In vitro and in vivo effects of the glass-ceramic Bio 2P on bone formation

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Resumo:
This study aimed to evaluate the potential of a glass-ceramic with 2 crystalline phases (Bio 2P) in stimulating in vitro the osteoblast (OB) activity and differentiation, and in vivo the bone formation. The OB activity was assessed in UMR-106 cells cultured on Bio 2P and 45S5 discs in osteogenic medium and determined at day 5 by ALP activity, matrix mineralization and the gene and protein expressions of bone markers. The OB differentiation was assessed in mesenchymal stem cells (MSC) cultured on Bio 2P, 45S5 and polystyrene (control) in non-osteogenic medium and detected at day 10 by ALP activity and gene expression of bone markers. Porous Bio 2P (76% of porosity, 5mm diameter and 2mm high) was implanted in 5-mm rat calvarial defects and bone formation was evaluated at 4 and 8 weeks by µ-CT and histology. Empty defects were used as control. Data were compared by Mann-Whitney or Kruskal-Wallis tests when appropriated (p<0.05). UMR-106 displayed higher ALP activity, matrix mineralization, gene expression of BSP, Runx2 and OPN and protein expression of ALP, Runx2, BSP and OPN when cultured on Bio 2P. In MSC ALP activity was higher in 45S5 (control<Bio 2P<45S5), gene expression of ALP was higher in Bio 2P (control<45S5<Bio 2P) while of Runx2, OPN and OC was higher in 45S5 (control<Bio 2P<45S5). Bone formation was detected by the µ-CT parameters bone surface, bone volume and bone surface/bone volume only in Bio 2P treated defects without any difference between 4 and 8 weeks. Histology showed bone formation in some areas always in close contact with Bio 2P but the defects were not fully repaired even after 8 weeks. Bio 2P stimulates OB to express bone markers and to produce mineralized matrix compared to 45S5. Despite its potential to induce OB differentiation 45S5 was slightly superior. The in vitro results may explain the bone formation induced by Bio 2P in non-repairing defects making it a good choice as scaffold in bone tissue engineering.