

電腦刀立體定位放射性手術於治療第一型及第二型聽神經
腫瘤之研究

**Hypofractionated cyberknife stereotactic
radiosurgery for acoustic neuromas with and
without association to neurofibromatosis Type**

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摘要

電腦刀立體定位放射性手術(Cyberknife stereotactic radiosurgery, CKSRS)，是一種非框架式的影像導引立體定位放射手術，已經被證實能有效地運用在顱內及脊椎病變的治療中。依據研究證據的準確性、高順形度以及均質性，證實了 CKSRS 除了能適當且有效地抑制腫瘤，尚能保護重要組織器官。對於聽神經瘤(acoustic neuromas, AN)的病人使用 CKSRS 來進行治療，保留病患的聽力、三叉神經以及顏面神經的功能會是其關鍵且相當重要，而聽力功能的保留程度在 CKSRS 的報告結果中，與其他放射療法相較之下，亦經得起考驗。在本篇研究中呈現我們使用 hypofractionated CKSRS 來治療 AN 的經驗。在過去兩年中，我們收集了 21 位罹患 AN 的病患。在這些病人中，15 位為單側性聽神經腫瘤 AN、6 位為雙側性；有 7 位為第二型神經纖維瘤(neurofibromatosis type-2, NF2)、剩下的 14 位皆為非 NF2。而在 NF2 的 7 位病人中，有 1 位為單側性 AN、其餘的 6 位皆為雙側性。所有的病人在手術前及手術後進行第 V、第 VII 及第 VIII 腦神經之神經功能評估，評估標準依據 Gardner-Robertson grading 評估聽力功能、顏面神經方面採用 House-Brackmann grading、而三叉神經功能則採用 semi quantitative scale。所有的病人均會在治療前以及治療後的三個月、六個月、十二個月以聽力紀錄圖(audiogram)來作為判定。治療後每三個月作一次核磁共振造影(MRI)。電腦刀治療過程的劑量值指標包括了：腫瘤包覆度(tumor coverage)、劑量均勻程度

(homogeneity index, HI)、順形參數(conformality index, CI)以及新順形參數 (new conformality index, NCI)，我們依據這些指標用以評估出一套精確的放射治療手術計劃，平均追蹤時間為 12 個月（範圍：2-22 個月）。病人腫瘤體積的範圍為 0.13-24.8 立方公分（平均 5.4 立方公分），以平均邊緣劑量 1820 cGy（範圍由 1800-2000 cGy）分三次進行療程。並用 80%-89%的等劑量線（平均 83%），以及平均 97%的腫瘤包覆度來治療腫瘤。在非 NF2 的病人中，11 位有 9 位(81%)在最後一次的追蹤結束後能保留正常聽力功能（Gardner-Robinson 1-2 級）；而在 NF2 病人中，5 位中有 3 位(60%)保留聽力。所有病人的顏面神經功能及三叉神經功能均沒有障礙發生。亦沒有病患有腦幹受損或小腦水腫的情形。在 MRI 的追蹤下顯示，有 20 位(95%)病人的腫瘤消退，一位(5%)腫瘤維持穩定，達到百分之百的腫瘤控制率。我們兩年的研究結果應證了 hypofractionated CKSRS 不僅可顯著的控制 AN 病患之腫瘤，同時對於 non NF-2 的病人也能有效的保留聽力功能。相對而言，NF-2 病患之腫瘤控制效果雖然也相當好，但其聽力保留不如非 NF-2 病患來得理想。

Abstract

Objective: Cyberknife stereotactic radiosurgery (CKSRS), an image-guided frameless stereotactic radiosurgery system, has been proven effective in the treatment of intra-cranial and spinal lesions. With evidence-proven accuracy, high conformality and homogeneity, CKSRS is feasible and effective not only in tumor control but also in vital organ sparing. Concerning in using CKSRS to treat patients with acoustic neuromas (AN), the preservation of hearing, trigeminal nerve, and facial nerve is critical and important. The results of CKSRS to preserve hearing function are amenable comparing to other irradiation treatment modality. In this study, we report our experience to treat acoustic neuromas using hypofractionated CKSRS. Methods: We collected 21 patients with AN in past 2 years. Among these 21 patients, 15 patients were unilateral AN; and 6 patients were bilateral. 7 patients were neurofibromatosis type 2 (NF2) and 14 patients were non-NF-2. Among the 7 patients with NF2, one patient was unilateral AN, and the other six were bilateral. Neurological evaluation of cranial nerves V, VII and VIII were performed preoperatively and postoperatively in all the patients according to the Gardner-Robertson grading on hearing function, House-Brackmann grading on facial nerve function, and semi quantitative scale on trigeminal nerve function. All patients were evaluated with audiograms before treatment and at 3, 6 and 12 months following treatment. Magnetic resonance (MR) image was obtained at 3 months intervals after treatment. The dosimetry indices of Cyberknife treatment, including tumor coverage, homogeneity index (HI), conformality index (CI), and new conformality index (NCI) of these patients were calculated to evaluate the precision of radiosurgery treatment planning. Mean follow-up was 12 months (range: 2-22 months) Results: Tumor volume ranged from 0.13 to 24.8 cm³ (mean 5.4 cm³) with the mean marginal dose 1820 cGy (range 1800-2000 cGy)/3

fractions. Tumors were treated with 80% to 89% isodose line (mean 83%) and mean 97.9% tumor coverage. For the non-NF-2 patients, useful hearing (Gardner-Robinson Class 1-2) was preserved in 9 (81%) of 11 patients at the last follow-up. For the NF-2 patients, 60% of patients (3/5) retained useful hearing. No new facial and trigeminal dysfunction developed in all patients. No patients experienced brainstem toxicity or cerebellar edema. Followed up MR images showed that tumor regression in 20 patients (95%) and stationary in one patient (5%), and achieved 100% tumor control rate. Conclusions: Our 2 years experience strongly support that hypofractionated CKSRS provided not only significant tumor control for AN but also excellent hearing preservation rate in non-NF-2 patients. On the contrary, in NF-2 patients, although tumor control was remarkable, hearing preservation rate is not so ideally as non-NF-2 patients.