

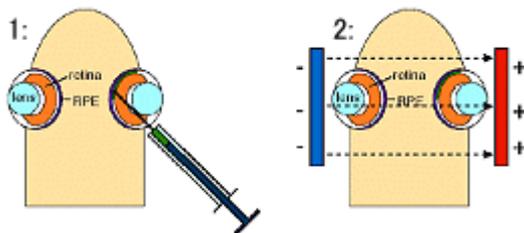
**Transfection into Mouse-Rat-Chick-Zebrafish: RETINA / CORNEA/ SPINAL CORD / SCIATIC NERVE by Electroporation**

The NEPA21 is the only device on the market to approach Electroporation from the perspective of optimising delivered energy.

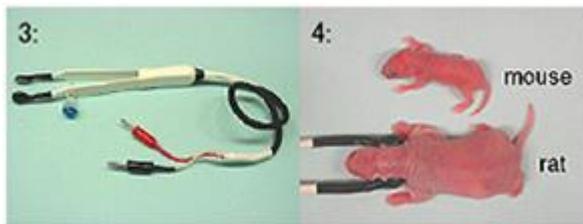
- Compared to devices from other suppliers, the NEPA21 system offers the researcher a level of previously unavailable control over energy delivery to the electroporation target. This control is generated via unique electroporation pulse-output configurations, client-confirmed protocols and application-customised electrodes.
- With this market-leading control and (user-independent) reproducibility of the technique, it is now possible to apply electroporation techniques to applications previously considered too sensitive for electroporation methodologies. Retina/Cornea, etc., electroporation are examples of such sensitive targets.
- The finer control over the delivered energy offers specific and important advantages for retina electroporation. As the thrust of NEPA21 protocols is to minimise delivered energy, this means that the targets are electroporated with less current (than competing device protocols).
- For particularly sensitive and delicate targets such as retina, identifying and only delivering the required energy (and no more) to porate the membrane is of utmost importance for their viability post electroporation.
- The success of the NEPA21 for retina electroporation is evident by the Application and Publication information following.
- The NEPA21 system is supported by a suite of over 250 different electrode configurations, which further enhance the applicability of the system and empower researchers with further experimental options and opportunities.

**APPLICATIONS**

**Transfection into Mouse-Rat-Chick-Zebrafish: RETINA / CORNEA/ SPINAL CORD / SCIATIC NERVE by Electroporation**



Schematic illustration showing the in vivo electroporation method.  
(1). DNA injection into subretinal space  
(2). Electroporation



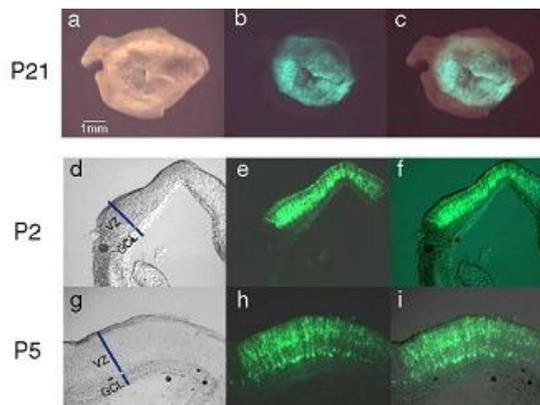
Tweezer-type electrodes (3) are placed to hold the head of newborn (P0) rat or mouse (4).

In vivo electroporated rat retinae harvested at various developmental stages.

(a) Whole-mount preparation of rat retina in vivo electroporated with pCAG-GFP at P0 and harvested at P21. Pictures were taken from the scleral side.

(b) Rat retinae in vivo electroporated with pCAG-GFP at P0 were harvested at P2(d-f), or P5(g-i), and cryosections were prepared.

**Takahiko Matsuda, Cepko laboratory**



## PUBLICATIONS

Transfection into Mouse-Rat-Chick-Zebrafish: **RETINA / CORNEA/ SPINAL CORD / SCIATIC NERVE** by Electroporation

In vivo Retina		Chick Embryos – In Ovo
In vivo/Ex vivo Retina		Chick Embryos – Ex Ovo
In vivo/Ex vivo Cornea		Chick Retina – Ex Vivo
Ex vivo Retina		Zebrafish Retina – In Vivo / Ex Vivo
Ex vivo Spinal Cord		
In vivo Spinal Cord		
In vivo Sciatic Nerve		

### In vivo Retina

#### [dCasMINI-mediated therapy rescues photoreceptors degeneration in a mouse model of retinitis pigmentosa](#)

Wang Q, Xu X, Chen S, Lu R, Li L, Lo CH, Liu Z, Ning K, Li T, Kowal TJ, Wang B, Hartnett ME, Wang S, Qi LS, Sun Y.  
Sci Adv. 2024 Dec 20;10(51): eadn7540.

#### [Optimization of HITI-Mediated Gene Insertion for Rhodopsin and Peripherin-2 in Mouse Rod Photoreceptors: Targeting Dominant Retinitis Pigmentosa](#)

Onishi A, Tsunekawa Y, Mandai M, Ishimaru A, Ohigashi Y, Sho J, Yasuda K, Suzuki K, Izpisua Belmonte JC, Matsuzaki F, Takahashi M.  
Invest Ophthalmol Vis Sci. 2024 Nov 18;65(13):38.

#### [SponGee: A Genetic Tool for Subcellular and Cell-Specific cGMP Manipulation](#)

Ros O, Zagar Y, Ribes S, Baudet S, Loulier K, Couvet S, Ladarre D, Aghaie A, Louail A, Petit C, Mechulam Y, Lenkei Z, Nicol X.  
Cell Rep. 2019 Jun 25;27(13):4003-4012.e6.

### In vivo/Ex vivo Retina

#### [Gene Transfer of Prolyl Hydroxylase Domain 2 Inhibits Hypoxia-inducible Angiogenesis in a Model of Choroidal Neovascularization.](#)

Takei A, Ekström M, Mammadzada P, Aronsson M, Yu M, Kvanta A, André H  
Sci Rep. 2017 Feb 10;7:42546.

#### [Requirement of retinoic acid receptor \$\beta\$ for genipin derivative-induced optic nerve regeneration in adult rat retina.](#)

Koriyama Y, Takagi Y, Chiba K, Yamazaki M, Sugitani K, Arai K, Suzuki H, Kato S.  
PLoS One. 2013 Aug 6;8(8): e71252.

#### [A role for ligand-gated ion channels in rod photoreceptor development](#)

Young TL, Cepko CL.  
Neuron. 2004 Mar 25;41(6):867-79.

#### [Electroporation and RNA interference in the rodent retina in vivo and in vitro](#)

Matsuda T, Cepko CL.  
Proc Natl Acad Sci U S A. 2004 Jan 6;101(1):16-22.

#### [Gene transfer into retinal ganglion cells by in vivo electroporation: a new approach](#)

Dezawa M, Takano M, Negishi H, Mo X, Oshitari T, Sawada H.

### In vivo/Ex vivo Cornea

#### [Targeted gene transfer to corneal stroma in vivo by electric pulses](#)

Oshima Y, Sakamoto T, Hisatomi T, Tsutsumi C, Sassa Y, Ishibashi T, Inomata H.  
Exp Eye Res. 2002 Feb;74(2):191-8.

### Ex vivo Retina

#### [Quantitative Analysis of the ThrbCRM1-centered Gene Regulatory Network](#)

Benjamin Souferi, Mark M Emerson  
Biol Open. 2019 Apr 26;8(4): bio039115.

**Bulk electroporation and population calcium imaging in the adult mammalian retina.**

Briggman KL, Euler T.

J Neurophysiol. 2011 May;105(5):2601-9.

**Roles of STAT3/SOCS3 pathway in regulating the visual function and ubiquitin-proteasome-dependent degradation of rhodopsin during retinal inflammation.**

Ozawa Y et al.

J Biol Chem. 2008 Sep 5;283(36):24561-70.

**Identification of a Retina-Specific Otx2 Enhancer Element Active in Immature Developing Photoreceptors**

Mark M Emerson, Constance L Cepko

Dev Biol, 360 (1), 241-55 2011 Dec 1

**Ex vivo Spinal Cord****Explant Culture of the Embryonic Mouse Spinal Cord and Gene Transfer by ex vivo Electroporation**

Kinoshita-Kawada M, Hasegawa H, Hongu T, Yanagi S, Kanaho Y, Masai I, Mishima T, Chen X, Tsuboi Y, Rao Y, Yuasa-Kawada J, Wu JY.

Bio Protoc. 2019 Sep 20;9(18): e3373.

**A crucial role for Arf6 in the response of commissural axons to Slit**

Kinoshita-Kawada M, Hasegawa H, Hongu T, Yanagi S, Kanaho Y, Masai I, Mishima T, Chen X, Tsuboi Y, Rao Y, Yuasa-Kawada J, Wu JY

Development. 2019 Feb 4;146(3)

**In vivo Spinal Cord****Convallatoxin Enhance the Ligand-Induced Mu-Opioid Receptor Endocytosis and Attenuate Morphine Antinociceptive Tolerance in Mice**

Chao PK, Chang HF, Ou LC, Chuang JY, Lee PT, Chang WT, Chen SC, Ueng SH, Hsu JT, Tao PL, Law PY, Loh HH, Yeh SH.

Sci Rep. 2019 Feb 20;9(1):2405.

**Morphine drives internal ribosome entry site-mediated hnRNP K translation in neurons through opioid receptor-dependent signaling.**

Lee PT, Chao PK, Ou LC, Chuang JY, Lin YC, Chen SC, Chang HF, Law PY, Loh HH, Chao YS, Su TP, Yeh SH

Nucleic Acids Res. 2014 Dec 1;42(21):13012-25.

**CCL-1 in the spinal cord contributes to neuropathic pain induced by nerve injury.**

Akimoto N, Honda K, Uta D, Beppu K, Ushijima Y, Matsuzaki Y, Nakashima S, Kido MA, Imoto K, Takano Y, Noda M.

Cell Death Dis. 2013 Jun 20;4(6): e679

**In vivo Sciatic Nerve****Molecular analysis of axonal-intrinsic and glial-associated co-regulation of axon degeneration**

Catenaccio A, Llaverro Hurtado M, Diaz P, Lamont DJ, Wishart TM, Court FA.

Cell Death Dis. 2017 Nov 9;8(11):e3166

**Schwann cell-derived exosomes enhance axonal regeneration in the peripheral nervous system.**

Lopez-Verrilli MA, Picou F, Court FA.

Glia. 2013 Nov;61(11):1795-806

**Chick Embryos – In Ovo****Lineage Tracing Analysis of Cone Photoreceptor Associated Cis-Regulatory Elements in the Developing Chicken Retina**

Estie Schick, Sean D McCaffery, Erin E Keblish, Cassandra Thakurdin, Mark M Emerson

Sci Rep, 9 (1), 9358 2019 June 27

**Single Cell profiling of CRISPR/Cas9-induced OTX2 deficient retinas reveals fate switch from restricted progenitors**

Miruna G Ghinia Tegla, Diego F Buenaventura, Diana Y Kim, Cassandra Thakurdin, Kevin G Gonzalez, Mark M Emerson

bioRxiv. 2019 February 2, <https://doi.org/10.1101/538710>**Irx4-mediated regulation of Slit1 expression contributes to the definition of early axonal paths inside the retina**

Jin et al.

Development, Volume 130, Issue 6, Pages 1037-1048, March 2003

**Chick Embryos – Ex Ovo**

[Single Cell profiling of CRISPR/Cas9-induced OTX2 deficient retinas reveals fate switch from restricted progenitors](#)

Miruna G Ghinia Tegla, Diego F Buenaventura, Diana Y Kim, Cassandra Thakurdin, Kevin G Gonzalez, Mark M Emerson  
 bioRxiv. 2019 February 2, <https://doi.org/10.1101/538710>

**Chick Retina – Ex Vivo**

[Lineage Tracing Analysis of Cone Photoreceptor Associated Cis-Regulatory Elements in the Developing Chicken Retina](#)

Estie Schick, Sean D McCaffery, Erin E Keblish, Cassandra Thakurdin, Mark M Emerson  
 Sci Rep, 9 (1), 9358 2019 June 27

**Zebrafish Retin – In Vivo / Ex Vivo**

[Inhibition of Müller glial cell division blocks regeneration of the light-damaged zebrafish retina](#)

Thummel et al.,  
 Developmental Neurobiology, Volume 68, Issue 3, Pages 392-408, 15 February 2008

**Cell Cultures (adherent Cells – electroporated directly in the well-plate electrode CUY900-13-35**

**Client Laboratory Verified RESULTS**

*Retinal Ganglion Cells from Human iPSCs*

[Generation of retinal ganglion cells with functional axons from human induced pluripotent stem cells.](#)

Tanaka T, Yokoi T, Tamalu F, Watanabe S, Nishina S, Azuma N  
 Sci Rep. 2015 Feb 10; 5: 8344.

Please note these **RETINA** cell line results:

Cell Line		V	TE		Cell Line	V	TE
RPE	Retinal Pigment Epithelium Cells	90%	70%	RPE-1	<a href="#">Retinal Pigment Epithelium Cells</a>	90%	80%



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