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분야 VI : Biofabrication/3D Printing

PO-206 **Magnetism guided fusion of stem cell spheroids to fabricate contraction modulatory macrotissue**

Hayeon Byun[1], Hyoryong Lee[2], Sukho Park[2], Heungsoo Shin[1,*]

[1]Department of Bioengineering, Hanyang University, Republic of Korea, [2]Department of Robotics Engineering, Daegu Gyeongbuk Institute of Science and Technology, Republic of Korea, hshin@hanyang.ac.kr

PO-207 **Biofabrication and application of photo-curable platelet lysate based bioink for Bioprinting**

S. J. Min[1], H. R. Nah[1], H. J. Moon[2], J. B. Bang[3], I. K. Kwon[2,*]

[1]Department of Dentistry, Graduate School, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea, [2]Department of Dental Materials, School of Dentistry, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea, [3]Department of Dental Education, School of Dentistry, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea, [*]Corresponding Author Email : kwoni@khu.ac.kr

PO-208 **3D Printed Extracellular Matrix Patches with Spatiotemporally Compartmentalized Multi-Growth Factors for Promoting Cerebral Angiogenesis**

Seung Hyeon Hwang[1], Jongbeom Kim[2], Chaejeong Heo[3], Hyeonji Kim[1], Chulhong Kim[4,*], Sun Ha Paek[5,*], and Jinah Jang[1,2,6,*]

[1]Department of Mechanical Engineering, Pohang University of Science and Technology (POSTECH), [2]Department of Convergence IT Engineering, POSTECH, [3]Center for Integrated Nanostructure Physics (CINAP), Institute for Basic Science (IBS), [4]Departments of Electrical Engineering, Mechanical Engineering, Convergence IT Engineering, and Interdisciplinary Bioscience and Bioengineering, and Medical Device Innovation Center, POSTECH, [5]Department of Neurosurgery, Seoul National University College of Medicine, [6]School of Interdisciplinary Bioscience and Bioengineering, POSTECH, [*]chulhong@postech.edu, paeksh@snu.ac.kr, jinahjang@postech.ac.kr

PO-209 **Fabrication of High-Resolution Microneedles Using 3D Printing for Transdermal Delivery**

Sang Min Choo[1] and Jae Hwan Jung[1,*]

[1]Department of Pharmaceutical Engineering, Dankook University, Republic of Korea, jjaehwan@dankook.ac.kr

PO-210 **3D Bioprinting of Hyaluronic Acid-Carboxymethylcellulose Bioink and Its Evaluation**

Orgilbold Baatarkhuu[1], Gopinathan Janarthanan[1,2], Hoyoun Kum[1], Insup Noh[1,2,*]

[1]Deptartment of Chemical and Biomolecular Engineering, Seoul National University of Science & Technology, Seoul 01811 Republic of Korea, [2]Convergence Institute of Biomedical Engineering and Biomaterials, Seoul National University of Science & Technology, Seoul 01811 Republic of Korea, [*]insup@seoultech.ac.kr

PO-211 **Additive manufacturing of chitosan-carboxymethyl cellulose bioinks for multilayered 3D bioprinting**

Gopinathan Janarthanan[1,2], Sechan Oh[1,2], JyHyun Kim[1], and Insup Noh[1,2,*]

[1]Deptartment of Chemical and Biomolecular Engineering, Seoul National University of Science & Technology, Seoul 01811 Republic of Korea, [2]Convergence Institute of Biomedical Engineering and Biomaterials, Seoul National University of Science & Technology, Seoul 01811 Republic of Korea, [*]insup@seoultech.ac.kr

PO-212 **Bioprinting on 3D Printed Titanium Scaffolds for Periodontal Ligament Regeneration**

Ui-Lyong Lee[1,2,†], Seokhwan Yun[3,†], Hua-Lian Cao[1], Geunseon Ahn[4,5], Jin-Hyung Shim[3,4], Su-Heon Woo[6] and Pill-Hoon Choung[1,*]

[1]Department of Oral & Maxillofacial Surgery, Dental Research Institute, School of Dentistry, Seoul National University, [2]Department of Oral & Maxillofacial Surgery, Chung-Ang University Hospital, [3]Department of Mechanical Engineering, Korea Polytechnic University, [4]Research Institute, T&R Biofab Co., Ltd., [5]Research Institute, Sphebio Co., Ltd., [6]R & D Center, Medyssey Co., Ltd., [*]Correspondence: smilemaker1@naver.com; Tel.:+82-2-535-6688 [†]These authors contributed equally to this work.

PO-213 **Fabrication of customized artificial 3D graft and evaluation of mechanical properties**

Ji Eun Lee[1], Chae Hwa Kim[1], Suk-Hee Park[2], Tae Hee Kim[1,*]

[1]Advanced Textile R&D Department, Korea Institute of Industrial Technology, Ansan, Korea, [2]School of Mechanical Engineering, Pusan National University, Busan, Korea, [*]thkim75@kitech.re.kr

PO-214 **Fabrication and analysis of poly-L-lysine grafted PLGA scaffold for sustained release of tauroursodeoxycholic acid to stimulate bone regeneration**

Hyejong Choi[1], Joohye Choi[1], Palem Ramassubba Reddy[1], Young-Kwon Seo[1,*] and Soo-Hong Lee[1,*]

[1]Department of Medical Biotechnology, Dongguk University, 32 Dongguk-ro, Ilsandong-gu, Goyang, Gyeonggi 10326, Republic of Korea, soohong@dongguk.edu

PO-206

Magnetism guided fusion of stem cell spheroids to fabricate contraction modulatory macrotissue

Hayeon Byun[1], Hyoryong Lee[2], Sukho Park[2], Heungsoo Shin[1,*]

[1]Department of Bioengineering, Hanyang University, Republic of Korea, [2]Department of Robotics Engineering, Daegu Gyeongbuk Institute of Science and Technology, Republic of Korea
hshin@hanyang.ac.kr

Biofabrication of macrotissue using scaffold-free cellular modules such as spheroids has been widely used in 3D tissue engineering. Among module assembly methods, using magnetic field has advantages of remote control and rapid assembly. However, long-term culture of assembled modules is challenging due to potential cytotoxicity of magnetic nanoparticles (MNPs) and cellular contraction may cause problems in applications such as tissue transplantation because the initial structure is hard to be maintained. In this study, we developed the method to fabricate contraction modulated magnetized stem cell spheroids using MNP coated synthetic fibers (MSFs) to assemble organ-like macrotissue. First, we successfully coated extracellular matrix-like synthetic nanofibers with MNPs and controlled magnetism of the fibers. We then fabricated composite spheroids using adipose derived stem cells and the MSFs and found maintained size of spheroids after 3 days with high viability (>90%). We also found controlled fusion of spheroids which contain MSFs after homotypic fusion. Finally, we assembled spheroids into ring and lamellar structure via magnetic assembly and found stable structure of the construct with high viability up to 50 days of culture. In conclusion, we expect that the composite spheroid fabrication method described here is a promising tool for biofabrication of organ-like structure.

PO-207

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S. J. Min[1], H. R. Nah[1], H. J. Moon[2], J. B. Bang[3], I. K. Kwon[2,*]

[1]Department of Dentistry, Graduate School, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea, [2]Department of Dental Materials, School of Dentistry, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea, [3]Department of Dental Education, School of Dentistry, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemum-gu, Seoul 02447, Republic of Korea
[*]Corresponding Author Email : kwoni@khu.ac.kr

Bioprinting systems involves the precise layering of cells, biologic scaffolds, and growth factors with the goal of creating bioidentical tissue for a variety of uses. However, its biocompatible, mechanical properties are a limiting factor associated with bioink. To overcome these limitations, we used platelet lysate (PL), obtained from platelet-rich plasma, containing bioactive molecules which enhance tissue regeneration. In addition, we synthesized PLMA through methacrylation to enhance mechanical property and prepared hydrogels via photo-crosslinking. Characterization of the PLMA hydrogel properties were examined using rheology, porosity, swelling assay. We found that the stiffness of PLMA hydrogel can be adjusted according to the degree of photo-crosslinking. *In vitro* assay demonstrated that the PLMA-based scaffold is biocompatible when applied as a bioink. Furthermore, to fabricate composite tissue, we deposited PCL followed by the positioning of cell-laden PLMA ink. As a result, we confirmed that the multilayer scaffolds fabricated by bioprinting not only have a stable structure but also a porous 3D construct in which encapsulated cells in PLMA ink can growth. Finally, we suggest that the developed PLMA bioink is considered to be a novel bioink with numerous potentials and can be applied in the field of tissue engineering.

PO-208

3D Printed Extracellular Matrix Patches with Spatiotemporally Compartmentalized Multi-Growth Factors for Promoting Cerebral Angiogenesis

Seung Hyeon Hwang[1], Jongbeom Kim[2], Chaejeong Heo[3], Hyeonji Kim[1], Chulhong Kim[4,*], Sun Ha Paek[5,*], and Jinah Jang[1,2,6,*]

[1]Department of Mechanical Engineering, Pohang University of Science and Technology (POSTECH), [2]Department of Convergence IT Engineering, POSTECH, [3]Center for Integrated Nanostructure Physics (CINAP), Institute for Basic Science (IBS), [4]Departments of Electrical Engineering, Mechanical Engineering, Convergence IT Engineering, and Interdisciplinary Bioscience and Bioengineering, and Medical Device Innovation Center, POSTECH, [5]Department of Neurosurgery, Seoul National University College of Medicine, [6]School of Interdisciplinary Bioscience and Bioengineering, POSTECH
[*]chulhong@postech.edu, paeksh@snu.ac.kr, jinahjang@postech.ac.kr

Significance of therapeutic angiogenesis has been spotlighted for brain ischemia, one of the most common causes of mortality in worldwide. However, effective strategies of mimicking angiogenesis have not been developed. Here, we developed a novel vascular-tissue-derived-decelluarized ECM (VdECM) based 3D-printed patch, sustained and sequential releasing two angiogenic growth factors (GFs) for promoting neovascularization. VdECM and methacrylated hyaluronic acid (HAMA) formed a hybrid biomaterial-ink (HAVEM-ink) via dual crosslinking; chemical crosslinking by aza-Michael addition and thermal crosslinking. The density of crosslinking was tailored by the ratio of HAMA, regulating releasing rate of encapsulated GFs. We 3D-printed with HAVEM-inks to fabricate spatiotemporal compartmentalized cerebral angiogenesis-inducing (SCAI) patch. Particularly, each VEGF and HGF laden HAVEM-inks was used to print outer and inner layers of 3-layered-disc patch, respectively, exhibiting to release VEGF first, followed by HGF for 30 days. The vitrified SCAI patch yields high mechanical strength (18.62 MPa), flexibility, and manageable, increasing transplantation efficiency at surgery. Consequently, the SCAI patch demonstrated angiogenesis-inducing property by enhancing angiogenic genes expression of HBMECs *in vitro* and successful time-dependent *in vivo* cerebral neovascularization for 14 days, monitored by OR-PAM. Overall, we expected our novel SCAI patch could be widely applied in various ischemic diseases and cerebral vascular diseases.

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Sang Min Choo[1] and Jae Hwan Jung[1,*]

[1]Department of Pharmaceutical Engineering, Dankook University, Republic of Korea, jjaehwan@dankook.ac.kr

In this study, we demonstrated a 3D printing-based dissolving microneedle patch (DMP) for transdermal drug delivery. Microneedle structure used as masters to make molds for DMP are mainly fabricated based on MEMS (microelectrochemical systems) technology. Although the conventional technology provides high-precision resolution in nanoscale, it requires expensive instrument and maintenance. Furthermore, the microneedle design has been difficult to revise and limited to be simple due to the process complexity. To address the issues, we employed stereolithography (SLA)-typed 3D printing to fabricate the microneedle structure designed by a CAD program. The shape of the printed microneedle was 1.21±0.02 mm in height, 0.49±0.01 mm in the base, 30.4±4.5 μm in diameter of the microneedle tip. There was an 8.5±0.8% difference between input (computer dimension) and output (3D printed dimension). A DMP negative mold was fabricated using polydimethylsiloxane (PDMS), then, 2% w/v sodium carboxymethylcellulose (CMC-Na) and 40% w/w polyvinylpyrrolidone (PVP) K-30 were utilized to manufacture DMPs. The DMPs were successfully fabricated with 1.18±0.01 mm in height, 0.49±0.01 mm in the base, and 32.35±4.79 μm in diameter of the tip. The DMPs penetrated the pig skin ex vivo and dissolved within 20 min.