Radiotherapeutic Bandage for the Treatment of Skin Cancer
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Purpose
Squamous cell carcinoma (SCC), a subtype of non-melanoma skin cancer, is the second most common skin cancer with more than 700,000 new cases estimated annually in the US. Radiation therapy is used in the clinic against inoperable tumor lesions and in patients that cannot undergo surgery and it is used to treat recurring lesions after a primary surgical approach (i.e., Mohs micrographic surgery). We have previously reported on the incorporation of ¹⁶⁵Ho-nanoparticles into electrospun nanofibrous mats (“bandages”) for potential use in the treatment of SCC. A ¹⁶⁵Ho-containing polymer nanofibrous bandage was prepared via electrospinning using ¹⁶⁵Ho-nanoparticles (¹⁶⁵HoIG) and polyacrylonitrile. These bandages can be manipulated for easy application to tumor lesions, and can be made on a large scale; they are made radioactive just prior to therapy using neutron-activation, a strategy currently used for the cancer radiotherapeutic TheraSphere®. The prepared bandages are able to withstand neutron-activation to become radioactive (¹⁶⁶Ho), and we are able to achieve high radioactivities. The goal of the present study is to test our radiotherapeutic bandage against SCC in an animal model, to determine clinical relevance.

Methods
Polyacrylonitrile polymer bandages containing ¹⁶⁵HoIG were prepared as previously reported. The radiotherapeutic bandages were produced via neutron-activation of the ¹⁶⁵HoIG-containing bandages in a 10¹² neutrons/cm²•s thermal neutron flux using a 1 MW nuclear reactor. A xenograft mice model for SCC is being used; COLO-16 SCC cells are injected subcutaneously into the flanks of female athymic nude mice. When tumors are palpable, the radiotherapeutic bandage and controls are applied. Before and after treatment (for up to 30 days), tumor sizes are measured using a caliper twice a week, and inhibition of tumor growth compared among all treatment and control groups to determine efficacy. Mice will be sacrificed for pathologic evaluations to determine if any damage to muscles or internal organs resulted from therapy, and to compare damage, if any, between groups.

Results
¹⁶⁵Ho-nanoparticles were successfully incorporated into electrospun nanofibrous polyacrylonitrile bandages and could be neutron-activated to achieve therapeutically relevant radioactivities. The bandage was stable after neutron-activation, and in vivo efficacy studies are ongoing.

Conclusion
The radiotherapeutic bandages have been prepared and animal studies are ongoing.