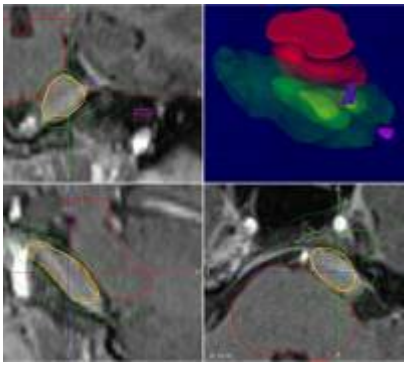
IntuitivePlan

http://www.intuitivetherapeutics.com/index.php/en/



Levivier et al. developed a new, real-time interactive inverse planning approach, based on a fully convex framework, to be used for Gamma Knife radiosurgery.

The convex framework is based on the precomputation of a dictionary composed of the individual dose distributions of all possible shots, considering all their possible locations, sizes, and shapes inside the target volume. The convex problem is solved to determine the plan, i.e., which shots and with which weights, that will actually be used, considering a sparsity constraint on the shots to fulfill the constraints while minimizing the beam-on time. The system is called IntuitivePlan and allows data to be transferred from generated dose plans into the Gamma Knife treatment planning software for further dosimetry evaluation.

The system has been very efficiently implemented, and an optimal plan is usually obtained in less than 1 to 2 minutes, depending on the complexity of the problem, on a desktop computer or in only a few minutes on a high-end laptop. Dosimetry data from 5 cases, 2 meningiomas and 3 vestibular schwannomas, were generated with IntuitivePlan. Results of evaluation of the dosimetry characteristics are very satisfactory and adequate in terms of conformity, selectivity, gradient, protection of organs at risk, and treatment time.

The possibility of using optimal, interactive real-time inverse planning in conjunction with the Leksell Gamma Knife opens new perspectives in radiosurgery, especially considering the potential use of the full capabilities of the latest generations of the Leksell Gamma Knife. This approach gives new users the possibility of using the system for easier and quicker access to good-quality plans with a shorter technical training period and opens avenues for new planning strategies for expert users. The use of a convex optimization approach allows an optimal plan to be provided in a very short processing time. This way, innovative graphical user interfaces can be developed, allowing the user to interact directly with the planning system to graphically define the desired dose map and to modify on-the-fly the dose map by moving, in a very user-friendly manner, the isodose surfaces of an initial plan. Further independent quantitative prospective evaluation comparing inverse planned and forward planned cases is warranted to validate this novel and promising treatment planning approach [1)].

To compare planning indices achieved using manual and inverse planning approaches for Gamma knife radiosurgery for arteriovenous malformation.

For a series of consecutive AVM patients, treatment plans were manually created by expert planners using Leksell GammaPlan (LGP). Patients were re-planned using a new commercially released inverse planning system, IntuitivePlan. Plan quality metrics were calculated for both groups of plans and compared.

Overall, IntuitivePlan created treatment plans of similar quality to expert planners. For some plan quality metrics statistically significant higher scores were achieved for the inversely generated plans (Coverage 96.8% vs 96.3%, P = 0.027; PCI 0.855 vs 0.824, P = 0.042), but others did not show statistically significant differences (Selectivity 0.884 vs 0.856, P = 0.071; GI 2.85 vs 2.76, P = 0.096; Efficiency Index 47.0% vs 48.1%, P = 0.242; Normal Brain V12 (cc) 5.81 vs 5.79, P = 0.497). Automatic inverse planning demonstrated significantly shorter planning times over manual planning (3.79 vs 11.58 min, P < 10-6) and greater numbers of isocentres (40.4 vs 10.8, P < 10-6), with an associated cost of longer treatment times (57.97 vs 49.52 min, P = 0.009). When planning and treatment time were combined, there was no significant difference in the overall time between the two methods (61.76 vs 61.10, P = 0.433).

IntuitivePlan can offer savings on the labor of treatment planning. In many cases, it achieves higher quality indices than those achieved by an “expert planner” [2].

References

[1]
Levivier M, Carrillo RE, Charrier R, Martin A, Thiran JP. A real-time optimal inverse planning for Gamma Knife radiosurgery by convex optimization: description of the system and first dosimetry data. J Neurosurg. 2018;129(Suppl1):111-117. doi:10.3171/2018.7.GKS181572

[2]
Paddick I, Grishchuk D, Dimitriadis A. IntuitivePlan inverse planning performance evaluation for Gamma Knife radiosurgery of AVMs [published online ahead of print, 2020 Aug 4]. J Appl Clin Med Phys. 2020;10.1002/acm2.12973. doi:10.1002/acm2.12973