Osteogenic capacity of PLGA embedding simvastatin for biofunctionalization of titanium abutments

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Background

Even though the high success rate of oral rehabilitations using dental implants, the peri-implant bone loss can still be observed.¹ Biomaterials have been studied with incorporation of drugs that can be released locally and help the maintenance or the biological reestablishment of peri-implant tissues.² To obtain a greater marginal stability, a titanium surface coating was proposed as a biofunctionalized prosthetic abutment.

Aim

This study evaluates the capacity of 0.6% simvastatin (SIM), incorporated into polylactic co-glycolic acid (PLGA) on titanium (Ti) surface, to promote osteogenic differentiation of stem cells of human exfoliated deciduous teeth (SHED).

Methods and Materials

SHEDs were seeded on discs surface in culture plates with non-osteogenic medium and incubated at 37°C and 5% CO₂. In addition to experimental groups, three cell control groups were tested: SHED in non-osteogenic (N-OST) medium; SHED in osteogenic (OST) medium; and osteoblasts MC3T3-E1 in osteogenic medium.

Osteogenic Differentiation Analysis

Alkaline Phosphatase (ALP) Activity (ELISA Fluorimetric assay) → **3, 7, 10 days**

Bone Proteins Expression (ELISA assay) → **Osteonectin (ONT)** → **14, 21 days**
Osteocalcin (OCN)

The tests were performed in triplicate and the results were statistically analyzed by one-way ANOVA followed by Tukey's test ($p < 0.05$).

Results

SIM promoted the highest ALP activity at day 3 ($p < 0.0001$), while MC3T3-E1 group had the lowest. SHEDs with osteogenic and non-osteogenic medium and MC3T3-E1 demonstrated the lowest ALP activity at days 7 and 10 (Figure 1A). As shown in Figure 1B, Ti+PLGA+SIM0.6% group showed the highest OCN expression at days 14 and 21 ($p < 0.0001$). Ti+PLGA group promoted the highest expression of OCN at day 21 ($p = 0.0022$). All control groups presented the lowest OCN expression at days 14 and 21. According to Figure 1C, SIM promoted the highest ONT expression at day 14 ($p < 0.0001$). The lowest ONT expressions were presented by SHED N-OST followed by SHED OST and MC3T3-E1 OST at days 14 and 21.

Conclusions

Since SIM promoted the highest expressions of bone proteins and ALP activity at the most important experimental time, it can be concluded that biofunctionalization of Ti surface coated by PLGA incorporating SIM stimulated osteogenic differentiation of mesenchymal stem cells and can be considered as a clinical option. In vivo and clinical future experiments must be carry out to confirm this clinical indication.

References

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