

Development of Stem Cell Carriers for Bone Regeneration

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INTRODUCTION: In bone tissue engineering, three-dimensional scaffolds play an important role in directing stem cell attachment, growth and differentiation. As cell carriers, scaffolds not only provide a physical support for cell growth and load bearing *in vivo*, but also act as a vehicle for protein and gene delivery to facilitate the regeneration of functional tissue. Therefore, careful design of the composition, microstructure and surface properties of the scaffolds is crucial for their success [1].

The aim of this work was to develop bioactive scaffolds based on poly(ϵ -caprolactone) (PCL) for bone regeneration.

METHODS: Poly(ϵ -caprolactone) scaffolds were prepared by rapid prototyping (RP) technology.

The bioactive scaffolds were fabricated by incorporation of bioactive protein rhBMP-7 and by surface modification technique developed in our laboratory.

The release profile of rhBMP-7 from the scaffolds was evaluated using enzyme-linked immunosorbent assay (ELISA).

Cell attachment on the scaffolds was tested using MC3T3 and human mesenchymal stem cells. After culturing for 5 hours, the samples were studied by DAPI staining and scanning electron microscopy (SEM). For SEM measurements, the samples were fixed overnight in 3% glutaraldehyde in PBS at 4°C, and then dehydrated in a graded ethanol series. All the specimens were then sputter-coated with gold before being examined in a Philips scanning electron microscope 515 at a voltage of 10kV.

RESULTS: Pore size of the scaffolds prepared was in the range of 300-500 μm , which was optimised for bone regeneration [2].

For rhBMP-7 containing scaffolds, ELISA results revealed that the rhBMP-7 was released from the scaffolds for a period of over one month.

Examination of cell attachment on the scaffolds was performed by SEM and DAPI staining. Figure 1 shows the cells formed a confluent cell

layer on the modified scaffold, while there was much less cell attachment on the unmodified one. This was in good agreement with the results from DAPI staining (with 238 ± 133 and 2000 ± 493 cells attached on unmodified scaffold and modified scaffold respectively).

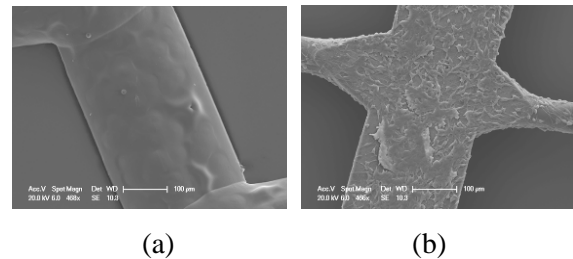


Fig. 1: SEM images showing the effect of surface modification on cell attachment on the scaffolds: a, control scaffold; b, modified scaffold

DISCUSSION & CONCLUSIONS: Bioactive polymer scaffolds have been developed by incorporation of growth factor and by surface modification. It was found that a sustained release of the growth factor from the scaffolds was achieved for a period of over a month. Surface modification of the scaffolds greatly improved cell attachment and growth. These scaffolds can be good candidates as stem cell carriers for bone tissue engineering applications.

REFERENCES

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