



Double-Modified Beltawse Reconstruction Using Pedicled Triceps Fascia and Tunneled Polypropylene Augmentation for Late-Presenting Monteggia Lesion

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Purpose: Chronic radial head instability after missed Monteggia injury remains difficult to treat when soft tissue attenuation compromises stability. This report describes a double-modified Beltawse technique combining pedicled triceps fascia reconstruction with supplemental tunneled polypropylene augmentation.

Methods: A 15-year-old male with chronic left radial head instability after a missed Monteggia fracture underwent restoration of ulnar alignment and annular ligament reconstruction. A pedicled triceps fascia strip was used in a modified Beltawse configuration. Because residual radiocapitellar subluxation persisted during intraoperative rotational testing, No. 1 polypropylene augmentation was passed circumferentially around the radial neck and secured through ulnar tunnels.

Results: After augmentation, radiocapitellar congruity was maintained throughout intraoperative flexion–extension and pronation–supination. At 1-month in-person follow-up, the elbow remained clinically stable with maintained radiocapitellar alignment on radiographs. Range of motion improved to 10° to 120° flexion–extension, 70° pronation, and 60° supination. At 7-month follow-up via video consultation, the patient reported no pain, recurrent subluxation, or symptoms suggestive of infection. Visually estimated motion was approximately 5° to 135° flexion–extension, 80° pronation, and 75° supination. DASH score improved from 61 to 12.5, and estimated Mayo Elbow Performance Score was 95. Updated radiographs could not be obtained because the patient was unable to return for in-person radiographic assessment.

Conclusions: This double-modified Beltawse technique provided satisfactory early to mid-term clinical stability in this case. Longer in-person clinical and radiographic follow-up is required to assess durability and late complications.

Keywords: Radial head instability, Annular ligament reconstruction, Beltawse, Pedicled graft, Elbow instability

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Chronic radial head instability is an uncommon but functionally significant condition, often resulting from missed Monteggia injuries or inadequately treated ligamentous disruption. Persistent instability may cause pain, mechanical symptoms, limited forearm rotation, and progressive radiocapitellar degeneration.

Annular ligament reconstruction is the cornerstone for treating chronic cases. The Bell

Tawse procedure uses triceps tendon tissue to recreate the annular ligament, and modifications involve preserving a pedicled attachment to improve graft vascularity and incorporation.

However, chronic soft tissue attenuation, capsular contracture, and altered joint mechanics may result in persistent instability despite reconstruction. This report presents a chronic radial head instability case in which pedicled modified Beltawse reconstruction alone was insufficient, requiring supplemental circumferential polypropylene augmentation.

Case Presentation

A 15-year-old male presented with chronic instability of the left elbow following a missed Monteggia fracture initially managed at a different institution. The patient reported recurrent subluxation and functional limitation, particularly during forearm rotation, with symptoms persisting for several months despite failed non-operative management before surgical intervention. Follow-up was performed at 1 month postoperatively with in-person clinical and radiographic assessment. At 7 months postoperatively, follow-up was conducted via video consultation because the patient could not return for an in-person assessment.

Examination revealed instability of the radiocapitellar joint, most evident during pronation and supination. Range of motion was limited because of apprehension, although no neurovascular deficits were noted.

Radiographic evaluation demonstrated a Monteggia fracture–dislocation pattern with malunion of the ulna and persistent radial head dislocation (*Fig. 1A*). The chronic deformity resulted in altered radiocapitellar alignment and persistent instability during forearm rotation. The injury was classified as AO type 2U2A2c. Findings were consistent with chronic radial head instability secondary to annular ligament insufficiency.

Given the chronicity of the condition and functional limitation, surgical intervention was planned to restore ulnar alignment and reconstruct the annular ligament. Informed consent for publication of this case report and accompanying

images was obtained from the patient and legal guardian.

The clinical timeline comprised an initially missed Monteggia lesion, delayed presentation with chronic radial head instability, operative correction with ulnar fixation and double-modified Beltawse reconstruction, 1-month in-person clinical and radiographic follow-up, and 7-month follow-up via video consultation.

Surgical Technique

A posterior approach to the elbow was performed. Abundant callus formation with minimal comminution was noted at the ulnar fracture site. Open reduction and internal fixation of the ulna using a 3.5-mm dynamic compression plate was performed to restore ulnar length and alignment (*Fig. 1B*). Following restoration of ulnar length, the radiocapitellar joint reduced anatomicallly. No residual ulnar bowing or malalignment contributing to persistent radial head instability was observed following fixation.

A strip of triceps fascia was harvested in a pedicled manner, preserving its distal attachment to maintain vascularity and optimize biological incorporation. The fascia strip was passed around the radial neck to recreate the annular ligament in a modified Beltawse configuration (*Fig. 1C*).

Following pedicled graft reconstruction, stability was assessed under direct visualization by moving the elbow through flexion–extension and forearm pronation–supination. Fluoroscopy was not used for this assessment. Residual radiocapitellar subluxation was observed during rotational testing, most evident in supination, while the radial head reduced or almost reduced in pronation. Persistent visible radiocapitellar incongruity during passive forearm rotation despite restored ulnar length and pedicled graft reconstruction indicated the need for additional stabilization.

A No. 1 polypropylene suture was passed circumferentially around the radial neck and secured through ulnar tunnels to reinforce the reconstruction (*Fig. 1D*)^(a). The augmentation was added to improve rotational stability while retaining the pedicled graft reconstruction. The

final construct is illustrated in Fig. 1E. After augmentation, repeat dynamic assessment demonstrated maintained radiocapitellar congruity

throughout flexion–extension and pronation–supination without apparent over-constraint.

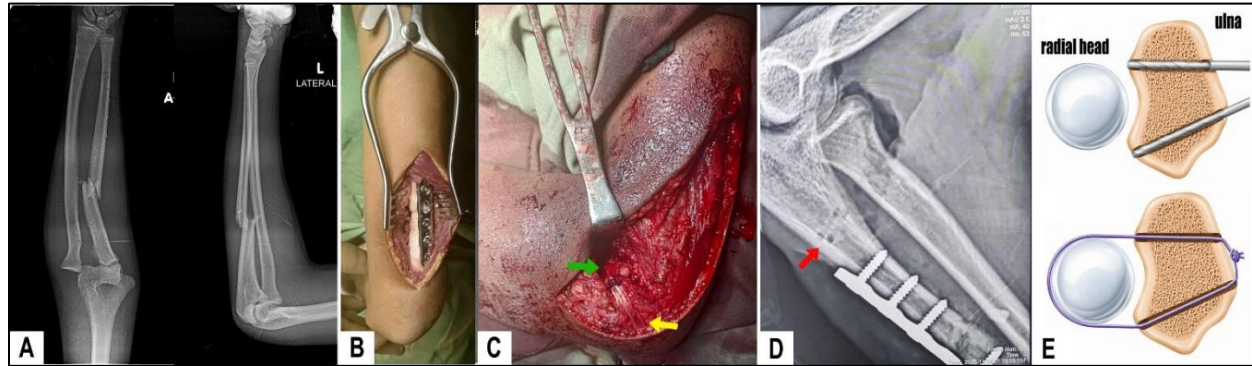


Fig. 1 Preoperative findings and surgical reconstruction. (A) Preoperative radiographs showing ulnar malunion with radial head dislocation. (B) Intraoperative fixation of the ulna restoring length and alignment. (C) Annular ligament reconstruction using a pedicled triceps fascia graft passed around the radial neck (green arrow, radial head; yellow arrow, preserved distal attachment). (D) Circumferential polypropylene augmentation secured through ulnar tunnels. (E) Schematic of the final reconstruction.

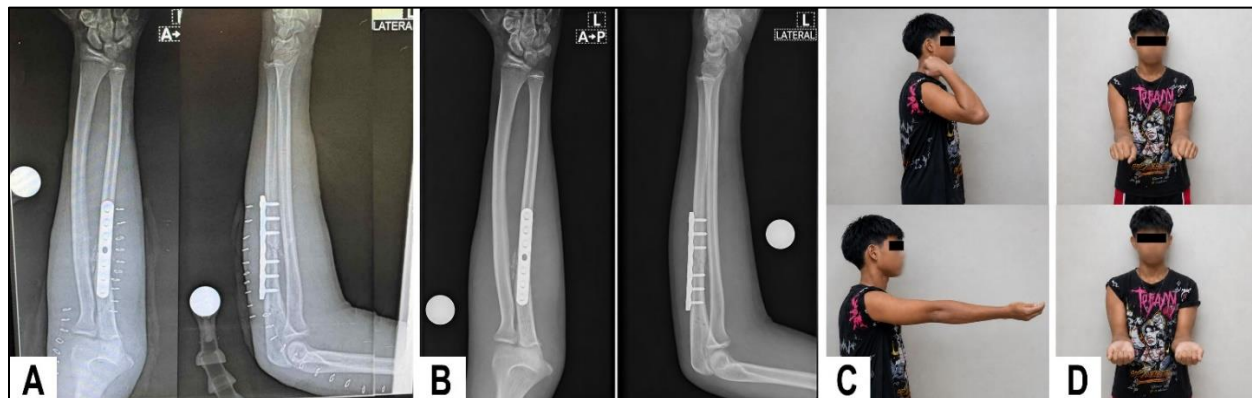


Fig. 2 Postoperative and follow-up assessment. (A) Postoperative radiographs showing restored ulnar alignment and radiocapitellar reduction. (B) One-month follow-up radiographs showing maintained radiocapitellar alignment. (C) Seven-month follow-up images demonstrating elbow extension and flexion. (D) Seven-month follow-up images demonstrating forearm supination and pronation.

RESULTS

Postoperatively, rehabilitation followed a staged surgeon-directed protocol. The elbow was protected in a hinged brace, with early active and active-assisted range-of-motion exercises initiated within a protected range. During the first 3 weeks, lifting, resisted activity, and forceful forearm rotation were avoided. Thereafter, motion exercises

were advanced progressively to minimize stiffness, followed by gradual strengthening and return to daily activities.

At 1-month in-person follow-up, the elbow remained clinically stable, with maintained radiocapitellar alignment on radiographs and no recurrence of instability (Fig. 2A-B). Range of motion improved from a preoperative arc of 30° to

100° flexion–extension, 50° pronation, and 20° supination to 10° to 120° flexion–extension, 70° pronation, and 60° supination.

At 7-month follow-up via video consultation, the patient reported no pain, no recurrent subluxation, no symptoms or visible signs suggestive of infection, and satisfaction with the outcome. He described improved confidence during forearm rotation and had returned to usual daily activities, with mild difficulty only when carrying heavy objects using the affected arm. Visual assessment during the video consultation showed near-normal motion, approximately 5° to 135° flexion–extension (*Fig. 2C*), 80° pronation, and 75° supination (*Fig. 2D*). Video- and image-based assessment of elbow range of motion has demonstrated acceptable validity and reliability compared with conventional clinical goniometry^(2,3). Functional assessment administered during the video consultation showed improvement in DASH score from 61 preoperatively to 12.5, and Mayo Elbow Performance Score was estimated at 95.

DISCUSSION

Annular ligament reconstruction remains the primary treatment for chronic radial head instability, with the Beltawse technique and its modifications demonstrating reliable outcomes in restoring radiocapitellar stability^(4,5). The use of a pedicled triceps fascia graft offers a distinct biological advantage, as preservation of vascularity may enhance graft incorporation and healing compared with free tendon grafts.

Despite these advantages, residual instability may still occur, as demonstrated in this case. Chronic instability is frequently associated with soft tissue attenuation, capsular contracture, and altered joint biomechanics, all of which can limit the effectiveness of isolated ligament reconstruction^(5,6). In chronic Monteggia lesions, restoration of ulnar length is a critical step in achieving radiocapitellar reduction, as demonstrated in this case^(6,7).

The conventional Bell Tawse procedure reconstructs the annular ligament using a detached triceps tendon strip passed through a transosseous ulnar tunnel⁽⁴⁾. By contrast, the modified Beltawse

technique preserves the distal attachment of the triceps fascia or tendon strip, maintaining a pedicled graft that may improve vascularity but lacks tunnel-based fixation. The present double-modified technique combines these principles by retaining a pedicled biologic graft while adding separate circumferential No. 1 polypropylene augmentation through ulnar tunnels after residual intraoperative instability⁽¹⁾. Polypropylene was selected because it is readily available, nonabsorbable, and has a smooth monofilament profile. Although high-strength braided sutures or suture tape may provide greater tensile strength, the goal was to achieve controlled maintenance of radial head reduction during soft tissue healing rather than rigid fixation. The suture was tensioned sufficiently to maintain radiocapitellar congruity, and forearm rotation was reassessed after fixation to avoid over-constraint.

Limitations include the single-case design, video-based nature of the 7-month follow-up, and absence of updated radiographs because the patient was unable to return for in-person assessment. Although clinical outcomes remained satisfactory, radiographic maintenance of reduction, late degenerative changes, and suture-related complications require longer in-person follow-up.

CONCLUSION

The double-modified Beltawse technique, incorporating a pedicled graft and supplemental circumferential fixation, provides a balanced approach to managing chronic radial head instability and may offer improved stability in cases where standard reconstruction alone is inadequate.

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