Editorial re: Facial nerve function and hearing after microsurgical removal of sporadic vestibular schwannomas in a population-based cohort by Ismail Taha et al.

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The authors present their results of facial nerve function and hearing after microsurgical removal of vestibular schwannoma (VS) between the years 2001 and 2017. During this period, the treatment protocol was changed remarkably with the introduction of stereotactic Cyber Knife (CK) radiosurgery. Between the years 2001 and 2012, the aim of surgery was gross-total resection of the tumor with drilling of the internal acoustic canal in order to concurrently remove the intrameatal part of the tumor. In 2012, the operative strategy changed to partial tumor resection of only the extrameatal tumor, and this practice was applied during the latter period 2013–2017. The aim of this change was to reduce surgery-related facial nerve injuries, since the availability of CK provides a second-line treatment option in the case of residual tumor growth. Authors demonstrated improved facial nerve outcomes compared to the pre-Cyber Knife era (0% poor outcomes versus 22.8% poor outcomes).

However, they confess a tumor regrowth rate of 19.8% during 2013–2017 Cyber Knife era (4-year follow-up) compared to 24.7% in the period 2001–20012 (11-year long-term follow-up).

This “paradigm shift to Cyber Knife strategy” brings two essential problems. First, authors showed no respect to microsurgical principles of advanced VS microsurgery and without sufficient long-term results, they programmatically switched to partial resection without opening the internal auditory canal (IAC). Secondly, they irresponsibly exposed patients to a higher risk of recurrence with an uncertain long-term prognosis.

(1) Changing the operative strategy after purchasing Cyber Knife is a controversial and almost unacceptable approach and indicates a misunderstanding of the role of stereotactic radiosurgery in the management of VS. Resection of only the extrameatal portion of the tumor is an incomplete procedure. Identification of the facial nerve in internal auditory canal (IAC) is a fundamental step to identify the facial nerve laterally from the tumor and represents the easier part of the operation. The highest tumor adherence is usually 6–10 mm medially from the IAC. In modern neurosurgery, we should not ignore and neglect microsurgical principles established and improved by personalities of the field since the 1980s (Yasargil, Samii, Koos, Fukushima [1, 6, 8, 11, 12]). Long-term results of these meticulous techniques with the aim of radical resection result in long-term cure of patients [8].

The main operation goal should be radical resection, the near total resection (NTR) is determined by an increase in the MST (minimal stimulation threshold) when the nerve adheres to the tumor. Moreover, the near total resection (resection of 95–99% of the tumor) is defined as a thin film of linear enhancement after surgery, which is usually stable within MR follow-up, with a risk of recurrence of 9.4% within a 5-year follow-up [9].

Leaving the tumor within the internal acoustic canal can never fulfill the definition of NTR (resected 99–95% of the tumor). Authors could achieve only partial resection with residual substance of the tumor on MRI. Partial resection increases the risk of recurrence up to 27.6% after 5 years [9], which corresponds with the authors results (19.8% recurrence after CK with a mean follow-up of 4 years).

Surgery of VS is a responsibility, not a prestige of the department. If the skull base team is not able and not willing to aim for radical or near total resection guided by an increase of MST, the department should not attempt this kind of surgery. Incidence of VS is relatively low and represents only 1 case /100,000 inhabitants per year. This incidence represents 50 cases for a 5 million population per year. Only a few

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dedicated skilled teams should perform this demanding microsurgery in a country with a population of five million. This is the case in most other countries. Radiosurgery is a great adjuvant method for treating growing remnants of VS; however, the purchase of Cyber Knife does not mean one can forsake the basic principles of microsurgery. As a side note, the authors achieved resection of the intrameatal tumor portion in only 58% of cases in the pre-CK era, which is evidence of low accentuation of this demanding and delicate microsurgery.

The path of comfort and low competence can negatively affect young neurosurgical colleagues and poses a serious threat to the quality of the specialized neurosurgery field. Unfortunately, this article represents evidence of the loss of basic microsurgical skills.

(2) Conservative partial surgery followed by SRS has unfortunately appeared in literature since 2003. The authors of only four studies have reported outcomes between 2003 and 2008, although the number of included patients was small [4]. However, even today, we do not have reliable long-term follow-up to justify this policy of partial resection followed by radiosurgery. The reported recurrence is 14%; however, median follow-up is only 5 years [5], or 11.1% regrowth with a median follow-up of 2.8 years [7]. However, patients younger than 50 years old exhibited tumor regrowth in 33%. Residual tumor volume greater than 6 cm³ before radiosurgery had a significantly greater chance of tumor regrowth of 37.5%. Daniel [2] published a paper demonstrating a residual volume treated at gamma knife of 31%, representing a resection of only 69% of the Schwannoma volume. Utilizing the strategy of not to opening IAC is dangerous as the surgeon cannot control the position of the facial nerve and cannot assess tumor remnants in lateral part of tumor. A large residual volume at radiosurgery increases the chance of salvage surgery at the time of transient expansion (pseudo-progression between 3 and 30 months) [7]. However, distinction between transient tumor expansion and tumor growth is not always easy [2]. Salvage surgery was necessary in 10.5% [5]. Salvage surgical resection after failed radiosurgery is reported to be a challenge in preserving cranial nerve function due to their adhesion to the surrounding structures [3].

One of the last articles published by Starnoni 2018 [10], the authors attempt to analyze the existing literature through a systematic review of this questionable policy. They included 9 studies and 248 patients with a mean follow-up of 4.8 years. The pooled rate of overall tumor control was 93.9%. However, authors conclude that longer-term follow-up and larger patient cohorts are necessary to fully evaluate the rate of tumor control. The main limitations of this review are related to the observational nature of these studies, incomplete data, varied follow-up periods, and diverse definitions of tumor control. These weaknesses characterize the low quality of evidence of this review. The authors' warning that the concept

of an incomplete resection should in no way encourage a nonspecialty or less experienced surgical team to attempt this treatment is absolutely crucial.

It is also necessary to cautiously discuss the possibility of economic motivation, when indicating indication of this treatment strategy. Partial resection and radiosurgery leads to double charging of these procedures and higher hospital profits, which also brings into question the ethical dimension of this controversy.

In conclusion, in cases of large vestibular schwannomas, microsurgery is the main treatment option, and complete removal which is a definite cure of the patient is considered the primary goal. Treatment strategies and patient expectations have changed over the last decade. Radical surgical resection at any price is no longer acceptable. QOL and facial nerve function is one of the most important outcome parameters. Once the intraoperative situation suggests, that we cannot achieve radical removal (high adherence of the tumor to the facial nerve, increasing MST to 0.2 mA and higher), we adapt our resection to a tailored tumor removal (near total removal). The use of advanced microsurgical techniques (Fukushima sharp dissection, blunt arachnoidal Samii dissection technique) [8, 11] is necessary to decrease the size of the tumor safely to small "film like remnant" of the capsule on the nerve. This near total resection also brings long-term tumor growth control with a recurrence rate of only 9.4% after 5 years [9]. Radiosurgery is indicated for these recurrences. Planned partial resection followed by radiosurgery is not a proper procedure and is not supported by long-term results. In addition, the centers publishing this strategy have a very low patient turnover rate with only 3–5 patients per year [2, 4, 7]. There is still a reason to learn microsurgical tumor removal and operate our patients in competent specialized neurosurgical centers.

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