We establish a bijective correspondence between gauge equivalence classes of dynamical twists in a finite-dimensional Hopf algebra H based on a finite abelian group A and equivalence classes of pairs $(K, \{V_\lambda\}_{\lambda\in\widehat{A}})$, where K is an H-simple left H-comodule semisimple algebra and $\{V_\lambda\}_{\lambda\in\widehat{A}}$ is a family of irreducible representations satisfying certain conditions. Our results generalize the results obtained by Etingof-Nikshych on the classification of dynamical twists in group algebras.