Introduction: Several methods have been described to optimize the dwell time distribution for the stepping source brachytherapy technique. Most of these methods are based on the minimization of an objective function, which in general is the variance between prescribed and actual doses at reference points located on the surface of the target region.
Method: Our method is based on linear programming techniques. Using a 3D imaging technique (CT,MR,US) the spatial relation between target and source points is known. After defining three dimensionally the target volume and critical organs reference points i are automatically generated inside and at the surface of these structures. Thereafter the physician prescribes a minimum dose D_{min}^{target} to the target and maximum doses $D_{max}^{co}{}_j$ to the critical structures co_j. The dose at a reference point i is the sum of the dose rates from sources at position k times the dwell time t_k at this position. The simplex algorithm is used to minimize the total irradiation time $T = \Sigma\, t_k$, with the constraints $D_{target}(i) > D_{min}^{target}$ and $D^{co}(i) < D_{max}^{co}{}_j$. It has been shown that the simplex algorithm is resolution complete: it solves this problem if there is a solution and finds the solution with the minimal T.
Result: We have compared this method for simple target volumes with traditional optimization methods and always found an improvement.
Conclusion: The main advantage of this method is that dosage is straightforward an that the objective function T which is minimized has a clear clinical meaning.