Pig Models

Pigs closely resemble humans in anatomy, physiology, and cognition, making them ideal for research in ischemic models, pain, wound healing, orthopedic models, FOB studies, and pharmacokinetic profiling. They are cost-effective and much more accessible than other large animals such as dogs and monkeys. The fields of medical device and pharmaceutical development have been shifting from using dogs and monkeys to working with pigs.

Domestic Pigs

Domestic pigs are cost-effective, relatively easy to work with, and offer great genetic variability. However, due to their rapid weight gain, studies are typically limited to around one month. Additionally, domestic pigs are juvenile and not sexually mature, which can limit their applicability for certain types of research.

Göttingen Minipigs

Göttingen minipigs are a miniature breed with a well-characterized genetic background. Their slower weight gain allows for standardized sizing and longer-term studies, including those involving sexually mature animals. They are commonly used in toxicology and PK studies, as well as research on chronic conditions such as pain, diabetes, and age-related diseases.

Purpose-Built Research Facility

Our 20,000-square-foot GLP facility, completed in 2021, is purpose-built for translational research. It features dedicated wings for rodent studies, large animal studies, in vitro work, and biomarker research. The pig housing wing features open-fenced pens and shared cognitive spaces to encourage natural social behavior, minimizing variability and supporting reproducible outcomes. The facility also includes advanced capabilities for neurophysiology, in vivo electrophysiology, ex vivo biomarker analysis, histology, and imaging. Surgical suites are fully equipped for complex procedures conducted by our team of expert surgeons with extensive experience in preclinical models.

Dosing Routes and Administration

We deliver strong preclinical data by designing rigorous and robust efficacy studies that consider dosing route, regimen, and reproducibility. Our preclinical pig models support a range of clinically relevant dosing routes to better reflect therapeutic delivery in human patients. These administration methods enhance study design and support targeted pharmacological evaluations.

- **Topical administration**
  Delivers compounds directly to the skin or surgical site for targeted, localized effects.

- **Intradermal and subcutaneous administration**
  Enables localized or controlled systemic delivery, commonly used for vaccines or depot formulations.

- **Intra-DRG injection**
  Delivers compounds to the dorsal root ganglion to evaluate effects on sensory neurons, commonly used in pain research.

- **Intravenous administration**
  Delivers compounds directly into the bloodstream for rapid systemic distribution and pharmacokinetic studies.

- **Intramuscular administration**
  Delivers compounds into muscle tissue for controlled systemic absorption, widely used in pig studies.

- **Epidural administration**
  Delivers compounds around the spinal cord for targeted pain or CNS evaluation.

- **Intrathecal administration**
  Delivers compounds into the cerebrospinal fluid for CNS-targeted therapies.

- **Oral administration**
  Delivers compounds via pills or liquids to mimic common human dosing, reflecting common clinical delivery methods.

Translational Pig Models

Model	Description
Post-Operative Pain	The flank incisional model involves creating an incision on the flank, ideal for assessing local and topical analgesics.[1] The leg incisional model includes an incision in the lower part of the dorsal-lateral part of the hind leg.[2] Both models allow for evaluation of peripheral nerve block efficacy, regional analgesics, and local wound care therapeutics.
Peripheral Neuritis Trauma-Induced Pain (PNT)	The peripheral neuritis trauma model is induced by placing pre-soaked CFA silk thread around the sciatic nerve to mimic chronic peripheral neuropathy. This model enables quantification of spontaneous pain behavior and hypersensitivity reversal using pharmacological treatments.[3]
Nerve Block	In the nerve block model, the sciatic nerve is surgically exposed for targeted dosing of anesthetics or analgesics.[4] This allows for precise screening of nerve-blocking agents and supports the development of localized therapies, including novel drug delivery systems and reversal agents.
Peripheral Nerve Repair	The model is created through dissection of the peroneal or tibial nerve, leading to neuroma formation. This model allows for the study of symptomatic neuromas and nerve repair devices such as nerve wraps, tube fillers, new tubes, ablation, or neuroinhibitory compounds.
Wound Healing: Excisional Wounds	Full-thickness wounds are created by removing skin and fascia, optionally including muscle retraction to replicate surgical wounds. This model supports evaluation of therapies aimed at improving local wound healing, such as a bandage, sponge, biologic.
Wound Healing: Incisional Wounds	Full-thickness wounds are created by removing skin and fascia, optionally including muscle retraction to replicate surgical wounds. This model is used to assess new adhesion materials or sutures for incision closure.
Wound Healing: Diabetic Wounds	Wounds are created in diabetic pigs to study impaired healing.[5] This allows for testing of advanced wound therapies, including chronic wound interventions under metabolic stress conditions.
Wound Healing: Burn Wounds	Controlled thermal injuries are applied to the skin to simulate burns. This model enables assessment of anti-inflammatory agents, re-epithelialization, and therapies supporting vascularization and nerve regeneration.[6]
Acute Kidney Injury	The acute kidney injury model is induced via nephrectomy of one kidney and temporary occlusion of the other. This model mimics ischemia-induced renal dysfunction and enables evaluation of nephroprotective agents, renal biomarkers, and post-injury recovery strategies.
Spinal Cord Injury	Spinal cord injury is induced by calibrated contusion at the T10 vertebral level. Animals are then monitored over several months using computerized gait analysis, behavioral scoring, and electrophysiological assessments.

1. Castel et al., *Eur J Pain*. 2014 Apr;18(4):496-505.
2. Castel et al., *J Anesth Surg Care*. 2019;2:101.
3. Castel et al., *J Pain*. 2016 Jan;17(1):36-49.
4. Wojtalewicz et al., *Drug Deliv Transl Res*. 2025 Apr;15(4):1424-1443.
5. Schirmer et al., *Adv Sci (Weinh)*. 2021 Sep;8(18):e2100293.
6. Schauder et al., *Chronic Burn Wounds*, EWMA 2025, Barcelona.

Pharmacokinetic Studies

Pigs offer unmatched anatomical and metabolic similarity to humans, making them an ideal species for pharmacokinetic (PK) studies. These models enable detailed analysis of how compounds are absorbed, distributed, metabolized, and excreted.

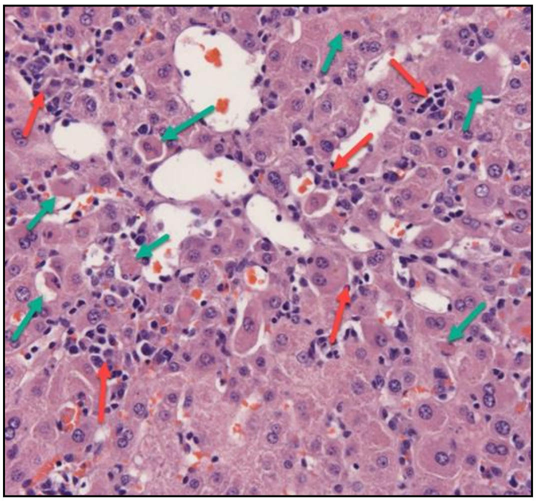
At the forefront of translational science, our team leverages deep expertise and unique capabilities to design studies that mirror clinical conditions. These studies include appropriate control compounds and clearly defined sampling intervals for blood, CSF, synovial fluid, and tissue distribution. We also incorporate diversity into PK studies by considering factors such as sex, age, and comorbidities, which is essential to:

- Identify potential differences in metabolism or absorption.
- Optimize dosing guidelines for diverse populations.
- Ensure drug safety and efficacy across all demographics.

Toxicology Studies

MD Biosciences offers GLP-compliant toxicology studies in pig models that provide a clinically relevant evaluation of compound safety. Studies are custom designed with appropriate dosing routes, regimens, and levels, incorporating standard assessments such as clinical signs, body weight, clinical pathology, organ weights, full histopathology reporting, and targeted biomarker analysis.

Our purpose-built facility supports advanced capabilities including neurotoxicity testing, PK bioanalytics, and in vivo biomarker sampling. In-house expertise in **SEND data** and **eCDT tables** streamlines regulatory submission and ensures alignment with global standards. These comprehensive and robust studies offer the insight needed to reduce risk and move confidently toward clinical development.

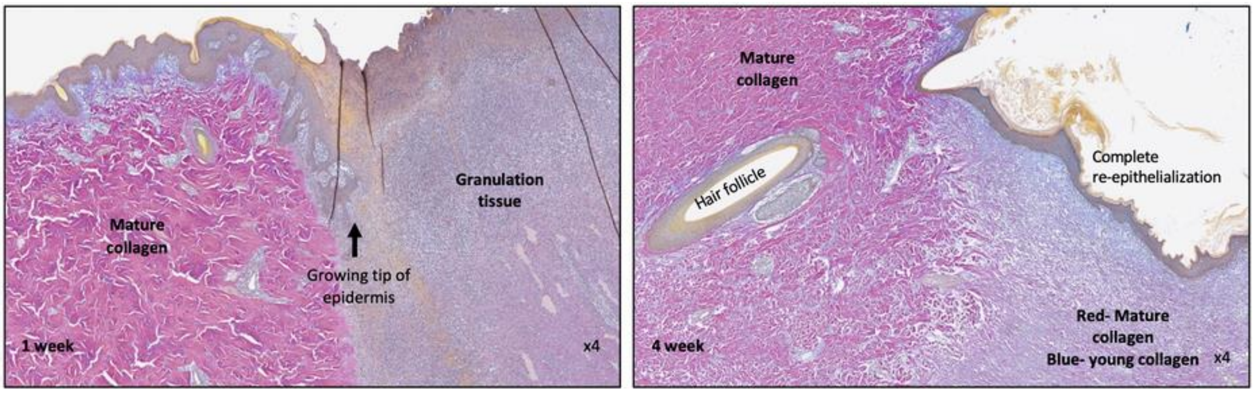


Histopathology evaluation: Section of male pig liver harvested one month after dosing. Single hepatocytic cell necrosis (green arrows) associated with inflammatory cell infiltration (red arrows) (x40). This finding is considered an incidental, spontaneous lesion.

Histology

Histochemical staining

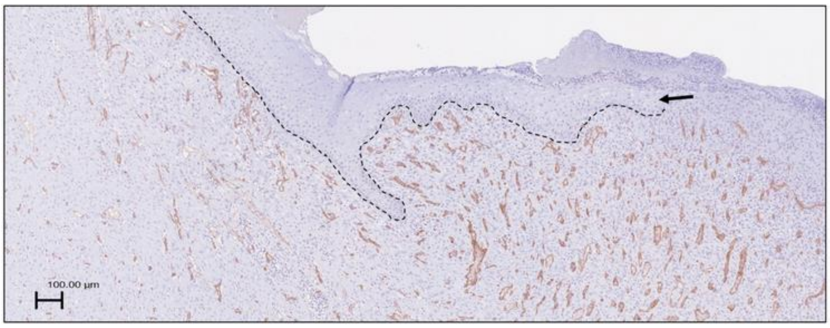
Histochemical staining methods are essential for studying tissue characteristics and the microscopic structure of cells. Staining methods include Hematoxylin and Eosin (H&E), Masson Trichrome (MT), PAS, Elastin, and Herovici.



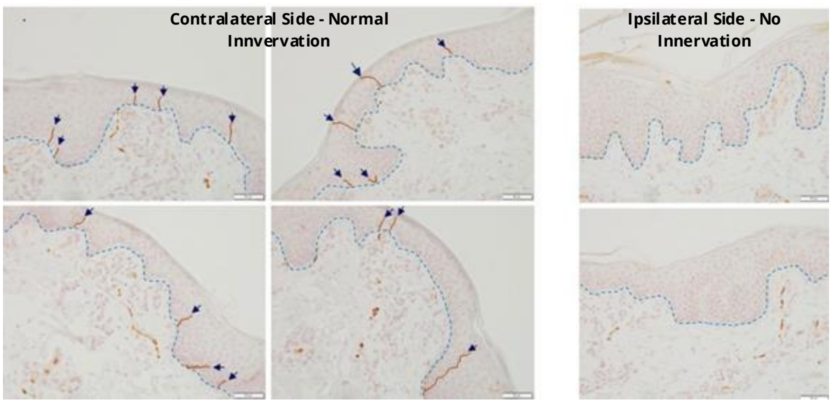
Aged pig excisional wound healing model: *Herovici collagen staining one-week post-wounding, granulation tissue and new epidermal growth begin to cover the wound (left). By four weeks, the wound is fully covered with epidermis and mature collagen, with young collagen present in the scar region (right).*

Immunohistochemistry (IHC)

IHC allows for the detection of specific cells or structures in the tissue. We validate staining protocols using various antibodies in either paraffin sections or frozen sections, depending on the model, target, or mode of action. The antibody may be coupled to a fluorescent marker (IF), with imaging methods including brightfield and fluorescent microscopy for detailed analysis.



Excisional wound healing model: *Immunohistochemical staining for blood vessels using anti-CD31 antibody. Tissues were harvested on study day 12. Granulation tissue (right) shows increased vascularization compared to healthy tissue (left). The arrow indicates the advancing tip of the epidermis, highlighted by the dashed underline.*



Peroneal nerve dissection model: *Beta-3-tubulin immunostaining highlights intraepidermal nerve fibers (IENFs). The contralateral side (left) displays normal innervation with visible nerve fibers (arrows) crossing into the epidermis, while the ipsilateral side (right) shows a loss of IENFs following peroneal nerve dissection. The dashed blue line marks the boundary between the dermis and epidermis.*