J Orthop Spine Trauma. 2026 June; 12(3): 143-7. DOI: 10.18502/jost.v12i3.22007

Case Report

Avascular Necrosis Following Pediatric Distal Humerus Fracture: A Report of 2 Cases and Follow-Up Strategies

Negin Bayat[1], Ramin Haj Zargarbashi[2], Taghi Baghdadi[3], Pouya Tabatabaei Irani[4,*]

[1] Center for Orthopedic Trans-Disciplinary Applied Research, Tehran University of Medical Sciences, Tehran, Iran
[2] Associate Professor, Department of Orthopedics and Trauma Surgery, Children's Medical Center, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
[3] Professor, Department of Orthopedics, Joint Reconstruction Research Center, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
[4] Assistant Professor, Department of Orthopedics, Joint Reconstruction Research Center, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

[*]Corresponding author: Pouya Tabatabaei Irani; Department of Orthopedics, Joint Reconstruction Research Center, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-9132249312; Email: pouya.tabatabaei94@gmail.com

Received: 04 February 2026; **Revised:** 19 April 2026; **Accepted:** 21 May 2026

Abstract

Background: Supracondylar humerus fractures are the most common pediatric elbow injuries. Avascular necrosis (AVN) of the distal humerus is rare and may present months to years after injury, even when minimally displaced.
Case Report: Two children developed distal humeral AVN after supracondylar fractures, one treated in a cast and one with percutaneous pinning. Both later reported pain, motion loss, and deformity. Imaging confirmed AVN, with a fishtail deformity in one case and cubitus-varus deformity in the other. The first was observed with preserved function; the second underwent a lateral closing wedge extension osteotomy with good recovery.
Conclusion: Distal humeral AVN can follow both nondisplaced and displaced injuries. Young patients and higher-risk patterns warrant prolonged follow-up until trochlear ossification. Early recognition and a structured surveillance plan support timely intervention and better outcomes.

Keywords: Necrosis; Distal Humerus Fractures; Deformities; Elbow Injuries

Citation: Bayat N, Haj Zargarbashi R, Baghdadi T, Tabatabaei Irani P. **Avascular Necrosis Following Pediatric Distal Humerus Fracture: A Report of 2 Cases and Follow-Up Strategies.** *J Orthop Spine Trauma* 2026; 12(3): 143-7.

Background

Distal humerus fractures are among the most common elbow injuries in children, accounting for up to 60% of pediatric elbow fractures, with supracondylar fractures being the most frequent pattern. While most cases heal uneventfully with appropriate management, disruption of the distal humeral vascular supply can lead to serious late complications, including avascular necrosis (AVN) of the trochlea. The vascularity of the distal humerus in children is derived primarily from an anastomotic network of the radial, ulnar, and interosseous recurrent arteries. The trochlea is particularly vulnerable because its blood supply is largely intraosseous and lacks a robust collateral network, making it sensitive to trauma or surgical insult (1-3).

AVN following distal humerus fractures is uncommon but clinically significant. Reported incidence varies depending on fracture type: up to 1.4% after lateral condyle fractures, and sporadically following supracondylar fractures, even when nondisplaced (4-7). Known risk factors include high-energy trauma, fracture displacement, open reduction with extensive dissection, multiple pin passes, and delayed diagnosis. Importantly, AVN may develop months to years after the initial injury, underscoring the need for long-term surveillance (2, 4, 7, 8).

Several characteristic deformities have been described as sequelae of post-traumatic trochlear AVN. Fishtail deformity, first described in 1962, presents as a V-shaped central notch of the distal humerus on imaging and is often linked to growth disturbance or ischemia (1, 7, 9). Hegemann's disease refers to the idiopathic AVN of the trochlea but shares radiographic and pathological features with post-traumatic cases (3). Dissolution of the trochlea, seen in some series after supracondylar fractures, represents an advanced destructive stage of AVN (8). Clinical consequences range from mild, asymptomatic deformity to significant elbow stiffness, pain, and instability, sometimes necessitating corrective osteotomy or even salvage procedures (7, 9).

Although several case series and reviews have explored the etiology and imaging features of these conditions, literature on structured follow-up strategies and management algorithms is sparse (3, 8, 9). In particular, guidance is limited on optimal surveillance intervals, imaging modalities for early detection, and decision-making when AVN is identified. Here, we present two pediatric cases of post-traumatic distal humeral AVN, each with distinct fracture patterns and clinical courses, followed by a review of the literature and a proposed practical algorithm for diagnosis, follow-up, and management.

Case Report

Case 1: A 2-year-old girl fell from standing height and presented with right elbow pain and swelling. Examination revealed localized tenderness over the distal humerus with an intact neurovascular exam. Radiographs showed a nondisplaced supracondylar fracture (Gartland type I) of the distal humerus (Figure 1).

She was treated in a long-arm cast at 90° flexion, achieving uneventful healing. At 1-month follow-up, she had regained full, painless motion, and no further imaging was obtained at that time. Two years post injury, at age 4, she developed intermittent elbow discomfort during daily activities, without new trauma. Examination showed a 10° loss of extension but preserved flexion, forearm rotation, and normal carrying angle.

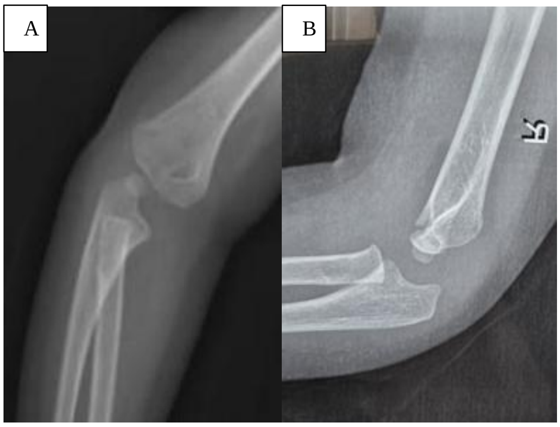

Figure 1. A) Lateral elbow radiograph at presentation demonstrating a nondisplaced supracondylar (Gartland I) fracture; B) Flexion lateral radiograph at presentation confirming alignment and absence of displacement

There were no symptoms of locking or instability. Radiographs revealed a central concavity ("fishtail" deformity) of the distal humerus with a notch in the trochlear ossification center (Figure 2).

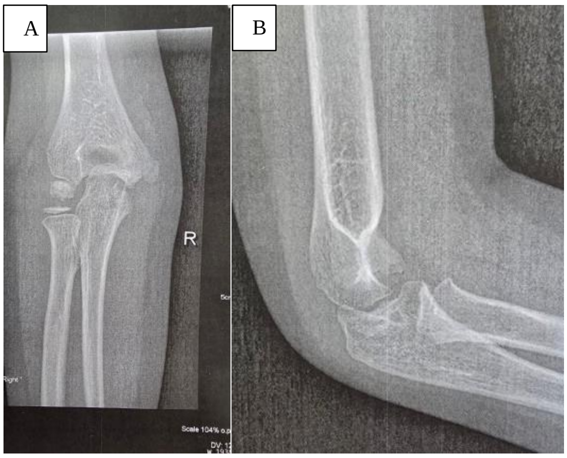

Figure 2. A) Anteroposterior (AP) elbow radiograph at 24 months demonstrating a central trochlear concavity ("fishtail" deformity) with preserved coronal alignment; B) Lateral elbow radiograph at 24 months showing subtle trochlear contour irregularity with maintained ulnohumeral congruity

Computed tomography (CT) confirmed collapse of the trochlear epiphysis with subchondral sclerosis and fragmentation, consistent with early AVN of the trochlea. The lateral condyle and capitellum were intact, and no loose bodies were identified (Figure 3).

Given her preserved arc of motion and mild, intermittent symptoms, conservative management was chosen. The family was educated on the natural history of post-traumatic trochlear AVN, including the possibility of progressive deformity or late mechanical symptoms. Follow-up with periodic clinical evaluation and serial radiographs was arranged to monitor joint congruency and trochlear morphology. Activity modification was advised to minimize repetitive high-impact loading. Surgical options, such as corrective osteotomy or arthroscopic debridement, were reserved for potential future deterioration in pain, motion, or alignment.

Case 2: A 2-year-old boy sustained a posteriorly displaced supracondylar/transphyseal fracture of the distal humerus after a fall (Figure 4). Due to medial physeal involvement and gross instability, he underwent closed reduction and percutaneous pinning with one lateral Kirschner wire (K-wire).

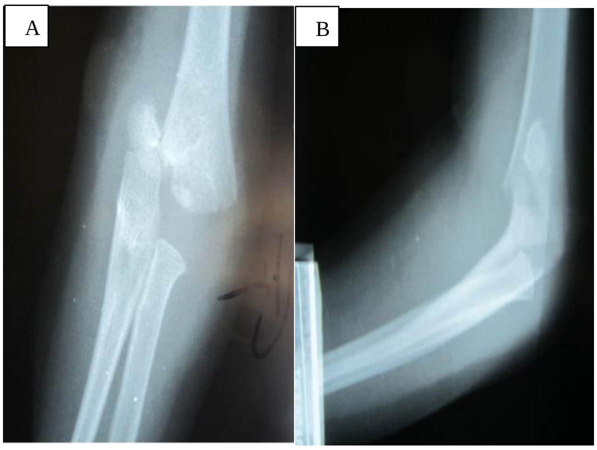

Figure 4. A) Anteroposterior (AP) elbow radiograph at presentation demonstrating a posteriorly displaced supracondylar/transphyseal fracture of the distal humerus with suspected medial physeal involvement; B) Lateral elbow radiograph at presentation confirming posterior displacement of the distal fragment relative to the humeral shaft, consistent with an unstable supracondylar/transphyseal pattern

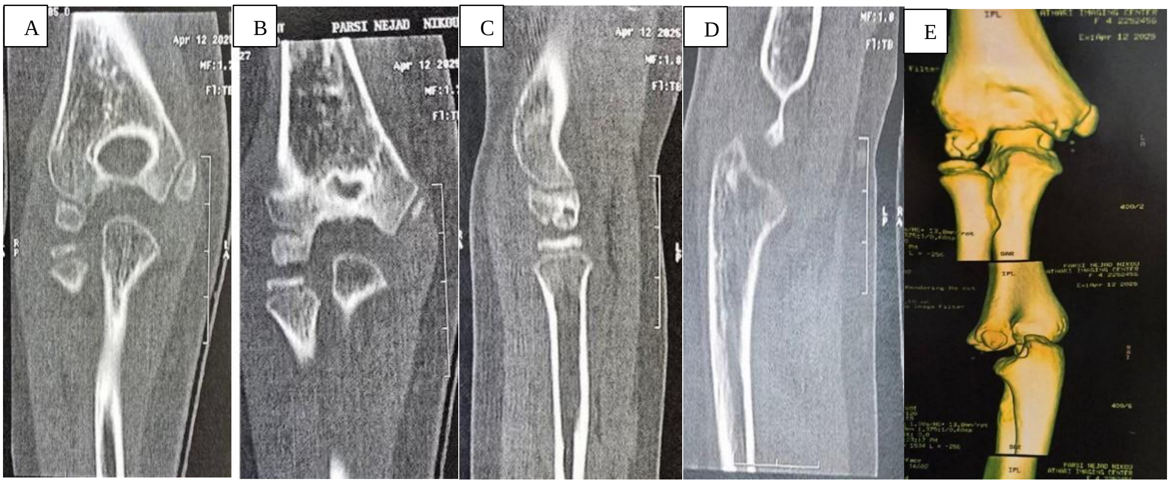

Figure 3. A, B) Computed tomography (CT)-scan coronal reconstruction showing subchondral collapse and sclerosis of the central-lateral trochlea with irregular physeal contour, compatible with post-traumatic osteonecrosis (the lateral condyle remains intact); C, D) CT-scan sagittal reconstruction demonstrating focal trochlear epiphyseal collapse with subchondral change; no intra-articular loose bodies identified; E) Three-dimensional (3D) CT-scan surface rendering illustrating the central distal humeral notch (fishtail morphology) used for patient counseling and surveillance planning

Postoperative radiographs confirmed satisfactory alignment (Figure 5). The limb was immobilized in a cast, pins were removed at 4 weeks, and he regained a full range of motion (ROM). Routine follow-up was discontinued thereafter.

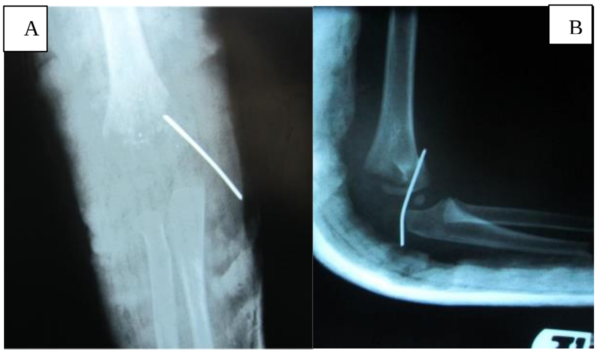

Figure 5. A) Anteroposterior (AP) elbow radiograph obtained immediately after closed reduction and percutaneous fixation with one lateral Kirschner wire (K-wire), showing restored coronal alignment and appropriate pin position and spread; B) Lateral elbow radiograph obtained immediately after pinning, confirming maintenance of reduction with congruent ulnohumeral alignment and satisfactory pin trajectory

Eighteen months later (age 4), he presented with progressive elbow stiffness and activity-related pain. Parents noted a visible elbow deformity. Examination revealed a 30° flexion contracture, 15° varus carrying angle, and mild ulnar deviation, with preserved neurovascular function. Supination was slightly restricted due to periarticular tightness. Radiographs demonstrated physeal irregularity and collapse of the medial trochlea (Figure 6).

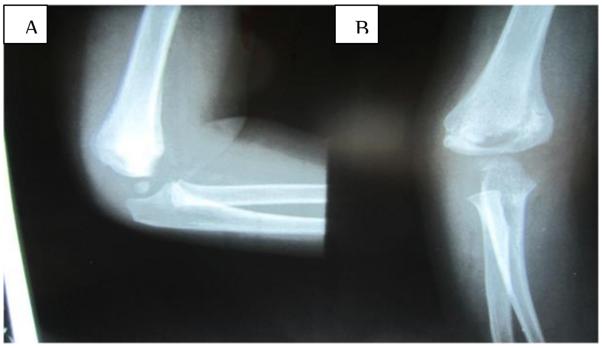

Figure 6. A) Lateral elbow radiograph at 18 months showing a fixed flexion posture with trochlear contour irregularity; B) Anteroposterior (AP) elbow radiograph at 18 months demonstrating varus coronal alignment with medial trochlear irregularity and preserved overall ulnohumeral congruity

The ossification center was small and fragmented with patchy sclerosis, consistent with type B AVN involving the medial crista and adjacent metaphysis.

The capitellum and lateral condyle were normal, and there were no loose bodies or joint subluxation. An expert pediatric trauma panel reviewed the case, noting that AVN following routine pin fixation is rare.

Given his young age, preserved overall function, and absence of instability, initial management consisted of observation, night extension bracing, and physiotherapy, with periodic clinical and radiographic follow-up. Over the following year, varus deformity and flexion contracture persisted despite therapy (preoperative AP and lateral views again demonstrating cubitus varus and flexion contracture; Figure 7). At age 5, he underwent a lateral closing-wedge extension osteotomy of the distal humerus to correct varus alignment and improve extension, combined with ulnar nerve transposition. Intraoperatively, the medial trochlear cartilage appeared underdeveloped. Postoperatively, he achieved improved carrying angle and near-full extension. At one-year follow-up, he was pain-free, with stable joint congruity and only a 5° extension deficit compared with the contralateral side.

Discussion

Trochlear osteonecrosis is an infrequent late outcome of pediatric distal humerus fractures that is documented across case series and likely underrecognized after supracondylar injuries, because presentation often occurs well after union (2, 4, 7, 8). Cohort data for lateral condyle fractures confirm a low single-digit clinical incidence, establishing the complication as uncommon but real (6). The pathoanatomy explains susceptibility: the trochlear ossify nucleus is supplied by end arterial branches with minimal collateralization, rendering it vulnerable to ischemia from displacement or surgical soft-tissue stripping and, in apparently minor injuries, from intracapsular hematoma-related tamponade (1-3, 9). Diagnostic characterization relies on imaging. The fishtail deformity, a central metaphyseal-epiphyseal defect, may only become evident as the trochlea ossifies. Magnetic resonance imaging (MRI) detects marrow and subchondral change earlier, whereas CT delineates defect topography and joint congruity for operative planning (3, 5, 7, 9).

Associated findings described in case series radiocapitellar subluxation, synovitis, early joint space narrowing –correlate with greater motion loss and a more refractory clinical course (7, 9).

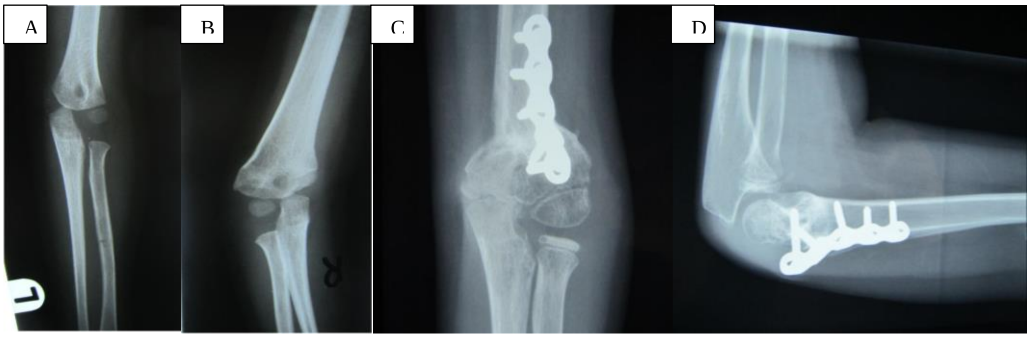

Figure 7. A) Preoperative anteroposterior (AP) elbow radiograph demonstrating persistent cubitus varus with medial trochlear irregularity before corrective osteotomy; B) Preoperative lateral radiograph showing a fixed flexion posture with preserved ulnohumeral congruity; C, D) Post-operative AP and lateral radiograph following lateral extension valgus osteotomy fixed by plate

A pragmatic scheme distinguishes type A involvement, affecting the lateral or central trochlea and often clinically quiet with preserved congruity, from type B involvement, affecting the medial crista with or without metaphyseal extension and commonly linked to cubitus varus and extension deficit; at the severe end, progressive dissolution of the trochlea has been reported despite anatomically reduced fractures, underscoring a vascular rather than alignment-driven pathogenesis (2, 8).

1) How do you follow patients after treatment of distal humerus fractures for risk of AVN development?

Answer: Follow-up should be risk-stratified and deliberately prolonged, because trochlear osteonecrosis often becomes apparent only after an asymptomatic interval and commonly around the time the trochlea ossifies (approximately 7-8 years) (2, 9). After standard reviews to radiographic union, children with displaced supracondylar or transphyseal fractures, markedly displaced lateral condyle fractures, very young age at injury, physeal involvement, or open reduction merit a surveillance phase that extends beyond healing. In practice, this consists of scheduled clinical assessments with intermittent radiography when indicated, rather than routine discharge at union.

Each visit documents elbow ROM with goniometry, comparison of carrying angle to the contralateral side, presence of mechanical symptoms such as catching or locking, and tenderness along the ulnohumeral and radiocapitellar articulations; subtle loss of extension or evolving varus or valgus alignment should prompt imaging even if the child is otherwise well (7, 9). Families are counselled to re-present for new pain, recurrent mechanical symptoms, motion loss, or visible alignment change, since case series consistently show that radiographs may lag clinical findings and that many AVN cases are detected only after routine follow-up has ended (2, 3, 7, 9). Cohort data in lateral condyle fractures confirm that clinically evident AVN is uncommon but real, reinforcing the rationale for targeted long-term surveillance rather than universal intensive imaging in all patients (6).

2) What is the modality of choice for diagnosis and decision-making of AVN?

Answer: Start with plain radiography, because it establishes the pattern of growth disturbance and reveals hallmark features such as a central trochlear defect (fishtail), physeal irregularity, column asymmetry, and evolving coronal or sagittal malalignment; however, radiographic change often lags clinical symptoms (5, 7, 9). When examination suggests disease but radiographs are equivocal, MRI is the preferred test for diagnosis, as it detects early osteonecrosis through marrow and subchondral signal change and simultaneously evaluates articular cartilage before structural collapse becomes visible, which refines prognosis and timing of intervention (2, 9). For operative decision-making in established deformity, CT is most informative because it delineates the three-dimensional (3D) osseous defect, quantifies lateral or central versus medial crista involvement, and assesses ulnohumeral and radiocapitellar congruity with the precision required to plan wedge magnitude and orientation in corrective osteotomy (7, 9). Applied together, radiographs answer whether there is a recognizable pattern and whether it is progressing, MRI answers whether early AVN is present and how the subchondral bone and cartilage are affected, and CT answers how the bony architecture should be corrected; this tiered approach aligns with case series that also link imaging features to clinical patterns (type A lateral or central involvement versus type B medial crista with or without metaphyseal extension) and to associated findings, such as radial head subluxation or early joint space change, that portend a stiffer elbow and higher intervention rates (2, 7, 9).

3) What is the best approach when AVN is identified, and what are the key points for choosing surgical or non-surgical treatment?

Answer: Management should be individualized and anchored to symptom severity, elbow alignment and congruity, ROM, lesion pattern, and remaining growth. Limited lateral-central involvement with preserved ulnohumeral congruity and minimal symptoms, typically a type A pattern, can be treated non-operatively with activity modification, analgesia as needed, a structured ROM program, and planned clinical-radiographic surveillance; durable function under observation is reported in such presentations (2, 5).

Operative treatment is favored when pain persists, mechanical symptoms recur, coronal or sagittal malalignment progresses, a fixed contracture limits function, or imaging demonstrates incongruity or instability, particularly in type B disease with medial crista involvement (2, 7, 8). Procedure selection should match the dominant pathology: arthroscopic or open debridement addresses loose bodies and impinging chondral flaps but may require repeat intervention; capsular release restores motion when contracture predominates; corrective distal humerus osteotomy, often a lateral closing-wedge with an extension component, reliably improves alignment and function when deformity is the principal driver of impairment; selective epiphysiodesis is considered in young children with asymmetric physeal arrest; salvage interposition procedures are reserved for advanced incongruity near maturity (1, 7, 8).

Prognosis is influenced by pattern and associated findings. Medial involvement, radiocapitellar subluxation, and early joint space narrowing correlate with stiffer elbows and higher intervention rates, whereas clinically evident AVN after lateral condyle fractures is uncommon in larger cohorts and tends to fare well when alignment is preserved (6, 7). Our two patients illustrate this framework, with non-operative surveillance sufficient for a limited type A presentation and corrective osteotomy restoring alignment and motion in a progressive type B presentation, consistent with previously reported series (2, 5, 7).

Conclusion

Trochlear osteonecrosis after pediatric distal humerus fracture is uncommon but clinically consequential. Our cases show two distinct trajectories: a small, centrally based defect that remained functional with observation, and a medial-sided collapse with combined coronal-sagittal malalignment that benefited from corrective osteotomy. The practical takeaway is to extend follow-up beyond union in young children and in displaced or physeal injuries, and to let symptoms and alignment, rather than radiographs alone, drive intervention. Applied consistently, this approach limits secondary deformity and preserves elbow function.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgements

None.

References

1. Nwakama AC, Peterson HA, Shaughnessy WJ. Fishtail deformity following fracture of the distal humerus in children: historical review, case presentations, discussion of etiology, and thoughts on treatment. J Pediatr Orthop B. 2000;9(4):309-18. doi: 10.1097/01202412-200010000-00016. [PubMed: 11143476].
2. Etier BE, Jr., Doyle JS, Gilbert SR. Avascular Necrosis of Trochlea After Supracondylar Humerus Fractures in Children. Am J Orthop (Belle Mead NJ). 2015;44(10):E390-3. [PubMed: 26447417].
3. Claessen FM, Louwerens JK, Doornberg JN, Van Dijk CN, Van den Bekerom MP, Eygendaal D. Hegemann's disease and fishtail deformity: aetiopathogenesis, radiographic appearance and clinical outcome. J Child Orthop. 2015;9(1):1-8. doi: 10.1007/s11832-014-0630-z. [PubMed: 25577162]. [PubMed Central: PMC4340852].
4. Takagi T, Seki A. Delayed avascular necrosis after non-displaced distal humerus fracture. BMJ Case Rep. 2024;17(6):e260607. doi: 10.1136/bcr-2024-260607. [PubMed: 38926129].
5. Schulte DW, Ramseier LE. Fishtail deformity as a result of a non-displaced supracondylar fracture of the humerus. Acta Orthop Belg. 2009;75(3):408-10. [PubMed: 19681330].
6. Shabtai L, Lightdale-Miric N, Rounds A, Arkader A, Pace JL. Incidence, risk factors and outcomes of avascular necrosis occurring after humeral lateral condyle fractures. J Pediatr Orthop B. 2020;29(2):145-8. doi: 10.1097/bpb.0000000000000698. [PubMed: 31821269].
7. Glotzbecker MP, Bae DS, Links AC, Waters PM. Fishtail deformity of the distal humerus: a report of 15 cases. J Pediatr Orthop. 2013;33(6):592-7. doi: 10.1097/BPO.0b013e3182933c51. [PubMed: 23774206].
8. Bronfen CE, Geffard B, Mallet JF. Dissolution of the trochlea after supracondylar fracture of the humerus in childhood: an analysis of six cases. J Pediatr Orthop. 2007;27(5):547-50. doi: 10.1097/BPO.0b013e318070cc60. [PubMed: 17585265].
9. Narayanan S, Shailam R, Grottkau BE, Nimkin K. Fishtail deformity--a delayed complication of distal humeral fractures in children. Pediatr Radiol. 2015;45(6):814-9. doi: 10.1007/s00247-014-3249-9. [PubMed: 25527301].