RCI89

Periodontal regeneration using gingival stem/progenitor cells in conjunction with IL-1ra-hydrogel extracellular matrix

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Aim: The present study investigated the periodontal regenerative potential of gingival-margin-derived-stem/progenitor cells (G-MSCs) in conjunction with IL-1ra releasing hyaluronic acid synthetic extracellular matrix (HA-sECM).

Material and Methods: Periodontal defects were induced at four sites in eight miniature-pigs in the premolar/molar area (–4 weeks). Autologus G-MSCs were isolated from the free gingival margin and magnetically sorted using anti-STRO-1-antibodies. Colony-formation and multilineage differentiation potential were tested. The G-MSCs were expanded and incorporated into IL-1ra-loaded/unloaded HA-sECM. Within every miniature-pig, four periodontal defects were randomly treated with IL-1ra/G-MSCs/HA-sECM (test-group), G-MSCs/HA-sECM (positive-control), scaling and root planning (SRP; negative-control-1) or left untreated (no-treatment; negative-control-2). Differences in clinical attachment level (ΔCAL), probing depth (ΔPD), gingival recession (ΔGR), radiographic-defect-volume (ΔRDV) and changes in bleeding on probing (BOP) between baseline and 16-weeks-post-transplantation, as well as periodontal attachment level (PAL), junctional epithelium length (JE), connective tissue adhesion (CTA), cementum regeneration (CR) and bone regeneration (BR) per treated root area 16-weeks-post-transplantation were evaluated.

Results: G-MSCs showed stem/progenitor-cell characteristics. IL-1ra loaded and unloaded G-MSCs/HA-sECM showed significant periodontal regeneration with statistically higher ΔCAL [Median: 5 mm (Q25/Q75: 4.3/6.8) and 5 mm (3.0/6.0) respectively], ΔPD [4 mm (4.0/7.5) and 5 mm (3.3/5.8) respectively], ΔGR [0.5 mm (−0.75/1.75) and 0 mm (0.0/1.0) respectively], PAL [62.3% (49.2/71.2) and 45.2% (36.3/70.1) respectively], CR [67.7% (56.0/85.0) and 59.7% (37.9/70.1) respectively], BR [68.4% (49.2/75.8) and 37.9% (27.0/60.0) respectively] and a lower JE [0.0% (0.0/0.0) and 18.4% (16.7/41.7) respectively] compared to the negative controls ($p < 0.05$; Mann–Whitney) and improved BOP ($p < 0.05$; McNemar).

Conclusion: G-MSCs in conjunction with IL-1ra-loaded/unloaded HA-sECM show a significant periodontal regenerative potential in vivo.

RCI90

Behaviour of human mesenchymal stem cells on calcium phosphosilicate scaffolds in vitro bone tissue engineering applications

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Aim: To evaluate the viability, adhesion and proliferation of human mesenchymal stem cells (MSC) on porous three-dimensional (3-D) calcium phosphosilicate (CPS/bioglass) bone substitutes in vitro.

Material and Methods: Human bone marrow-derived MSC (passage 3–4) characterized by marker-expression (CD105, CD73, CD90) were used in this study. CPS scaffolds (Novabone®) were preconditioned in basal medium for 24-h prior to seeding with MSC (1×10^4 cells/scaffold). Equivalent cells in 2-D culture were used as a control. Cell adhesion, viability and proliferation on scaffolds were evaluated by scanning electron microscopy (SEM), colorimetric trypan blue (TB) and MTT assays, respectively, at various time-points. Experiments were performed in triplicates and statistically analysed at a 0.05 significance level.

Results: MSC seeded on 3-D CPS scaffolds demonstrated characteristic fibroblastic morphology, and favourable attachment and spreading after 48–72 h. The scaffolds demonstrated well-defined, interconnected pore structures into which cellular ingrowth was observed (SEM). A majority of MSC on the scaffold were viable, with no evidence of cytotoxicity (TB-assay) after 1-, 3-, 5- and 7-days, comparable with cells in 2-D culture. Concurrently, a progressive increase in cell metabolic-activity (MTT-assay) suggested active MSC proliferation, which was higher on CPS scaffolds than in 2-D culture.

Conclusion: Porous CPS bone substitutes support MSC viability, adhesion and proliferation in vitro, and warrant further investigation as potential bone tissue engineering scaffolds.