With MLC based IMRT, the maximum usable field size is often smaller than the maximum field size for conventional treatments. This is due to constraints on the over-travel distances of MLC leaves and/or upper jaws. Using a new leaf sequencing algorithm, the IMRT field length can be enlarged to the full length of 27 cm of a conventional MLC field for a Siemens linear accelerator without violating the upper jaw over-travel limit of 10 cm. The algorithm uses the step and shoot delivery method, and allows the upper jaws to be positioned less than 0.5 cm beyond the boundaries of any MLC segment. The strategy employed by the algorithm is to connect the intensity elements outside the jaw over-travel limit with those inside the jaw over-travel limit. The algorithm used several methods to establish connections, including reducing delivery intensity, alternating segmentation directions, and limiting growing field size. The algorithm was tested with 1000 random intensity patterns with dimensions of 21 x 27 cm^2, and 800 random intensity patterns with higher intensities outside jaw limit and lower intensities within the jaw limit. Four clinical treatment plans that were undeliverable using the standard segmentation method from a commercial treatment planning system were also tested. For these test patterns, the algorithm achieved 100% success rate with a slightly increased number of segments compared to the standard segmentation method when segmenting previously undeliverable intensity patterns. The algorithm provides a solution to extend the IMRT field length from 20 cm to 27 cm.