Am J Otolaryngol 40 (2019) 236–246

Contents lists available at ScienceDirect

Am J Otolaryngol

journal homepage: www.elsevier.com/locate/amjoto

Quality of life related to symptomatic outcomes in patients with vestibular schwannomas: A Canadian Centre perspective

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A B S T R A C T

Patients with vestibular schwannomas (VS) typically present with hearing loss and tinnitus as well as variable cranial nerve dysfunctions. Surgical resection, stereotactic radiotherapy and/or conservative management employing serial magnetic resonance or computed tomography imaging serve as the main treatment options. Quality of life (QoL) may be impacted by the extent of tumour burden and exacerbated or relieved by treatment. Subjective assessment and quality of life inventories provide valuable information in client centered approaches with important implications for treatment. The intention of QoL measurements affecting VS patients within a clinical setting is to facilitate discussions regarding treatment options and objectively evaluate patient- centered clinical outcomes in a naturalistic setting.

1. Introduction

Vestibular schwannomas (VS), also known as acoustic neuromas, account for the majority of cerebellopontine angle (CPA) tumours [1,2,3] with the annual worldwide incidence estimated to be between 13 and 20 per million [4,5]. A small percentage of VS diagnoses are incidental findings, due to improvement in and more frequent use of imaging technologies [6]. The natural history of VS suggests unpredictable growth patterns with linear or intermittent growth patterns in some, and growth stability and less commonly tumour shrinkage post-diagnosis in others, with a peak diagnostic age between 40 and 60 years [7,8].

Amongst patients with VS, hearing loss and tinnitus on the affected side are the most common initial symptoms [9,10]. Other presenting symptoms include disequilibrium, vertigo, and less commonly facial hypoesthesia and facial weakness [11]. Headache, nausea and vomiting may occur when enlarging tumours result in hydrocephalus and brainstem compression [11,12]. Management strategies for CPA tumours include surgical resection, stereotactic radiosurgery (SRS)/radiotherapy (SRT), and conservative management. All of these options may impact quality of life (QoL). The purpose of this study was to assess and compare QoL in patients in the clinical setting as a contemporary study of a regular skull base clinic. Self-reported QoL of VS patients both before and following treatment may outline clinical discussions surrounding treatment options recognizing that while many patients have similar physiological presentation, QoL is complex and interwoven amidst personal factors.

2. Methods

A retrospective chart review of 210 patients (149 conservative treatment; 40 SRT; 21 surgery) seen in the Maritime Lateral Skull Base Clinic (MLSBC) between 2007 and 2017 with VS was conducted. The MLSBC provides coordinated care and management decisions through

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https://doi.org/10.1016/j.amjoto.2018.11.004
Received 26 October 2018

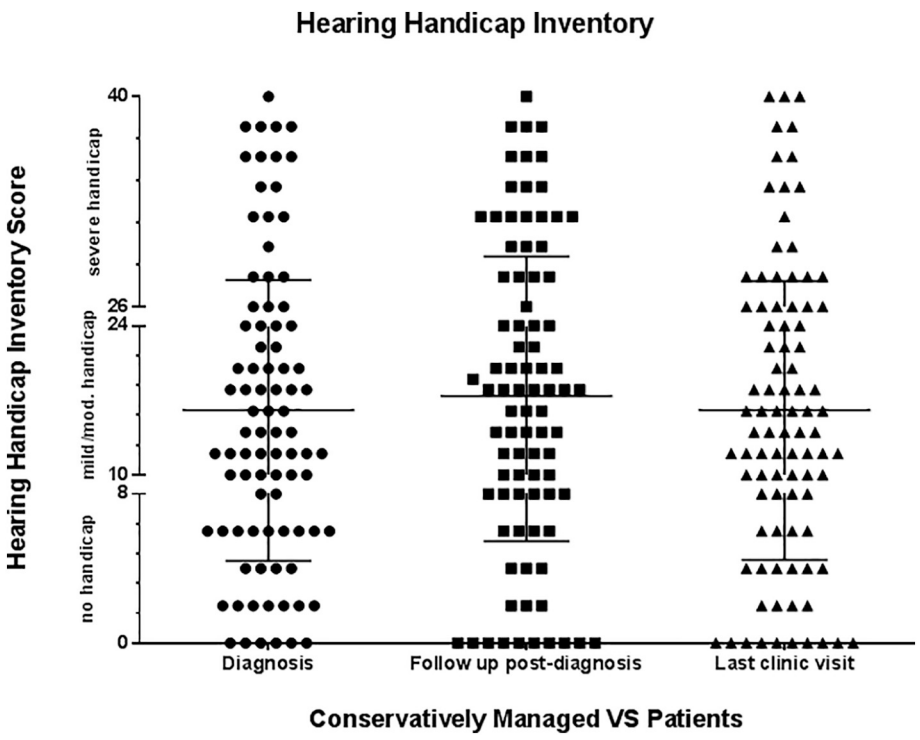


Fig. 1. Hearing Handicap Inventory Scores: Conservative Management. The Hearing Handicap Inventory contained nine questions corresponding to social and emotional domains. Responses for each domain were scored and summed, to give a maximum score. A higher score corresponded to a greater perceived handicap. Hearing loss in conservatively managed patients did not seriously impact patients' total QoL scores over the course of observation from diagnosis to last clinic visit.

neurotology, neurosurgery and radiation oncology to patients with unilateral or bilateral vestibular schwannoma and a range of other lateral skull base neoplasms. MLSBS utilizes QoL questionnaires in clinical management of symptoms which is recorded in the patient's medical record.

Inclusion criteria included: being a patient of the MLSBC within the past 10 years with unilateral VS; have completed at least one QoL questionnaire booklet before or after treatment (or if conservatively managed have completed one or more QoL questionnaire booklets). Patients were excluded with: bilateral VS (NF2) diagnosis; other tumour type besides VS or not completing questionnaires.

Patients completed questionnaires at diagnosis or at the first clinic visit, then generally on an annual, 2-year, or five-year interval. Data were analyzed from 3 questionnaires per patient over 3 time frames. The first questionnaire recorded was as close to diagnosis, pre-SRT or pre-surgery for conservatively, SRT or surgically managed patients; the second questionnaire analyzed was mid- diagnosis for conservatively managed patients but as close to post-treatment of SRT and surgical patients as possible given the naturalistic observational design; and for all patients the third time point was the last questionnaire completed at their most recent clinic visit.

Quality of life questionnaire booklets contained the Hearing Handicap Inventory for Adults [13], Dizziness Handicap Inventory [14], and Tinnitus Handicap Inventory [15]. The Hearing Handicap Inventory contained nine questions corresponding to social and emotional domains. Responses for each domain were scored and summed with higher scores corresponding to a greater handicap [13]. Both the Dizziness and Tinnitus Handicap Inventories consisted of 25 questions with a higher score indicative of a greater handicap [14,15].

3. Statistical analysis

Analysis of the data was performed using GraphPad® Statistical

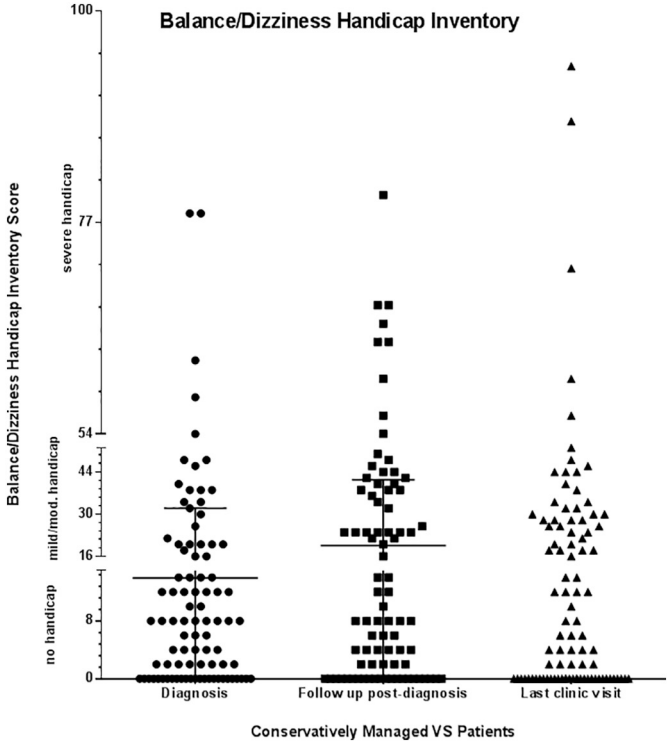


Fig. 2. Balance/Dizziness Handicap Inventory Scores: Conservative Management. The Dizziness Handicap Inventory consisted of 25 “yes”, “sometimes”, or “no” questions (yes = 4 points, sometimes = 2 points, and no = 0 points), which were answered and scored. A higher score indicated a greater handicap. Conservative management was not associated with increased handicap over the time course of observation from diagnosis to last clinic visit.

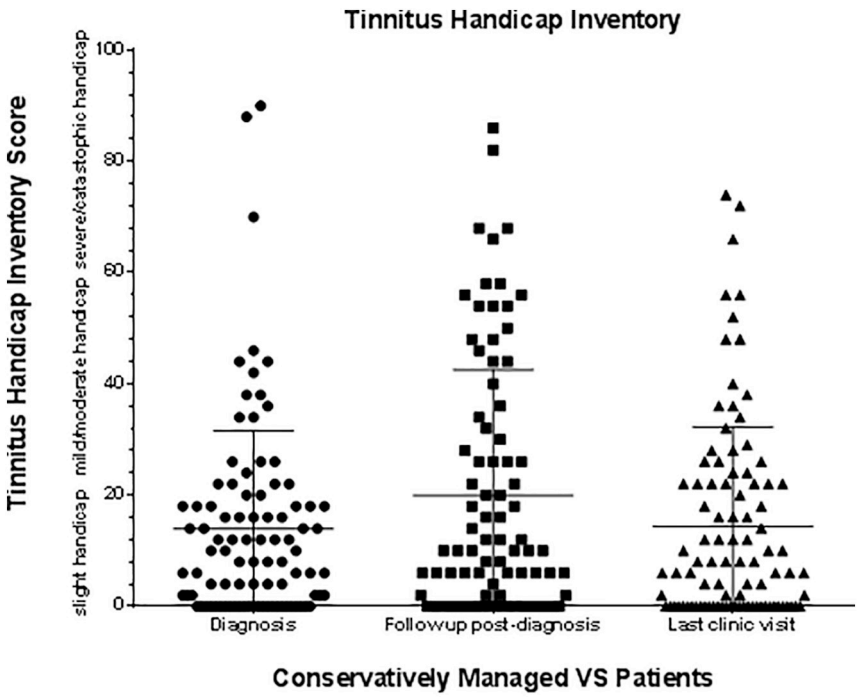


Fig. 3. Tinnitus Handicap Inventory Scores: Conservative Management. The 25 "yes", "sometimes", or "no" questions on the Tinnitus Handicap Inventory were scored (yes = 4 points, sometimes = 2 points, and no = 0 points) with a higher score corresponding to a greater handicap. An increase in handicap was reported in the immediate follow up period with patients reporting baseline levels of handicap at their last clinic visit. The upper panel shows the distribution of scores for conservatively managed patients from diagnosis to last clinic visit. The bottom panel is the same data regraphed to illustrate the increase in Tinnitus handicap during the follow-up post-diagnosis clinic visit with return to diagnosis baseline at the last clinic visit.

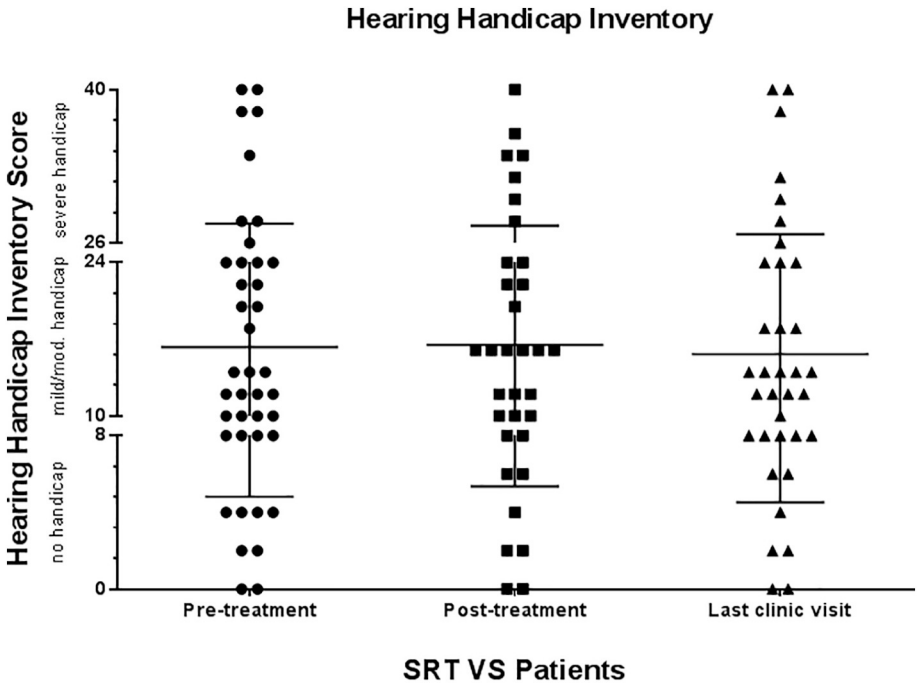


Fig. 4. Hearing Handicap Inventory Scores in patients treated with radiation. Ten "yes", "sometimes", or "no" questions about subjective social and emotional hearing difficulties are answered by patients. Answers are scored with yes = 4 points, sometimes = 2 points, and no = 0 points. Points are summed with the maximum possible score being 40 indicative of a high probability of hearing impairment handicap. Patients treated with radiation reported comparable hearing handicap over the three time periods sampled, pre-treatment, immediate post-treatment and last clinic visit.

Software. Continuous data was analyzed using a 2-tailed unpaired *t*-test. Statistical significance was defined as $p < 0.05$.

4. Results

Of the 210 VS patients: 21 have undergone surgery, 40 have had SRT, and 149 have been conservatively managed. Average age at diagnosis was 55 years of age, 60% male and 40% female. Conservatively managed patients ranged in age from 13 years to 85 years (mean 56.19 years; median 57 years); patients at the age of SRT ranged from 37 to 81 years (mean 60.39 years; median 60 years) and patients at the age of surgery ranged in age from 37 to 77 years of age (mean 52.33 years; median 51 years). Surgery patients were younger than SRT but not conservatively managed patients ($p = 0.02$) Surgical approaches for patients undergoing surgery included translabyrinthine ($n = 14$), retrosigmoid ($n = 6$), and middle cranial fossa ($n = 1$). Patients treated with radiation received 5 fractions with a total dose of 2500 cGy ($n = 30$), or 25 fractions with a total dose of 5000 cGy ($n = 10$).

4.1. Vestibular schwannoma (VS): conservative management

There were no reported group changes in increasing or lessening severity of subjective HHI amongst patients conservatively treated from time of diagnosis to most recent clinic visit ($p > 0.05$). Relatively equal numbers of patients reported no handicap, mild/moderate handicap or severe handicap across the 3 times sampled (see Fig. 1).

There were no reported group changes in increasing or lessening severity of subjective balance/dizziness handicap amongst patients conservatively treated from time of diagnosis to most recent clinic visit ($p > 0.05$) (see Fig. 2).

Patients reported increased handicap related to tinnitus in the intermediate period following diagnosis with subsequent lessening severity at most recent clinic visit ($p < 0.05$) (see Fig. 3).

4.2. VS: stereotactic radiotherapy

There were no reported group changes in increasing or lessening severity of subjective HHI amongst patients treated with radiation from time of diagnosis to most recent clinic visit ($p > 0.05$) (see Fig. 4).

There were no reported group changes in increasing or lessening severity of subjective balance/dizziness handicap amongst patients treated with radiation from time of diagnosis to most recent clinic visit ($p > 0.05$) (see Fig. 5).

Patients reported lessening of tinnitus handicap in the intermediate period post-SRT with further improvement at the most recent clinic visit ($p < 0.05$) (see Fig. 6).

4.3. VS: surgery

There was increasing severity of subjective HHI amongst patients in the immediate postoperative period with no subjective worsening (or improvement) at the most recent clinic visit ($p < 0.05$) (see Fig. 7).

Patients reported increased handicap related to balance/dizziness in the immediate period post-operatively with subsequent improvement to pre-operative levels at most recent clinic visit ($p < 0.05$) (see Fig. 8).

Patients reported increased handicap related to tinnitus in the immediate period post-operatively with subsequent improvement to pre-operative levels at most recent clinic visit ($p < 0.05$) (see Fig. 9).

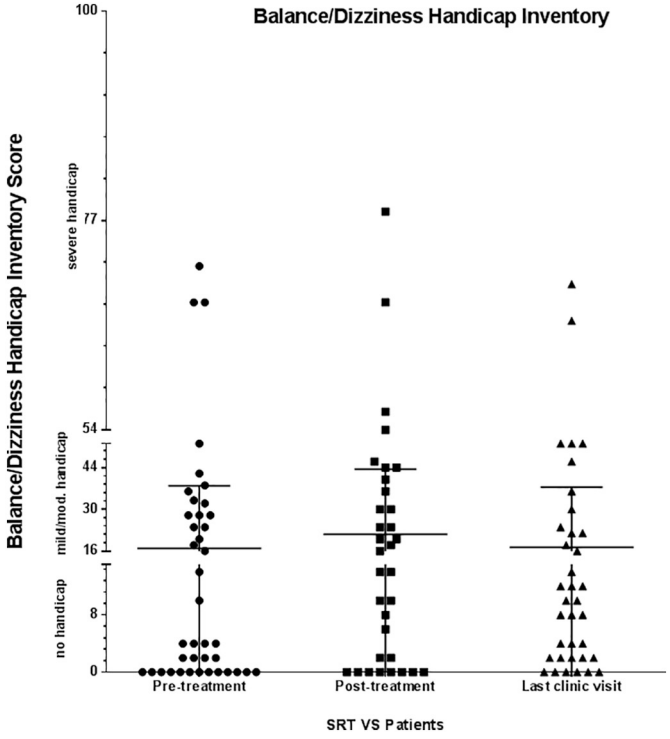


Fig. 5. Balance/Dizziness Handicap Inventory Scores: Stereotactic Radiosurgery/radiotherapy. The Dizziness Handicap Inventory consisted of 25 "yes", "sometimes", or "no" questions (yes = 4 points, sometimes = 2 points, and no = 0 points), which were answered and scored. A higher score indicated a greater handicap. Radiation treatment was not associated with increased handicap over the time course of observation; pre-treatment, immediate post-treatment and last clinic visit.

4.4. Conservative, radiation and surgical treatment modalities

Management strategies did not affect Hearing Handicap Inventory rating scores although surgery was associated with slightly higher ratings in the post-surgical and last clinic visit period (see Fig. 10). Balance/Dizziness handicap scores were higher amongst surgical patients in the immediate post-operative period (see Fig. 11). Radiation treatment had a favorable effect on Tinnitus handicap scores in the post-treatment and last clinic visit ratings (see Fig. 12).

5. Discussion

QoL measures in a contemporary clinical setting provide valuable data that can guide treatment decisions amongst patients with VS. Undoubtedly, patients with large VS, who are unable to have SRT and conservative management is not clinically reasonable; may not fully appreciate the effects of complete hearing loss coupled with increased dizziness and balance difficulties in the immediate post-operative period. Patients undergoing surgical options, while younger than those followed in the clinic conservatively or undergoing radiation therapy, may be predicted to cope reasonably well given the younger age.

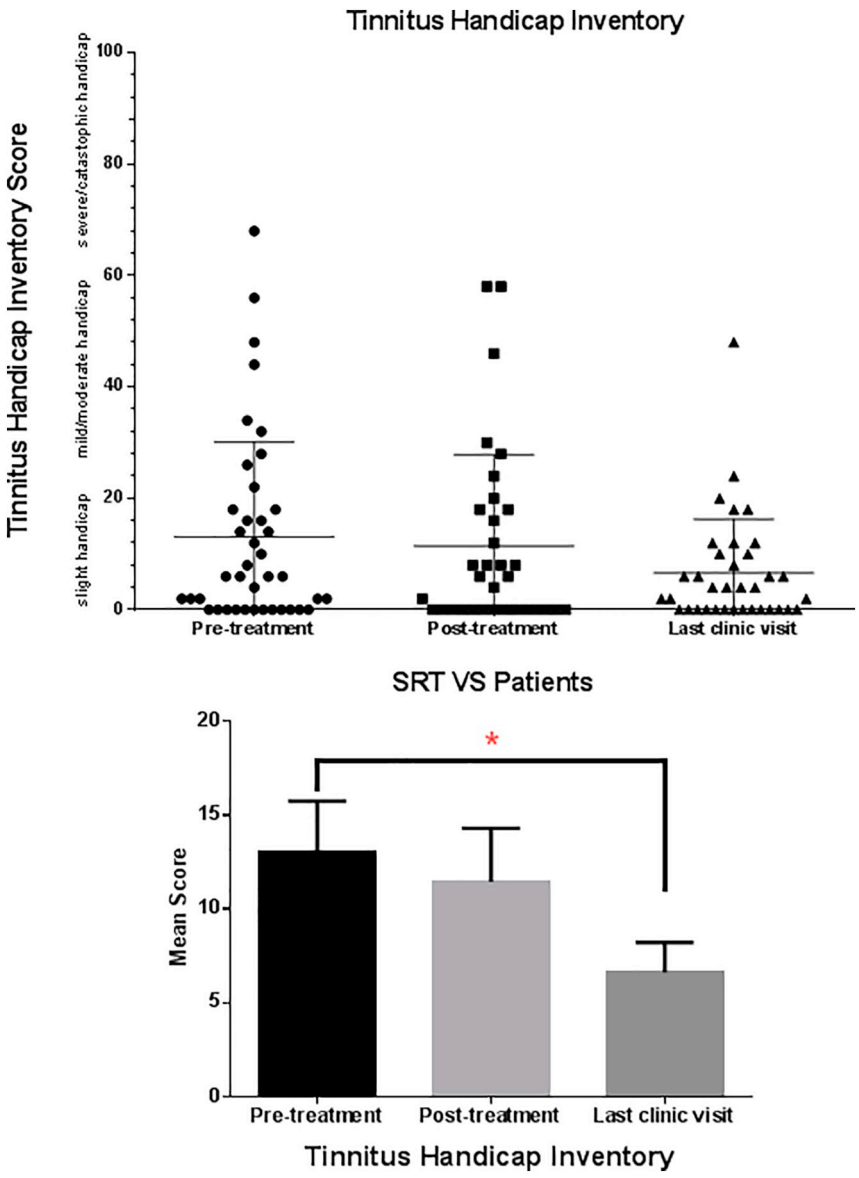


Fig. 6. Tinnitus Handicap Inventory Scores: Stereotactic Radiation. The 25 "yes", "sometimes", or "no" questions on the Tinnitus Handicap Inventory were scored (yes = 4 points, sometimes = 2 points, and no = 0 points) with a higher score corresponding to a greater handicap. A decrease in handicap was reported by patients at their last clinic visit post-treatment. The upper panel shows the distribution of scores for patients with VS treated with radiation from pre-treatment to last clinic visit. The bottom panel is the same data regraphed to illustrate the decrease in Tinnitus handicap over the course of observation with Tinnitus handicap reported as significantly less relative to pretreatment.

Following surgery or radiation for VS, pre-treatment symptoms may improve, remain unchanged, or deteriorate and additional symptoms can develop [16]. It should be considered that the choice of treatment may predict quality of life indices. In a similar vein, quality of life may be differentially affected by treatment methods with each treatment modality having varying results from patient to patient. Although risks/potential side effects of treatment methods, tumour growth, and symptom severity are factors in making management decisions for VS, discussions also include physical, psychological, and social consequences faced as a result of treatment [17]. Quality of Life (QoL) assessments help establish patient expectations about potential QoL post-treatment [18], and can be used to compare QoL outcomes of different treatment methods [19]. Each management strategy carries risk of additional and/or an accumulation of symptoms which may affect the patient's QoL [18,20]. VS patients are likely to experience one or more types of physical impairment from management, such as hearing loss, tinnitus, facial paralysis or pain, balance problems, dizziness, headache, or fatigue, which have been linked to a reduced QoL in both VS and other patient groups [18].

Hearing loss is the most common symptom for VS patients both pre- and post-active treatment [21]. Surgically treated patients reported that the biggest problems with regard to QoL were hearing loss, balance difficulties, and facial numbness and weakness [22]. Additionally, surgically treated VS patients have been shown to have significantly worse QoL scores than general population controls [22]. Though surgery can result in lower overall QoL scores, it has been indicated to have a greater increase in social support compared to both conservative

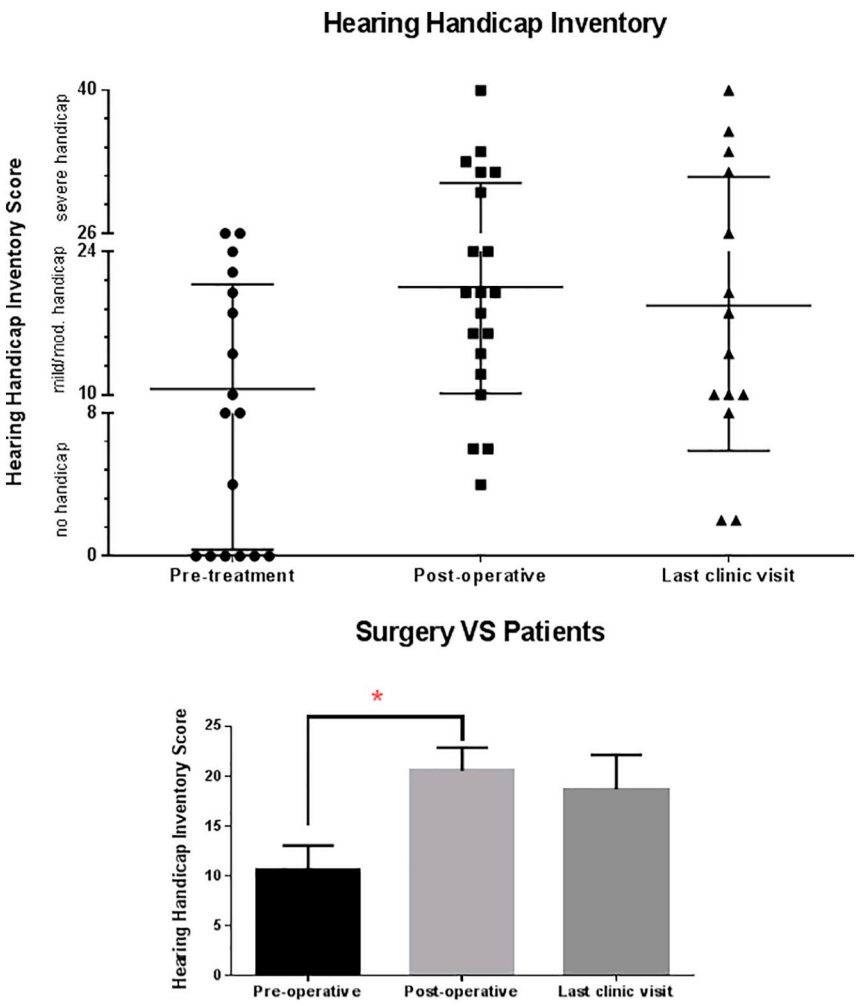


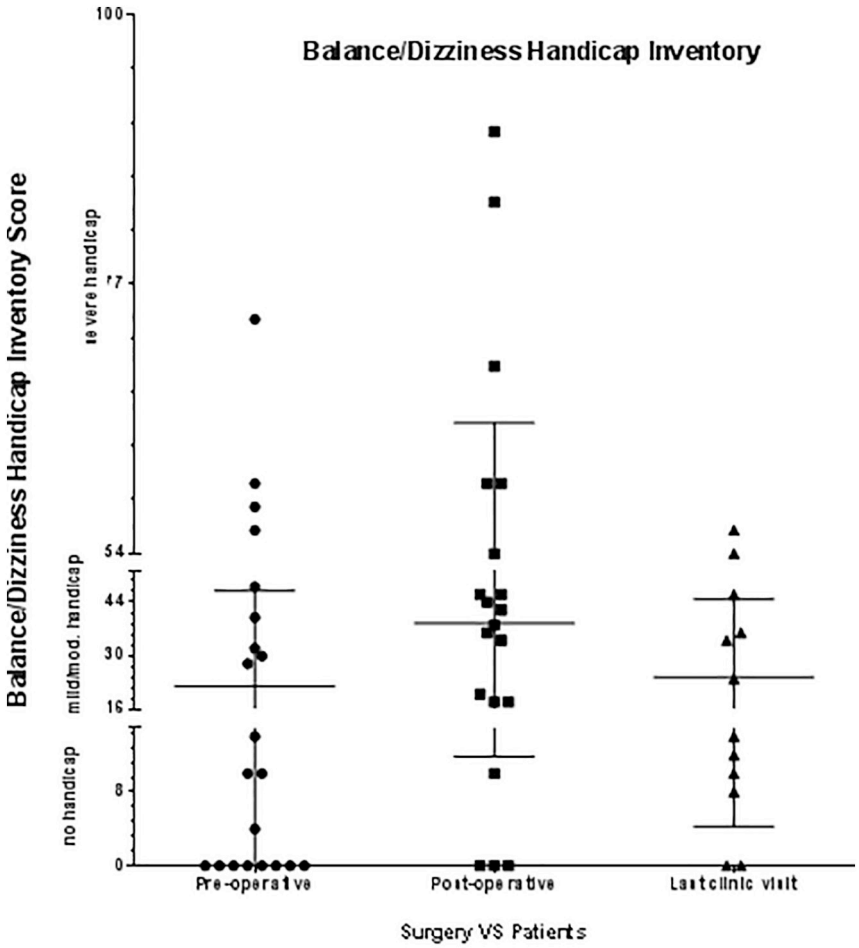
Fig. 7. Hearing Handicap Inventory Scores: Surgery. The Hearing Handicap Inventory contained nine questions corresponding to social and emotional domains. Responses for each domain were scored and summed, to give a maximum score. A higher score corresponded to a greater perceived handicap. Hearing loss in surgical patients was most seriously impacted in the immediate post-operative period and remaining elevated over the course of observation. The upper panel shows the distribution of scores for surgical patients from pre-treatment to last clinic visit. The bottom panel is the same data regraphed to illustrate the increase in Hearing Handicap scores in the immediate post-operative period with handicap scores remaining elevated at the last clinic visit.

management [18] and SRT patients [23]. Although the general QoL of surgical VS patients tends to decrease compared to the other treatment methods [18], radiation has also shown a lower QoL than conservative management [23,24].

Hearing loss in conservatively managed patients has been shown to not seriously impact patients' total QoL scores, though a significant decrease in social functioning was shown, likely due to complete unilateral hearing loss in some patients as a result of the VS [25]. Tinnitus and hearing loss were not found to be directly associated with a reduced QoL in conservatively managed patients with VS [25]. In our group, amongst conservatively treated patients hearing and balance/dizziness handicap scores for the group were consistent throughout the temporal assessment. Tinnitus appeared to be relatively bothersome early on in the diagnosis but patients' ability to apply coping strategies were evident by the decrease of handicap reported on the last clinic visit.

Tinnitus is the most problematic symptom irrespective of treatment. The disabling nature of tinnitus should not be ignored as it has been reported in the literature as preceding suicide. Patients with pre-existing depression report increased psychological distress associated with tinnitus [26,27] and depression may dampen coping strategies. In conservative treatment and in surgical groups, tinnitus handicap tends to increase before returning to diagnostic levels. In patients treated with SRT, the pattern is different. Tinnitus tends to be rated as more distressful at diagnosis and post-treatment tinnitus handicap scores tend to improve. It has been demonstrated that during short term follow-up (< 5 years) QoL was significantly higher for SRT VS patients than either conservative treatment or surgery [19]. However, no long term (> 5 years) difference in QoL between the three treatment strategies was found [19].

Although excellent tumour control rates can be achieved with resection of VS, surgery-related complications and post-surgical symptoms can occur. Hearing loss, ataxia, facial nerve weakness and/or numbness, and lower cranial neuropathy [28,29] amongst other difficulties can occur post-surgically. In all three inventories, hearing, balance/dizziness and tinnitus, handicaps worsened in the immediate post-operative period. In patients who underwent surgical resection, there was a small minority that scored in the severe hearing handicap range, which is curious as almost all patients experience abrupt hearing loss on the tumour side in the immediate



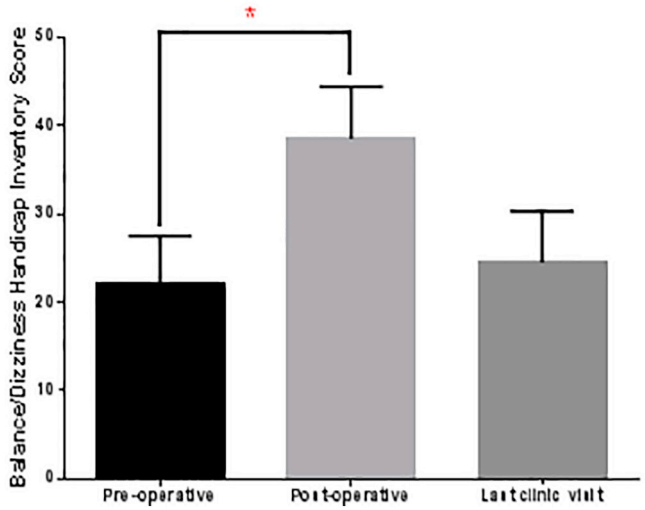


Fig. 8. Balance/Dizziness Handicap Inventory Scores: Surgery. The Dizziness Handicap Inventory consisted of 25 "yes", "sometimes", or "no" questions (yes = 4 points, sometimes = 2 points, and no = 0 points), which were answered and scored. A higher score indicated a greater handicap. Patients reported increased handicap in the immediate post-operative period with symptoms lessening by the last clinic visit. The upper panel shows the distribution of scores for surgical patients from pre-treatment to last clinic visit. The bottom panel is the same data regraphed to illustrate the increase in Balance/Dizziness Handicap scores in the immediate post-operative period with handicap scores returning to pre-operative levels at the last clinic visit.

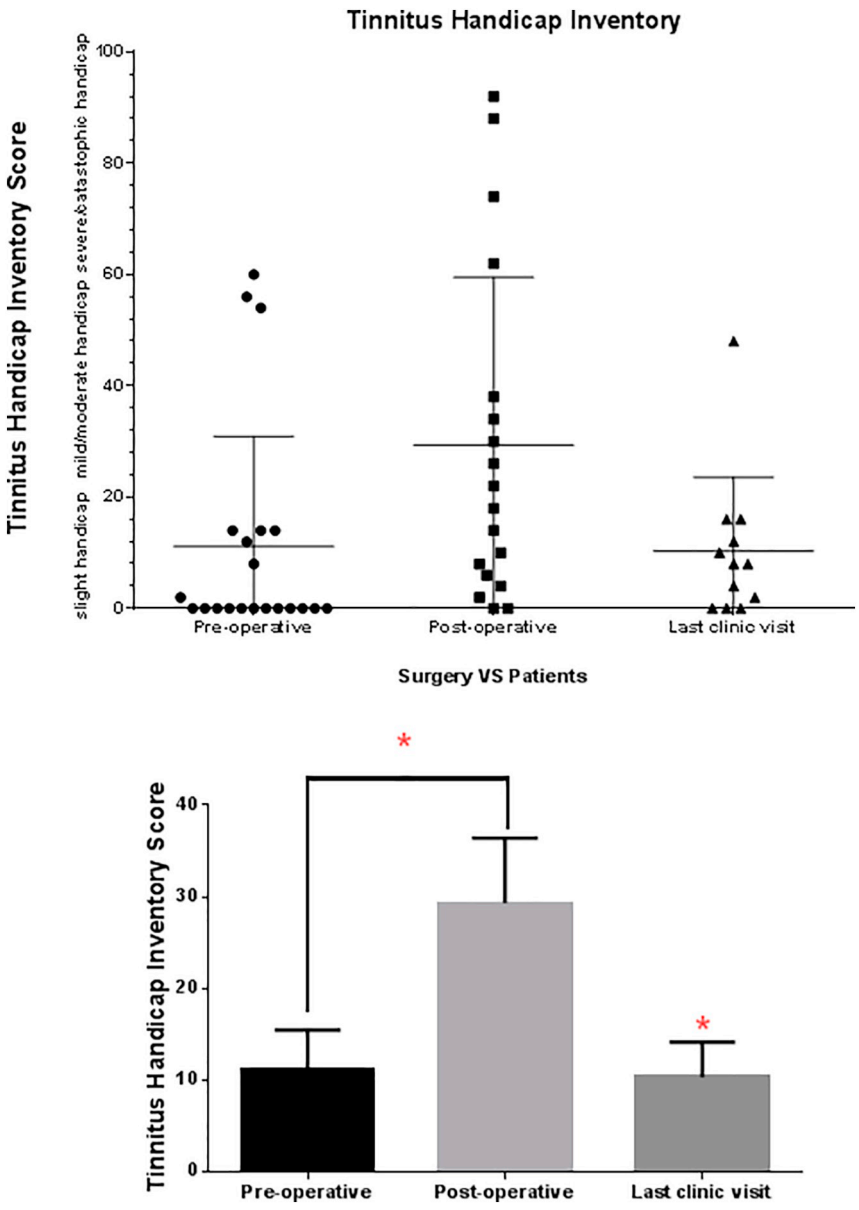


Fig. 9. Tinnitus Handicap Inventory Scores: Surgery. The 25 "yes", "sometimes", or "no" questions on the Tinnitus Handicap Inventory were scored (yes = 4 points, sometimes = 2 points, and no = 0 points) with a higher score corresponding to a greater handicap. Patients reported increased handicap in the immediate post-operative period with symptoms lessening by the last clinic visit. The upper panel shows the distribution of scores for surgical patients from pre-treatment to last clinic visit. The bottom panel is the same data regraphed to illustrate the increase in Tinnitus Handicap scores in the immediate post-operative period with handicap scores returning to pre-operative levels at the last clinic visit.

post-operative period. It should be considered that patients who rated hearing handicap as severe are less resilient and handicap is perhaps reflective of trait personality.

Facial paralysis was associated with increased levels of reported distress and social withdrawal although reports showed wide variation and appeared to be unrelated to the grade of facial nerve paralysis [30]. Even so, a developing surgical concept is a deliberately incomplete VS resection in attempt to preserve cranial nerve integrity [31]. An implication of this approach is potential progressive tumour growth post-resection. At this juncture, it is suspected that the distress experienced by facial dysmorphia also is projected to other domains and reflected as scores in the severe handicap range. Notwithstanding, amongst the surgical patients, handicaps in balance/dizziness and tinnitus improved to pre-operative levels at the last clinic visit.

6. Conclusion

Quality of Life (QoL) measures of balance/dizziness and tinnitus seem relatively unaffected long-term by specific treatment modalities. In comparison, hearing handicaps tend to persist amongst surgical patients. Patients who report good quality of life whether from a hearing, dizziness/balance, tinnitus or generalized physical and emotional health perspective appear to continue to do so after treatment. As such, these data are encouraging and may be used to promote effective discussions pre-treatment regarding strategies and supports for VS patients.

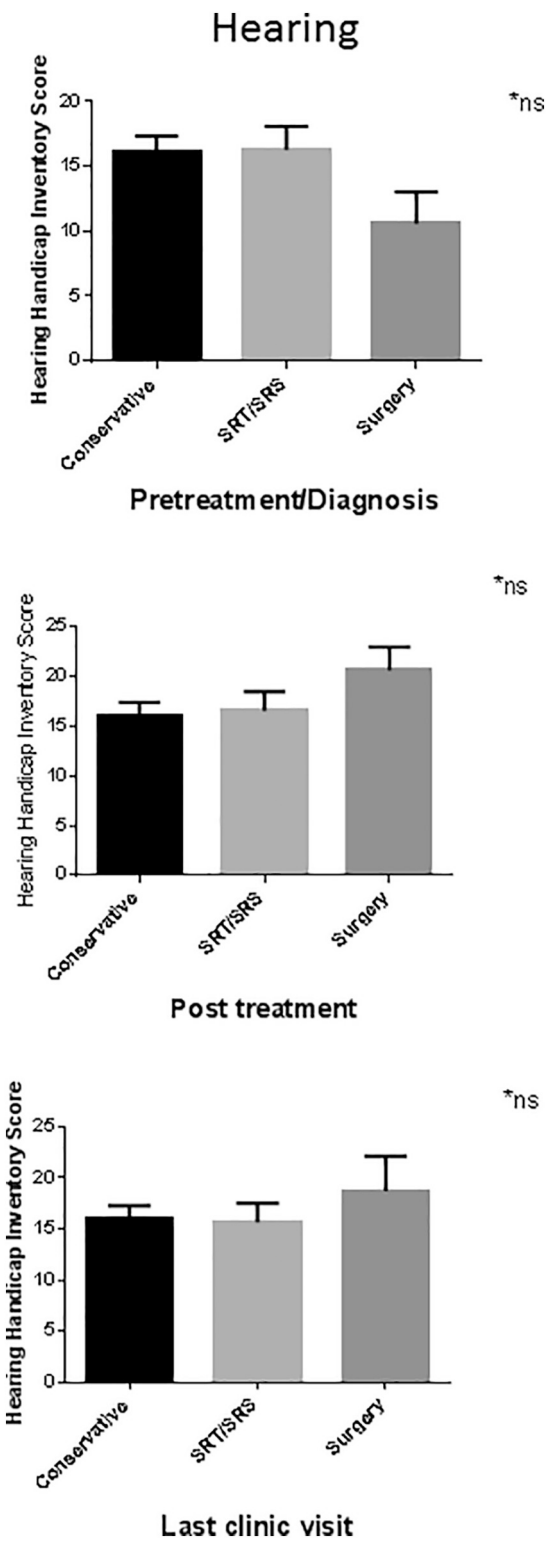


Fig. 10. Management strategies for VS include conservative management, stereotactic radiotherapy (SRT) or radiosurgery (SRS), and surgery. Hearing handicap inventory scores did not differ ($p > 0.05$) amongst the 3 groups (conservative, SRT/SRS or surgery patients) at any of the times sampled (diagnosis/pre-treatment- upper panel; post-treatment- middle panel; last clinic visit- bottom panel), although surgery patients appeared less affected by hearing deficits pre-operation and more affected post-operation compared to other groups.

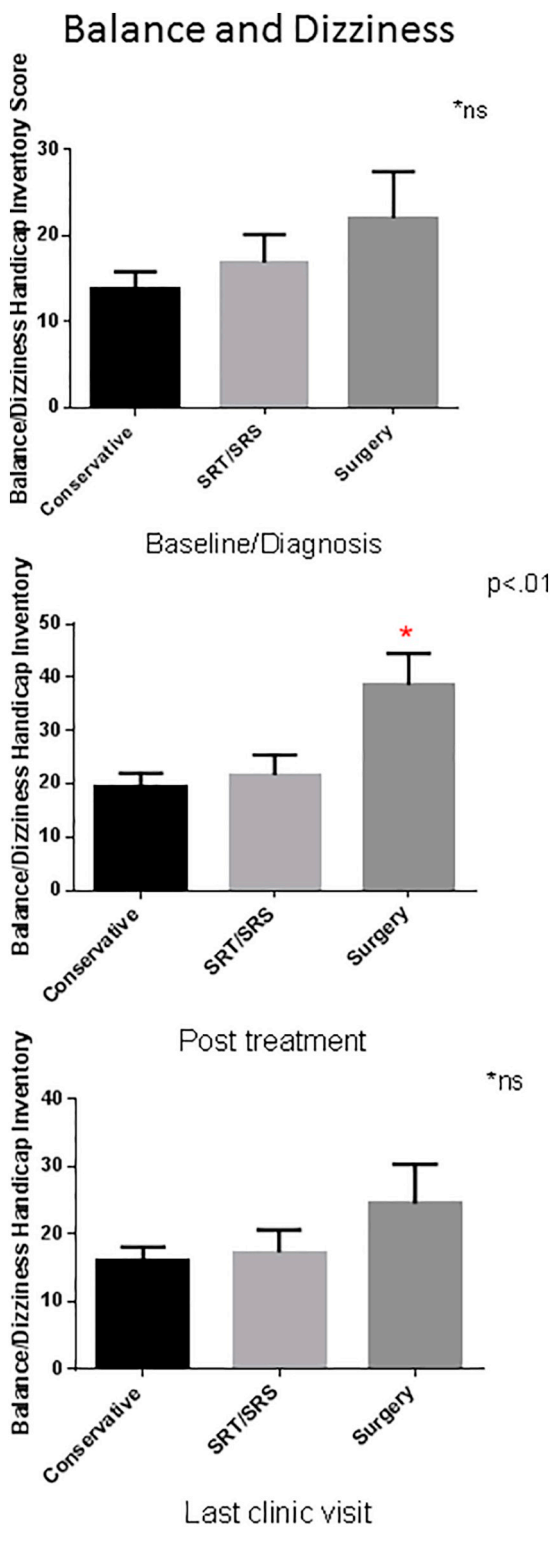


Fig. 11. Balance/Dizziness handicap scores were similar between conservative and pre- and post-SRT (diagnosis/pre-treatment- upper panel; post-treatment- middle panel; last clinic visit- bottom panel). Patients consented for surgery experienced increased balance/dizziness handicap at baseline with increased severity of post-surgically. Balance/Dizziness handicap inventory scores were increased in the immediate post-operative period amongst surgical patients relative to conservative and SRT/SRS groups. Symptoms appear to resolve at the last clinic visit with no differences evident amongst the groups ($p > 0.05$).

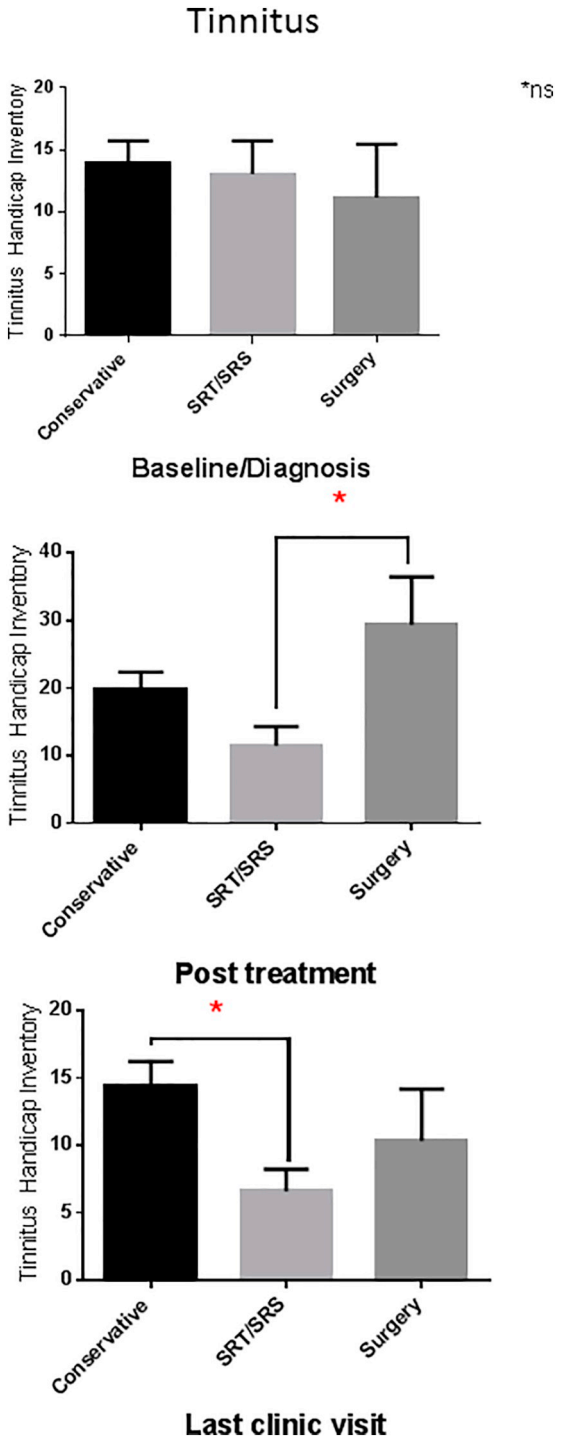


Fig. 12. Tinnitus handicap scores were comparable amongst the three groups at Baseline/Diagnosis. Tinnitus handicap scores were decreased in patients who had undergone SRT while increased in surgery patients in the immediate post-treatment period. Patients treated with SRT continued to be unaffected by tinnitus as demonstrated by reduced handicap scores during the last clinic visit. Diagnosis/pre-treatment- upper panel; post-treatment- middle panel; last clinic visit- bottom panel.

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