Optimisation of Osteogenic and Chondrogenic Differentiation Potential Using Clonal Mesenchymal Stem Cell Populations Derived from Synovial Fat Pad

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INTRODUCTION: Mesenchymal stem cells are a potential source of cells for the repair of bone and articular cartilage defects. We have previously demonstrated that the infrapatellar synovial fat pad is a rich source of mesenchymal stem cells and these cells are able to undergo osteogenic and chondrogenic differentiation [1, 2]. Although synovial fat pad derived mesenchymal stem cells may represent a heterogenous population, clonal populations derived from the synovial fat pad have not previously been studied.

METHODS: Mesenchymal stem cells were isolated from the infrapatellar synovial fat pad of a patient undergoing total knee arthroplasty and expanded in culture. Six clonal populations were also isolated before initial plating using limiting dilution and expanded. The cells from the mixed parent population and the derived clonal populations were characterised for stem cell surface epitopes, and then cultured in osteogenic medium for 21 days and as cell aggregates in chondrogenic medium for 14 days. Gene expression analyses; alizarin red staining; alkaline phosphatase, glycosoaminoglycan and DNA assays; and immunohistochemical staining were determined to assess osteogenic and chondrogenic responses.

RESULTS: Cells from the mixed parent population and the derived clonal populations stained strongly for markers of adult mesenchymal stem cells including CD44, CD90 and CD105, and they were negative for the haematopoietic marker CD34 and for the neural and myogenic marker CD56. Aa variable number of cells were also positive for the pericyte marker 3G5 both in the mixed parent and clonal populations. The clonal populations exhibited a variable osteogenic and chondrogenic response; two clonal cell populations exhibited a significantly greater osteogenic response, and one clonal cell population exhibited a significantly greater chondrogenic response when compared with the mixed parent population. Results for immunohistochemical staining for collagen I, collagen II, and aggrecan, and Safranin O staining for the six clonal populations and the mixed population are shown in the figure.

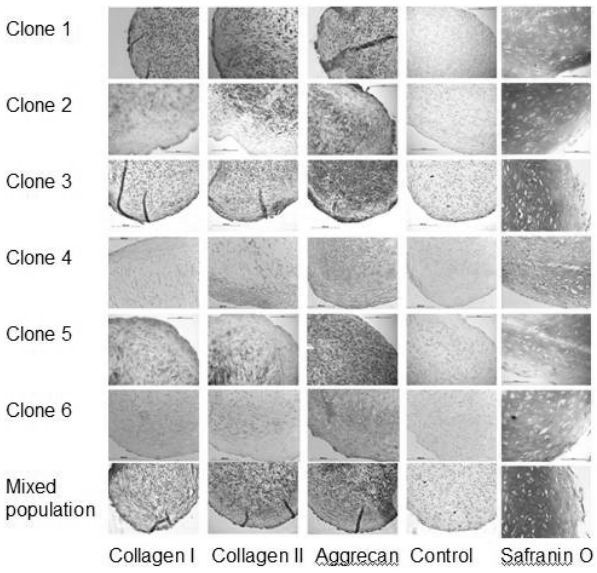

Figure: Immunohistochemical staining for collagen I, collagen II, and aggrecan, and Safranin O staining for the six clonal populations and the mixed population.

DISCUSSION & CONCLUSIONS: Pericytes are a candidate stem cell in many tissue and our results show that all six clonal populations derived from the heterogenous synovial fat pad population express the pericyte marker 3G5. The variable osteogenic and chondrogenic responses suggest inherent differences between these populations. The osteogenic and chondrogenic potential of the synovial fat pad could be optimised by the identification of clonal populations with a propensity to differentiate down particular differentiation pathways.

REFERENCES: [1] Khan W.S., Tew S.R., Adesida A.B. & Hardingham T.E. (2007) Human infrapatellar fat pad-derived stem cells express the pericyte marker 3G5 and show enhanced chondrogenesis after expansion in FGF-2. *Arthritis. Res. Ther.* 10, R74. [2] Khan W.S., Adesida A.B., Tew S.R. & Hardingham T.E. (2009) The epitope characterisation and the osteogenic differentiation potential of human fat pad-derived stem cells is maintained with ageing in later life. *Injury.* 40, 150-7.