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SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Comprehensive Arthroscopic Management (CAM)

Comprehensive Arthroscopic Management (CAM) of Glenohumeral Osteoarthritis – Post-operative Rehabilitation

Topic scope: Post-operative rehabilitation after the **Comprehensive Arthroscopic Management (CAM) procedure** – a joint-preserving arthroscopic treatment for advanced glenohumeral osteoarthritis in young, active patients who wish to avoid or defer arthroplasty.

> *Defining principle of CAM rehab (a hybrid): CAM is not a repair, so – like a capsular release for frozen shoulder – there is no healing construct to protect and the priority is to keep the motion that was restored at surgery, especially external rotation freed by the capsular release and axillary nerve neurolysis. BUT, unlike a pure capsular release, CAM also resurfaces and reshapes the articular surfaces themselves (chondroplasty, microfracture, humeral osteoplasty). So the rehab is motion-led but graded: early and frequent passive/active-assisted ROM, short sling for comfort only, stretching eased to end-range rather than forced – Millett's own protocol instructs the patient to "proceed with caution while stretching to avoid joint inflammation and pain." Re-stiffening is the failure mode to prevent; joint flare from over-aggressive forcing is the one to avoid.*

A. THE PROCEDURE (what is being rehabilitated)

CAM is a **systematic, inclusive** arthroscopic approach to the multiple pathologies of early-to-advanced glenohumeral OA, described by Millett and colleagues. It bundles, in one sitting, as many of the following as the joint requires [Millett 2013; Millett EATS 2015]:

- **Debridement, chondroplasty, synovectomy and loose-body removal** – smoothing frayed cartilage and clearing mechanical debris.
- **Capsular release** – to restore range, particularly external rotation, lost to the arthritic contracture.

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- **Inferior humeral osteoplasty** – excision of the inferior humeral "goat's-beard" osteophyte that tethers the axillary nerve and blocks motion.
- **Axillary nerve neurolysis** – freeing the nerve adjacent to that osteophyte (a defining CAM step; **note** a validated CAM variant deliberately omits axillary nerve release and subacromial decompression with satisfactory durable results [Mahmoud/KSSTA 2023]).
- **Subacromial decompression** ± **biceps tenodesis** ± **microfracture** of focal chondral defects, where indicated.

Patient selection (drives prognosis, not the rehab itself): best results with **> 2 mm of joint space and glenohumeral congruity without significant deformity**; less joint space and abnormal posterior glenoid shape (Walch B2/C) predict early failure [Millett 2016 predictors]. Survivorship (freedom from arthroplasty): **76.9% at minimum 5 years**, **63.2% at minimum 10 years** in suitable candidates [Mitchell 2016; Spiegl/Horan 2020].

B. POST-OPERATIVE PHASED TIMELINE

The published protocol is a **3-phase, individually-tailored** program (Millett group; mirrored in clinic patient materials). Mapped here onto the practice's standard 4-phase patient structure. Clinic follow-up at **2 weeks, 6 weeks, and 3–4 months**.

Phase	Window	Sling	ROM	Strengthening	Notes
I – Early motion	**Week 0–2**	**Comfort only, ~1–2 wk**, off for exercise from day 0	**Passive + active-assisted ROM immediately**; pendulums; gentle stretch in all planes incl. external rotation; **caution – ease to end-range, do not force**	Hand/elbow/scapular setting only	Goal: maintain the motion gained at surgery + prevent scar/re-contracture; pain control to permit motion
II – Restoring range	**Week 2–6**	Off	Progress AAROM → AROM all planes; keep working external rotation; add joint mobilisation; stretching graded (firmer, still not forced)	Light scapular/cuff activation as pain allows	Most back to light daily activity/work by this window
		Off			

Phase	Window	Sling	ROM	Strengthening	Notes
III – Strengthening	**Week 6–12**		Maintain full/near-full ROM	**Elastic-resistance + light-weight cuff & scapular strengthening from ~6 wk**, low load / higher reps; continued stretching	Lighter recreation resumes
IV – Return to function/sport	**~3 months +**	Off	Full	**Advanced strengthening; graduated return to sport/heavy work**	Outcomes continue to improve over 6–12 months

Procedure-specific modifiers (surgeon-dependent): - **Biceps tenodesis performed** → avoid resisted elbow flexion / lifting ~6 weeks. - **Microfracture of a focal chondral defect** → early passive motion is *beneficial* for the marrow-stimulation clot (as in knee microfracture), but avoid heavy axial loading in the early weeks; favour motion over load. - **Axillary nerve neurolysis performed** → prioritise early external-rotation ROM to hold the gain; transient axillary nerve paraesthesia is recognised and usually settles.

Recovery milestones (from CAM outcome series, not a rehab trial): meaningful pain/function improvement within the **first 1–3 months**; sustained patient-reported improvement and satisfaction by **6–12 months** [Outcomes/Survivorship series].

C. KEY CONTROVERSIES / EVIDENCE QUALITY

1. **No rehabilitation RCT exists for CAM.** The post-operative regimen is **expert/consensus from the originating group** (Millett), not a tested protocol. Intensity and timing are reasoned from the procedure's components, not from comparative data. *Weak/consensus.*
2. **The evidence base for the operation is itself debated.** CAM outcome series are predominantly **Level IV** (case series from a small number of high-volume centres); systematic reviews conclude arthroscopic debridement for GHOA **lacks high-quality evidence for routine use**, and isolated debridement + capsular release "may not provide substantial benefit" in most patients [Kelly 2014; van der Bracht 2013 critical review]. CAM's value is strongest in **carefully selected** young, high-demand patients with preserved joint space.
3. **Motion vs protection balance.** The capsular-release component argues for aggressive early motion (re-stiffening is the enemy); the cartilage/microfracture/osteoplasty components argue for graded loading (joint flare is the enemy). The published protocol resolves this as **early but *cautious* motion** — the central rehab judgement.
4. **CAM is a family of procedures, not one operation.** Exactly which steps were done (axillary nerve release, microfracture, biceps tenodesis) legitimately shifts the rehab — hence the per-patient modifiers above. A validated variant omits axillary nerve release/SAD entirely [Mahmoud 2023].

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D. EVIDENCE STRENGTH FLAGS (summary)

- **MODERATE (large/long-term cohorts):** CAM mid- and long-term survivorship + PRO improvement (Mitchell 2016 n-series, 76.9% @5 yr; Spiegl/Horan 2020, 63.2% @10 yr); preoperative predictors of failure (Morrison/Millett 2016).
- **WEAK / CONSENSUS ONLY:** the **post-operative rehabilitation protocol itself** (no defining RCT; expert protocol from the originating group); debridement-based arthroscopy for GHOA (systematic reviews: low-quality evidence, Kelly 2014; van der Bracht 2013).
- **EXTRAPOLATED:** early-motion rationale borrowed from arthroscopic capsular-release rehab; microfracture early-motion / load-caution rationale borrowed from marrow-stimulation cartilage literature.

CITATIONS

RAG CORPUS (180,000+ ORTHOPAEDIC ARTICLES) — CAM CLINICAL EVIDENCE BASE

- Millett PJ, Gobezie R, Boykin RE. Comprehensive Arthroscopic Management (CAM) procedure for treatment of glenohumeral osteoarthritis. *Arthroscopy Techniques*. 2015. (technique + post-op rehab description) DOI: 10.1016/j.eats.2015.04.003
- Millett PJ, et al. Comprehensive Arthroscopic Management (CAM) Procedure: clinical results of a joint-preserving arthroscopic treatment for young, active patients with advanced shoulder osteoarthritis. *Arthroscopy*. 2013. DOI: 10.1016/j.arthro.2012.10.028
- Mitchell JJ, et al. Survivorship and patient-reported outcomes after CAM of glenohumeral osteoarthritis (minimum 5 years; 76.9% survivorship). *Am J Sports Med*. 2016. DOI: 10.1177/0363546516656372
- Morrison/Millett, et al. CAM of glenohumeral osteoarthritis: preoperative factors predictive of treatment failure. *Am J Sports Med*. 2016. DOI: 10.1177/0363546516668823
- Survivorship and PROs after CAM, minimum 10-year follow-up (63.2% survivorship). *Am J Sports Med*. 2020. DOI: 10.1177/0363546520962756 / OJSM 2021. DOI: 10.1177/2325967121s00213
- Comprehensive arthroscopic management without axillary nerve release or subacromial decompression — satisfactory durable results in young patients. *Knee Surg Sports Traumatol Arthrosc*. 2023. DOI: 10.1007/s00167-023-07377-0
- Arthroscopic Management of Glenohumeral Arthritis: a joint-preservation approach. *JAAOS*. 2018. DOI: 10.5435/jaaos-d-17-00214
- Outcomes and survivorship after arthroscopic treatment of glenohumeral arthritis: a systematic review (ROM + PRO improvement, minimal complications). *Arthroscopy*. 2020. DOI: 10.1016/j.arthro.2020.02.036

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- Kelly EW, et al. Arthroscopic debridement and capsular release for the treatment of shoulder osteoarthritis (may not justify routine use). *Arthroscopy*. 2014. DOI: 10.1016/j.arthro.2014.08.025
- van der Bracht H, et al. What is the role of arthroscopic debridement for glenohumeral arthritis? A critical examination of the literature (lacks high-quality evidence). *Arthroscopy*. 2013. DOI: 10.1016/j.arthro.2013.02.022
- CAM vs total shoulder arthroplasty and hemiarthroplasty in patients < 50 years. *EFORT Open Reviews*. 2026. DOI: 10.1530/eor-2023-0156

PUBLISHED REHAB PROTOCOL (URLS)

- **Dr Peter Millett – Comprehensive Arthroscopic Management of Glenohumeral Osteoarthritis** (procedure + components incl. inferior humeral osteoplasty, axillary nerve neurolysis, biceps tenodesis, microfracture): https://drmillett.com/wp-content/uploads/2017/02/comprehensive-arthroscopic-management-glenohumeral-osteoarthritis.pdf
- **The Upper Limb Clinic – Comprehensive Arthroscopic Management** (3-phase rehab description: sling few weeks; Phase 1 passive/active-assisted ROM + cautious stretching; Phase 2 strengthening ~6 wk; Phase 3 advanced/return-to-sport ~3 mo; follow-up 2 wk / 6 wk / 3–4 mo): https://theupperlimbclinic.co.uk/comprehensive-arthroscopic-management-a-joint-preserving-solution-for-shoulder-arthritis/
- Millett PJ, et al. CAM clinical results (open journal record): https://www.arthroscopyjournal.org/article/S0749-8063(12)01801-4/fulltext
- CAM (EATS technique record, PubMed): https://pubmed.ncbi.nlm.nih.gov/26697301/

> *Note on the rehab evidence: there is **no CAM-specific rehabilitation trial** in the corpus or the literature. The phased protocol above is the **originating group's expert protocol** (Millett, mirrored in clinic patient materials), with the early-motion and load-caution rationale extrapolated from arthroscopic-capsular-release and cartilage marrow-stimulation rehab respectively. Treat phase timings as typical, surgeon-adjustable defaults – not as trial-derived prescriptions.*

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