Optimisation Level Index (OLI):
An ALARA Framework for Prostate Cancer SBRT

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Precision motion-managed SBRT is a good strategy for prostate cancer radiotherapy under ALARA principles

Optimisation Level Index (OLI) increases up to 15-fold compared to conventional fractionation

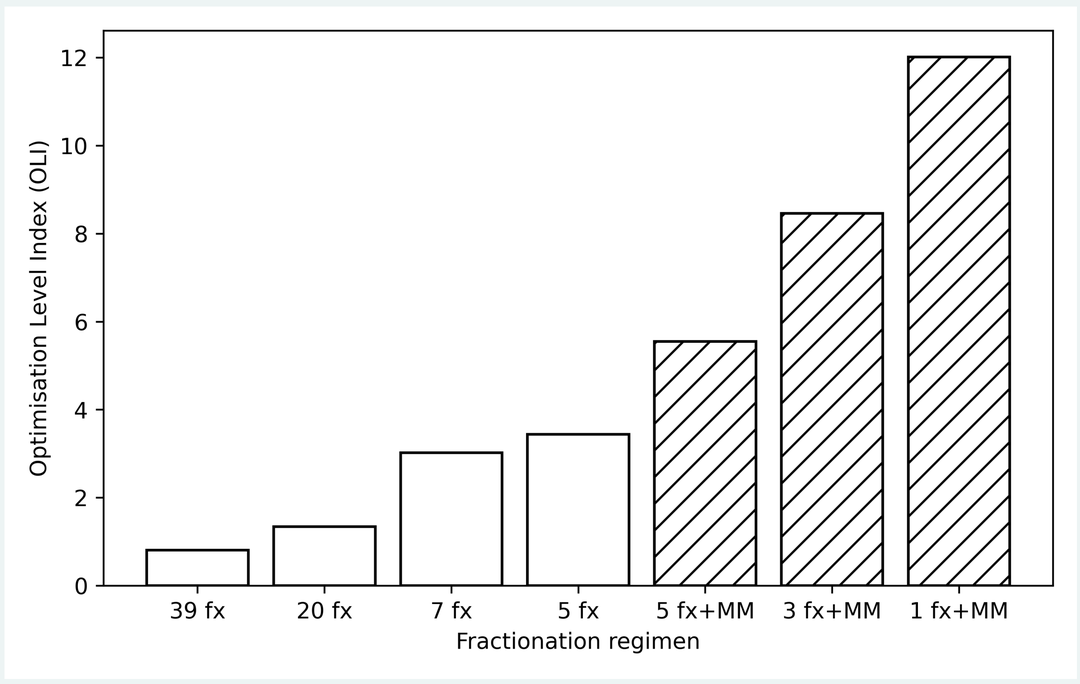
by combining extreme hypofractionation with

- maximal tumour control (TCP ≈ 1),
- minimal toxicity (NTCP ↓ markedly),

dramatically reduced treatment burden (Load ↓ 80–92 %, including CBCT imaging dose)

Conclusion: Advanced motion management enabling tight margins unlocks the full potential of ultra-hypofractionation.

Take-home message: Move toward precision 1–5 fraction regimens – biology + geometry + burden *must* be optimised together.



Optimisation Level Index (OLI) across fractionation regimens. OLI increases with decreasing number of fractions. Motion-managed regimens (hatched bars) demonstrate further gains consistent with reduced treatment burden and reduced NTCP while maintaining TCP. OLI is defined as OLI = (TCP − NTCP_avg) / Load.

Background & Purpose

Prostate cancer radiotherapy shifts toward **hypofractionation and SBRT** thanks to low α/β (~1.5 Gy).

Current optimisation often separates:

- Radiobiological endpoints (BED, TCP, NTCP)
- Physical/treatment burden (fractions, CBCT imaging dose, motion management)

We introduce the Optimisation Level Index (OLI) A unified metric for **ALARA-compliant** comparison of regimens – including motion-managed (“augmented”) SBRT with reduced margins.

Conflict of Interest / Disclosure The author is a board member of Micropos AB, a company developing radiotherapy motion-management technology. No commercial influence affected the modelling assumptions, methods, or conclusions of this study.

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Materials & Methods

Modelling framework:

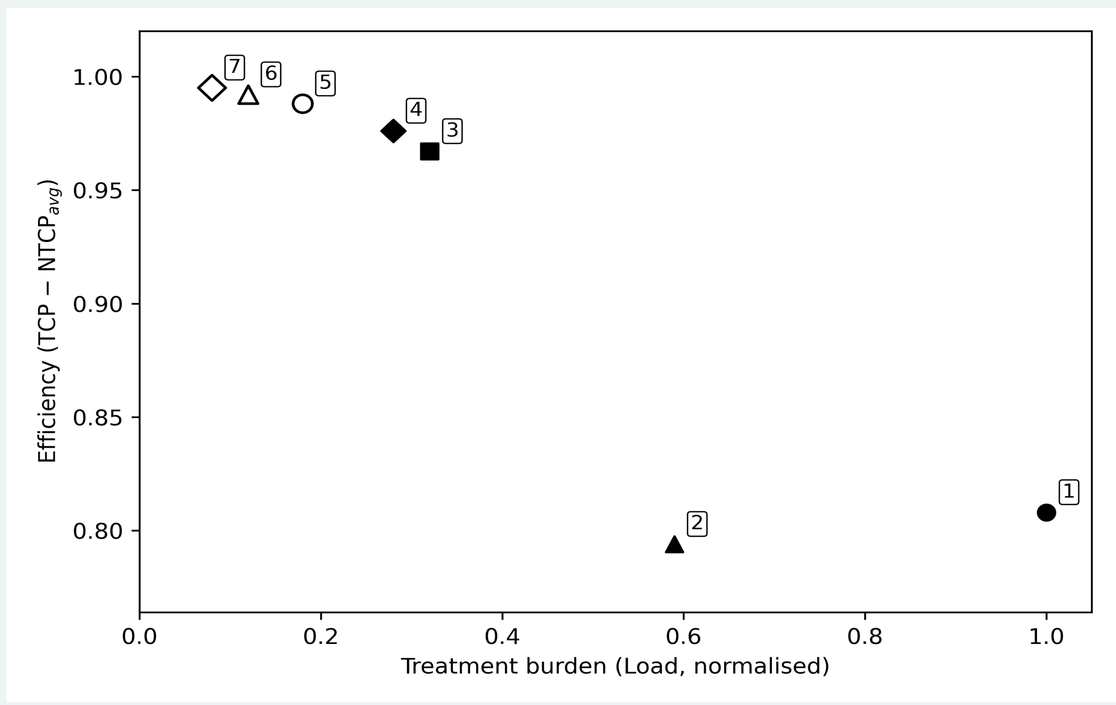
- Linear-quadratic model (α/β = 1.5 Gy)
- Poisson-based TCP
- Lyman–Kutcher–Burman NTCP (rectum & bladder)
- Composite Load = weighted sum: • Fractions (N) • Cumulative CBCT dose (~10 mSv/scan) • Motion-management burden (M: 1–10) • Total treatment time (T)

OLI = (TCP – NTCP_avg) / Load

Higher OLI = better therapeutic efficiency under ALARA

Regimens modelled (7 total):

- Conventional: 78 Gy / 39 fx
- Moderate hypo: 60 Gy / 20 fx
- Ultra-hypo: 42.7 Gy / 7 fx
- Standard SBRT: 40 Gy / 5 fx
- Augmented SBRT (motion-managed, reduced margins): • 40 Gy / 5 fx • 40 Gy / 3 fx • 24 Gy / 1 fx



Efficiency versus treatment burden across fractionation strategies.
Efficiency is defined as TCP − NTCP_avg, where NTCP_avg is the mean of rectum and bladder NTCP. Numbers indicate regimens: (1) 39 fx, (2) 20 fx, (3) 7 fx, (4) 5 fx, (5) 5 fx + motion management (MM), (6) 3 fx + MM, and (7) 1 fx + MM. The plot provides an intuitive ALARA interpretation: desirable strategies move towards higher efficiency at lower burden.

My research focuses on optimisation frameworks in medical imaging and radiotherapy, developing unified metrics like the Optimisation Level Index (OLI) as one approach to integrate biological dose, toxicity, and treatment burden in prostate SBRT under ALARA principles.

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