

INTRODUCTION

- SBRT achieves >90% local control in early-stage NSCLC¹⁻³; radiation pneumonitis limits functional preservation^{4,5}.
- Ring-based optimization ignores segmental anatomy, so low dose spills into uninvolved segments — segments that do not contain the tumor (Fig 1A).
- Anatomic preservation: JCOG0802/WJOG4607L showed better 5-year overall survival with segmentectomy⁶; at 10 years survival converged while local recurrence remained twice as frequent⁷. CALGB140503: sublobar resection non-inferior⁸.
- SPARE (Segment-targeted Precision Ablative Radiotherapy with Exact delivery) confines dose to the tumor-bearing segment (Fig 1B)⁹.
- **Aim: quantify the dose reduction in uninvolved segments.**

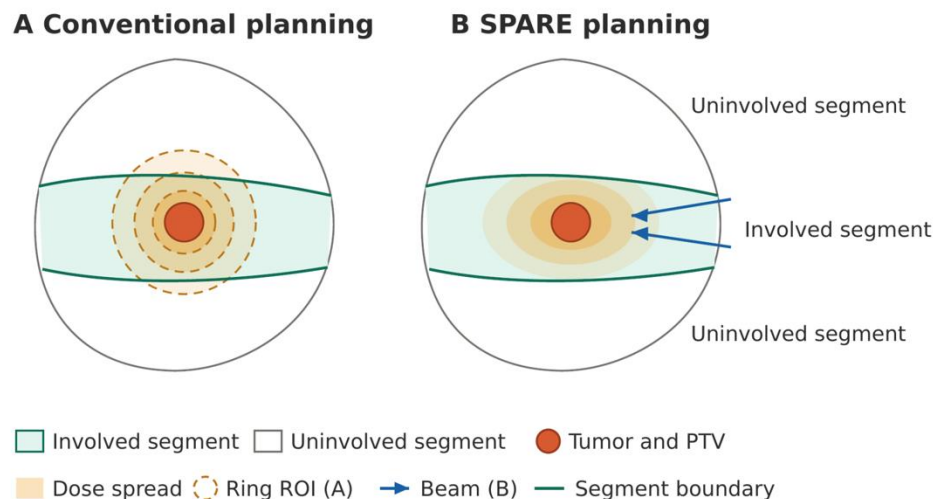


Fig 1. Ring-based optimization crosses intersegmental boundaries (A); SPARE terminates dose at the boundary of the involved segment (B). Schematic; not derived from planning data.

METHODS

- 4 patients, peripheral cStage IA NSCLC, 56 Gy in 4 fractions; median age 79; tumors in left S1+2b, right S9, right S1ai, right S1aii.
- Intra-patient paired comparison: SPARE and conventional plans with identical target volumes and prescription dose.
- SPARE plans by the first author; conventional plans by a board-certified radiation oncologist with no knowledge of SPARE; both plans reviewed and validated by both oncologists.
- Both plans met standard lung constraints (RTOG 0236/0915; JCOG 0403/0702/1408): V20 < 20%, V15 < 25%, mean lung dose < 18 Gy.
- All bronchopulmonary segments contoured on high-resolution CT, classified as involved or uninvolved.
- Endpoint: SPARE-to-conventional ratio for V10, V12, V15, V20 per segment; Wilcoxon rank-sum test.

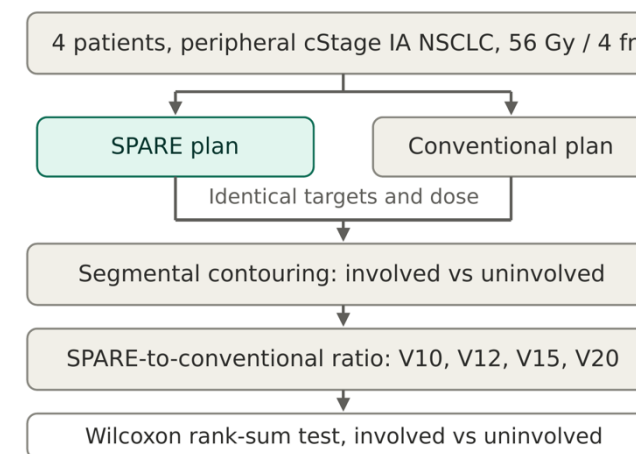


Fig 2. Study design.

RESULTS

Uninvolved segments: median SPARE-to-conventional ratio 0.6–0.8 (20–40% reduction).
Involved segments: ratio ≈ 1.0 — target coverage preserved. Significant for every parameter tested.

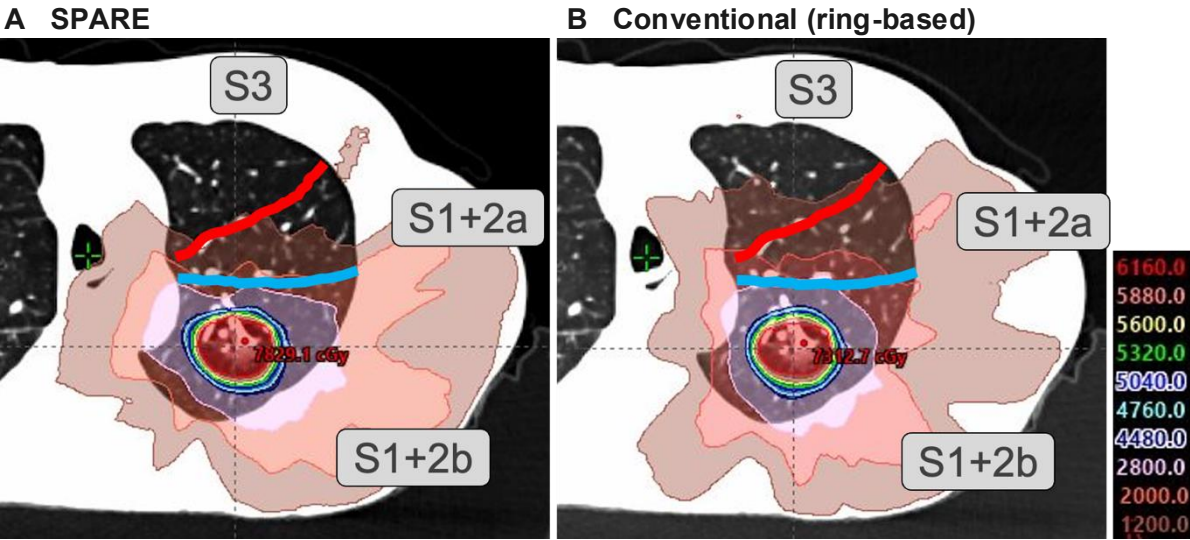


Fig 3. Same patient and slice, identical isodose levels (12–61.6 Gy). Red: S3 – S1+2 boundary; blue: S1+2a – S1+2b boundary. Dose stops at the boundary with SPARE (A) but extends into S1+2a and S3 with conventional planning (B).

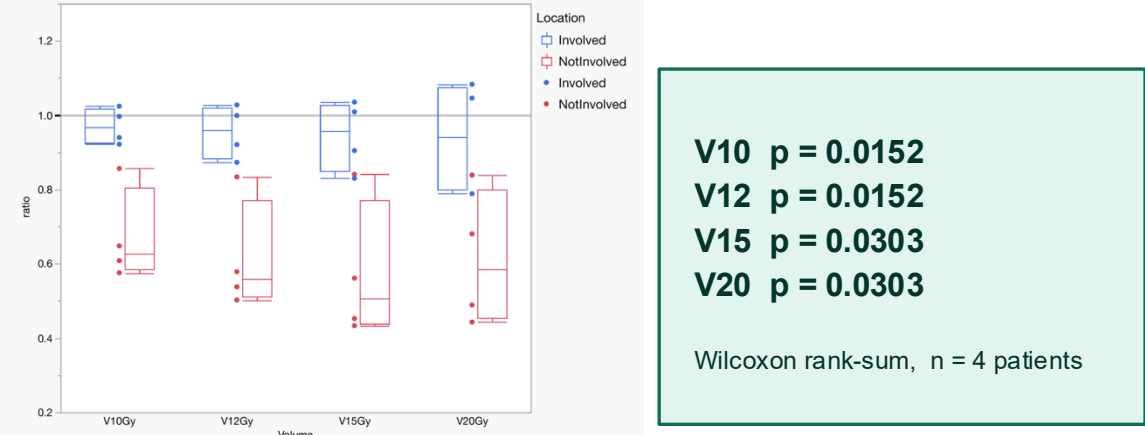


Fig 4. SPARE-to-conventional ratio for V10, V12, V15, V20 in involved (blue) and uninvolved (red) segments, 4 patients.

REPRESENTATIVE CASE

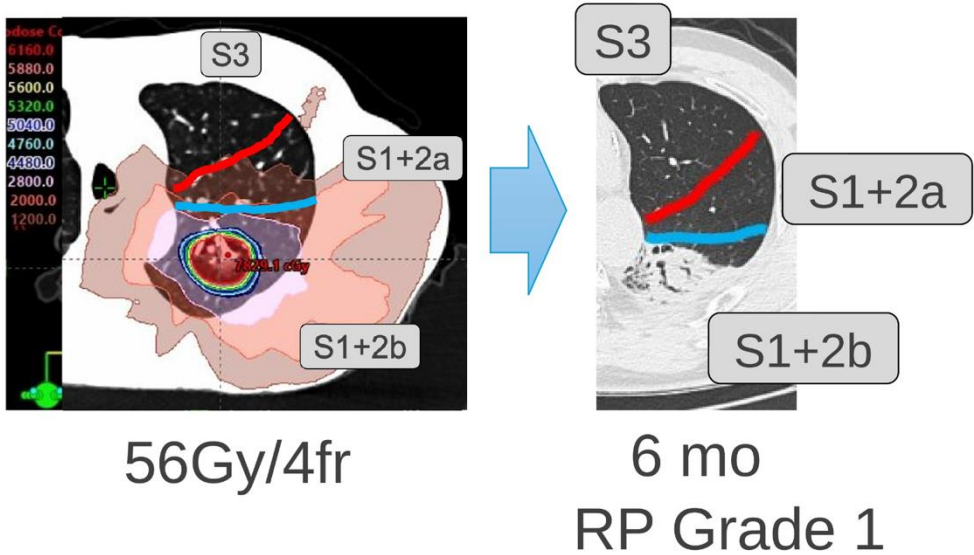


Fig 5. Left S1+2b, 56 Gy in 4 fractions: grade 1 pneumonitis at 6 months confined to the treated segment. Illustrative single case; clinical toxicity was not a study endpoint. Reproduced from ref 9.

CONCLUSION

- SPARE reduces low-to-intermediate dose in uninvolved segments while maintaining coverage of the involved segment.
- **Take away: contain dose by anatomy, not only by geometry.**

Limitations: dosimetric endpoints only; 4 patients; segment-level constraints not yet standardized; the conventional planner was unfamiliar with SPARE but not formally blinded to the study hypothesis.
AI Use Disclosure: Claude (Anthropic) was used for language refinement and for drafting the schematic diagrams in Figs 1 and 2; not used for study design, dose planning, data analysis, statistical testing or clinical interpretation. All data and conclusions are the authors' own and were verified by the authors.