

Antenna design for Microwave Cancer Ablation of Osteosarcoma

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Osteosarcoma is the most common primary malignant bone cancer in children. Because it usually develops from osteoblast (cells responsible for bone growth) it most commonly affects individuals between 10 and 25 years of age. This type of cancer often occurs in the long bones of the arms and legs at areas of rapid growth around the knees and shoulders. It is often very aggressive with risk of spread to the lungs. The five-year survival rate for osteosarcoma is approximately 65%.

Among the different medical procedures being developed to treat tumors, microwave ablation stands out as one of the most promising. Some of the advantages offered by this technique over traditional treatments are: it requires minimal invasiveness; it localizes treatment to the affected area; it can be indicated for patients that cannot undergo surgery, drug treatments or chemotherapy; it provides fast treatments and healing times. The main types of microwave ablation applicators are: superficial and interstitial. Interstitial microwave ablation applicators are coaxial-based antennas like cap-choke, monopoles and dipoles. These applicators have the disadvantage of producing small ablation areas and requiring insertion into the tumor under treatment. Superficial applicators on the other hand do not require insertion but are large and produce unwanted heating on the healthy tissues surrounding the tumor.

The disadvantages mentioned before demonstrate that traditional microwave ablation applicators are not suited to treat osteosarcoma. Typically osteosarcoma develops into large tumors that due to their size and shape cannot be treated effectively by traditional applicators. Additionally the theory behind microwave ablation applicators has been developed for soft tissues (skin, blood, muscle). These tissues have electrical properties that differ significantly from the properties of the hard tissues (bone cortical, bone marrow, bone cancellous) from which osteosarcoma develops. In this work we show the design of microwave applicators that can treat osteosarcoma effectively. The performance of these applicators is demonstrated through numerical simulations of the absorbed power and temperature increase, which were computed using FDTD and the Bio-Heat equation.