**HETEROTOPIC OSSIFICATION FOLLOWING HIP SURGERY: AN ANIMAL MODEL COMPARING PREOPERATIVE IRRADIATION OF THE FEMORAL SHAFT VERSUS THE ABDUCTOR MUSCULATURE**

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**Introduction:** Heterotopic ossification (HO) occurs in up to 90 per cent of patients following total hip arthroplasty. Nearly 10 per cent of these patients experience functional impairment such as pain and decreased range of motion. In extreme cases joint ankylosis may result. Severe cases of HO require revision surgery to restore function and to relieve pain. Several studies have demonstrated that pre-operative irradiation of the hip joint is effective in reducing the development of HO following total hip arthroplasty. However, the source of the HO-forming osteoprogenitor cells is unknown. These cells may differentiate from muscle mesenchymal origin, from the neighboring bony stroma or both. Utilizing selective irradiation of the hip abductor musculature or the femoral shaft, our study investigates the source of osteoprogenitor cells responsible for HO following total hip arthroplasty in an animal model.

**Methods:** Our Institution’s Animal Care and Use Committee approved the protocol. Utilizing a randomized block design, 20 3-kilogram New Zealand White (NZW) rabbits received 1200 cGy radiation 24 hours pre-operatively to either the greater trochanter, abductor musculature, and hip joint, or to the femoral shaft on each hindquarter. An equal number of left and right sides were included in each group. Each rabbit was irradiated with 1200 cGy at the specified time utilizing a Clinac-2300 C/D unit (Varian, Palo Alto, California) using six-megavolt photons. Treatments were made with a posteriorly applied field with the subjects lying prone and a source-to-skin distance of 100 centimeters. Each subject underwent simulation prior to actual treatment and a confirmation radiograph was obtained after transferring the subject to the treatment machine. Under general endotracheal anesthesia by a Veterinarian, subjects were placed onto a custom surgical board that allowed full immobilization and ideal positioning for bilateral hip surgery. Each hindquarter was shaved, prepped and draped in a sterile fashion. The procedure was identical bilaterally and designed to mimic the approach for a total hip arthroplasty in a human. A 2.5-cm incision was made over the greater trochanter, and the dissection was carried down to bone with wide exposure of the greater trochanter and acetabulum, up to grade 4.

Radiographs were analyzed by two observers who were blinded to the pre-operative radiation status. Repeat evaluations were performed to assess intra-observer reproducibility. The Fleiss weighted Kappa statistic was used to assess the reliability of the review process. Standard error of the mean and 95% confidence intervals were calculated. Results were analyzed utilizing a paired t-test with p-values less than 0.05 considered significant.

**Results:** There were no peri-operative deaths or complications. The Fleiss weighted Kappa Statistic was 0.872 indicating “almost perfect” agreement between the two sets of ratings. The average HO grade for the group receiving radiation to the hip was 2.575 versus 2.0 for the group receiving radiation to the femoral shaft. This was statistically significant (p<0.02).

**Discussion:** Radiation as a prophylactic measure against HO following hip surgery has been shown to be clinically effective. We have previously developed a reproducible animal model in the NZW rabbit from which we developed the surgical and radiation protocols for this investigation. In our previous studies utilizing this model we have determined a minimal effective dose required to achieve adequate HO prophylaxis. We have also demonstrated that the efficacy of irradiation 24 hours post-operatively is equivalent to that given 24 hours pre-operatively in preventing HO (1). We utilized our existing animal model for HO production following a simulated total hip arthroplasty to study the source of osteoprogenitor cells responsible for HO.

It is thought that these cells originate from either the abductor musculature or from the femoral canal. A radiation dose of 1200 cGy to the hip and irradiation at 24 hours pre-operatively have been shown to be effective in preventing HO following hip surgery in an animal model. Although both seem to be effective, our results demonstrate that irradiation of the femoral canal is significantly more effective than irradiation of the hip joint and abductor musculature in diminishing HO. This suggests that the osteoprogenitor cells responsible for HO originate from both the hip abductors and the femoral canal, but the femoral canal may be a more important source of these cells. Our results warrant further investigation into the origin and biology of the primitive osteoprogenitor cells that are responsible for HO as well as the cellular mechanisms controlling bone formation.

**Reference:**


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