



ORIGINAL RESEARCH PAPER

Plastic Surgery

ACQUIRED RADIAL CLUB HAND

KEY WORDS: Acquired radial club hand, Centralization, Flap cover.

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ABSTRACT

Introduction: Acquired Radial club hand is a unusual terminology and is a very rare disease. Though it looks similar to congenital cases, based on it's functional and cosmetic deficit, the pathology and management options are unique. External fixator, Distraction, Bone grafting and micro vascular reconstructions have all been attempted in the past. The options and guidelines for treating the congenital variety may not be applicable in the treatment of the acquired type. **Materials and methods:** Between 2011 and 2020, 9 patients came to our hospital with acquired radial club hand. There were 7 male patients and 2 female patients. There were 4 patients with right hand involvement and 5 patients with left hand involvement. All the patients were under 40 years of age, the average age being 14.5 years. Patients underwent sequestrectomy, centralization of ulna and if required a flap cover for soft tissue deficit. **Result:** All patients were followed up for a period of 18 months postoperatively. All patients had significant improvement following sequestrectomy and centralization of ulna. Angle of radial deviation decreased on an average (radiologically) preoperatively from 55 degrees to 5 degrees post-operatively. Preoperatively no ulnar angulations were observed. Length of ulna remains similar to the contra-lateral side and has started taking the shape of radius. No neurovascular complication noted and near normal range of movement was regained. **Conclusion:** Acquired radial club hand results in a significant functional and cosmetic deformity. Osteomyelitis with significant loss of radius is a reconstructive challenge. Older patients require additional skin cover. With extensive bone loss (large radius defect), centralisation of carpus over the ulna and conversion into a single bone forearm gives a consistent and reasonably good result. Stable wrist, good grip, but no forearm rotation are the expected outcome of the procedure. Though it's a salvage procedure, the functional outcome for the patient is rewarding.

INTRODUCTION:

Radial club hand deformity secondary to trauma and infection with bone loss and arrest of physal growth is a challenging reconstructive problem (1). The most common cause of radial club hand deformity is congenital that is radial ray deficiency which is estimated to be 1 per 100,000 live birth. But similar deformity can be acquired as a complication of osteomyelitis of radius bone. In addition to bone loss, there are issues like persistent infection, lack of function in hand and wrist, limb length inequality, and appearance that need to be addressed (2). The osteomyelitis results in absorption and lysis of radius, causing a radial defect resulting in shortening of radius. The defect varies from small defect to total absence, leaving only the distal metaphysis carrying the carpus. In addition, there is a possibility of Ulnar angulation and Distal radioulnar joint dislocation. These lead to radial deviation deformity of wrist. These cases if left untreated resulted in severe cosmetic and functional deformity.

There are many treatment guidelines for acquired radial club hand. The options include debridement with cancellous or structural non vascularized bone grafting (3), open reduction internal fixation of the radius with ulnar shortening (4), creation of a 1-bone forearm (5) use of vascularized fibula (6) and bone transport using an external fixator. Netrawichien (7) reported good results in two patients treated by cancellous bone graft, plating and ulnar shortening. Ono et al. treated nine patients by interposition bone grafting, centralization, radio ulnar transposition and an Ilizarov external fixator, with good results. Sabharwal (1) reported two patients with open fracture of distal radius with atrophic nonunion treated by staged Ilizarov apparatus and obtained good results.

The basic principle in treating these patients include sequestrectomy and centralizing the ulna which would

correct the deformity. Having this in mind, we have done a retrospective study of 9 cases of acquired radial club hand treated in our hospital. The results were evaluated radiologically and clinically for hand functions.

MATERIALS AND METHODS:

This study is a retrospective study between 2011- 2020. About 9 patients with acquired radial club hand were treated in our department. 4 patients in the age group of 1-10, 3 patients in the age group of 10-20 and one each in the age group of 20-30 and 30-40 were part of the study, with a mean age of 14.5 years. All patients were right hand dominant, in which 4 patients had right hand involvement and 5 patients had left hand involvement.

Haematogenous osteomyelitis was seen in 5 patients and in 4 patients, trauma followed by infection was the cause of radial clubbing. The mean interval between infection and operative intervention was 6 months. The mean angle of radial deviation was 55 degrees (40-80 degrees) preoperatively (Fig 1A-C). Blood investigations including white cell count, erythrocyte sedimentation rate and C-reactive protein confirmed the absence of active infection. Elbow, wrist and hand mobility were improved pre-operatively by physiotherapy, followed by the application of a short-arm cast for at least four weeks to stretch the skin and soft tissues on the radial side.

The patient's were operated on supine under general anaesthesia or brachial plexus block, with the forearm on a radiolucent table. Through a lazy-s or c- shaped incision including the preexisting scar (Fig 2), skin flaps raised. Before skeletal reconstructive surgery, the wrist was corrected to as neutral a position as possible by manual traction and soft-tissue release. Sequestrectomy of the distal radius and proximal row carpectomy where required was done (Fig 3).

The distal end ulna was freed from its surrounding. A rectangular-shaped slot was made in cartilaginous mass of carpal bones with its dimension matching the distal ulna. The cartilage of distal ulna was shaved, if needed, to fit into the carpal notch without damaging the physal plate. A k-wire (Fig 4) was passed through this slot into the third metacarpal and was pushed retrograde into the ulna medullary canal after fixing the ulna into the notch. Centralisation of ulna on the carpus done. Additional wrist capsule and extensor carpi ulnaris plication done. Wherever tissue deficiency was present, reconstruction done with flap cover (Abdominal Flap, Fig 5A,5B). Flap division done at the end of 2 weeks. The wrist was kept immobilized in the above elbow plaster slab, with 90 degrees elbow flexion and mid-prone position for 2 weeks. Suture removal and cast conversion done at 2 weeks and retained for 4 more weeks. Physiotherapy to mobilize the fingers and elbow done during this period. Detachable wrist splint applied from 6 weeks to 3 months. K-wire removal done at 3 months.

Follow-up evaluation was done monthly for 3 months, then after 3 monthly intervals (Fig 6). The average follow-up period was 1.5 years (range 12–18 months). At final follow-up, the range of motion of fingers and elbow was recorded. Radial deviation (i.e. angle between third metacarpal and distal end of ulna) in anterior-posterior (AP) and lateral views were recorded radiographically (Fig 7A and Fig 7B) and also the change in the length of ulna, if any, was recorded.

RESULTS:

9 patients with acquired radial club hand were treated by release, club hand correction, sequestrectomy, and centralization of ulna. 3 patients required abdominal flap cover for skin deficit. The average radial deviation of wrist at presentation was 55 degrees (45–80 degrees) as measured on radiograph (i.e. angle between third metacarpal and distal end of ulna). At the last followup, the angle of radial deviation corrected to the average 5 degrees (4–10 degrees). Thus, the average correction attained during the study was 50 degrees of radial deviation.

The length of ulna post-operatively remains equal to the opposite limb and signifies that no injury occurred to the distal ulnar epiphysis during the operative intervention. There was a widening of distal ulna and it was forming a pseudo wrist joint and was gradually becoming like radius. All the patients regained near normal movements in fingers and elbow post-operatively. At a mean follow-up of 18 months, all patients were satisfied with the functional and cosmetic outcome.

One patient developed superficial infection in the pin tract site, which resolved with oral antibiotics. There were no deep infections and no recurrence of osteomyelitis. There was an early exit of k-wire in one patient at 6 weeks, which was managed with splinting.

DISCUSSION:

Acquired radial club hand is a challenging reconstructive problem, especially in terms of restoring good cosmetic and functional hand. It is not as common as congenital club hand. Treatment by cancellous bone graft and plating, combined with ulnar shortening, interposition bone grafting, centralisation and creation of a one-bone forearm have been reported (7,8). Bone transport using Ilizarov and callus distraction with monorail fixator are also used in treating forearm bone defect has also been reported (9-13).

The acquired radial club hand is totally different from congenital club hand, in that the acquired radial club hand does not have any associated skeletal and soft tissue defect like abnormally placed median nerve, hypoplastic thumb, absent or short radius, bowing of ulna, stiff fingers, and so on. In acquired radial club hand, the defect is in its radius and skin

component. Ulna has its normal growth potential. In his review of nine cases, Ono et al. (8) recommended that cases with defect in the distal part of radius, with metaphysis and diaphysis affected, it is essential to perform centralization of the carpus over the distal ulna. In cases with intact distal metaphysis and small diaphysis bone grafting can be done and cases with large radial defect having only distal epiphysis should be treated by radioulnar transposition. In our series as all the patients had an extensive loss of bone including distal growth plate and had a thin cartilaginous flange remaining, we used centralization as a definitive procedure.

One of the methods used to construct single-bone forearm is by distraction osteogenesis (14). Distraction osteogenesis technique with circular external fixator involves complex instrumentation. This method requires high commitment from patients with regards to prolonged period of treatment and meticulous pin care.

Furthermore, external fixator method has other complications such as pin site problems, nerve palsies, mal-union, re-fracture and infection (15). The use of vascularised bone graft is technically demanding. Arai et al (6) reported the use of vascularised fibular graft to create single-bone forearm. However, fibular graft can be complicated with infection, graft resorption, refracture, delayed union and donor site morbidity.

The aim of treatment in most of the patients with acquired radial club hand is to improve cosmesis and function and in our cases, treatment was primarily considered as salvage only. Single-bone forearm is a salvage procedure for cases where the usual reconstruction techniques are not feasible. In resource-limited centres, Kirschner wires can be utilized to achieve single-bone forearm. This method is simple, requires minimal technology and practical for patients with compliance issues. It also negates the need to sacrifice another healthy site for harvesting bone graft, thus avoiding donor site morbidity.

Limitations:

The small number of patients and the relatively short period of follow-up are the limitations of this study.

CONCLUSION:

Acquired radial club hand is difficult to treat. There are several options for treatment. Centralization of carpus over the ulna has showed good results in correcting the deformity and producing wrist stability and providing good grip. There was no detrimental effect on the growth of the distal ulnar epiphysis. Older patients will require additional skin cover.

Figures



1. Figure 1 A: Preoperative view



2. Figure 1 B: Postoperative view



3. Figure 1 C: X-ray Preoperative view - AP VIEW/OBLIQUEVIEW



4. Figure 2 :Incision



5. Figure 3: Sequestrectomy of Distal Radius and Carpectomy



6. Figure 4 : Centralisation and K-Wire Fixation



7. Figure 5a :Preoperative View



8. Figure 5b :Abdominal Flap



9. FIGURE 6 : 12 MONTHS FOLLOWUP



10. FIGURE 7A : PREOP RADIAL DEVIATION - 55 DEGREES



11. FIGURE 7B : POSTOP RADIAL DEVIATION - 5 DEGREES

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