In this work, we present an adaptive polygonal finite element method (Poly-FEM) for the analysis of two-dimensional plane elasticity problems. The generation of meshes consisting of n − sided polygonal finite elements is based on the generation of a centroidal Voronoi tessellation (CVT). An unstructured tessellation of a scattered point set, that minimally covers the proximal space around each point in the point set, is generated whereby the method also includes tessellation of nonconvex domains. In this work, we propose a region by region adaptive polygonal element mesh generation. A patch recovery type of stress smoothing technique that utilizes polygonal element patches for obtaining smooth stresses is proposed for obtaining the smoothed finite element stresses. A recovery type *a − posteriori* error estimator that estimates the energy norm of the error from the recovered solution is then adopted for the Poly-FEM. The refinement of the polygonal elements is then made on an region by region basis through a refinement index. For the numerical integration of the Galerkin weak form over polygonal finite element domains, we resort to classical Gaussian quadrature applied to triangular subdomains of each polygonal element. Numerical examples of two-dimensional plane elasticity problems are presented to demonstrate the efficiency of the proposed adaptive Poly-FEM.