

Introducing “Antimicrobial Brachytherapy” Protocol for Chronic Periprosthetic Joint Infection in Total Knee Arthroplasty: Case Series with Preliminary 2-year Results

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Question: Can Chronic PJI be treated without Systemic Antibiotics?

Introduction:

- Despite aggressive exchange protocols and extended perioperative antimicrobials, PJI treatment success has **remained unchanged** over two decades.
- Improving success demands **tactical shift** with better local site eradication while preserving systemic host health.
- Emerging concepts prioritize **focused local therapy** and **avoidance of systemic antimicrobials** which disrupts host cytokine signaling, inflammation, and tissue repair.
- Longer explantation intervals** may be needed to allow additional time in select patients allowing for host and limb rejuvenation.
- We introduce “**Antimicrobial Brachytherapy**” Protocol (ABP) - analogous to oncologic brachytherapy - delivering **targeted local antimicrobial therapy** while minimizing systemic antimicrobial exposure.

Methods:

- A **consecutive** series of 25 ABP procedures between January 2019 & May 2023.
- Inclusion criteria: Chronic PJI after TKA (both primary and revision).
- PJI defined according to International Consensus Meeting 2018 (ICM-18) definition w/ PJI grading according to McPherson
- Antimicrobial Brachytherapy Protocol (ABP)** summarized in the table below.
- Outcomes at **two-years** were rated according to the Musculo-Skeletal Infection Society (**MSIS**) **Tier Outcome Reporting Tool**.

Antimicrobial Brachytherapy Protocol

Items	Description	Dosing	Comments
1.5 Implant Exchange	Cement Commercial Implants with <u>High Dose</u> Antibiotic Loaded Bone Cement		Provides patient comfort & longer explantation time to allow host & limb rejuvenation
High Dose Antibiotic Loaded Bone Cement (ALBC)	High Dose Antimicrobial Formula Closed bowl mixing w/ digital pressurization within bone Calcium sulfate beads as restrictor	40g Palacos® powder 5g vancomycin powder 3.6g tobramycin powder 10cc saline with 1cc methylene blue Antifungal when needed: Voriconazole 400mg	Saline is added with the monomer to mix all powders Methylene blue serves as cement marker & accelerant
Perioperative Antiseptic Lavage - 1:1 PIHP	Lavage after all implants removed 1:1 mix of povidone iodine & hydrogen peroxide	10% Povidone Iodine + 3% Hydrogen peroxide Dwell time 5 minutes each application Rinse with saline until clear	Mixed at point of care Deliver immediately after mixing to target areas including medullary canals
Antibiotic Loaded Calcium Sulfate Beads ALCSB	Mix antibiotics into CaSO ₄ powder Create 3.0 & 4.6mm beads	Synthecure® 10cc CaSO ₄ powder 1g vancomycin powder 240mg tobramycin liquid (6cc) Antifungal when needed: Voriconazole 200mg	Fill the canals with beads up to the level of stems 10-15 cc beads into joint space
Limited Parenteral Antibiotics	No more than 3 days Weight-based 1 st generation cephalosporin	Ancef 1-2g every 8 hours	Used for <u>prophylactic purposes</u> only No long-term indwelling percutaneous catheters
Oral Antibiotic of limited duration	Doxycycline, if possible	Duration 3 weeks only	Tailor to microbe sensitivity

Results:

- 25 chronic TKA PJI: Mean age 71.3 years (range 46.5 to 93.1).
- 15 patients were revision TKAs with 73% (11/15) having a prior 2-stage exchange
- At minimum 2-year follow-up, MSIS tier rating outcomes show:
 - Tier 1 success: 64%**(16/25) (infection free w/o antimicrobial suppression).
 - In these 16 patients, 3 were still using their 1.5 implant at a mean 4.2 yrs.
 - Tier 3C outcome: 8% (2/25) (**aseptic** revision at 3 and 5 months),
 - Tier 3E failure: 25% (6/25) (amputation, resection arthroplasty or arthrodesis)
 - 4 amputations for recurrent infection: 3 of which had fungal microbes identified in post-resection aspirations.
 - 2 underwent a repeat exchange for recurrent infection.
 - Tier 4a outcome: 4.15% (1/25) (mortality at 8 weeks).
- Tier 1 success **comparable** to traditional 2-stage exchanges with extended i.v. antimicrobials.
- The combined host and limb rating and MSIS tier 1 success rates are shown in **tables** below.

Combined Host & Limb Scoring N=25				Tier 1 Success by Combined Host & Limb Scoring			
	Limb Score 1	Limb Score 2	Limb Score 3		Limb Score 1	Limb Score 2	Limb Score 3
Host Score A	1	0	2	Host Score A	100%	n/a	0%
Host Score B	2	6	11	Host Score B	100%	80%	63.3%
Host Score C	0	1	2	Host Score C	n/a	0%	50%

n/a = not applicable - no patients

- The majority of patients were **significantly compromised**: with B and C hosts having 2 and 3 limb scores comprising **80% of the study cohort**.
- In patients **without prior history** of a two-stage exchange, tier 1 success rate was **71.4%** (10/14). In comparison, patients with a prior history of a two-stage exchange, tier 1 success rate was **54.4%** (6/11), (p=0.38).

Figure A-D Radiographs demonstrating articulating 1.5 exchange TKA.



Figure A-C: Non-articulating 1.5 exchange modular endofusion.



Conclusions:

- Preliminary outcomes of Antimicrobial Brachytherapy Protocol for chronic TKA PJI show MSIS **tier 1** results **comparable** to 2-stage protocols employing extended parenteral/oral antimicrobials.
- The principal concepts of **ABP** are:
 - 1) applying local site, multimodal antimicrobial therapy, employing **only one** antimicrobial formula.
 - 2) avoiding systemic antimicrobials to maintain host-microbiome
 - 3) **individualized explantation intervals** (longer when needed) via a 1.5 exchange allowing time for host and limb rejuvenation.
- ABP has potential to **redefine** clinical PJI management.
- Early results justify further rigorous evaluation and refinement.

Take Away Message
This study and SoLario trial show an emerging trend towards local antimicrobial treatment for PJI

