Durney and Ramsay (1973) described various vein microstructures formed during deformation, which they named antitaxial (growth direction outwards), syntaxial (inwards) and stretched crystals (unspecified). In 1980, John Ramsay introduced the crack-seal mechanism. This mechanism, based on solid inclusion bands arranged parallel to the vein wall, was frequently used to explain syntectonic vein microstructures. We will summarize recent advancements in the understanding of syntectonic vein microstructures. We will show that (i) inclusion bands are not a sufficient criterion to infer the crack-seal mechanism, (ii) stretched crystals often grow at the vein wall interface and not by random fracturing within the vein, (iii) antitaxial veins were initiated by fracturing followed by continuous growth, (iv) a distinction of fibrous microstructures based on a length/width ratio is not applicable, (v) even wide antitaxial fibrous veins did not act as significant fluid conduits, (vi) antitaxial microstructures did not necessarily grow from a locally derived fluid, (vii) syntaxial veins are rare to find and are frequently stretched at some growth sites and (viii) long fractures cannot be completely sealed by transport along the fracture. Often, vein microstructures display a more complex history than generally thought, and deducing the boundary conditions of vein formation based on microstructures can be a difficult task.