Wait-and-see strategy compared with proactive Gamma Knife surgery in patients with intracanalicular vestibular schwannomas

Clinical article

JEAN RÉGIS, M.D.,† ROMAIN CARRON, M.D.,† MICHAEL C. PARK, M.D., PH.D.,† OUTOMA SOUMARE, M.D.,‡ CHRISTINE DELSANTI, M.D.,† JEAN MARC THOMASSIN, M.D., PH.D.,† AND PIERRE-HUGUES ROCHE, M.D.‡

†Service de Neurochirurgie Stéréotaxique et Fonctionnelle, Centre Hospitalier Universitaire (C. H. U.) la Timone; ‡Service de Neurochirurgie, and ‡Fédération d’Oto-Rhino-Laryngologie, C. H. U. la Timone, AP-HM, Assistance Publique des Hôpitaux de Marseille, Marseille, France

Object. The roles of the wait-and-see strategy and proactive Gamma Knife surgery (GKS) in the treatment paradigm for small intracanalicular vestibular schwannomas (VSs) is still a matter of debate, especially when patients present with functional hearing. The authors compare these 2 methods.

Methods. Forty-seven patients (22 men and 25 women) harboring an intracanalicular VS were followed prospectively. The mean age of the patients at the time of inclusion was 54.4 years (range 20–71 years). The mean follow-up period was 43.8 ± 40 months (range 9–222 months). Failure was defined as significant tumor growth and/or hearing deterioration that required microsurgical or radiosurgical treatment. This population was compared with a control group of 34 patients harboring a unilateral intracanalicular VS who were consecutively treated by GKS and had functional hearing at the time of radiosurgery.

Results. Of the 47 patients in the wait-and-see group, treatment failure (tumor growth requiring treatment) was observed in 35 patients (74%), although conservative treatment is still ongoing for 12 patients. Treatment failure in the control (GKS) group occurred in only 1 (3%) of 34 patients. In the wait-and-see group, there was no change in tumor size in 10 patients (21%), tumor growth in 36 patients (77%), and a mild decrease in tumor size in 1 patient (2%). Forty patients in the wait-and-see group were available for a hearing level study, which demonstrated no change in Gardner-Robertson hearing class for 24 patients (60%). Fifteen patients (38%) experienced more than 10 dB of hearing loss and 2 of them became deaf. At 3, 4, and 5 years, the useful hearing preservation rates were 75%, 52%, and 41% in the wait-and-see group and 77%, 70%, and 64% in the control group, respectively. Thus, the chances of maintaining functional hearing and avoiding further intervention were much higher in cases treated by GKS (79% and 60% at 2 and 5 years, respectively) than in cases managed by the wait-and-see strategy (43% and 14% at 2 and 5 years, respectively).

Conclusions. These data indicate that the wait-and-see policy exposes the patient to elevated risks of tumor growth and degradation of hearing. Both events may occur independently in the mid-term period. This information must be presented to the patient. A careful sequential follow-up may be adopted when the wait-and-see strategy is chosen, but proactive GKS is recommended when hearing is still useful at the time of diagnosis. This recommendation may be a main paradigm shift in the practice of treating intracanalicular VSs. (DOI: 10.3171/2010.8.GKS101058)

Key Words • audiometry • functional preservation • hearing • quality of life • radiosurgery • vestibular schwannoma

WAIT-AND-SEE strategy1,2,19 is a classic recommendation in the management of intracanalicular VSs (Koos Grade I lesions).8 This long-standing axiom was based both on the assumption that small intracanalicular lesions are frequently stable and that patients are likely to retain functional hearing for a long period of time. The risks of microsurgical tumor removal, the only approach commonly available at the time, were additional arguments for postponing resection until the tumor grew and destroyed functional hearing. During the past 3 decades, there have been dramatic advances in the diagnosis and treatment of VSs. The proportion of small intracanalicular lesions identified at the time of imaging-based diagnosis has increased dramatically.25 However, there are still patients in whom a conservative management approach, or wait-and-see strategy, might represent a suitable alternative. The natural history of untreated VSs remains a matter of controversy, particularly for the subgroup of intracanalicular VSs. The aim of this period of time. The risks of microsurgical tumor removal, the only approach commonly available at the time, were additional arguments for postponing resection until the tumor grew and destroyed functional hearing. During the past 3 decades, there have been dramatic advances in the diagnosis and treatment of VSs. The proportion of small intracanalicular lesions identified at the time of imaging-based diagnosis has increased dramatically.25 However, there are still patients in whom a conservative management approach, or wait-and-see strategy, might represent a suitable alternative. The natural history of untreated VSs remains a matter of controversy, particularly for the subgroup of intracanalicular VSs. The aim of this
study was to analyze our own experience with conservatively treated intracanalicular VSs with an emphasis on tumor volume behavior and functional hearing preservation. A comparison of these results with a control group of intracanalicular lesions treated with GKS was made to evaluate our treatment paradigm for intracanalicular VSs. In addition to the question of tumor control, a specific question of whether preservation of useful hearing is best done by observation or early GKS was addressed.

**Methods**

Between 1981 and 1999, a conservative strategy of wait and see was systematically proposed for 60 consecutive patients harboring an intracanalicular VS. Thirteen patients did not accept further follow-up investigation, and data were obtained in the remaining 47 patients who accepted this protocol. For the purpose of this paper, our clinical data were supplemented by data provided by referring physicians and the patients themselves (hearing level and imaging data). Comparisons of means were made using the Student t-test, Mann-Whitney U-test, and Kruskal-Wallis test. The chi-square test and Fisher exact test were also used to compare distributions. Survival curves were calculated using the Kaplan-Meier method.

**Evaluation of Tumor Volume and Growth Kinetics**

For patients whose VS was diagnosed in March 1990 or later, MR imaging was routinely used for sequential imaging follow-up. The study of tumor growth was based on tumor diameter and volume. The tumor growth rate based on diameter size (or TGR diam.) is expressed as millimeters per year and is defined by the difference between the final and initial diameter of the tumor divided by the number of follow-up years. The tumor growth rate in volume (TGR vol.) is expressed as cubic millimeters per year and is defined by the difference between the final and initial volume of the tumor divided by the number of follow-up years. The tumor volume is calculated using \( y \times x \times x / 2 \), where \( y \) is the transverse diameter and \( x \) is the anteroposterior diameter of the tumor, assuming that the anteroposterior and craniocaudal extensions are very similar. Then, the TDT is calculated using the following formula:\(^{13}\)

\[
TDT = \log 2 \times (\text{time})/\left[\log (\text{last measured tumor volume}) - \log (\text{initial tumor volume})\right].
\]

Changes in tumor size were also described using the Koos grading system.\(^6\) Statistical correlations between tumor growth and the following parameters were performed: patient age, patient sex, initial ABR, hearing level, homogeneous versus heterogeneous contrast loss, and IAC deformation.

Failure of the clinical strategy for the wait-and-see group or for the control group treated by GKS, the primary end point of this study, was defined as tumor control failure and/or loss of hearing functionality (for example, see Fig. 1). Tumor control failure for both groups was defined as significant tumor growth requiring either microsurgical or radiosurgical treatment. For our otoneurosurgery group, a new treatment was proposed after GKS when a patient presented with continued tumor growth more than 3 years after radiosurgery.

**Evaluation of Hearing and its Changes**

Pure tone average was calculated by averaging the hearing loss at thresholds of 500, 1000, 2000, and 4000 Hz. The SDS was also systematically recorded, and Gardner-Robertson classes could thus be determined. Patients found to be deaf at the time of diagnosis and those with missing data were excluded from interpretation of the hearing level kinetics evaluation. Level of hearing was defined as unchanged when the difference between the initial and final PTA did not exceed 10 db.

**Patient Demographics**

**Wait-and-See Group.** Forty-seven patients received conservative management of their VSs. There were 22 men and 25 women in this group, and their mean age at the time of inclusion was 54.4 years (range 20–71 years). The mean (± SD) duration of follow-up was 43.8 ± 40 months (range 9–222 months), and the median duration of follow-up was 34.7 months.

![Graph showing Kaplan-Meier survival curves for patients without treatment failure in both the wait-and-see group (47 patients) and the GKS control group (34 patients). Failure was defined as the necessity of radiosurgery or microsurgery in patients displaying tumor growth and/or hearing deterioration (loss of functional hearing). The rate of failure is significantly higher in the wait-and-see population than in the control group treated proactively by GKS.](image-url)
VS was sudden vertigo and progressive hearing loss in 1 patient; dizziness in 3 patients followed by progressive hearing loss in 2 patients; and dizziness and imbalance in 2 patients. Dizziness, imbalance, and tinnitus together were noticed in 2 patients and only tinnitus in 1 patient. In 1 patient, the findings of VS were incidental. At the time of diagnosis, hypoacusis was found in 46 patients, which included deafness in 4 patients (9%), tinnitus in 26 patients (55%), dizziness in 16 patients (34%), imbalance in 21 patients (45%), and the feeling of fullness in the ear in 3 patients (6%).

On initial CT or MR images, homogeneous contrast enhancement of the tumor was observed in 45 patients (96%), whereas heterogeneous contrast enhancement was identified in 2 patients (4%). In 22 patients (47%), the tumor extended to the fundus of the IAC. On a bone-window CT scan, the shape of the IAC appeared normal in 34 patients (72%), whereas there was widening of the canal in 10 patients (21%) and osteolysis in 3 patients (6%).

Control GKS Group. The control group consisted of 34 consecutively enrolled patients with unilateral intracanalicular VSs, who had not undergone previous surgery, had functional hearing at the time of radiosurgery, and had participated in a minimum imaging and audiometric follow-up lasting longer than 3 years. These patients were treated using a Gamma Knife model B (Elekta AB) according to our previously published methodology.21 The median dose directed at the tumor margin was 12 Gy, and the median isodose to the margin was 50%. Evaluations in the 12 remaining cases was 49.95 ± 46.49 months, and the median follow-up duration was 33.4 months. The mean TGR diam. was 2.8 ± 1.9 mm/year (median 2.4 mm/year).

Including the whole wait-and-see population, we found that the mean initial transverse diameter of the tumor was 8.1 ± 2.5 mm, and the mean final transverse diameter was 13.1 ± 4.6 mm (p < 0.001). The mean initial tumor volume was 84.5 ± 48.9 mm³, and the mean final tumor volume was 409.5 ± 841.7 mm³ (p < 0.001). The mean TGR diam. was 2.1 ± 2 mm/year. For 45 patients, the mean TGR vol. was 122 ± 244 mm³/year. For the 10 tumors that remained stable, the mean and median follow-up times were 60.4 ± 46.4 and 45.2 months, respectively. The TDT was obtained in 35 cases of tumor growth (incomplete data in 1 case), with follow-up ranging from 4.8 to 164.7 months (mean 27.8 ± 16.2 months). The TDT was less than 1 year in 11 patients (31%), between 1 and 3 years in 18 patients (51%), and longer than 3 years in 6 patients (17%). No statistical correlation could be found between tumor growth or the TDT and the following parameters: patient age, patient sex, initial PTA, initial SDS, ABR, contrast enhancement, and IAC deformation findings.

Results

Failure of conservative management or “wait and see” was defined as the necessity of radiosurgery or microsurgical treatment. This failure was observed in 35 patients (74%), with conservative treatment still ongoing in 12 patients. The mean duration of follow-up in patients in whom conservative management failed was 41.3 ± 37.08 months, and the median duration was 34.7 months (range 10.6–222 months). The mean duration of follow-up in the 12 remaining cases was 49.95 ± 46.49 months, and the median duration was 33.94 months (range 9.2–167 months). One of these patients required translabyrinthine removal of the VS because the lesion progressed to Koos Grade IV after 46 months. Thirty patients underwent GKS: 1 patient harbored a Koos Grade III tumor; 24 patients had Grade II tumors; and 5 patients had Grade I tumors. Four patients are currently scheduled for GKS: 3 patients harboring Grade I lesions and 1 patient with a Grade II lesion.

Analysis of Tumor Behavior

In the wait-and-see group, there was no change in tumor size in 10 patients (21%), tumor growth in 36 patients (77%), and a moderate decrease in the size of the tumor in 1 patient (2%) during the follow-up period. For the 36 patients whose tumor increased in size, the mean follow-up duration was 39.7 ± 37.1 months, and the median follow-up duration was 33.4 months. The mean TGR diam. was 2.8 ± 1.9 mm/year (median 2.4 mm/year).

Among the 47 patients in the wait-and-see group, 40 were available for a study of hearing level; 4 patients were already deaf at the time of inclusion, and there was a lack of audiometric data in 3 other patients. In 24 patients (60%), the PTA (and consequently the hearing class) did not change at 3 years. Fifteen patients (38%) presented with greater than 10 db hearing loss and 2 of these became deaf. One patient (2.5%) experienced an improvement in her hearing from 56.3 to 43.8 dB (PTA) over a 39.5-month period. The mean and median follow-up periods in the unchanged hearing group were 35.1 ± 42.5 and 22.3 months, respectively, and the mean and median

<table>
<thead>
<tr>
<th>Factor</th>
<th>Wait-and-See Group</th>
<th>Proactive GKS Group</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koos Grade</td>
<td>I</td>
<td>I</td>
<td>NS</td>
</tr>
<tr>
<td>useful hearing (Gardner-Robertson Class I or II)</td>
<td>31 of 47</td>
<td>34 of 34</td>
<td>NS</td>
</tr>
<tr>
<td>male/female ratio</td>
<td>22:25</td>
<td>13:21</td>
<td>NS</td>
</tr>
<tr>
<td>mean pt age (yrs)</td>
<td>54.4</td>
<td>51.0</td>
<td>NS</td>
</tr>
<tr>
<td>mean FU (mos)</td>
<td>43.8</td>
<td>45.5</td>
<td>NS</td>
</tr>
<tr>
<td>prior op</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>mean max diameter of VS (mm)</td>
<td>8.1</td>
<td>9.6</td>
<td>NS</td>
</tr>
<tr>
<td>mean vol of VS (mm³)</td>
<td>84.5</td>
<td>112.5</td>
<td>NS</td>
</tr>
</tbody>
</table>

* FU = follow-up; NS = not statistically significant, no meaningful differences between the 2 groups were observed; pt = patient.
follow-up periods in the worsened hearing group were 57.8 ± 24.2 and 55.3 months, respectively. No statistical difference was found between the 2 groups regarding TGR diam., TGR vol., and TDT and the following initial parameters: SDS, ABR, first symptom, sex, age, and imaging findings. There was no evidence of a predictive parameter of hearing loss at the time of initial management.

Analysis of Useful Hearing

Among the 47 patients, 31 (66%) presented with useful hearing at the time of diagnosis (PTA ≥ 50 dB and SDS ≥ 50%). During the follow-up period, 21 patients (68%) retained useful hearing and 10 patients (32%) lost it. Another patient improved from nonuseful hearing (56.25 dB PTA at the time of the initial test) to useful hearing (43.75 dB PTA at 39.5 months). The mean and median follow-up periods in the 31 patients with useful hearing at the time of the diagnosis were 40 ± 39.4 and 32.2 months, respectively. The mean and median follow-up periods in the 21 patients whose hearing level was preserved were 40.8 ± 45 and 32.2 months, respectively, and the mean and median follow-up periods in the 10 patients whose hearing worsened were 38.21 ± 26 and 33 months, respectively. Among the 31 patients with useful hearing at the time of enrollment, 25 patients (81%) experienced tumor growth, 5 patients (16%) harbored a stable tumor, and 1 patient (3%) harbored a tumor that had decreased in size. Among the 25 patients whose tumor displayed growth, 8 patients (32%) lost their useful hearing, whereas among the 5 patients with stable tumors, 1 patient (20%) lost his useful hearing. Tumor growth was not correlated with the potential for hearing loss. The useful hearing preservation rates in the wait-and-see group at 3, 4, and 5 years were 75%, 52%, and 41%, respectively (Fig. 2). For comparison, the useful hearing preservation rates in the control group at 3, 4, and 5 years were 77%, 70%, and 64%, respectively.

Analysis of Patients With a Near-Normal Hearing Level

Among the 47 patients, 16 (34%) patients presented with near-normal hearing at the time of their inclusion in the study (PTA ≤ 30 dB and SDS ≥ 70%). During the follow-up period (mean 34.2 ± 23.7 months, median 26.3 months), 11 (69%) of the 16 patients kept the same hearing level, whereas 5 patients (31%) experienced a deterioration in their hearing. During the same period, the VS grew in 13 (81%) of the 16 patients and remained stable in 3 patients (19%). Among the 13 patients whose tumors enlarged, 3 (23%) demonstrated hearing degradation. Among the 3 patients without tumor growth, 2 patients (67%) experienced worsened hearing. Tumor growth was not statistically correlated to hearing preservation.

Failure of the Strategy

The chances of retaining functional hearing and avoiding further intervention (Table 2) were much higher in the control group treated by GKS (79% and 60% at 2 and 5 years, respectively) than in the wait-and-see group (43% and 14% at 2 and 5 years, respectively). This difference was statistically significant after the 1st year of follow-up.

Discussion

For many years it has been postulated that intracanalicular tumors belong to a distinct category of VS that displays original biological behavior. Martin et al. studied the histopathological characteristics of 144 VSs and observed that 100% of intracanalicular tumors displayed an Antoni A architecture, whereas the majority of large tumors (76.8%) displayed a B-type pattern. Additionally, Kasantikul et al. emphasized a predilection of male patients for intracanalicular tumors and a female predilection for large VSs. Taken collectively, these data indicated that intracanalicular VS were less aggressive in behavior and that most of these tumors were able to maintain stability in the long term. We shared this opinion at the start of GKS in our institution and thereby decided to adopt a wait-and-see policy in this group of patients. Therefore, we recommended sequential follow-up for this population with attention to changes in tumor volume and hearing status.

In the management of VS, there are several reasons to adopt a wait-and-see policy, such as patients with asymptomatic VS, patients in whom only the hearing ear is involved, elderly patients with mild symptoms, and patients who refuse any treatment. In the series published by Deen et al., the proportions corresponding to each of these reasons were 4%, 4%, 55%, and 21%, respectively. For individual cases, a conservative attitude may also depend on the experience of the surgical team when the issue of hearing preservation is at stake. Another important issue to consider is whether microsurgery after a failed conservative policy (observation of tumor growth) provides less of a chance of recovery to the patient compared with early proactive treatment. Raut et al. analyzed both groups and found similar functional outcomes and comparable tumor cure rates in matched cases. Sughrue et al. in a review analysis of the published literature on the natural history of VS with respect to hearing outcome, found 34 published papers aggregating a total of 982 patients. The mean tumor growth rate was 2.9 ± 1.2 mm/year, the rate
Wait-and-see versus GKS in Koos Grade I vestibular schwannomas

TABLE 2: Statistical study of tumor control and functional hearing*

<table>
<thead>
<tr>
<th>Group</th>
<th>% of Pts w/ Tumor Control &amp; Functional Hearing During FU</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Yr</td>
<td>2 Yrs</td>
</tr>
<tr>
<td>wait-and-see</td>
<td></td>
<td></td>
</tr>
<tr>
<td>proactive GKS</td>
<td>78.0</td>
<td>43.0</td>
</tr>
<tr>
<td>(control)</td>
<td>88.2</td>
<td>79.4</td>
</tr>
<tr>
<td></td>
<td>0.0009</td>
<td>0.000012</td>
</tr>
</tbody>
</table>

* The risk of failure (tumor growth or functional hearing loss) was significantly higher in the wait-and-see group than in the proactive GKS (control) group after 1 year of follow-up. Statistical significance was established at p < 0.05.

of intervention was 16%, and the duration of follow-up ranged between 26 and 52 months. Tumor growth was greater than 2.5 mm/year in 75.32% of the patients. The mean functional hearing preservation rate was 54%, and that rate was better in patients in whom the tumor growth rate was lower than 2.5 mm/year and in those harboring a larger tumor.28 The same authors have recently confirmed the conclusions of the literature analysis through a prospective trial.27

When analyzing the literature about the wait-and-see policy in small VSs, it is evident that many methodological pitfalls weaken the value of the conclusions that were drawn (Table 3).1,2,19 Studies relied mainly on a retrospective design, and there was a lack of sequential MR imaging. Numerous patients were lost to follow-up and were not consecutively enrolled but were highly selected for this strategy. Moreover, studies did not focus exclusively on intracanalicular VSs. We attempted to avoid such drawbacks in our own protocol, but our study also suffered from an insufficient follow-up and a limited number of enrolled patients. Additionally, some authors have a very personal definition of tumor growth. For example, Stangerup et al.24 surprisingly reported only a 17% rate of tumor increase in a group of 230 Koos Grade I tumors with a mean follow-up of 3.6 years (range 1–15 years). In fact, the authors decided to define as “growing” only those tumors becoming extrameatal. Thus, for these authors, a small tumor, 2 mm in diameter, that increases in size to 14 mm in diameter (from 4 to 420 mm²) but still resides within the canal is considered a nongrowing tumor.

Regarding the issue of hearing preservation, results from the literature are in line with our own observations. First, a decline in hearing occurs in a significant percentage of patients, and second, hearing deterioration is independent of tumor volume.24 Series results in the literature favor a higher risk of functional hearing loss in patients with an annual tumor growth greater than 2.5 mm.28 However, centers whose only therapeutic option is microsurgical removal through a translabyrinthine approach, which always results in complete loss of hearing with a significant rate of facial palsy, still advocate for a “wait-and-scan” strategy.1,26 Those centers that are able to provide patients with high-resolution GKS increasingly consider a more proactive approach.

For numerous years, our team has advocated the wait-and-see strategy in the treatment of intracanalicular VSs.14,15 For all our patients presenting with nongrowing Koos Grade I VSs, we recommended a wait-and-see strategy regardless of the usefulness of the patient’s level of hearing. Some of these patients were concerned about harboring an untreated tumor and asked for a more proactive therapy. Thus, at their request, a group of patients was treated proactively by GKS. Preliminary work on the long-term efficacy of conservative management24 showed us a high rate of tumor growth and a significant risk of hearing loss following this strategy.22 Long-term follow-up in this patient cohort and its comparison with a control group of patients treated radiosurgically are currently confirming the findings of our initial experience. Our observations moved our team to make a dramatic paradigm shift, and now we recommend proactive GKS to our patients with Koos Grade I VSs who retain functional hearing. For those patients harboring a Koos Grade I VS who have already lost their functional hearing, we recommend that they either wait until there is evidence of tumor growth or undergo proactive GKS. In our otoneurosurgery group, microsurgical tumor resection is only proposed as

TABLE 3: Summary of recent series of conservatively managed VSs*

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Pts</th>
<th>Study Design</th>
<th>Mean FU</th>
<th>Pts w/ Stable Tumor Vol</th>
<th>Pts w/ Tumor Growth</th>
<th>Pts w/ Hearing Decrease</th>
<th>Pts Needing More Treatment†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deen et al., 1996</td>
<td>68</td>
<td>retro, CT, &amp; MRI</td>
<td>3.4 yrs</td>
<td>71%</td>
<td>29%</td>
<td>—</td>
<td>15%</td>
</tr>
<tr>
<td>Raut et al., 2004</td>
<td>72</td>
<td>pro, serial MRI</td>
<td>80 mos (range 52–242 mos)</td>
<td>41.7%</td>
<td>32%</td>
<td>—</td>
<td>32%</td>
</tr>
<tr>
<td>Bozorg et al., 2005</td>
<td>111</td>
<td>retro</td>
<td>33 mos</td>
<td>47%</td>
<td>47%</td>
<td>56%</td>
<td>15%</td>
</tr>
<tr>
<td>Sughrue et al., 2010</td>
<td>982</td>
<td>rev of 34 papers</td>
<td>26–52 mos</td>
<td>24.67% (&lt;2.5 mm/yr)</td>
<td>75.32% (mean for all populations 2.9 ± 1.2 mm/yr)</td>
<td>46%</td>
<td>17%</td>
</tr>
<tr>
<td>present series</td>
<td>47</td>
<td>pro</td>
<td>44 mos</td>
<td>76%</td>
<td>22%</td>
<td>23% (3 yrs), 30% (4 yrs), 59% (5 yrs)</td>
<td>74%</td>
</tr>
</tbody>
</table>

* pro = prospective; retro = retrospective; rev = review.
† More treatment includes additional microsurgery or radiosurgery.

J Neurosurg / Volume 113 / December 2010
a treatment for large tumors because a much lower risk of complication is associated with GKS for small (Koos Grades I–III) VSs, especially regarding preservation of facial motor function. For large tumors, we are systematically recommending a combined approach: partial tumor resection while monitoring facial nerve motor function followed by radiosurgical treatment of the residual tumor.4,5 The microsurgical tumor resection is performed using a retrosigmoid, middle fossa, or translabyrinthine approach, depending on tumor presentation.

Gamma Knife surgery has been shown, in several prospective comparative trials, to provide patients with higher rates of preservation of facial nerve motor function and functional hearing than microsurgical tumor resection while achieving a high rate of long-term tumor control.11,16,17,21 The long-term tumor control rate in large series from experienced centers ranges between 95% and 98%, regardless of tumor size.3,7,18,21 Globally, the functional hearing preservation rate stands between 60% and 74% at 3 years. This rate of functional hearing preservation is highly dependent on a series of factors related to either the patient or technical nuances of radiosurgery.9,16,20,23,29 In patients with a high level of hearing, the rate of functional hearing preservation is 78.4%.29 In patients with no history of sudden hearing loss and Gardner-Robertson Class I hearing at the time of radiosurgery, this rate reaches 95%.21 In cases of intracanalicular VS, Niranjani et al.12 reported a global functional hearing preservation rate of 64.5% with a median follow-up of 28 months. In our prospectively evaluated control group of 34 consecutive patients harboring an intracanalicular unilatera l VS with Gardner-Robertson Class I or II hearing, the risk of failure (either tumor progression or loss of hearing functionality) was greatly reduced compared with the natural history of such intracanalicular lesions. In our control group, the probability of tumor control with retention of functional hearing was 88.2% at 1 year, 79.4% at 2 years, and 59.7% at 5 years. In contrast to these good results of radiosurgery at 5 years, the percentage of patients whose tumors were managed conservatively without failure was only 14% (Fig. 1).

Conclusions

The results of this study indicate that conservative management of small VSs exposes patients to a significant risk of tumor growth or hearing loss in the years following the decision to use a wait-and-see strategy. Clearly, preservation of useful hearing is best obtained by performing early GKS rather than conservative observation. Thus, the wait-and-see option should be proposed in highly selected cases, and its risks should be explained to the patient. If adopted, conservative management requires a sequential follow-up with interval scanning. These conclusions led us to change our strategy in the management of intracanalicular VSs and to propose early proactive radiosurgical treatment when hearing is still useful at the time of diagnosis. A prospective randomized trial conducted in a larger population and providing longer follow-up may further validate this recent evolution in our practice.
Wait-and-see versus GKS in Koos Grade I vestibular schwannomas


Address correspondence to: Jean Régis, M.D., Service de Neurochirurgie Fonctionnelle et Stereotaxique, Hôpital d’adulte de la Timone, 264 rue Saint Pierre, 13385 Marseille Cedex 05, France. email: jregis@ap-hm.fr.