Optimization of Tenocyte Lineage-Related Factors from Mesenchymal Stem Cells

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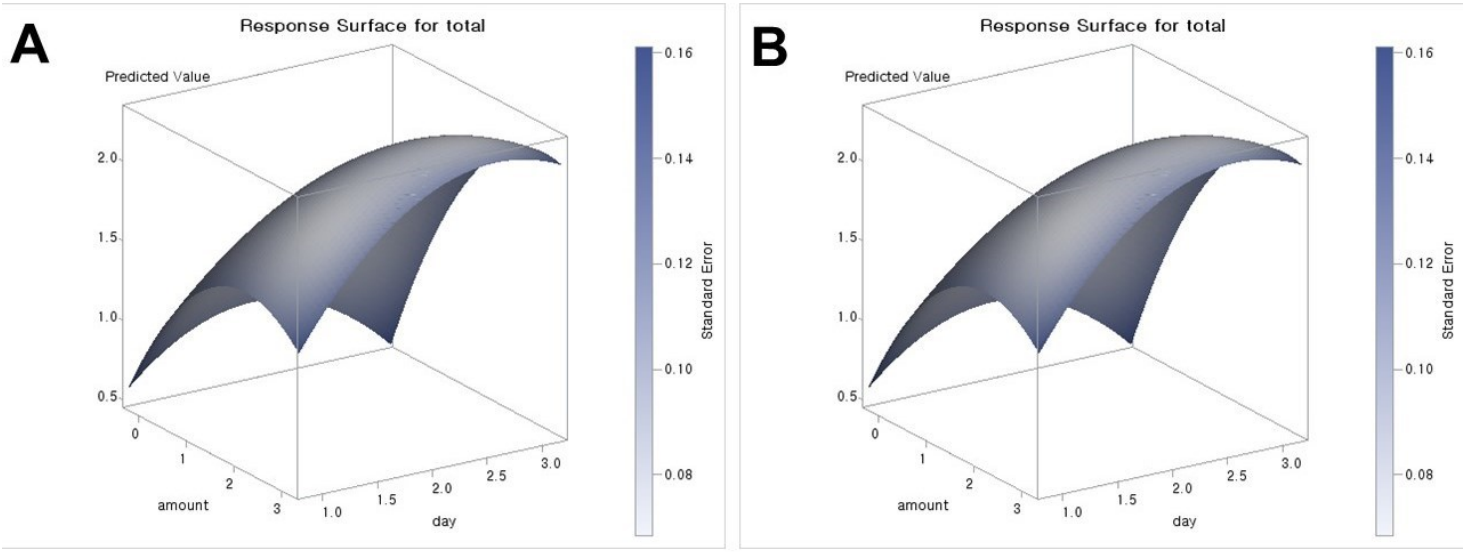
Introduction/Purpose: Researchers should consider various potential factors that affect tenogenic differentiation of MSCs. Numerous experimental settings are associated with high cost and time. Response surface methodology (RSM), a component in the design of experiments (DOE), is gaining recognition as a powerful tool in optimizing conditions for the production of industrially important products such as chemicals and enzymes. The purpose of this study was to access the differential effects of transforming growth factor beta 3 (TGF-β3) on the tenogenesis of tonsil-derived mesenchymal stem cells (T-MSCs) and bone marrow-derived mesenchymal stem cells (BM-MSCs) using RSM.

Methods: Bone marrow was collected from four patients (mean age: 79.0±2.2) and mononuclear cells were separated. The tonsillar tissues were collected from four patients (mean age: 7.6±0.6). After isolation of MSCs, they were treated with 5ng/ml and 10ng/ml of TGF-β3 with vehicle control. The full-factorial experimental design was employed to study the effect of tension based on T-MSCs. The design was composed of three levels being coded as -1, 0 and +1 and a total of 18 runs were carried out in duplicates to optimize the level of chosen variables, such as days and amount. A total of 84 trials were utilized and fitted with RSM; they were then used to obtain mathematical prediction models.

Results: Exposure of TGF-β3 to T-MSCs and BM-MSCs resulted in an increase in the expression of SCX, TNMD, decorin, collagen I, and tenacin C. Most tenocyte lineage-related factors from T-MSCs and BM-MSCs presented a maximum increase in 2-3day treatment. Considering all of tenocyte lineage-related factors that we assessed, the predicted value of the factors was significantly induced at 2.7 ng/mL of TGF-β3 ($p < 0.001$) on 2.5-day culture ($p = 0.001$). (Fig A) Considering all of tenocyte lineage-related factors that we assessed, the predicted value of the factors was significantly induced on 2.3-day culture ($p = 0.004$) regardless of the concentration of TGF-β3. (Fig B)

Conclusion: We demonstrated that tenocyte-like cells can be successfully differentiated from T-MSCs and BM-MSCs under TGF-β3 stimulation. This study demonstrated that T-MSCs and BM-MSCs in tenogenic stimulation with TGF-β3 have a similar tenogenic differentiation potential using RSM.



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