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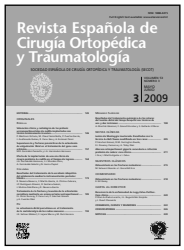

ORIGINAL PAPERS

Inveterate Monteggia Injury. Results of 3 cases with the modified Bell-Tawse procedure

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KEYWORDS
Monteggia fracture;
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Bell Tawse technique;
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Abstract
Purpose: Monteggia injuries are a rare occurrence (2%of all elbow fractures), and inveterate cases are extremely unusual. We present 3 cases treated by means of open reduction and reconstruction of the annular ligament with a strip of triceps fascia.
Materials and methods: The mean age of the 3 patients was 7 years (range: 5-9). Two of them were male and all presented with type 1 Bado injuries on the right side. All 3 were treated by means of the Bell Tawse technique as modified by Lloyd-Roberts and Bucknill; one of the patients was also subjected to ulnar osteotomy.
Results: There were no complications. After a mean follow-up of 35 months (range: 9-84) all patients achieve a functional flexion-extension range. They experienced a slight loss of pronosupination but they reported no restrictions to their activities of daily living or any functional impairment.
Conclusions: The modified Bell-Tawse technique is an effective method, even if it leads to a slight loss of mobility, especially in terms of pronosupination. The long-term results of this technique are better than those achieved with a late excision of the dislocated radial head.

PALABRAS CLAVE
Fractura de Monteggia;
Luxación del codo;
Niños;
Técnica de Bell-Tawse;
Luxación de la cabeza radial

Lesión de Monteggia inveterada. Resultados con la técnica de Bell-Tawse modificada en tres caso

Resumen
Objetivo: La lesión de Monteggia es poco frecuente (el 2%de las fracturas de la región del codo) y los casos inveterados son muy raros. A continuación se presentan 3 casos tratados mediante reducción abierta y reconstrucción del ligamento anular con fascia tricipital.

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Casos clínicos: La edad media de los 3 sujetos era de 7 años (rango de 5 a 9), 2 de ellos eran varones y todos presentaban lesiones tipo I de Bado en el lado derecho. Los 3 recibieron tratamiento mediante técnica de Bell-Tawse modificada por Lloyd-Roberts y Bucknill; en un enfermo se asoció osteotomía cubital.
Resultados: No se presentaron complicaciones. Tras un seguimiento medio de 35 meses (rango de 9 a 84) todos los sujetos consiguieron un arco de flexoextensión funcional con una pérdida leve de pronosupinación, pero no se detectaron restricciones en las actividades de la vida diaria ni déficit funcional.
Conclusiones: La técnica de Bell-Tawse modificada es un método efectivo, aun cuando produce una pérdida leve de movilidad, especialmente de pronosupinación. Los resultados a largo plazo de esta técnica son mejores que los que se consiguen con la escisión tardía de la cabeza radial luxada.

Introduction

In 1814, Giovanni Monteggia described an injury that carries his name: it is an ulnar Shaft fracture accompanied by radial head and proximal radioulnar joint dislocation[1]. Since then, a large number of variants of Monteggia's original fracture-dislocation have been identified[1,2]. The ulna may present with a complete fracture, a greenstick fracture or a plastic deformity[1,2]. José Luis Bado used the direction in which the radial head was dislocated in order to distinguish several types of Monteggia fracture: anterior or type I, posterior or type II, lateral or type III, and associated to a radial fracture or type iv[1,2]. Bado type i fractures account for around 70%of all Monteggia injuries in children[1,2].

Monteggia fracture dislocation is relatively infrequent in children (2%of elbow fractures)[1,2]. This injury can produce a high number of complications[3], largely due to initial diagnostic errors (such as confusing it with an isolated ulnar Shaft fracture), or even go unnoticed[4,5]. When these injuries, especially radial dislocation, go unnoticed or are inadequately treated they generate though problems such as pain, limited elbow flexion, cubitus valgus, valgus instability of elbow, late ulnar nerve and posterior interosseous nerve palsy or anterior radial and interosseous nerve palsy[3,6].

That late diagnosis (after over a month) of proximal radioulnar dislocation remains a therapeutic challenge is evident from the numerous procedures that have been described for its treatment[7-15]. Some authors suggest keeping the radial head dislocation inveterate until skeletal maturity and carry out an excision of the lead if there is pain or functional limitation[10]. Other authors propose late reconstruction of the annular ligament, accompanied of radial shortening or a corrective ulnar osteotomy[8-14]. If Monteggia's fracture is relatively recent (up to 2 years old) the best solution is to restore forearm anatomy by following the same principles as in the acute phase: correct the ulnar angulation and reduce the radial dislocation[9]. Obviously both of these require open surgery: an osteotomy, a corrective procedure and fixation of the ulna, as well as open reduction with reconstruction of the annular ligament to address the radial dislocation. Bell-Tawse's technique involves using a triceps tendon fascial graft in order to reconstruct the annular ligament[13]. Treatment of cases with over 2 years' evolution is extremely controversial and each case must be evaluated individually[10,12].

This review presents 3 cases of chronic post-traumatic dislocation of the radial head, treated with the Bell-Tawse technique as modified by Lloyd-Roberts and Bucknill[14].

Case reports

From the year 2000 to 2007, 3 children under 14 years of age presented at the Department of Pediatric Orthopedic and Trauma Surgery with an inveterate Monteggia fracture-dislocation sustained over one month before.

Two of the children were male and mean age of the series was 7 years (range: 5-9). All injuries had occurred on the right side following a fortuitous fall. In 2 cases, they had gone unnoticed, while in the third it had been diagnosed as an isolated ulnar shaft fracture. All 3 injuries were discovered in the course of an x-ray evaluation made following minor trauma for a neoplasm in the antecubital fossa (fig. 1) or for pain and persistent functional limitation. Time elapsed from injury to diagnosis was 5.6 months (range: 3-7) and all injuries were Bado type I (table 1).

At the time of consultation all 3 children reported mild to moderate pain and disrupted elbow range of motion. Mean initial flexion was 113.33° (range: 100°-125°), with a mean flexion lag of 16.6° (range: 30°-5°); mean extension lag was 10°; one child (case 1) presented with a limitation to pronosupination (70° loss of de pronation and 80° of supination). Bauman's angle was symmetrical in 2 children and one case (case 1) presented with initial cubitus valgus.

Radiographs were performed with the elbow flexed at 90° in the lateral position and with the palm of the hand facing down. This affords a truly anteroposterior view of the forearm and a lateral view of the elbow and it allows identification of ulnar curvature or radial head dislocation. X-rays of the contralateral arm were also performed in all cases to compare ulnar morphologies.

The same surgical team treated all the children by means of open reduction and annular ligament reconstruction through a classical Boyd approach. The graft used was lateral strip of triceps fascia (Bell-Tawse technique as modified by Lloyd-Roberts and Bucknill)[13,14], as well as

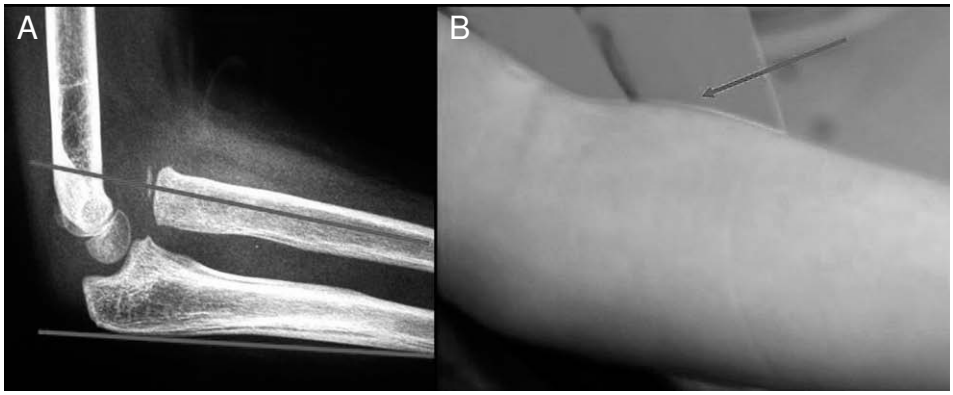

Figure 1 Chronic post-traumatic dislocation of the radial head (A) presenting as a neoplasm in the antecubital fossa (B).

Table 1 Epidemiological data of our 3 cases

Case	Follow-up	Sex	Age	Side	Dominance	Mechanism	Cause chronicity	Reason for presentation	Bado score	Time-to surgery	Ulnar osteotomy
1	84	M	9	R	R	Fortuitous fall	Undetected	Persistence of pain	I	3	No
2	12	M	7	R	R	Fortuitous fall	Undetected	Limited motion	I	7	Yes
3	9	F	5	L	L	Fortuitous fall	Isolated ulnar fracture	Persistence of pain	I	7	No

R: right; L: left; M: male; F: female.

transcondylar Kirschner wire fixation of the reduced radial head (fig. 2). Ulnar osteotomy was performed in one patient; it was fixed with an intramedullary K-wire. Immobilization and K-wires were removed at 6 weeks.

Results

After a mean follow-up of 35 months (range: 9-84) none of the children presented with pain in the operated elbow (table 2).

Mean final flexion was 128.33° (range: 125°-130°); all 3 children improved their flexion by a mean of 15° (range:5°-30°). In 2 children (cases 2 and 3) the 10º extension lag persisted, whereas case 1 achieved full extension (fig. 3). Mean final pronation was 83.33° (range: 70°-90°); it improved in case 1, deteriorated by 20° in case 2, and remained equal in case 3. Mean final supination was 80° (range: 60°-90°); it improved by 75° in case 1, it deteriorated by 30° in case 3, and remained equal in case 2.

At the end of follow-up, none of the children presented with cubitus valgus, functional limitations or restrictions to perform any kind of activity. In the child where ulnar osteotomy was performed, full healing occurred after 6 weeks (fig. 4).

There were no complications, nor were any subsequent procedures necessary (fig. 5).

Discussion

Monteggia fracture is an unusual injury in the pediatric population, which means that a high number of these lesions either go unnoticed or are inadequately treated; this could result in an inveterate dislocation of the radial head[1-6]. When the radiocapitellar relation is disturbed, radiologic assessment of the shape of the radial head and neck helps determine the cause of the disruption, especially if there is no traumatic history and if the severity of trauma is unclear.

Bucknill[16] reviewed the differences between congenital fractures and old traumatic dislocations of the radial head. He considered that, most probably, the classical McFarland description[17] of an atypically deformed radial head with a dysplastic humeral condyle and a proximal ulna with a concave posterior border with associated periarticular ossifications corresponded to old traumatic dislocations. Lloyd-Roberts and Bucknill[14] thought that the congenital nature of certain unilateral anterior dislocations was still to be demonstrated and claimed that they should be considered old traumatic dislocations. Lloyd-Roberts[14] recognizes Caravias[18] for having questioned the existence of anterior congenital dislocation as an isolated entity, since the true congenital dislocation of the radial head is certainly rare. When a true congenital dislocation occurs, it is generally bilateral and posterior, and it is often associated to various

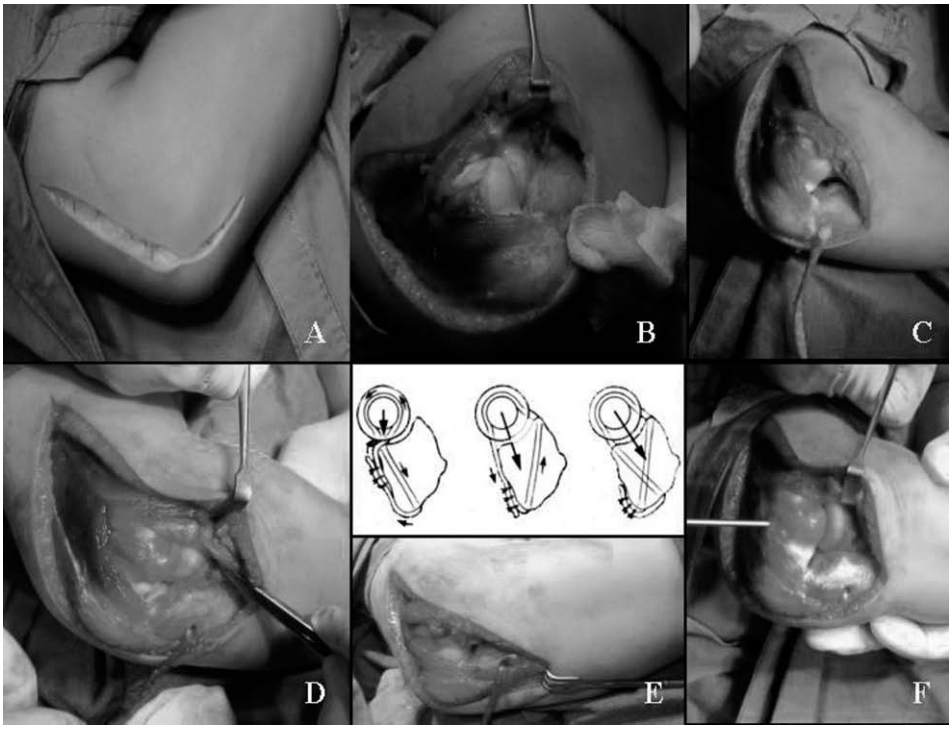

Figure 2 Bell-Tawse technique as modified by Lloyd-Roberts and Bucknill (A, B, C, D, E, F). The double-tunnel variant was used in all 3 cases; this is a technically more demanding procedure but which allows a better centering of the head.

Table 2 Results

Case	Initial pain	Final pain	Initial FE range	Final FE range	Initial PS range	Final PS range	Cubitus valgus	Complications	Reoperations
1	Moderate	None	100/10	130/0	20/15	90/90	No	No	No
2	Mild	None	125/10	130/10	90/90	70/90	No	No	No
3	Moderate	None	115/10	125/10	90/90	90/60	No	No	No

FE: flexion-extension; PS: pronosupination.

syndromes, such as the Ehlers-Danlos syndrome, the nail patella syndrome and the Silver-Russell syndrome[14]. Therefore, any isolated anterior and anterolateral dislocation of the radial head, regardless of symptoms, must be considered of a post-traumatic origin[14]. Its treatment should be the same as that of known post-traumatic dislocations of the radial head (even if not previously detected)[14].

Classical techniques include open resection of the radial head and reconstruction of the annular ligament with a strip of the triceps fascia, followed by transcondylar pinning of the radiocapitellar Joint and, if necessary, an ulnar osteotomy for curvature correction. A fundamental step to achieve and maintain an appropriate reduction is to withdraw the calcified remains of the annular ligament and the anterior capsule. Sometimes these get trapped between the dislocated radial head and the humeral capitellum, thereby hampering reduction.

These reconstruction techniques no always afford excellent results, and some children lose some elbow motion, especially pronosupination[9,11,13,14]. However, this slight loss is, in the majority of cases, preferable to the long-term results of a dislocated radial head: chronic pain, cubitus valgus and ulnar and posterior interosseous neuropathies. Results of the reconstruction are also much better than those of delayed excision of the radial head when skeletal maturity is reached: loss of strength, proximal radius migration, valgus elbow deviations, valgus instability, ulnar neuropathy, pain in the distal radioulnar joint and carpal impaction of the ulnar head[10-15]. In the brief series described herein, all the children presented with a functional range of motion without limitations to carry out their activities of daily living.

The annular ligament is the most important structure for keeping the radial head in its anatomic position. This means that any surgical attempt to reduce the head to its anatomic position without reconstruction of the ligament is doomed to failure and recurrence. The results obtained in this series together with the findings in the relevant literature seem to indicate that it is well worth attempting an anatomic

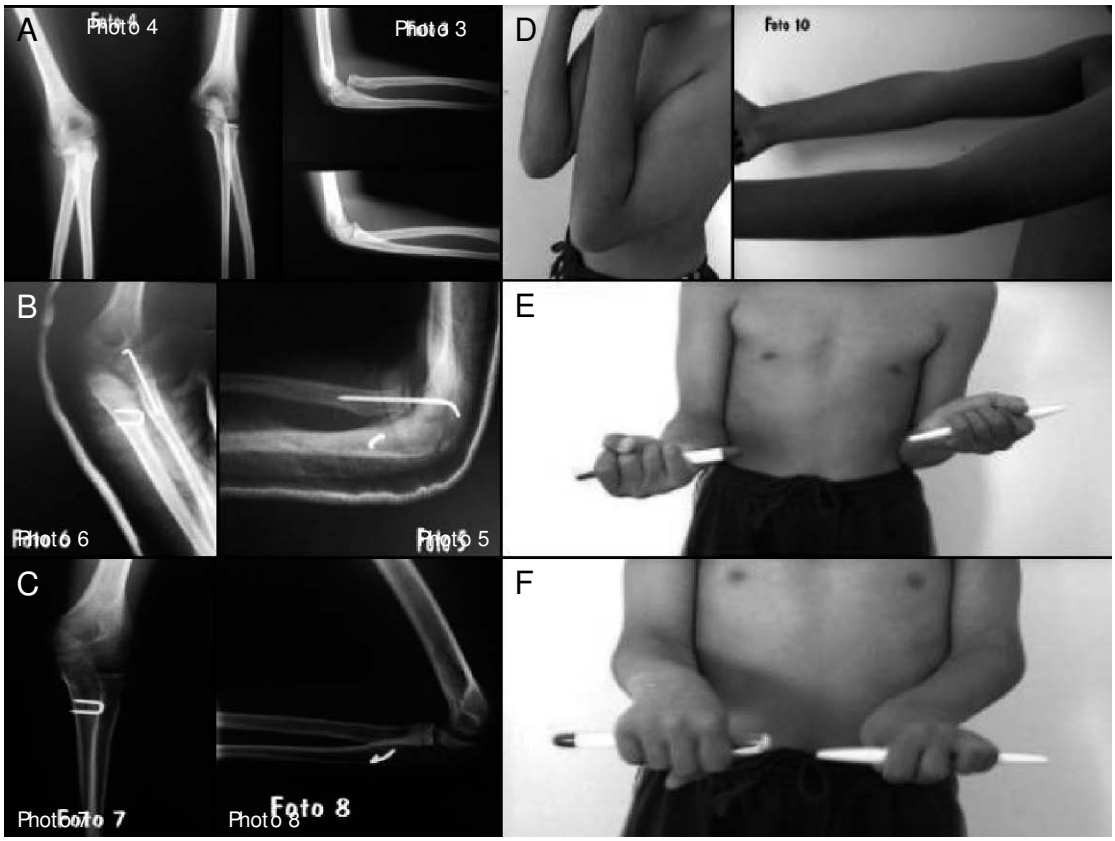

Figure 3 Case 1, initial radiographic views (A), post-op (B) and at the end of follow-up (C); patients showing final ROM achieved (D, E, F).

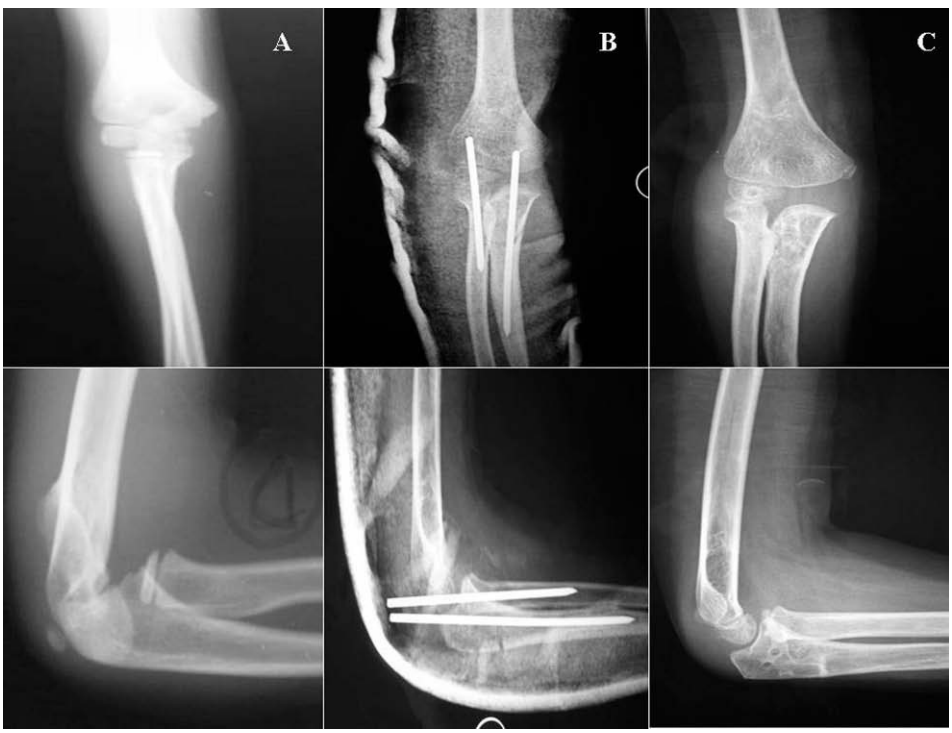

Figure 4 Case 2, initial radiographic views (A), post-op (B) and at the end of follow-up (C).

Figure 5 Case 3, initial radiographic views (A), post-op (B) and at the end of follow-up (C).

reconstruction of this type of injury with annular ligament reconstruction graft.

Conflict of interests

The authors have not received any financial support in the preparation of this article. Nor have they signed any agreement entitling them to receive benefits or fees from any commercial entity. Furthermore, no commercial entity has paid or will pay any sum to any foundation, educational institution or other non-profit-making organization to which they may be affiliated.

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