Apatite Thin Film can Provide Good Cell Adhesion to Poly(vinyl alcohol) Hydrogel as an Artificial Articular Cartilage

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INTRODUCTION: In developing artificial cartilage (AC) (Fig.1), made from poly(vinyl alcohol) hydrogel (PVA-H) and titanium-made mesh mold [1], in particular, it is important to develop a method for imparting cell adhesion to certain areas of PVA-H surface because PVA-H itself has very poor biocompatibility. In this study, hydroxyapatite (HA) thin film 300nm thick was deposited by pulsed laser deposition technique (PLD) on AC. And the interaction between PVA-H and mouse fibroblasts and osteoblasts were examined by a cell culture method.

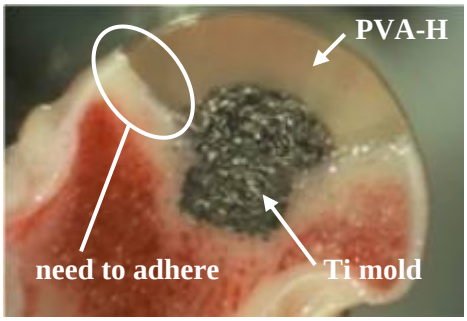

Fig. 1: PVA-H type artificial articular cartilage (AC). AC is implanted in femoral head of a canine.

METHODS: PVA-Hs were made from poly(vinyl alcohol) powder which has a degree of polymerization of 1700. They were gelled by a low-temperature crystallization method [2]. Plate shaped PVA-Hs were soaked in distilled water to hydrate for 48 h. 2 kinds of PVA-Hs, water content (WC) 33 and 53 wt%, and pure titanium plate used as media in the cell culture experiment were disc shape of 15.6 mm in diameter. Stoichiometric apatite ($Ca_{10}(PO_4)_6(OH)_2$) was then deposited to the surface of each of WC33, WC53 and Ti-plate samples through a common PLD technique [3] at a thickness of approximately 300 nm. 10000 cells of mouse fibroblasts (L929) and osteoblasts (MC3T3-E1) were cultured on the PVA-Hs and Ti-plates respectively. A commonly used tissue culture multidish was also used in a control group. The number of experiments for each culture condition was set at *n*=3, and the cells were stripped from media by trypsin at 24, 78, 120 and 168 h after beginning the culture. Then the number of viable cells was counted with a hemocyte meter.

RESULTS: Fig.2 is an example of L929 cell counts after 168 h in the WC33 samples. The cell counts of WC33+HA was 1.8 times larger than WC33non-HA. And furthermore, there was no significant difference of cell counts between the control group and WC33+HA group. Also in the osteoblast growth in the PVA-H samples, the cell counts were made to increase in comparison with the non-apatite group by the apatite deposition at 2.5 times. And also, alkaline phosphatase (ALP) activity and osteocalcin (OCN) production were increased significantly by the apatite deposition. In the case of titanium media, APL activity was increased slightly and OCN production was increased significantly by the apatite deposition.

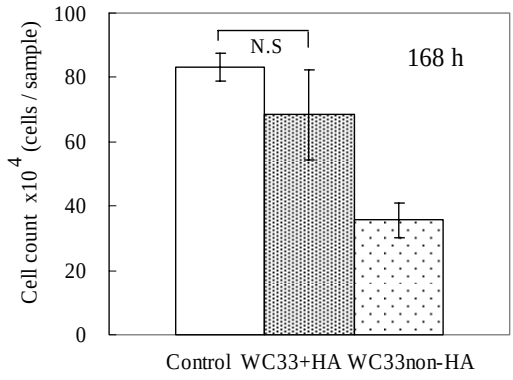

Fig.2: L929 cell counts after 168 h in the PVA-H-WC33 samples.

CONCLUSIONS: PLD technique can deposit hydroxyapatite thin film on AC. The effectiveness of the hydroxyapatite deposition on cell adhesion in both PVA-H and titanium medium was confirmed.

REFERENCES: [1] M. Oka, et al (1997) *J Bone Joint Surg* **76B**:*1003-7*. [2] K. Ushio, et al (2004) *J Biomed Mater Res* **68B**:*59-68*. [3] R.K Singh, et al (1994) *Biomaterials* **15**:*522-528*.