**Appendix A: Calculation of the skeletal-specific S-values**

Absorbed dose was calculated using the MIRD-formalism. The time integrated activity of each site, $\tilde{A}$ and site volume $V$ were determined from volumes of interest drawn with PMOD vs 3.8 (PMOD industries, Zurich). The volume was corrected with the ICRP-cellularity factor (70 %) and a correction for trabecular volume fractions taken from table 4 in (O’Reilly et al. 2016) and table 1 from (Hough et al. 2011) for female (0.1260) and male (0.1025) patients, respectively. A mass density of 1.03 g/ml was also used in accordance with both look-up-tables to form the mass of the red marrow:

|  |  |  |
| --- | --- | --- |
|  | $$m\_{AM}=V(1-f\_{TBM})⋅CF$$ | (A1) |

CF- specific absorbed energy fractions were calculated by the specific uptake fractions found in the tables A1-A13 of the appendices of (O’Reilly et al. 2016) and (Hough et al. 2011) multiplied by the red marrow masses. The reference masses were calculated using tables 4 and 1 from (O’Reilly et al. 2016) and (Hough et al. 2011) respectively, and equations (2) and (4) from (Hough et al. 2011).

|  |  |  |
| --- | --- | --- |
|  | $$ϕ(AM\leftarrow AM,CF,E)=Φ(AM\leftarrow AM,CF,E)⋅m\_{AM-ref}$$ | (A2) |

The final $S$-factor was found by summation of the mean energy, $Δ\_{i}$ and corresponding $ϕ$ for all $β-$, internal conversion and auger-electron-emission ($i$) of 177Lu. These were extracted from the software program DECDATA version 2.7, which contains the data of ICRP-publication 107 (International Commission on Radiological Protection 2008).

|  |  |  |
| --- | --- | --- |
|  | $$S(AM\leftarrow AM,CF)=\sum\_{i}^{}Δ\_{i}ϕ(AM\leftarrow AM,CF,E\_{i})$$ | (A3) |
|  | $$D(AM,CF)=\frac{\tilde{A}⋅S(AM\leftarrow AM,CF)}{m\_{AM}}$$ | (A4) |

The required values to do the dose calculations were implemented as a python-class object to create a phantom from specific absorption fractions and energy spectrum from DECDATA, together with associated class-methods to do dosimetry calculation based on input in the form of time integrated activity and volume measurements (python version 3.7.6). The software with included documentation is freely available on github: <https://github.com/blakkisrud/RedMarrowSFactor>.

**Appendix references**

1. Matthew Hough et al *An image-based skeletal dosimetry model for the ICRP reference adult male—internal electron sources.* 2011 Phys. Med. Biol. 56 2309
2. Shannon E O’Reilly et al *An image-based skeletal dosimetry model for the ICRP reference adult female—internal electron sources.* 2016 Phys. Med. Biol. 61 8794
3. ICRP*. Nuclear Decay Data for Dosimetric Calculations.* ICRP Publication 107. 2008 Ann. ICRP 38