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*World J Clin Cases* 2023 June 26; 11(18): 4210-4457



## REVIEW

- 4210 Should gastroenterologists prescribe cannabis? The highs, the lows and the unknowns  
*Samuel S, Michael M, Tadros M*

## MINIREVIEWS

- 4231 Application of artificial intelligence in trauma orthopedics: Limitation and prospects  
*Salimi M, Parry JA, Shahrokhi R, Mosalamiaghili S*
- 4241 Weight loss maintenance after bariatric surgery  
*Cho YH, Lee Y, Choi JI, Lee SR, Lee SY*
- 4251 Bicuspid aortic valve with associated aortopathy, significant left ventricular hypertrophy or concomitant hypertrophic cardiomyopathy: A diagnostic and therapeutic challenge  
*Sopek Merkaš I, Lakušić N, Predrijevac M, Štambuk K, Hrabak Paar M*
- 4258 Application experience and research progress of different emerging technologies in plastic surgery  
*Yang B, Yang L, Huang WL, Zhou QZ, He J, Zhao X*

## ORIGINAL ARTICLE

## Case Control Study

- 4267 Multimodal integrated intervention for children with attention-deficit/hyperactivity disorder  
*Lv YB, Cheng W, Wang MH, Wang XM, Hu YL, Lv LQ*

## Retrospective Study

- 4277 Portal vein computed tomography imaging characteristics and their relationship with bleeding risk in patients with liver cirrhosis undergoing interventional therapy  
*Song XJ, Liu JL, Jia SY, Zhang K*

## Observational Study

- 4287 Wrist-ankle acupuncture combined with pain nursing for the treatment of urinary calculi with acute pain  
*Wu LM, Liu Q, Yin XH, Yang LP, Yuan J, Zhang XQ, Wang YL*

## CASE REPORT

- 4295 Coexistence of diffuse large B-cell lymphoma, acute myeloid leukemia, and untreated lymphoplasmacytic lymphoma/waldenström macroglobulinemia in a same patient: A case report  
*Zhang LB, Zhang L, Xin HL, Wang Y, Bao HY, Meng QQ, Jiang SY, Han X, Chen WR, Wang JN, Shi XF*
- 4306 Collagen fleece (Tachosil®) for treating testis torsion: A case report  
*Kim KM, Kim JH*

- 4313** Morphological features and endovascular repair for type B multichanneled aortic dissection: A case report  
*Lu WF, Chen G, Wang LX*
- 4318** Hepatic inflammatory myofibroblastic tumor: A case report  
*Tong M, Zhang BC, Jia FY, Wang J, Liu JH*
- 4326** Endometriosis of the lung: A case report and review of literature  
*Yao J, Zheng H, Nie H, Li CF, Zhang W, Wang JJ*
- 4334** Delayed dislocation of the radial head associated with malunion of distal radial fracture: A case report  
*Kim KB, Wang SI*
- 4341** Synchronous endometrial and ovarian cancer: A case report  
*Žilovič D, Čiurlienė R, Šidlovská E, Vaicekauskaitė I, Sabaliauskaitė R, Jarmalaitė S*
- 4350** Nivolumab-induced tumour-like gastritis: A case report  
*Cijauskaite E, Kazenaite E, Strainiene S, Sadauskaite G, Kurlinkus B*
- 4360** Solitary thyroid gland metastasis from rectal cancer: A case report and review of the literature  
*Chen Y, Kang QS, Zheng Y, Li FB*
- 4368** Anesthesia for extracorporeal membrane oxygenation-assisted thoracoscopic lower lobe subsegmental resection in a patient with a single left lung: A case report  
*Wang XF, Li ZY, Chen L, Chen LX, Xie F, Luo HQ*
- 4377** Indium chloride bone marrow scintigraphy for hepatic myelolipoma: A case report  
*Sato A, Saito K, Abe K, Sugimoto K, Nagao T, Sukeda A, Yunaiyama D*
- 4384** Fibromatosis-like metaplastic carcinoma of the breast: Two case reports  
*Bao WY, Zhou JH, Luo Y, Lu Y*
- 4392** Perforating and ophthalmic artery variants from the anterior cerebral artery: Two case reports  
*Mo ZX, Li W, Wang DF*
- 4397** Diagnostic use of superb microvascular imaging in evaluating septic arthritis of the manubriosternal joint: A case report  
*Seskute G, Kausaite D, Chalkovskaja A, Bulotaite E, Butrimiene I*
- 4406** Primary prostate Burkitt's lymphoma resected with holmium laser enucleation of the prostate: A rare case report  
*Wu YF, Li X, Ma J, Ma DY, Zeng XM, Yu QW, Chen WG*
- 4412** Pancreatitis, panniculitis and polyarthritides syndrome: A case report  
*Pichler H, Stumpner T, Schiller D, Bischofreiter M, Ortmaier R*
- 4419** Acute neck tendonitis with dyspnea: A case report  
*Wu H, Liu W, Mi L, Liu Q*

- 4425** Next-generation sequencing technology for the diagnosis of *Pneumocystis* pneumonia in an immunocompetent female: A case report  
*Huang JJ, Zhang SS, Liu ML, Yang EY, Pan Y, Wu J*
- 4433** Superior laryngeal nerve block for treatment of throat pain and cough following laryngeal herpes zoster: A case report  
*Oh J, Park Y, Choi J, Jeon Y*
- 4438** Removal of unexpected schwannoma with superficial parotidectomy using modified-Blair incision and superficial musculoaponeurotic system folding: A case report  
*Nam HJ, Choi HJ, Byeon JY, Wee SY*
- 4446** Simultaneously metastatic cholangiocarcinoma and small intestine cancer from breast cancer misdiagnosed as primary cholangiocarcinoma: A case report  
*Jiao X, Zhai MM, Xing FZ, Wang XL*

**LETTER TO THE EDITOR**

- 4454** Erroneous presentation of respiratory-hemodynamic disturbances and postsurgical inflammatory responses in patients having undergone abdominal cavity cancer surgery  
*Idrissov KS, Mynbaev OA*

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## Delayed dislocation of the radial head associated with malunion of distal radial fracture: A case report

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### Abstract

#### BACKGROUND

Traumatic radial head dislocation (RHD) is a well-described injury in the pediatric population. It is usually associated with an injury to the ulna in Monteggia fracture-dislocation, although it can occur as an isolated injury. Traumatic RHD with ipsilateral radial shaft fracture has rarely been reported. Delayed RHD secondary to the malunion of an isolated radial shaft fracture is extremely rare.

#### CASE SUMMARY

We report a 9-year-old boy with limited pronation of the right elbow. The patient was diagnosed with delayed RHD associated with the malunion of a distal radial fracture. Since the annular ligament was disrupted with forearm rotation causing subluxation of the radial head, a modified double-strip Bell Tawse procedure was performed to reconstruct the annular ligament without corrective osteotomy for the malunited site. Four years after surgery, the angulation deformity of the distal radius was corrected with the restoration of the normal curvature of the radius. There was no recurrence of RHD.

#### CONCLUSION

Annular ligament reconstruction without corrective osteotomy could reduce RHD and restore the normal curve of the radial shaft in children with delayed dislocation of the radial head associated with malunion of the radial shaft. Annular reconstruction using double triceps tendon strips might be useful for maintaining a more stable reduction by augmenting anterolateral parts.

**Key Words:** Dislocation; Radial head; Malunion; Radius shaft; Reconstruction; Annular ligament; Case report

**Core Tip:** Delayed radial head dislocation secondary to the malunion of an isolated radial shaft fracture is extremely rare. Corrective wedge osteotomy was performed in all previously reported cases to restore the normal curve of the radial shaft. The authors report a case in which the normal curve of the radial shaft was restored with a modified double-strip Bell Tawse procedure without corrective wedge osteotomy.

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## INTRODUCTION

Traumatic radial head dislocation (RHD) with ipsilateral radial shaft fracture has rarely been reported[1, 2]. Delayed RHD secondary to the malunion of an isolated radial shaft fracture is extremely rare. Only four such cases have been reported in the English-language literature[3-6]. Thus, currently, there are no clear guidelines on surgical methods that can be successfully used for RHD with the malunion of a radial shaft fracture.

Corrective wedge osteotomy was performed in all previous cases to restore normal radial curvature (Table 1).

Herein, we report a case of delayed RHD associated with the malunion of a distal radial fracture in a 9-year-old boy. In the present case, the modified double-strip Bell Tawse procedure without corrective wedge osteotomy reduced the RHD and restored the normal curve of the radius shaft.

## CASE PRESENTATION

### Chief complaints

A 9-year-old boy visited our clinic complaining of pain and pronation limitation of the left forearm.

### History of present illness

The patient sustained an angulated left distal radial fracture without a concomitant injury after falling from a height of three meters three months earlier. His fracture was immobilized with an above-elbow plaster cast for six weeks after closed reduction at a local clinic.

### History of past illness

Computed tomography (CT) images of the left forearm performed at the time of injury showed a fracture with angulation of the radius at the distal third (Figure 1A). There was no dislocation of the radial head (Figure 1B). Two weeks after the injury, there was no evidence of displacement progression in the radial fracture, although mild subluxation of the radial head was observed radiographically.

### Personal and family history

The patient had no significant medical history. No specific genetic disease was found in the family history.

### Physical examination

Physical examination revealed limited pronation of the last 35° in the forearm.

### Imaging examinations

Malunion with a posterior convex deformity of 22° was observed at the radial fracture site on the radiograph taken at our clinic three months after the injury.

## FINAL DIAGNOSIS

The patient was diagnosed with a delayed dislocation of the radial head associated with the malunion of a distal radial fracture (Figure 1E).

**Table 1 Clinical information on the present case and previously published four cases related to delayed radial head dislocation with malunion of radial fracture**

Ref.	Gender (boy/girl)	Age (yr)	Fracture site of radius	Initial treatment	Time interval between injury and operation (mo)	Treatment method	Metal removal
Kim <i>et al</i> (present case)	Boy	9	Distal 1/3	CR and cast immobilization	3	Annular ligament reconstruction	(-)
Yasutomi <i>et al</i> [3], 2000	Boy	15	Mid 1/3	CR and cast immobilization	36	Corrective osteotomy	(+)
Yamazaki <i>et al</i> [4], 2007	Girl	12	Proximal 1/3	CR and cast immobilization	6	Corrective osteotomy+annular ligament repair	(+)
Wang <i>et al</i> [5], 2022	Boy	12	Proximal 1/3	CR and cast immobilization	16	Corrective osteotomy+annular ligament reconstruction	(+)
Haines <i>et al</i> [6], 2020	Girl	2	Proximal 1/3	CR and cast immobilization	10	Corrective osteotomy	(+)

CR: Closed reduction.

## TREATMENT

Although the patient was asymptomatic except for limitations in pronation, as his skeleton matures, radial head dislocation could cause long-term problems with forearm rotation and elbow function. Since remodeling ability remained in the malunion three months after injury in this 9-year-old child, good results could be obtained without corrective osteotomy as long as the reduction of the radial head and sufficient stability of the radiocapitellar joint could be maintained.

The elbow joint was approached from the lateral aspect. Soft tissue, such as the joint capsule, was impinged between the capitellum and the radial head. The annular ligament was ruptured, making it difficult to recognize (Figure 2A). After the capsular block was removed, the radial head was reduced. However, rotation of the forearm continued to cause subluxation of the radial head. Thus, an 8 cm × 1 cm strip of lateral triceps fascia and another 5 cm × 1 cm strip were harvested using a posterior incision, leaving the distal portion attached to the proximal ulna. This distal attachment was dissected subperiosteally to the level of the annular ligament insertion on the ulna to provide appropriate alignment of the reconstructed ligament (Figure 2B). After passing this double-strip down to anconeus, the long fascial strip was passed around the neck of the radius from behind to forward and sutured back to itself and the ulnar periosteum. The short strip was additionally augmented to the anterior part of the long strip to provide stability to the radiocapitellar joint (Figure 2C). Finally, reduction of the radial head was performed using transarticular Kirschner wires with the elbow at 90° of flexion and the forearm in neutral rotation. Kirschner wires were removed after cast immobilization for three weeks, and active elbow flexion-extension was started. Active forearm rotation was permitted five weeks after surgery.

## OUTCOME AND FOLLOW-UP

The RHD was well reduced within the radiocapitellar joint in the lateral forearm radiograph taken three months after surgery. However, angulation of the distal radius remained (Figure 3A). The angulation deformity of the distal radius was corrected four years after surgery with the restoration of the normal curvature of the radius. There was no recurrence of RHD (Figure 3B). The flexion of the right elbow was 130° with extension at 0°. Supination was 85°, and pronation was 80° for the left forearm (Figure 4).

## DISCUSSION

RHD is a well-described injury in the pediatric population. It is usually associated with an injury to the ulna in a Monteggia fracture-dislocation. Although rare, traumatic RHD with ipsilateral radial shaft fracture can occur when excessive pronation force is applied while the radial head is dislocated [7]. Many traumatic dislocations of the radial head are missed during the acute phase of treatment. Weisman *et al* [8] reported that the diagnosis of traumatic dislocation of the radial head was delayed in 10 (9.1%) of 110 children treated with these injuries. In eight children, the dislocation was overlooked on the initial radiographs. In two children, the radial head was reduced on the initial elbow radiographs. It was dislocated 10 d later in one child and 21 d later in the other. In the present study, we could not



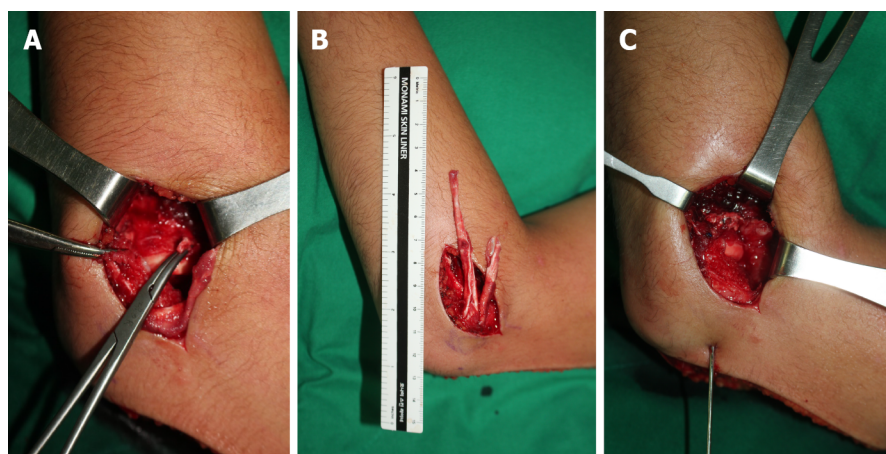


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**Figure 1 Images.** A and B: Computed tomography images of the left forearm performed at the time of injury. A linear fracture with angulation is seen in the distal third of the radius (A); there is no radial head dislocation in the elbow joint (B); C and D: Radiographs of the left forearm performed two weeks after the injury. The radial fracture is well reduced and shows no evidence of displacement progression (C); a mild subluxation of the radial head, which was not observed at the time of injury, is seen at the elbow joint (D); E: Preoperative radiographs of the left forearm performed three months after the injury. Malunion with a posterior convex deformity of 22° at the radial fracture site associated with complete anterior dislocation of the radial head is shown.

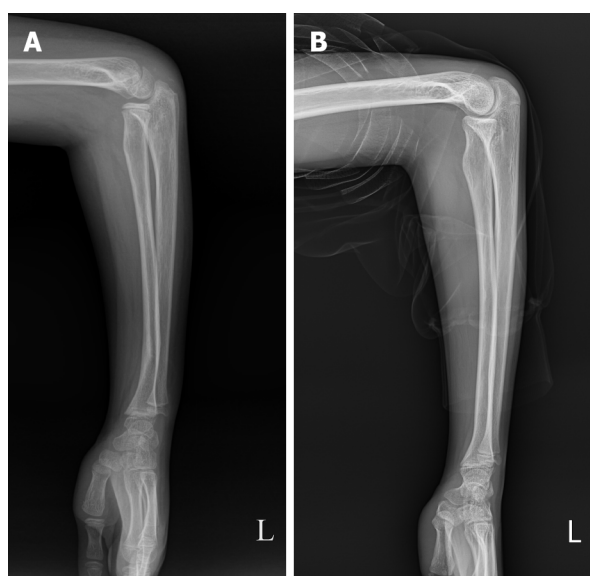
obtain initial elbow radiographs of the patient taken at a local clinic. The radial head was well positioned at the radiocapitella joint without subluxation or dislocation on CT images at the time of injury (Figure 1A and B). However, radiographic evaluation of the elbow using the radiocapitellar line showed subluxation of the radial head two weeks after the injury (Figure 1C and D). Radiographs taken 12 wk after the injury showed dislocation (Figure 1E). The most likely explanation was that the radial head might have dislocated at the time of impact and spontaneously reduced by the time the first radiographs were obtained. It was then re-dislocated while the arm was in a cast.

Delayed RHD associated with the malunion of an isolated radial shaft fracture is extremely rare. Only four such cases have been reported in the English-language literature[3-6]. Currently, there are no clear guidelines on surgical methods that can be successfully used for delayed RHD with the malunion of a radial shaft fracture. A study has performed corrective osteotomy to restore the normal curve of forearm bones and prevent dislocation of the radial head in a 15-year-old boy[3]. Yamazaki *et al*[4] have performed a corrective osteotomy of radial shaft and repair of the annular ligament in six months after the injury. In another report, a 12-year-old boy underwent corrective osteotomy with annular ligament reconstruction at 16 mo after injury[5]. In previously reported cases, corrective wedge osteotomy was performed in all cases to restore the normal curvature of the radius, with the repair or reconstruction of the annular ligament performed in two cases for RHD (Table 1) [3-6]. However, in the present case, the question was whether corrective osteotomy should be additionally performed in a situation where open reduction and repair or reconstruction of the annular ligament was considered. Although Sinikumpu *et al*[9] reported that operative treatment could be considered for angulation of more than 15° in forearm shaft fractures in children older than 8 years old, we judged that there was still the ability for spontaneous remodeling at the fracture site without corrective osteotomy on radiographs taken 12 wk after injury in our patient. Therefore, this lesion was treated with only annular ligament reconstruction



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**Figure 2 Surgical findings of dislocation of the radial head associated with malunited radial shaft.** A: The elbow joint was approached from the lateral aspect. Soft tissue, such as the joint capsule, was impinged between the capitellum, and the radial head and annular ligament were ruptured, making it difficult to recognize; B: An 8 cm × 1 cm strip of lateral triceps fascia and another 5 cm × 1 cm strip were harvested using a posterior incision, leaving the distal attached to the proximal ulna; C: The long fascial strip was passed around the neck of the radius from behind to forward and sutured back to itself and the ulnar periosteum. The short strip was additionally augmented to the anterior part of the long strip. Finally, reduction of the radial head was held using transarticular Kirschner wires with the elbow in 90° of flexion and the forearm in neutral rotation.



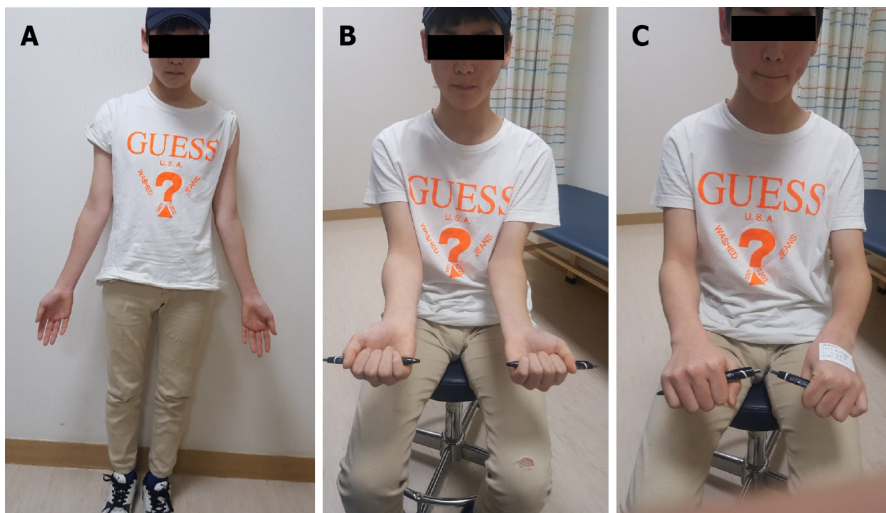
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**Figure 3 Radiographs of the left forearm performed during postoperative follow-up.** A: The radial head dislocation was well reduced within the radiocapitellar joint in the forearm lateral radiograph taken three months postoperatively, although angulation of the distal radius remained; B: Four years after surgery, the angulation deformity of the distal radius was corrected with the restoration of the normal curvature of the radius, showing no recurrence of radial head dislocation.

using triceps strips without corrective osteotomy of the radial shaft. The reduction of the radial head was well-maintained four years postoperatively, and the normal curve of the radial shaft was restored.

Several resources have been used for reconstructing the annular ligament, including grafts from fascial strips of the forearm, fascia lata, tendon of palmaris longus, triceps tendon, and extensor aponeurosis[10]. However, each of these tissues has drawbacks. The forearm fascia and tendon of the palmaris longus are too weak to restrict the radius, and an additional incision is required for harvesting fascia lata.

The Bell Tawse procedure was originally introduced to treat a malunited anterior Monteggia fracture [11]. Bell Tawse described reconstruction of the annular ligament by turning down a strip of the triceps tendon, leaving it attached to the ulna, passing it around the neck of the radius from behind to forward, and securing it through a drilled hole in the ulna. Since its original description, several variations of the Bell Tawse procedure have been published. Lloyd-Roberts *et al*[12] preferred reconstruction of the



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**Figure 4** Clinical photographs taken at the last follow-up. A: The active range of motion was 130° of flexion, 0° of extension; B: 85° of supination; C: 80° of pronation for the left elbow in the last follow-up photographs.

annular ligament using a lateral slip of the triceps tendon because it confined the operation to one surgical field. In addition, preservation of the normal ulnar attachment inspires confidence in the viability of the refashioned ligament. Hurst *et al*[13] suggested that it is important to strip the tendon of the proximal olecranon with a 2- to 3-cm segment of the dorsal periosteum so that the attachment site of the newly reconstructed ligament will be parallel to the radial neck, not proximal to it. This alignment more closely approximates the normal anatomy of the annular ligament, unlike fixation to the olecranon. We also prefer to reconstruct the annular ligament using the triceps tendon. During the procedure, we dissected the distal attachment subperiosteally to the level of the annular ligament insertion in the ulna, as suggested by Hurst *et al*[13]. However, it is difficult to always obtain a good quality fascia strip of sufficient length for successful reconstruction since re-dislocation may occur as the graft material becomes loose. We have recently used a double-strip procedure that includes the lateral portion of the triceps tendon. First, the long strip was passed around the neck of the radius from behind to forward and sutured to itself and the ulnar periosteum. Next, the short strip was additionally reinforced in the anterior part of the long strip. This modified double-strip procedure is thought to provide greater stability to the radiocapitellar joint than a single strip, although biomechanical studies need to be performed in the future. Therefore, we could prevent limitations in the range of motion of the forearm by removing the transarticular Kirschner wire after three weeks and allowing active forearm rotation from four weeks after surgery.

## CONCLUSION

In the present case, annular ligament reconstruction alone without corrective wedge osteotomy reduced RHD and restored the normal curve of the radial shaft. A modified double-strip Bell Tawse procedure might be useful for maintaining a more stable reduction through the plication of anterolateral parts.

## FOOTNOTES

**Author contributions:** Wang SI designed the case report; Kim KB performed the research; Wang SI and Kim KB analyzed the data and wrote the manuscript; and all authors read and approved the final manuscript.

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