Journal of Southeast Asian Orthopaedics
ISSN 2821-9848 (Print)
ISSN 2821-9864 (Online)
https://doi.org/10.56929/jseaortho-2026-0344 https://jseaortho.org

Chronic Monteggia Lesions in Children Treated With Radial Head Reduction Through an Enlarged Native Annular Ligament and Ulnar Osteotomy Without Reconstruction

Varinthorn Adulyanukosol, MD, Supphamard Lewsirirat, MD

Department of Orthopedic Surgery, Maharat Nakhon Ratchasima Hospital, Nakhon Ratchasima, Thailand

Purpose: To evaluate outcomes of a ligament-preserving technique for chronic Monteggia lesions in children.

Methods: We retrospectively reviewed 26 children treated surgically for chronic Monteggia lesions between 2008 and 2023. All patients underwent radial head relocation through the native annular ligament combined with individualized proximal metaphyseal ulnar osteotomy. Controlled enlargement of the annular ligament was performed in all patients. In one patient with a partial annular ligament tear, the remaining ligamentous ring was enlarged to facilitate radial head passage, followed by direct suturing without graft reconstruction. Clinical and radiographic outcomes were evaluated after a mean follow-up of 37.2 ± 10.1 months.

Results: Mean age was 7.7 years, and mean follow-up was 37.2 months. Intraoperative radiocapitellar stability was achieved in all patients after ulnar correction. At final follow-up, radiocapitellar congruity was maintained in 24 patients (92.3%), whereas two (7.7%) had mild residual subluxation. Elbow motion improved significantly. The mean Kim score was 82.3 ± 10.1, and the mean Mayo Elbow Performance Score was 89.6 ± 12.1. All osteotomies united, with no neurovascular injuries, infections, implant failures, or unplanned reoperations.

Conclusion: A preservation-based approach involving controlled enlargement of the native annular ligament, with direct repair when necessary, combined with individualized proximal metaphyseal ulnar osteotomy was associated with favorable radiographic and functional outcomes. Neither annular ligament reconstruction nor transcapitellar pinning was required. Further comparative studies are needed to determine the benefits of this approach.

Keywords: Chronic Monteggia lesions, pediatric elbow, ulnar osteotomy, annular ligament, radial head dislocation

Monteggia lesions consist of an ulnar fracture or plastic deformation associated with radial head dislocation [1,2]. In children, a good outcome requires early diagnosis and stable anatomical reduction of the ulna [3]. Lesions diagnosed more than 4 weeks after injury are considered chronic or neglected [4-6] and may result in persistent radiocapitellar incongruity, restricted motion, deformity, and degenerative changes [4-8]. Chronic Monteggia lesions remain a challenging reconstructive problem in children [5,6,9-11].

Article history:
Received: August 18, 2026 Revised: October 12, 2026
Accepted: November 18, 2026
Correspondence to: Varinthorn Adulyanukosol, MD
Department of Orthopedic Surgery, Maharat Nakhon Ratchasima Hospital, Nakhon Ratchasima, Thailand
E-mail: varinthorn.adul@gmail.com

In chronic Monteggia lesions, the annular ligament is often preserved rather than completely ruptured [8,11-15]. Missed diagnosis is common, particularly in younger children with subtle ulnar plastic deformation [6,16-18].

Persistent ulnar malalignment is considered a principal biomechanical factor contributing to chronic radial head dislocation. Depending on the Bado type, ulnar angulation alters the relative alignment of the radius and ulna, resulting in persistent radiocapitellar incongruity [5,7,18-20]. Therefore, restoration of ulnar alignment is a key principle of surgical treatment.

Traditional treatment includes open reduction, corrective ulnar osteotomy, annular ligament reconstruction, and, occasionally, transcapitellar pinning [9,10,21-24]. However, ligament reconstruction may be associated with stiffness, heterotopic ossification, restricted forearm rotation, and recurrent instability [10-13,16,22]. Recent studies suggest that corrective ulnar osteotomy combined with preservation of the native annular ligament, with selective enlargement when necessary, can provide stable radiocapitellar reduction without routine ligament reconstruction [12-15,25-28].

This study aimed to evaluate the radiographic and functional outcomes of a preservation-based technique involving controlled enlargement of the native annular ligament, with direct repair when necessary, combined with individualized proximal metaphyseal ulnar osteotomy, without annular ligament reconstruction or transcapitellar pinning. Maintenance of radiocapitellar congruity at final follow-up was the primary outcome. We hypothesized that this approach would provide stable radiocapitellar alignment and improve elbow function.

MATERIALS AND METHODS

This retrospective cohort study included children younger than 18 years with chronic Monteggia lesions who underwent surgical treatment between 2008 and 2023 at a tertiary referral center. Chronic lesions were defined as persistent radial head dislocation for more than 4 weeks after injury. Patients with congenital radial head dislocation, previous elbow surgery, neuromuscular disorders, pathological bone diseases, or less than 18 months of follow-up were excluded. Mean follow-up was 37.2 ± 10.1 months (range, 18–59). A total of 30 pediatric patients with chronic Monteggia lesions were identified during the study period. Four patients with less than 18 months of follow-up were excluded, leaving 26 patients for the final analysis. The study was approved by the Institutional Review Board of Maharat Nakhon Ratchasima Hospital (MNRH IRB; Approval No. 014/2026). The requirement for informed consent was waived by the Institutional Review Board because of the retrospective nature of the study.

Demographic and preoperative variables included age, sex, affected side, mechanism of injury, interval from injury to surgery, pain, and elbow range of motion (ROM). Preoperative radiographs were evaluated for Bado classification, ulnar angulation, direction of radial head displacement, and radial head morphology.

Operative variables included surgical approach, annular ligament status and management, radial head reducibility before ulnar osteotomy, details of proximal metaphyseal ulnar osteotomy and fixation, operative time, blood loss, and use of transcapitellar pinning. Postoperative outcomes included time to radiographic union, radiocapitellar alignment, radial head morphology, elbow ROM, Kim Elbow Performance Score (29), Mayo Elbow Performance Score (MEPS) (30), complications, and reoperation.

At follow-up, radiocapitellar alignment was assessed on anteroposterior (AP) and lateral elbow radiographs. Congruent alignment was defined as a centered radial head with maintained radiocapitellar alignment and congruent articulation between the radial head and capitellum on both views. Radiocapitellar subluxation was defined as partial translation or eccentric positioning of the radial head relative to the capitellum without complete dislocation.

No predetermined ulnar lengthening or shortening was performed. Instead, the direction and magnitude of ulnar angulation were adjusted dynamically according to radiocapitellar reduction and stability. Implant removal was routinely planned approximately 1 year after the index

procedure, following confirmation of osteotomy union.

Kim and MEPS were assessed at final follow-up. Preoperative Kim and MEPS were not routinely recorded and were therefore unavailable for preoperative-to-postoperative score comparisons.

Surgical Technique

All procedures were performed under general anesthesia using a standard Kocher approach. After capsular exposure, the radial head and annular ligament were assessed. Initial radial head reduction was attempted before ulnar osteotomy; however, reducibility at this stage was not considered equivalent to stable reduction. The direction of ulnar correction was individualized according to the Bado type and intraoperative radiocapitellar stability: posterior angulation for Bado type I, anterior angulation for Bado type II, and medial angulation for Bado type III lesions.

The annular ligament was identified intraoperatively in all patients. In 25 patients, the native annular ligament remained attached to the radial notch of the ulna but was flattened and constricted, with a markedly narrowed opening. Under direct visualization, the ligamentous ring was gradually dilated using a clamp, as illustrated in Figure 1. No predetermined dilation diameter was used; instead, dilation was performed incrementally according to the individual anatomy. A small bone file, approximately 5 mm wide, was then used as a lever to gently guide the radial head through the enlarged ligamentous ring with circumferential manipulation. Enlargement was stopped immediately once the radial head could pass through the ring. The ligament was generally thick, and its continuity and intrinsic tension were preserved throughout the procedure. No iatrogenic ligament tears occurred during enlargement. After passage of the radial head, the preserved ligament remained closely apposed around the radial neck, with satisfactory tension on intraoperative assessment. One patient with a Bado type III lesion had a partial tear of the native annular ligament. The remaining ligamentous ring underwent controlled enlargement to allow radial head passage through the native annular ligament; passage was facilitated by the pre-existing partial tear. The torn portion was subsequently repaired by direct suturing without graft reconstruction. Corrective ulnar osteotomy was then performed to achieve stable radiocapitellar alignment. No complete tear or absent annular ligament was identified.

Radial head reduction was attempted using gentle distal-to-proximal pressure combined with controlled forearm rotation. After enlargement of the ligamentous ring, the radial head was gently guided through the annular ligament. At this stage, the radial head was contained within the ligamentous ring but was not necessarily concen-

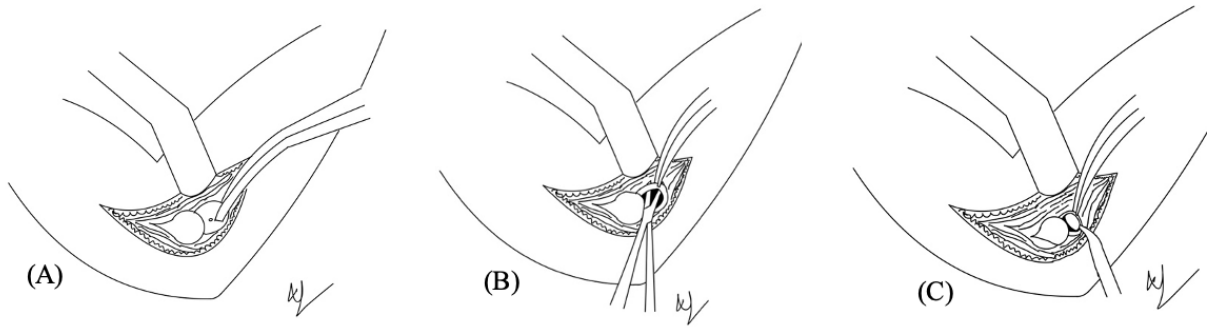


Fig. 1 Stepwise illustration of passage of the radial head through the enlarged native annular ligament. Illustration created by the authors. (A) Identification of the native annular ligament just distal to the capitellum. (B) Controlled enlargement of the annular ligament under direct visualization to permit passage of the radial head. (C) The radial head is gently guided through the enlarged annular ligament with controlled forearm rotation while preserving ligament continuity.

trically reduced to the capitellum because the underlying ulnar deformity had not yet been corrected. Therefore, an individualized proximal metaphyseal ulnar osteotomy was performed to restore the radius–ulna relationship and achieve radiocapitellar alignment and stability. No temporary transcapitellar pinning was used during reduction.

An individualized complete transverse osteotomy was performed at the proximal ulnar metaphysis, distal to the olecranon tip, while preserving sufficient proximal bone to accommodate approximately three screw holes of a small dynamic compression plate. This metaphyseal level was selected because of its favorable healing potential and proximity to the radiocapitellar joint. The direction of correction was adapted according to the Bado classification and underlying ulnar deformity: posterior angulation for type I lesions, anterior angulation for the type II lesion, and medial angulation for type III lesions. No predetermined ulnar lengthening or shortening was performed. After the osteotomy was created, the radial head was manually seated against the capitellum while the magnitude of ulnar angulation was adjusted dynamically according to radiocapitellar reduction and tracking.

Before final fixation, stability was assessed by direct visualization while the elbow was taken through full flexion and extension and the forearm through full pronation and supination. Reduction was considered stable only when the radial head remained concentrically reduced and tracked with the capitellum throughout the entire ROM without visible subluxation. If subluxation persisted, the direction and/or magnitude of osteotomy correction was further adjusted until a concentric, self-maintained radiocapitellar reduction was achieved without manual support. The osteotomy was then definitively fixed using a contoured small dynamic compression plate. No temporary transcapitellar fixation was used.

The wound was closed in layers. Postoperatively, the elbow was immobilized in a long-arm slab for approximately 4 weeks. Bado type I and III lesions were immobilized with the elbow at approximately 90° of flexion and the forearm in supination. The Bado type II lesion was immobilized with the forearm in supination and the elbow at approximately 30° of flexion, closer to extension, followed by initiation of active ROM exercises. Follow-up radiographs were obtained to monitor osteotomy union and maintenance of alignment.

Elbow flexion and extension and forearm pronation and supination were measured using a handheld goniometer by the two treating surgeons during outpatient assessment. Measurements were obtained jointly, with agreement between the two observers, and were recorded in approximately 5° increments. The same method was used preoperatively and at final follow-up. The observers were not blinded to treatment status or assessment time point.

Radiographic Assessment

Ulnar angulation was quantified as the angle between the longitudinal axes of the proximal and distal ulnar segments in the plane of maximal deformity. Posterior angulation was measured on the lateral radiograph for Bado type I lesions, anterior angulation on the lateral radiograph for the type II lesion, and medial angulation on the AP radiograph for Bado type III lesions. Radiocapitellar congruity was defined as a centered radial head with maintained radiocapitellar alignment and congruent articulation with the capitellum on both AP and lateral radiographs. Subluxation was defined as eccentric positioning or partial translation of the radial head relative to the capitellum without complete dislocation.

Radial head morphology was classified descriptively as concave, flattened, dome-shaped, or irregular. The first three categories were adapted from Oka et al. (28), whereas the category "irregular" was used when the radial head had an irregular contour that could not be assigned to the other three categories. Radiographs were reviewed by two investigators, and disagreements were resolved by consensus. The observers were not blinded to the clinical course or timing of the radiographs.

Statistical Analysis

Continuous variables were summarized as mean ± standard deviation (SD) or median with

interquartile range (IQR), as appropriate, whereas categorical variables were presented as frequencies and percentages. Because ROM measurements demonstrated non-normal distributions with clustering near the upper limits of motion, preoperative and final ROM values were summarized as median (IQR) and compared using the Wilcoxon signed-rank test. For the exploratory analysis according to injury-to-surgery interval (≤3 months vs >3 months), continuous outcomes were compared using the Mann–Whitney U test, and categorical outcomes were compared using Fisher's exact test. All tests were two-sided, and $P < 0.05$ was considered statistically significant. Statistical analyses were performed using Microsoft Excel 365 (Microsoft Corp., Redmond, WA, USA).

RESULTS

Twenty-six children met the inclusion criteria. The mean age at surgery was 7.7 ± 2.7 years (range, 3–14). The cohort comprised 16 men and 10 women, and the right elbow was affected in 14 patients. Falls accounted for 24 of the 26 injuries (92.3%), whereas the remaining two injuries (7.7%) resulted from traffic accidents. The median interval from injury to surgery was 3.5 months (range, 1–72), and the mean follow-up was 37.2 ± 10.1 months (range, 18–59). Patient demographics are summarized in Table 1.

Table 1 Patient Demographics and Preoperative Characteristics (n = 26).

Characteristic	Value
Age at surgery, years, mean ± SD (range)	7.7 ± 2.7 (3–14)
Sex, n (%)	
Male	16 (61.5)
Female	10 (38.5)
Affected side, n (%)	
Right	14 (53.8)
Left	12 (46.2)
Mechanism of injury, n (%)	
Fall	24 (92.3)
Traffic accident	2 (7.7)
Injury-to-surgery interval, months, median (IQR) [range]	3.5 (1.25–12) [1–72]
Follow-up duration, months, mean ± SD (range)	37.2 ± 10.1 (18–59)
Bado classification, n (%)	
Type I	23 (88.5)
Type II	1 (3.8)
Type III	2 (7.7)
Preoperative pain, n (%)	
Yes	5 (19.2)
No	21 (80.8)
Preoperative radial head morphology, n (%)	
Concave	19 (73.1)
Flattened	5 (19.2)
Dome-shaped	2 (7.7)
Preoperative ulnar angulation, °, mean ± SD (range)	7.0 ± 4.5 (2–20)
Direction of radial head displacement, n (%)	
Anteromedial	23 (88.5)
Lateral/posterolateral	3 (11.5)

Values are presented as mean ± SD (range), median (IQR) [range], or n (%), as appropriate. IQR, interquartile range; SD, standard deviation.

Only 3 of the 26 radial heads (11.5%) were reducible to the capitellum before ulnar osteotomy. However, none of these reductions remained stable throughout the full ROM of the elbow and forearm because of persistent subluxation during motion. Therefore, all patients underwent corrective ulnar osteotomy.

Elbow and forearm ROM improved significantly from preoperative assessment to final follow-up. Median flexion increased from 97.5° (IQR, 90–110) to 140° (IQR, 140–140), extension improved from −20° (IQR, −30 to −10) to 0° (IQR, 0–0), pronation increased from 50° (IQR, 50–50) to 90° (IQR, 82.5–90), and supination increased from 50° (IQR, 50–80) to 90° (IQR, 80–90). All improvements were statistically significant (all $P < 0.001$). Preoperative and final follow-up ROM measurements are summarized in Table 2.

Table 2 Preoperative and Final Range-of-Motion Outcomes.

Range of motion, median (IQR), °	Preoperative	Final follow-up	P
Elbow flexion	97.5 (90–110)	140 (140–140)	<0.001
Elbow extension	−20 (−30 to −10)	0 (0–0)	<0.001
Forearm pronation	50 (50–50)	90 (82.5–90)	<0.001
Forearm supination	50 (50–80)	90 (80–90)	<0.001

Values are presented as median (IQR). Preoperative and final follow-up measurements were compared using the Wilcoxon signed-rank test. IQR, interquartile range.

Intraoperatively, the native annular ligament remained attached to the radial notch of the ulna but appeared flattened and constricted, with a markedly narrowed opening, in 25 patients (96.2%). A partial annular ligament tear was identified in one patient (3.8%). Controlled enlargement of the native annular ligament was performed in all 26 patients to allow passage of the displaced radial head through the ligamentous opening. In the patient with a partial tear, the torn portion was subsequently repaired by direct suturing without graft reconstruction. No complete tear or absent annular ligament was identified.

Preoperative ulnar angulation was present in all patients, ranging from 2° to 20°, with the direction corresponding to the Bado type. At final follow-up, radiocapitellar congruity was maintained in 24 of 26 patients (92.3%), whereas two patients (7.7%) had mild residual radial head subluxation. One of these patients had a Bado type III lesion with a partial annular ligament tear, which was managed by controlled enlargement of the remaining native annular ligament followed by direct suture repair. Stable radiocapitellar reduction had been achieved intraoperatively in this patient. No recurrent complete dislocation was observed.

The mean operative time was 68.5 ± 14.9 minutes (range, 45–105), and the mean estimated blood loss was 11.9 ± 4.0 mL (range, 10–20). All ulnar osteotomies were stabilized using a small dynamic compression plate. Operative and radiographic outcomes are summarized in Table 3.

The median interval from injury to surgery was 3.5 months (range, 1–72). Patients were stratified according to the interval from injury to surgery into those treated within 3 months of injury (n = 13) and those treated after 3 months (n = 13). No statistically significant differences were observed between the groups in final elbow flexion, extension, forearm pronation, forearm supination, Kim score, or MEPS (all $P > 0.05$). Final pronation and Kim scores were numerically lower in the group treated >3 months after injury, although these differences did not reach statistical significance ($P = 0.052$ and $P = 0.058$, respectively). Radiocapitellar congruity was achieved in 12 of 13 patients (92.3%) in each group, with one case of mild residual radial head subluxation in each group ($P = 1.000$).

Table 3 Clinical and Radiographic Outcomes at Final Follow-up.

Outcome	Value
Congruent radiocapitellar joint, n (%)	24 (92.3)
Mild residual radial head subluxation, n (%)	2 (7.7)
Recurrent complete radial head dislocation, n (%)	0 (0)
Radiographic union time, weeks	9.1 ± 2.2 (5–12)
Postoperative ulnar angulation, °	20.2 ± 4.8 (10–28)
Final radial head morphology, n (%)	
Concave	18 (69.2)
Flattened	6 (23.1)
Irregular	2 (7.7)
Kim score	82.3 ± 10.1 (55–90)
MEPS	89.6 ± 12.1 (55–100)
Unplanned reoperation, n (%)	0 (0)

Values are presented as mean ± SD (range) or n (%), as appropriate. MEPS, Mayo Elbow Performance Score; SD, standard deviation.

Radiographic union of the ulnar osteotomy occurred in all patients, at a mean of 9.1 ± 2.2 weeks (range, 5–12). At final follow-up, radial head morphology was concave in 18 patients (69.2%), flattened in six (23.1%), and irregular in two (7.7%). Compared with preoperative morphology, radial head morphology remained unchanged in 22 of 26 patients (84.6%). Among the four patients with morphological change, two changed from dome-shaped to flattened, one from concave to irregular, and one from flattened to irregular. At final follow-up, the mean Kim score was 82.3 ± 10.1 (range, 55–90), and the mean MEPS was 89.6 ± 12.1 (range, 55–100).

Representative radiographs demonstrating the progression from chronic radial head dislocation to postoperative radiocapitellar alignment and subsequent remodeling are shown in Figure 2.

No neurovascular injuries, infections, or implant failures occurred. Mild residual radial head subluxation was observed in two patients (7.7%), with no recurrent complete dislocation. No unplanned reoperation was required.

All 26 patients underwent elective implant removal at approximately 1 year after the index procedure, following confirmation of osteotomy union. None required premature implant removal because of an implant-related complication. No patient reported wrist or distal radioulnar joint symptoms during follow-up.

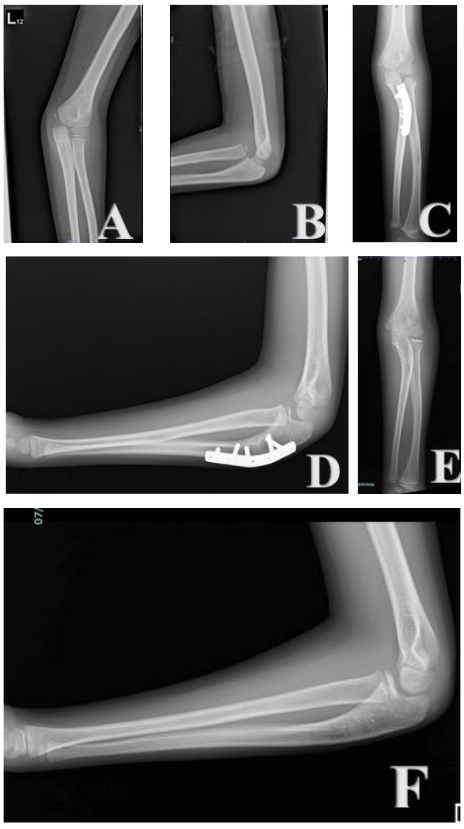


Fig. 2 Representative radiographic case of a chronic Monteggia lesion managed with annular ligament enlargement and proximal ulnar

osteotomy. (A–B) Preoperative AP and lateral radiographs of a 7-year-old girl with a chronic Bado type I lesion demonstrating anterior radial head dislocation. (C–D) Postoperative radiographs showing restoration of radiocapitellar alignment following individualized proximal ulnar angulation osteotomy with plate fixation and progressive union. (E–F) Final follow-up radiographs at 11 years of age demonstrating maintained radiocapitellar reduction and interval remodeling of the radial head and proximal ulna.

DISCUSSION

Consistent with previous studies, persistent ulnar deformity plays an important role in maintaining radial head dislocation in chronic Monteggia lesions [5,7,19]. Plastic deformation or malunion of the ulna alters the proximal radioulnar relationship and may prevent stable radiocapitellar reduction. In our series, only three of 26 radial heads were reducible before ulnar osteotomy, and none remained stable throughout the full ROM. These findings support correction of the underlying ulnar deformity as an important component of surgical treatment. The proposed relationship among ulnar deformity, radial head displacement, and annular ligament distortion is illustrated in Figure 3.

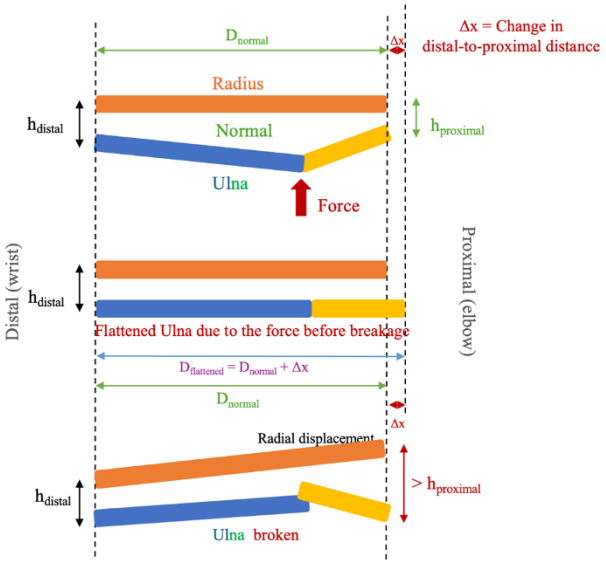


Fig. 3 Schematic illustration of the proposed relationship between ulnar deformity and radial head displacement in chronic Monteggia lesions. Sustained loading and plastic deformation of the ulna may alter the proximal radius–ulna relationship and contribute to displacement of the radial head. The schematic illustrates the geometric changes associated with ulnar deformity and the resulting alteration in radiocapitellar alignment. Preservation of the native annular ligament may permit controlled enlargement and reuse during surgical reduction when sufficient ligament continuity is present.

Our findings are consistent with those of Baydar et al. [15], who described corrective opening-wedge ulnar osteotomy combined with dilatation and mobilization of the preserved, intact annular ligament in 14 children with chronic Monteggia fracture-dislocation. They reported an improvement in the mean Kim score from 69.6 preoperatively to 92.9 at final follow-up, although recurrent radial head subluxation occurred in two patients. Their findings support preservation and enlargement of the native annular ligament rather than routine reconstruction when adequate ligament tissue remains.

In the present series, controlled enlargement of the native annular ligament was performed in all 26 patients to permit radial head passage. In 25 patients, the ligament was intact but constricted; in one patient with a partial tear, the pre-existing opening facilitated enlargement and radial head passage through the remaining ligamentous ring. The torn portion was subsequently repaired directly. These findings suggest that native ligament preservation with controlled enlargement, supplemented by direct repair when indicated, may avoid routine reconstruction when adequate native tissue remains.

Based on our intraoperative findings, we propose a practical framework for ligament management. An intact but constricted annular ligament may be managed with controlled enlargement. When a partial tear is present but sufficient native tissue remains, the remaining ligamentous ring may also require controlled enlargement to permit radial head passage, followed by direct repair of the torn portion.

Reconstruction may be considered when the ligament is absent or irreparable. However, no complete tear or absent annular ligament was encountered in this cohort, and reconstruction was not directly evaluated.

One patient with a partially torn annular ligament who underwent direct repair demonstrated mild residual radial head subluxation at final follow-up despite satisfactory intraoperative stability. However, the contribution of ligament injury to the residual subluxation cannot be established from a single case.

Limitations

First, its retrospective design, lack of a comparison group, and relatively small sample size limit the ability to draw causal conclusions or directly compare this preservation-based approach with annular ligament reconstruction or other surgical strategies. In addition, 23 of the 26 patients had Bado type I lesions, whereas Bado type II and III lesions were uncommon. Therefore, the findings primarily apply to chronic Monteggia lesions classified as Bado type I and should not be generalized to all Bado types. The mean follow-up was approximately 3 years, and not all patients were followed until skeletal maturity. Consequently, the long-term durability of radiocapitellar alignment and radial head remodeling remains uncertain.

Radiographic assessments were performed by two investigators who reached a consensus without blinding or independent repeated measurements. Therefore, interobserver and intraobserver reliability could not be assessed. Similarly, elbow and forearm ROM was measured clinically in approximately 5° increments by the two treating surgeons without blinding, which may have introduced measurement and observer bias and contributed to the ceiling effect observed in final ROM values. Preoperative Kim and MEPS scores were not routinely collected, precluding direct comparisons of these functional scores between preoperative and final follow-up assessments. Standardized wrist radiographs were not routinely obtained; therefore, ulnar variance could not be assessed. The carrying angle was also not routinely recorded and could not be reliably reconstructed retrospectively.

Finally, no patient had a completely absent or irreparable annular ligament. Therefore, the applicability of this preservation-based approach in such cases remains uncertain, and the potential role of annular ligament reconstruction when adequate native tissue is unavailable was not directly evaluated in this cohort.

CONCLUSION

In this retrospective series, a preservation-based approach involving controlled enlargement of the native annular ligament, with direct repair when necessary, combined with individualized proximal metaphyseal ulnar osteotomy was associated with favorable radiographic and functional outcomes at a mean follow-up of approximately 3 years. Annular ligament reconstruction and transcapitellar pinning were not required. This approach may be effective, particularly in Bado type I lesions, which constituted the majority of the cohort. Longer-term comparative studies, including follow-up to skeletal maturity, are needed to establish the durability and applicability of this technique across different Bado types.

REFERENCES

1. Bado JL. The Monteggia lesion. Clin Orthop Relat Res 1967;50:71-86.
2. Boyd HB, Boals JC. The Monteggia lesion: A review of 159 cases. Clin Orthop Relat Res 1969;66:94-100.
3. Ring D, Waters PM. Operative fixation of Monteggia fractures in children. J Bone Joint Surg Br 1996;78:734-9.
4. Nakamura K, Hirachi K, Uchiyama S, et al. Long-term clinical and radiographic outcomes after open reduction for missed Monteggia fracture-dislocations in children. J Bone Joint Surg Am 2009;91:1394-404.
5. Horii E, Nakamura R, Koh S, et al. Surgical treatment for chronic radial head dislocation. J Bone Joint Surg Am 2002;84:1183-8.

6. Wintges K, Cramer C, Mader K. Missed Monteggia injuries in children and adolescents: a treatment algorithm. Children (Basel) 2024;11: 391.
7. Hirayama T, Takemitsu Y, Yagihara K, et al. Operation for chronic dislocation of the radial head in children. Reduction by osteotomy of the ulna. J Bone Joint Surg Br 1987;69:639-42.
8. Bhaskar A. Missed Monteggia fracture in children: Is annular ligament reconstruction always required? Indian J Orthop 2009;43:389-95.
9. Rodgers WB, Waters PM, Hall JE. Chronic Monteggia lesions in children. Complications and results of reconstruction. J Bone Joint Surg Am 1996;78:1322-9.
10. Mohan Kumar EG, Yathisha Kumar GM, Noorudheen M. Functional outcome of Bell-Tawse procedure for the management of chronic unreduced Monteggia fracture-dislocation in children. Indian J Orthop 2019;53:745-50.
11. Wang J, Jiang LD, He AY, et al. Annular ligament reconstruction by suture anchor for treatment of radial head dislocation in children. BMC Musculoskelet Disord 2015;16:181.
12. Chen HY, Wu KW, Dong ZR, et al. The treatment of chronic radial head dislocation in Monteggia fracture without annular ligament reconstruction. Int Orthop 2018;42:2165-72.
13. Soni JF, Valenza WR, Matsunaga CU, et al. Chronic Monteggia fracture-dislocation in children: Surgical strategy and results. Acta Ortop Bras 2019;27:244-7.
14. Zhang M, Zhou Y, Wang P, et al. The necessity of ulnar osteotomy in children with missed Monteggia fractures. Front Pediatr 2025;13: 1636165.
15. Baydar M, Öztürk K, Orman O, et al. Use of corrective ulnar osteotomy and radial head relocation into preserved annular ligament in the treatment of radiocapitellar instability secondary to pediatric chronic Monteggia fracture-dislocation. J Hand Surg Am 2022;47: 481.e1-481.e9.
16. Choi MH, Moon MH, Kang SW, et al. Challenges in diagnosing pediatric Monteggia fractures: role of clinical experience and imaging. Medicina (Kaunas) 2025;61:1457.
17. Langenberg LC, Beumer A, The B, et al. Surgical treatment of chronic anterior radial head dislocations in missed Monteggia lesions in children: A rationale for treatment and pearls and pitfalls of surgery. Shoulder Elbow 2020;12:422-31.
18. Zhang R, Wang X, Xu J, et al. Neglected Monteggia fracture: a review. EFORT Open Rev 2022;7:287-94.
19. Tajima T, Yoshizu T. Treatment of chronic radial head dislocation. Clin Orthop Relat Res 1995; 318:228-38.
20. Smith BG, Fuchs SM. Chronic radial head dislocation: pathogenesis and management. J Pediatr Orthop 1998;18:469-74.
21. Eamsobhana P, Kaewpornsawan K. Chronic Monteggia lesions treatment with open reduction and Z-lengthening technique with annular ligament reconstruction. J Med Assoc Thai 2012; 95 Suppl 9:S47-S53.
22. Datta T, Chatterjee N, Pal AK, et al. Evaluation of outcome of corrective ulnar osteotomy with bone grafting and annular ligament reconstruction in neglected Monteggia fracture dislocation in children. J Clin Diagn Res 2014;8:LC01-LC04.
23. Song KS, Ramnani K, Bae KC, et al. Indirect reduction of the radial head in children with chronic Monteggia lesions. J Orthop Trauma 2012;26:597-601.
24. Eamsobhana P, Chalayon O, Kaewpornsawan K, et al. Missed Monteggia fracture dislocations treated by open reduction of the radial head. Bone Joint J 2018;100-B(8):1117-24.

25. Liao S, Pan J, Lin H, et al. A new approach for surgical treatment of chronic Monteggia fracture in children. Injury 2019;50:1237-41.

26. Liu Y, Shi W, Li Y, et al. Ulnar osteotomy and monolateral external fixator for the treatment of chronic Monteggia fractures in children: comparison between gradual and acute radial head reduction. J Pediatr Orthop B 2023;32:583-92.

27. Shu C, Zhong G, Li H, et al. Missed Monteggia fractures in children treated by open reduction of the radial head and corrective osteotomy of the ulna. Sci Rep 2022;12:16819.

28. Oka K, Murase T, Moritomo H, et al. Morphologic evaluation of chronic radial head dislocation: three-dimensional and quantitative analyses. Clin Orthop Relat Res 2010;468:2410-8.

29. Kim HT, Park BG, Suh JT, et al. Chronic radial head dislocation in children, Part 2: results of open treatment and factors affecting final outcome. J Pediatr Orthop 2002;22:591-7.

30. Morrey BF, An KN. Functional evaluation of the elbow. In: Morrey BF, editor. The Elbow and Its Disorders. 2nd ed. Philadelphia, PA: W.B. Saunders; 1993. p.86-9.