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Biological behavior of the castor oil polyurethane containing zirconia and silica nanoparticles as graft for bone defect in the femoral diaphysis of rats

R. S. Nacer [(1)], R. R. Poppi [(1)], A. N. Odashiro [(2)], I. S. Silva [(3)], B. A. K. da Silva[(4)] , P. T. C. de Carvalho [(5),] A.A.S.T. Delben [(6)*]

(1) PG Saúde e Desenvolvimento na Região Centro-Oeste, UFMS
(2) Departamento de Medicina, UNIDERP
(3) Departamento de Veterinária, UNIDERP
(4) Departamento de Fisioterapia, UNIDERP
(5) Departamento de Fisioterapia, UFS
(6) Departamento de Física,UFMS, cx. p. 549, 79070-900, Campo Grande, MS, asdelben@yahoo.com (corresponding author)

Abstract – Composites were prepared with castor oil polyurethane and nanoparticles of silica and zirconia. The castor oil polyurethane is a biocompatible material and the addition of the oxide nanoparticles preserved this property, while the high concentration of silica improved bone formation.

The aim of this study was to evaluate the biological behavior of the composite castor oil polyurethane and nanoparticles of zirconia and silica as a substitute in bone defects in the femoral diaphysis of rats at different times of evolution. We used 36 male Wistar rats, divided into four groups and subdivided by period of analysis, as follows: group 1 (G1) - bone defect filled with polymer of castor oil and calcium carbonate, group 2 (G2) - polymer of castor oil with calcium carbonate containing 5% of silica nanoparticles, group 3 (G3) - castor bean polymer with calcium carbonate doped containing 10% of nanoparticles of silica, and group 4 (G4) - polymer of castor oil plus calcium carbonate containing 5% zirconia. After the observation period of 15, 30 and 60 days, the animals were sacrificed and the femurs removed for histological evaluation and scanning electron microscopy. The porosity depended on the dopant, according to electron microscopy. Histological evaluation showed that there was bone growth in all groups studied, with larger growth tendency on the group containing only polyurethane and calcium carbonate. In the initial period of assessment (15 days) there was no new bone formation in the animals of G2, which showed, together with the animals in the G4, intense presence of fibroblasts and a pseudocapsule of fibrous tissue around the implant. At 30 days, all groups showed similar results, the differences were not statistically significant. After 60 days, it was noted less new bone formation in animals in groups 2 and 4 when compared to those of groups 1 and 3, however, increased growth into the bone material was observed in group 1 and increased presence of fibroblasts, osteoblasts and osteoclasts in group 3. There was no statistical difference regarding the presence of inflammatory reaction among the groups studied. The association of the polymer of castor oil with nanoparticles of silica and zirconia is viable since both the silica and zirconia shown to be biocompatible, allowing bone growth into the pores of materials. However, at all times studied there was a higher estimated quantity of mature bone tissue in animals with implants of polymer of castor oil without dopant. The greater presence of osteoblasts, osteocytes and osteoclasts in the animals of the group containing 10% of silica in the polymer of castor oil suggest that the silica presented osteoinductive potential, favoring the aggregation and cell differentiation, persisting the integrated activity of the three types of cells involved in the process of activation-resorption-bone formation, even after long period of observation.

Key words: Biocompatible Materials, graft, osteoinduction