

Fracture Repair – General Information

What is a fracture and how do they develop?

Fractures occur commonly in dogs and cats. Appropriate repair of these fractures is essential for return to function and to an active, pain free life. Fracture repair is a significant portion of the specialized training that board certified surgeons receive during a surgical residency. We are highly trained in numerous methods of fracture repair and have access to a vast inventory of specialized equipment and implants. We can provide your pet the best chance for a return to normal function.

Most fractures are the result of trauma, such as being hit by a car, falling from a height, being stepped on, or from a fight. Some fractures occur as a result of relatively minor trauma. In these cases, the bone is abnormally weak due to underlying disease processes (cancer, hyperparathyroidism, or severe nutritional imbalances).

What types of fractures exist?

Fractures are described and classified depending on a variety of factors, including the location of the fracture within the bone, the number of fragments present, and whether the skin over the fracture is intact or not. When a bone breaks into two pieces the fracture is described as a “simple fracture”. When there are several pieces, it is a “comminuted fracture”. It is important to determine if the skin over the fracture is intact. In most cases the skin is intact. This is known as a closed fracture. If the skin is open it is considered an open fracture. Open fractures can be severely contaminated. Proper management of these injuries is essential in order to achieve an acceptable outcome.



Picture©: D. von Pfeil

Simple fracture



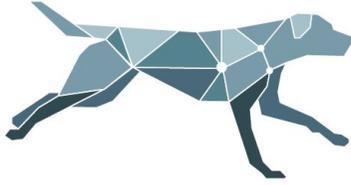
Picture©: D. von Pfeil

Comminuted fracture

Fractures in young animals are classified separately. Their bone contains a zone of cartilage near each end of each long bone. This zone of cartilage is where growth occurs and is referred to as a growth plate. Growth plates are inherently weak, relative to the surrounding bone. Consequently, fractures in young, growing animals often occur at, or through, the growth plates. These fractures are referred to as Salter-Harris fractures and are categorized according to the configuration of the fracture). *Please see our handout on Orthopedic Problems in the Immature Dog for additional information on Growth Plate Fractures.*

What needs to be done prior to fracture repair?

Most patients with fractures have suffered significant trauma. Consequently, these patients are thoroughly evaluated to ensure that they are free of potentially life-threatening injuries. For example, when a dog is hit by a car, there may be damage to the lungs, urinary bladder, or the vertebral column (back bone). In addition to a thorough physical examination, radiographs (x-rays) of the chest and belly, laboratory tests, an electrocardiogram (ECG), and a complete neurological examination may be indicated prior to anesthesia for fracture repair. In many cases, fracture repair is postponed to allow resolution of more life-threatening problems.



How is a fracture repaired?

Fracture repair is performed once the animal is stable enough to undergo anesthesia safely. Depending on the specific fracture, various stabilization methods are available. Your surgeon will explain the various repair options appropriate for your pet and will make recommendations based on thorough consideration of all factors. It is important to realize that stabilization of the fracture is only the first step in a long process. Proper postoperative care is essential in order to achieve a successful outcome. Your surgeon and the hospital staff will make specific recommendations for the postoperative management and care of your pet. Please follow these instructions closely and be sure to call us if you have questions or concerns.

The following paragraphs will explain some of the most common methods of fracture fixation.

External Coaptation (splint or cast): In some cases, the bone is only cracked. This is referred to as a fissure or greenstick fracture. Many patients with greenstick fractures can be successfully treated with a cast or splint. Some patients suffer complete fractures; however, the fragments remain in place. Many of these patients, especially very young or very small patients can be successfully treated with a cast or splint.

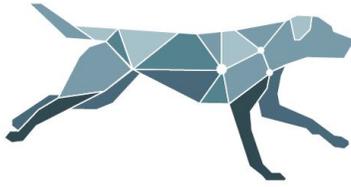


Picture©: D. von Pfeil

Patients with casts or splints should return to the hospital weekly for evaluation.

Fractures of the metacarpal or metatarsal bones (long bones of the feet) often can be treated in this way. A cast is first applied by wrapping the leg with cast padding. Fiberglass cast material is then wrapped around the padded leg. In some cases a splint is applied, rather than a cast. With splinting, the leg is padded the same as for a cast. The difference is that a splint is typically applied to one surface of the leg, rather than being wrapped around it. Splints can be made of fiberglass, moldable plastic, or aluminum rods. The cast or splint should extend above the joint above the fracture and down to the toes. Pressure sores are a common complication associated with external coaptation. If the cast slips or is chewed by the patient, it can act like a fulcrum and actually apply more stress on the fracture. In some cases, the bandage can act like a tourniquet and create severe complications. Consequently, animals with casts or splints require constant close supervision.

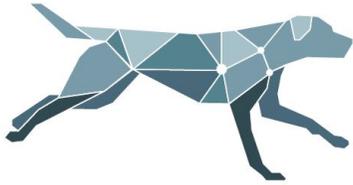
Intramedullary (IM) Pin: An intramedullary pin is a stainless steel pin introduced into the medullary cavity of a long bone and utilized to stabilize a fracture. IM pinning is one of the oldest forms of fracture fixation in use today. IM pins alone, have limited application in veterinary medicine.



Interlocking nail: An interlocking nail is a form of intramedullary pin that accommodates screws in each end. These screws are intended to lock the pin in place and to allow resistance to compression and rotation. The advantages of interlocking nails are that they can be applied in most cases through small incisions. Thus, this method of repair is less invasive and more cosmetic, compared to a traditional open approach. Some reports show that healing occurs more rapidly than with other implants. This is most likely because the surgical procedure is less invasive. Dr. von Pfeil was involved in development of an interlocking nail (I-Loc). Interlocking nails are the state of the art to treat fractures of the long bones in humans due to their overall advantages when compared to bone plates.

Bone plate: Bone plating has been shown to be an extremely effective means of fracture repair. The potential forces acting on the bone at the fracture site include bending, rotation, compression, shear, and tension. Properly applied bone plates are capable of counteracting all these forces thus ensuring a very stable fracture repair. A stable repair increases the likelihood of uncomplicated bone healing and a successful outcome. In the traditional form of plating for fracture repair, the bone fragments are exposed through an open approach. The fragments are then reduced (put back in place) and held together with a combination of bone holding forceps and wires while a plate is contoured to match the shape of the bone. The plate is then applied to the surface of the bone and secured with screws. Cerclage wire can be used to stabilize these regions of bone. Thorough knowledge of the regional anatomy is crucial to a successful outcome. Care must be taken to avoid damage to local nerves and major blood vessels. Care must also be taken to avoid unnecessary damage to the surrounding musculature. Consequently, the surgeon must be well trained in the approach to the affected bone. The plate must be accurately contoured to match the shape of the bone and it must be applied to the proper surface of the bone in order to effectively neutralize the forces acting on the fracture site. Bone plates are usually left in the patient unless problems occur. Some patients experience discomfort during cold weather after bone plate application. In these cases, or if a plate becomes loose, or there appears to be infection, we recommend removal of the bone plate after the fracture is adequately healed. In very young dogs it may be beneficial to remove a bone plate once bone healing has occurred. One disadvantage to bone plate application using the traditional approach is that it usually requires an extensive approach for exposure of the fracture site. Creating this approach compromises blood supply to the region and may slow bone healing. In select cases, it may be possible to reduce the fracture and apply a bone plate or screws and wires using a minimally invasive approach. This is accomplished through the use of a video style X-ray unit (fluoroscope) and other specialized equipment. We currently utilize these techniques wherever possible. Bone plating in a minimally invasive manner preserves the soft tissues around the injured bone, and has been shown to provide faster healing than traditional plating. As with any type of fracture repair, bone plate application can be technically demanding. Our surgeons are highly experienced and have been specifically trained in this technique.

Bone plate and rod combination: Severely comminuted fractures are often treated with a combination of bone plate and rod. In some severely comminuted fractures, small fragments are present which cannot be effectively reduced and incorporated into the fracture repair. Excessive manipulation of these fragments results in unnecessary compromise of blood supply. In cases like this, it is preferable to minimize manipulation of the fragments. These fractures can be treated with a combination of an intramedullary pin and a bone plate. The pin is used to align the top and bottom fragments of the bone and to provide resistance to bending forces acting on the fracture site. A bone plate is then contoured to the shape of the upper and lower fragments and is secured with screws to the major fragments. Biomechanical studies have shown that this technique provides a significant increase in strength of the repair. When using this method of repair, manipulation of the fragments is avoided. The blood supply is minimally disrupted in most cases, thus resulting in earlier callus (healing bone tissue) formation, and earlier healing than may otherwise occur. This technique is most commonly utilized on fractures of the femur. The femur is the bone between the hip and the knee. This technique is most appropriate for fractures involving a significant portion of bone. One challenge inherent in the treatment of this particular type of fracture is to accurately align the hip and the knee and to restore the leg to an acceptable length. This can be extremely challenging when a significant portion of the bone cannot be reconstructed. Our surgeons are highly experienced and have been specifically trained in this technique.



External fixator: An external fixator consists of several pins driven through the skin, into the bone, and sometimes exiting on the other side of the leg. The ends of the pins, protruding out of the skin, are connected by a series of clamps to a side bar or ring. An external fixator is applied to a fracture when there is a large open soft-tissue wound in concurrence with the fracture, or if there is severe comminution, which cannot be reconstructed. External fixators can be applied to a variety of fractures. They are probably most appropriate for open fractures because they can be applied without spreading the contamination further. Similarly, since they can often be applied without exposing the affected bone, the healing process is not interrupted and may progress more rapidly. Some surgeons prefer external fixation over bone plate application because it does not require shaping the implant to match the shape of the bone. The external fixator is removed after the fracture has healed. External fixators can also be applied across joints. This means that they can be used to treat fractures present in the joint or to provide additional support for joint fractures stabilized with pins and screws. The main disadvantage to an external fixator is the fact that your pet will have a bulky, metallic apparatus present on his or her leg for at least 8 weeks. This apparatus can injure other pets or people in your house and can damage furniture. There is the potential for the device to get caught on furniture and vegetation. The potential exists for contamination of the pin tracts from environmental sources. Drainage from the pin tracts is a common occurrence. Careful attention to detail during application and postoperative care is necessary in order to maximize the potential for an excellent outcome. If your pet is treated by external fixation, your surgeon will most likely recommend re-evaluation here at least once a week. These rechecks will allow us to evaluate the progress your pet is making toward healing and to assess integrity of the fixator. Occasionally, it is necessary to tighten clamps, remove pins, or add pins. Our surgeons are well trained in the application and maintenance of external fixators.

Screws, pins, and wires: Some fractures, especially those near joints, create fragments too small to accommodate a bone plate or external fixator. In these cases the small fragments can be stabilized with implants such as cerclage wire, screws or pins. Cerclage wire is stainless steel, surgical grade wire that is used to encircle bone and stabilize a fracture. Kirschner –wires (K-wires) are small, typically smooth, pins that can be used to secure small bone fragments. In many cases a combination of screws, pins, wires and bone plates are used to stabilize a fracture.

Examples of the methods of fracture repair as explained above can be seen in the following images:



Plate

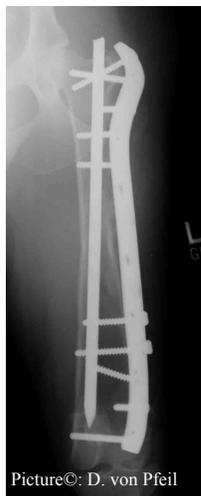


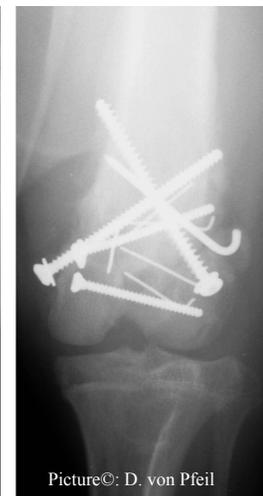
Plate-Rod



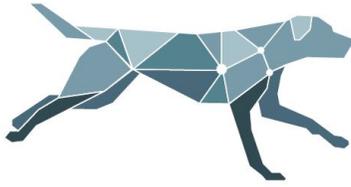
External Fixator



Interlocking Nail



Screws and Pins



What is involved in the postsurgical care after fracture repair?

Fracture repair is only the first step on the road to recovery. During the postoperative period, it is important to work closely with your surgeon and with your regular veterinarian. This will help reduce the risk of a complication. Even more importantly, it may allow early detection of a potential complication. Typically speaking, it is easier to address a complication if it is detected early.

- Activity at home:

After surgery it is important to limit your pet's activity for 6-8 weeks. If your pet is too active during the postoperative period, the surgical implants may loosen. This will create motion at the fracture site and will delay bone healing. If the fracture was open and contaminated or infected, bone healing will be delayed. Older patients exhibit slower bone healing. Highly comminuted fractures and fractures with gaps between the fragments take longer to heal. The patient should be separated from other pets and should not be allowed to run, jump, play or roughhouse during this time. Short leash walks, for bathroom breaks only, are allowed.

- Monitoring the incision:

The incision is usually covered with thin Band-Aid. This should be removed at 2-3 days after surgery. Thereafter, the incision should be inspected twice daily for excessive redness, pain, swelling, odor, or discharge. Please contact either us or your regular veterinarian if you notice any of these signs.

- Icing and application of warm packs to the surgical site:

The first three days after surgery, cold compresses should be applied to the surgical site – as long as no bandage is applied. This will help to reduce the post-surgical inflammation. A clean and dry cotton cloth is placed over the incision, and an ice bag is applied to the area for 5-10 minutes, if possible three times daily.

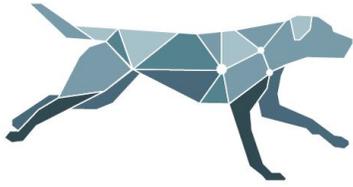
During days three to five a warm pack can be applied in a similar manner. We typically provide a commercial pack that can be used for icing and heat application. Otherwise, you can fill an old sock with dry rice grains, put the pack into the microwave to heat it up until it is "hand-warm", and then apply this pack to the surgical site for 5-10 minutes. This will help to increase the blood supply to the area, which in turn results in faster healing.

- Cone / E-collar:

Elizabethan collars are used to prevent the animal from licking or chewing the bandage or incision. Contact us if your pet does not tolerate the Elizabethan collar. We can make suggestions for alternative forms of restraint for your pet. It is, however, important to prevent licking or chewing the bandage or incision line.



An Elizabethan or similar collar has to be on for at least two weeks. It is used to prevent the animal from licking the incision or bandage. Licking or chewing at the surgical site may lead to severe complications.



• **Bandage care:**

As indicated above, a cast or bandage are sometimes used as sole means to stabilize a fracture. But they can also be applied to support a primary fracture repair, for example after using a bone plate.

Bandage care is imperative to prevent problems during the recovery period. The bandage must be kept dry and clean.



Picture©: D. von Pfeil

Check the toes for swelling 2x/day.



Picture©D. von Pfeil

Keep bandage dry



Picture©: D. von Pfeil

Protect bandage when going outside

Place a sturdy plastic bag over the bandage when going outside, and remove it when back inside. Do not allow your pet to step into a water puddle. Do not allow your pet to lick or chew on the bandage. The bandage material works like a wick in an oil-lamp, and any moisture that is apparent on one end of the bandage, is likely to move up on the inside of the bandage, possibly leading to skin infection. Contact us immediately if there are any concerns with the bandage Even if there is no damage to the bandage, frequent bandage changes may be necessary to minimize the risk of complications, such as pressure sores underneath the bandage.

At what point do I need to return to the clinic for rechecks?

Incision recheck:

The incision is typically inspected and staples or skin stitches are typically are removed at the 10-14 day recheck. In some cases, the incision is closed with absorbable suture, which is placed underneath the skin surface. These sutures do not need to be removed. In some cases the suture knots buried under the skin create small bumps which you will be able to feel. These will resolve over time, but occasionally removal is needed with chronic irritation – this is done without sedation.

Monitoring of bone healing: x-ray rechecks:

Follow up radiographs (x-rays) are taken in most cases after 8 weeks. In young animals, or with specific fracture types, this may be done earlier. At that time bone healing is evaluated, and a plan will be created for rehabilitation to ensure the best outcome possible. If the fracture remains unhealed, we will recommend an additional 4 weeks of activity restriction and radiographs will be repeated.

What are possible complications following fracture repair?

Possible complications with fracture repair may include but are not limited to infection, muscle contracture, growth plate damage, implant loosening or failure, nerve dysfunction, delayed -non- or malunion. However, with appropriate surgery and post-operative care, we do not expect complications to occur. With most fractures it can be anticipated that excellent bone healing will occur, and the patient will return to normal activity over time.