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Forearm Reconstruction after Loss of Radius: Case Report

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SUMMARY

Introduction Osteomyelitis of the radius resulting in the radial clubhand is a very rare condition and few studies have been published about its prognosis and treatment.

Case Outline This is a case report of hematogenous osteomyelitis of the radius with a complete loss of the radius leaving only the distal radial metaphysis to carry the carpus. In order to achieve best functional results, four-step operative protocol was performed for reconstruction; lengthening of the forearm by external fixator, radioulnar transposition to create a one-bone forearm, plate removal and transposition of brachioradialis to the extensor pollicis longus as well as proximal row carpectomy. After nine years of the last operation, the function of the elbow and hands is good with acceptable cosmetic result. The forearm is 5 cm shorter and there has been a persistent mild limitation of palmar flexion.

Conclusion Creation of the one-bone forearm normalizes the elbow and wrist function, corrects forearm malalignment, and improves forearm growth potential.

Keywords: radial clubhand; one-bone forearm; osteomyelitis; proximal row carpectomy

INTRODUCTION

Radial clubhand is a term first used in 1733 to describe the congenital bilateral absence of the radius [1]. It presents a clinical picture of congenital radial longitudinal intercalary or terminal deficiency [1, 2, 3]. Clinically similar to congenital clubhand, an acquired radial clubhand is most commonly caused by trauma [4]. There are limited reports of acquired radial clubhand due to osteomyelitis [2, 5-9]. This one is in association with osteomyelitis of the radius which has been generally quoted in about 3% of papers [8]. Options for the surgical treatment of radial clubhand include interposition bone grafting, centralization, radioulnar transposition and circular external fixator [2, 3, 8, 10]. One-bone forearm works best in the treatment of radial clubhand when the proximal ulna and distal metaphysis of the radius are present, thus preserving both the humeroulnar and radiocarpal joint [11]. Physiological basis of this procedure is the fact that the ulna as a distal extension of the arm is important for elbow function and the radius as a proximal extension of the hand is important for function of the radio-carpal joint [12]. Despite multiple published series of the one-bone forearm following the injury, there are not many reports of post-osteomyelitic radial clubhand treated by a one-bone forearm [7, 8]. For achieving additionally better functional and cosmetic results, the elongation was performed before creation of the one-bone forearm followed by proximal row carpectomy.

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CASE REPORT

A nine-year-old girl was admitted to our institution in September 2001. She had experienced acute hematogenous osteomyelitis of the left radius when she was two years old. The left forearm was shortened in a form of radial clubhand. The hand was in pronation with the thumb in palm pattern. The wrist was in fixed dorsiflexion without movements. Generally, her hand was not useful and only very week grip was possible. The X-ray showed that the radius was absent as a result of sequestration, except the distal metaphysis, and the wrist was in a form of radial clubhand with marked protrusion of the ulna. Distal epiphysis of the radius and ulna were open (Figure 1).

A simple external fixation with two pins placed in the ulna, one in the distal part of the radius and one in the second MC bone were performed. The radial side of the forearm was 6 cm elongated, measured on the external fixator during 35 days (Figure 2).

Neurovascular status of the hand was monitored on daily basis and there was no sign of transient nerve palsy of any nerve during distraction period.

After 35 days from the first operation, the second operative procedure involving the removal of the external fixator and radioulnar transposition was carried out, creating one bone forearm. To achieve good bone surface for healing, the ulnar diaphysis was step-cut at 4 cm proximally from the distal end and proximal end of the distal metaphysis of the radius. The

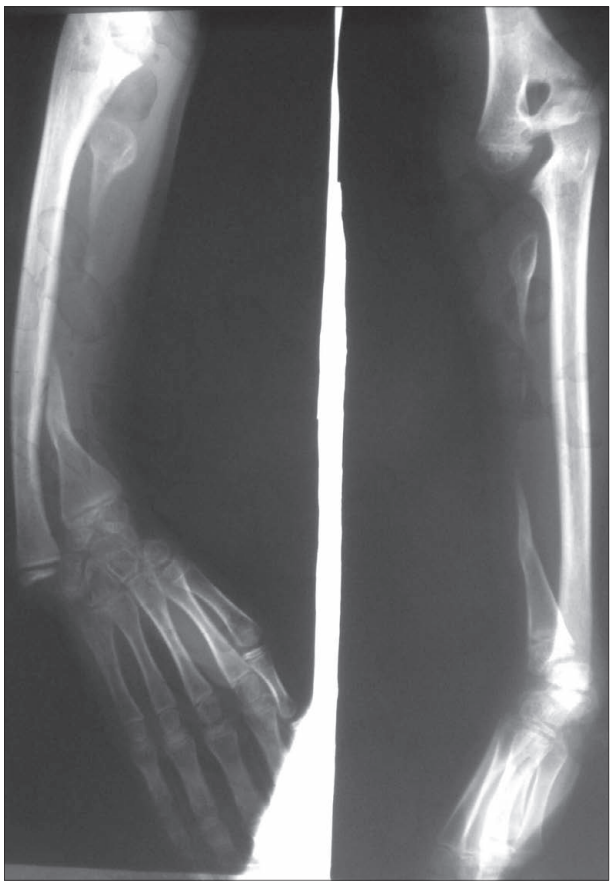

Figure 1. Only distal part of the radius is present with decentralization of the carpus. Note severe protrusion of the ulna. Radiocarpal joint is fixed in dorsiflexion.

ulnar diaphysis was joined to the distal radial metaphysis using the plate with a screw. The distal part of the ulna was retained. In the same procedure, the centralization of the carpus over the radius was achieved (Figure 3). Operation was performed by dorsal approach allowing for exposure of extensor tendons, which were affected by osteomyelitis that caused them to become shortened, fused to each other, and fibrotic as well as excursion of tendons that was insufficient, which we considered inappropriate for elongation. Bone union was achieved and the plate was removed only 8 months after osteosynthesis. In the same procedures, the transfer of the brachioradialis to the extensor pollicis longus was performed for making the extension of the thumb possible (Figure 4). The patient was referred to physical therapy. On the control 8 moths after third surgery, the motion of the wrist was still limited with the wrist in dorsiflexion and limited flexion in MCP joints. The patient had moderate pain in her wrist only during intensive work therapy. To get a better motion of her wrist and eliminate the pain, proximal row carpectomy was performed followed by fixation of the wrist with 2 K-wire during three weeks (Figure 5).

At the control 9 years after the last operation, the left forearm was shorter 5cm in comparison to the opposite hand, the one-bone forearm was characterized by 10 degree pronation, and full range of motion in the elbow was possible. Full dorsiflexion of the wrist was possible but 20 degree flexion of the palm was still persistent. The patient was able to make complete fist and grip, which were quite satisfactory. Function of the hand was good; opposition of the thumb to all fingers was possible (Figure 6).

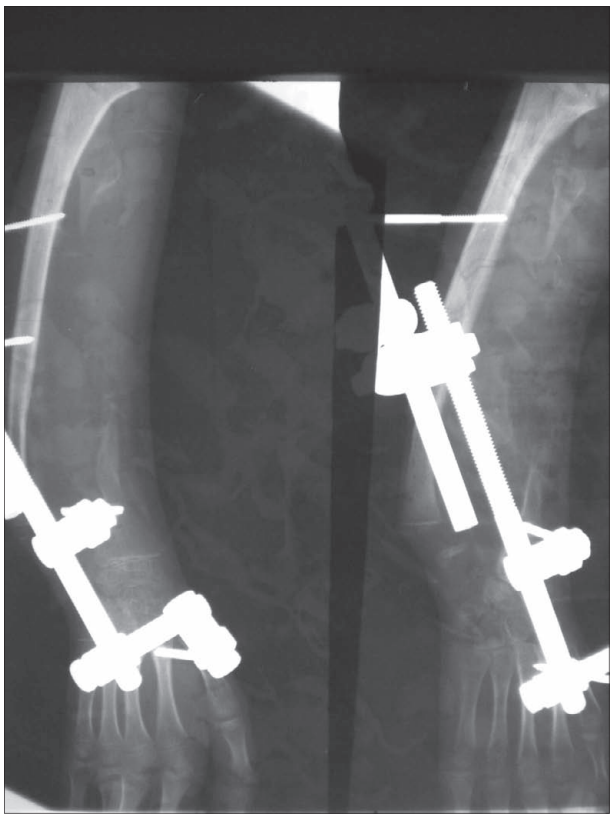

Figure 2. Note elongation of radius by comparing the distance between the ulna and radius in Figures one and two

Figure 3. Osteosynthesis between the radius and ulna. Dorsiflexion of the wrist and extension of the MCP and flexion of PIP and DIP joints due to short extensors.

Figure 4. Good bone healing. Note extension of the thumb. The remaining distal part of the ulna contributed to bone healing between the ulna and radius, making the synostosis which additionally stabilized the wrist. Note centralization of the carpus and good relationship between the ulna and radius in the wrist.

Figure 5. After carpectomy; the wrist is in neutral position

DISCUSSION

Since Hey Groves first performed one-bone forearm in 1921, it has been used for a variety of underlying conditions to treat congenital or acquired deformity and instability [13]. Different functional results and complications were reported [14, 15, 16]. Ono CM considers radioulnar transposition a method of choice in cases of radial clubhand with a large radial defect but intact epiphysis. There are limited reports of the ulnar diaphysis joined to the distal radial metaphysis in which case one bone forearm works best [8, 17, 18].

We consider that our case required step by step operative protocol rather than one single operation to achieve good functional results. The goal of the first operation was elongation of the forearm by external fixator. Some authors used distraction as a method to overcome soft tissue contracture [2]. In our case, dorsiflexion of the wrist and extension in MCP joint were increased during the elongation, meaning that the contracture of extensors still persisted and was not solved by elongation. The reasons for this were degenerative changes of the extensor muscles and tendons which were found in the second operation. Limitation of motion in the radiocarpal joint was mainly caused by shortened extensor and it was the reason for proximal row carpectomy, which increased the motion of the wrist and MCP joints.

It is difficult to compare functional outcome of different methods for treatment of the acquired radial clubhand. Reason for this is different etiology; trauma, tumor, infection and neurologic deficit as well as different pathologic findings, depending on which parts of the radius and ulna were preserved.

One-bone forearm is a method of choice for managing the radial clubhand deformity in which case the distal metaphysis of the radius and proximal ulna are preserved. To achieve the best functional results, we recommend step by step operative protocol instead of one single procedure; elongation before one bone procedure and also, if necessary, other operations; proximal row carpectomy and tendon transfers.

Figure 6. Full dorsiflexion in the wrist is possible but 20 degree limitation of palmar flexion still persists. The patient is able to make complete fist and grip, which is quite satisfactory. Function of the hand is good, and opposition of the thumb to all fingers is possible.

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Реконструкција подлактице после губитка жбичне кости – приказ болесника

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КРАТАК САДРЖАЈ

Увод Остеомијелитис радијуса који доводи до деформитета познатог у англосаксонској литератури под називом *radial clubhand* веома је ретко стање и објављен је мали број радова о лечењу особа с овим деформитетом и о функционалном исходу.

Приказ болесника Ово је приказ случаја хематогеног остеомијелитиса радијуса који је довео до потпуног губитка радијуса изузев дисталне метафизе која носи карпус. Да би се постигли најбољи функционални резултати, урађене су четири сукцесивне операције: продужавање подлактице спољашњим фиксатором, примена хируршке методе„једне кости подлактице“ (енгл. *one-bone forearm*), вађење остеосинтетске плочице и транспозиција тетиве брахиорадиалиса за дуги екстензор палца, те проксимална карпектомија. Девет година након последње операције функција лакта, ручног зглоба и шаке болесника била је добра, с прихватљивим естетским резултатом. Подлактица болесника је краћа за 5 *cm*, а постоји и умерено ограничена палмарна флексија ручног зглоба.

Закључак Применом хируршке методе „једне кости подлактице“ за лечење деформитета *radial clubhand* могуће је постићи корекцију осовине подлактице и добру функцију лакта и ручног зглоба.

Кључне речи: *radial clubhand*; метода „једне кости подлактице“; остеомијелитис; проксимална карпектомија

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