Smart Ephys | multichannel systems a division of Harvard Bioscience, Inc.

Customer App Note

Multi-Well Electrode Array Restoration to Reconstruct Cardiomyocyte Networks for Repetitive Electrophysiological Studies

Authors: Viviana Zlochiver[1], Stacie Edwards[1], Rosy Joshi-Mukherjee[1,2]

1 Aurora Research Institute, Aurora Health Care; 960 N 12th Ave, Milwaukee, WI, 53233; USA

2 Department of Biomedical Engineering, College of Engineering and Applied Science, University of Wisconsin-Milwaukee, WI, 53211; USA

Contact information: Rosy Joshi-Mukherjee, rosy.joshi-mukherjee@aurora.org

Multiwell microelectrode arrays from Multi Channel Systems (MCS) were restored multiple times to reconstruct hiPSC-derived cardiomyocyte networks for repetitive electrophysiological studies. The 24 well array was subjected to Terg-a-zyme® cleaning solution with extensive sterile, double-distilled water wash to remove dead cell debris and residues and stored in 4 °C. Quality controlled cardiomyocytes ($3x10^4$ cells/well in a 5µl droplet) were plated in each well coated with fibronectin to form a syncytial beating network. Recordings were performed from the same array and after multiple reuses as shown in Figure 1. Baseline recording of the post-clean array and prior to replating was performed for quality check of electrodes and wells.

Signal-to-noise ratio was similar across multiple reuses. Field potential (FP) signals and action potential (AP) waveforms were recorded at a sampling rate of 10 and 20 kHz, respectively. FPs were recorded for a minute prior to electroporation and in continuation an electroporating pulse (1 V, 1 Hz, and 1 ms) was delivered for 30 s to allow for transition from FPs to APs and record for another minute for APs to revert back to FPs. All AP traces are selected 5 s post electroporation for consistency and a 10 s window was analyzed for various AP duration (APD) parameters using a custom Matlab script developed in the lab.

The recorded FP and AP signals across multiple reuses demonstrate the reliability of the array for repetitive electrophysiological studies (Figure 1). Simultaneous electroporation across 288 electrodes allows high-throughput AP waveform measurement for electrophysiological studies. Overall, we demonstrate efficient restoration of multiwell arrays that had no discernable detrimental effect on cell culture health or signal quality.

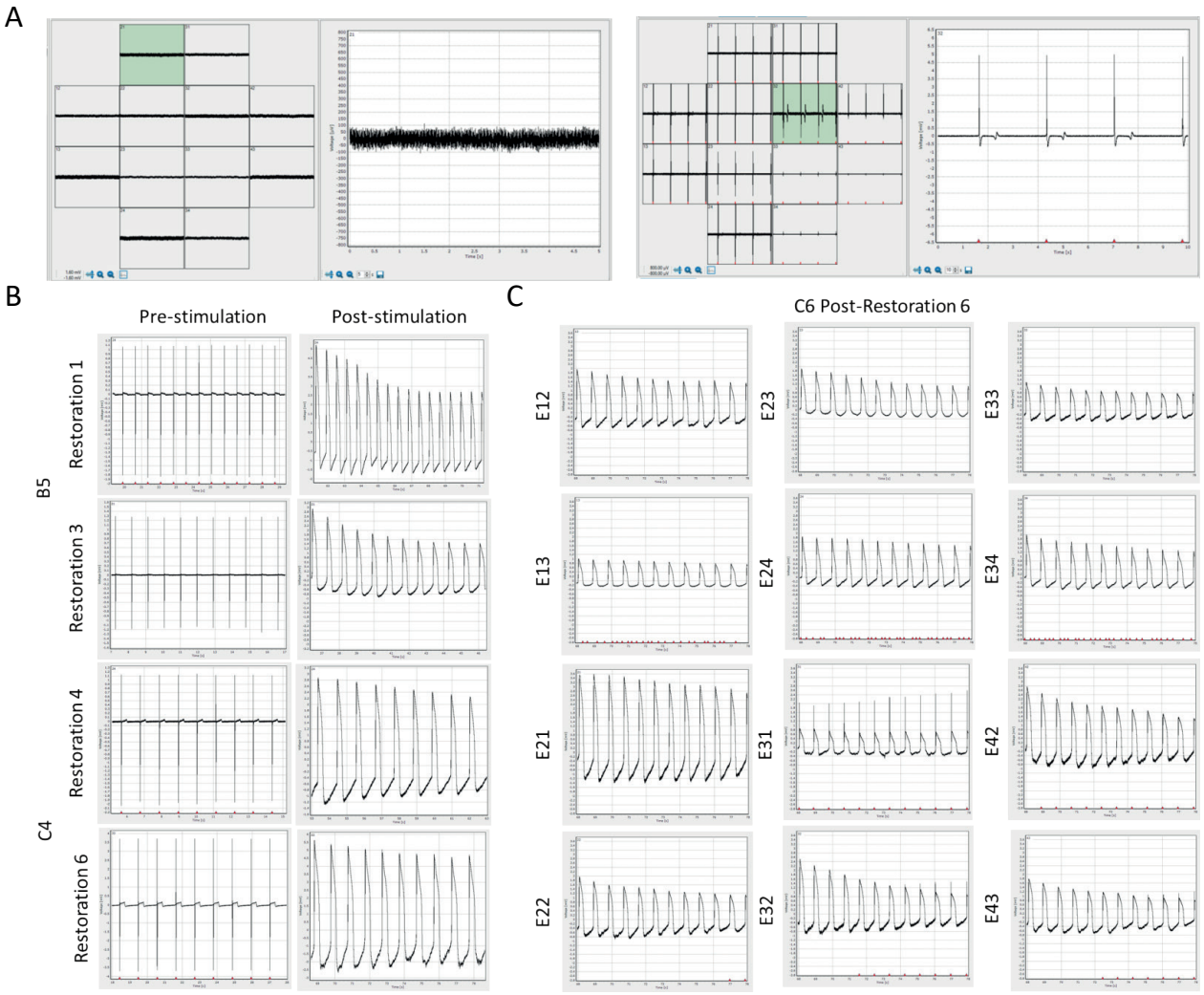

Figure 1:

FP and AP signals from the new and restored array are shown in A, B and C. The baseline signal of the new array shows minimal signal to noise ratio (left panel in A) and FP signals show the electrical activity of the network (right panel in A). The array after 1, 3, 4 and 6 reuses recorded for FPs and APs demonstrate successful regeneration. FP and AP signals from the same electrode after multiple reuses within a well demonstrate feasibility of the array for repetitive electrophysiological studies (B). Simultaneous electroporation can be employed to record APs across all electrodes in an array (C).

Multi Channel Systems
MCS GmbH
Aspenhaustrasse 21
72770 Reutlingen
Germany

Phone +49-7121-909 25-0
Fax +49-7121-909 25-11

sales@multichannelsystems.com
www.multichannelsystems.com