

Biodegradable PEG-PLGA/ hydroxyapatite/ tricalcium phosphate composites for injectable drug delivery systems

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Introduction

The clinical gold standard is bone auto-grafting, but autologous grafting can lead to donor site morbidity and limited donor site availability; allogeneic grafting can lead to infection. Polymer scaffolds or composites will be the best bone substitutes. Our early researches show that biodegradable hydrogels or microsphere comprehended hydroxyapatite(HAp), tricalcium phosphate(TCP) or other osteoconductive molecules will enhance bone defects repairing.^{1,2} The objective of our study was to investigate the in vivo performance of bone defects implanted with novel composite (thermo-sensitive hydrogel mPEG-PLGA /HAp/TCP).

Materials and Methods

Lactide and glycolide were purchased from Purac. mPEG, stannous octoate, hydroxyapatite and tricalcium phosphate were purchased from Sigma. The details of synthesis and characterization of mPEG-PLGA could be found early report.³

Novel composite bone substitutes comprised different ratio of thermo-sensitive hydrogel mPEG-PLGA/HAp/TCP: group I (hydrogel: HAp/TCP is 2:1, and HAp: TCP is 7:3), group II (hydrogel: HAp/TCP is 2:1, and HAp: TCP is 5:5), group III (hydrogel: HAp/TCP is 2:1, and HAp: TCP is 3:7).

Ten New Zealand White rabbits were created a bone non-union defect by drill at right femur bones. Thermo-sensitive hydrogel/HAp/TCP composite was implanted into rabbit bone defect. Radiological studies were performed at timed intervals (2, 4, 8, and 12 weeks). After 12 weeks follow-up time, histological studies of implanted PEG-PLGA was also assayed.

Results & Discussion

mPEG-PLGA are mixed with ceramic powder (HAp/TCP). This type of composite can inject into bone defects in minimum invasive surgery applications with lower pain.



Figure 1. mPEG-polyester/HAp/TCP injectable composite

The radiographic studies show that after 12 weeks post-operation, the group I defect is obscure under the x-ray, and seems that convalescence (Fig.2). However, the group III still has a obvious cavity. After μ CT analyzed, we have the same results (Fig.3).



Figure 2. radiographic studies. From left to right is autologous control, group I, group II and group III.

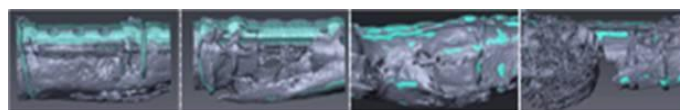


Figure 3. μ CT studies. From left to right is autologous control, group I, group II and group III.

Conclusion

The results validated the usage mPEG-PLGA hydrogel/HAp/TCP as bone substitute. Calcium ceramic with a ratio of HAP: TCP 7:3 had better osteoconductive bone formation than others but lesser than the auto-graft bone group. The next step of animal study will be verified the bone regeneration rate by BMP2 effecting.

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References

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