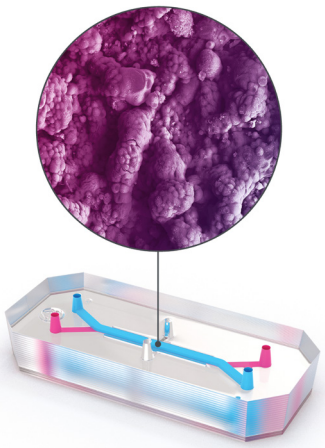
Emulate Duodenum Intestine-Chip S1 BioKit

Study drug toxicity in a primary-organoid-based model of the human small intestine



Overview

The human small intestine plays a critical role in human health and gastrointestinal disease but remains challenging to study due to the complex cell-cell interactions and dynamic conditions that drive duodenal functionality. The small intestine's intricate microanatomy, heterogeneous cell populations, and intestinal wall contractions are often not included in *in vitro* experimental models of the small intestine, despite their importance in both intestinal biology and pathology. The Emulate Duodenum Intestine-Chip addresses these challenges, as it is the only model that replicates *in vivo* human physiology by incorporating pre-qualified, biopsy-derived primary human organoids and duodenal endothelial cells in a dynamic, tissue-specific microenvironment. This model can be applied to study toxicity, understand disease mechanisms, and evaluate drug efficacy.

Model Configuration

The Emulate human Duodenum Intestine-Chip combines organoids and Organ-on-a-Chip technology to overcome many of the limitations of organoid suspension culture, including the lack of vasculature and mechanical forces. Organ-on-a-Chip technology enables researchers to recreate the intestinal microenvironment, resulting in improved cell morphology, functionality, and gene expression compared to organoid culture alone. The model features two parallel channels separated by an extracellular-matrix-coated porous membrane, enabling cell-cell interactions between epithelium and vasculature (see **Figure 1**). Vacuum channels alongside the culture channels allow users to apply cyclic stretch to recreate intestinal peristalsis.

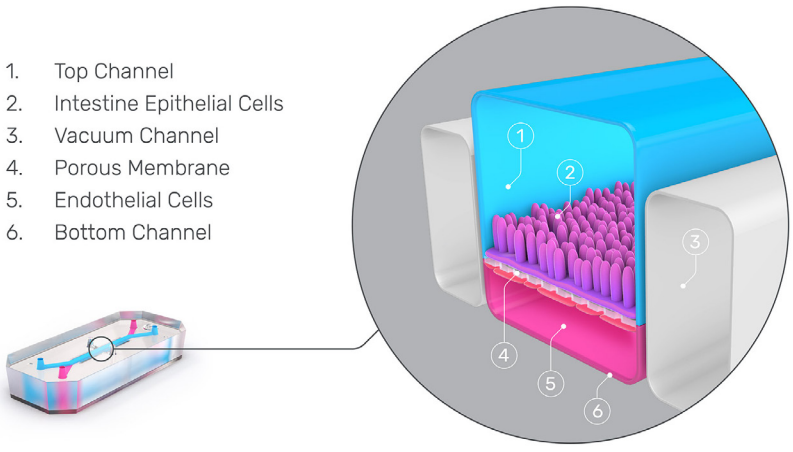


Figure 1: *Duodenum Intestine-Chip Cross Section.*

Model Characterization

Mechanical forces on the Duodenum Intestine-Chip provide an *in vivo*-relevant environment, resulting in improved model functionality compared to conventional cell culture. In this dynamic microenvironment, cells become well-polarized and exhibit *in vivo*-like morphology, functionality, and gene expression, while allowing for access to both the apical and basal surfaces. This contrasts with conventional cell cultures, which have limited and largely undifferentiated cell populations as well as a lack of physical stimuli.

- **Human-based advanced cell model:** Incorporates primary human cells to more closely model human characteristics, overcoming the translational challenges of animal models.
- **Physiologically relevant ratios of major cell types:** Recapitulates *in vivo* ratios and functions of major intestinal epithelial cell types—absorptive enterocytes, enteroendocrine cells, goblet cells, and Paneth cells (see **Figure 2**).
- ***In vivo*-like morphology and cytoarchitecture:** Closely resembles *in vivo* duodenal epithelium cytoarchitecture via microvilli and polarization, unlike Caco-2 models.

Learn more in the Duodenum Intestine-Chip Characterization Note.

Multilineage Epithelial Differentiation in the Duodenum Intestine-Chip

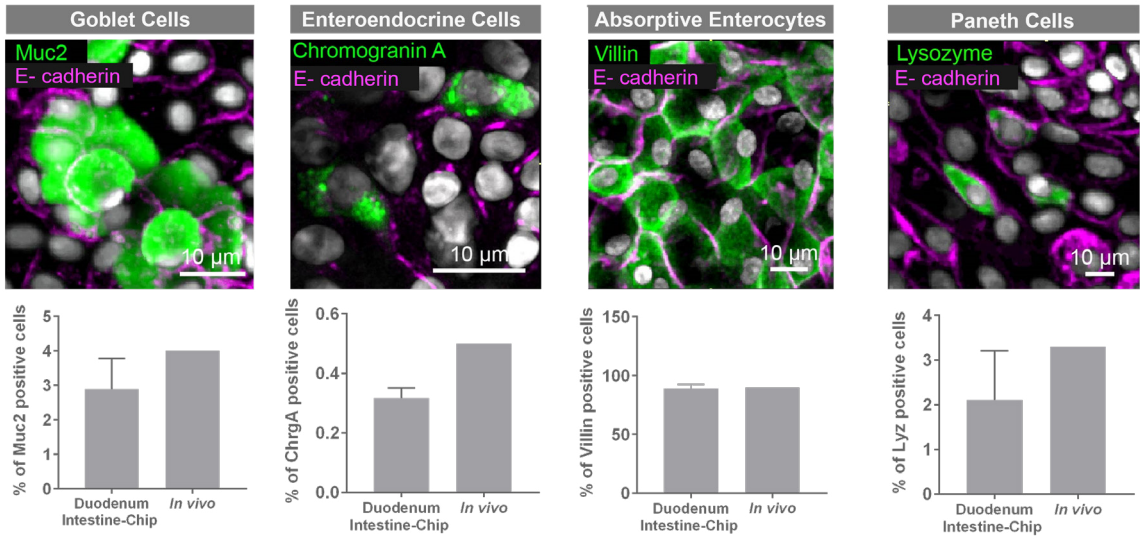


Figure 2: *Duodenal organoids differentiate into the four major intestinal epithelial cell types at ratios similar to human tissue. Cell ratios are based on 10 different fields of view counted in three individual chips (each from a different donor). Error bars = mean ± SEM.*

SUPPORTED APPLICATION

Toxicology

The Emulate human Duodenum-Intestine Chip has been characterized as a model of gastrointestinal toxicity—one of the most common side effects seen in clinical trials. Therefore, predicting the risk of intestinal toxicity as part of the preclinical drug candidate safety profile could help improve the quality of drug treatments and reduce unwanted side effects in the clinic. The Duodenum Intestine-Chip can be used to assess gastrointestinal toxicity by modeling:

- Morphological degradation (see **Figure 3**)
- Barrier disruption
- Release of cellular injury markers (see **Figure 4**)

Learn more in the Duodenum Intestine-Chip Toxicity Application Note.

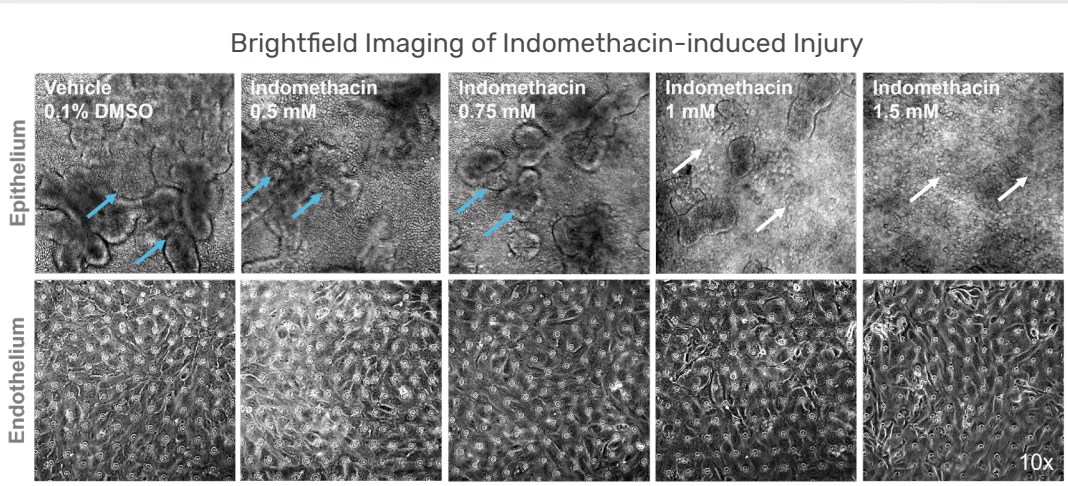


Figure 3: *Indomethacin induces a concentration-dependent epithelial injury and significant blunting of the villi-like structures. Blue arrows indicate healthy morphology. White arrows indicate morphological damage.*

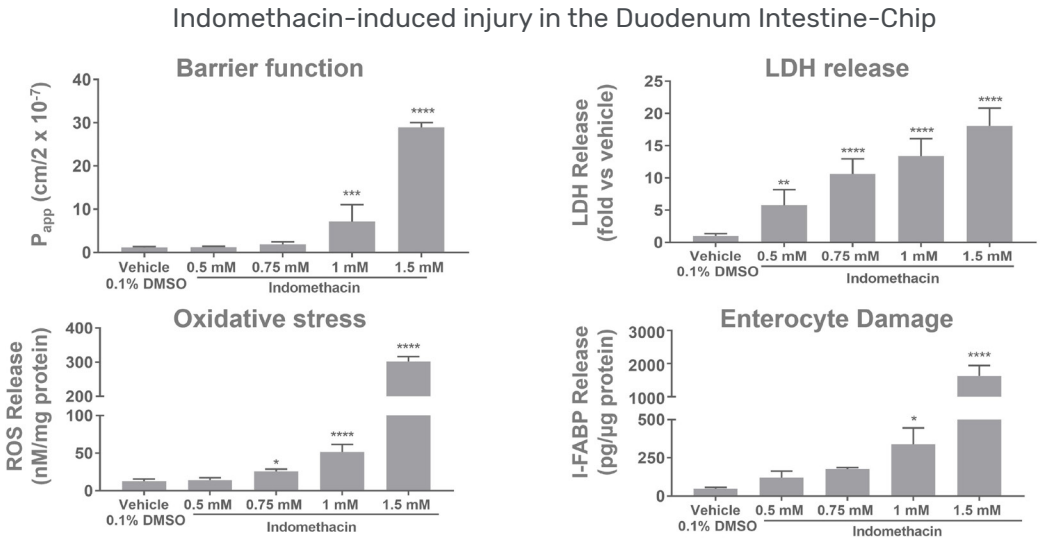


Figure 4: *The indomethacin-induced toxicity is also linked to greater epithelial apparent permeability and increased release of injury markers—like LDH reactive oxygen species (ROS), and I-FABP. 1-way ANOVA (n=4). *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001. Error bars = mean ± SEM.*

Part of the Human Emulation System®

The Duodenum Intestine-Chip is designed to be cultured using the Human Emulation System, a complete Organ-on-a-Chip solution that includes instruments, consumables, and software, providing the dynamic conditions needed to culture up to 12 Organ-Chips.

Duodenum Intestine-Chip Specifications

Specification	Details
Supported applications	Toxicology
Storage conditions	• Cells: Store in liquid nitrogen • ER-1® Reagent: -20°C • ER-2® Reagent: 2–8°C • Other kit components: Ambient temperature (15–25°C)
Shelf life	• Cells: Guaranteed for 6 months from date of shipment • Organ-Chip consumables: 2 years from date of manufacture • ER-1 & ER-2: 1 year from date of manufacture
Cell types	Biopsy-derived human duodenal organoids and primary small intestine microvascular endothelial cells
Characterization endpoints	• Immunofluorescent staining of intestinal cell types • qPCR and immunofluorescent analysis confirming key cell types and transporters • Barrier integrity (P_{app}, tight junction staining)

Ordering Information

Every Duodenum Intestine Bio-Kit includes the essential components needed to create the Duodenum Intestine-Chip—including pre-qualified cells—and is available in multiple sizes to meet various study needs.

To learn more, visit emulatebio.com/duodenum-intestine-chip

Product Name	Cells	Chips per Kit	Catalog Number
Duodenum Intestine Bio-Kit	Chip-S1® Stretchable Chips, Pod® Portable Modules, ER-1® / ER-2®, Steriflip® Filter, Emulate-qualified human cells: Biopsy-derived human duodenal organoids and primary small intestine microvascular endothelial cells.	12	BIO-DH1-C012