Introduction: Persistent atrial fibrillation (AF) shows concurrently organized and disorganized activity, which is unexplained. We hypothesized that successful ablation may enable organized zones to progressively enlarge, ultimately eliminating disordered AF. Conversely, ablation which does not allow organized zones to expand may not be successful.

Methods: We studied patients undergoing AF ablation in whom AF acutely terminated during ablation (group I, n=20) or required cardioversion (group II, n=20). Unipolar electrograms (from a 64 pole basket catheter) were analyzed at the earliest AF segment, compared to just before termination or cardioversion. We determined progression of organized and disorganized zones by mapping AF activation vectors using a novel wavefront field (WFF) approach.

Result: Patients (61.1±13.2 years; 100% persistent AF, left atrial size 47.1±6.9 mm) showed organized and disordered zones with different progression between groups I, II. The figure shows a 55 year old man (A) AF shows 2 small zones which control small regions (ellipses) by WFF mapping. Ablation of one organized zone (X) did not terminate AF. However, (B) AF shows expansion of the remaining organized zone (red), which now covers a large proportion of the atrium. (C) Ablation within this area terminated AF in the (D) posterior wall (labeled). Overall, organized zones in patients with acute AF termination enlarged progressively until termination (32.2±15.7% to 44.1±11.1% of mapped atrium, p<0.05), while organized zones in patients with acutely unsuccessful ablation did not expand and actually decreased in size until cardioversion (23.6± 6.3% to 15.2±5.6%, p<0.0001).

Conclusion: Mapping of global activation vectors reveals that persistent AF consists of organized zones controlling varying atrial areas. Ablation that progressively enlarges organized zones ultimately led to acute AF termination, and vice versa. Further studies are needed to determine underlying mechanisms of organized regions, and to determine if real time visualization of spatial control may help guide ablation.