A Systematic Review of Radiosurgery Versus Surgery for Neurofibromatosis Type 2 Vestibular Schwannomas

Lawrance K. Chung[1], Thien P. Nguyen[1], John P. Sheppard[1], Carlito Lagman[1], Stephen Tenn[2], Percy Lee[2,4], Tania Kaprealian[1,2,4], Robert Chin[2], Quinton Gopen[3], Isaac Yang[1-4]

Key words
- Hearing
- Neurofibromatosis type 2
- Stereotactic radiosurgery
- Vestibular schwannoma

Abbreviations and Acronyms
HB: House-Brackmann
NF2: Neurofibromatosis type 2
SRS: Stereotactic radiosurgery
VS: Vestibular schwannoma

From the Departments of [1]Neurosurgery, [2]Radiation Oncology, [3]Head and Neck Surgery, and [4]Jonsson Comprehensive Cancer Center, University of California, Los Angeles, Los Angeles, California, USA

To whom correspondence should be addressed: Isaac Yang, M.D. [E-mail: iyang@mednet.ucla.edu]

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OBJECTIVE: **Neurofibromatosis type 2 (NF2) is an autosomal dominant disease characterized by bilateral vestibular schwannomas (VSs). NF2-associated VSs (NF2-VSs) are routinely treated with microsurgery; however, stereotactic radiosurgery (SRS) has emerged as an effective alternative in recent decades. To elucidate the role of SRS in NF2-VSs, a systematic review of the literature was conducted to compare outcomes of SRS versus surgery.**

METHODS: **PubMed, Web of Science, Scopus, Embase, and Cochrane databases were queried using relevant search terms. Retrospective studies investigating outcomes of NF2-VS patients treated with either SRS or surgery were included. Single-patient case reports were excluded. Outcome measures between the SRS and surgery groups were compared using χ^2 2-sample tests for equality of proportions on the pooled patient data.**

RESULTS: **A total of 974 patients (485 SRS, 489 surgery) were identified. The mean 5-year local control rate for SRS was 75.1%, and the mean recurrence rate for surgery was 8.1%. The mean hearing and facial nerve preservation rates were 40.1% and 92.3%, respectively, for SRS and 52.0% and 75.7%, respectively, for surgery. Rates of hearing preservation were higher after surgery than after SRS ($P = 0.006$), whereas rates of facial nerve preservation were higher after SRS than after surgery ($P < 0.001$).**

CONCLUSIONS: **SRS appears to be a safe and effective alternative to surgery for NF2-VS. Although rates of hearing preservation were higher in the surgery cohorts, SRS demonstrated high rates of local control and significantly lower facial nerve complications. Certain patients may therefore benefit more from SRS than surgery.**

INTRODUCTION

Neurofibromatosis type 2 (NF2) is an autosomal dominant disease characterized by multiple neoplasms due to a mutation in the tumor suppressor gene NF2 on chromosome 22q12.[1-3] NF2 prevalence is estimated at 1 in 25,000 live births and can present with a variety of signs and symptoms.[4,5] Individuals with NF2 often develop multiple neoplasms in the skin, eyes, and central nervous system.[1,2,6] By the age of 60, the disease has nearly 100% penetrance.[2,6] Bilateral vestibular schwannomas (VSs) are a hallmark of the disease.

NF2-associated VSs (NF2-VSs) are often managed conservatively with annual magnetic resonance imaging scans to monitor for disease progression.[7-9] When intervention is indicated, VSs are routinely treated with microsurgery for tumor resection. Although complete resection may be curative, the multilobulated morphology and infiltrative nature of the tumor induces significant risk for iatrogenic injuries during surgery—namely, hearing loss and facial nerve damage.[10] Advancements in microsurgical techniques have reduced the risk of complications to adjacent cranial nerves, but hearing loss remains relatively common.[11]

More recently, stereotactic radiosurgery (SRS) has been used successfully to mitigate many of the risks associated with surgery.[12-20] In most experienced centers, SRS achieves long-term tumor control in more than 95% of cases of sporadic VS.[21-23] This lends credence to SRS as a primary treatment modality for NF2-VS.[24,25] Although SRS has demonstrated high local control rates in NF2-VS, one concern with radiation is the potential for malignant tumor transformation. As a result, controversy remains among clinicians regarding the use of SRS as a treatment option. In this study, the authors systematically analyzed the current literature to examine outcomes of SRS versus surgery for the treatment of NF2-VS.

METHODS

Adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses was maintained throughout the preparation of this study.

Sources and Search Strategy

A systemic review of the literature was performed by independent authors (L.C. and T.N.) to identify studies that

investigated outcomes of SRS and surgery for NF2-VS. A search was conducted using PubMed, Web of Science, Scopus, Embase, and Cochrane databases in November 2016 using a strategic combination of terms: "neurofibromatosis type 2," "vestibular schwannoma," "acoustic neuroma," "stereotactic," "radiation therapy," "gamma knife," and "surgery." The search process is summarized in Figure 1. English-language articles, randomized clinical trials, prospective cohorts, and retrospective studies were selected. The titles and abstracts of these studies were screened, and pertinent full-text articles were reviewed for inclusion. The references of the identified studies were queried further for relevant studies.

Article Selection

Only studies that investigated NF2-VS with sufficient clinical information were included. For studies with substantial overlap in patient populations, only the most recent publication was included. SRS studies using Gamma Knife or linear accelerators were included. Studies that reported on patients with spinal lesions, aggregated sporadic VS, or used other forms of radiation other than single-fraction SRS were excluded. Single-patient case reports were also excluded.

Data Extraction

Data for patient demographics, treatment parameters, treatment outcomes, complications, and follow-up length were extracted. Outcome measures included local control, hearing preservation, trigeminal nerve preservation, facial nerve preservation, and tumor recurrence. Reported outcomes and complication rates were obtained from the last clinical follow-up, unless noted otherwise. Hearing preservation was defined as the proportion of individuals with serviceable hearing who maintained serviceable hearing at last follow-up. Serviceable hearing was defined as either a Gardner-Robertson grade I-II or

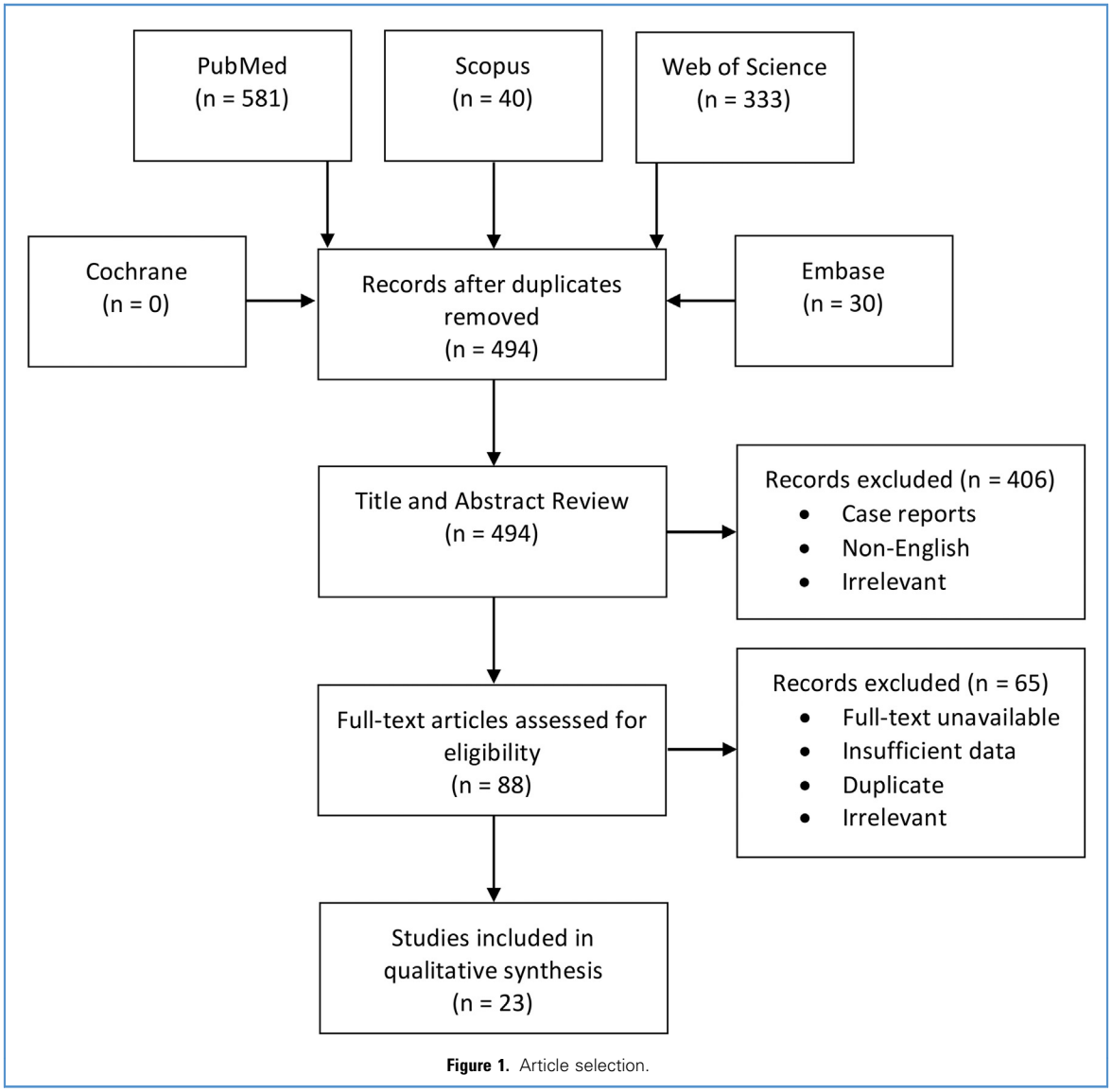

Figure 1. Article selection.