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CHRONIC RADIAL HEAD DISLOCATION IN CHILDREN. TREATMENT BY OPEN REDUCTION AND ULNAR OSTEOTOMY

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ABSTRACT

Purpose: To present the results of open reduction and angulating-distraction ulnar osteotomy in children with chronic radial head dislocation.

Material and Methods: This is a retrospective review of 4 children (3 girls, one boy) with chronic radial head dislocation treated in our hospital between 2009 and 2012. The average age at the time of surgery was 6.6 (4.2 – 9.1 years).The interval between initial trauma and surgery was from 2 to 25 months. Three of the patients had a plastic deformation of the ulna with a positive "ulnar bow sign" and one was with missed radial head dislocation after an equivalent injury.

The surgical strategy in all patients included proximal ulnar osteotomy with angulation and distraction and open reduction of the dislocated radial head without annular ligament reconstruction or pinning. Osteotomy was fixed with a prebent one-third tubular plate and a tricortical bone graft.

Results: The mean follow-up was 4 years (range 2.5 - 5.5). Radial head remained reduced and stable in all cases. All ulnar osteotomies healed without any complications. The postoperative range of motion was improved in all of the patients. Functional outcomes assessed by Elbow Performance Score were excellent in three and good in one of the patients.

Conclusions: The treatment of an unrecognized radial head dislocation in children continues to pose a therapeutic challenge. The osteotomy of the proximal ulna with both angulation and elongation allows stable radial head reduction without necessity of annular ligament reconstruction in most of the cases.

Key words: Chronic radial head dislocation, Monteggia lesion, children, ulnar osteotomy

INTRODUCTION

Radial head dislocation is an uncommon injury in children. In most of the cases it is associated with an ulnar fracture or deformation as a part of the spectrum of Monteggia lesions. The classification of Bado remains the most commonly used for these types of injuries. It divides four types true Monteggia lesions and some "equivalent lesions" based on the direction of ulna angulation and radial head displacement. [1] Letts et al. proposed a pediatric classification, subdividing the Bado type 1 based on the ulnar fracture pattern (plastic deformation, greenstick, and complete). [2]

Monteggia fractures in the pediatric population can result in excellent outcomes if recognized early and treated promptly. Restoration and maintaining the length and alignment of the ulna by closed reduction or surgery usually results in stable reduction of the radiocapitellar joint. However, missing or delayed recognition of radial head dislocation is the most common (16% - 50%) and serious complication of pediatric Monteggia lesions, especially with plastic deformation of the ulna, resulting in a far more complex injury with often unpredictable surgical outcome. Unreduced dislocation of the radiocapitellar joint that is still present more than four weeks after the injury is considered chronic. [3] Although in the short term persistent dislocations do well, the natural history of chronic Monteggia lesions is not benign and is associated with restricted forearm rotation and elbow flexion, radial head overgrowth, progressive valgus deformity, pain, instability, tardy nerve palsies and potential degenerative arthritis. [4, 5, 6, 7, 8] Treatment of chronic radial head dislocation is much more complicated and challenging then the management of an acute Monteggia lesion. The published literature is confusing and controversial with ill-defined indications, variable results and common, sometimes severe, complications and uncertain prognosis. Treatment options and the proposed surgical procedures are multiple and variable. They have included no treatment, resection of the radial head at the end of the growth, open reduction with or without transcapitellar pinning, annular ligament repair or reconstruction, osteotomy of the ulna or the radius, or both, combined ulnar osteotomy and ligament reconstruction, gradual lengthening of the ulna etc. [7, 9, 10, 11, 12, 13, 14, 15]

In this report we present the clinical outcomes after treatment of chronic dislocated radial head in children by open reduction and angulating ulnar osteotomy.

MATERIALS AND METHODS

This is a retrospective review of 4 children (3 girls, one boy) with chronic radial head dislocation who were treated in our hospital between 2009 and 2012. The average age at the time of surgery was 6.6 (4.2 – 9.1 years). The right elbow was involved in two, and the left in the other two of patients. All patients had a history of trauma without signs of congenital radial head dislocation at radiography of both elbows. The mean interval between initial injury and the surgery was 12 months (range 2-25). All patients had limited

elbow flexion, restricted forearm pronation-supination and pain or discomfort. Two of them with a long-term dislocation (18 and 25 months) had an increased carrying angle and valgus instability. Preoperative paresis of the radial nerve was found in one of the children. All patients showed a disturbed radiocapitellar line on the preoperative radiography. Three of them had a plastic deformation of the ulna with a positive "ulnar bow sign". According to Bado classification two had a type I with anterior radial head dislocation, and one had a type III with anterolateral dislocation. Fourth case was a 9 years old girl with missed anterior radial head dislocation after operative treatment of an equivalent lesion (radial neck fracture) by Metaizeau technique.

Surgical technique

A tourniquet was applied and the arm was positioned on an arm table. Gordon-Boyd approach was used to expose both the radiocapitellar joint and the proximal third of the ulna with the same incision. A subperiostal transverse osteotomy of the ulna was performed 5 cm below the olecranon as described by Hirayama et al. [10] Fibrous scar tissue around the radiocapitellar joint was carefully excised. In all cases an entrapped in the proximal radio-ulnar joint intact annular ligament was founded. In two of them the obliterated ligament was gradually dilated and then repositioned over the radial head. (Fig 1) In other case fixed and entrapped ligament was transected, released and then repaired. In fourth case the posterior interosseous nerve was found entrapped in the radiocapitellar joint. (Fig 2) Radial head reduction was secured and controlled by posterior angulation and distraction at the osteotomy site with aim to overcorrect the ulnar deformity. The degree of angulation and distraction was determined by evaluation of the stability of reduction of the radial head in all combinations of flexion, extension, pronation and supination under direct vision and fluoroscopy. The osteotomy was fixed with a pre-bent one-third tubular plate and wedge-shaped tricortical autograft. It was not necessary to perform, neither ligament reconstruction with tendon or fascial strip, nor temporary transcapitellar pinning in any of the patients. Postoperatively, the elbow was immobilized in a long arm plaster splint for4 to 6 weeks. After cast removal active forearm rotation, flexion and extension of the elbow were initiated without formal physiotherapy prescribed.

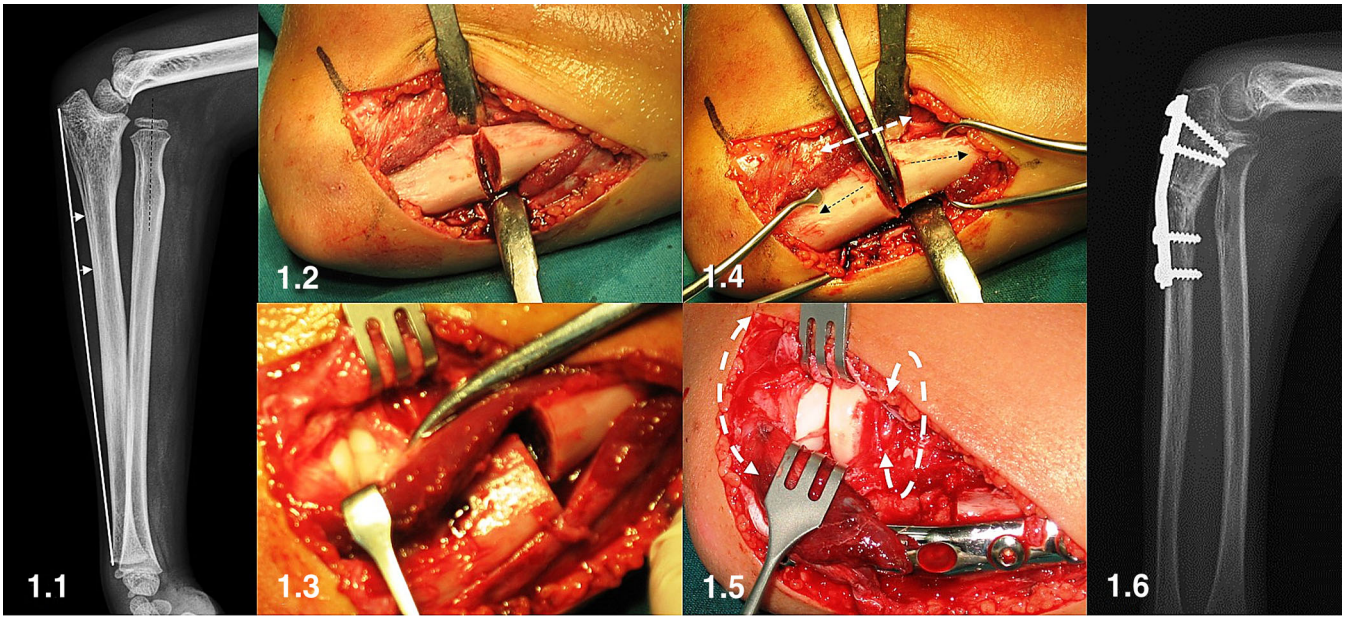

Fig. 1. A 7 years old girl with missed radial head dislocation and Bado 1 plastic deformation of the right ulna, 2 years ago. **1.1** – Preoperative X-ray image with positive "ulnar bow sign" and deviation of the radiocapitellar line; **1.2** – Transverse osteotomy of the ulna; **1.3** – Repositioning of the annular ligament over the radial head; **1.4** – Distraction and angulation of the osteotomy; **1.5**–Fixation of the osteotomy and testing stability of reduction in flexion-extension and pronation-supination. **1.6** – Postoperative X-ray image, three months later.

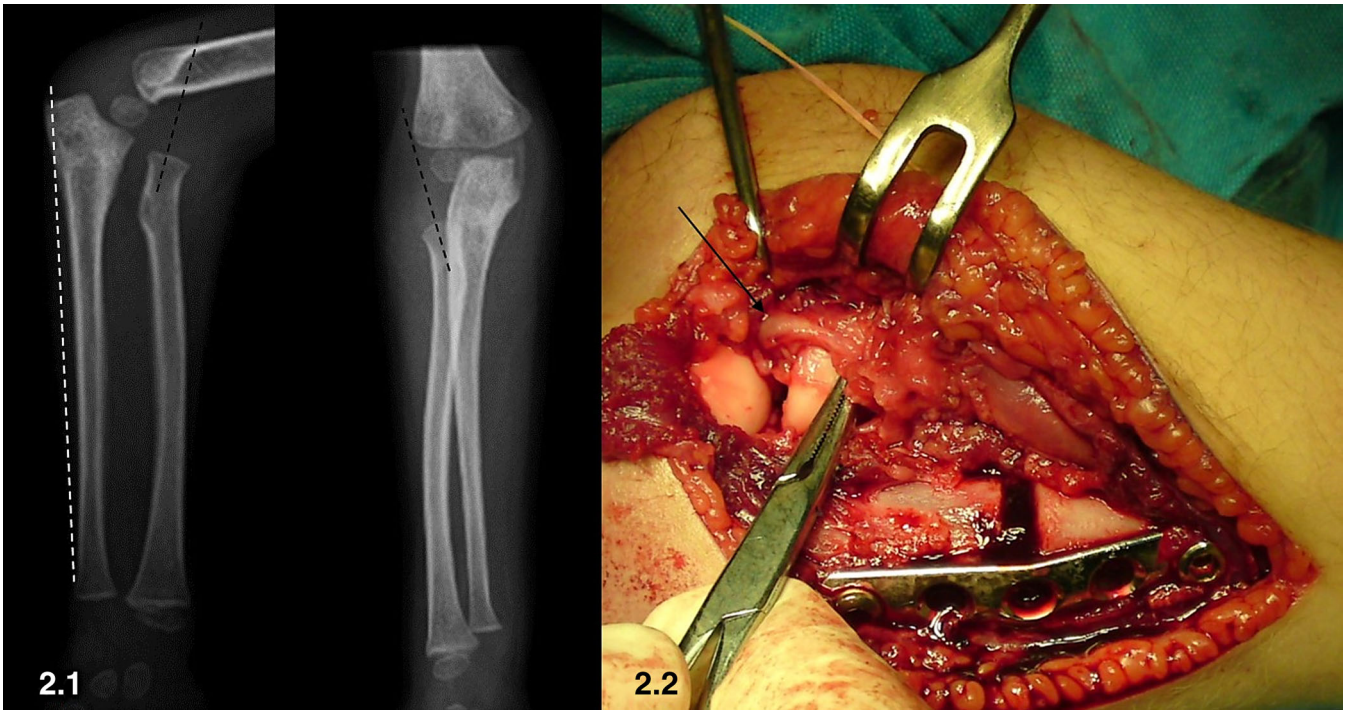

Fig. 2. A 4 years old boy with Bado 3 Monteggia lesion and radial nerve paresis, two months ago. **2.1** – Preoperative X-ray images; **2.2** – Intraoperative image of the interposed posterior interosseous nerve (arrow).

RESULTS

The mean follow-up was 4 years (range 2.5 - 5.5).

Radiographs were taken after cast removal and at follow-up visits to assess radial head reduction and ulna remodeling. Elbow and forearm range of motion were recorded at regular intervals. Functional results were evaluated according to Elbow Performance Score devised by Kim (2002) [16]. The elbow was assessed for deformity, pain, range-of-motion and function. The four parameters were weighted equally, 25 points each, for a perfect score of 100 points.

All wounds healed primarily with no infection, neurovascular complications or compartment syndrome. The healing of ulnar osteotomies was uneventful with no cases of delayed union or nonunion. At the time of the last radiographic follow-up the radial head in all cases remained reduced and stable. In one of the patients there were mild residual subluxation, as determined by the position of the radiocapitellar line, and moderate hypertrophy of the radial neck. The post-operative range of motion was improved in all of the patients. (Table 1) The functional outcomes according to Kim were excellent in three and good in one of the children. (Fig 3, Fig 4)

Table 1. Clinical data and results.

Case	Gender	Side	Age at surgery (years)	Delay between injury and surgery (months)	Bado type	Preop ROM (Extension-Flexion / Pronation-Supination)	Postop ROM (Extension-Flexion / Pronation-Supination)
1	F	R	7.3	25	1	0°-120°/50°-75°	0°-140°/85°-90°
2	F	L	5.9	18	1	-15°-110°/50°-70°	-10°-150°/75°-90°
3	M	R	4.2	2	3	0°-120°/30°-85°	5°-140°/60°-90°
4	F	L	9.1	2	equivalent	-5°-105°/10°-65°	-5°-135°/50°-75°

* ROM – range of motion

Fig. 3. Clinical and functional results of the patient from Fig.1, 12 months after surgery.

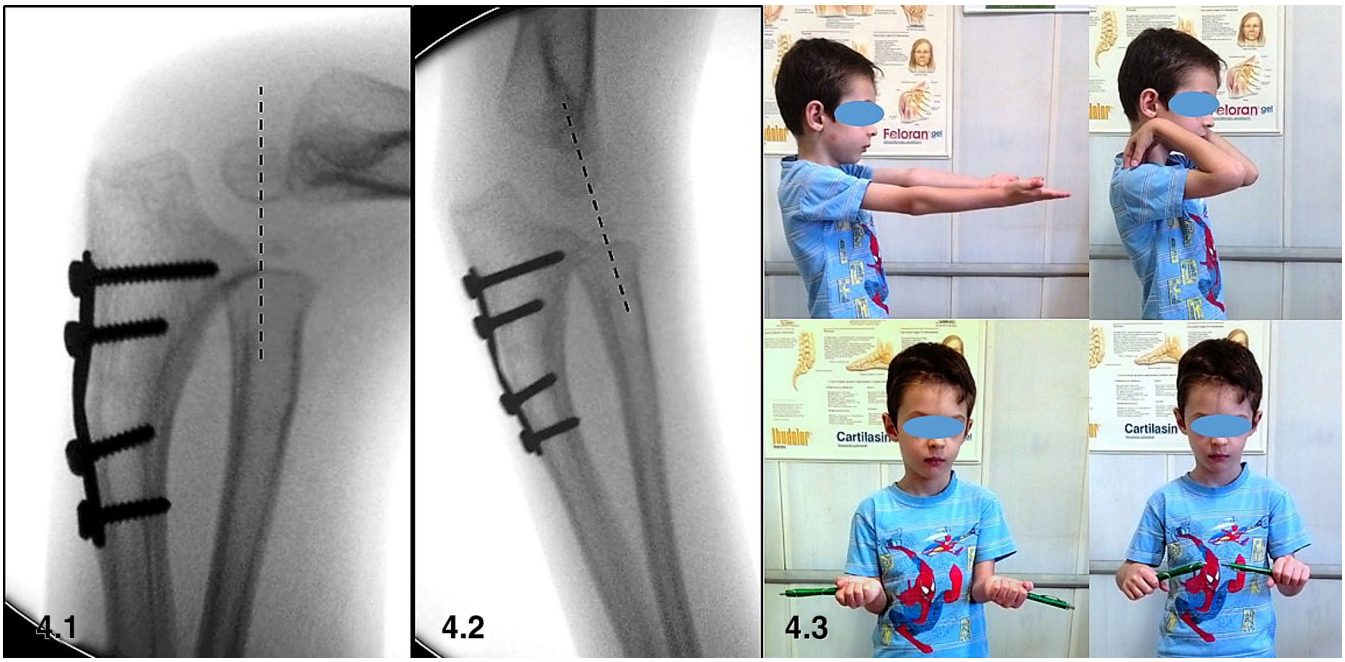

Fig. 4. Clinical and functional results of the patient from Fig.2, one year later.

DISCUSSION

"Isolated" traumatic radial head dislocation in children is an extremely rare injury. It is more frequently associated with a missed plastic deformation of the ulna, which may make closed reduction difficult and the long term results of repair uncertain. Lincoln and Mubarak proposed the "ulnar bow sign" by drawing a straight line on the lateral radiograph along the dorsal border of the ulna from the level of the olecranon to the distal ulnar metaphysis. Anterior deviation of the ulnar diaphysis, more than 1 mm from this line, is significant for plastic deformation and may help alert the physician to an undetected radial head dislocation. [17]

The decision to reconstruct a chronic dislocation of the radial head can be challenging because of the variety of causes and surgical techniques. The outcome of surgery may be unpredictable. Persistent or recurrent instability of the head and post-operative deterioration of movement of the elbow and forearm are the main causes of failure. The

complications of surgical intervention may be more troublesome than the impairment of the joint due to persistent dislocation of the radial head. Despite the risk of complications, surgery is recommended as long-standing radial head dislocation will possibly cause restriction of elbow flexion, deformity of the radial head, overgrowth of the radius, instability and early osteoarthritic changes of the elbow joint. [6, 12, 16]

The type of surgery varies and there is no clear consensus regarding treatment of missed Monteggia fracture.

Some authors have recommended annular ligament reconstruction without osteotomy, using central or lateral slip of triceps fascia [4, 18], forearm fascia [19], fascia lata [20], or palmaris longus tendon. [21] In theory this fascial slip acts both as a dynamic and static stabilizer and prevents radial head subluxation. Actually reconstruction alone is insufficient to maintain the reduction. In addition, possible complications comprise osteolytic changes, avascular necrosis, tight constriction, narrowing and growth disturbance of the radial neck, heterotopic ossification, radio-ulnar synostosis and restricted pronation and supination. [22]

Most surgeons recently advocate some form of ulnar osteotomy with or without ligament repair/reconstruction for a pediatric chronic Monteggia lesion. Various types of osteotomies have been used to facilitate reduction of the radial head and to prevent recurrent subluxation. They include floating osteotomy without fixation or stabilized by graft, corrective diaphyseal osteotomy, proximal bending osteotomy, angulation and elongation osteotomy, gradual lengthening and angulation of the ulna using an external fixator. [7, 10, 11, 12, 13, 14, 15, 16, 21, 23, 24]

The treatment strategy we have used in our cases is based upon the hypothesis that the primary problem is malunion of the ulna or an intact ulna, preventing reduction of the radial head. The surgical technique consists of an ulnar osteotomy with lengthening and angulation. Lengthening permits reduction, providing sufficient place for the radial head while avoiding excessive pressure on the radiocapitellar joint. The angulation creates an overcorrection and tensioning of the interosseous membrane which firmly maintains the head in place for the time necessary for its stabilization [10, 13]. All our osteotomies were internally fixed with a pre-bent plate and screws and bone graft to decrease the risk of secondary displacement and to allow early mobilization. The technique required removal of the scar tissue or the posterior interosseous nerve (as in one of the cases) interposed in the radiocapitellar joint and a direct repair or repositioning of the annular ligament. Our and other authors experience confirms the opinion that reconstruction of the annular ligament by fascial strip is not always necessary, as all the radial heads were stable without such reconstruction. [10, 13, 23, 24, 25]

CONCLUSIONS

The treatment of an unrecognized radial head dislocation in children continues to pose a therapeutic challenge. The outcomes of the multiple surgical techniques are still uncertain. The osteotomy of the proximal ulna with both angulation and elongation allows stable radial head reduction without necessity of annular ligament reconstruction in most of the cases. Some residual functional limitation is still possible. The best treatment is prevention by prompt recognition and stabilization of acute Monteggia lesions.

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