The Effects of Adipose Derived Stromal Cells with PCL Nano-tubes on Neurogenic Differentiation and Induction of Nerve Regeneration

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INTRODUCTION

Autologous nerve grafting has been applied as the best method of treating peripheral nerve defects but it has problems such as donor site morbidity. Thus, this research was planned in order to see if it is possible to culture adipose derived stromal cells(ASCs) and differentiate and multiply them to neuronal cells and to graft the neuronal progenitor cells and ASCs into nerve defects bridged with polycaprolactone (PCL) nano-tube in vivo and examine the effects of the grafting on nerve regeneration.

METHODS

Using ASCs, neurogenic differentiation was induced in a mono-layered culture medium containing neuronal induction agents.
In addition, we made a 15mm long defect in the sciatic nerve of 30 rats and connected a PCL nano-tube to the defect(Fig. 1).
Then, we grafted neuronal progenitor cells differentiated from ASCs to a group of rats(the experimental group 1), ASCs to another group of rats(the experimental group 2), and no cells to the other group (the control group). After 10 weeks from the grafting, nerve conduction velocity(NCV) and histological observations were made.

RESULTS

ASCs differentiated to the neuronal cells were observed in a monolayered culture. The NCV was improved more in the experimental groups after 10 weeks from grafting (exp 1 : 18.0000 ±7.4864 m/s, exp 2 : 17.4750 ±6.9259 m/s) than in the control group (4.3250 ±2.6174 m/s) (p<0.05). But, there was no statistical difference between experimental groups(p<0.05) (Fig. 2). Histologic(H&E, Toluidine blue staining) and immunohistochemistric(Nestin, MAP-2, GFAP) staining showed more regenerated nerve findings(Fig. 3).

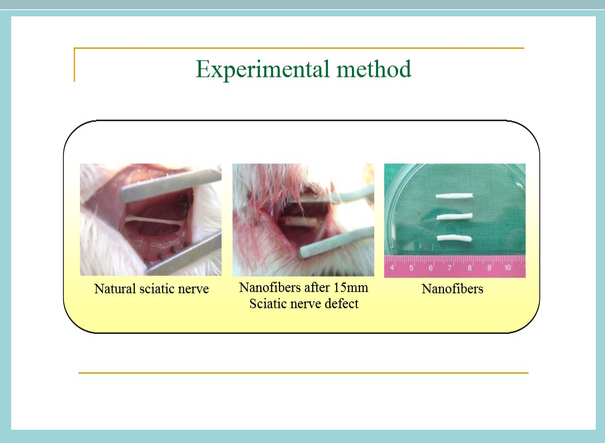
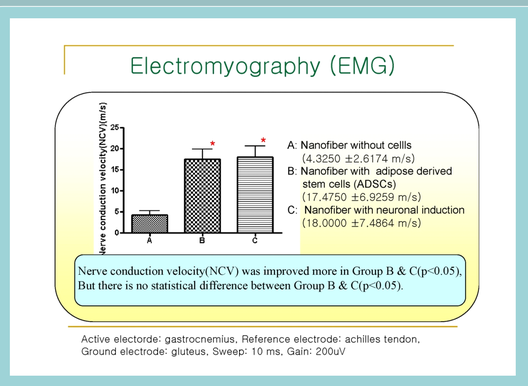


Fig. 1. Exposed sciatic nerve and PCL nano-tube.



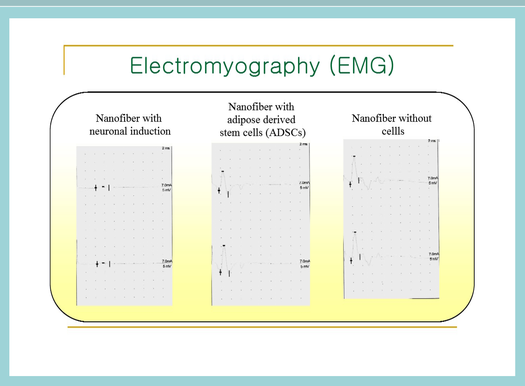


Fig. 2. EMG shows that nerve conduction velocity and action potential of experimental groups experimental groups were improved more than those of experimental group.

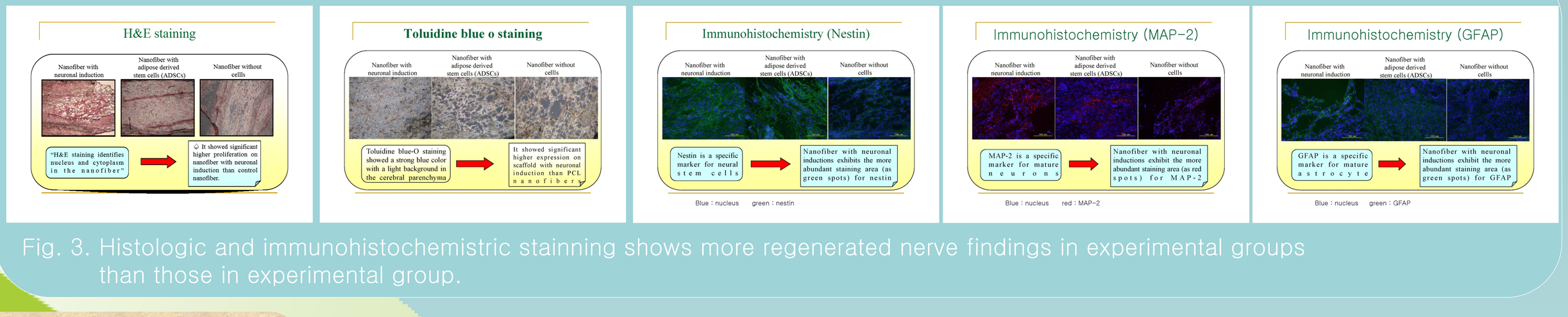


Fig. 3. Histologic and immunohistochemistric stainning shows more regenerated nerve findings in experimental groups than those in experimental group.

CONCLUSION

This research proved that ASCs could multiply and differentiate into neuronal cells. When they were grafted into nerve defects, the grafted cells were differentiated into Schwann like-supportive cells and contributed to peripheral nerve regeneration by an unknown mechanism, for example trophic factors and cytokines in vivo that might act on surviving host cells.
Further evaluation is needed to analyze the facts of grafted cells and clarify the mechanism of nerve regeneration. However, any functional improvement of this research gives much hope for the use of adipose tissue as an alternative source of neuronal cells for treating peripheral nerve defects.