

Facial nerve monitoring in skull base surgery

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Abstract

The purpose of this work was to compare pre- and post-operative facial nerve function between unmonitored and monitored cases of skull base lesions. The study involved 32 patients suffering from lateral skull base tumours (10 unmonitored and 22 monitored). Facial nerve function was monitored intraoperatively by an acoustic facial electromyographic system (NIM-2). Post-operative facial function was graded according to the House–Brackmann scale. In the group of monitored cases, facial nerve function was normal (Grade 1 or 2) in 79 per cent of the patients, while the unmonitored patients showed normal function in only 50 per cent of the cases.

These results confirm previous observations that audible evoked electromyographic monitoring significantly reduces permanent facial nerve dysfunction.

Key words: Skull base, electromyography, facial nerve

Introduction

Lateral skull base approaches frequently require the anterior or posterior mobilization of the intratemporal facial nerve to obtain wide and adequate exposure for complete removal of the lesions and, at the same time, for safe control of adjacent neurovascular structures (House and Hitselberger, 1976; Fisch, 1982; Harner *et al.*, 1988). However the surgical manipulation to reroute the facial nerve can damage its function in several ways. Significant neural trauma can occur during the uncovering of the facial nerve and its removal from the fallopian canal. Other iatrogenic injury may be produced by the tumour dissection through direct mechanical neural stimulation. Intraoperative facial nerve monitoring is an additional tool to aid facial nerve preservation. This system is used to identify the nerve electrophysiologically during surgery, to minimize iatrogenic trauma and to predict neural integrity at the end of the operation (Prass and Luders, 1986; Harner *et al.*, 1988; Kartush, 1989; Leonetti *et al.*, 1989; Silverstein *et al.*, 1989; Newell *et al.*, 1992; Stechison, 1992).

The purpose of the present paper is to compare pre- and post-operative facial nerve function results between unmonitored and monitored surgical cases of skull base lesions. The study reviews 32 cases focussing upon the usefulness of evoked electromyographic facial monitoring.

Materials and methods

The records of 32 skull base tumour patients, who were referred for surgery between 1 March, 1988 and 1 July,

1992 at the Second and Fourth ENT Clinics, University 'La Sapienza' Rome, were reviewed retrospectively. Each record was evaluated for sex and age of the patient, location, pathway and size of the tumour, different surgical approaches dictated by the clinical and radiological criteria, complications of the procedures and degree of pre-operative and post-operative facial function assigned to one of the six grades as described by House and Brackmann (1985).

The group analysed consisted of 19 women and 13 men. The average age was 44.9 years with a range from 22 to 71 years. The patients suffered from different histological lesions located in various regions of the skull base (clivus, petrous apex, temporal bone, jugular foramen and intratemporal fossa) (see Table I).

All patients underwent skull base surgery with anterior or posterior displacement of the VIIIth cranial nerve (type A and B: infratemporal approach and transcochlear approach) as described respectively by Fisch (1982) and House and Hitselberger (1976), performed by the same

TABLE I
TUMOUR TYPE

Histology	Unmonitored patients	Monitored patients
Glomus	6	10
Cholesteatoma	2	5
Basal cell carcinoma	1	1
Cranial nerve neuroma	–	2
Adenoid cystic carcinoma	–	2
Meningioma	1	2

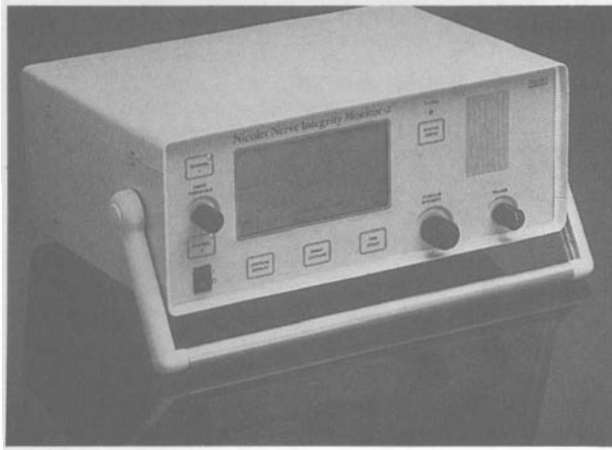


FIG. 1
Nerve Integrity Monitor (NIM-2).

surgeon (G.M.). No patients received pre- or post-operative radiotherapy.

The first 10 patients in this series were operated on from 1988 to mid 1990 without the benefit of intraoperative facial nerve monitoring. The remaining 22 patients had intraoperative electromyographic (EMG) monitoring to assess facial nerve function using a two-channel device with a loudspeaker (Figure 1) to allow the surgeon ongoing feedback and with a circuitry to reduce cautery artifacts. It is called Nerve Integrity Monitor (NIM-2) (Xomed-Treace) (Kartush *et al.*, 1991). The evoked EMG responses have been evaluated as categorized by Prass and Luders (1986). During general anaesthesia the monitored patients received only an initial dose of muscle relaxant medication (succinyl choline). No other doses were administered afterwards in order to have a reliable monitoring of the facial nerve.

The patients were recalled and assessed at various times after surgery. This ranged from three to 52 months (mean 16.9 months).

Results

The data from the monitored and unmonitored cases of lateral skull base tumours regarding tumour pathology and tumour size are listed in Tables I and II. The histopathology showed minimal differences between the two groups. Adenoid cystic carcinoma and cranial nerve neuroma were observed only in the monitored patients. The numbers in Table II delineate the discrepancies between the unmonitored and EMG monitored groups with a small preponderance of the largest tumors being in the monitored group.

Pre-operative facial nerve function is summarized in Table III. The House–Brackmann grade results showed that the majority of patients in both groups had normal

TABLE II
TUMOUR SIZE

Skull base tumours	Unmonitored patients	Monitored patients
<2 cm	2	3
3–5 cm	6	14
>5 cm	2	5

TABLE III
PRE-OPERATIVE FACIAL NERVE FUNCTION

House–Brackmann grades	Unmonitored patients	Monitored patients
1	7	18
2	1	–
3	–	1
4	–	–
5	–	–
6	2	3

(Grade 1) or good (Grade 2) function. Five patients (two unmonitored and three monitored) were Grade 4 pre-operatively. One of these patients had undergone previous surgery, while in the others the facial nerve was invaded by the tumour in its mastoid portion.

Table IV summarizes the post-operative facial nerve function findings. Table IV lists the patients in which rerouting of the facial nerve was performed excluding the cases with tumour invasion of the facial nerve managed by reconstructive techniques of the facial nerve (three great auricular nerve grafts, one sural nerve graft and one hypoglossal–facial anastomosis). Seventy-nine per cent of the EMG monitored group fell into the Grade 1 or Grade 2 categories (which represent excellent or good function) compared with only 50 per cent of the unmonitored cases. Moderate function (Grades 3 and 4) was achieved by 21 per cent of the monitored cases and 25 per cent of the unmonitored cases.

These data were substantiated by finding no development of Grade 5 and 6 facial nerve dysfunction in the monitored group compared with 25 per cent of the unmonitored cases who had poor or no function of the VIIth nerve.

Discussion

In skull base diseases, facial nerve function is placed at risk not only by the neural involvement due to the lesions (Makek *et al.*, 1990), but also by the surgical procedures necessary to complete their removal. During rerouting of the VIIth nerve, its manipulation can produce significant trauma resulting in post-operative dysfunction of various degrees. Intraoperative monitoring of facial electromyographic activity represents an adjunctive aid in the anatomical and functional preservation during lateral skull base procedures.

In our experience, it proved to be efficacious. During the rerouting of the facial nerve, the appearance of evoked EMG activity indicated a mechanical stimulation and a relative trauma to the nerve. This status obliged us to

TABLE IV
POST-OPERATIVE FACIAL NERVE FUNCTION (ONLY FOR PATIENTS
(N = 27) WITH REROUTING OF THE FACIAL NERVE)

House–Brackmann grades	Unmonitored patients	Monitored patients
1	2	9
2	2	6
3	2	2
4	–	2
5	1	–
6	1	–

reduce the surgical manipulation in order to prevent iatrogenic trauma. Data from this study, which compares monitored cases with unmonitored cases, supports the use of continuous evoked electromyographic monitoring for any procedure involving the facial nerve. The advent of acoustic EMG facial monitoring enhanced our preservation rate of the VIIth nerve and maximized post-operative function. Favourable facial function (Grades 1 or 2) was noted in 79 per cent of patients with normal pre-operative function who were monitored intraoperatively: this compared with 50 per cent of the unmonitored group. In addition, no cases of the monitored patients developed Grade 5 or Grade 6 function, while 25 per cent of the unmonitored patients showed this unfavourable outcome.

The limited number of the unmonitored group and the heterogeneity of the lesions do not allow a reliable and valid statistical analysis. Moreover increasing surgical skill and experience undoubtedly has improved our results. However the large differences observed between the unmonitored and monitored groups cannot be attributable to this factor alone and indirectly they point out the contribution of the evoked EMG monitoring to the improved results. Our observations parallel the experiences from other studies such as Leonetti *et al.* (1989) who reported a normal, immediate post-operative facial function in 93 per cent of the monitored cases and 70 per cent of the cases in the unmonitored group. They indicated that an EMG monitoring system, with acoustic feedback, represents an important tool (during skull base surgery) with which to reduce the incidence and severity of facial nerve deficits. Such a device increases the chances of neural preservation also facilitating its neural identification from the tumour and other non-neural soft tissue. It should be emphasized, however, that, according to an Editorial by Luetje (1989), facial monitoring is only a technical aid and it cannot be a substitute for the skill, experience and anatomical knowledge of the surgeon.

Intraoperative monitoring proved to be useful also in predicting facial nerve function after surgery (Silverstein *et al.*, 1989). Further study is underway to evaluate our experience in this particular field.

Conclusions

Based on the findings of this study, intraoperative

evoked electromyographic facial monitoring appears to be clinically important during lateral cranial base procedures. Its use has significantly improved the preservation rate of the VIIth nerve. In the present series, the best results occurred in the monitored group of patients.

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