To elucidate the genetic basis of a hereditary sensory neuropathy type 1 (HSN I) subtype in a family excluded for mutations in the known dominant HSN genes, the exonic information of a 14.3 Mb disease linked interval on chromosome 14q was resequenced utilizing a microarray-based sequence capture approach. Thereby we detected a novel mutation (c.1065C>A, p.N355K) of the atlastin-1 (ATL1) gene that is known to be mutated in early-onset hereditary spastic paraplegia SPG3A. Affected individuals presented with a severe distal sensory neuropathy in the lower limbs, repeated foot-ulcerations and amputations. In some patients also mild to moderate upper motor neuron signs were present. Nerve conduction studies revealed an axonal motor and sensory neuropathy. The mutant protein exhibits reduced GTPase activity and prominent disruption of ER network morphology when expressed in COS7 cells. Identification of two further ATL1 mutations (c.196G>C, p.E66Q and c.976Gdel; p.L325fsX333) in dominant HSN I families suggests a major role for the ATL1 GTPase in sensory neuron function and identifies HSN I and SPG3A as allelic disorders.