Introduction: The recently proposed thermobrachy seed combines a sealed radioactive source with a ferromagnetic core serving as a source for self-regulating hyperthermia when placed in an alternating electromagnetic field. This seed has the potential to address some shortcomings of other methods suggested for delivery of radiotherapy and hyperthermia, such as, as an inadequate temperature control due to complex invasive thermometry and feedback loops, temperature non-uniformity, and prolonged time delay between hyperthermia and radiation treatments.
Materials and Method: The thermobrachy seed consists of Ni-Cu ferromagnetic alloy core coated with carbon containing I-125 source and encapsulated in titanium capsule. The external dimension of the seed is the same as the BEST Model 2301 I125. In our modeling study, seeds are located in the central region of cylindrical water phantom. An alternating magnetic field was applied using an externally wrapped current carrying coil. The temperature distribution within the phantom due to the induction heating of the ferromagnetic seed was obtained using a finite element analysis method. This distribution was compared to radiation dose distribution from treatment planning system.
Results: The thermoseed surface temperature rises rapidly and stays constant around the Curie temperature of the ferromagnetic material used. The temperature self-regulation eliminates the need for invasive thermometry and simplifies the treatment procedure. The phantom volume reaching the therapeutic temperature range increases with increase of frequency or magnetic field strength. The temperature coverage over the target volume can be optimized by changing the magnetic field variables (intensity and frequency). Furthermore the tuning of the variables allows us achieving isothermal surfaces exactly similar to the radiation isodoses.
Conclusion: The result shows that one can obtain the optimal isothermal distribution on the target volume to match with the prescribed radiation isodose distribution for the seed configuration by changing frequency and intensity of the alternating applied magnetic field.