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In Vivo Evaluation of a Novel Citric-acid Based Implant for Osteochondral Defects

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Purpose*:* This is the first in vivo study to investigate a novel elastomeric composite of poly (1,8 octanediol-ctirate) (POC) with hyproxyapatite(HA) as a scaffold-alone treatment for osteochondral defects.

Hypothesis*:* POC-HA will be a biocompatible implant that provides a favorable environment for cartilage regeneration.

Significance*:* POC is an elastomer allowing its biomechanical properties to be controlled. A biomechanically favorable environment for cartilage regeneration is important for normal cartilage development.

Materials and Methods*:* Twenty-six rabbit knees, in which an osteochondral defect was created, were stratified into 3 groups. Group 1 received POC-HA plugs and sacrificed at 6 weeks for gross and histological analysis (n=14) and biomechanical analysis (n=3). Group 2(n=3) was sacrificed at 6 weeks for empty-defect control group. Group 3(n=3) received POC-HA plugs and sacrificed at 52 weeks for histological analysis. Histological analysis was made using scoring scales with the assistance of a pathologist. An indentation testing model was used for biomechanical analysis. T-test was used for statistical analysis with $p<0.05$ for a significant result.

Results*:* The mean gross score (max:10) of the 6 week POC-HA group was 8.86+/-0.66. There was no difference ($p=0.133$) between mean histological score (max:25) for 6-week POC-HA group (13.07+/-5.24) and the control (16.67+/-1.15). The POC-HA group had less chondrocyte clustering indicating formation of more organized cartilage than the control group ($p=0.026$). The 52-week POC-HA group had a mean score of 18.67+/-1.53 and was significantly greater than the 6-week POC-HA group ($p=0.047$). The stiffness and failure strength was greater at 6 weeks after implantation than at time zero ($p=0.027$, $p=0.043$ respectively).

Conclusions*:* POC-HA is biocompatible up to 52 weeks post-implantation. Higher histological subcategory scores indicate that the quality of regenerated tissue seems to favor the POC-HA group. POC-HA plugs displayed superior biomechanical properties at 6 weeks than 0 time-point control. POC is an elastomer allowing the stiffness of the product to be controlled. A more physiologic biomechanical scaffold can provide a better environment for hyaline cartilage growth.