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Evaluation of VIIth–XIIth cranial nerve anastomosis results by age

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Abstract

Objective. To evaluate VIIth–XIIth cranial nerve (hypoglossal–facial nerve) anastomosis results by age.
Method. A total of 34 patients who attended a follow-up visit in 2016, aged 20–63 years, were enrolled. The House–Brackmann facial nerve function grading system and the Facial Clinimetric Evaluation scale were applied.
Results. Regarding post-anastomosis facial nerve function, in the group aged 40 years or less, 14 patients (78 per cent) had House–Brackmann grade III and 4 patients (22 per cent) had House–Brackmann grade IV facial nerve function post-anastomosis. In the group aged over 40 years, nine patients (56 per cent) had House–Brackmann grade III and seven patients (44 per cent) had House–Brackmann grade IV facial nerve function post-anastomosis. There was a statistically significant difference between the two groups in mean facial movement domain scores ($p = 0.02$). Analysis between age and facial movement score in all 34 patients demonstrated a moderate negative correlation (Pearson correlation coefficient: −0.38) and statistical significance ($p = 0.02$).
Conclusion. Facial reanimation yielded better results in younger than in older patients.

Introduction

Vestibular schwannoma surgery has low mortality rates given the advancements in intra-operative monitoring, imaging, and microscopic and endoscopic surgery techniques. These developments have also contributed to the preservation of facial nerve integrity and reduced facial nerve damage rates. However, the most feared morbidity following surgery is still facial nerve damage. In patients with a large tumour[1] who have undergone radiotherapy prior to resection,[2] the risk of facial nerve damage increases. Facial nerve damage is encountered in 1.5–2.5 per cent of cases.[3] Sometimes, the facial nerve does not function after resection, even if it was left anatomically intact during surgery.

Ultimately, regardless of the reason it occurs, facial nerve palsy significantly affects a patient's quality of life.[4] In such situations, facial reanimation surgery can alleviate both the functional and psychosocial negative effects on quality of life. Among the surgical options available, VIIth–XIIth cranial nerve (hypoglossal–facial nerve) anastomosis is the most preferred, and most established and reliable, nerve transfer technique, despite tongue morbidity.[5–7]

Many of the possible factors that could affect the outcome of facial reanimation surgery have been investigated. Two main points have been addressed: post-injury early repair and long-term follow up.[8] Although there are clinical studies showing that age, gender and affected side do not have an effect on outcome, other clinical studies have shown that advanced age may have a negative effect on outcome.[9] No definitive conclusion has been reached regarding the effect of age on facial reanimation results because of the limited number of patients studied.

This study aimed to investigate the effect of age on recovery results and on life-quality perception in patients who underwent end-to-end VIIth–XIIth cranial nerve repair following total facial paralysis that occurred after vestibular schwannoma removal via a retrosigmoid approach.

Materials and methods

This study was conducted at the Gazi University Department of Otorhinolaryngology in Ankara, Turkey, and it was approved by the University Clinical Research Ethics Committee. All patients provided written informed consent for their participation.

A retrospective review was conducted of 58 patients who had experienced complete facial paralysis after retrosigmoid vestibular schwannoma removal and had subsequently undergone VIIth–XIIth cranial nerve anastomosis, between 1985 and 2014. Data were

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Table 1. Patient characteristics according to age groups

Characteristic	≤40 years	>40 years	*P*-values
Group size (*n*)	18	16	
Gender (*n*)			
– Male	11	11	
– Female	7	5	
Age (mean ± SD (range); years)	29.5 ± 7.1 (20–39)	53.6 ± 6.5 (41–63)	0.001
Interval between injury & repair ((mean ± SD (range); months)	4.8 ± 4.1 (0–14)	2.6 ± 2.1 (0–7)	0.07
Interval between repair & survey ((mean ± SD (range); months)	43.8 ± 27.6 (12–92)	64.1 ± 29.7 (22–104)	0.48
House–Brackmann grade at follow up (*n* (%))			0.18
– Grade III	14 (78)	9 (56)	
– Grade IV	4 (22)	7 (44)	

SD = standard deviation

retrieved from the medical records, and patients who attended a follow-up visit in 2016 were included in the study. A total of 34 patients, aged 20–63 years, were enrolled.

The House–Brackmann facial nerve function grading system and the Facial Clinimetric Evaluation ('FaCE') scale were used in the follow-up examination. The House–Brackmann grades (from I to VI) are assigned by the physician, wherein I represents normal facial nerve function and VI reflects total facial paralysis. The Facial Clinimetric Evaluation scale is a validated quality-of-life instrument for facial impairments, and it represents a patient's overall self-perception of their facial movements. The questionnaire contains 15 items,[10] each of which is answered on a five-point Likert scale: 1 signifies the lowest function score and 5 signifies the highest function score. The survey gives an overall total score and scores for six domains: facial movement, facial comfort, oral function, eye comfort, lacrimal control and social function. Each domain score is calculated using a specific formula, and scores range between 0 and 100, corresponding to the worst and the best possible function, respectively.

Statistical analysis was performed using SPSS software (version 22; SPSS, Chicago, Illinois, USA), and $p < 0.05$ was considered statistically significant. The results are presented as mean ± standard deviation (SD) (minimum–maximum) values.

The study population was first classified according to House–Brackmann grade III or grade IV facial nerve function, and the Facial Clinimetric Evaluation scale scores of these two groups were compared. The patients were then classified in terms of age groups – 40 years or less, or over 40 years. This enabled analysis of the relationship between age and House–Brackmann grades and Facial Clinimetric Evaluation scale scores. A one-sample Kolmogorov–Smirnov test was used to examine the conformity of the data to normal distributions. Differences were assessed using a student's two-tailed *t*-test for normally distributed numerical data or a Pearson chi-square test for categorical data. The Spearman's rank correlation coefficient was calculated to determine the relationship between age and Facial Clinimetric Evaluation scale scores for the entire study population.

Results

The data of 34 patients aged 20–63 years were evaluated. All those patients included had developed House–Brackmann grade VI facial paralysis following vestibular schwannoma surgery and had subsequently undergone end-to-end VIIth–XIIth cranial nerve anastomosis.

Post-anastomosis, 23 patients (68 per cent) had House–Brackmann grade III facial nerve function and 11 patients (32 per cent) had House–Brackmann grade IV. The Facial Clinimetric Evaluation scale scores of the House–Brackmann grade III and House–Brackmann grade IV patient groups were analysed, and only the results for facial movement domain reflecting physical function were found to be significantly different between the two groups ($p = 0.04$).

The study patients were separated into two age groups of 40 years or less and over 40 years, in order to ascertain whether there was a true difference in outcome by age. Exact division was based on attempts to create roughly equivalent group sizes that were similar in terms of gender and post-operative follow-up time. There were 18 patients aged 40 years or less and 16 patients aged over 40 years. The demographic data of these two groups are summarised in Table 1.

The mean time between facial nerve injury and repair was 4.8 ± 4.1 months (range, 0–14 months) for patients aged 40 years or less and 2.6 ± 2.1 months (range, 0–7 months) for patients aged over 40 years ($p = 0.07$). The mean time between the VIIth–XIIth cranial nerve repair and the survey was 43.8 ± 27.6 months (range, 12–92 months) for patients aged 40 years or less and 64.1 ± 29.7 months (range, 22–104 months) for patients aged over 40 years ($p = 0.48$).

In terms of post-anastomosis facial nerve function, 14 patients (78 per cent) in the younger group had House–Brackmann grade III facial nerve function, and the remaining 4 patients (22 per cent) had House–Brackmann grade IV. In those patients aged over 40 years, nine (56 per cent) had House–Brackmann grade III facial nerve function and the remaining seven patients (44 per cent) had House–Brackmann grade IV. No statistically significant difference was found between the two groups according to the House–Brackmann grades ($p = 0.18$), although there was a higher percentage of patients with House–Brackmann grade III facial nerve function in the group aged 40 years or less.

The mean Facial Clinimetric Evaluation scale scores of the two age groups are summarised in Figure 1. A statistically significant difference was found in the facial movement domain ($p = 0.02$). Correlational analysis was performed between age and facial movement score in all 34 patients, which revealed a moderate negative correlation (Pearson correlation

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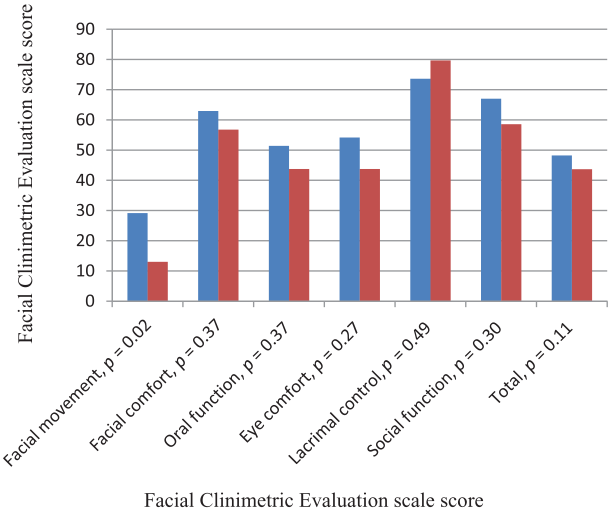

Fig. 1. Facial Clinimetric Evaluation scale domain and total scores for both age groups, with *p*-values.

coefficient = −0.38) with statistical significance ($p = 0.02$). Functional recovery was observed to decrease slightly with ageing.

Discussion

Functional loss of the facial nerve can occur after vestibular schwannoma surgery, trauma, tumour and chronic otitis surgery. In such cases, restoration can be achieved with other cranial nerves or branches, which can provide cortical neural input to the distal part of the injury. Among these, the hypoglossus is the most commonly used option in facial nerve restoration – it has the highest static facial muscle success rate, despite donor site morbidity.[5,6] The successful results of VIIth–XIIth cranial nerve anastomosis are attributed to the close proximity of the hypoglossus and facial nerve nuclei in the brain stem and the neuronal plasticity of the brain.[11,12]

Various methods are available to evaluate facial nerve function and objectively determine the level of paresis. The most widely used method is the House–Brackmann facial nerve function grading system, which is physician-based. In addition, the Facial Clinimetric Evaluation scale inventory has been developed to determine the level of handicap that results from facial paralysis and examine how it affects a patient's quality of life. This is a patient-based inventory with six different domains, all of which reflect a patient's own perception of physical disability and social handicap.

In the current study, comparisons of the Facial Clinimetric Evaluation scale scores of patients who recovered either with House–Brackmann grade III or House–Brackmann grade IV facial nerve function revealed a statistically significant difference in terms of the facial movement domain scores (which reflect physical functional impairment). However, there was no difference in social function and other domains. This was postulated to be because social perception is affected by multifactorial parameters, such as age, gender and psychosocial status.[4,13] Therefore, the Facial Clinimetric Evaluation scale facial movement domain scores were used in the age analysis as they reflected physical impairment from the perspective of patients in more detail via numerical data.

Parameters affecting the success of facial reanimation repairs have been evaluated previously, and the importance of early repair, before the development of muscular atrophy, denervation fibrosis and neural degeneration, has been emphasised. In addition, comparisons of short-term and long-term success rates after anastomosis have revealed that the long-term results are better.[7,8] Surgery technical difficulty, less experience and late repair have been reported to have a negative effect on outcome.[14] In addition, parameters that do not have an impact on final outcomes, such as gender, side affected and facial nerve function grade before repair, have also been evaluated.

Of these parameters, age seems to be a controversial issue. Some authors have suggested that age does not have prognostic value in the recovery process, when evaluating using the House–Brackmann grading system.[15,16] In contrast, in evaluations made with life-quality indices, some series have determined that younger age contributes to recovery and that younger patients benefit more from facial reanimation procedures.[9,17,18] In particular, the presence of more than nine hundred axons in the donor area, which is associated with younger age, has been shown to increase success.[19] Other studies have shown that advanced age is an independent negative predictor of a positive outcome.[20] Considering the decrease in axonal load and reductions in neural plasticity that come with ageing,[21] it remains a strong possibility that age could be a prognostic parameter.

- Parameters affecting facial reanimation success have been assessed in limited studies and age is a controversial parameter
- In this study, the younger age group (≤ 40 years) had a lower House–Brackmann facial nerve function grade
- In addition, Facial Clinimetric Evaluation scale facial movement domain scores were higher in the younger group
- There was a moderate negative correlation between Facial Clinimetric Evaluation scale scores and age
- The data suggest that younger age contributes to better reanimation recovery, outcomes and facial movement scores

In the current case series, the results obtained support the link between younger age and a better outcome. In our study, all patients underwent the same surgical approach and were only separated in terms of age. The younger group had a higher number of patients with House–Brackmann grade III than the older group, and the Facial Clinimetric Evaluation scale facial movement domain scores were significantly higher in the younger group. These results were obtained despite the longer mean interval between facial nerve injury and repair, and the shorter average long-term follow-up period, in the younger patient group. Furthermore, in this study, a statistically significant moderate negative correlation was determined between Facial Clinimetric Evaluation scale scores and age. Thus, the analysis of this series of facial reanimation cases indicates that facial movement scores decrease with increasing age.

Knowledge of the parameters that affect the final result of facial reanimation is scarce given the limited number of facial reanimation cases. Sharing the experience of each clinical series contributes to the discussion. This end-to-end VIIth–XIIth cranial nerve anastomosis case series, which had a level of evidence of 3b, investigated the effect of age on final recovery

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success and on patients' facial movement perception. Facial reanimation at a younger age was found to yield better results. These results must, of course, be verified by further, more comprehensive studies of facial reanimation cases.

When considering the timing of vestibular schwannoma surgery, the need for reanimation should be taken into account, in addition to factors such as tumour size, rapid growth, aggressive symptoms and hearing status.[22] If surgery is planned for the patient, it should be performed at an earlier age. In addition, when delivering pre-operative information to elderly patients who are candidates for facial reanimation, it should be stated that their recovery may result in a higher House–Brackmann grade than in younger patients.

Competing interests. None declared

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