

PJI Revision Staging · One-Stage vs Two-Stage

FAST & FRUGAL TREE · POST-OPERATIVE DECISION AID · 3-CUE MAXIMUM

FFT · GIGERENZER FRAMEWORK

TKA & THA PJI · Primary + Revision

Walsh / OrthoScenius · 2026

DECISION TREE — THREE CUES, FOUR EXITS

CUE 1 · HIGHEST VALIDITY

Virulent or resistant organism confirmed OR suspected?

(MRSA, MRSE, fungal, Gram-negative bacilli, polymicrobial, culture-negative + systemic signs)

Validity anchor: Non-MRSA is a major criterion for DAIR/SSR success (80.98% vs 57.11% overall) — Qu 2019 · N=1,266 · SSR selection criteria: Pradhan 2024

▲ YES

▼ NO

EXIT 1 · TWO-STAGE REVISION

Two-Stage Revision

Stage 1: explant + antibiotic spacer · Stage 2: reimplant at 6–12 weeks

Virulent/resistant organisms are an absolute contraindication to SSR. High biofilm burden and antibiotic resistance preclude single-stage eradication.

Pradhan 2024: SSR contraindicated in MRSA, fungi, GNB, polymicrobial · Biofilm impairs antibiotic penetration — Ashley 2024

CUE 2 · TISSUE / BONE VALIDITY

Significant bone loss (AORI 2B/3) OR soft-tissue compromise (sinus tract, poor coverage)?

Validity anchor: Good soft-tissue cover + minimal bone loss are mandatory SSR criteria — Pradhan 2024 · CRIME80 score includes tissue assessment

▲ YES

▼ NO

EXIT 2 · TWO-STAGE REVISION

Address defect at Stage 1 with augment spacer

Bone loss prevents adequate primary fixation at reimplant; sinus tract indicates established chronic biofilm not amenable to SSR debridement.

Pradhan 2024: aseptic loosening 8.8% in SSR — tissue compromise increases this risk · ICM DAIR 2025: stable implant required

CUE 3 · HOST VALIDITY

Immunocompromised host?
McPherson Grade C · Active immunosuppression · Uncontrolled DM · Severe malnutrition

Validity anchor: Immunocompetence is a mandatory SSR criterion — Pradhan 2024 · Siqueira 2015: higher revision number + comorbidities → suppression failure

▲ YES

▼ NO

EXIT 3 · TWO-STAGE + OPTIMISE

Two-Stage + Medical Optimisation

Address immune deficiency before Stage 2

Immunocompromised hosts cannot mount adequate response to eradicate residual organisms after SSR. Optimise before reimplant: reduce immunosuppression, control glycaemia, nutrition.

Pradhan 2024: immunocompetence mandatory for SSR · Siqueira 2015: McPherson C → high suppression failure rate

EXIT 4 · SINGLE-STAGE CANDIDATE

Confirm: bacteriology proven + ID on board · Susceptible organism + intact soft tissue + immunocompetent host + preoperative pathogen ID success 73–100% · Requires 6 weeks IV + 3–6 months oral antibiotic post-op.

Pradhan 2024: re-infection 7.1% · TSR 8.8% · Siqueira 2015: HR 0.63 (p=0.008) with chronic oral suppression · ICM DAIR 2025: stable implant required

CUE VALIDITY RANKING — QUANTIFIED EFFECT SIZES

RANK	CUE	EFFECT SIZE	SOURCE · N
1	CUE 1 MRSA vs non-MRSA DAIR outcome	Success: 80.98% (non-MRSA) vs 57.11% overall (MRSA inc.)	Qu 2019 Pooled N=1,266
1a	CUE 1 Symptom duration ≥3 weeks (failure)	Major failure criterion (algorithm: both criteria needed for 80.98%)	Qu 2019 · N=1,266 ICM DAIR 2025
2	CUE 2 SSR soft tissue / bone criteria	SSR success 73–100% when ALL criteria met	Pradhan 2024 26 studies, N=4–1.5M
2a	CUE 2 Biofilm on implant surface	Antibiotic penetration impaired; requires mechanical removal	Ashley 2024 Narrative review
3	CUE 3 Chronic oral suppression (S. aureus)	HR 0.63 (p=0.008) 5-yr survival 68.5% vs 41.1%	Siqueira 2015 N=368 PSM cohort
3a	CUE 3 ESR:CRP ratio ≥1.31 (chronic PJI)	AUC 0.80; sensitivity 75% specificity 84% for reinfection	Maier 2020 N=179

ERROR COST ASYMMETRY · THRESHOLD RATIONALE

MISS — UNDER-STAGE (FALSE NEGATIVE)

Attempt SSR in unselected patient → Persistent PJI → Arthrodesis, amputation, or sepsis death. Mortality from PJI complications: 2–5% / year suppression failure.

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FALSE ALARM — OVER-STAGE (FALSE POSITIVE)

Choose two-stage when SSR would have succeeded → Second anaesthetic + OR + spacer interval morbidity. Significant but recoverable; mortality <1% additional from second stage.

Asymmetry Rule: Persistent PJI failure is catastrophic and often irreversible (arthrodesis, amputation, or death). An unnecessary second stage adds morbidity but preserves the limb. Cues 1 and 2 therefore set a **low threshold** for two-stage — any single YES exits immediately. Cue 3 (host status) further confirms: even with a susceptible organism and intact tissue, an immunocompromised host cannot reliably eradicate residual organisms. **Sensitivity is maximised over specificity at every exit node.**

DAIR 2025 modular
exchange protocol

THRESHOLD CHOICES · JUSTIFICATION

ALWAYS: Multidisciplinary ID team involvement · Bacteriological proof before staging decision · Intraoperative tissue cultures (≥5 sites) · Antibiotic-loaded cement regardless of stage · Shared decision-making re: amputation vs arthrodesis as salvage · Re-evaluate staging if intraoperative findings differ from preoperative assessment

- **Exit 1 (virulent/resistant organism):** MRSA, fungi, and GNB form highly resistant biofilms. Single-stage debridement cannot achieve the organism-kill density needed for cure — re-infection rates approach 30–40% in MRSA SSR attempts (Pradhan 2024, registry data).
- **Exit 2 (bone/soft tissue):** AORI 2B/3 defects prevent primary fixation stability at reimplant; a sinus tract signals mature chronic biofilm requiring staged spacer to sterilise the dead space before final implant.
- **Exit 3 (host):** McPherson Grade C or equivalent immunosuppression dramatically reduces immune-mediated bacterial clearance. SSR relies on host immunity to mop up residual organisms post-debridement — compromised hosts cannot fulfil this requirement.
- **Exit 4 (SSR candidate):** All three negative criteria met = textbook SSR candidate. Confirm bacteriological proof, engage ID, use antibiotic-laden cement, plan 6-week IV + 3–6 month oral suppression (Siqueira 2015: HR 0.63 benefit).

Sources (Vault-grounded): Pradhan et al. 2024 (Single-Stage Revision TKA Review, 26 studies) · Qu et al. 2019 (DAIR Pooled Analysis, N=1,266) · Siqueira et al. 2015 (Chronic Oral Suppression, N=368) · Maier et al. 2020 (ESR:CRP Ratio DAIR, N=179) · Ashley et al. 2024 (Biofilm & PJI) · ICM 2025 DAIR Consensus

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