

## SURGICAL MANAGEMENT OF A DIPHYRSARY CLOSED TRANSVERSE FRACTURE OF THE RADIUS AND ULNA USING BONE PLATES IN A DOG: A CASE REPORT

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### ABSTRACT

A 2 year old male Lhasa apso was presented with the anamnesis of right fore limb lameness to the District Veterinary Centre, Thiruvananthapuram. The animal had a history of external violence of jamming the legs under the supports of bed. Physical examination revealed that there was pain, crepitus, deformity and abnormal mobility of the radio- ulnar bone. Radiograph revealed a closed, single, transverse, diphyrsary fracture of the radius and ulnar bones, which formed the basis for confirmatory diagnosis. Since all the physiological parameters were within the normal range, surgical correction was opted. Bone plates were introduced to the site after the required length of incision and screwed it, under the umbrella of antibiotics. The incision was apposed and bandaged. Post-operative medication with antibiotics, supportives and Staphban ointment was advised for a week. The animal recovered after 2 months and the plates were removed.

**KEYWORDS:** Bone Plates, Diphyrsary Fracture, Radius And Ulna

Diphyrsary fracture of the radius and ulna occur at all levels, but fractures of the distal one third of the radius and ulna are the most common (Gibert et al., 2015; Piras et al., 2011). Fractures may be complete or incomplete and may include one or both the bones. Anatomically, the radius is formed proximally by the oval and concave radial head, which articulates with the humeral head. The metaphyseal area tapers slightly to become the flattened radial diaphysis. The diaphysis is of uniform shape, flattened cranial-caudally, and curves slightly as it moves from a lateral position at the elbow to a medial position at the carpus. Distally the metaphysis enlarges and enters the epiphysis. The distal epiphysis has a concave articular surface that sits upon the radial carpal bone. A medial pointed prominence, the styloid process serves as proximal attachment of the medial collateral ligament (Evans, 1993). The proximal ulna is formed by a large bony process, the olecranon, which serves as the insertion of the triceps muscles. The articular surface, termed the trochlear notch or semilunar notch, articulates with the humeral trochlea of the medial condyle. The proximal trochlear notch is formed by the anconeal process, while the distal trochlear notch ends in the coronoid process. The ulna tapers below the articular surface and curves cranially, and the diaphysis continues to taper along its length, which begins medially at the elbow and ends laterally at the carpus. The distal process, the styloid process, is the proximal attachment of the lateral collateral ligament of the carpus. The medullary canal of the radius is usually uniform in size and much wider medial-laterally than cranio-caudally. The ulnar medullary cavity is wide proximally and tapered along its entire length. In some

small dogs it may be very small or non-existent (Brinker et al., 1983).

Fractures of the distal one third of the radius and ulna are associated with a higher incidence of delayed union or non-union, which has been related to the precarious blood supply of this area in small breed dogs (Muir, 1997; Welch et al., 1997). Open reduction and internal fixation of closed fractures is usually performed when the leg is inherently unstable, as with comminuted fractures or long oblique fractures, or when closed reduction is not possible or a simple open reduction is unstable. Among the internal fixation devices, the plate and screw have the highest degree of success, especially in small breed dogs (Brinker, 1983). The plate is applied on to the cranial surface of the radius, and apparently no attempts are made to stabilize the ulna. If the radius heals and the ulna is in contact, the ulna will heal. Seldom in small breed dogs, atrophy of the ulna occur, and the distal ulna may wane entirely. This does not adversely affect function or fracture healing of the radius. Majority of the complications of radial and ulnar fractures seems to occur while the usage of intramedullary pins, especially in small breed dogs (Smith, 1970). These pins seem to interact in an area of poor vascularity in such a way that the stability achieved is not complete and a fibrous nonunion will ensue. Shaft fractures of the radius and ulna occur at all levels; however, fractures of the distal one-third of the radius and ulna are the most common.

Fractures may be complete or incomplete and may include one or both bones. The level of the fracture site may be the same in both bones or may be widely

separated. Fractures of the distal one-third of the radius and ulna are troublesome in nature due to the anatomical peculiarities. Most animals that have radial and ulnar fractures will present non-weight-bearing on the affected limb, but occasionally animals with greenstick fractures or non-displaced epiphyseal injuries may present weight-bearing (Heron, 1974). Majority of the forelimb fractures when presented to the Veterinarian will be displaced and unstable. A detailed physical examination is necessary to determine the level of the fracture and to ascertain if the fracture is open or closed. Owing to the small muscle mass surrounding the radius and ulna on the forelimb, countenances the open fractures to occur commonly in the distal forelimb. Biplane radiographic techniques are used to establish the extent of the fracture and for assessing treatment and prognosis (Frost, 1965).

Prognosis and choosing of fixation techniques in any case significantly depends on the age of patient. Also, size of the animal plays a very important role in prognosis. The smaller the dog, the more difficult it may be to achieve healing, probably as a result of diminished surface contact. Small dogs need good reductions with adequate stability if they are to progress toward satisfactory union (Siitnikow, 1970). The larger the dog, the need to have a perfect anatomical reduction of the fracture decreases. The stability that can be achieved in larger dogs with this amount of bone contact is usually sufficient to provide adequate callus and union. In small breed dogs this amount of reduction would provide very little stability, which in turn may lead to loss of reduction, with delayed union or nonunion. Fractures in dogs with open physes may heal more completely than those in dogs with closed physes, especially if a gap exists at the fracture line (Kelber, 1958). Experimentally, dogs with open physes have evidenced healing of large defects that would produce nonunions in dogs with closed physes. Thus the combination of age and size makes the determination of treatment modality for a radial and ulnar Fracture dependent upon the individual animal. Treatment regimens may vary markedly yet produce equally good results. Bone plating has got significant advantages compared to other fixation techniques, which in turn provides the surgeon with an alternative choice. The present case study deals with successful union of the distal diphyseal fracture of radio-ulnar bone in a Lhasa Apso.

## MATERIALS AND METHODS

A 2 year old male Lhasa Apso was presented with the anamnesis of right fore limb lameness to the District Veterinary Centre, Thiruvananthapuram. The

animal had a history of external violence of jamming the legs under the supports of bed. Physical examination revealed that there was pain, crepitus, deformity and abnormal mobility of the radio-ulnar bone. Radiograph revealed a closed, single, transverse, diphyseal fracture of the radius and ulnar bones, which formed the basis for confirmatory diagnosis. Since all the physiological parameters were within the normal range, surgical correction was opted.

Animal was under general anesthesia (induced with Xylazine @ 1mg/kg body weight intramuscularly and maintained with Ketamine and Diazepam in the ratio 1:1 intravenously) and was given amoxicillin-clavulanic acid (12.5 mg/kg intravenously) and Meloxicam @ 0.2 mg/kg bodyweight intravenously at least 30 minutes preoperatively. The affected limb was clipped circumferentially and the dog was positioned in a metal frame in sternal recumbency with the neck in extension. The limb was prepared aseptically by scrubbing with solution of povidone iodine and spirit. Then draped with single-use water-impermeable cloth. A craniomedial approach to the radius was performed and care was taken to preserve the tendon of the abductor pollicislongus muscle. Bone plates were introduced to the site after the required length of incision and screwed it, under the umbrella of antibiotics. The incision was apposed and bandaged. Post-operative medication with antibiotics, supportives and Staphban ointment® (Povidone iodine) was advised for a week. As a part of the post-operative management, modified Robert Jones bandage was applied for at least a week postoperatively, and further bandage treatment was recommended for up to 3 weeks. The owner was advised to keep the patient in rest. The bandage was changed on the second postoperative day and bandage changes were continued twice a week. Skin sutures were removed after the 7<sup>th</sup> day of surgery. Bone plate removal was planned after radiographic union at a time point convenient time fixed by the owners according to rate of healing after two months' time.

## RESULTS AND DISCUSSION

The animal recovered after 2 months of surgery and the plates were removed. After implant removal, a modified Robert Jones bandage was applied for 2 or 3 days, and NSAIDs were given for 5–7 days. It was also recommended that the owner restrict dog exercise postoperatively for 3 or 4 weeks. Follow ups were done by the means of record collection from the hospital. Thus, the surgery was successful and the dog came back to its normal life. There are lots of challenges associated

with distal radial fractures in small dogs. This situation has impelled the exploration of strategies which aim at consistent and effective stabilization, such as external coaptation, intramedullary pinning, external skeletal fixation, and bone plating, all resulting in variable outcomes. But each and every strategy has got its own merits and demerits. It is up to the surgeon to weigh upon and choose it according to the availability of materials for the surgical procedure. The use of casts or splints are avoided in this case as they tend to produce non-unions and malunions due to the limited bone diameter, poor soft tissue support and a tendency for carpal and digital flexor muscles to cause a caudo-lateral displacement of the distal bone fragment (Larsen et al., 1999). Intramedullary pinning is weighed out due to the penetration of pins into antebrachial joints or compromising vascularity, potentially leading to fibrous non-union (Muir, 1997; Welch et al., 1997). External skeletal fixators can successfully be applied in this case, but require more postoperative management and frequent follow-ups. Bone plate fixation is most commonly selected to immobilize these fractures because of the prompt return to function with minimal postoperative care (Gibert et al., 2015) and is most appropriate in this case. However, potential complications associated with bone plate and screws include delayed union, non-union, development of osteoporosis and re-fracture after plate removal (Larsen et al., 1999). Fracture healing rates have been reported to approximately 89%-100% after plate fixation, including locking compression plates. Thus the use of bone plating of the distal transverse fracture was successfully applied in this case.



**Figure 1: The exposed site of radio- ulnar fracture**



**Figure 2: Screwing of the introduced bone plate at the fracture site**

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