Purpose:
The Red Shell is defined as the surrounding irradiated tissue that will be permanently damaged in SBRT. We examined the relationship of BED and fractionation on a small radiosurgical target, computed using multiple a/b ratios.

Methods: A 2cm spherical target received a spherical radiation dose cloud with 10% fall-off per 2mm from the center. Its Red Shell was defined as tissue that received at least a BED equivalent to 2Gy x 30. First, we used a BED equivalent to 12.5Gy x 4 for various tumor a/b ratios and fractionation schemes (1 to 10 fractions). Second, using a/b ratio of 10 Gy, various 3-fraction schedules were plotted along with their corresponding BEDs from 1-10 fractions. Red Shell volumes were individually calculated to analyze the fractionation effect for different a/b ratios and prescription doses.

Results: In the first set of calculations with a BED equivalent to that of 12.5Gy x 4, an increase in fractionation was most beneficial in reducing the Red Shell volume when the a/b ratio was high. The greatest benefit was seen within the first few fractions. When the a/b ratio was low, an increase in fractionation was detrimental. With a/b ratio of 5.15Gy, all fractionation schemes had the same Red Shell volume. In the second set of calculations, the greatest Red Shell volume reduction with increased fractionation was seen with the lowest BED equivalent to 10Gy x 3; the least volume reduction was seen with the highest BED. There was a detrimental effect to fractionation with the highest BED at 30Gy x 3. For a/b ratios resulting in a BED equivalent to 28.7Gy x 3, all fractionation schemes had the same Red Shell volume.

Conclusions: Multiple interrelated factors, particularly a/b ratio and BED, affect Red Shell volume. Increased fractionation was not always beneficial, and was detrimental when the a/b ratio was low or if the BED was very high.