Shriners Hospitals for Children®
Boston, Massachusetts

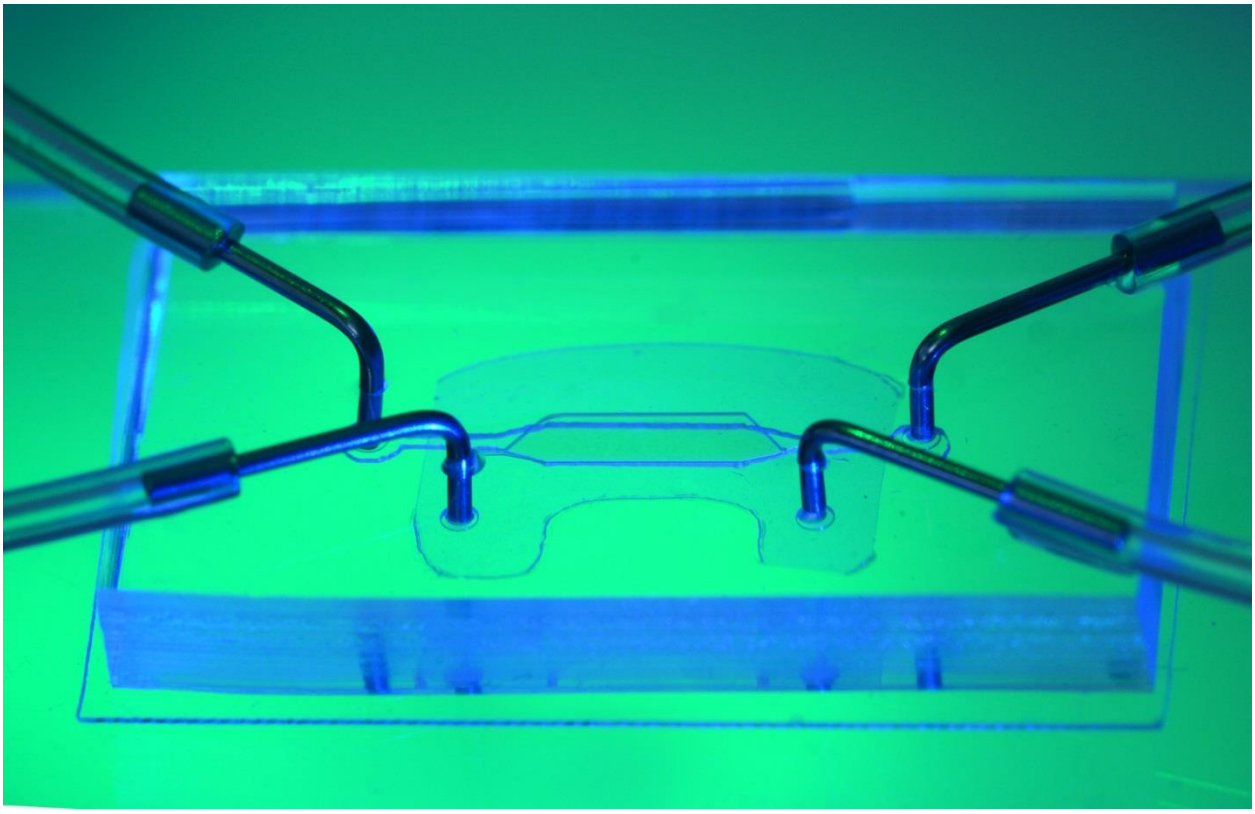
ORGANS-ON-CHIPS (MICRO-TISSUES)

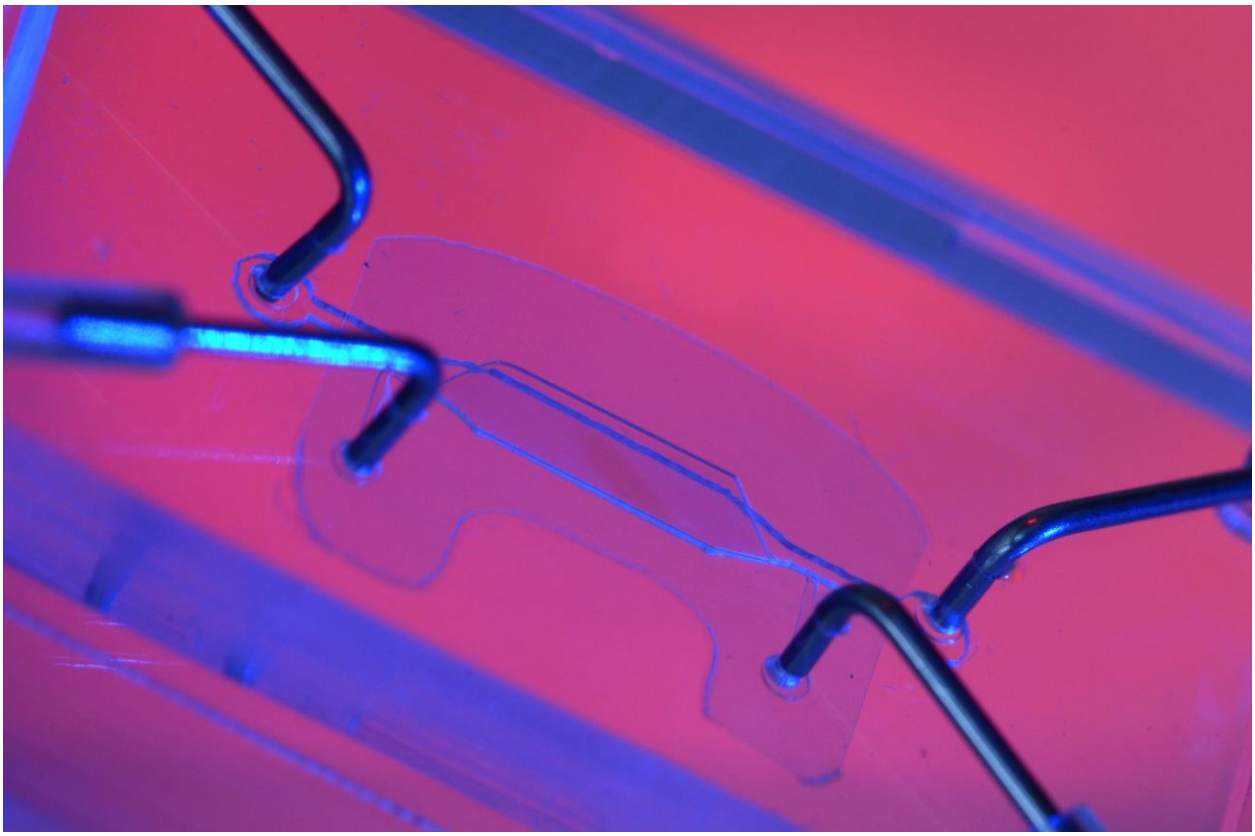
Microengineered organs-on-chips and organ arrays are engineered microsystems representing units of human organs recapitulating both their structure and physiology. The chips represent cutting edge technology fusing techniques borrowed from modern tissue engineering (Bio) and computer industry (MEMS) to create miniature models of living organ tissues on optically clear microchips (BioMEMS). Ranging in size from a quarter to a house key, the chips are lined by living cells and contain features designed to replicate the complex biological functions of specific organs.

At Shriners Hospitals for Children — Boston, our research group is one of the pioneers in the field, developing various organs-on-chips, including models of the liver, skin, brain and kidney. Our team recently developed a complex micro-liver model with primary human cells and also chartered new territory in materials science by creating an ultrathin-collagen coating to be used in such models. In our more recent work, our researchers are also showing how and why microenvironments are more suitable to develop organ models through their studies on cell-cell and organ-organ interactions along with their pioneering work on recapitulation of liver zonation in their micro-liver models. With our skin and brain models we are also pursuing questions in the unknown territories of in-vitro models where we tackle immune reactions (allergies) in skin and injuries such as traumatic brain injury.

Recent Publications

1. Usta OB, McCarty WJ, Bale S, Hegde M, Jindal R, et al. (2015) Microengineered cell and tissue systems for drug screening and toxicology applications: Evolution of in-vitro liver technologies. Technology 03: 1-26.
2. McCarty WJ, Usta OB, Luitje M, Bale SS, Bhushan A, et al. (2014) A novel ultrathin collagen nanolayer assembly for 3-D microtissue engineering: Layer-by-layer collagen deposition for long-term stable microfluidic hepatocyte culture. Technology 2: 67.
3. Hegde M, Jindal R, Bhushan A, Bale SS, McCarty WJ, et al. (2014) Dynamic interplay of flow and collagen stabilizes primary hepatocytes culture in a microfluidic platform. Lab Chip 14: 2033-2039.
4. Bhushan A, Senutovitch N, Bale SS, McCarty WJ, Hegde M, et al. (2013) Towards a three-dimensional microfluidic liver platform for predicting drug efficacy and toxicity in humans. Stem Cell Research & Therapy 4.
5. Dolle, Jean-Pierre; Morrison 3rd, Barclay; Schloss, Rene S et al. (2014) Brain-on-a-chip microsystem for investigating traumatic brain injury: Axon diameter and mitochondrial membrane changes play a significant role in axonal response to strain injuries. Technology (Singap World Sci) 2:106.





Images provided by Berk Usta, Ph.D