Percutaneous Pinning for Fracture Repair in Dogs and Cats

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KEYWORDS

• Growth plate fracture • Pinning • Percutaneous • Minimally invasive

KEY POINTS

- Pinning is the treatment of choice for the surgical repair of physeal fractures.
- All traditional principles of intramedullary or cross-pinning apply when considering the use of percutaneous pinning.
- Fractures should ideally be minimally displaced with a signification portion of bridging periosteum remaining intact.
- A thorough physical and orthopedic examination should be performed to identify any serious concomitant injury.
- For closed reduction of physeal fractures, the precise technique depends on the direction and degree of displacement of the epiphysis.

INTRODUCTION

Steinman pins or Kirschner wires (herein referred to as pins) can be used to stabilize a variety of different fracture configurations in the dog and cat.[1–3] Traditional pinning of fractures has been typically described with an open approach in order to achieve direct reduction and facilitate accurate placement of implants. When this method of fracture fixation is performed in a minimally invasive fashion, the procedure is known as percutaneous pinning. Placement of pins in a minimally invasive fashion through small stab incisions may offer significant advantages when compared with traditional open pinning, such as less postoperative pain, accelerated healing, and less iatrogenic trauma to important structures such as the physes and joint capsule.[4] Juxta-articular pediatric fractures in humans are frequently treated in this manner.[4–8] Percutaneous pinning has been used at the authors' institution with a high success rate; however, appropriate case selection, fluoroscopic guidance, and surgeon experience is required if it is attempted. The purpose of this article is to describe the optimal selection of cases, surgical technique, and anticipated outcomes for percutaneous pinning in the dog and cat.

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SURGICAL TECHNIQUE

Case Selection

All traditional principles of intramedullary or cross-pinning apply when considering the use of percutaneous pinning. Salter-Harris type I and II physeal fractures are the most amenable to this form of fracture fixation, for several reasons. Pins mainly serve to counteract bending forces, whereas rotational and compressive forces are poorly neutralized, even when multiple pins are used. As such, juxta-articular, noncomminuted fracture configurations with some inherent stability after reduction are suitable for stabilization by use of pins alone. Because pins have limited ability to sustain long-term stability in all 3 planes when compared with other forms of fixation, pinning alone is generally used in young animals with rapid capacity for bone healing. As pins cannot provide interfragmentary compression, intra-articular fractures should not be treated with pins alone.

Candidates for percutaneous pinning must meet additional criteria to those already described. Fractures should ideally be minimally displaced with a signification portion of bridging periosteum remaining intact. Intact periosteum has the potential to further contribute to stability by acting as a tension band if combined with appropriately positioned pins.[9] Percutaneous pinning may still be possible in moderately displaced fractures, as long as the interval between trauma and surgical intervention is short. Closed reduction will not be possible in fractures that are not immediately treated (more than 24–48 hours after trauma), because of muscular contraction and adhesions from callus formation. Very small fracture fragments can be difficult to palpate, manipulate, or identify with intraoperative fluoroscopy, hence an open approach is more suitable in these cases. Fracture fragments that are covered with large amounts of soft tissue may also be more difficult to align with indirect methods, which may preclude the use of percutaneous pinning.

The authors have successfully performed percutaneous pinning for Salter-Harris type I and II fractures of the distal femoral, femoral capital, proximal tibial, tibial apophyseal, distal tibial, distal radial, and proximal humeral physes.

Preoperative Management and Planning

Preoperative planning for fracture repair must begin with appropriate case selection, as already described. A thorough physical and orthopedic examination should be performed to identify any serious concomitant injury. At a minimum, thoracic radiographs and orthogonal-view radiographs of the affected bone are acquired. Radiographs typically require moderate sedation or anesthesia to achieve optimal positioning and projections. It is strongly recommended to obtain radiographs of the contralateral bone. Comparing contralateral radiographs can help accurately discriminate minimally displaced physeal fractures from normal physeal anatomy. Rarely, stress radiographs are necessary to demonstrate location and degree of instability of a physeal fracture. Radiographic tracings of the fracture fragments in normal alignment, or digital templating is required to plan pin insertion site, size, and trajectory. Implant size and positioning is often more accurate when planned from the normal contralateral radiographs, because it is not uncommon for fracture segments to be rotated out of plane.

As manipulation of the affected limb may not be well tolerated, sedation for radiographs presents an opportunity to carefully palpate the fracture site. Thorough palpation of the fracture is particularly crucial when considering percutaneous pinning. Occasionally, minimally displaced fractures that retain extensive soft-tissue integrity may be stable enough to treat conservatively with cage rest with or without external coaptation. At the other end of the spectrum, physeal fractures that are several