

## Radiocarpal arthrodesis using bone graft for the management of radial paralysis in dogs: clinical and radiographic evaluation

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*A comparative study on radiocarpal arthrodesis using different bone grafts was carried out in 18 animals. Autograft (cancellous bone graft) and allograft (demineralized bone matrix) were used in each group of 6 animals, and remaining 6 animals were kept as control. Dynamic compression plating was done to provide rigid fixation of the carpal joint. Clinical and radiographic evaluations were carried out to compare the effectiveness of arthrodesis. Radiographs revealed complete bridging of the joint space in group I (autograft) and persistence of a radiolucent line in group II (allograft) and no evidence of fusion in group III (control) on 60<sup>th</sup> postoperative day. Arthrodesis of the radiocarpal joint with rigid internal fixation using mini dynamic compression plate and use of bone grafts produced satisfactory results suggesting its suitability as a salvage procedure for the treatment of radial paralysis.*

**Key words:** Bone grafts, Radial paralysis, Radiocarpal arthrodesis

Arthrodesis is the surgical fixation of a joint, designed to accomplish fusion of the joint surfaces by promoting the proliferation of bone cells. It is considered as a salvage procedure and can be used only when there is no possibility to bring back the joint to normal function by other methods. The treatment of radial paralysis attempted by many workers consisted of arthrodesis of carpal joint (Frost and Lumb, 1966), tendon transfer (Hussain and Petit, 1967) and nerve anastomosis (Knecht and Clair, 1969). Carpal arthrodesis improves the mechanics of the limb. In this study the effect of radiocarpal arthrodesis using different bone grafts for radial paralysis was carried out and evaluated based on the clinical and radiographic findings.

### Materials and Methods

The study was conducted in 18 indigenous dogs randomly divided in to 3 groups of 6 animals each. Animals of group I received autogenous cancellous bone graft and group II allogenic demineralized bone matrix-hydroxy apatite-polyglycidyl methacrylate-gentamycin composite (ADBM-HA-PGMA-G). Group III dogs were treated as control.

Initially, the dogs were operated to create radial paralysis in the right or left limb by transecting the radial nerve proximal to its triceps branch under general anaesthesia. All the dogs were kept for 7 days to evaluate the clinical and neurological abnormalities. Radiocarpal arthrodesis was carried out in all the dogs after 7 days by incorporating bone grafts along with rigid internal fixation employing dynamic compression plating. With the exception of the type of the graft used to fill the radiocarpal joint for induction of arthrodesis, all the other treatments and follow up procedures were same for the dogs of the 3 groups. However, no graft was used in control group.

The autogenous cancellous bone grafts were collected from the medial aspect of proximal tibia adopting the standard technique. The ADBM-HA-PGMA-G was prepared following the method described by Sastry (1989). Arthrodesis of radio-carpal joint was performed on the 8<sup>th</sup> day after neurectomy. The dogs were premedicated with atropine sulphate 0.04 mg/kg body wt. s.c. and triflupromazine HCl 1 mg/kg i.v. Gentamicin sulphate was administered i.m. 2 mg/kg body wt. preoperatively. The limb affected with radial paralysis was shaved completely from the elbow up to the digits, and thoroughly scrubbed with soap and water, and povidone iodine solution was painted over the area after drying. General anaesthesia was induced and maintained with thiopentone sodium administered i.v. The toe was wrapped with sterile bandage and draped.

Skin incision was made from mid radius and ulna across the carpus to the mid metacarpus on the anterior aspect. The extensor tendons were isolated and retracted laterally. The extensor carpi radialis tendon was severed in order to improve the exposure of the joint because in any case the tendon would be rendered functionless after the fusion of the radiocarpal joint. The joint capsule was cut horizontally to expose the joint surfaces. The articular cartilage was removed from the surface to the depth of bleeding subchondral bone.

A 7-hole 2.7 mm mini dynamic compression plate was applied to the joint by drilling a 2 mm hole first in

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the radial carpal bone and positioned the limb in the required angle tightly packing the joint with bone graft (autograft or allograft). A second hole was drilled eccentrically in the radius. The second screw was driven and tightened. The remaining screws were inserted in the neutral position on the radius and the third metacarpal bone. The wound edges were closed by applying subcuticular sutures followed by skin sutures.

An external support was provided with a plaster of Paris splint applied over the volar aspect of the limb from the elbow up to the toe. Gentamicin 2 mg/kg body wt. was given postoperatively. The sutures were removed on the 7<sup>th</sup> postoperative day. The plaster of Paris splint was retained till the 6<sup>th</sup> postoperative week.

The graft site/wound was examined for any reactions such as hyperaemia, swelling and exudation until healing. The weight bearing ability of the operated limb and the gait were observed daily until 2 weeks, and then at weekly intervals.

Lateral radiographs were made for all the dogs on the first postoperative day and then on 15<sup>th</sup>, 30<sup>th</sup> and 60<sup>th</sup> postoperative days to assess healing and graft incorporation.

### Results and Discussion

In all groups the important symptoms noticed after neurectomy were the loss of motor function after recovery from anaesthesia, loss of cutaneous sensation over the dorsal surface of the forearm, inability to extend the carpus and to bear weight. The toe was kept off the ground during ambulation and the foot rested on the dorsum of the carpus and metacarpus. These signs were also recorded by Hurov *et al.* (1966) and Braud (1986).

Anterior approach was found satisfactory for the surgery. The plaster of Paris splint used for additional external support for 6 weeks as suggested by Sexton and Hurov (1978) was found to be useful.

There was no evidence of wound dehiscence during the entire postoperative period, except for hyperaemia and mild swelling at the incision site. It indicated that there was no apparent graft rejection.

The clinical signs of paralysis due to radial neurectomy disappeared in all the dogs from the first postoperative day and the dogs began to rest the paw on the ground indicating partial weight bearing. Following arthrodesis, the affected limb appeared to be positioned normally with disappearance of toe dragging, but the atrophy of the muscles observed earlier persisted during the postoperative period (Fig. 1).

Following the removal of plaster of Paris splint after the 6<sup>th</sup> week, the gait of all the dogs of groups I and II became normal. This might be attributed to the clinical union of radiocarpal joint. The carpus was stable and no pain on manipulation was noticed. Mild serous

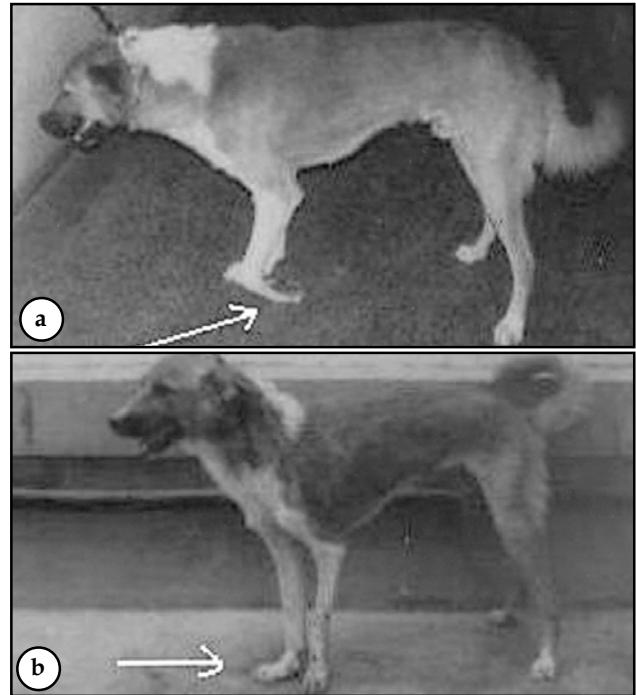


Fig. 1: Animal before (a) and after (b) arthrodesis of carpal joint.

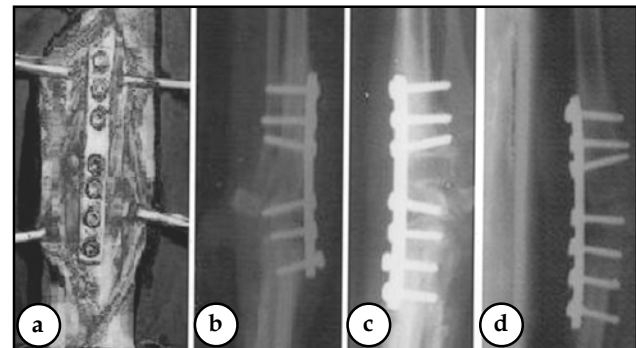


Fig. 2: DCP in position (a) and radiographs of group I(b), II(c) and III(d) at 60<sup>th</sup> postoperative day.

discharge from the distal end of the wound edges noticed in 3 dogs during the first 4 postoperative days in the dogs where allograft was used. The dogs of group III were not able to walk properly for a week after the removal of plaster of Paris splint, which could be due to incomplete fusion of the joint.

Radiographs revealed mild radiodensity at the radiocarpal joint in the immediate postoperative radiograph in group I and group II dogs. Implants were in position. On 15<sup>th</sup> day there was mild radiolucency at the radiocarpal joint, however, evidence of radiodensity at the distal end of the radius and proximal end of the radial carpal bone was observed. On 30<sup>th</sup> day, there was evidence of new bone formation and calcification. By 60<sup>th</sup> day, complete obliteration of the joint was noticed in all the dogs. There was evidence of calcification and fusion of radiocarpal joint, which was faster in group I.

In group II, immediate postoperative radiograph showed mild radiodensity, which persisted till 15<sup>th</sup> day. There was evidence of bony changes in the form of periosteal proliferation at the distal end of the radius and proximal end of radial carpal bone. On 30<sup>th</sup> day, signs of new bone formation at the distal end of the radius and proximal end of radial carpal bone with evidence of calcification were seen. Marked periosteal thickening was noticed around the ends of the plates at the radiocarpal joint. On 60<sup>th</sup> day, obliteration of the joint space was almost complete with evidence of calcification. However, complete bridging of the gap was not seen in all the dogs. Similar findings were observed by Tuli and Singh (1978), hence a more time may be required for the complete fusion of the joint when allografts are used.

There was no evidence of obliteration of joint space in control animals even after 60 days (Fig. 2) suggesting the need of bone graft to promote arthrodesis.

The results of the present study suggested that arthrodesis of the radiocarpal joint with rigid internal fixation using mini dynamic compression plate and use of bone grafts produced satisfactory results suggesting its suitability as a salvage procedure for the treatment of radial paralysis.

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