

# Acute shortening and subsequent lengthening of the radius and ulna for the treatment of an infected nonunion in a dog

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**Abstract** — A 3-year-old, male crossbred dog with osteomyelitis of the radius and ulna was treated using Ilizarov's method. Two centimeters of infected bone was resected, then acute bone shortening and subsequent lengthening of a healthy bone site were performed. The infection was eradicated, but a residual leg-length discrepancy was present.

**Résumé** — Résection et allongement subséquent du radius et du cubitus, pour le traitement d'une non-union infectée chez un chien. Un chien de race croisée âgé de trois ans, atteint d'ostéomyélite au radius et au cubitus, est traité selon la méthode d'Ilizarov. On procède à la résection de deux centimètres d'os infecté, puis à une résection aiguë et à l'allongement subséquent de l'os sain. L'infection est éliminée, mais il subsiste un écart entre la longueur de la patte traitée et celle de l'autre patte.

(Traduit par Madame Suzanne Gasseau)

Can Vet J 2001;42:724-726

A 3-year-old, 10.5 kg, intact male crossbred dog was admitted to the Veterinary Hospital with suspected osteomyelitis. The dog had a diaphyseal fracture involving the proximal third of the right radius and ulna, caused by dog bite. The fracture had been stabilized by using an intramedullary pin, approximately 2 mo prior to this presentation.

The dog was nonweight-bearing on the affected limb at the time of presentation and moderate muscle atrophy of the limb was evident. There was no fever, but pain and crepitation on palpation at the fracture site were noted, and a draining fistulous tract to the skin was observed near the fracture site. Radiographs showed nonunion of the fracture, periosteal reaction, and areas of lysis in the fracture site (Figure 1a).

The planned treatment included oral trimethoprim-sulfa [15 mg/kg body weight (BW), q12h, for 10d] and flunixin meglumine (1.1 mg/kg BW, q24h, for 4 d), implant removal, and fracture stabilization using a Ilizarov fixator.

The Ilizarov frame was preassembled with 3 rings for fixation and 4 rods with the aid of preoperative radiographs. Under general anesthesia, 2 tensioned transosseous wires of 1.5-mm diameter were placed in each ring, with an intersection angle between the wires of between 60° and 90°. A 2-cm portion of infected bone was resected, and bone shortening was effected by compression of the proximal and distal fragments. A fine-needle aspirate from the fracture site, taken after the debridement, was submitted for aerobic and anaerobic culture; *Staphylococcus epidermidis* was isolated.

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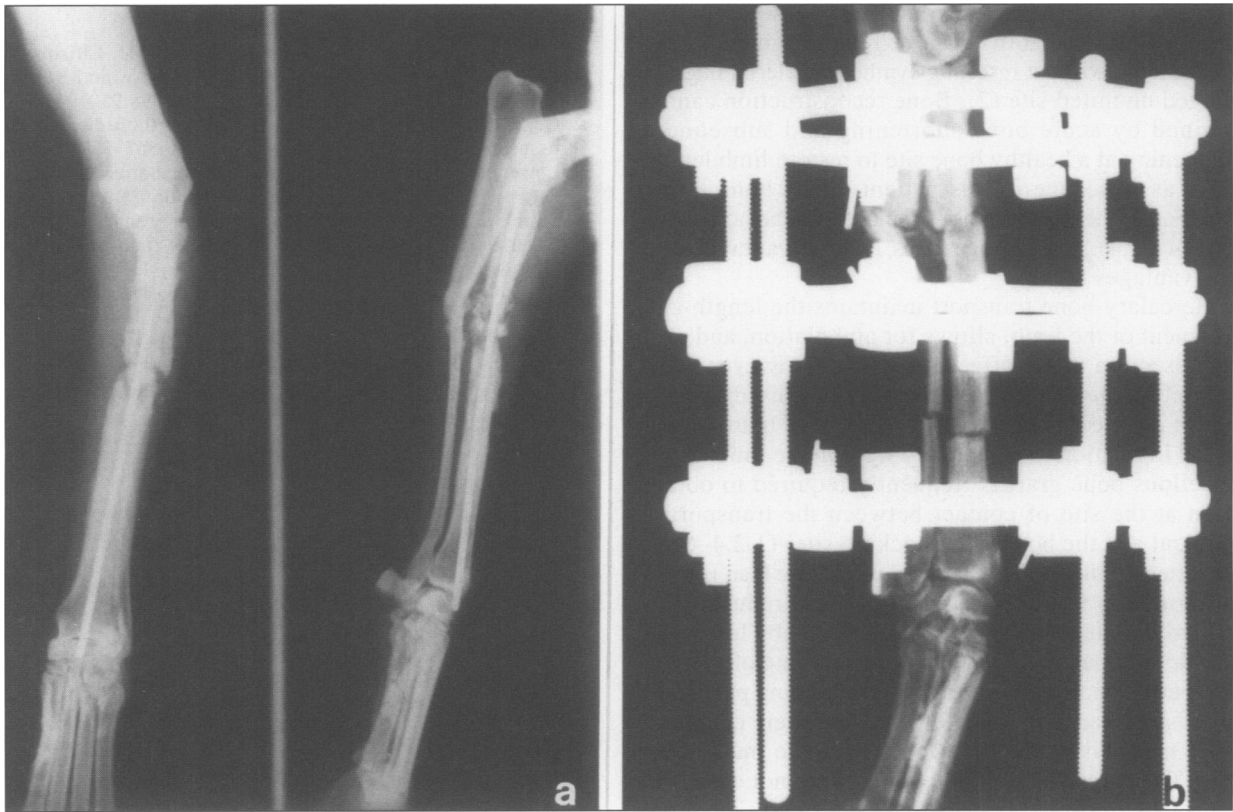
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Although trimethoprim-sulfa is not the best antibiotic treatment for fractures, it was used because of the owner's low economic status and the availability of a free sample of the drug.

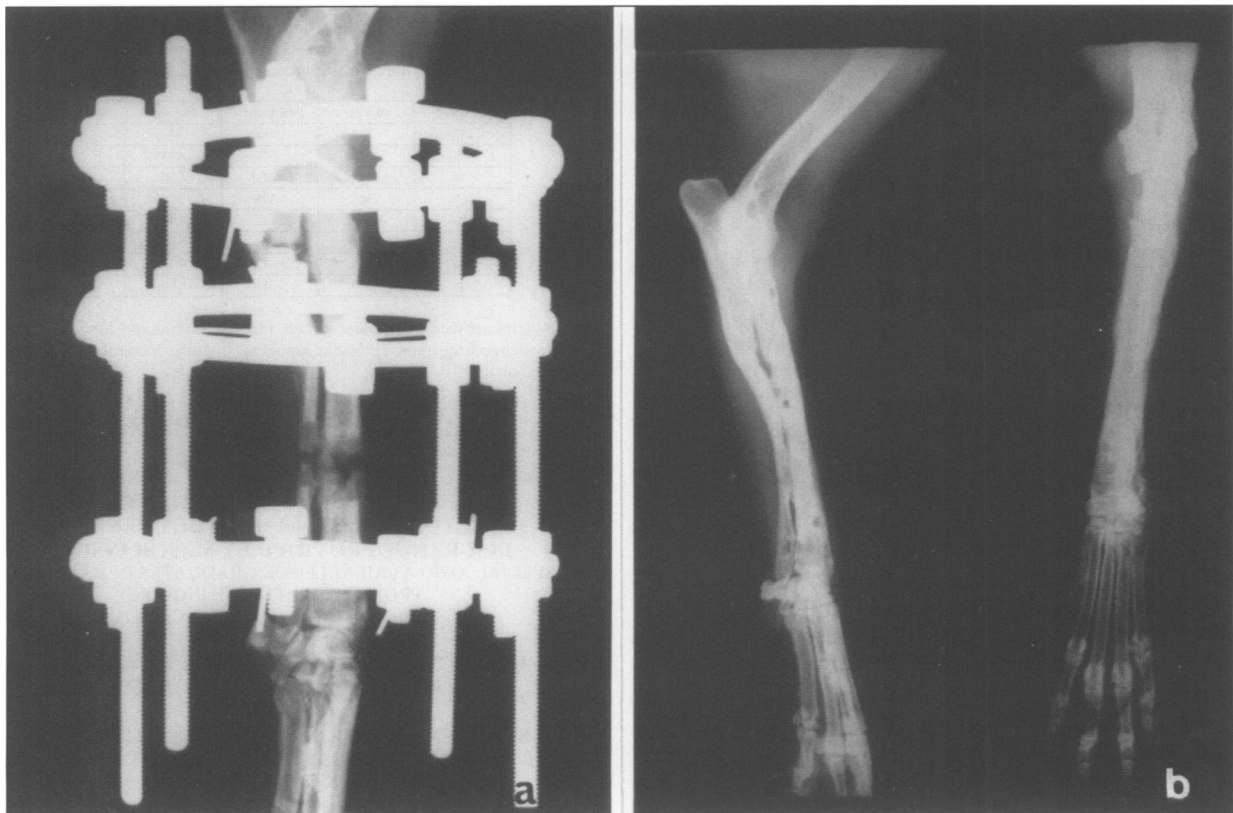
Two weeks later, the draining tract had disappeared, and a subperiosteal osteotomy of the radial and ulnar diaphyses was performed, distal to the nonunion focus and between the middle and distal rings, using a medial approach to the radius and a lateral approach to the ulna (Figure 1b). The subperiosteal osteotomy was performed by elevating the periosteum from the cortex and making multiple drill holes at the selected osteotomy site; these were then connected by using a 4-mm wide osteotome to complete the transverse osteotomy. After a latency period of 7 d, necessary to improve osteogenesis, bone lengthening was commenced at a rate of 1 mm/d, in increments of 0.5 mm every 12 h, for 20 d. At the same time, compression at the fracture site was effected, 0.5 mm once per week, until healing of the radius was obtained, 7 wk after surgery. Periodic radiographs evaluated new bone formation within the gap caused by the lengthening (Figure 2a).

The apparatus was left in place for a further 6 mo to obtain consolidation of the regenerated bone (neutral fixation period). During this period, the animal developed inflammation around one of the proximal pins, with osteolysis apparent on a radiograph. It was treated successfully with trimethoprim-sulfa (15 mg/kg BW, PO, q12h, for 10 d). At gait examination during the neutral fixation period, full weight-bearing on the injured limb was noted when the dog walked slowly, but not when running. The fixator was removed at the end of the neutral fixation period. Although equalization of the length of the limbs had not been obtained, the 1.5-cm gain in length was sufficient for the dog to walk in a functional manner. At the last evaluation, 7 mo after removal of the fixator, there was no evidence of infection (Figure 2b) and the dog was walking normally.

The Ilizarov method is an alternative treatment for bone loss associated with osteomyelitis (1). This circular



**Figure 1.** (a) Preoperative lateral and craniocaudal views showing nonunion of the fracture of the radius and ulna, periosteal reaction, and areas of lysis. (b) Lateral radiograph showing radius and ulna shortened at the area of infected nonunion and after the debridement and diaphyseal osteotomy.



**Figure 2.** (a) Appearance of the bone lengthening. (b) Lateral and craniocaudal views showing final appearance 7 mo after removal of the fixator.

external fixator with tensioned transosseous wires allows adequate stabilization of bone fragments after debridement, without inserting synthetic material into the infected ununited site (2). Bone reconstruction can be obtained by acute bone shortening and subsequent lengthening at a healthy bone site to restore limb length (2-4), as was done in this patient, or by bone transport; that is, the creation of a segment of bone across the defect (1,2,4). Both procedures have advantages and disadvantages (2-4).

Intercalary bone transport maintains the length and alignment of the limb, allows for ambulation, and permits resection of the affected area (2). However, joint contracture may develop because the origins and insertions of muscles attached in the area of bone transport are moved in relation to where they were in the limb, and a cancellous bone graft is frequently required to obtain union at the site of contact between the transported fragment and the host bone (docking site) (1,2,4-6).

Shortening the limb is a simpler procedure than is bone transport; the fracture fragments can be reduced and stabilized under direct visualization, thereby lessening the risk of nonunion (2-4). However, folding of soft tissues, nerves, and vessels during the shortening procedure may result in arteriolar occlusion with severe edema or tissue necrosis, and alteration of muscle mechanics (2,3). These types of complications were not observed in this case, most likely because of the small size of the bone defect; in humans, they may occur when 2 or 3 cm of bone is removed (3,7).

The total treatment time in months divided by the amount of lengthening in centimeters (healing index) (5) was higher in this dog than mentioned by other authors for dogs (8,9). This was likely the result of several factors: for example, osteogenesis in the radial diaphysis in this patient may have been delayed because bone regeneration and mineralization is better in the metaphysis than in other sites (2,5), and the osteogenesis in the diaphysis may have been decreased because the blood is supplied by a single nutrient artery (5). The distraction rate of 1 mm/d in increments of 0.5 mm 2X/d was used for the owner's convenience. However, bone formation seems more reliable with a daily incremental rhythm of 4X/d (1.0 mm/d in 4 steps of 0.25 mm) (10).

Although the Ilizarov procedure has shown that better osteogenesis is obtained by using corticotomy rather than osteotomy, other authors have found that corticotomy is technically difficult and unnecessary for satisfactory bone formation, since the periosteal tube is maintained with osteotomy (1,5,9), as it was in our patient. Also, it is important to consider the involvement of regional vascularity, pre-operatively in this case, especially because the fracture had been stabilized by using an intramedullary pin, resulting in compromise of endosteal circulation.

Although this dog was submitted to 20 d of bone lengthening, equalization in limb length was not obtained because length was lost during compression. Because the residual leg-length discrepancy was not significant to the animal's ability to ambulate, and because the infection was eradicated, the objectives of treatment were met.

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