

THE EVOLVING ROLE OF RADIOTHERAPY IN KELOID MANAGEMENT, OPTIMISATION OF BED VALUES AND FRACTIONATION REGIMENS: A 30-YEAR UK PERSPECTIVE

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Running Title

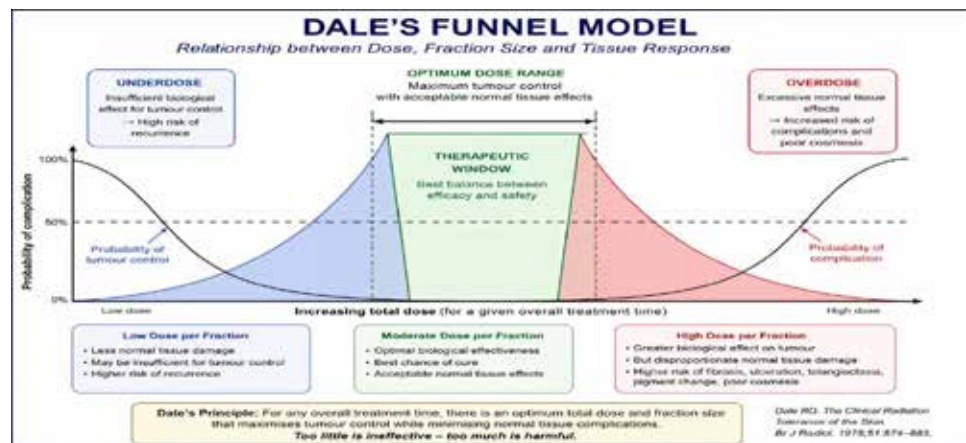
The Evolving Role of Radiotherapy in Keloid Management, Optimisation of BED Values and Fractionation Regimens: A 30-Year UK Perspective

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BACKGROUND

The biologically effective dose (BED) is a radiobiological method for comparing radiotherapy dose-fractionation schedules by converting total dose and dose per fraction into a common biological effect scale. This is based on the linear–quadratic (LQ) model for cell survival, from which an “ α/β ratio” (i.e. the dose, in Gy, where the linear/single-hit and quadratic /multi-hit cell killing components of dose are equal) is determined for the tissue under consideration. The LQ model has proven to be robust across many tissues but uncertainty persists in keloid radiotherapy, both because fibroblasts are involved and because BED values for keloid treatment have frequently been reported without specifying whether they are calculated using $\alpha/\beta=10$ (BED₁₀), as employed in early radiobiological analyses, or 2.5 (BED_{2.5}), as increasingly argued to be more appropriate for the post-excisional keloid bed. This ambiguity complicates interpretation of dose–response relationships and comparison between treatment regimens.

Further controversy concerns whether outcome is determined primarily by dose, radiation modality, fractionation schedule, timing of postoperative irradiation, or whether these factors converge within an optimal therapeutic BED window, consistent with Dale’s funnel model of radiobiological optimisation.



In this optimisation framework, underdosing risks recurrence, while, in the case of post-excisional keloids, over-escalation of dose may increase fibrosis, skin injury and produce poorer cosmesis, without improving control. Additional uncertainty exists regarding

CONCLUSIONS

Systematic review of available outcome data supports a model of BED guided optimisation, rather than simple dose escalation (e.g. up to a historically proposed $BED_{10} = 30$ Gy) or fraction-number selection, as a rational framework for post-excisional keloid radiotherapy. Current evidence suggests an effective therapeutic BED window may exist in which durable recurrence control can be achieved while minimising toxicity, consistent with Dale's funnel model.

A single 10 Gy fraction delivered within 24 hours appears to lie within this effective window between $BED_{2.5} = 40$ Gy and $BED_{2.5} = 60$ Gy and compares favourably with more fractionated regimens, when biological dose and follow-up maturity are considered. The evidence further suggests that ambiguity surrounding α/β assumptions has contributed substantially to confusion in the literature and that BED values should always be explicitly reported as $BED_{2.5}$ or BED_{10} .

While prospective comparative studies remain needed, present evidence increasingly supports the hypothesis that achieving an optimal BED window and treating early may matter more than fraction number per se.

REFERENCES

As listed beneath the relevant Figure.