We theoretically study how time- and angle-resolved photoemission spectroscopy can be applied for imaging coherent electron dynamics in molecules [1]. We consider a process in which a pump pulse triggers coherent electronic dynamics in a molecule by creating a valence electron hole. An ultrashort extreme ultraviolet probe pulse creates a second electron hole in the molecule. Information about the electron dynamics is accessed by analyzing angular distributions of photoemission probabilities at a fixed photoelectron energy. We demonstrate that a rigorous theoretical analysis taking into account the indistinguishability of transitions induced by the ultrashort, broadband probe pulse and electron hole correlation effects, is necessary for the interpretation of time- and angle-resolved photoelectron spectra. We show how a Fourier analysis of time- and angle-resolved photoelectron spectra from a molecule can be applied to follow its electron dynamics by considering photoelectron spectra from an indole molecular cation with coherent electron dynamics.