Supplemental Information

Supplemental Table 1. List of primers used for single-cell RT-PCR

Gene/primer	Forward	Reverse
Gapdh inner	CCAGCCTCGTCCCGTAGACA	CGCTCCTGGAAGATGGTGAT
Gapdh outer	GAGAGGGAGGAGGGGAAATG	CTCGTGGTTCACACCCATCA
Rest inner	ACCACTACATGGCACACCTG	TTCTCACCTGAATGAGTCCGC
Rest outer	GAACCCCAGCCCGTATTTGA	TCTCACCTGAATGAGTCCGC
Kcnq2 inner	AGGAAGCCGTTCTGTGTGAT	GCAGAGGAAGCCAATGTAC
Kcnq2 outer	TCTCCTGCCTTGTGCTTTCT	GCATCTGCGTAGGTGTCAAA
Kcnd3 inner	GAGGGGGTAGTGGGGAGTAA	CCCCTAATGCCAATCCCCT
Kcnd3 outer	CACCAGTCGCTCCAGCCTTAAT	GGGCAGCTCTTGGTCTTGTG
Oprm1 inner	ACTTCTGCATTGCCTTGGGT	AGAAAGCACATACCTGGTGGTT
Oprm1 outer	TACAGGCAGGGGTCCATAGAT	TTCTCCAGTAACCGACCTCCT
Scn10a inner	ACCGACAATCAGAGCGAGGAG	ACAGACTAGAAATGGACAGAATCACC
Scn10a outer	TTGAAGAAGACACCGACGCA	TGTAAAACAGGCTTCGGGCT

Supplemental Table 2. Incidence of detection of *Rest* and four of its target genes in DRG neurons as detected by single-cell RT-PCR in tamoxifen-injected *Rest*$^{loxP/loxP}$/WT mice in control conditions, four weeks after the SNI injury and in the tamoxifen-injected *Rest*$^{loxP/loxP}$/AvCreER-T2 mice after the SNI injury.

Gene name		***Rest*$^{loxP/loxP}$/WT (control)**	***Rest*$^{loxP/loxP}$/WT+SNI**	***Rest*$^{loxP/loxP}$/AvCreER-T2+SNI**
Total number of neurons analysed		79	89	79
Number of positive cells (%)	*Gapdh*	79 (100)	57 (64)***	79 (100)$^{\#\#\#}$
	Rest	15 (19)	48 (54)***	4 (5)$^{\#\#\#}$
	Kcnq2	46 (58)	19 (21)***	30 (38)$^{\#}$
	Kcnd3	48 (61)	29 (33)***	52 (66)$^{\#\#\#}$
	Oprm1	32 (41)	24 (27)	25 (32)
	Scn10a	18 (23)	14 (16)	18 (23)

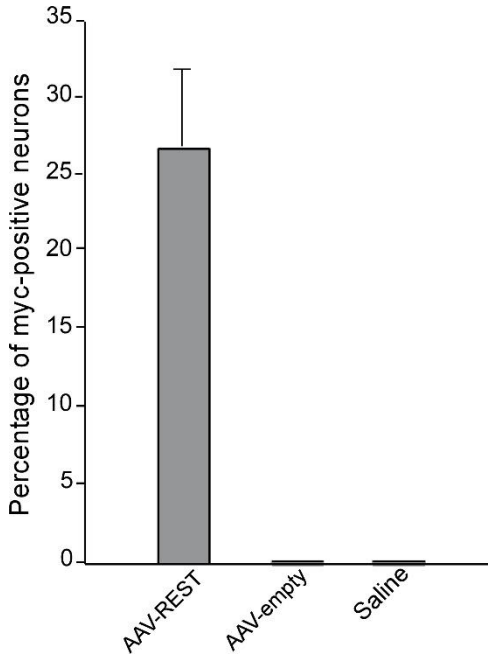
*** Significantly different from control; Fisher's exact test, $p<0.001$

$^{\#,\#\#\#}$ Significantly different from tamoxifen-injected *Rest*$^{loxP/loxP}$/WT mice after the SNI injury; Fisher's exact test, $p<0.05$ or $p<0.001$

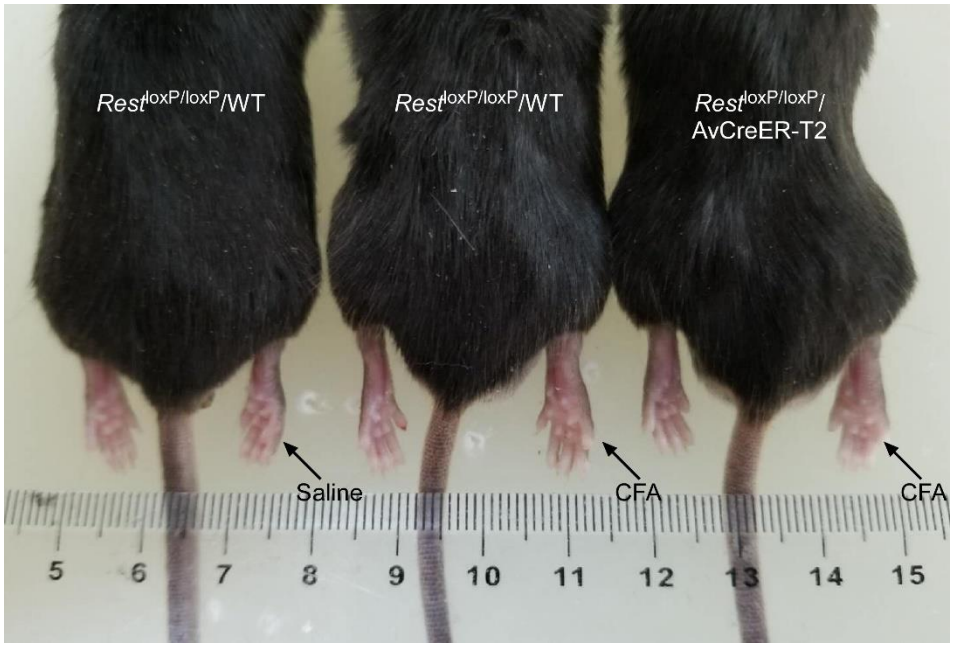
Supplemental Table 3. RE1-containing K^+ channel genes, their expression in sensory afferents and chronic pain associated downregulation.

Gene name[1]	**Subunit**	**Expression in nociceptors**[2]	**Downregulated in chronic pain model(s)**[2]
KCNA2	Kv1.2	++	Yes
KCNA4	Kv1.4	+++	Yes
KCNC1	Kv3.1	+	unknown
KCNC3	Kv3.3	-	unknown
KCNC4	Kv3.4	+++	Yes
KCND3	Kv4.3	+++	Yes
KCND2	Kv4.2	+	Yes
KCNH1	EAG	-	unknown
KCNH2	HERG	-	unknown
KCNH4	ELK1	-	unknown
KCNK9	TASK3	+	Yes
KCNMA1	KCa1.1 (SLO1)	++	Yes
KCNN4	KCa3.1 (SK4)	+[3]	unknown
KCNQ2	Kv7.2	+++	Yes
KCNQ3	Kv7.3	+++	Yes
KCNQ5	Kv7.5	+++	Yes
KCNAB2	BETA-2	++	unknown
KCNIP2	KCHIP2	+++[4]	unknown
KCNIP4	KCHIP4	-	unknown

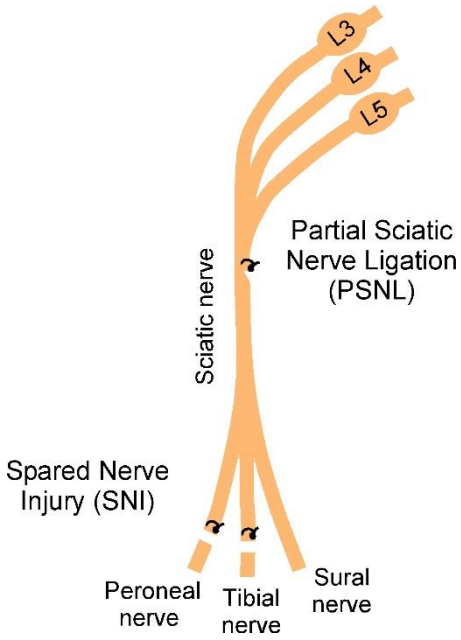
[1]RE1-containing K^+ channel genes for which REST binding has been identified by Transcription Factor ChIP-seq Uniform Peaks from ENCODE/Analysis (http://genome-euro.ucsc.edu)
[2]Unless indicated otherwise, data are from Du X & Gamper N (2013) Potassium channels in peripheral pain pathways: expression, function and therapeutic potential. Curr Neuropharmacol 11:621-640.
[3]Lu R, et al. (2017) KCa3.1 channels modulate the processing of noxious chemical stimuli in mice. Neuropharmacology 125:386-395.
[4]Kuo YL, et al. (2017) K^+ Channel Modulatory Subunits KChIP and DPP Participate in Kv4-Mediated Mechanical Pain Control. J Neurosci 37:4391-4404.



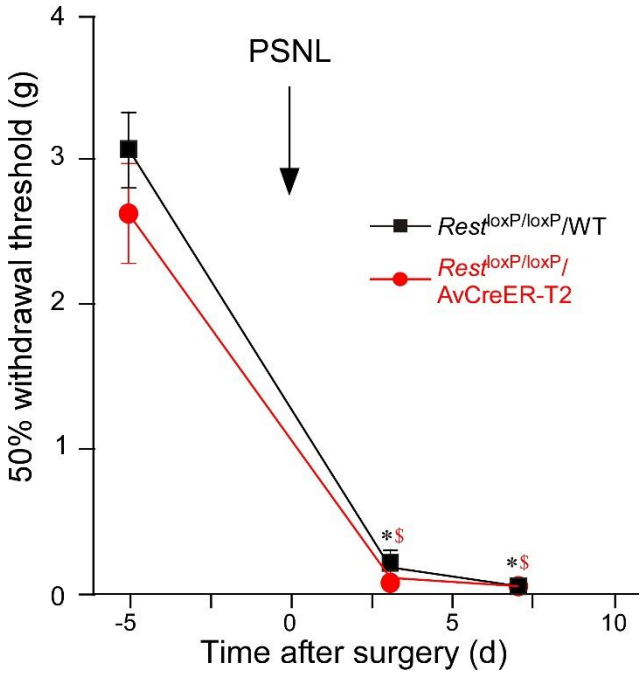
Supplemental Figure 1. Quantification of immunohistochemical analysis of Myc expression in L4 DRG of mice DRG-injected with AAV2/9-REST, empty AAV2/9 particles or saline (example images are presented in Fig. 1C); for each conditions 3 mice, 5-6 sections were analysed.



Supplemental Figure 2. Deletion of Rest does not affect paw edema. Hind-paw injection of the Complete Freund's Adjuvant (CFA, 20 μl) produced similar degree of paw swelling in the tamoxifen-injected *Rest*$^{loxP/loxP}$/AvCreER-T2 and *Rest*$^{loxP/loxP}$/WT mice; injection of saline produced no swelling. Photographs are taken 2 weeks after the CFA injection.



Supplemental Figure 3. Schematic of neuropathic pain models used.



Supplemental Figure 4. In the absence of tamoxifen *Rest*$^{loxP/loxP}$/AvCreER-T2 mice have normal mechanical threshold and develop hyperalgesia following partial sciatic nerve ligation (PSNL) similarly to the WT littermates. *Rest*$^{loxP/loxP}$/AvCreER-T2 (red symbols, lines; n=10); *Rest*$^{loxP/loxP}$/WT (black symbols, lines; n=10).$^{*,\$}$ different from the pre-injury measurements in the same animal; $P < 0.05$ (two-way repeated measures ANOVA with Tukey post-hoc test).

Supplemental Movie 1. Wild-type mice *in vivo* injected with AAV2/9 REST into the right L4 DRG display paw dragging and change of gait. Video was recorded on day 34 after the injection.

Supplemental Movie 2. Control wild-type mice *in vivo* injected with empty AAV2/9 into the right L4 DRG display normal gait. Video was recorded on day 34 after the injection.

Supplemental Movie 3. Tamoxifen-injected *Rest*$^{loxP/loxP}$/WT (control) mice after SNI displayed dragging of injured (right) paw and changed gait. Video was recorded on day 21 after the surgery.

Supplemental Movie 4. Tamoxifen-injected *Rest*$^{loxP/loxP}$/AvCreER-T2 mice after SNI displayed nearly normal gait and no dragging of the injured (right) paw. Video was recorded on day 21 after the surgery.