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## Acute necrosis after Gamma Knife surgery in vestibular schwannoma leading to multiple cranial nerve palsies

Kapitza, S ; Pangalu, A ; Horstmann, G A ; van Eck, A T ; Regli, L ; Tarnutzer, A A

**Abstract:** We discuss a rare acute complication after Gamma Knife therapy (Elekta AB, Stockholm, Sweden) in a single patient. A 52-year-old woman presented with vertigo, facial weakness and hearing loss emerging 48 hours following Gamma Knife radiosurgery for a right-sided vestibular schwannoma. Neurological examination 6 days after symptom onset showed right-sided facial palsy, spontaneous left-beating nystagmus and pathologic head-impulse testing to the right. Pure-tone audiogram revealed right-sided sensorineural hearing loss. A diagnosis of acute vestibulocochlear and facial neuropathy was made. Brain MRI demonstrated focal contrast sparing within the schwannoma, likely related to acute radiation necrosis. Acute multiple cranial neuropathies of the cerebellopontine angle after Gamma Knife treatment should raise suspicion of acute tissue damage within the schwannoma and should result in urgent MRI. Treatment with steroids may be considered based on accompanying swelling and edema.

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# **Acute Necrosis after Gamma Knife Surgery in Vestibular Schwannoma leading to Multiple Cranial Nerve Palsies**

## Authors

Sandra Kapitza, MD<sup>1</sup>, Athina Pangalu, MD<sup>2</sup>, Gerhard A. Horstmann, MD<sup>3</sup>, Albert T. van Eck, MD<sup>3</sup>, Luca Regli, MD<sup>1</sup>, Alexander A. Tarnutzer, MD<sup>1</sup>

## Affiliations

<sup>1</sup> Department of Neurosurgery, University Hospital Zurich and University of Zurich, Zurich, Switzerland

<sup>2</sup> Institute of Neuroradiology, University Hospital Zurich, Zurich, Switzerland

<sup>3</sup> Gamma Knife Center Krefeld, Krefeld, Germany

## Email addresses:

Sandra Kapitza: [sandra.kapitza@usz.ch](mailto:sandra.kapitza@usz.ch)

Athina Pangalu: [athina.pangalu@usz.ch](mailto:athina.pangalu@usz.ch)

Gerhard Horstmann: [horstmann@gammaknife.de](mailto:horstmann@gammaknife.de)

Bert van Eck: [vaneck@gammaknife.de](mailto:vaneck@gammaknife.de)

Luca Regli: [luca.regli@usz.ch](mailto:luca.regli@usz.ch)

Alexander Tarnutzer: [alexander.tarnutzer@usz.ch](mailto:alexander.tarnutzer@usz.ch)

## Correspondence should be addressed to:

Alexander A. Tarnutzer, MD

Department of Neurosurgery, University Hospital Zurich

Frauenklinikstr. 10, 8091 Zurich, Switzerland

Phone: 0041 44 255 11 11

Fax: 0041 44 255 43 80

Email: [alexander.tarnutzer@usz.ch](mailto:alexander.tarnutzer@usz.ch)

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Highlights

- A rare complication after gamma-knife radiosurgery of vestibular schwannoma.
- Single case with acute vestibulocochlear and facial neuropathy 48h after treatment.
- MRI suggestive for acute radiation necrosis with contrast sparing within schwannoma.
- Steroids may be considered based on accompanying edema.

## **Abstract**

Here we discuss a rare acute complication after Gamma-Knife therapy in a single case. A 52-year-old woman presented with vertigo, facial weakness and hearing loss emerging 48 hours following gamma-knife radiosurgery of a right-sided vestibular schwannoma. Neurological examination six days after symptom-onset showed right-sided facial palsy, spontaneous left-beating nystagmus and pathologic head-impulse testing to the right. Pure-tone audiogram revealed right-sided sensorineural hearing loss. A diagnosis of acute vestibulocochlear and facial neuropathy was made. Brain-MRI demonstrated focal contrast sparing within the schwannoma, likely related to acute radiation necrosis. Acute multiple cranial neuropathies of the cerebellopontine angle after gamma-knife treatment should raise suspicion of acute tissue damage within the schwannoma and should result in urgent MR-imaging. Treatment with steroids may be considered based on accompanying swelling and edema.

## Manuscript

Gamma-knife radiosurgery was introduced as a treatment of vestibular schwannoma in 1973 and has become a less invasive alternative compared to microsurgical resection in small-sized vestibular schwannoma although randomized controlled trials are lacking to prove superiority or inferiority compared to microsurgery [1]. As a side effect hearing deterioration occurs in approximately 10-53% and facial neuropathy in 1-5.2% of the patients with low margin dose radiation (13Gy) [2]. Whereas long-term radiation toxicity is not uncommon, acute cranial neuropathies evolving 1-4 days after radiosurgery are rare in schwannoma. Here we describe a case with acute onset severe cranial neuropathy after stereotactic radiosurgery of a vestibular schwannoma within 48 hours and link clinical findings with MRI-confirmed structural damage.

In a 52-year-old female presenting with progressive dizziness, impaired balance and mild hearing deterioration a right-sided vestibular schwannoma was diagnosed (Fig. 1AB). Gamma-Knife radiosurgery was applied (margin-dose=13Gy, maximum-dose=20Gy) [3] and the patient was discharged hours later without complaints. On the second day after treatment she woke up with intense vertigo, nausea, gait imbalance, hearing-loss and painless facial palsy on the right side. Evaluation on the emergency department of another hospital the same day including brain MRI did not reveal a specific diagnosis and treatment with methylprednisolone was started. When we first saw the patient on day eight after gamma-knife surgery, she demonstrated a spontaneous left-beating nystagmus (Alexander grade II), a pathologic horizontal head-impulse test to the right with partial ocular tilt reaction (ipsilesional ocular torsion and head tilt), right-sided hearing-loss (complete) and peripheral facial palsy (House-Brackmann IV). A diagnosis of multiple cranial neuropathies with acute right-sided vestibulo-cochlear and facial neuropathy was made. Follow-up MRI (day 13) demonstrated focal sparing of contrast uptake within the schwannoma (Fig. 1EF), which retrospectively could already be seen on the first MRI (Fig. 1CD). Treatment with methylprednisolone was continued and slowly tapered out over four weeks. Over the next weeks the patient's balance and facial palsy improved, while anacusis persisted.

Based on MR-imaging with focal sparing of contrast uptake within the schwannoma, we consider acute radiation necrosis the most likely pathomechanism. Radiation-induced edema and swelling with consecutive hypoperfusion and ischemia may have caused such necrosis, as previously hypothesized by others [4, 5]. Other possible causes include bleeding, swelling of the vestibular nerve or radiation-induced neuropathy. While MR-imaging speaks against bleeding, swelling or radiation-neuropathy are typically delayed.

In the literature, we identified two similar cases; both presenting with acute combined neuropathy of the facial nerve and the vestibule-cochlear nerve, emerging 36-48 hours after radiosurgery of vestibular schwannomas [5, 6]. In both cases MR-imaging demonstrated reduced contrast uptake of the schwannoma, while no focal changes such as bleeding or edema were reported. This contrasts our case and may be explained by the different MRI-devices and sequences used in our patient and the two cases from the literature published 15 and 17 years ago. Noteworthy, decreased contrast-enhancement in the central area of the tumor was reported in a single case with isolated acute hearing-loss after gamma-knife surgery of a facial nerve schwannoma, resembling the MR-findings reported here [7].

To conclude, acute multiple cranial neuropathies of the cerebellopontine angle after gamma-knife treatment should raise suspicion of acute tissue damage within the schwannoma and should result in urgent MR-imaging. Symptomatic treatment with steroids may be considered based on accompanying edema, while prophylactic application of steroids is not justified because of the rare occurrence of this side effect. Early vestibular rehabilitation is recommended [8] and attention should be paid to protection of the cornea in patients with incomplete eyelid closure. Prognosis regarding facial nerve function is usually good, while hearing impairment shows less recovery [5, 6].

**Figure 1:**

T1-weighted contrast-enhanced MR-images. Panels AB: before treatment (day 0), indicating homogeneous gadolinium-uptake (courtesy: Gamma-Knife Center Krefeld, Germany). Panels CD (with fat suppression): obtained few hours after symptom-onset (day 2), demonstrating focal sparing of contrast-enhancement (white arrows) (courtesy: Amerikan Hastanesi, Istanbul, Turkey). Panels EF (with fat suppression): area of contrast-sparing becoming smaller (day 13; courtesy: University Hospital Zurich, Switzerland).

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