

Treatment by the Use of an Ilizarov External Fixator of Incongruity in the Elbow Joint Due to Premature Closure of the Distal Radial Growth Plate in a German Shepherd

Kemal ALTUNATMAZ, Zihni MUTLU, Rauf YÜCEL, Defne ŞADALAK
Department of Surgery, Faculty of Veterinary Medicine, İstanbul University, Avclar, İstanbul - TURKEY

Received: 04.04.2002

Abstract: In a 9-month-old male German Shepherd, degenerative arthritis and incongruity of the elbow joint were observed due to premature closure of the distal radial growth plate. An obvious shortening was present in the radius and ulna, when compared to the contralateral leg. Corticotomy was carried out on the radius and an Ilizarov apparatus was applied to the leg by passing Kirschner wires through the proximal and distal fragments of the radius. The radius was lengthened 1 mm daily starting from postoperative day 4. Consequently, the incongruity of the elbow joint was corrected and functional recovery was observed to a great extent in the postoperative period.

Key Words: Dog, elbow joint, incongruity, growth plate, Ilizarov external fixator

Bir Alman Kurt Köpeğinde, Radius'un Distal Büyüme Plağının Erken Kapanmasına Bağlı Dirsek Eklemindeki Uyumsuzluğun İlizarov Eksternal Fiksatorü İle Sağaltımı

Özet: Dokuz aylık bir erkek Alman kurt köpeğinde distal radius büyüme plağının erken kapanmasına bağlı, dirsek ekleminde dejeneratif artrit ve dirsek ekleminde uyumsuzluk saptandı. Radius ve ulna'da sağlam bacağa göre belirgin bir kısalık vardı. Radiusa kortikotomi yapılarak radiusun proximal ve distal fragmentlerinden geçirilen Kirschner telleri ile bacak Ilizarov aparatına alındı ve 4. günden itibaren günde 1 mm olmak üzere radius uzatıldı. Sonunda dirsek eklemindeki uyumsuzluk düzeltildi ve operasyondan üç ay sonraki kontrolde büyük oranda bir fonksiyonel iyileşme sağlandı.

Anahtar Sözcükler: Köpek, dirsek eklemi, uyumsuzluk, büyüme plağı, Ilizarov eksternal fiksatorü

Introduction

Unsynchronised growth of the radius and ulna due to premature closure of the growth plates is the greatest cause of deformity observed in the forelimbs of dogs (1-4). The reason for this premature closure is usually Salter-Harris fractures (1-7), along with genetic factors, nutritional imbalances, radiation and intramedullary pin applications involving the growth plates (1,3,4).

In most cases, premature closure of the growth plates in the radius results in the shortening of the bone. Since the whole growth plate is affected, premature closure of either the distal or the proximal growth plate of the radius is symmetrical (3,4,7). This is why rather than angular deformity, a step is formed in the radio-ulnar joint on the elbow plane due to the shortening of the radius (1-5,7).

The first symptom of closure is a slowly progressing lameness and pain observed in the elbow joint region. Surgical intervention is inevitable in order to minimise the alterations formed or that may form in the joint (1,2,4,7-9). Radius ostectomy is recommended (3-7) for immature dogs diagnosed in the early period; however, in cases where incongruity and degeneration develop in the joint, following radius osteotomy, plates or external fixators are used for fixation (3,6,8,10). It is reported (2,4,7-12) that the Ilizarov apparatus is the most convenient fixator for distraction. For cases in which radial shortening is minimal and the animal is nearly mature, removing a short section (ostectomy) of the ulna to restore the congruency of the elbow joint may be the treatment of choice, but this will cause the leg to shorten (13).

Stretching of the bone length is performed according to the distraction osteogenesis principle. Distraction osteogenesis involves new bone formation due to step-by-step controlled distancing of bone fragments when the fragments are stabilised in a central region. Circular external fixators have been reported to be the most appropriate method for this procedure (3,11-17).

Description of the Case

Our case was a 9-month-old male German shepherd. The reason for the disease could not be determined because the dog had been obtained from an unknown source 1 month prior to admission to our clinic. In the clinical examination, it was revealed that the patient was lame in the left leg, touching the ground with the tip of the toes, and pain was present in the elbow joint. Degenerative arthritis of the elbow joint, formation of a step in the radio-ulnar joint (1.2 cm), premature closure of the distal growth plate of the radius and subluxation together with a slight degree of carpal valgus in the radio-carpal joint were observed radiologically. In the radiological measurement of the antebrachium bones it was seen that the length of the radius was 15.4 cm, which was 3 cm shorter than the healthy leg (Figure 1).



Figure 1. Mediolateral radiograph of the left antebrachium illustrating incongruity of the elbow and a short radius.

Closure had not yet occurred in the distal growth plate of the radius in the healthy leg (Figure 2). The length of the ulna was 0.7 cm shorter than that in the normal leg.

Surgical Intervention

After routine preparation of the patient, an incision was made cranio-laterally to approach the mid diaphysis of the radius. Corticotomy was performed on the radius by entering between the extensor carpi radialis muscle and the extensor digitorum communis muscle. After the incision was closed, two Kirschner wires 1.6 mm in diameter were placed in the proximal fragment. The wires were placed parallel to the joint surface of the head of the radius with one of the wires coursing from the cranio-lateral to the caudo-medial direction and the other from the cranio-medial to the caudo-lateral direction. The wires were fixed to a ring and stretched. The Ilizarov apparatus was constructed by the same procedure on the distal fragment (Figure 3).

Starting on post-operative day 4, distraction was achieved by raising the upper ring 0.5 mm proximally



Figure 2. Mediolateral radiograph of the sound leg.

each morning and evening (at intervals of 12 hours) for 16 days (Figure 4).

At the end of this procedure it was observed that the elbow joint returned to normal with regression of degenerative changes and the incongruity in the joint had disappeared to a great extent 41 days after surgery (Figure 5).

A partial contracture was observed in the flexor tendons due to late adaptation of the soft tissues to the distraction procedure. The Ilizarov apparatus was removed 6 weeks later. There were few or no clinical and radiological problems three months after the removal of the fixator (Figure 6).

Results and Discussion

Premature closure of the antebrachial growth plates is frequently seen due to exogenous and endogenous factors resulting in the deformation of the related joint and bones (1-5,7,16,17).

Although a detailed history was not obtained in this case, our opinion is that the premature closure was due to trauma.



Figure 3. Immediate postoperative radiograph after corticotomy of radius and fixation with the Ilizarov apparatus.

In early-diagnosed cases, where development is not yet complete and anatomical changes have not yet started, treatment involves ostectomy of either the radius or the ulna (1-5,7,10,13). However, in cases where degenerative disorders have already formed in the joints and the anatomical structure is impaired, external fixators are the ideal method of treatment (2-4,7,9). Based on this, we treated the dog using an Ilizarov external fixator after corticomy of the radius. Although there was a step of 1.2 cm in the proximal radio-ulnar joint, it was only possible to bring the joint close to normal after a distraction of 1.6 cm. We think that this difference of 0.4 cm resulted from a downward movement of the distal fragment during distraction. We agree with Latte (6) that this complication can be eliminated by performing distraction on the ulna by making a flag.

We think that the reason for the ulna of the injured leg being 0.7 cm shorter than that of the other, normal leg (Figures 1 and 2) is due to all the weight on the antebrachium during ground contact being carried by the ulna, and that the growth plate may have closed prematurely due to this excessive load.

Clinical and radiological follow-up at 3 months (Figure 6) showed that lameness and degenerative arthritis in the elbow regressed to a great extent, to the satisfaction of the owner.



Figure 4. Immediate postoperative radiograph during proximal distraction of the radius.



Figure 5. Radiographic view of the elbow joint after treatment of incongruity 41 days after surgery.



Figure 6. Radiographic appearance of the leg 3 months later after the removal of the fixator.

References

1. Braden, T.D.: Histopathology of the Growth Plate Injuries. In: Disease Mechanisms in Small Animal Surgery. Second edition. Bojrab, M.J. (ed.) Philadelphia, London, Lea & Febiger. 1993; 1027-1041.
2. Carrig, C.B.: Growth Abnormalities of the Canine Radius and Ulna. *Vet. Clin. North. Am. Small Anim. Pract.* 1983; 13: 91-113.
3. Johnson, A.L.: Growth Deformities. In: Small Animal Orthopaedics. Olmstead, M.L. (ed.) Philadelphia, Mosby, 1995; 293-309.
4. Johnson, A.L.: Correction of Radial and Ulnar Growth Deformities Resulting from Premature Physeal Closure. In: Current Techniques in Small Animal Surgery. Bojrab, M.J. (ed.) Philadelphia, London, Lea & Febiger. 1998; 1091-1101.
5. Altunatmaz, K., Yücel, R.: Orthopaedic Lesions of the Antebrachium in the Dog and Clinical Studies on the Treatment of These Conditions. *Turk. J. Vet. Surg.* 1999; 5: 118-126.
6. Latte, Y.: Application of the Ilizarov Method in Veterinary Orthopaedic Surgery (part I). *E.J.C.A.P.* 1997; 7: 26-50.
7. Olson, N.C., Brinker, W.O., Carrig, C.B.: Premature Closure of the Distal Radial Physis in Two Dogs. *J. Am. Vet. Med. Assoc.* 1980; 176: 910.
8. Ilizarov, G.A.: Clinical Application of the Tension-Stress Effect for Limb Lengthening. *Clin. Orthop.* 1990; 250: 8-26.
9. Paley, D., Tetsworth, K.D.: Deformity Correction by the Ilizarov Technique Operative Orthopaedics, Chapman, M.W. and Madison, M. (eds). J.B. Lippincott Company, Philadelphia. 1993; 883-948.
10. Morgan, P.W., Miller C.W.: Osteotomy for Correction of Premature Growth Plate Closure in 24 Dogs. *Vet. Comp. Orthop. Traumatol.* 1994; 7: 129-135.
11. Yanoff, S. R., Hulse, D.A., Palmer, R.H., Herron, M.R.: Distraction Osteogenesis Using Modified External Fixation Devices in Five Dogs. *Vet. Surg.* 1992; 21: 480-487.
12. Elkins, A.D., Morandi, M., Zembo, M.: Distraction Osteogenesis in the Dog Using the Ilizarov External Ring Fixator. *J. Am. Anim. Hosp. Assoc.* 1993; 29: 419-426.
13. Piermattei, D.L., Flo, G.L.: Brinker, Piermattei and Flo's Handbook of Small Animal Orthopedics and Fracture Repair. Philadelphia, W.B. Saunders Co., 1997; 689-712.
14. Lesser, A.S.: Segmental Bone Transport for the Treatment of Bone Deficits. *J. Am. Anim. Hosp. Assoc.* 1994; 30: 322-330.

15. Preston, C.A.: Distraction Osteogenesis to Treat Premature Distal Radial Growth Plate Closure in a Dog. *Aust. Vet. J.* 2000; 78: 387-391.
16. Stallings, J.T., Lewis, D.D., Welch, R.D., Samchukov, M., Marcellin-Little D.J.: An Introduction to Distraction Osteogenesis and the Principles of the Ilizarov Method. *Vet. Comp. Orthop. Traumatol.* 1998; 11: 59-67.
17. Denny, H.R., Butterworth, S.: *A Guide to Canine and Feline Orthopaedic Surgery*. Fourth Edition, Blackwell Science, London, 2000; 397-408.