Purpose: Accelerated partial breast irradiation (APBI) and external beam boosts of the lumpectomy cavity are accessible non-invasive alternatives to brachytherapy techniques. However, the utilization of IMRT, in a manner to adequately spare normal tissue beyond the chest wall, is limited due to angular and geometrical clearance restrictions in isocentric breast setups. To address this, a novel method is introduced in which synchronized motion of the gantry and couch, in conjunction with a prone breast setup, enables the placement of horizontal arcs around the ipsilateral breast and provides conformal coverage of complex targets with substantial sparing of normal tissue. Methods: Optimization algorithms were developed to determine non-collisional gantry and couch trajectories that can concurrently maintain the target within beam apertures defined by a multi-leaf collimator. The Varian TrueBeam STx, which in Developer Mode allows for customized programmable motion of the couch during beam-on, was used to implement the method. Patient scans, simulated in the prone position on an in-house immobilization board were used for treatment planning of non-isocentric intensity modulated arcs. The dosimetric results were quantified against conventional limited angle IMRT for the clinical cases of APBI and lumpectomy boosts. Results: Relative to a typical 5 field IMRT APBI beam arrangement as suggested by RTOG-0413, the proposed dynamic arc method resulted in 44% lower volume of normal tissue receiving 50% of the prescription (V50), and 40% lower volume of normal tissue receiving 100% of the prescription (V100). Conclusions: Recent reports have correlated the occurrence of unacceptable cosmesis in APBI to the volume of normal breast tissue receiving 50% and 100% of the prescription dose. From the results of this study, it is anticipated that the proposed method of synchronous treatment trajectories of the couch and gantry can allow for more clinically favorable APBI treatments.