

Supplementary Table 1. *NEU1* variants associated with sialidosis type 1

AA change (A1)	AA change (A2)	Age at onset (yr)	Gender	Ataxia	Dysarthria	Myoclonus	Seizure	Impaired cognition	Cherry-red spot	Abnormal EEG	Abnormal SEP	Abnormal VEP	Abnormal MRI	Reference	
p.V143E	p.S182G	13	F	Y	Y	Y	Y	N	Y	Y	N	Y	N	This study	
		14	M	Y	Y	Y	Y	N	Y	N	NA	Y	N	This study	
p.P80L	p.Y268C	12	M	Y	Y	Y	Y	N	Y	NA	Y	Y	N	1	
p.P80L	p.S182G	12	F	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	1	
		17	M	Y	Y	Y	Y	N	Y	NA	Y	N	N	1	
		8	M	N	N	N	N	N	N	N	NA	Y	N	2	
		12	F	Y	Y	Y	Y	N	Y	Y	NA	NA	Y	N	2
		17	M	Y	NA	Y	Y	Y	Y	NA	NA	NA	NA	NA	3
p.R280X	p.D135N	10	F	Y	Y	Y	Y	N	Y	NA	NA	NA	N	1	
		10	F	Y	Y	Y	Y	N	Y	N	NA	Y	N	2	
c.1118T>C	p.S182G	10	M	Y	Y	Y	Y	N	Y	NA	Y	Y	Y	1	
p.R341X	p.S182G	10	M	Y	Y	Y	Y	N	Y	Y	NA	NA	N	2	
p.S182G	p.A106_G118del	12	M	Y	N	Y	Y	N	N	Y	Y	Y	N	4	
p.S182G	p.S182G	14	M	Y	Y	N	Y	NA	NA	NA	NA	NA	Y	5	
		NA	M	NA	Y	Y	NA	NA	NA	NA	NA	NA	NA	6	
		27	M	Y	NA	Y	Y	N	N	N	NA	NA	N	7,8	
		19	M	Y	NA	Y	Y	NA	N	Y	NA	NA	Y	7,8	
		14	M	Y	NA	Y	Y	N	N	NA	NA	NA	NA	7	
		26	M	Y	NA	Y	Y	N	N	N	NA	NA	Y	7,8	
		16	F	Y	NA	N	Y	N	N	NA	NA	NA	NA	7	
		12	M	Y	NA	N	Y	N	N	NA	NA	NA	NA	7	
		20	F	Y	NA	Y	Y	N	N	N	NA	NA	Y	7,8	
		33	M	Y	NA	Y	Y	N	N	N	NA	NA	Y	7,8	
		20	M	Y	NA	Y	N	N	N	N	NA	NA	N	7,8	
		15	M	Y	NA	Y	N	N	N	N	NA	NA	Y	7,8	
		18	M	Y	NA	Y	Y	N	N	NA	NA	NA	NA	7	
		28	F	Y	NA	Y	Y	N	N	NA	NA	NA	NA	7	
		19	M	Y	NA	Y	Y	N	N	N	NA	NA	Y	7,8	
18	F	Y	NA	Y	Y	N	N	N	NA	NA	N	7,8			
14	M	Y	NA	Y	Y	Y	N	Y	N	NA	NA	Y	7,8		
p.G328S	p.L91R	13	F	Y	Y	Y	Y	NA	Y	Y	Y	Y	Y	9	
p.G328S	p.S403Tfs*85	13	F	Y	Y	Y	Y	N	N	Y	Y	NA	Y	9,10	
		12	F	Y	N	Y	N	N	Y	Y	Y	NA	Y	9	
p.R305H	p.E209Sfs*94	17	F	Y	Y	Y	Y	N	N	Y	N	N	Y	9,10	
p.S182G	27.5 kb deletion	9	F	N	N	N	N	N	Y	NA	NA	NA	N	11	
p.D310N	p.P6Qfs*21	12	F	Y	Y	Y	Y	N	Y	Y	NA	NA	Y	12	
p.R280X	g.2869A>T	14	F	Y	N	Y	N	N	Y	N	Y	Y	Y	13	
p.S182G	c.667_679del	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14	
p.P210L	p.P210L	16	M	Y	N	Y	Y	NA	Y	Y	NA	Y	N	15	
p.S182G	p.G227R	12	M	Y	Y	Y	Y	N	N	N	NA	NA	N	16	
p.Glu209SerfsTer94	p.D310N	18	M	Y	Y	Y	Y	NA	Y	NA	NA	NA	Y	17	
p.S182G	c.619C>T	12	M	Y	Y	Y	Y	N	Y	Y	NA	NA	Y	18,19	
p.G248C	p.G248C	9	M	Y	N	Y	N	N	Y	N	NA	NA	N	20	
p.S233R	p.Y268C	8	M	N	N	N	N	N	Y	Y	NA	Y	N	21	
p.G227R	p.H399_Y400dup	12	F	Y	N	N	N	N	Y	NA	NA	NA	N	22	
		13	F	Y	N	Y	N	N	Y	NA	NA	NA	N	22	
p.G328S	p.G227R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	
p.D234N	p.R341X	26	M	Y	Y	Y	N	NA	Y	Y	NA	NA	Y	23	
		NA	NA	NA	NA	Y	NA	NA	Y	NA	NA	NA	NA	24	
p.S67I	p.S67I	23	M	N	N	Y	N	N	N	N	Y	NA	N	25	
		25	F	Y	N	Y	N	N	N	N	Y	NA	Y	25	
		22	F	Y	N	Y	Y	N	N	N	N	Y	NA	Y	25
p.G227R	p.R305C	25	F	N	N	Y	N	N	N	N	Y	NA	Y	25	
		25	F	N	N	Y	N	N	N	N	N	Y	NA	N	25
		32	M	N	N	Y	N	N	N	N	N	Y	NA	N	25
p.P80L	p.D135N	14	M	Y	Y	Y	N	Y	Y	NA	NA	NA	Y	26	
p.Q282H	p.Q282H	13	NA	Y	N	Y	N	N	N	NA	NA	NA	NA	24	
p.R294C	c.1191delG	14	F	Y	Y	Y	N	N	Y	NA	NA	NA	NA	27	
p.V217M	p.G243R	15	M	Y	N	Y	Y	Y	Y	N	Y	NA	N	28	
		17	F	Y	Y	N	Y	N	Y	NA	NA	NA	NA	29	
		32	M	Y	Y	Y	N	N	Y	NA	NA	NA	NA	29	
p.S182G	p.Q55stop	12	F	Y	N	Y	Y	N	Y	NA	NA	NA	NA	7,8	
p.S182G	p.A319V	14	M	Y	N	Y	Y	N	Y	N	NA	NA	N	7,8	
p.G136E	p.V275A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	30	
p.L111P	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	30	
p.T345I	p.T345I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	30	
p.P316S	p.P316S	14	M	Y	Y	Y	Y	N	Y	NA	NA	NA	NA	31	
p.R294S	p.L231H	11	F	Y	Y	Y	Y	N	Y	NA	NA	NA	NA	32	
p.R294S	p.C218A	8	F	N	N	N	N	Y	Y	NA	NA	NA	NA	32	
p.V54M	p.G378stop	17	F	Y	Y	Y	Y	N	Y	NA	NA	NA	NA	32	
		15	F	Y	Y	Y	Y	N	N	NA	NA	NA	NA	32	
p.G328S	p.Dpl399HisTyr	13	F	Y	Y	Y	Y	N	N	Y	NA	Y	NA	32	
p.V54M	p.E377X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	33	

AA, amino acid; EEG, electroencephalography; SEP, somatosensory-evoked potential; VEP, visual evoked potential; MRI, magnetic resonance imaging; F, female; M, male; Y, yes; N, no; NA, not applicable; ND, not determined.

REFERENCES

- Lv RJ, Li TR, Zhang YD, Shao XQ, Wang Q, Jin LR. Clinical and genetic characteristics of type I sialidosis patients in mainland China. *Ann Clin Transl Neurol* 2020;7:911-923.
- Han X, Wu S, Wang M, Li H, Huang Y, Sui R. Genetic and clinical characterization of mainland Chinese patients with sialidosis type 1. *Mol Genet Genomic Med* 2020;8:e1316.
- Guan RY, Wu JJ, Ding ZT, Wang J, Sun YM. Clinical and genetic findings in a cohort of Chinese patients with autosomal recessive spinocerebellar ataxia. *Clin Genet* 2020;97:532-535.
- Fan SP, Lee NC, Lin CH. Clinical and electrophysiological characteristics of a type I sialidosis patient with a novel deletion mutation in *NEU1* gene. *J Formos Med Assoc* 2020;119(1 Pt 3):406-412.
- Jiao B, Zhou Z, Hu Z, Du J, Liao X, Luo Y, et al. Homozygosity mapping and next generation sequencing for the genetic diagnosis of hereditary ataxia and spastic paraplegia in consanguineous families. *Parkinsonism Relat Disord* 2020;80:65-72.
- Lukong KE, Elsliger MA, Chang Y, Richard C, Thomas G, Carey W, et al. Characterization of the sialidase molecular defects in sialidosis patients suggests the structural organization of the lysosomal multienzyme complex. *Hum Mol Genet* 2000;9:1075-1085.
- Lai SC, Chen RS, Wu Chou YH, Chang HC, Kao LY, Huang YZ, et al. A longitudinal study of Taiwanese sialidosis type 1: an insight into the concept of cherry-red spot myoclonus syndrome. *Eur J Neurol* 2009;16:912-919.
- Huang YZ, Lai SC, Lu CS, Weng YH, Chuang WL, Chen RS. Abnormal cortical excitability with preserved brainstem and spinal reflexes in sialidosis type I. *Clin Neurophysiol* 2008;119:1042-1050.
- Coppola A, Iannicello M, Vanli-Yavuz EN, Rossi S, Simonelli F, Castellotti B, et al. Diagnosis and management of type 1 sialidosis: clinical insights from long-term care of four unrelated patients. *Brain Sci* 2020;10:506.
- Muona M, Berkovic SF, Dibbens LM, Oliver KL, Maljevic S, Bayly MA, et al. A recurrent de novo mutation in *KCNC1* causes progressive myoclonus epilepsy. *Nat Genet* 2015;47:39-46.
- Li X, Zhang Q. Heterozygous structural variation mimicking homozygous missense mutations in *NEU1* associated with presenting clinical signs in eyes alone. *Ophthalmic Genet* 2020;41:279-283.
- Ahn JH, Kim AR, Lee C, Kim NKD, Kim NS, Park WY, et al. Type 1 sialidosis patient with a novel deletion mutation in the *NEU1* gene: case report and literature review. *Cerebellum* 2019;18:659-664.
- Bhoi SK, Jha M, Naik S, Palo GD. Sialidosis type 1: giant SSEP and novel mutation. *Indian J Pediatr* 2019;86:760-761.
- Liu SP, Hsu YH, Huang CY, Ho MC, Cheng YC, Wen CH, et al. Generation of novel induced pluripotent stem cell (iPSC) line from a 16-year-old sialidosis patient with *NEU-1* gene mutation. *Stem Cell Res* 2018;28:39-43.
- Aravindhan A, Veerapandian A, Earley C, Thulasi V, Kresge C, Kornitzer J. Child neurology: type 1 sialidosis due to a novel mutation in *NEU1* gene. *Neurology* 2018;90:622-624.
- Mohammad AN, Bruno KA, Hines S, Atwal PS. Type 1 sialidosis presenting with ataxia, seizures and myoclonus with no visual involvement. *Mol Genet Metab Rep* 2018;15:11-14.
- Gultekin M, Bayramov R, Karaca C, Acer N. Sialidosis type I presenting with a novel mutation and advanced neuroimaging features. *Neurosciences (Riyadh)* 2018;23:57-61.
- Wang IH, Lin TY, Kao ST. Optical coherence tomography features in a case of type I sialidosis. *Taiwan J Ophthalmol* 2017;7:108-111.
- Hu SC, Hung KL, Chen HJ, Lee WT. Seizure remission and improvement of neurological function in sialidosis with perampanel therapy. *Epilepsy Behav Case Rep* 2018;10:32-34.
- Gowda VK, Srinivasan VM, Benakappa N, Benakappa A. Sialidosis type 1 with a novel mutation in the neuraminidase-1 (*NEU1*) gene. *Indian J Pediatr* 2017;84:403-404.
- Mütze U, Bürger F, Hoffmann J, Tegetmeyer H, Heichel J, Nickel P, et al. Multigene panel next generation sequencing in a patient with cherry red macular spot: identification of two novel mutations in *NEU1* gene causing sialidosis type I associated with mild to unspecific biochemical and enzymatic findings. *Mol Genet Metab Rep* 2017;10:1-4.
- Schene IF, Kalinina Ayuso V, de Sain-van der Velden M, van Gassen KL, Cuppen I, van Hasselt PM, et al. Pitfalls in diagnosing neuraminidase deficiency: psychosomatics and normal sialic acid excretion. *JIMD Rep* 2016; 25:9-13.
- Sobral I, Cachulo Mda L, Figueira J, Silva R. Sialidosis type I: ophthalmological findings. *BMJ Case Rep* 2014;2014:bcr2014205871.
- Coutinho MF, Lacerda L, Macedo-Ribeiro S, Baptista E, Ribeiro H, Prata MJ, et al. Lysosomal multienzymatic complex-related diseases: a genetic study among Portuguese patients. *Clin Genet* 2012;81:379-393.
- Canafoglia L, Robbiano A, Pareyson D, Panzica F, Nanetti L, Giovagnoli AR, et al. Expanding sialidosis spectrum by genome-wide screening: *NEU1* mutations in adult-onset myoclonus. *Neurology* 2014;82:2003-2006.
- Sekijima Y, Nakamura K, Kishida D, Narita A, Adachi K, Ohno K, et al. Clinical and serial MRI findings of a sialidosis type I patient with a novel missense mutation in the *NEU1* gene. *Intern Med* 2013;52:119-124.
- Ranganath B, Sharma V, Danda S, Nandineni MR, Dalal AB. Novel mutations in the neuraminidase-1 (*NEU1*) gene in two patients of sialidosis in India. *Indian J Med Res* 2012;136:1048-1050.
- Uchiyama T, Ohashi K, Kitagawa M, Kurata M, Nakamura A, Hirokawa K, et al. Sialidosis type I carrying V217M/G243R mutations in lysosomal sialidase: an autopsy study demonstrating terminal sialic acid in lysosomal lamellar inclusions and cerebellar dysplasia. *Acta Neuropathol* 2010;119:135-145.
- Naganawa Y, Itoh K, Shimamoto M, Takiguchi K, Doi H, Nishizawa Y, et al. Molecular and structural studies of Japanese patients with sialidosis type 1. *J Hum Genet* 2000;45:241-249.
- Seyrantep V, Poupetova H, Froissart R, Zabot MT, Maire I, Pshezhetsky AV. Molecular pathology of *NEU1* gene in sialidosis. *Hum Mutat* 2003;22:343-352.
- Itoh K, Naganawa Y, Matsuzawa F, Aikawa S, Doi H, Sasagasaki N, et al. Novel missense mutations in the human lysosomal sialidase gene in sialidosis patients and prediction of structural alterations of mutant enzymes. *J Hum Genet* 2002;47:29-37.
- Bonten EJ, Arts WE, Beck M, Covanis A, Donati MA, Parini R, et al. Novel mutations in lysosomal neuraminidase identify functional domains and determine clinical severity in sialidosis. *Hum Mol Genet* 2000;9:2715-2725.
- Bonten E, van der Spoel A, Fornerod M, Grosveld G, d'Azzo A. Characterization of human lysosomal neuraminidase defines the molecular basis of the metabolic storage disorder sialidosis. *Genes Dev* 1996;10:3156-3169.