CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

PIP Joint Replacement

Silicone PIP Joint Replacement — Procedure Outcomes & Post-operative Rehabilitation (Swanson-type Arthroplasty for PIP Osteoarthritis)

Topic scope: post-operative rehabilitation after **silicone (Swanson-type) proximal interphalangeal (PIP) joint arthroplasty** for primary osteoarthritis. The worn joint surfaces are excised and a **flexible silicone spacer** is implanted; this is an *interposition / encapsulation* arthroplasty, not a rigidly-fixed mechanical hinge. The implant works as a flexible spacer around which a peri-implant fibrous capsule forms to provide stability. The dominant, reliable benefit is **pain relief**; the functional gain is a **modest active arc (~40–60°)**, not restoration of normal range.

> *Defining principle of the rehab here: the rehabilitation pathway is **dictated by the surgical approach**, because the rate-limiting tissue is the **extensor mechanism**, not the implant. A **volar (palmar) approach** leaves the central slip and extensor mechanism intact → it permits **immediate / early active motion** (within 3–5 days). A **dorsal approach** must split or reflect the central slip to reach the joint → the extensor repair must be **protected first** with extension orthotics and a graded, short-arc flexion programme. Across both pathways the silicone spacer is stable in the sagittal (flexion–extension) plane but vulnerable in the **coronal plane**, so the programme deliberately **avoids lateral / torsional load** and tracks the joint in a pure sagittal arc (buddy strapping). Therapy aims to bank the useful arc before scar maturation fixes it while protecting extension and the implant — it is not an immobilise-to-heal construct in the volar case.*

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A. PROCEDURE OUTCOMES (silicone PIP arthroplasty for osteoarthritis)

Silicone PIP arthroplasty is a **reliable pain-relieving** operation with **predictable but modest motion**; the principal debates are over **surgical approach** and **implant choice** (silicone vs surface-replacement/pyrocarbon), not whether arthroplasty relieves pain.

- **Pain relief is high and durable; motion gains are modest.** A long-term series of Swanson silicone PIP arthroplasty for osteoarthritis (mean ~10-year follow-up) reported excellent pain relief (mean VAS ~0.4) with **essentially unchanged arc** (≈ 55° pre-op → ≈ 50° post-op) and high patient satisfaction — patients would have the surgery again despite limited motion gain [Bales, Wall & Stern, *J Hand Surg Am* 2014]. *Moderate (level-IV long-term cohort).*
- **The volar approach can improve the active arc.** A volar-approach silicone PIP series reported the active arc improving from ~33° to ~72°, with good function and satisfaction, by preserving the extensor mechanism and enabling early motion [Proubasta et al., *J Hand Surg Am* 2014]. *Moderate–weak (level-IV).*
- **Radiographic implant deformation/fracture is common but poorly correlated with symptoms.** In the long-term Swanson series most implants deformed and many fractured radiographically, yet clinical revision was uncommon (survivorship ~90% at ~10 years) and there was **no correlation between radiographs and satisfaction** [Bales, Wall & Stern 2014]. *Strong natural-history signal within a cohort.*
- **Silicone vs surface-replacement and pyrocarbon implants give broadly comparable clinical results; no implant is clearly superior.** Systematic review across implants/approaches found comparable outcomes with implant-/approach-specific complication profiles [Yamamoto et al., *Plast Reconstr Surg* 2017; Carlson Strother, Moran & Rizzo, *JAAOS* 2023]. *Moderate (SR + narrative review).*
- **Pyrocarbon and resurfacing implants carry their own failure modes** (subsidence, squeaking, intra-operative periprosthetic fracture, instability), informing implant choice rather than rehab [Watts et al., *J Hand Surg Am* 2012; Wagner et al. medium-term 2018 & intra-op fractures 2015; Branam et al. resurfacing-vs-silicone 2007]. *Moderate.*

B. REHABILITATION / THERAPY EVIDENCE

The central rehab questions are (1) **how soon to move** and (2) **how to splint**, and the answer to both is **set by the surgical approach** and the **extensor mechanism**. The evidence base is **low-level (expert consensus / single-cohort therapy series)** — there are no RCTs comparing PIP arthroplasty rehab pathways.

- **Approach dictates the timeline (the core principle).** Surgical reviews establish that a **volar approach preserves the central slip and permits immediate active and passive motion**, while a **dorsal approach requires post-operative protection** of the split/repaired central slip before flexion is advanced [Renfree, *Bone Joint J* 2022 (surgical approaches); Herren, *Hand Clin* 2017; Yamamoto et al. 2017]. *Moderate (surgical evidence) — strong mechanistic basis.*

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- **A structured 12-week, splint-based therapy programme is the consensus framework (dorsal pathway).** Feldscher's hand-therapy protocol for PIP (pyrocarbon, central-slip-splitting dorsal approach) uses a **volar static finger orthosis allowing a limited short-arc PIP/DIP active arc that is increased over the rehab course**, with a hand-based resting splint (MCP flexed, PIP/DIP near 0°) for full-time use except during template-splint exercise [Feldscher, *J Hand Ther* 2010]. *Weak (expert-consensus protocol).*
- **A defined controlled-motion program exists and reports good arcs.** A controlled-motion rehabilitation program for PIP arthroplasty reported favourable range-of-motion outcomes, supporting graded controlled motion over rigid immobilisation [Ramanathan, Koludrovich & Evans, *J Hand Ther* 2021]. *Weak (cohort / programme description).*
- **Static and dynamic extension splinting give similar results.** A comparison of static vs dynamic splinting after PIP pyrocarbon arthroplasty found comparable outcomes, favouring **static splinting** for simplicity and patient convenience [Jennings & Livingstone / static-vs-dynamic cohort, *J Hand Ther* 2011]. *Weak–moderate (comparative cohort).*
- **Coronal-plane protection is the durable, lifelong caveat.** Collateral integrity and avoidance of lateral stress underpin long-term implant stability; collateral compromise drives instability/deviation [Carlo et al., collateral reconstruction, *J Hand Surg Am* 2016; Carlson Strother et al. 2023]. *Consensus / mechanistic.*

RECOVERY TRAJECTORY (EXPECTED, EVIDENCE-ANCHORED)

Phase	Window	Restraint (by approach)	Hand-therapy focus	Strength / load	Notes
I – Protect & initiate motion	**Week 0–3**	**Volar:** active motion at 3–5 days, short flexion arc (~30°) in template/ extension-block splint. **Dorsal:** PIP splinted near extension full-time; supervised short-arc flexion only	Protected sagittal PIP/DIP motion; tendon glides; buddy strapping; uninvolved-joint motion; **no lateral/ torsional load**	None (no grip/ pinch)	Implant stable in flexion–extension, vulnerable coronally
II – Advance motion	**Week 3–6**	Progressively increase flexion arc toward ~40–60°. **Dorsal:** wean extension splint as central slip consolidates (≈ wk 4–6); guard against extensor lag	Graded active/ AAROM flexion–extension; blocking; scar massage once healed; continue buddy strapping	Still no resisted strengthening	Bank the useful arc before scar maturation fixes it
III – Strengthen & return	**Week 6–12+**	Lifting/grip restrictions progressively lifted; **lateral/twisting load avoided indefinitely**	Light grip → cautious pinch; functional & work-specific loading	Grip from ~6 wk, graded	Pain relief is the durable gain; final arc (~40–60°) largely set by ~3 months

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(Phase windows mirror the precautions in the patient protocol; they are typical guides — not trial-derived deadlines — and the volar vs dorsal split is the dominant variable.)

C. KEY CONTROVERSIES / EVIDENCE QUALITY

1. **Volar vs dorsal approach (the rehab-defining question).** The volar approach spares the extensor mechanism and permits early active motion (and a better reported arc), at the cost of being more technically demanding; the dorsal approach is more familiar but mandates extensor protection and a slower, splint-led flexion programme. Choice is surgeon-dependent and drives the entire rehab pathway. *Moderate surgical evidence; no head-to-head rehab RCT.*
2. **Implant choice (silicone vs surface-replacement vs pyrocarbon).** No implant is clearly superior on clinical outcomes; silicone is durable for pain relief with high radiographic deformation/fracture that poorly predicts symptoms, while pyrocarbon/resurfacing trade different complication profiles (subsidence, instability, intra-operative fracture). *Moderate (SR + cohorts).*
3. **Static vs dynamic splinting (dorsal pathway).** Comparable outcomes; static splinting is favoured for simplicity and convenience. *Weak–moderate.*
4. **Motion gain is modest and that is expected, not failure.** Patients reliably lose pain but gain little arc (especially via dorsal/silicone); mislabelling the modest arc as a poor result misframes a successful pain-relieving operation. Counsel the ~40–60° expectation up front. *Strong natural-history signal.*
5. **Lifelong coronal-stress avoidance.** Long-term stability depends on the peri-implant capsule and collaterals; forceful lateral/twisting load risks deviation, instability and implant failure. *Consensus.*

D. EVIDENCE STRENGTH FLAGS (summary)

- **STRONG (mechanistic / natural-history):** the surgical-approach principle (volar preserves extensor mechanism → early motion; dorsal splits central slip → protect extension first); the modest-arc / reliable-pain-relief outcome pattern; radiographic implant deformation poorly predicting symptoms.
- **MODERATE:** procedure outcomes are **level-IV case series** (long-term Swanson silicone series; volar approach series); implant-comparison systematic review/narrative review; surgical-approach reviews.
- **WEAK / EXPERT CONSENSUS:** the **specific rehabilitation regimen** — short-arc controlled motion, 12-week splint-based programme, static-vs-dynamic splinting equivalence, exact phase timings. These are **low-level, expert-consensus / single-cohort** therapy descriptions, not trial-derived; individualise to the operative approach and tissue quality.

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CITATIONS

RAG CORPUS (180,000+ ORTHOPAEDIC ARTICLES)

- Bales JG, Wall LB, Stern PJ. Long-term results of Swanson silicone arthroplasty for proximal interphalangeal joint osteoarthritis. *J Hand Surg Am*. 2014. DOI: 10.1016/j.jhsa.2013.11.008
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- Wagner ER, Van Demark R, Kor DJ, et al. Intraoperative periprosthetic fractures in proximal interphalangeal joint arthroplasty. *J Hand Surg Am*. 2015. DOI: 10.1016/j.jhsa.2015.06.101
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- Aversano FJ, Calfee RP. Salvaging a failed proximal interphalangeal joint implant. *Hand Clin*. 2018. DOI: 10.1016/j.hcl.2017.12.011

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PIP ARTHROPLASTY REHABILITATION LITERATURE (URLS)

- Feldscher SB. Postoperative management for PIP joint pyrocarbon arthroplasty. *J Hand Ther*. 2010. https://pubmed.ncbi.nlm.nih.gov/20036511/
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