Repairing segmental defect with a composite associating collagen membrane and MBCP+® combined with total bone marrow graft in irradiated bone defect: an experimental study in Rabbit.

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INTRODUCTION

Cancer management usually requires surgical removal of the lesion, followed by postoperative radiotherapy. Reconstruction of large bone defects is still a challenge. The bone tissue engineering models used today in this goal are still a long way from any oncological application as immediate post-implantation irradiation would decrease their osteoinductive potential. The aim of this study was to reconstruct a segmental critical size defect in a weight-bearing bone irradiated after implantation.

MATERIALS AND METHODS

Implantation of the composite on the right femur of 8-week old New Zealand rabbits was performed. Animals were divided into 4 groups: no radiation, total dose of 14 Gy delivered at a rate of 2 Gy/Dy, 4Dy/Wk or 24Dy/Wk. The defect was either a critical size defect or a non-critical size defect.

RESULTS

Quantitative results: No significant (ns) difference (p>0.05) was observed between the levels according to bone marrow grafts and bone ingrowth and ceramic resorption was observed whereas classical centripetal bone colonization could be expected at 16 weeks. This suggests that BM grafting right in the center of the defect may have an osteoinduction effect. The osteoinductive potential of bone marrow grafts has already been demonstrated. This has significant implications for the bone tissue engineering approach in patients with cancer-related segmental bone defects.

DISCUSSION

This study is the first evaluation of a composite based on calcium phosphate ceramic to reconstruct segmental defects in high weight-bearing bone with immediate post-implantation irradiation. Results demonstrate the biofunctionalitat of the model and that the tested concept lead to successful regeneration of irradiated critical segmental long bone defect.

Defects measuring 20 mm in length have already been described as being a critical size defect at 16 weeks in rabbit femurs. On these bases, the defect presented was considered to be critical and for ethical reasons no control group was constituted for this study. Radiation reduces bone healing, BCP osteoconductivity and bone marrow cells quality. Ceramics used alone are not able to regenerate large defects. Despite the combination of multiple compromising conditions (radiation, large defect, weight bearing), no complication has occurred.

The collagen membrane that is a resorbable healing scaffold may have led to a periosteum-like tissue formation on the external bone surface. Compromising conditions (radiation, large defect, weight bearing), no complication has occurred. This study received a grant from the French government, the French National Research Agency (Agence Nationale de la Recherche, ANR 2005), and the BioRimp Project.

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