Introduction

Bioresorbable materials are part of the fast developing area of spinal interbody cages. These materials bring many advantages compared to metallic cages such as radiolucency, reduced stiffness and biodegradation. A spinal cage should provide an appropriate biomechanical environment to facilitate interbody fusion. Previous studies have shown that bioresorbable PLA-based cages can provide adequate stability for spinal fusion. However, at present the best bioresorbable materials, the optimal cage stiffness and the desired period over which the cage should biodegrade are unknown. To evaluate the effect of polylactic acid polymer composition and internal stabilization on the rate and quality of interbody fusion, we performed a study of lumbar interbody fusion using PLA-based bioresorbable fusion cages in a goat model.

Materials and Methods

Interbody fusions were performed at the L3-L4 level in 35 skeletally mature Dutch milk goats. Titanium and poly(L-lactide-co-D,L-lactide) (70% L, 30% DL) PLDLLA cages (Macropore, San Diego, CA) were implanted at random as stand alone cages (SA). In addition, PLDLLA cages were implanted with anterior fixation (AF). The goats were sacrificed at three, six or twelve months. Radiographical, MRI, histologic and histomorphometric analyses were performed on retrieved segments. Degradation of the retrieved PLDLLA cages was assessed by chemical analysis. Beforehand, chemical and mechanical degradation of the PLDLLA cages were assessed in vitro.

Results

At three months, bone graft was almost completely remodeled in the PLDLLA cages. Endochondral bone formation was observed in all specimens. At six months, 50% of the PLDLLA SA cages and 83% of the PLDLLA AF cages were fused. At twelve months, 38% of the PLDLLA SA and 83% of the titanium cages realized fusion. Figure 1) A very mild and dispersed foreign body reaction was seen in all PLDLLA specimens.

E-beam sterilized PLDLLA cages degraded more rapidly in vivo as compared to both, PLDLLA cages in vitro, and EtO sterilized PLLA cages in vivo used in a previous study.

Conclusions

Within the three to six months time period, PLDLLA SA cages provided insufficient mechanical stability, which manifested as cracking and deformation of the cages and lower fusion rates. Supplemental internal fixation proved sufficient to obtain successful fusion with PLDLLA cages. In vivo degradation occurred at a faster rate than in vitro independently from AF. E-beam sterilized PLDLLA cages degrade faster than EtO sterilized PLLA cages. In all cases only a mild host response was seen, indicating good biocompatibility.

Reference


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