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External Fixation of Avian Fractures

Mitchell Bush, DVM

PROBLEMS unique to avian orthopedics include pre- and postoperative care, anesthesia, and the choice of a suitable method for fracture repair.[1-4] Recent studies on the mechanism of avian fracture repair utilizing radiographic and histologic correlations have documented basic information concerning the mechanisms by which avian bones heal.[5,7,8] In these studies, it was concluded that the basic mechanism of fracture repair is similar in both birds and mammals. The major callus that occurs in avian fractures is intramedullary (IM). This callus provides rapid and rigid support to a well-aligned, stable fracture. The periosteal callus appears to provide secondary support and is not as extensive, unless there is motion at the fracture site. A well-aligned, stabilized fracture in a bird will heal in about 3 weeks.

The classic objectives in mammalian fracture repair hold true in the repair of avian fractures: rigid fixation, good alignment and apposition, absence of infection, and early return of the fractured appendage to function during healing.

Coaptation splinting by binding the fractured appendage to the body works well in small birds, but in medium sized birds, excessive periosteal callus formation may be a problem. The formation of a large callus can impair mobility and dexterity of the appendage, with resultant loss of function, even after the fracture is healed. Other problems are joint stiffness or ankylosis, and if this occurs in the wing, flight may be hampered.

Fracture fixation with IM pins has been attempted in birds but has several disadvantages. First, if the pinning is retrograde, the fracture site has to be invaded surgically, which may further disrupt blood supply to the fractured segment. Second, in the air sac-lined pneumonic bones, the medullary space is extremely large, requiring 1 large pin or several small pins, which may lead to excessive weight of this type of fixation. Rotation of an IM pin may also be a problem because of the inability to fill the medullary cavity and, due to the lack of dense bone, either proximal or distal, in which to seat the pin. Thus, IM fixation usually requires some other support to prevent rotation. Also, since a major portion of the callus in avian fracture repair is IM, the pins tend to disrupt or prevent its formation. Bone plates with bone screws have been used occasionally in avian fracture repair, but the severity of the fracture and the thin, brittle cortex are factors that discourage their use. Another problem with plates is the large surgical exposure area required, which leads to more disruption at the fracture site and necessitates longer anesthesia during fracture repair.

From the Office of Animal Health, National Zoological Park, Smithsonian Institution, Washington, DC 20008.

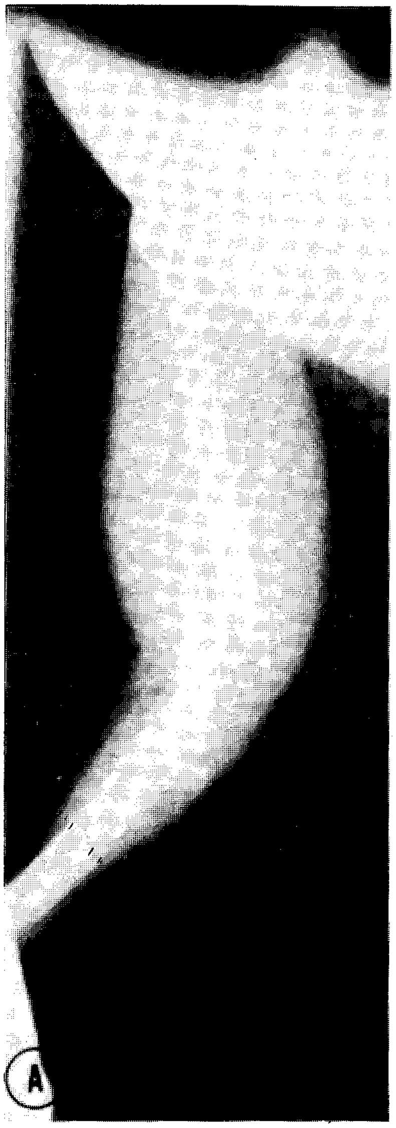
For optimal success in avian fracture repair, the technique should include: rigid fixation, short surgery and anesthesia time, minimal disruption to fracture site and callus formation, rapid return to function, and a fixation method that is tolerated by the bird. A method that seems to fulfill these criteria in medium sized and large birds utilizes the external half-pin or full-pin splint.[a] This method can also be used in combination with IM pinning to prevent rotation, or can be used with a coaptation split or fiberglass cast.

The basic concept for the external splint (either half-pin or full-pin) is simple.[6] With the full-pin splint, the fixation pins penetrate through the bone and both surfaces of the skin so the external support rods are medial and lateral to the fracture. This type of fixation is the most rigid. The fixation pins in the half-pin splint penetrate both cortices but do not exit through the skin, and the external support rod is on one side of the fracture. In many instances, it is necessary to use a combination of the 2 splints on the same fracture, when it is not possible to have fixation pins exit. For example, this occurs on the medial aspect of the proximal end of the humerus and the medial aspect of the femur.

Use of external fracture repair in medium sized and large birds is best suited for fractures of the humerus, femur, and tibia. The fixation pins are 2.03 mm (0.080 in) in diameter and sharp. When placing these pins in the cortex, using a hand drill, care should be made to prevent further splintering. The pins should be placed perpendicular to the axis of the bone, using many rotations while penetrating the cortex and keeping the pin in a single axis. If the fixation pin is not going to exit through the skin and is going to be placed in half-pin fashion, then the opposite cortical surface is engaged but not completely penetrated. Ideally, 2 fixation pins should be used on each side of the fracture. The entrance point and expected exit point of the fixation pins on the skin are surgically prepared, by carefully plucking the feathers, cleansing the area with surgical soap, and rinsing with an organic iodine preparation.

The first 2 pins are placed farthest away (proximally and distally) from the fracture site. The connecting bar is attached by means of fixation clamps applied to these 2 pins. The 2 remaining pins are placed adjacent to the fracture site, along the line of the connecting bar, so that reduction of the fracture can be maintained properly. If it is impossible to align the fixation pins with 1 connecting bar, additional bars can be used. The exposed sharp metal edges and fixation clamps must be

[a] Kirschner Scientific Division, Hazelton Laboratories, Seattle, Wa.



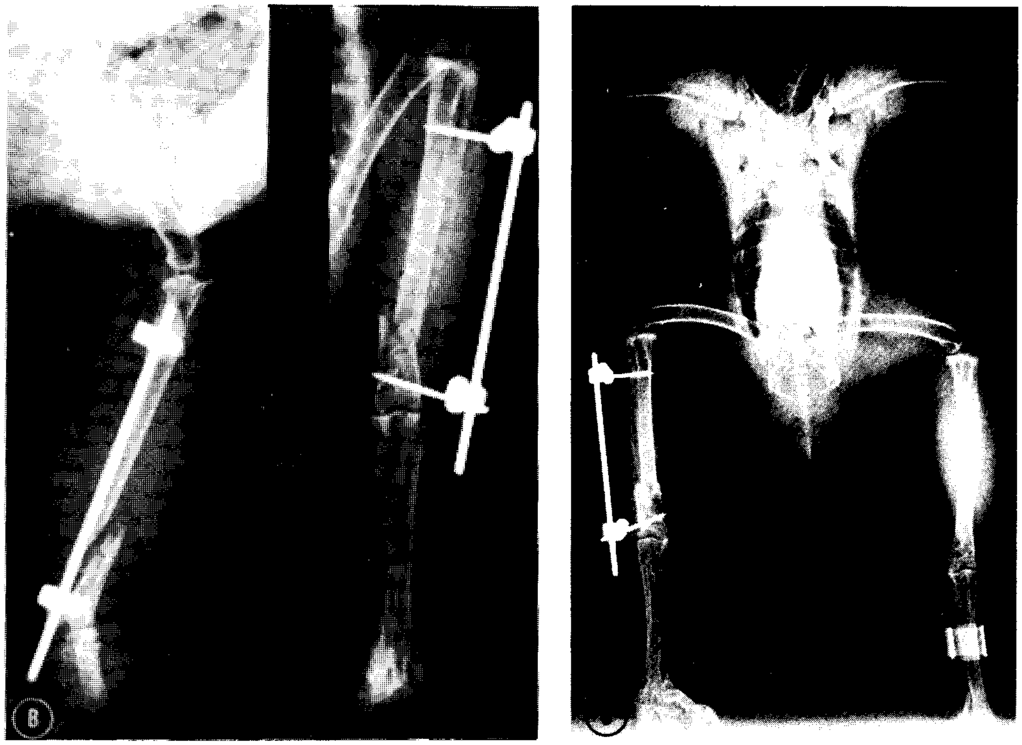


Fig 1A—Lateral radiographic view of a comminuted distal fracture of tiba in a red-tailed hawk.

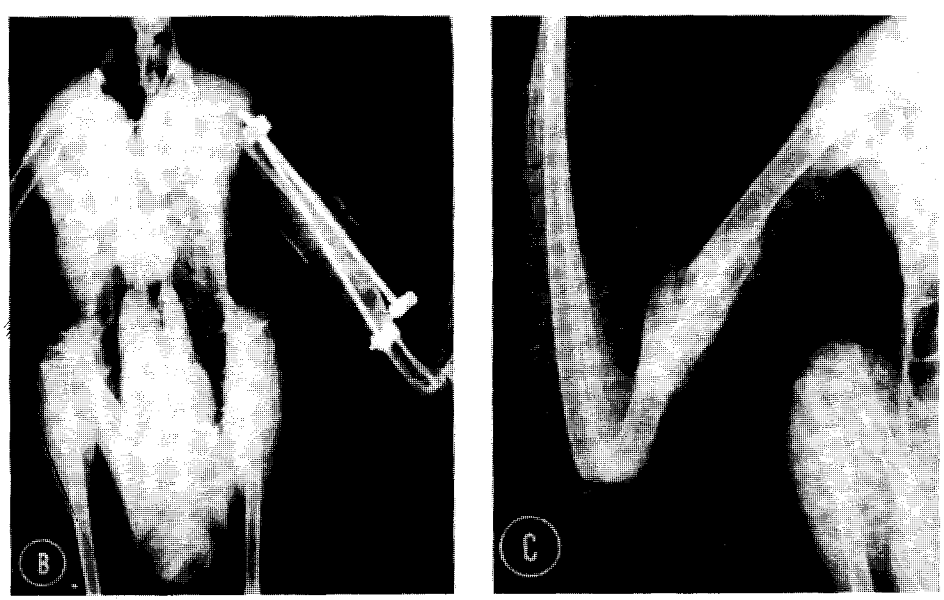
B—Anteroposterior and lateral radiographic views following fixation with an external half-pin splint. The distal fragment appears displaced posterior, but the bone is aligned well and the fixation is solid. The fixation pins barely have penetrated the far cortex.

C—Anteroposterior radiographic view 1 month after surgery. The fixation device was removed and the fracture site was solid. There is increased density at the fracture site and incorporation of the segments but minimal callus.

Fig 2A—Lateral radiographic view of a compound distal fracture of humerus in a great blue heron.

B—Postsurgical lateral radiographic view, showing stabilization by a full-pin external splint. Both fixation pins pass through the wing.

C—Lateral radiographic view following removal of the fixation device at 5 weeks after surgery.



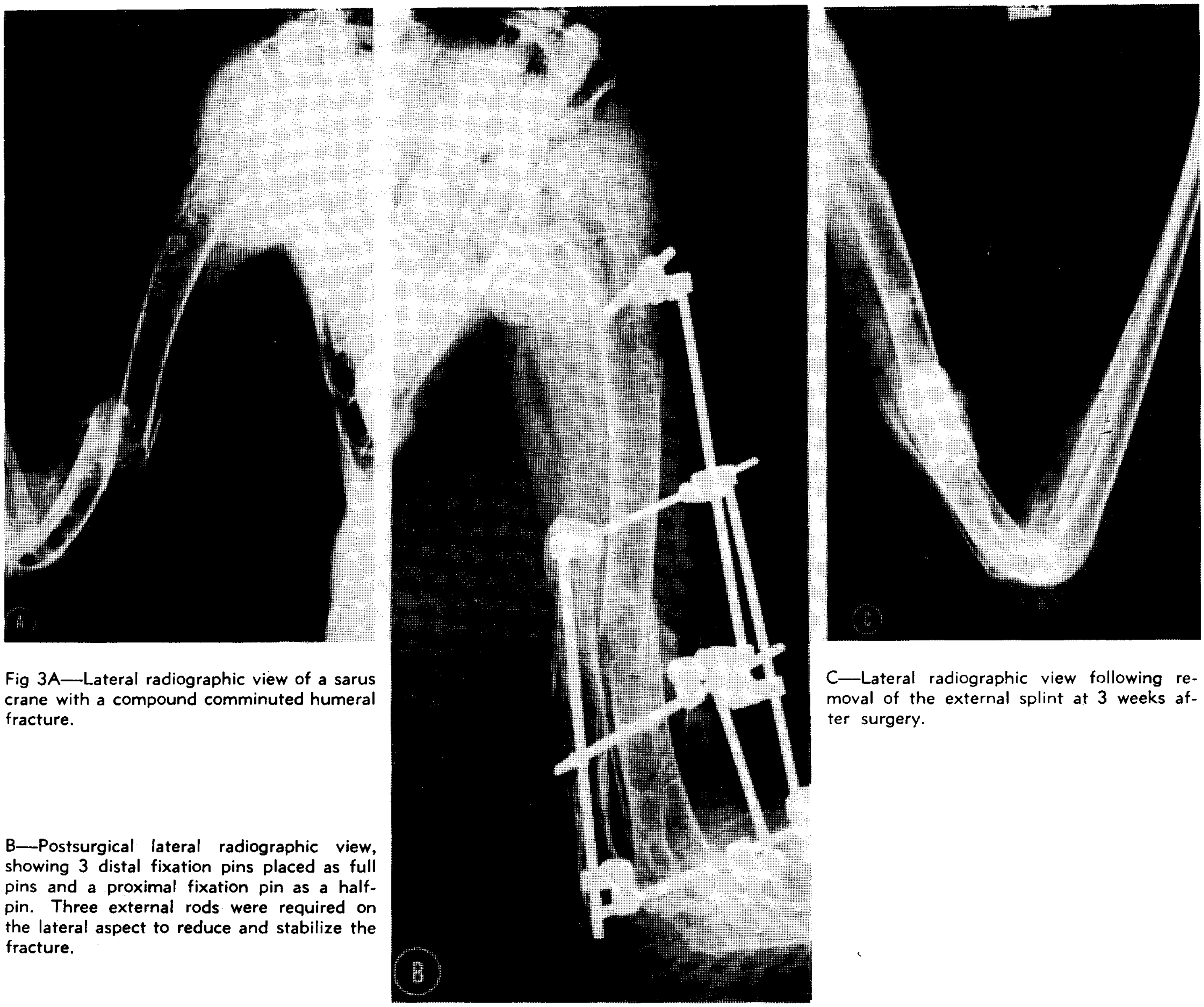


Fig 3A—Lateral radiographic view of a sarus crane with a compound comminuted humeral fracture.

B—Postsurgical lateral radiographic view, showing 3 distal fixation pins placed as full pins and a proximal fixation pin as a half-pin. Three external rods were required on the lateral aspect to reduce and stabilize the fracture.

C—Lateral radiographic view following removal of the external splint at 3 weeks after surgery.

padded, especially on the medial aspect, to prevent self-inflicted trauma.

Case Reports

The following selected cases illustrate the use of the external splinting for the repair of avian fractures.

Case 1—A wild, adult red-tailed hawk *(Buteo jamaicensis)* with a distal fracture of the tibia (Fig 1A) was given gentamicin sulfate (8 mg/kg), dexamethasone (0.5 mg/kg), and intravenous lactated Ringer's solution. The hawk was then anesthetized with halothane. The fracture was reduced, and a half-pin splint was applied to the lateral aspect of the tibia (Fig 1B). The fixation was solid and the bird was able to perch with the leg 4 days postoperatively. The hawk was given gentamicin sulfate (8 mg/kg BID) for 7 days and was hand-fed for 10 days. One month postoperatively the fixation device was removed, and the fracture was well healed (Fig 1C). The bird's recovery continued without complication and it was returned to the wild.

Case 2—A free-living great blue heron *(Ardea herodias)* with a compound fracture of the humerus (Fig 2A) was given gentamicin sulfate (8 mg/kg) and was anesthetized with a 1:1 combination of tiletamine hydrochloride and zolazepam, supplemented with halothane and nitrous oxide. The fracture was reduced, and a full-pin splint was applied (Fig 2B). The stabilization was rigid, and the bird held the fractured wing in its proper position on the 4th day after surgery. Antibiotic treatment was continued for 6 days after surgery. The full-pin splint was removed at 5 weeks after surgery, at which time the fracture was healed (Fig 2C). There was moderate callus formation at the fracture site as well as some IM callus at the pin fixation sites. The periosteal callus at the fracture site was due to the lack of complete immobilization. In this case, the splint may have loosened postoperatively, emphasizing the need to reexamine the apparatus. A more rigid fixation would have been achieved if more than 2 fixation pins had been used. The bird was returned to the wild after an additional 2 months of rehabilitation.

Case 3—A sarus crane *(Grus antigone)* with a comminuted compound fracture of the humerus (Fig 3A) was given gentamicin sulfate (8 mg/kg) and dexamethasone (0.5 mg/kg), and was then anesthetized with halothane and nitrous oxide. The fracture was reduced and fixed with both a full-pin and a half-pin splint (Fig 3B). Following surgery, the fracture site was extremely stable, and the bird tolerated the splints well. The splints were removed 3 weeks later, at which time the fracture site was solid, with a good endosteal callus (Fig 3C). The lack of a periosteal callus indicated that minimal motion occurred at the fracture site. The endosteal callus is extensive and is the major uniting element. This callus would have been disrupted if IM pins had been used, especially if an attempt had been made to fill the medullary cavity to prevent rotation.

References

1. Altman, I. E.: Disorders of Skeletal System. In *Diseases of Cage and Aviary Birds*. Edited by M. L. Petrak. Lea & Febiger, Philadelphia, Pa (1969): 255–262.
2. Altman, I. E.: Fracture of the Extremities of Birds. In *Current Veterinary Therapy. IV*. W. B. Saunders Company, Philadelphia, Pa (1971): 400–402.
3. Bush, M.: Avian Orthopedics. In *Proceedings*. Am Assoc Zoo Vets, Atlanta, Ga (1974): 111–113.
4. Bush, M., and James, A. E.: Some Considerations of Practice of Orthopedics in Exotic Animals. J Am Anim Hosp Assoc, 11, (1975): 587–594.
5. Bush, M., Montali, R. J., Novak, G. R., and James, A. E.: The Healing of Avian Fractures: A Histological Xeroradiographic Study. J Am Anim Hosp Assoc, 12, (1976): 768–773.
6. Leonard, E. P.: Orthopedic Surgery of the Dog and Cat. W. B. Saunders Company, Philadelphia, Pa (1961): 46–55.
7. Montali, R. J., and Bush, M.: Avian Fracture Repair, Radiographic and Histopathologic Correlation. In *Proceedings*. Am Assoc Zoo Vets, San Diego, Ca (1976): 150–153.
8. Newton, Charles D., and Zeitlin, Salvatore: Avian Fracture Healing. JAVMA, 170, (March 15, 1977): 620–625.