# Implementation of the Gradient Index in Robotic Radiosurgery Treatment Planning

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## Abstract

Objectives: To implement calculation of the Gradient Index (GI) into routine treatment planning for robotic radiosurgery and analyze the effect of collimator choice on GI values.

Methods: The gradient index (GI) is calculated from the ratio of the volume of half the prescription isodose to the volume of the prescription isodose. This index is not automatically calculated in the robotic radiosurgery treatment planning system; however, it may be calculated with modifications: the soft tissue volume (ST) display excludes the target volume, e.g. if we are prescribing treatment to the 80% isodose line of a 25 cc target, GI may be calculated as the ratio of "ST volume of 40% isodose + 25 cc" to the "ST volume of 80% isodose +25 cc". In the planning system, we could alternatively use the 'skin' contour to obtain these volumes and then calculate the GI.

Results: Preliminary results for GI of 10 cases are compared between 1) fixed collimator, 2) IRIS collimator and 3) Multi-leaf collimators (MLC). In general, GI for the IRIS and MLC are better than fixed collimator plans. For some plans of targets between 16 cc and 42 cc, the fixed collimator GI has a range between 2.9 to 4.4 and with MLC between 2.9 to 3.3. GI is also compared with fixed collimator plans for a 10 cc target (size 26x30x24 mm). Generating three separate plans, controlling for the same conformity index of 1.2, the GI using a 12.5 mm collimator was 3.3, 15 mm collimator was 3.7, and for 20 mm collimator was 4.6.

Conclusions: Besides the currently available heterogeneity index and conformity index, in order to optimize treatment planning by minimizing dose to normal tissue outside of the target, the gradient index is an important consideration. Given the multiple means on collimation with robotic radiosurgery, the gradient index allows comparison between plans. We encourage the manufacturers of radiosurgical equipment to enable the routine automated output of the gradient index in all treatment plans.