

Jaw periosteal cells: a suitable source for mesenchymal stem cells?

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INTRODUCTION: Jaw periosteal cells (JPC) could be an alternative to mesenchymal stem cells for the engineering of cell-based osteoinductive grafts. Harvest of the jaw periosteum is simple and causes minimal morbidity. The aim of this work is to exactly characterize the differentiation process and to examine the requirement of bone morphogenetic protein-2 (BMP-2) for the stimulation of the osteoblast phenotype of JPC.

METHODS: Biopsies of jaw periosteum were obtained during maxillofacial routine interventions (n=8). Three groups were analysed: 1) untreated JPC, 2) JPC treated with differentiation medium (OB) and 3) JPC treated with differentiation medium and BMP-2 for the initial 10 days (OB/BMP-2). Proliferation rates of JPC after day 5, 10 and 20 of differentiation were analysed using an MTT-based assay. Quantitative PCR for the expressions of several genes related to osteogenesis were analysed after day 5, 10 and 20. Deposited calcium release of osteoblast progenitor cells was stained by use of alizarin after 20 days of differentiation and photometrically quantified.

RESULTS: 5 days after initiation of differentiation, no relevant differences between proliferation rates of differentiated and untreated JPC were observed. After 10 days of differentiation, both JPC treated with differentiation medium only and those additionally induced with BMP-2 revealed reduced proliferation rates. When gene expression was taken into consideration, a couple of growth and transcription factors were induced in differentiated JPC during osteogenesis. We found several genes to be susceptible to BMP-2, such as osterix (Osx), cartilage oligomeric protein (COMP), type I collagen (coll I), type XI and XII collagen (coll XI, coll XII). Semi-quantitative analyses of von Kossa stainings showed a stronger mineralization in JPC being additionally induced with BMP-2 in

comparison to those differentiated in the absence of this osteogenic inducer. These results were confirmed by quantitative measurements of alizarin stainings. However, we found large interindividual varieties in the capacity of different patients to mineralize in vitro (Fig. 1).

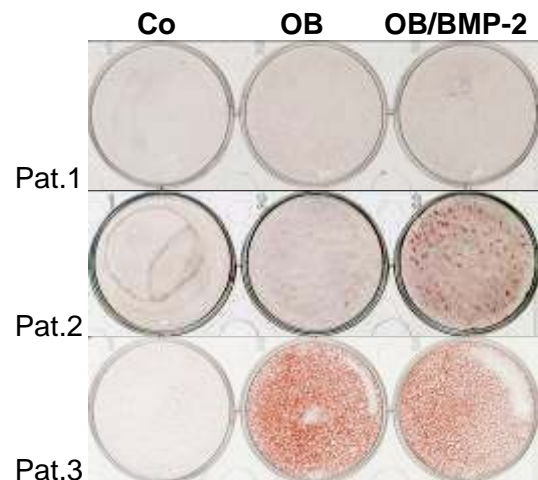


Fig. 1: Alizarin staining of untreated (Co) and differentiated (OB; OB/BMP-2) JPC from three different patients. The red colour denotes the calcium precipitates.

DISCUSSION & CONCLUSIONS: Our experiments support the requirement of BMP-2 for osteoblast differentiation of JPC and indicate that BMP-2 accelerates and intensifies the response of periosteal cells only induced with differentiation medium. On the other side, more research work is needed to characterize periosteal cells as a source of stem cells. Specific surface marker should be found to facilitate the isolation of a pure population of periosteum-derived stem cells. At present, the disability to obtain a pure stem cell population could lead to failure of tissue engineering applications using this cell type. We concluded that an osteogenic mineralization test should be carried out in vitro before each application of tissue engineering using this cell type.