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Biological Optimization following BM-MSC Seeding of Partially Demineralized and Partially Demineralized Laser-Perforated Structural Bone Allografts Implanted in Critical Femoral Defects

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Abstract : Background: Despite promising results have shown by osteogenic cell-based demineralized bone matrix composites, they need to be optimized for grafts that act as structural frameworks in load-bearing defects. The purpose of this experiment is to determine the effect of bone-marrow-mesenchymal-stem-cells seeding on partially demineralized laser-perforated structural allografts that have been implanted in critical femoral defects. Materials and Methods: P3 stem cells were used for graft seeding. Laser perforation in four rows of three holes was achieved. Cell-seeded grafts were incubated for one hour until they were planted into the defect. We used four types of grafts: partially demineralized only (Donly), partially demineralized stem cell seeded (DST), partially demineralized laser-perforated (DLP), and partially demineralized laser-perforated stem cell seeded (DLPST). histologic and histomorphometric analysis were performed at 12 weeks. Results: Partially demineralized laser-perforated had the highest woven bone formation within graft limits, stem cell seeded demineralized laser-perforated remained intact, and the difference between partially demineralized only and partially demineralized stem cell seeded was insignificant. At interface, partially demineralized laser-perforated and partially demineralized only had comparable osteogenesis, but partially demineralized stem cell seeded was inferior. The interface in stem cell seeded demineralized laser-perforated was almost replaced by distinct endochondral osteogenesis with higher angiogenesis in the vicinity. Partially demineralized stem cell seeded and stem cell seeded demineralized laser-perforated graft surfaces had extra vessel-ingrowth-like porosities, a sign of delayed resorption. Conclusion: This demonstrates that simple cell-based composites are not optimal and necessitates the supplementation of synergistic stipulations and surface changes.

Keywords : structural bone allograft, partial demineralization, laser perforation, mesenchymal stem cell
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