Minimally Invasive Plate Osteosynthesis in Small Animals

Radius and Ulna Fractures

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KEYWORDS

• Plate osteosynthesis • MIPO • Fracture • Radius • Ulna

KEY POINTS

- Minimally invasive plate osteosynthesis for radius and ulna fractures is performed by reducing the radius in a closed, indirect fashion and applying a dorsal bone plate through two small plate insertion incisions made remote from the fracture site.
- The surgical approach for minimally invasive plate osteosynthesis of the radius preserves the soft tissue structures and vascular supply supporting the fracture site which results in rapid bone healing.
- A simple circular fixator frame is an excellent tool for facilitating closed reduction and alignment of radius and ulna fractures prior to minimally invasive plate stabilization.
- Minimally invasive plate osteosynthesis is most suited for acute, comminuted radius and ulna fractures, but can be applied to chronic fractures or simple fractures in selected cases.
- Open reduction and internal fixation may be a better surgical option than minimally invasive plate osteosynthesis for most simple oblique, open, or chronic mal-aligned radius and ulna fractures.

INTRODUCTION

Radius and ulna fractures are common in dogs and cats with the radius being the third most commonly fractured bone in dogs in one study.[1,2] The most common cause of fractures of the radius is traumatic injury due to a fall.[2] Surgical management of radius and ulna fractures typically consists of the application of a bone plate and screws or an external skeletal fixator to stabilize the radius.[2,3] Bone plates have traditionally been applied to the cranial or, less commonly, the medial surface of the radius using an open surgical approach and direct reduction of the fracture.[4–6] More recently, minimally invasive bone plating techniques have been developed that minimize soft tissue

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trauma and preserve the vascular supply to the fracture site to a greater extent than is possible with an open surgical approach.[7–12] The technique of minimally invasive plate osteosynthesis (MIPO) entails the stabilization of a fractured bone with a bone plate and screws that are applied without performing an extensive open surgical approach to directly expose, reduce, and stabilize the fracture. When MIPO is performed, the fracture segments are aligned using indirect reduction techniques in a closed fashion. Small plate insertion incisions are made over the anticipated (intended) locations of the proximal and distal ends of the bone plate. An epiperiosteal tunnel is developed adjacent to the fractured bone, beneath the overlying soft tissues. The epiperiosteal tunnel extends from one plate insertion incision to the other, spanning the fracture site. The plate is inserted through the tunnel and fixed in place with screws inserted through the plate insertion incisions. Small stab incisions can be made over unexposed plate holes to insert additional screws if necessary. MIPO techniques can result in superior preservation of blood supply to the fracture site,[13–15] less disruption of supporting soft tissue structures, and potentially a faster return to function and more rapid bone healing than would be achieved with an open surgical approach to facilitate bone plating.[16]

ANATOMY OF THE RADIUS AND ULNA

The closed reduction techniques and small plate insertion incisions used when performing MIPO do not allow direct observation of the fascial layers and neurovascular structures around the fracture site. A thorough knowledge of the anatomy of the antebrachium is essential for performing MIPO to stabilize radial fractures to prevent complications.

The radius and ulna articulate by means of the proximal radioulnar joint, the distal radioulnar joint, and along their length are bound together by a strong interosseus ligament. The architecture of the joints and supporting ligaments permit minimal translational motion between the radius and the ulna while some rotational motion, known as pronation and supination of the distal limb, is allowed.[17] The caudal interosseus branch of the common interosseus artery, which originates from the median artery, runs in the interosseus space between the radius and ulna and supplies a nutrient artery to both the radius and ulna. The nutrient arteries enter at the level of the proximal third of the radius and the distal third of the ulna.[18]

Under the skin, the antebrachium is surrounded by a delicate superficial antebrachial fascia layer. Underneath and protected by the superficial antebrachial fascia, the cephalic vein, two branches of the cranial superficial antebrachial artery, and two branches of the superficial radial nerve course together on the dorsomedial aspect of the antebrachium. During the surgical approach to the distal aspect of the radius, the superficial fascia is incised lateral to the cephalic neurovascular bundle, after which the neurovascular bundle is gently retracted medially. Under the superficial antebrachial fascia is a deep antebrachial fascia layer that surrounds and protects the antebrachial muscles. The deep antebrachial fascia will also be incised during the surgical approach to the radius to expose the underlying antebrachial muscles.

INDICATIONS AND DECISION-MAKING

Simple Versus Comminuted Fractures

Proper case selection is important to achieve good outcomes with MIPO. MIPO is not the optimal fixation technique for all radius and ulna fractures. When MIPO is performed to stabilize a radial fracture, the bone plate is typically applied in bridging fashion and secondary bone healing with proliferative callus formation is expected.[19]