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ORTHOPEDIC MANAGEMENT OF LEG FRACTURES

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INTRODUCTION

Method of Fixation

The tie-in fixator (TIF), a combination of an intramedullary pin (IM) linked to external skeletal fixator pins (ESF), has been adapted and found extremely useful in managing avian fractures. Compared to standard methods used from the early 1970’s through the mid-90’s in our clinic, a clear improvement in results was realized with overall success rate, as measured by full return to function, going from 40% to over 65%,

The TIF consists of a conventional intramedullary pin (IM), selected to fill an estimated 50 - 65% of the marrow cavity and two or more positive profile threaded ESF pins (Acrylic Half-pins. Imex Veterinary Inc. 1227 Market St, Longview, TX 75604 USA) linked to the IM pin by a metal or acrylic connecting bar (Technovit Jorgensen Laboratories, Inc. 1450 North Van Buren Ave. Loveland, CO 80538 USA). For most birds, ESF pins of 0.045", 0.062" and 0.078" are used (1.14mm, 1.6mm & 2 mm dia.). Fractures of the femur will heal in 3 – 4 weeks and tibiotarsal fractures in approximately 5 weeks. The rigidity of this system is attested to by occurrence of primary bone healing in many cases. Within two weeks of removal of all of the hardware, a patient is a candidate for a program of exercise that may see its return to the wild in as little as three months from time of injury.

Principles of Surgery

It is axiomatic in orthopedic surgery that rigid stabilization is required for rapid bone healing. This is the most important goal. Rotational alignment is critical, restoration of bone length is of concern (but some shortening is not entirely deleterious) and acquisition of partial load-sharing between the bone and the fixator is desirable. Exact anatomical alignment of loose fragments is of lesser importance. The additional insult to the soft tissues associated with manipulation of fragments and placement of cerclage wires outweighs any advantages gained by their placement. “Biological” management of fractures, stressing restoration of length and rotation with as little manipulation of bone fragments and soft tissues as possible and relying on bridging osteosynthesis to fill areas of bone defects is of great importance in avian orthopedics.

In this manuscript, I will review the current procedures that are found to yield a high degree of success in avian orthopedics. As most of my experience is drawn from medical care of injured wild and captive raptors where success is measured by efficacy in returning the patient to full function suitable for survival in the wild, the information presented herein will reflect that.

Basic Application Procedures

See section on wing fractures for descriptive information

Fractures of the Femur

For diaphyseal femoral fractures, the intramedullary pin for the TIF is typically introduced at the fracture site and retrograded proximally, exiting at the hip. The distal ESF pin is placed from lateral to medial in the condyles percutaneously or through a small incision and tunnel created in the soft tissue. The proximal ESF pin is placed from lateral to normograde proximally, exiting at the hip. The distal ESF pin passes from lateral to medial through both condyles. Seating of the proximal ESF pin must be done by feel as it is not possible to palpate the medial side. Care must be taken to not drive it more than 1 – 2 threads past the medial cortex.

Fractures of the Tibiotarsus

Among raptors held for falconry purposes, fractures of the tibiotarsus in the proximal 1/3 arising from bating accidents are seen frequently. Bating is the forceful jumping off from a perch to which the raptor is tethered by a short leash. These are typically low-energy, transverse fractures. Wild casualty birds most often have complicated and comminuted, high-energy fractures involving the tibiotarsus. Psittacines typically present with mid-diaphyseal or distal fractures of the tibiotarsus. Owing to the large muscle masses, especially in the proximal region, tibiotarsal fractures are seldom open and prognosis is good. Three caveats exist for wild casualty birds:

1) nerve damage often accompanies their fractures of the tibiotarsus leading to slow return to use of the lower limb, and
2) spinal injury often accompanies these fractures, but may be hard to detect at admission owing to the analgia in the broken limb; failure to properly assess this condition may lead to an unnecessary and unproductive fixation procedure,
3) due to uneven weight bearing for 1 – 3 weeks post-operatively, the contralateral foot is prone to develop bumblefoot – this must be managed for prevention.

While a Type II ESF is advocated by many surgeon, we’ve found an adaptation of the TIF to produce exceptional results, again making it the method of choice in all but those cases involving severe comminution, wherein a Type II fixator may be preferred (Figure 2). For application of the TIF to the tibiotarsus, the IM pin is introduced either to the tibial plateau on the medial aspect of the femorotibial joint and passed retrograded proximally or introduced at the fracture site and retrograded at the stifle. In either case, lateral displacement of the patellar tendon to protect against pin penetration is necessary. This displacement can be accomplished percutaneously. The fracture is reduced and the pin advanced into the opposing fragment. When selecting the IM pin, use the bone diameter as measured at the distal end on the radiograph as this bone tapers substantially in the distal portion.
Figure 2. Tie-in fixator applied to the tibiotarsus. The completed fixator should look like this. Note landmarks and points of placement of pins.

Threaded ESF pins are placed distally and proximally. The distal pin should be placed 2 –3 mm proximal to the condyles to avoid driving it through the sulcus between the condyles or damaging the supra-tendinal ridge through which the tendon of the long digital extensor passes on the cranial surface. The placement of the proximal pin entails caution also. It should be introduced on the craniolateral aspect just distad to the tibial plateau and cranial to the fibula. It should be directed caudo-medially to avoid neurovascular bundles on the lateral and medial sides of the proximal tibiotarsus. The IM pin is again bent at 90 degrees and directed laterally so that it can be joined to the ESF pins with an acrylic bar or conventional fixator clamps and a bar.

Post-operatively, one should expect little or no weight-bearing on the affected leg for 3 - 5 days owing to transitory neuroparalysis arising either from the injury itself or the surgical procedure; “knuckling over” is common. It is important to wrap the digits of the affected limb with protective materials (e.g. Vetrap, 3M) to prevent abrasion of the dorsal surfaces. Concurrently, the asymmetric weight bearing predisposes bumblefoot formation in the contralateral foot, so it too should be given protective bandaging.

Fractures of the Tarsometatarsus

The tarsometatarsus bears resemblance to the metacarpus in terms of paucity of soft tissue coverage and therefore many of the same management problems. Under most normal circumstances, the bone is positioned at an angle to the perching surface so load bearing applies bending as well as rotational forces to the bone. Anatomically, it has no marrow cavity in the proximal 1/3 in hawks, eagles & most psittacines, while in falcons and owls, a marrow cavity runs the full length. In cross-section, it is a “U” shaped bone formed embryonically from the fusion of elements of the metatarsal and tarsal bones. The flexor tendons run in the tunnel so formed; veins are present on the lateral and medial aspects and arterial blood supply along with nerves are found on the cranial aspect. Also, the bone is protected at both ends by joint elements. Generally, intramedullary pinning is a poor fixation choice. Coaptation in which the hock joint is flexed and the metatarsus is taped to the tibiotarsus is an acceptable choice for small birds as is the Altman tape splint. Casting with semi-tubular thermoplastic materials can be used, particularly in cases of closed fractures wherein no wound management procedures are required.

Figure 3. Altman tape splint for repair of distal pectoral limb fractures in birds less than 50 grams body weight. Opposing adhesive tape surfaces are applied to either side of the limb and crimped together with fingers or a hemostat.

Schroeder-Thomas splints are another alternative for birds weighing less than about 1- 1.5 kg. A Type II or Type III ESF is applicable in a wide variety of situations and is the
method of choice in any situation where there is comminution or there are open wounds that require management.

Shoulder and femur: Luxations of the shoulder elements and the femur are typically managed with cage rest, and, in the case of the shoulder, with coaptive bandaging of the wing to the body for a period of 10 - 14 days.

Coracoid Fractures: Extensive comparison in our clinic of outcomes between coracoid fractures managed by intramedullary pinning and those managed by taping of the wing to the body and cage rest yields unequivocal evidence that the latter yields a far higher success rate.

Tendon Repairs: Methodology for and success with repair of transected or ablated flexor and extensor tendons of the avian foot have been described. Both translocation of vascularized grafts as well as free grafts have yielded satisfactory results. In another paper in this session, a case report on the repair of an ablated extensor tendon of the distal halux is presented.

REFERENCES

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