

CHAPTER 5 CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on the research conducted, the following conclusions were drawn:

1. The direct application of Li et al. (2022) parameters for the VitalBeam LINAC at RSAM Bukittinggi failed because it did not achieve GPR > 90% under the 1%/1mm criterion for both PDD and profiles (in-plane and cross-plane). The GPR values were 96.17% (PDD), 60.40% (in-plane), and 51.41% (cross-plane). This failure was caused by unit-to-unit variations, instrumentation differences, and computational limitations, as the replication uncertainty was higher (2.21%) compared to the < 2% reported by Li et al. (2022). This failure consequently led to independent tuning
2. Parameter tuning yielded optimal values of IEBC = 6.5 MeV, FWHM-E = 0.05 MeV, and FWHM-FS = 0.15 cm, increasing the 1%/1mm GPR for in-plane profiles to 63.10% and cross-plane to 66.27%. The model met clinical criteria with GPR > 90% at 3%/3mm against both commissioning and the latest QA data, but failed to achieve > 90% for profiles at 2%/2mm and for all parameters at 1%/1mm. These failures are attributed to geometric differences between the Clinac 2100 surrogate and the actual VitalBeam, as well as computational limitations during the tuning phase. Additionally, inconsistencies between commissioning and QA data indicate beam characteristic shifts during clinical use.

5.2 Suggestions

Based on the conducted research, several suggestions for future studies are as follows:

1. Increase the number of primary particle histories during the tuning phase. To minimize statistical uncertainty and ensure more accurate parameter selection, future tuning should utilize at least 10^8 or 10^9 histories for each parameter variation, rather than the 2×10^7 histories used in this study, which was constrained by computational limitations.
2. Utilize more adequate computational resources and allocate more time, along with a stable power supply (without power outages).
3. Conduct analysis not only on the quantitative gamma values but also on the shape of the resulting curves.

