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DISSERTATION

"ZINC ENHANCES THE OSTEOGENIC CAPACITY OF BONE ALLOGRAFTS"

by

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Friday, April 30th, 2021
1 p.m.
Zoom Link Below:
https://rutgers.zoom.us/j/98095725415?pwd=VjVkNmlncTdtQU1KNnNmWjNueWdSUT09

Meeting ID: 980 9572 5415
Password: 131039

Abstract

Delays and failures in bone formation at sites requiring arthrodesis lead to higher medical costs, revision surgeries and extended recovery times for patients. One widely used method to aid the intrinsic ability of the body to regenerate bone is use of allografts. However, processing methods used to sterilize and to remove allograft immunogenicity significantly compromises the osteogenic ability of allograft. Recent research has tested use of adjuvants to enhance the osteogenic property of allografts. In this study, zinc was tested as a possible adjuvant to increase the osteogenic activity of human allograft in an immunocompromised rodent femur segmental defect model. Rodent femoral defects were treated with human demineralized bone matrix (DBM) mixed with $ZnCl_2$ (0, 75, 150, 300 µg), Zn stearate (347 µg), Zn Acetate (120 µg) or Zn Citrate (112 µg). Rat femur defects treated with DBM-$ZnCl_2$ (75 µg) and DBM-Zn Stearate (347 µg) showed radiographic evidence of increased calcified tissue in the defect site as compared to defects treated with DBM only. µCT and histomorphometry showed an increased amount of new bone formed in and around the defect for the DBM-$ZnCl_2$ (75µg) and DBM-Zn Stearate (347 µg) treated defects. Proliferation and viability of skeletal cells (RAW264.7, MC3T3-E1 and ATDC5 cells) were measured in media supplemented with Zn acetate, Zn citrate, Zn sulfate, or $ZnCl_2$. ATDC5 cells showed greater sensitivity to zinc supplemented media as compared to the other cell types. Another allograft tested in the study was cancellous bone chips. Zinc was bound to the bone chips by incubating the bone chips in $ZnCl_2$ solution. Zinc adsorbed onto the chips in a time and concentration dependent manner. The Zn-bound bone chips were then added to femur segmental defects in Rag-2 null rats. µCT and histomorphometry analyses showed that the Zn-bound bone chips formed more bone in rat femur defects than untreated control bone chips. The results indicate that addition of zinc to allograft can improve the osteogenic activity of processed human allograft. Zinc dose and release kinetics can be modified using different zinc salts and different forms of bone allograft to provide customizable solutions for improving arthrodesis