Objective: The manufacturer specified mechanical or beam delivery accuracy of the Leksell Gamma Knife (LGK) is 0.3 mm. This study intends to determine the system accuracy, or total clinical relevant accuracy, of LGK system.

Materials and Methods: The system accuracy of LGK mainly depends on the accuracies of beam delivery, target localization, and treatment plan systems. An Accuray anthropomorphic head phantom was used in this study. The mechanical accuracy was measured based on a simple and accurate technique developed by one of the authors. The phantom contains a ball-cube that holds a spherical target and 2 pieces of GafChromic film, precisely cut to a 63mm by 63mm square. The ball-cube is made of four identically shaped plastic rectangles. Two films are perpendicular to each other and have a known spatial relationship to the anterior, left and superior edges of the ball-cube. The target was identified within the respective CT images (1.5mm thickness, 512x512 resolution and 250mm x 250mm field of view) and three treatment plans with a single isocenter of 18 mm collimator were designed such that the isodoselines were symmetric around the target. The phantom was then treated to 40Gy with a model C of LGK. The system accuracy is the offset between the delivered dose centroid and the center of the targeting sphere.

Results: Target localization error was estimated to be 0.25mm in the axial plane and 0.75mm in the coronal or sagittal plane, resulting in a combined error of 0.83 mm. The mean mechanical accuracy measured in the annual QA with the 4mm collimator was 0.14 mm±0.05mm over the last seven years. The system accuracy, or total clinical relevant accuracy, was 0.66mm±0.06mm.

Conclusion: The LGK Model C is capable of over-all sub-millimeter accuracy when CT slice thicknesses of 1.5 mm with 512x512 resolution are used.