Otology & Neurotology
26:516–521 © 2005, Otology & Neurotology, Inc.

Facial Paralysis and Surgical Rehabilitation: A Quality Of Life Analysis in a Cohort of 1,595 Patients after Acoustic Neuroma Surgery

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Objectives: On the basis of survey results of the Acoustic Neuroma Association, we report patient ratings of facial dysfunction and outcomes for various facial rehabilitative therapies after surgical treatment of acoustic neuroma (AN). We assessed patients' perceived quality of life (QOL) and reviewed the literature regarding facial dysfunction and its management associated with AN.
Study Design: The Acoustic Neuroma Association mailed a detailed questionnaire to 2,372 members to identify preoperative and postoperative symptoms, complications, and long-term effects on physical and psychosocial function. A cohort of 1,595 (82.2%) respondents who underwent surgical treatment of ANs reported their experiences with facial dysfunction.
Patients: Of all 1,940 survey respondents, 1,682 of 1,875 that had ANs underwent surgical treatment. The study included 1,595 patients with ANs (82.2% of all respondents) who underwent surgical treatment by way of the translabyrinthine, suboccipital, or middle fossa approaches and excluded 87 respondents who did not report the type of surgical approach.
Methods: Respondents answered questions intended to qualify and quantify the degree that facial dysfunction impacted QOL parameters. Responses were analyzed for tumor size, surgical approach, patient age, and sex. Statistical analysis was performed using SPSS software.
Results: In our analysis, 11% of all respondents experienced some degree of preoperative facial weakness or eye problems. Of all respondents, 45.5% (725 patients) experienced worsened facial weakness caused by surgery, and of these, 72% reported that it was permanent. The most commonly used successful therapy for facial reanimation for 271 (19.6%) patients was placement of a gold weight. The factor most often associated with poor outcome was a large tumor. Of all respondents, 28% felt significantly affected by facial weakness, 63% felt their smile was symmetric, and 70% were content ''quite a bit'' or ''very much'' with their QOL.
Conclusions: In this large cohort study of AN patients, facial dysfunction was a significant morbidity. Physicians should be aware of the risk factors identified, specifically large tumor size and the impact facial dysfunction has on QOL, when counseling patients regarding optimal management of AN.
Key Words: Acoustic neuroma—Quality of life—Facial paralysis—Facial rehabilitation—Acoustic Neuroma Association—Tumor size.
Otol Neurotol **26:**516–521, 2005.

Advances in the management of acoustic neuromas (AN) have reduced both its mortality and morbidity (e.g., facial nerve paralysis, cerebrospinal fluid leak, meningitis). Facial nerve function preservation is an essential aspect in surgical treatment of ANs. Numerous studies have described the surgical outcomes from a physician's perspective, typically anatomic preservation and objective assessment of facial nerve function with the House-Brackmann (HB) grading system. Preservation rates vary for given tumor sizes, surgical approaches, tumor types, and previous treatments (1–11). However, few large multi-institution studies examine facial function and rehabilitation after AN surgery from a patients' perspective and the impact it has on quality of life (QOL).

In this study, we attempt to analyze questions that qualify and quantify the degree that facial dysfunction impacts patients' QOL. Responses of this large cohort of patients who underwent surgical treatment of ANs were stratified for sex, age, tumor size, and surgical approach.

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MATERIALS AND METHODS

In 1998, the Acoustic Neuroma Association (ANA) mailed a questionnaire consisting of 234 closed-answer items to 2,372 members to identify pre- and postoperative symptoms, surgical complications, and long-term effects on physical and psychosocial function. This survey included detailed questions on preoperative and postoperative facial dysfunction, rehabilitation measures that were taken, and patient satisfaction with

outcome (Fig. 1). This questionnaire was previously piloted among a small group of ANA members; its results are largely supported by previously reported studies. (7,12–15) Of 1,940 (81.8%) patients who responded, 1,875 (96.6%) reported having underwent treatment of AN, 24 (1.2%) for meningioma, 11 (0.6%) for facial neuroma, and 16 (0.8%) for other tumors; 14 (0.7%) either gave multiple responses or did not respond. Of the 1,875 patients who had ANs, 1,682 (89.7%) patients underwent surgical treatment, 90 (4.8%) underwent radiosurgery, 81 (4.2%) were observed, and 22 (1.2%) gave no answer. The study was limited to 1,595 (82.2% of all respondents) patients with ANs who underwent one of the after surgical approaches: translabyrinthine, suboccipital/retrosigmoid, or middle fossa approaches; 87 respondents were excluded who did not report the type of surgical approach that they underwent. Reported percentages relate to the number of valid, single responses for each question; no response and multiple responses possible for certain questions were excluded from this study. When totals do not equal the 1,595 patients in the study, it is because not all answered the question.

Questions related to facial dysfunction included preoperative facial weakness or eye problems; onset and status (temporary or permanent) of worsening facial weakness or eye problems; and rehabilitation for facial paralysis (which was required) and satisfaction from its outcome. Respondents also rated the overall degree to which they were affected by facial weakness, symmetry of smile, satisfaction with physical appearance, and contentment with QOL.

Statistical Analysis

Responses were stratified by patient sex and age, tumor size, and surgical approach. The Pearson chi-square test for independence was used to determine statistical significance ($P \leq 0.05$ unless stated otherwise). Statistical analysis was performed with the SPSS 11.0 data analysis program (SPSS Inc., Chicago, IL, U.S.A.).

RESULTS

Demographics

Of 1,595 patients who underwent surgical treatment of ANs, 529 (33%) were men, and 1,052 (66%) were female, ranging in age from 9 to 82 (mean 49.5) years old. We divided patients into four age groups: 40 years or less (n = 349), 41 to 55 years (n = 659), 56 to 70 years (n = 455), and older than 70 years old (n = 50). Tumor size was small (<1.5 cm) in 314 (21.3%) patients, medium (1.5–2.5 cm) in 588 (39.8%) patients, or large (>2.5 cm) in 575 (38.9%) patients. Surgical approaches included the translabyrinthine in 962 (60.3%) patients,

Preoperative symptoms (yes/no):

Facial weakness or paralysis
Eye Problems

In the weeks or months after treatment, did you experience and of the following problems, either temporary or permanent, specify the time of onset:

Worsened facial weakness or paralysis
Eye problems

Rehabilitation: Have you required (or chosen) rehabilitation surgery or therapy?

Tarsorrhaphy	Yes	Worked Well	No	Worked Poorly
7/12 nerve transfer				
Temporalis muscle transposition				
Masseter muscle transposition				
Eyelid spring				
Gold weight in eyelid				
Facial electrical stimulation				
Facial muscle retraining				

How are you affected by any of the following problems now?

Question	Not at All	A little bit	Somewhat	Quite a bit	Very Much
Facial weakness or paralysis					
Eye pain, dryness, wetness, irritation requiring use of eye drops?					

As it relates to your acoustic neuroma treatment, what is your current physical/functional or emotional status?

Question	Not at All	A little bit	Somewhat	Quite a bit	Very Much
My smile is symmetric					
I am satisfied with the way I look					
I am content with the quality of my life now					

FIG. 1. Facial dysfunction survey questions (adapted with permission of the Acoustic Neuroma Association).

retrosigmoid in 527 (33%), and middle fossa in 106 (6.6%). The interval between surgery and survey was a mean of 8 years. Of note, in this cohort, the middle fossa approach was used primarily in patients with small tumors versus the retrosigmoid or translabyrinthine approaches ($p < 0.0001$).

Preoperative Facial Dysfunction

Approximately 1,300 patients answered questions regarding preoperative symptoms; percentages reported are relative to respondents only. Preoperative facial weakness and eye were reported by 177 (13.9%) and 200 (15.6%) of these patients, respectively.

Facial Impairment Onset and Status

Of 806 patients who reported onset of facial weakness, 78.9% (40% of the entire cohort) occurred in the hospital, and 14% reported a delayed onset (within 6 months). Of the 725 patients (45% of the entire cohort) who reported worsened facial weakness, 524 (72.3%) felt it was permanent. Furthermore, of 858 patients (57.3% of the entire cohort) who reported worsened eye problems, 647 patients (75.4%) felt it was permanent.

Facial Rehabilitation Required and Outcome

Approximately 1,350 patients answered detailed questions regarding the rehabilitation required and resulting outcome of their facial impairment (Table 1). The most frequent single therapy for facial impairment was facial muscle retraining (21%), which was followed up by gold weight placement (19.6%), tarsorrhaphy (17.4%), facial electrical stimulation (15.6%), and hypoglossal-to-facial (7–12) nerve transfer (13.1%). Because many patients required various combinations of these therapies (Table 2), the ultimate outcome likely reflects their combined effectiveness. However, patients were asked to rate effectiveness separately for each modality. The two most common combinations included first, gold weight and muscle retraining (8.2%) and, second, gold weight, muscle retraining, and tarsorrhaphy (2.9%). The most effective single therapy (patient felt it worked well) was gold weight (83.5%) followed up by 7–12 nerve transfer (79.7%), temporalis muscle transposition (78.4%), eyelid spring (75.4%), and tarsorrhaphy (66.7%) (Table 1). Interestingly, the fourth most commonly used and least effective therapy was facial electrical stimulation.

Degree Affected by Facial Dysfunction and QOL Assessment

Approximately 1,500 patients responded to the 5-point Likert scale question ''How are you affected by facial weakness or paralysis now?'' Of the 1,497 (94%) respondents, 41% reported ''not at all,'' = 16.4% ''a little,'' = 14.2% ''somewhat,'' 10.8% ''quite a bit,'' and 17.4% ''very much.'' That is, most were not significantly affected by facial weakness. Of the 1,514 (95%) respondents who rated the degree that they were affected by eye problems, 36.9% reported ''not at all,'' 13.1% ''a little,'' 12.5% ''somewhat,'' 11.4% ''quite a bit,'' and 26.1% ''very much.'' Most were not significantly affected by eye problems. Similarly, 51.5% of these patients felt that their smile was symmetric either ''very much'' or ''quite a bit,'' 59.5% felt that they were satisfied with their physical appearance, and 72% were content with their QOL (Table 3).

Stratification by Patient Factors (Sex, Age, Tumor Size, Surgical Approach)

All responses to preoperative symptoms, time of onset, status of facial dysfunction, therapies required and their outcomes, and degree affected by facial dysfunction and measures of QOL were stratified by tumor size, patient sex, age at the time of surgery, and surgical approach. All statistically significant relationships are reported in Table 4. The most common patient factor associated with preoperative facial problems, immediate onset facial weakness in the hospital, permanent facial weakness, or eye problems was a larger tumor size. Additional significant relationships are reported in Table 4.

DISCUSSION

During the past several decades, improvements in diagnosis and surgical innovations in the treatment of ANs have lowered mortality rates and created less significant morbidity. Once potentially life-threatening, this tumor is now treated electively with high expectations for preservation of the facial nerve and, in select cases, hearing preservation (6). Facial paralysis or

TABLE 1. *Therapy required and resultant outcome for facial rehabilitation*

Therapy required	Respondents with therapy (N)	%	All respondents (n)	Worked well, n (%)
Facial muscle retraining	285	21.0	1358	153 (63.2)
Gold weight in eyelid	271	19.6	1382	242 (83.5)
Tarsorrhaphy	243	17.4	1399	144 (66.7)
Facial electrical stimulation	210	15.6	1350	59 (31.7)
7-12 nerve transfer	180	13.1	1371	126 (79.7)
Eyelid spring	72	5.4	1331	52 (75.4)
Temporalis muscle transposition	56	4.2	1329	40 (78.4)
Masseter muscle transposition	11	0.8	1314	7 (63.6)

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TABLE 2. *Combinations of top five therapeutics modalities*

Combined therapics	n (%)
GW + MR	111 (8.2)
ES + MR	101 (7.6)
TR + GW	86 (6.4)
TR + ST	85 (6.3)
TR + MR	84 (6.2)
GW + ST	82 (6.1)
GW + ES	73 (5.5)
MR + ST	61 (4.6)
ES + ST	59 (4.4)
ES + TR	21 (1.7)
TR + MR + GW	39 (2.9)
TR + MR + ES	39 (2.9)
TR + GW + ST	32 (2.4)
TR + MR + ST	29 (2.2)

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TR, tarsorrhaphy; GW, gold weight; MR, muscle retraining; ES, electrical stimulation; ST, 7-12 transfer.

impairment is a significant psychosocial morbidity. Numerous studies, largely case reports, have previously documented facial nerve outcomes on the basis of physician-assessed measures, such as the HB scale (16) or postsurgical rehabilitation outcome (17). Others have developed patient self-assessment scales for facial dysfunction; (18) however, few have analyzed the impact significant facial impairment has on the QOL of surgically treated AN patients in a large multi-institutional cohort. On the basis of the survey results of ANA members, we have identified several patient factors that may help treating physicians counsel prospective surgical patients.

Patients with larger tumors had more preoperative facial dysfunction; more often required facial rehabilitation therapies; had poorer results for gold weight placement, tarsorrhaphy, and muscle retraining; felt more affected by facial weakness and eye problems; and were less satisfied with their smile, physical appearance, and QOL. Similar to our findings, several studies have documented the negative impact that a larger tumor size has on facial function outcome (2,4,7,14,15). This may be intuitive because anatomically larger tumors are more likely to have compressed or splayed the facial nerve, making its preservation more challenging. However, once the nerve has been damaged and rehabilitation therapies are required, it is unclear why a larger tumor size would afford a poorer outcome for various therapies

TABLE 3. *Degree affected by facial dysfunction and quality of life assessment in 1,595 respondents*

QOL question	Responded "quite a bit" or "very much" (%)	Of 1,595 respondents
Affected by facial weakness	28.2	421
Affected by eye problems	37.5	567
Smile symmetric	51.5	793
Satisfied with appearance	59.5	931
Content with QOL	71.9	1126

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(e.g., gold weight, tarsorrhaphy, muscle retraining). It is speculative whether the damage for smaller tumors was only partial and nerve recovery occurred, augmenting the results of these nondestructive adjunctive therapies. This may explain why no difference for tumor size was noted for 7–12 nerve transfers, which sacrifice the damaged nerve.

Younger patients more often required a 7–12 nerve transfer, used electrical stimulation, required a temporalis transposition, and had more successful outcomes with gold weight placements. However, they felt more affected by facial weakness and less often felt their smiles were symmetric.

Oghalai et al. (13) reported that patient age had no impact on facial dysfunction based on objective measures such as HB score. In contrast, Sood et al. (12), who used the Glasgow Benefit Index to assess QOL in AN patients who had 7–12 transfers for facial paralysis, reported that younger patients had significantly more benefit. Females reported more preoperative facial dysfunction, felt more affected by it as a result of surgery, and were less satisfied with their physical appearance.

With regard to surgical approach, overall results were similar for translabyrinthine and retrosigmoid approaches. However, patients who underwent middle fossa approaches, albeit for smaller tumors, less often required facial rehabilitation therapies, felt less affected by facial dysfunction, and more often felt their smiles were symmetric.

In these ANA respondents, we have identified additional patient factors associated with facial impairment, rehabilitation measures, and their outcomes. The ANA provides support and information for patients with ANs, promotes research and awareness about this disease, and has more than 5,000 members. Although ANA respondents were treated at large institutions and private practice settings representing wide treatment and practice variability, one might argue that these respondents may not represent a random cross-section of the patient population but rather a group biased toward more negative outcomes. Indeed, 40% of this entire cohort reported significant facial impairment, and 70% of those with dysfunction felt it was permanent, which may be higher than the typical case series (1,2,7,8,11,15) and may represent one end of the surgical outcome spectrum. However, the purpose of this study was not to add to the literature yet another case series and to extrapolate our morbidity rates to the entire AN population but to analyze facial impairment and rehabilitation in detail among a large group of patients who had experienced it. Regardless, the perspective of this large group of patients is an invaluable asset for treating physicians counseling patients with ANs.

Numerous therapies are commonly used for rehabilitation of a paralyzed face (19). Gold weight placement (20,21), tarsorrhaphy, eyelid spring (22), static slings (23), various muscle transpositions such as temporalis (24,25) or masseter, and nerve transfers such as the hypoglossal to facial or cross facial have been described in detail in the

TABLE 4. *Statistically significant relationships between facial dysfunction rehabilitator, and outcome versus patient factors*

Facial dysfunction measure	Patient factor	Trend	*p* value
Preoperative facial weakness	Tumor size	Increases with larger tumors	0.001
Preoperative eye problems	Tumor size	Increases with larger tumors	0.001
Preoperative eye problems	Sex	More common with females	0.002
Onset facial weakness in hospital	Tumor size	Increases with larger tumors	0.045
Permanent facial weakness	Tumor size	Increases with larger tumors	0.0001
Permanent eye Problems	Tumor size	Increases with larger tumors	0.0001
Tarsorrhaphy required	Surgical approach	TL and RS more than MF	0.04
Tarsorrhaphy required	Tumor size	Increases with larger tumors	0.0001
7-12 nerve transfer required	Surgical approach	TL and RS more than MF	0.02
7-12 nerve transfer required	Tumor size	Increases with larger tumors (none for small tumors)	0.0001
7-12 nerve transfer required	Age	More common in younger patients	0.0001
Temporalis muscle transposition	Surgical approach	RS > TL > MF	0.027
Temporalis muscle transposition	Tumor size	Increase with larger tumors	0.0001
Temporalis muscle transposition	Age	More common in younger patients	0.029
Masseter muscle transposition	Tumor size	Utilized only with larger tumors	0.001
Eyelid spring required	Tumor size	Increases with larger tumors	0.0001
Gold weight required	Tumor size	Increases with larger tumors	0.0001
Electrical stimulation used	Surgical approach	TL and RS more than MF	0.027
Electrical stimulation used	Tumor size	Increases with larger tumors	0.0001
Electrical stimulation used	Age	More common in younger patients	0.049
Electrical stimulation used	Sex	More common with females	0.0001
Muscle retraining required	Surgical approach	RS > TL > MF	0.027
Muscle retraining required	Tumor size	Increases with larger tumors	0.0001
Muscle retraining required	Sex	More common with females	0.002
Tarsorrhaphy worked well	Tumor size	Worked better for smaller tumors	0.038
Temporalis muscle transposition	Surgical approach	100% MF (n=1), 96% RS (n=24), 60% TL (n =15)	0.007
Gold weight worked well	Age	Worked better for younger patients	0.011
Gold weight worked well	Tumor size	Worked better for smaller tumors	0.047
Muscle retraining	Tumor size	Worked better for smaller tumors	0.047
7-12 nerve transfer	All factors	No significant relationships	N/A
Affected by facial weakness	Tumor size	More affected with larger tumors	0.0001
Affected by facial weakness	Surgical approach	RS + TL > MF	0.046
Affected by facial weakness	Age	Younger patients more affected	0.007
Affected by facial weakness	Sex	Females > men	0.047
Affected by eye problems	Tumor size	More affected with larger tumors	0.0001
Affected by eye problems	Sex	Females > Men	0.0001
Smile is symmetric	Tumor size	More common in smaller tumors	0.0001
Smile is symmetric	Surgical approach	MF > RS + TL	0.018
Smile is symmetric	Age	Less common in younger patients	0.012
Smile is symmetric	Sex	Men > females	0.013
Satisfied with appearance	Sex	Men > females	0.0001
Satisfied with appearance	Tumor size	More common in smaller tumors	0.0001
Content with QOL	Tumor size	More common in smaller tumors	0.033

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literature and is beyond the scope of this study. Facial electrical stimulation and muscle retraining are advocated by some (26,27) and could be an important adjuvant during recovery, although randomized controlled studies are lacking. The type of paralysis (early versus delayed) (28), whether the nerve was anatomically preserved or killed, timing, and combination of these therapies are important factors that can influence outcome immensely. These objective data are unavailable in this study.

CONCLUSIONS

In the largest cohort study to date of AN patients with facial impairment who underwent over 1,000 reported interventions for rehabilitation, several patient-related factors were identified. The most significant patient factor for negative outcome and poorer satisfaction from therapy and QOL was a large tumor size. Electrical stimulation, although commonly practiced as a single and combined therapy, showed the least effective results. Females and younger patients felt more affected by facial paralysis or eye problems and were less satisfied with their appearance. On the basis of the results of the ANA survey, we believe it is incumbent for the treating physicians to familiarize themselves with the sentiments of patients with ANs when counseling and recommending optimal management strategies.

Acknowledgments: The authors thank The Neuroscience Institute for medical editing and the senior biostatistician Rakesh Shukla, Ph.D., Professor of Biostatistics and Director Center for Biostatistical Services at the University of Cincinnati Medical Center, for biostatistical support.

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INVITED COMMENTARY

This manuscript discusses a survey conducted by the Acoustic Neuroma Association concerning facial paralysis and surgical rehabilitation following acoustic neuroma treatment. The survey provides an interesting perspective on the effect facial dysfunction has on patients' quality of life. Every clinician is acutely aware of the importance of facial nerve function, and this is emphasized in the report.

In regard to facial nerve rehabilitation, it is interesting that facial electrical stimulation was commonly used and was the least effective therapy. This observation is in agreement with the experience of most physicians active in the field.

The authors did point out that these respondents may not represent a random cross section of the acoustic neuroma patient population but rather a group biased toward more negative outcomes. As they point out, 40% of the group reported significant facial impairment, and this is greater than reports from centers treating acoustic neuromas. Nevertheless, I do believe this report from the patients' perspective is very important.

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