AbstractID: 3911 Title: Activation of metallic prostheses in patients undergoing fast neutron therapy

Purpose: To quantify the induced activity and estimate the tissue dose from metallic prostheses in patients undergoing fast neutron therapy.
Method and Materials: Three metal samples were tested, each having the dimensions of 5 x 5 x 0.5 cm^3. The metals were composed of alloys that have been used in prosthetic hip implants: cobalt-chromium, titanium-aluminum-vanadium, and stainless steel. The samples were irradiated with fast neutrons produced by d(48.5) + Be reaction in a superconducting medical cyclotron. The samples were placed in a tissue-equivalent phantom and irradiated in a 10 x 10 cm^2 field to a total dose of 9 Gy in 9 x 1 Gy daily fractions. Following each fraction, the sample was measured using a high-purity germanium gamma-ray detector. Spectra were taken at the following intervals: 1 minute, 1 hour, 2 hours, 3 hours, and approximately 24 hours after irradiation.
Results: Activity 1 minute after irradiation averaged 5.4 mCi for CoCr, 4.9 mCi for Steel, and 9.3 mCi for TiVAl. Although the TiVAl sample had the highest initial activity, within 3 hours it had decayed the most. TiVAl also had the lowest activity 14 days after the last fraction. For a given dose, activities varied only slightly from day to day. An increase in dose delivered yielded an increase in induced activity.
Conclusion: It appears that the TiVAl alloy would be the safest prosthetic material for patients undergoing fast neutron therapy, because of its fast decay rate. The presence of Co-60 in the CoCr sample is undesirable because of its long half life. Exposure to surrounding tissue as a result of the activation was negligible compared to the levels of radiation caused by neutrons. The level of activation should be considered only if the device is to be removed from the patient after neutron therapy.