Morphological and functional imaging methods are used for staging of gastrointestinal stromal tumors (GIST) and to follow-up GIST patients undergoing therapy. Computed tomography is the most frequently used morphological imaging procedure and has been recommended as the imaging method of choice according to current GIST guidelines. However, positron emission tomography using [(18)F]-2-fluoro-2-deoxy-D-glucose (FDG-PET) as the radiotracer has shown to be advantageous over morphological imaging procedures when assessing therapy response at an early time point. While tumor size reduction in morphological imaging typically requires time to develop, a decrease in FDG uptake can be detected as early as 24 h following therapy initiation. To overcome the limitations of size-based therapy response assessment on morphological imaging procedures, new density-based therapy response criteria have been developed and implemented for GIST. This review addresses both indications and accuracy of morphological and functional imaging modalities for GIST.