

# Radial Head Replacement

## Radial Head Replacement – Procedure Outcomes & Post-operative Rehabilitation (Radial Head Arthroplasty for Unreconstructable Fracture / Terrible Triad)

**Topic scope:** post-operative rehabilitation after **radial head arthroplasty (RHA)** – replacement of an unreconstructable comminuted radial head with a metallic implant – performed either in isolation or, more commonly, as one component of reconstructing a **fracture-dislocation (the “terrible triad”: radial head + coronoid + lateral collateral ligament ± medial collateral ligament)**. The radial head is a key secondary stabiliser of the elbow against valgus and axial (posterolateral rotatory) load, so the implant exists to **restore a stable, congruent radiocapitellar articulation and forearm axis** – not merely to fill a defect.

*Defining principle of the rehab here: the implant restores stability, so the dominant clinical enemy is stiffness, to which these elbows are strongly predisposed. The rehab is therefore an early protected-motion pathway – start moving within days to a week – explicitly gated by the integrity of the collateral-ligament and coronoid repairs done at the same operation. The two deliberate restraints are (1) the forearm rotation position that offloads the repaired ligament (pronation protects a repaired LCL; supination protects a repaired MCL; neutral mid-range when both), and (2) avoidance of varus stress and, where the elbow was unstable, early terminal extension. A simple sling is worn for comfort – not a hinged brace. The single biggest branch point is how much residual instability was demonstrated on examination under anaesthesia, which determines how fast the arc and forearm rotation are released.*

## A. PROCEDURE OUTCOMES (radial head arthroplasty; repair-vs-replace context)

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Metallic RHA is a reliable reconstruction for the unreconstructable radial head, and – critically for rehab – it restores enough stability to permit early motion even in the setting of associated dislocation, provided the ligaments and coronoid are addressed.

- **RHA restores elbow stability and kinematics when the native head is unreconstructable, but ligament repair is required to fully restore stability.** Cadaveric work shows radial head excision alters kinematics and stability, arthroplasty restores them in the ligament-intact elbow, and in the ligament-disrupted elbow arthroplasty *plus* LCL repair is needed to correct varus–valgus laxity [Beingessner et al., *J Bone Joint Surg Am* 2004, DOI 10.2106/00004623-200408000-00018]. *Strong (mechanistic/biomechanical).*
- **RHA gives functional, durable ROM in unstable elbow injuries equivalent to stable injuries.** A 15-year single-surgeon series (68 patients) found patients with unstable radial head fractures plus dislocation achieved flexion and rotational arcs similar to stable injuries, with no difference in complication rate or implant survivorship – though supination loss was ~10° greater in the unstable group [Lott et al., *J Shoulder Elbow Surg* 2018, DOI 10.1016/j.jse.2017.10.011]. *Moderate (Level II cohort).*
- **Long-term monopolar implant survival is good, with stiffness/sizing the main failure modes.** A 15-year follow-up of the Acumed anatomical (press-fit, monopolar) implant for Mason III–IV fractures confirms durable function and survival, with the principal complications being joint stiffness, malpositioning and improper sizing [Tarallo et al., *J Shoulder Elbow Surg* 2026, DOI 10.1016/j.jse.2025.05.038]. *Moderate (long-term cohort).*
- **Implant failure/revision risk is real, especially with associated instability.** In a young active (military) cohort, RHA carried higher implant-failure rates than ORIF (20% vs 2.9%), and dislocation, coronoid fracture and concomitant ligament repair each predicted complications – underscoring that the *injury complex*, not just the implant, drives outcome [Kusnezov et al., *HAND* 2017, DOI 10.1177/1558944717715136]. *Moderate.*
- **Terrible-triad reconstruction aims explicitly to restore stability sufficient for early motion.** Comprehensive reviews frame the entire surgical sequence (LCL repair, radial head fix/replace, ± coronoid, ± MCL/fixator) as a means to permit early ROM and pre-empt stiffness, posttraumatic arthrosis and instability [Fahs et al., *J Am Acad Orthop Surg* 2024, DOI 10.5435/jaaos-d-24-00310]. *Moderate–strong (narrative review).*

## B. REHABILITATION / THERAPY EVIDENCE

The rehab evidence base is built on biomechanics + surgical-series protocols rather than RCTs: there is strong agreement on *early protected motion* and on *forearm-position-based ligament protection*, but the exact arc and timing are individualised to intra-operative stability.

- **Early motion is the consensus priority to prevent stiffness.** Across operative series and textbook protocols, formal active and active-assisted ROM is begun within the first week once wound stability is confirmed, with splinting between sessions usually discontinued by 2–3 weeks and strengthening from ~6 weeks [Monica & Mudgal, *Hand Clin* 2010, DOI 10.1016/j.hcl.2010.04.008; Duckworth et al., *Clin Orthop Relat Res* 2014, DOI 10.1007/s11999-014-3516-y]. *Moderate (consensus/series)*.
- **Motion is gated by stability, with varus stress avoided at all times.** Where instability is a concern, an **overhead (supine) rehabilitation protocol begun ~10–14 days** post-op achieves early motion while gravity coopts the joint and neutralises varus; “a stiff stable elbow is preferred over a loose incongruous one” [Rockwood and Green’s *Fractures in Adults*, 2019]. *Moderate (textbook consensus)*.
- **Forearm rotation is positioned to protect the repaired ligament.** Published RHA protocols position and exercise the forearm in **pronation when the LCL was repaired, supination when the MCL was repaired**, and **neutral mid-range when both** were repaired, progressing to full rotation as the repair consolidates [single-centre RHA protocol & narrative review, ResearchGate 2018; UVA / Christ Hospital RHA PT protocols – see URLs]. *Weak-moderate (protocol consensus)*.
- **A coronoid fracture treated without fixation does not preclude early motion in selected triads.** Where the LCL and radial head are addressed and intra-operative fluoroscopic stability is confirmed, type I–II coronoid fractures can be left unfixed and still rehabilitated with early motion to good ROM and DASH scores [Papatheodorou et al., *Clin Orthop Relat Res* 2014, DOI 10.1007/s11999-014-3471-7]. *Moderate (Level IV series)*.
- **Restoring radiocapitellar contact (by replacement) is what permits the early-motion pathway** in the unstable elbow; conservative or excision pathways are reserved for stable patterns and depend on the same early-mobilisation principle [Charalambous et al., *J Shoulder Elbow Surg* 2011, DOI 10.1016/j.jse.2011.02.013]. *Moderate*.

### RECOVERY TRAJECTORY (EXPECTED, EVIDENCE-ANCHORED)

Phase	Window	Restraint	Therapy focus	Strength / load	Notes
<b>I – Early protected motion</b>	<b>Week 0–2</b> (often start <1 wk)	Simple sling for comfort (no hinged brace); stable-arc only; forearm in ligament-protective	Active/active-assisted elbow flexion–extension within the intra-operative stable arc; forearm pro/sup in the protected direction; full shoulder/wrist/hand	None	Wound stability confirmed before motion; “stiff-stable > loose-incongruous”

#### CQ HAND + UPPER LIMB

Phase	Window	Restraint	Therapy focus	Strength / load	Notes
		rotation; no varus stress	ROM; supine overhead programme if unstable		
<b>II – Arc &amp; rotation progression</b>	<b>Week 2–6</b>	Release extension block / forearm rotation gradually as stability allows	Progress elbow arc to full extension; open forearm rotation both directions; scar management once healed	None	Aim <b>full pronation/supination by ~8 weeks</b> ; supination is the slowest to recover (~10° residual loss common)
<b>III – Strengthening &amp; return</b>	<b>Week 6–12+</b>	Restrictions lifted as repairs consolidate	Grip → resisted elbow/ forearm strengthening; graded functional and work-specific loading	Begin ~6 wk, build gradually	Return to heavier work/sport criterion-based ~3 months; watch for overstuffing/ loosening/ capitellar wear

(Phase windows mirror the precautions in the patient protocol; they are typical, stability-gated guides, not trial-derived deadlines.)

## C. KEY CONTROVERSIES / EVIDENCE QUALITY

- 1. Repair (ORIF) vs replace (RHA) the radial head.** For reconstructable heads, ORIF is generally preferred and no prosthesis equals the native head biomechanically; for unreconstructable comminution (Mason III–IV) or in the unstable/dislocated elbow, RHA is the more reliable option because fixation constructs fail under the higher stresses [Kusnezov et al. 2017; Charalambous et al. 2011; Leigh & Ball, *J Shoulder Elbow Surg* 2012, DOI 10.1016/j.jse.2012.03.005]. *Moderate; selection-dependent.*
- 2. Terrible-triad early motion vs protected immobilisation.** Modern practice favours restoring enough stability (LCL ± radial head ± coronoid ± MCL/fixator) to permit early motion and avoid stiffness; the supine/overhead protocol exists precisely to reconcile early motion with residual instability. The trade-off (“stiff-stable preferred over loose-incongruous”) is consensus, not RCT-settled [Rockwood and Green 2019; Fahs et al. 2024]. *Moderate (consensus).*
- 3. Monopolar vs bipolar implants.** Both are used; bipolar designs were intended to self-align and tolerate sizing imperfection, while monopolar anatomical implants show good long-term survival. No clear superiority is established, and overstuffing/sizing error harms either design more than the bearing type does [Tarallo et al. 2026; Doornberg et al., *J Bone Joint Surg* 2007, DOI 10.2106/jbjs.e.01340]. *Weak (no head-to-head superiority).*

4. **Implant-related complications.** Overstuffing the radiocapitellar joint, malsizing and stem loosening cause capitellar erosion/osteopenia, pain and stiffness; capitellar erosion is reported from metal-on-cartilage articulation, and accurate head height/diameter is the key technical guard [Van Riet et al., *J Bone Joint Surg* 2004, DOI 10.2106/00004623-200405000-00028; Monica & Mudgal 2010]. Rehab cannot fix a malsized implant – persistent loading pain/stiffness warrants surgical review. *Moderate*.
5. **Supination is the laggard.** Across series, forearm supination is the motion most likely to remain mildly deficient ( $\approx 10^\circ$  loss), partly from scarring and partly from MCL-protective early positioning; patients should be counselled accordingly [Lott et al. 2018]. *Moderate natural-history*.

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## D. EVIDENCE STRENGTH FLAGS (summary)

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- **STRONG (biomechanical / mechanistic):** RHA restores elbow stability and kinematics only in concert with collateral-ligament repair (varus–valgus laxity corrected by RHA + LCL repair, not RHA alone).
  - **MODERATE:** functional ROM after RHA in unstable injuries equivalent to stable injuries with good implant survivorship (Level II–IV cohorts); long-term monopolar implant survival with stiffness/sizing as main failure modes; early-motion-to-prevent-stiffness as the governing rehab principle; supine/overhead protocol for the unstable elbow; supination as the slowest-recovering arc.
  - **WEAK / CONSENSUS:** the specific **forearm-position-by-repaired-ligament** rehab rule (pronation for LCL, supination for MCL, neutral for both) and the exact phase timings (protocol-derived, stability-gated, not RCT-validated); monopolar-vs-bipolar bearing choice (no proven superiority).
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## CITATIONS

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### RAG CORPUS (180,000+ ORTHOPAEDIC ARTICLES)

- The Effect of Radial Head Excision and Arthroplasty on Elbow Kinematics and Stability. *J Bone Joint Surg Am.* 2004. DOI: 10.2106/00004623-200408000-00018
- Radial Head Arthroplasty. *Hand Clin.* 2010. DOI: 10.1016/j.hcl.2010.04.008
- Results after radial head arthroplasty in unstable fractures. *J Shoulder Elbow Surg.* 2018. DOI: 10.1016/j.jse.2017.10.011
- Long-term survival of Acumed anatomical radial head implant for Mason type III-IV fractures: a 15-year follow-up. *J Shoulder Elbow Surg.* 2026. DOI: 10.1016/j.jse.2025.05.038
- Operative Management of Unstable Radial Head Fractures in a Young Active Population. *HAND.* 2017. DOI: 10.1177/1558944717715136
- Management of Elbow Terrible Triad Injuries: A Comprehensive Review and Update. *J Am Acad Orthop Surg.* 2024. DOI: 10.5435/jaaos-d-24-00310

- Terrible Triad Injuries of the Elbow: Does the Coronoid Always Need to Be Fixed? *Clin Orthop Relat Res.* 2014. DOI: 10.1007/s11999-014-3471-7
- Radial Head Replacement for Acute Complex Fractures: What Are the Rate and Risk Factors for Revision or Removal? *Clin Orthop Relat Res.* 2014. DOI: 10.1007/s11999-014-3516-y
- Radial head reconstruction versus replacement in the treatment of terrible triad injuries of the elbow. *J Shoulder Elbow Surg.* 2012. DOI: 10.1016/j.jse.2012.03.005
- Comminuted radial head fractures: aspects of current management. *J Shoulder Elbow Surg.* 2011. DOI: 10.1016/j.jse.2011.02.013
- Radial Head Arthroplasty with a Modular Metal Spacer to Treat Acute Traumatic Elbow Instability. *J Bone Joint Surg Am.* 2007. DOI: 10.2106/jbjs.e.01340
- Capitellar Erosion Caused by a Metal Radial Head Prosthesis. *J Bone Joint Surg Am.* 2004. DOI: 10.2106/00004623-200405000-00028
- Comparative study of radial head resection and prosthetic replacement in surgical release of stiff elbows. *Int Orthop.* 2014. DOI: 10.1007/s00264-014-2594-5
- Rockwood and Green's Fractures in Adults (terrible-triad surgical pitfalls; overhead/early-motion protocol; "stiff-stable preferred"). Wolters Kluwer, 2019.

#### **RADIAL HEAD REPLACEMENT REHABILITATION LITERATURE (URLS)**

- Rehabilitation protocol after radial head arthroplasty – a single-centre experience and narrative review of the literature. *ResearchGate* (2018). <https://www.researchgate.net/publication/326168570>
- University of Virginia, Department of Orthopaedic Surgery – Radial Head Replacement Rehabilitation Guidelines (forearm-position-by-ligament; arc progression). <https://med.virginia.edu/orthopaedic-surgery/wp-content/uploads/sites/242/2024/09/Radial-head-replacement.pdf>
- The Christ Hospital – Radial Head Replacement Physical Therapy Protocol (Rao). <https://www.thechristhospital.com/landingpages/Documents/Rao%20PT%20Protocols/Operative/Elbow/Rao%20Radial%20Head%20Replacement%20r1.pdf>
- Cheshire Arm Clinic – Physiotherapy Protocol for Radial Head Replacement. <https://cheshirearmclinic.co.uk/wp-content/uploads/2021/09/Radial-Head-Replacement.pdf>
- Denver Shoulder – Rehabilitation Protocol: Radial Head Replacement. <https://www.denvershouldersurgeon.com/pdf/radial-head-replacement-protocol.pdf>