THE PROLIFERATION AND TENOCGERIC DIFFERENTIATION POTENTIAL OF HUMAN BONE MARROW-DERIVED MESENCHYAL STROMAL CELLS BY UNIAXIAL CYCLIC TENSILE LOADING

NH Yin¹, BP Murphy², Azlina AA¹, AM Merican¹, T Kamarul*¹

¹Tissue Engineering Group, NOCERAL, Department of Orthopaedic Surgery, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.
²Department of BioMedical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia.

1.0 Introduction

When tissues are not mechanically loaded for a long period of time, disuse atrophy and in some cases tissue degeneration inevitably occur resulting in the complete loss of their physiological function (3). It has been previously demonstrated that mechanical stimuli is important for multipotent progenitor cells, such as hMSCs, to maintain good tissue homeostasis and enhance tissue repair processes. In tendons, this is achieved by promoting cellular proliferation and tenogenic expression/differentiation. However, the exact loading conditions needed to achieve optimal proliferation rates and tenogenic differentiation until today remains unknown. To determine this, we therefore conducted a study to investigate the effects of mechanical uniaxial stretching using different strains on the proliferation and differentiation of hMSCs in vitro, without applying any biochemical factors or enhancers.

2.0 Materials and Method

hMSCs were isolated, expanded, and subjected to cyclical uniaxial stretching of 4 %, 8 % or 12 % strain at 1 Hz for 6, 24, 48 or 72 hours. Cell proliferation were analyzed using alamarBlue® assay whilst hMSCs differentiation was analyzed using total collagen assay and specific tenogenic gene expression markers (type-I collagen, type-III collagen, decorin, tenascin-C, scleraxis, and tenomudulin).

3.0 Results

Cell proliferation was highest when 4% strain was applied. However, at 8% strain, collagen production and the tenogenic
gene expression was found to be highest. In both instances maximal change was observed after 24 hours of stretching.

4.0 Discussions & Conclusions

Our results suggest that 4% strain and at 1 Hz cyclic uniaxial loading increases cell proliferation, but 8% strains are required for superior tenogenic expressions. Although the results are preliminary, this study suggests that hMSCs subjected to certain loading regimes can be applied clinically to enhance tendon healing or at least prevent tendon degeneration through the increase in tenocyte-like activities and the expression of potential tendon proteins.

Acknowledgement

This work was supported by HIR-MOHE research grant initiative, and University of Malaya postgraduate student grant (PS260/2010B). We also thank the University of Malaya for a PhD thesis scholarship for the first author.

References

