Pediatric Proximal Ulna Plastic Deformation with Anterior Radial Head Dislocation — A Rural Monteggia Fracture Two Weeks out in a Tertiary Care Center: A Case Report

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Abstract

The Monteggia fracture was originally described over two centuries ago. These fractures of the proximal one-third of the ulnar shaft with associated anterior dislocation of the radial head and its variants are well described and still an area of active debate. There is the additional challenge today of tertiary referral centers providing specialized care for this injury in the pediatric population, resulting in missed diagnosis and late referrals. This is a case report of one such patient, an eight-year old female referred to our center two weeks post injury with the diagnosis of an un-reducible radial head dislocation.

Case

An eight-year-old right-hand–dominant female had a fall from horse two weeks prior to presentation at our Pediatric Orthopaedic specialist clinic. Upon the fall, the patient had the left hand outstretched, and she experienced instant pain in her left elbow. She was seen at the Indian Health Services urgent care facility which was located near her home on a Native American Reservation home in eastern Arizona. As is typical in the situation of our patient, access is limited, and she was eventually referred locally and then regionally from her home to a care center in western New Mexico. Upon evaluation, the patient was found to have a dislocation of the radial head with no noted ulnar fracture. The patient was referred to the University of New Mexico Carrie Tingley Hospital, the only orthopaedic practice in the state subspecializing in Pediatric Orthopaedics. It was here that she received definitive orthopaedic management.

Upon evaluation in our clinic, the patient noted that her left elbow was still extremely painful. Her splint was removed and skin was found to be intact. She was found to be neurovascularly intact in the radial, ulnar, and median nerve distribution with palpable radial pulse. There was a prominence seen anteriorly over the antecubital fossa in the elbow, with ecchymosis anteriorly and medially, extending down the forearm. Range of motion of the elbow was limited from 40 degrees to 90 degrees of flexion with a neutrally oriented forearm. Pronation and supination examination were noted to be limited secondary to pain.

Plain radiographs revealed an anterior dislocation of the radial head can be seen (Figures 1a and 1b). Though there was no discrete fracture through the cortex of the ulna, there was an apex volar bowing of the ulna as seen on the lateral view. Closed reduction of the radial head could not be performed secondary to pain in the patient's elbow.

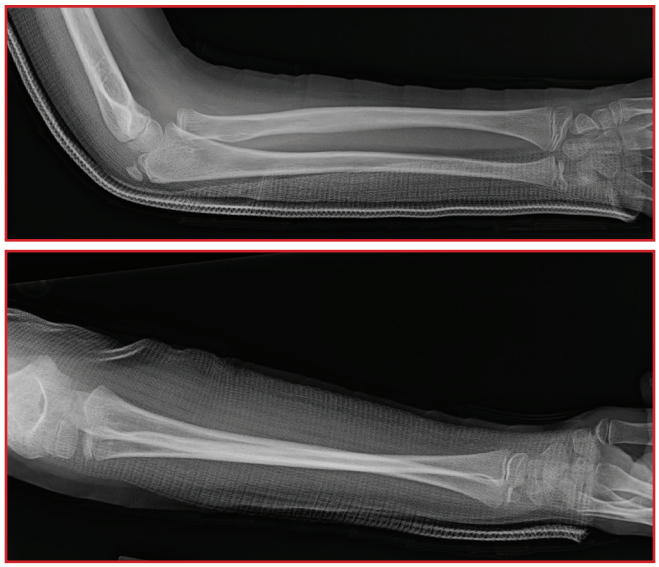

Figure 1:Initial outside x-rays showing radial head dislocation on lateral view.

A full and thorough conversation was undertaken with the patient and her parents. They were informed that the patient had an acute dislocation of the radial head and that she would require sedation for attempted reduction. They were furthermore informed that given the injury was two weeks remote and that inflammation and scar tissue and bowing of the ulna could possibly prevent closed reduction of the radial head. Thus after being informed of full risks and benefits to intervention the patient and parents

consented for anesthesia with closed reduction of radial head dislocation, ulnar osteotomy with internal fixation if necessary, and open reduction of radial head if necessary.

The following day, the patient was taken to the operating room where she underwent general anesthesia. Fifteen minutes of attempted closed reduction under c-arm fluoroscopy were undertaken, including manipulation of the ulnar bowing deformity (Figures 2a and 2b). Reduction of the radial head occurred only with maintained hyperflexion of the elbow.

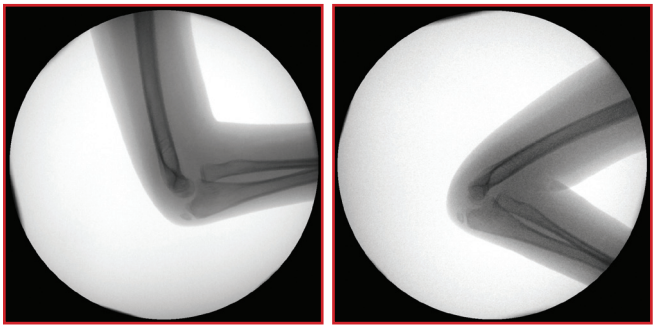

Figure 2: Intra-operative fluoroscan views showing radial head dislocation after unsuccessful attempt at closed reduction

The decision was made to perform the ulnar osteotomy. The patient was prepped and draped in the supine position with the right arm on the armboard. An incision was marked out along the proximal one-third of the ulna along and a direct approach between flexor carpi ulnaris and extensor carpi ulnaris.

Once the ulna had been subperiosteally exposed, the osteotomy was made in the middle of the proximal third of the ulna shaft in an oblique fashion. Fluoroscopy was then used to verify reduction of the radial head, which occurred easily. With the radial head concentrically reduced, a 3.5 LCDC plate was selected, and one screw distally and one proximally were inserted. The reduction of the radial head was found to be maintained throughout full range of motion, and the remainder of the plate was appropriately drilled and filled with non-locking screws totaling six cortices of fixation proximal and distal to the osteotomy.

Views of the radial head were then taken, anterior, oblique and lateral and reduction was found to be maintained (Figures 3a, 3b, and 3c). The patient was irrigated and closed in the standard fashion and placed into a long arm cast with forearm in supination. Intraoperative and postoperative

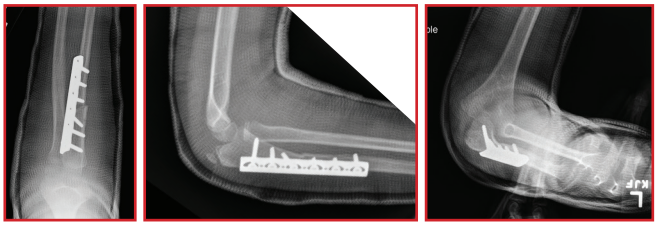

Figure 3: Immediate post operative x-rays after ulnar osteotomy and now concentric reduction of the radial head

imaging showed the radial head to maintain reduction throughout this procedure.

Close patient follow up was undertaken to ensure maintained reduction of radial head and for elbow range of motion rehabilitation. At both one and four weeks postoperative, the patient was found to have a maintained reduction, though range of motion was limited at the latter visit, and casting was discontinued with the stipulation that range of motion be the only activity that patient undergo. At five weeks, reduction was maintained throughout range of motion. At the two month follow up, reduction was maintained, the osteotomy site was found to be healed, and the patient was pain-free and had attained full range of motion and thus was returned to activity as tolerated (Figures 4a and 4b). At ten months postoperative, the patient underwent removal of hardware with no adverse events.

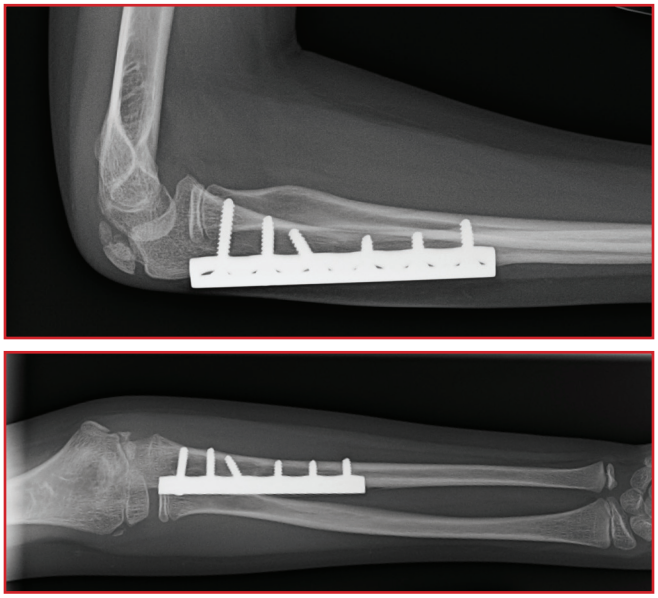

Figure 4: Ten month post-operative x-ray after ulnar osteotomy showing healed osteotomy and maintained concentric reduction of the radial head

Review of the Literature

Monteggia originally described an injury to the proximal one-third of the ulnar shaft associated with an anterior dislocation of the radial head, and though this injury was described in 1814, debate exists to this day about its proper classification and management.[1-4] This is due to the variability of the injury itself, the intricate anatomy in its vicinity of the injury, and the plethora of interventions that provide typically satisfactory yet frequently unreliable results. The forearm contains the radius and ulna and their proximal and distal articulations. When we are considering Monteggia injuries, the radiocapitellar articulation is paramount. The radius must glide along the capitellum in

elbow flexion and extension but must also rotate about the capitellum for the intricate act of forearm pronation and supination which affords uniquely human dexterity. This relationship is sensitive to small changes in the relationship. It was found that to maintain eighty percent of forearm rotation, the radial bow of an injured forearm would need to heal within five degrees of the contralateral side.[5]

Fractures of the proximal ulna associated with radial head dislocation were further categorized by Bado, who noted types 1, 2 and 3 for anterior, posterior, and lateral radial head dislocations, respectively. The observation was made by Ring that these could be considered equivalent to plastic or fracture deformities of the proximal ulna with apex in the same respective direction as radial head dislocation.[6] Rupture of the annular ligament, capsule, or other surrounding ligamentous structures then is obligatory if the radial head is to dislocate.[7] Thus, both ulnar and medial soft tissue deformities must be addressed for treatment of the injury. The injury is significant because it is often not diagnosed initially and the difficulty of reduction.[8] Consequences of a chronically dislocated radial head include pain, decreased range of motion, delayed posterior interosseous nerve palsy, osteoarthritis, and valgus instability,[2,7,9-11] and these problems may be progressive as ulnar growth discrepancy and soft tissue stretching increase with time. Intervention has been notorious for complication.[9-11] One recent case series of seven noted loss of fixation, non-union, radial nerve laceration, transient ulnar nerve palsy and compartment syndrome.[12] Thus, it is still a viable treatment option for irreducible radial head dislocations to be treated with and excision or replacement upon skeletal maturity should the patient have a clinically poor picture.[13]

Treatment options consist of closed reduction, open treatment of ulna, open treatment of radial head, or open treatment of both. Closed reduction can be used in some cases of ulnar deformity and rare cases of ulnar complete fracture. A series of 200 Monteggia lesions showed excellent results for maintained reduction with closed treatment though 10 of 14 Monteggia Bado type 1 closed reductions required reoperation in order to correct the radial head dislocation.[14] One study suggested surgical correction of ulnar deformity if greater than 5mm of deviation of ulnar bend remained from contralateral side[15] and most studies noted the importance of restoring natural ulnar border to be paramount to maintained reduction of the radial head, with splinting in flexion and supination to be the most stable.[6,14]

Most sources recommend initially treating failed closed reduction of the ulna with open correction of ulnar deformity. Surgical recommendation is for reduction of fracture deformity, or in cases of chronic or plastic deformities, osteotomy with fixation to correct deformity.[8, 15-17] There is no agreed upon method of fixation, though less invasive techniques such as wires with casting may be used in children when overall stability is provided.[4] It is suggested that intraoperative radiographic assessment of the radial head reduction be scrutinized by verification of concentricity of the radial head with the capitellum during both extension and flexion with pronation and supination.[6] Reduction of ulnar osteotomy should occur in the position where deformity is corrected but more importantly, where dynamic stability of the radiocapitellar joint occurs. Annular ligament reconstruction is recommended by some as a primary means of operative correction when the condition is chronic—lasting greater than eight weeks.[7,10,14]

Typical recommendation is for a combination of correction of ulnar deformity and repair or reconstruction of the soft tissue structures at the proximal radius when stability of the radial head is not conferred. If restoration of the flat ulnar border is undertaken and the radial head is not stable upon dynamic examination, the radial head must be stabilized.[8,18-19] A variety of techniques may be used, from reconstruction of the annular ligament using triceps fascia to open repair or reconstruction of the capsule while ignoring the annular ligament.[8,18] Other techniques include stabilization of soft tissue structures in the radiocapitellar joint by pinning of the joint until these structures heal.[20] If the radial head cannot be reduced after correction of the ulnar deformity, the joint must be opened to examine for blockage to reduction.[19]

Problems of chronic instability may not be correctable in the above manner by surgical intervention. These cases must be tempered by salvage operations. Children in whom the deformity is late or failed surgical treatment may have to deal with a deformity as continued treatment may lead to elbow stiffness. Eventual excision of the radial head may be a necessity, with or without arthroplasty While not ideal, results are typically better than the painfully chronically dislocated radial head.[4]

Summary

The Monteggia fracture and its variants have been the source of endless debate for greater than two centuries, prior to the roentogram. The principles of the injury are constant, though subtle variations to the injury make its treatment a challenge. Essential to successful treatment of lesions is the understanding that the forearm functions as one unit, and that both the integrity of the radiocapetellar joint and correction of ulnar deformity are necessary for treatment. Through examination of the literature, there is no one recommended treatment, though a clear treatment algorithm is suggested.

Initial workup of the patient should include a thorough history and physical and adequate radiographic examination of the patient. Prior to attempted closed reduction under sedation, the chronicity of the injury should be assessed. A congenital or chronic dislocation of the radial head will not likely reduce with closed manipulation, and an attempt would cause needless discomfort and incur the risks of sedation. An attempt under sedation should be attempted at acute presentation with splinting and close follow-up of patient regardless of success of reduction. A failed reduction should require formal attempt under operative sedation with the option of open treatment within two weeks of injury if possible. In the case of a late presentation, it is suggested that such an attempt can be undertaken anytime in the first year after injury.[8] It is important to evaluate the patient for additional injuries such as fracture of the radius, stability of distal radioulnar joint, and ulnar fracture, as these injuries will require different methods of treatment. If further intervention is required, additional imaging may be needed. When the ulnar deformity is not clear, plain radiographic imaging of the contralateral forearm with good lateral of the elbow should be undertaken for closed reduction and/or operative planning. In larger and more chronic deformities of the elbow, CT imaging should be considered, and 3D reconstruction can be useful for determination of failed forearm dynamics.[17]

As was the case with our patient, considerations must be given to the patient's access to health care. Furthermore, this consideration must be taken by care providers at every level of the patient's care. In our case, this meant arranging for general anesthesia with attempted closed treatment and operative intervention readied. Thus, the patient required anesthesia once for definitive treatment and once for implant removal following healing of osteotomy.

This well-described injury still poses challenges greater than two hundred years following its namesake's description. With knowledge of anatomy of fracture, treatment algorithm, and attention to the modern complexities of health care access, timely and successful management is possible.

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