an incision is made adjacent to the metacarpal pad, extending 1.5 cm proximally from the metacarpophalangeal (metatarsophalangeal) joint and 1.5 cm distally. At the proximal end of the incision, care should be taken to identify the distal venous arch. The metacarpal (metatarsal) pad is undermined slightly to begin dissection down to the affected sesamoid in a direct manner, rather than approaching it from the side. With this technique, little if any bleeding is encountered. The sesamoid bone is reached by blunt dissection using both small mosquito forceps and sharp/sharp scissors. The flexor tendon is moved aside, if necessary, to reach the sesamoid.

![FIG. 33-5 (A) Dorsopalmar radiograph demonstrates a comminuted fracture of a palmar sesamoid. (B) Postoperative radiograph demonstrates resection of the bone fragments.](image)

If sesamoid 6 or 8 is involved, the tendon need not be touched. After the sesamoid bone is reached, the sesamoidian ligaments are cut, at which time some joint fluid will escape. The damaged sesamoid bone is then removed.

In all cases, a small chisel or periosteal elevator is necessary to loosen the sesamoid bone from the underlying metacarpal (metatarsal) bone to which it has become adhered. Once loosened, both fragments of bone peel off easily, leaving a smooth metacarpal (metatarsal) bone beneath. It is imperative that all periosteal reactive bone be removed. As in man, the distal fragment or associated reactive bone, or both, are often wedged within the metacarpal (metatarsal) joint. Closure is accomplished by placing two interrupted 2-0 gut sutures through the medial and intersesamoidian ligaments, thereby closing the defect created by removing the sesamoid bone. The skin is then sutured with nonabsorbable suture material. The foot is splinted with a Mason meta splint for one week and sutures removed in ten days.
Complications following surgery are minimal, since the fractured bones have been removed. Problems associated with sesamoid fractures in the racing greyhound are discussed in Chapter 35.

FRACTURE OF THE RIBS
Rib fractures are associated with blunt chest trauma and may be undiagnosed if fractures of the appendicular skeleton are also present. The polytraumatized dog or cat frequently has rib fractures due to the severity of trauma. Rib fractures may be accompanied by one or more of the following signs: cough, dyspnea, cyanosis, pain, chest distortion, or subcutaneous emphysema. Pneumothorax or, more rarely, hemothorax may be present.

DIAGNOSIS
Single rib fractures are found if they are painful on palpation, protrude sharply into the subcutaneous tissues, or are significantly depressed into the chest. Radiography is likely to demonstrate the fracture in the course of routine chest films. Single rib fractures rarely require treatment (Fig. 33-6).

Multiple rib fractures (Fig. 33-7), usually in groups of three continuous ribs or more, may result in a flail chest and therefore require surgical correction. Ribs with multiple fractures per rib may also produce a flail chest and require surgical correction. Fractured ribs that penetrate into lung tissue must also be corrected.

SURGICAL REPAIR
Surgical repair of rib fractures requires special preoperative considerations. Since it is likely that the pleural cavity will be opened, positive pressure ventilation will be necessary. If severe lung damage is found, thoracotomy and lung lobe resection may have to be performed prior to rib reconstruction.

When proper preoperative preparations have been considered, the fracture or fractures can be approached. A skin incision directly over the fractures is usually adequate. Extensive dissection of the intercostal muscles is rarely needed. Once exposed, the fractures can be reduced and fixed using either simple wire sutures of orthopaedic wire or by using Kirschner wires as intramedullary pins. If Kirschner wires are used, they should be placed in a fashion that allows for implant removal following bony union (Fig. 33-8).

Large flail chests can be treated by improvised external chest cages to properly align the ribs to give adequate chest volume.
These external frames use multiple sutures around the ribs and attach to the frame.

Following surgery, the animal's chest should be aspirated; indwelling chest tubes may be necessary if lung damage was corrected simultaneously. Encircling chest bandages are unnecessary and may impair normal lung expansion. Postoperative complications of rib fractures are rare; however, complications due to thoracotomy or lung trauma may be considerable and require prolonged care.

FRACTURES OF THE OS PENIS
Fracture of the os penis can result from trauma associated with kicks, jumping fences, or breeding injuries. Because of the association of the os penis with the penile urethra, most signs at presentation relate to the urinary system. Clinical signs include frequent urination, hematuria, anuria, and pain when urinating. Pain, swelling, and crepitus will be present on palpation of the penis. Radiography will confirm the diagnosis (Fig. 33-9).

![FIG. 33-9 Medial-lateral radiograph demonstrates fracture of a canine os penis.](image)

Treatment necessitates thorough assessment of the urinary system. If laceration or stricture of the penile urethra is documented, surgical intervention and correction is needed. The os penis fracture may not need internal fixation if the urinary system is normal. Insertion of a French rubber catheter may provide a patent urinary tract and serve as an internal splint. (6,13)

If continual motion of the fracture fragments leads to recurring urethral trauma, internal fixation may be necessary. Usually simple interrupted sutures of orthopaedic wire through both bony fragments is adequate fixation (Fig. 33-10). Care must be taken to avoid the penile urethra. While reports do exist documenting treatment using small plates or the Kirschner-Ehmer apparatus, this degree of fixation seems unwarranted.

Postoperative complications may involve continued urinary discomfort due to urethral constriction or blockage. Some animals may require urethrostomy to resolve this complication.

![FIG 33-10 Illustration of a single orthopaedic wore suture in the dorsal os penis as a method of internal fixation for fracture.](image)

FRACTURE OF HYOID BONES
Hyoid bone fracture may be the result of direct trauma, such as choke collars, car accidents, or gunshot wounds. Concomitant soft tissue injuries of the neck frequently mask the fracture. Conversely the possibility of fracture may be overlooked if the external soft tissue injury is slight. Asphyxia with pharyngeal and laryngeal spasm may be fatal unless relieved promptly by tracheotomy.(9-11) The following discussion is quoted from Papavasiliou.(10)

Severe pain accentuated by swallowing, dysphagia or severe dyspnea may occur. Tongue protrusion may produce suffocation. Bone fragments may penetrate the soft tissue of the pharynx and cause profuse bleeding. Extensive subcutaneous emphysema may develop.

Radiographic criteria for diagnosis are a radiolucent line, interruption of the cortical continuity or displacement of the fragments. The fracture may be comminuted. No particular treatment of the fracture is necessary even when comminuted.
CLAVICULAR FRACTURES
The clavicle is present routinely in cats and occasionally in dogs. It resides cranial to the shoulder within the brachiocephalicus muscle.

Direct trauma may fracture the bone. Physical examination will demonstrate swelling, pain, and possibly crepitus on palpation. Radiographs may confirm the diagnosis if the bone is adequately projected.

No treatment of the fracture is required even if it is comminuted.

FRACTURES OF THE STERNEBRAE
Fractures of individual sternebrae are uncommon. Diagnosis relies on careful palpation of the sternum, checking for deformity or crepitus. Dyspnea, pneumothorax, or hemothorax may be associated with this fracture. Radiography confirms the diagnosis (Fig. 33-11). Treatment is rarely required unless the fracture results in a severe cosmetic deformity.

FIG. 33-11 Medial-lateral radiograph demonstrates fracture of a sternebra.

REFERENCES

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