Updates in fracture repair: Minimally Invasive Plate Osteosynthesis (MIPO)

In 1958, a group of Swiss orthopaedic surgeons formed the AO foundation, also known as the Association for the Study of Internal Fixation (ASIF). They established principles for fracture management that helped standardize fracture treatment protocols for the human and veterinary community. Initially, the AO recommended precise anatomic fracture reconstruction (known as direct reduction) be performed prior to internal fixation for all fracture configurations. However, in highly comminuted fractures, which are common in veterinary patients, anatomic reconstruction requires extensive surgical exposure, manipulation of fracture fragments, and additional injury to the supporting soft tissue envelope. Anatomic reconstruction must be accomplished by placement of interfragmentary cerclage wires or lag screws, followed by placement of a precisely-contoured bone plate.

Recent advances in fracture management in humans have focused on minimally invasive fracture stabilization techniques. Previous work has shown the invasive approaches necessary for anatomic fracture reconstruction and direct reduction disrupt the fracture hematoma and the extraosseous blood supply, each of which slow bone healing. Based on these findings, the AO has adopted principles of biological osteosynthesis which maximize healing by protecting the patient’s biology while at the same time accomplish biomechanical fracture fixation goals.

The principles of biological osteosynthesis are:

1) Minimize iatrogenic soft tissue disruption.
2) Utilize indirect reduction techniques (align the two major or parent fracture fragments in a functional position without anatomically reconstructing individual fracture fragments).
3) Provide stable fixation.
4) Promote the early return to limb function.

MIPO factoids...

- MIPO was developed as an internal fixation technique for achieving biological osteosynthesis
- During MIPO, the fracture fragments are typically not exposed or visualized; instead, a plate is inserted through small incisions known as portals and tunneled along the fracture
- MIPO results in an early return to function, a low incidence of complications, and rapid fracture healing

Figure 1: (Left) Immediate pre-op and post-op lateral radiographs of a fracture treated with MIPO. A FIXIN plate was used to stabilize this fracture. (Right) Intra-operative photo of a MIPO portal. The plate is placed from one portal, along the fractured bone, and out the other portal.

Did you know?

There are currently a number of locking plate systems available to veterinary surgeons. At Texas A&M, we utilize the LCP (Synthes Vet, West Chester, PA), SOP (Orthomed North America, Vero Beach, FL), and FIXIN systems (TraumaVet, Rivoli, Italy) when selecting a locking system for fracture repair. Only the FIXIN system contains a novel bushing-insert locking mechanism and is composed of both stainless steel and titanium components to more closely mimic the material properties of bone.
By respecting the soft tissue envelope and using indirect reduction techniques, biological osteosynthesis techniques have led to accelerated fracture healing, improved patient comfort and limb use, reduced surgical time, and a lower incidence of postoperative complications such as infections, delayed unions, and implant failures.

Many veterinary fractures are excellent candidates for indirect reduction using biological osteosynthesis techniques. Other fractures, such as two-piece, transverse mid-diaphyseal fractures continue to be excellent candidates for direct reduction. It is important to remember that even if direct reduction is selected for a particular fracture, many of the principles of biological osteosynthesis may still be followed.

Application of a cast or an external fixator to a fracture using closed reduction techniques accomplishes the goals of biological osteosynthesis. When used in appropriate cases, external skeletal fixation (ESF) is a highly successful and versatile system for fracture repair (Figure 2, 4), and we continue to use ESF regularly at Texas A&M. Unfortunately, many patients are not candidates for external skeletal fixation due to fracture configuration, patient temperament, or client compliance. Minimal Invasive Plate Osteosynthesis (MIPO) is a surgical technique that allows the surgeon to see the fracture site directly through an incision, and it is often used to treat fractures that are difficult to access using external fixators.

Surgery at Texas A&M, through the mentorship of Dr. Don Holle, has been utilizing MIPO to treat our patients’ fractures for several years, and our clinical experience has been very encouraging. Most MIPO patients are extremely comfortable and will walk on the operated limb as early as 1-2 days post-operatively. The incidence of infections, delayed unions, and implant failures appears to be lower than with traditional external fixation techniques, and the fractures heal rapidly and (similar to a fracture treated by closed application of an external fixator).

The recent shift toward biological osteosynthesis using MIPO have led implant manufacturers to develop implants that function more as internal fixators than traditional bone plates. These novel “locking” systems function in buttress mode and allow each screw to physically lock into the plate as well as engage the bone. Locking a bone screw into a plate results in a small gap between the plate and bone, which may protect the periosteal blood-supply and accelerate healing. Although we utilize a number of locking plate systems at Texas A&M, we are excited to announce that we recently began using the FIXIN system (TraumaVet, Rivoti, Italy). The FIXIN system is a locking system that utilizes a novel bushing-insert system to lock the bone screws into the bone plate (Figure 3). The bone plate is composed of stainless steel, but the bushings and screws are titanium alloy, which gives the system material properties that more closely mimic normal bone. The FIXIN system is offered in various sizes and shapes, is competitively priced when compared to other locking systems, and is highly amenable to MIPO techniques.

Summary

A paradigm shift has occurred in fracture repair in which care for the soft tissue envelope and fracture hematoma takes precedence over anatomic fracture reconstruction using large, open approaches and direct reduction techniques. This transition has led many orthopedists to operate with the mindset of a gardener, rather than that of a carpenter! Regardless of whether an open approach or MIPO is selected, or whether internal or external fixation is selected, we continue to offer our fixed price package for routine appendicular fractures. We hope this update has been helpful, and that you will continue considering Texas A&M when contemplating referral of your fracture patients.

References:

Dr. Brian Saunders is a 2001 graduate of the Texas A&M University College of Veterinary Medicine & Biomedical Sciences (DVM) and a 2005 graduate of Texas A&M University Health Science Center (PhD). After completion of a small animal surgical residency, he joined the faculty as a Clinical Assistant Professor in Orthopedic Surgery in 2009. He is a member of the American College of Veterinary Surgeons. Dr. Saunders clinical interests include joint replacement, arthroscopy, CORA-based correction of limb deformities, and minimally invasive fracture repair. He has a strong research interest, and is in the process of establishing a cell biology laboratory to investigate molecular causes as well as molecular- and cell-based therapies for common orthopedic conditions.

Visit the VMTH Small Animal Surgery Service on the web at vetmed.tamu.edu/services/orthopedics

Faculty Spotlight: Dr. Brian Saunders

Excellent limb use of external fixator patient 10 days post-op. (Click image to watch video.)