A phase retrieval method based on an iterative Fourier technique is tested together with the application of probe correction of the retrieved results; to the best of our knowledge, this is the first experimental demonstration of probe correction in phaseless near-field antenna measurements. The obtained results indicate good agreement with a measured reference pattern within the region of validity when the probe correction is applied after performing the phase retrieval from a pair of uncorrected probe signals. Additional improvements are obtained by introducing spatial filtering at the aperture of the antenna under test.