多孔質生物可吸收性聚左乳酸/氫氧基磷灰石複合材之研究：性質解析及活體內實驗

Physical Properties and In Vivo Study of Porous Biodegradable PLLA/ HA Composites

中文摘要

本研究乃利用燒結的方法製作多孔性氫氧基磷灰石(HA)燒結體，加入聚左乳酸(PLLA)後製成 PLLA/HA 的複合材，探討作爲生物硬組織可吸收性修補材料之物理性質及組織變化。複合材是以砂糖及食鹽當作 Filler/Binder，與 HA 混合後壓製(39kgf/cm2)成型，再以高溫燒結的方法製作多孔性的氫氣基磷灰石(HA)燒結體，浸入分子量 7.5 萬的聚左乳酸(PLLA)，從濃度 2%到 20%，讓聚左乳酸(PLLA)能漸漸地浸入 HA 燒結體的內外孔洞上，最終製成多孔質 PLLA/HA 複合材。再以 DSC, X-ray, 及 MTS 檢測，DSC 和 X-ray 可以證明 PLLA 和 HA 在處理後沒有轉變其他物質，MTS 測出本複合材強度可達 12 MPa。體外實驗顯示出時間越久，pH 值越低，乳酸也持續釋放。

複合材試樣滅菌後，以 Beagle Dog 爲主進行活體實驗，即把 PLLA/HA 及 pure HA 分別植入 14 隻 Beagle Dog 下顎骨 angle 部的 2x4x2 mm3 缺陷，以及一個不放任何材料的 control 組，在 1, 2, 3, 4, 9, 16, 26 週後取出觀察比較。組織反應方面，以 control 組修復的最快，在 9 週時就長滿新骨；其次是不加 PLLA 的 HA 燒結體，雖然在初期有些微纖維組織干擾，在 26 週時也長滿一半新骨；最差的則是加上 PLLA 的 HA 燒結體，雖然在偏光顯微鏡的觀察下，PLLA 隨著時間順利降解，但事實上一直到 26 週，才長滿骨細胞，而且整個骨組織的空腔常常包了纖維組織。所以本研究發現，PLLA 雖然可以增加 HA 燒結體的強度，在組織方面卻造成不必要的困擾。

英文摘要

The purpose of this study was to investigate tissue responses of porous poly(L-lactide) (PLLA)/ hydroxyapatite (HA) composites as biodegradable materials. The porous HA was obtained by mixing HA with the same amounts of sucrose as binder and salt as filler, pressing the mixure under 39 kgf/cm2 for 5 minutes, melting the sucrose at 220 C and sintering under 1345 C for 10 hours then. The obtained porous HA was immersed into graded PLLA solution series[1%, 5%, 10%, 20%] while the used PLLA was prepared via a thermal degradation method. Differential scanning calorimeter, material testing system, X-ray diffractometer were used to measure the physical properties of the composites. In vitro study suggested that PLLA might provide the acid environment to help HA to dissolve.

After sterilization, the composites are implanted into the 2x4x2 mm3 defects on mandible bones of 14 Beagle dogs. Two kinds of implants were used — HA with PLLA and without PLLA. 1, 2, 3, 4, 9, 16, 26 weeks after implantation, the samples were examined histologically by light microscopy. The results showed that new bone formation happened most fast in control groups, then HA-without-PLLA groups, slowest in HA-with-PLLA groups. PLLA/HA may not be good materials for bone grafts but the improved bending strength may be an advantage as implants.