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Stronger osteogenesis of induced pluripotent stem cell-derived MSCs as compared to dental follicle stem cells

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Bone loss is a common consequence of long lasting teeth loss. Fixation of dental implants requires a sufficient vertical and transversal bone level to guarantee long-term success. Autologous material cannot always be provided and xenogenic acellular material still fails to provide satisfactory durable results for the osseointegration of implants. A promising cell source is stem cells differentiated towards the osteogenic lineage. We could show that dental follicle-derived mesenchymal stem cells (DFCs) are already committed towards hard tissues and therefore a better source than mesenchymal stem cells. However, dental follicle cells are only available in the young or from allogenic donors. With the discovery of iPS cell generation in 2006, a new promising autologous cell source was established. iPS cells might be superior to DFCs due to their easy, non-invasive harvest, their infinite self-renewal, and their pluripotency. In this study the osteogenic differentiation potential of induced pluripotent stem cells was compared to that of dental follicle-derived mesenchymal stem cells. Both, DFCs and iPSC-derived iMSCs express the positive markers CD73, CD90, and CD105 recommended by the International Society for Cellular Therapy to define MSCs. IPS cells were shown to be pluripotent by immuno-fluorescent detection of pluripotency markers. Successful differentiation of these cells towards iMSCs was evaluated by RT-PCR with the respective markers. Both stem cell types were able to differentiate towards the osteogenic lineage as verified by Alizarin Red S staining. Several purinergic receptors were shown to be involved in osteogenesis, in particular the P2X7 subtype in DFCs. In both cell types P2X5 was down-regulated. Remarkably, another subtype, P2X3, is upregulated during the differentiation process towards osteoblasts in iPSCs and iMSCs. Interestingly, iMSCs exhibit an even stronger osteogenic capacity compared to DFCs. DFCs are derived from wisdom teeth and therefore, it is unlikely that they can be obtained from the respective patient. On the other hand, these cells have the advantage to be juvenile cells with a high proliferation capacity. However, iPS cells have an even higher proliferation capacity and can be reprogrammed from the patient's own cells. Here, we show for the first time that also their osteogenic capacity is better as that of other adult stem cells. This makes them an attractive cell source for bone replacement and dental implants in the future.

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