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In Radiation Oncology, Expanding the Use of Real-time Electromagnetic Tracking

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Introduction

The beyond 10 years, methods to further develop radiotherapy conveyance, for example, power adjusted radiation treatment (IMRT), picture directed radiation treatment for both between and intrafraction cancer confinement, and hypofractionated conveyance strategies, for example, Stereotactic Body Radiation Treatment (SBRT), have advanced massively. This survey article centers on just a single piece of that development, electromagnetic following in radiation treatment. Electromagnetic following is as yet a developing innovation in radiation oncology and, thusly, the clinical applications are restricted, the cost is high, and the repayment is deficient to take care of these expenses. In addition, the experience that has been gained with electromagnetic tracking applied to a variety of clinical tumor sites suggests that the potential advantages of electromagnetic tracking may be significant for radiation therapy patients. Everyday utilization of these global positioning frameworks is insignificantly obtrusive and conveys no extra ionizing radiation to the patient, and these frameworks can give unequivocal growth movement information. Despite the fact that there are various specialized and monetary issues that should be tended to, electromagnetic global positioning frameworks are supposed to assume a proceeded with part in working on the accuracy of radiation conveyance.

Description

Endoscopic navigation, image-guided interventional therapy and surgery, and more recently, localization and tracking systems for prostate radiotherapy are all examples of medical applications for electromagnetic tracking. Electromagnetic tracking systems have evolved from a need for surgical navigation to a need for precision radiotherapy over the past 15 years. Optic tracking was the foundation of the first systems for image-guided surgery and radiation therapy. However, the limitations of optical tracking systems have piqued interest in electromagnetic tracking systems for medical applications. In contrast to electromagnetic systems, optical tracking systems do not require a line of sight between tracking system cameras and light-emitting diodes. Electromagnetic frameworks can be utilized in PC supported operations by characterizing position and direction for guidewires in interventional radiology or catheter arrangement for bronchoscopic methodology. Improved techniques for modulating and directing radiation beams for radiation therapy reflect technological advancement. The significance of motion tracking and position localization in these techniques cannot be overstated. Exact motion data can be collected and recorded using electromagnetic tracking at a frequency of 10 Hz. When attempting to provide precise radiotherapy to organs that move within the body independently of the tissues surrounding them, the use of uninterrupted motion tracking for cancer targets has significant value. This value only goes up when doctors treat these organs by gating the linear accelerator's radiation beam or dynamically delivering intensity-modulated radiation therapy to these organs to reduce dose to normal tissues through smaller treatment margins [1,2].

The enhancements in exactness that positional following can give to radiation oncologists and physicists ought to assist producers of electromagnetic global positioning frameworks with pushing for progressions in their innovation, as well as mix of their advances with other significant conveyance frameworks throughout the following quite a while. Competing technologies, which may provide tracking through a different delivery system, pose an additional obstacle to electromagnetic tracking. Due to their rapid update rate, radiofrequency-based electromagnetic tracking systems can be used in real time to locate tumors, but new emerging technologies are constantly being developed that may offer a similar tracking mechanism. One such innovation gives the capacity to follow focuses inside the body. Navotek is fostering a gantry-mounted radioactive fiducial global positioning framework that is accounted for to give submillimeter precision to patient confinement and monitoring. Radioactive fiducial following, however not FDA-supported, challenges advancements like electromagnetic following specialized headways in implantable radioactive materials and limitation of these sources. In any case, this innovation might have deficiencies of its own, for example, the absence of capacity to give rotational data and conceivable organ disfigurement data [3,4].

Additionally, even if the radioactive source does migrate, it will be extremely challenging to ascertain how much and where it is migrating. Reimbursement is the final obstacle to electromagnetic tracking. The upfront capital cost of electromagnetic tracking systems and the on-going cost of implantable markers remain barriers to widespread implementation of these technologies, despite not being a technological limitation. It is prohibitively expensive for many centers to consider this technology for routine clinical use due to the high cost of these RF transmitters and the varying levels of reimbursement in various regions. Radiation oncology may not see further growth in electromagnetic tracking technology unless these reimbursement and cost issues are addressed. The results of ongoing collaborations in research must demonstrate that electromagnetic tracking is a developing technology with increased treatment options, proper and objective efficacy tests demonstrate an enhanced therapeutic effect, and electromagnetic tracking does assist in the localization and targeting of the tumor region. Dosimetric studies that show intrafraction motion during radiotherapy does result in differences in the delivered dose versus the planned dose, similar to some of the studies mentioned above related to retrospective dose recalculations, could be used to address the latter two points [5].

Conclusion

Accurate patient setup, respiratory correlated radiotherapy, collision avoidance, and adaptive radiation therapy are all made possible by electromagnetic tracking systems. Moreover, day to day utilization of these frameworks is insignificantly obtrusive and conveys no extra ionizing radiation to the patient. It is anticipated that electromagnetic tracking systems will continue to play a role in enhancing the precision of radiation delivery due to these benefits. However, in order to guarantee these technologies success in enhancing patient care over the next ten years and beyond, a number of technical and financial issues need to be resolved quickly.

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