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Comparative assessment of methods of the operative treatment of facial nerve damage caused during cerebellopontine angle neurinoma and meningioma removals

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The aim of this research paper is to point out the preconditions for facial nerve damage during CPA tumour removals and, in such cases, the appropriate choice of reconstructive surgery.

Materials and methods. In-Uzhhorod National University, during the period of 2008 to 2019, surgical treatment of 212 patients with neurinomas and meningiomas of the CPA has been carried out. We have analyzed the cases of 35 (16.5%) patients with intraoperative damage of the facial nerve.

The mentioned 35 patients underwent appropriate clinical examinations during the post-operative period, which confirmed the facial nerve damage to one degree or another according to the House-Brackmann scale. The clinical signs manifested as full eyelid contact with slight effort and slight facial asymmetry during maximal effortful laughter. Slight synkinesias were noticeable, and there were no contractures until the expression of clinical signs corresponding to grade 6 - total nerve paralysis in 5 patients.

Results. The research demonstrated that patients with neurinomas larger than 3 cm in size are 5 times more likely to undergo intraoperative damage to the facial nerve than patients with the same tumour but 3 cm or less in size and 5 times more likely than patients with meningiomas as a whole.

In the group of patients aged 20-40, there were twice as many men; in the group aged 40-50, women predominated; among patients older than 50, there were equal numbers of men and women.

Remote catamnesis was traced in 19 patients, and contact with the rest of the patients was lost due to the war. Among the interviewed patients, 58% of the anastomosis was performed in the first 3 months after the initial surgery, 21% - in 4-6 months, and 21% - in more than 12 months.

The optimal timing of reinnervation after the initial surgery is the first 6 months after tumour removal.

Conclusions. Nerve damage is more common during the removal of neurinomas 4cm or bigger in size. Reinnervation is accomplished by anastomosing the central end of the hypoglossal or accessory nerves to the peripheral end of the facial nerve, and both procedures are equally effective. Reinnervation should be performed 2 to 3 months after confirming nerve injury, but no later than 6 months.

Key words: neurinoma; meningioma; facial nerve damage

Introduction

According to research, cerebellopontine angle (CPA) tumours make up 5 to 10% of the total number of brain tumours, of which 75-85% are neurinomas, 10-15% are meningiomas, 2-5% are cholesteatomas and 1% are arachnoid cysts [1, 2, 3, 4, 5]. The clinical symptoms depend on the placement and size of the tumour. Sometimes, the course of this disease is complicated by occlusive hydrocephaly, requiring a shunting operation. The primary clinical manifestation comprises the following symptoms: vestibulocochlear syndrome, cranial nerve compression, particularly of the facial nerve, compression of the corresponding hemisphere or brain stem and increased intracranial pressure. Despite

measures such as intraoperative monitoring of the facial nerve, the use of ultrasound suction machine and microsurgical techniques, in about 15 to 17% of cases, facial nerve damage is unavoidable, especially during the removal of large neurinomas [4, 6, 7, 8, 9].

Patients with facial nerve damage develop serious functional, mental and cosmetic problems, as well as difficulties with salivation from the corresponding half of the mouth and articulation, dryness of the cornea (keratitis), and, at times, even cornea ulcerations, etc. In these patients, the inability to close their eyelids, the distortion of the corresponding half of the face and the facial expression disorder severely affect their mental state, making them difficult to understand by society

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and changing the quality of their lives. In that sense, the prevention of facial nerve damage and, in case of damage, its operative reconstruction remains the focus of surgical removal of tumours in the base of the skull, CPA tumours in particular [3, 4, 10, 11, 12].

All of this has served as a basis for searching and proposing microsurgical techniques of operative treatment of CPA tumours to preserve the facial nerve, techniques for using alternative nerves in facial reinnervation in case of damage and giving a comparative assessment of their effectiveness.

The first idea of facial nerve anastomosis with the spinal nerve occurred in 1879. 25 years later, in 1904, Korte was the first to perform and summarise his experience of facial nerve anastomosis with the hypoglossal nerve.

The aim of this research paper is to point out the preconditions for facial nerve damage during CPA tumour removals and, in such cases, the appropriate choice of reconstructive surgery.

Materials and methods

In Uzhhorod National University, during the period of 2008 to 2019, surgical treatment of 212 patients with neurinomas and meningiomas of the CPA has been carried out. We have analyzed the cases of 35 (16.5%) patients with intraoperative damage of the facial nerve.

The consent and written agreement were taken from all the patients participating in the research.

The research has been approved by the Committee of Ethics and Bioethics of the Regional Centre of Neurology and Neurosurgery, Uzhhorod (Minutes No 655/01.9-09, 21.10.2021).

The mentioned 35 patients underwent appropriate clinical examinations during the post-operative period, which confirmed the facial nerve damage to one degree or another according to the House-Brackmann scale (**Table 1**). The clinical signs manifested as full eyelid contact with slight effort and slight facial asymmetry during maximal effortful laughter. Slight synkinesias were noticeable, and there were no contractures until the expression of clinical signs corresponding to grade 6 - total nerve paralysis in 5 patients.

All patients were subjected to thorough clinical examination, including otoneurological and angiographic examinations, CT and MRI scans, intraoperative ENMG examination, microscopic, etc. According to the MRI data, a 3 cm or larger neurinoma was found in 24 out of 35 patients. Clinical signs of nerve injury were observed in 35 patients, which were also confirmed by ENMG before surgery. In all 35 patients, reconstructive surgery of the facial nerve was performed, using the sublingual nerve in 17 and the accessory nerve in 18 patients. There is catamnestic data for only 19 of them. The outcomes were assessed using the House-Brackman scale as well.

Table 1. House-Brackmann scale

The degree of damage	Determining symptoms
I	Normal function of all facial areas.
II	Minor weakness only on close examination. Full closure of the eyelids with slight effort. Slight facial asymmetry during maximal effortful laughter. Slight synkinesias (involuntary reflex movements or muscle contractions that accompany main active movement) are noticeable with no contractures.
III	Noticeable weakness of the face without deformity. Lifting the eyebrows may be impossible. Full closure of the eyelids and asymmetric movement with the maximum effort of the mouth. Apparent but not disfiguring synkinesias, massive muscle contractions or spasms.
IV	Obvious deformities and weakness. Inability to raise eyebrows. Incomplete eye closure and mouth asymmetry during maximal effort. Pronounced synkinesis, mass movements, spasms.
V	Barely noticeable movements. Incomplete eye closure, slight movements of corner of the mouth. Synkinesias, contractures and spasms are usually absent.
VI	Total paralysis and facial numbness with no movements.

Results and discussion

The research demonstrated that patients with neurinomas larger than 3 cm in size are 5 times more likely to undergo intraoperative damage to the facial nerve than patients with the same tumour but 3 cm or less in size and 5 times more likely than patients with meningiomas as a whole (**Table 2**).

Out of the 35 patients, facial nerve reconstruction was performed using the hypoglossal nerve in 17 and the accessory nerve in 18.

In the group of patients aged 20-40, there were twice as many men; in the group aged 40-50, women predominated; among patients older than 50, there were equal numbers of men and women (**Table 3**).

Remote catamnesis was traced in 19 patients, and contact with the rest of the patients was lost due to the war. Among the interviewed patients, 58% of the anastomosis was performed in the first 3 months after the initial surgery, 21% - in 4-6 months, and 21% - in more than 12 months (**Table 4**).

In this research paper, 35 patients with intraoperative facial nerve damage were taken as the baseline. The patients underwent various examinations, in particular ENMG and MRI examinations, and the nerve damage was proved by clinical signs and evaluated using the House-Brackmann scale. In all cases, total nerve damage was found. Data for postoperative case studies are available for 19 patients. The rest could not be obtained due to the war. When discussing the surgical issues of 35 patients, it is noticeable that nerve damage occurs more often in the case of large neurinomas, when the nerve is included in the structure of the tumour and damaged during the disconnection-dissection part of the surgery. At the same time, nerve damage occurs as a result of compression by the tumour and disturbance of local blood circulation.

In the case of nerve damage, if it is not confirmed by technical issues that occurred during the operation,

conservative treatment with the use of corticosteroids is initially carried out. After 2-3 months of treatment with no results, the surgical approach should be discussed.

The optimal timing of reinnervation after the initial surgery is the first 6 months after tumour removal (**Table 5**).

The surgery is performed by an anastomosis of the facial nerve to the hypoglossal or accessory nerve. Positive changes are observed during the first 5-6 months, which are expressed by changes in clinical symptoms and the ENMG data. The table below shows the rate of nerve recovery in months after reinnervation. The recovery process is observed during the first five months.

No wound-healing complications were observed. In 4 patients, no changes in the clinical signs were observed.

Table 2. Patients with intraoperative facial nerve damage, depending on the pathohistological structure and tumor size

Type of the tumour	Size of the tumour in cm				Total
	<2 cm	2-3 cm	3-4 cm	>4 cm	
Neurinoma	1	4	11	13	29
Meningioma	1	-	1	4	6
Total	2	4	12	17	35

Table 3. Patients with intraoperative facial nerve damage depending on age and gender

The nerve used for reconstruction	Age and Gender								Total	
	20-40		40-50		50-60		60>			
	m	f	m	f	m	f	m	f	m	f
Hypoglossal	4	1	-	2	2	2	2	4	8	9
Accessory	-	1	1	5	3	3	3	2	7	11
Total	4	2	1	7	5	5	5	6	15	17
	6		8		10		11		35	

Table 4. Patients with intraoperative facial nerve damage by the time of anastomosis

The nerve used for reconstruction	The term of anastomosis after the initial surgery, months												Total
	1	2	3	4	5	6	7	8	9	10	11	12>	
Accessory	2	2	3	-	1	-	-	-	-	-	-	2	10
Hypoglossal	-	2	2	-	2	1	-	1	-	-	-	1	9
Total	2	4	5	-	3	1	-	1	-	-	-	3	19

Table 5. Recovery of the nerve depending on the term of its reinnervation

Patient state	Time passed (Months)												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Improved	2	4	4	-	3	-	1	-	-	-	-	1	15
Unchanged	-	-	1	-	-	-	-	1	-	-	-	2	4

Conclusions

1. Nerve damage is more common during the removal of neurinomas 4 cm or bigger in size.
2. Reinnervation is accomplished by anastomosing the central end of the hypoglossal or accessory nerves to the peripheral end of the facial nerve, and both procedures are equally effective.
3. Reinnervation should be performed 2 to 3 months after confirming nerve injury, but no later than 6 months.

Disclosure

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

All procedures performed on patients comply with the ethical standards of institutional and national ethics committees, the 1964 Declaration of Helsinki and its amendments or similar ethical standards.

Informed consent

Informed consent was obtained from each of the patients.

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References

1. Samii M, Gerganov VM. Tumors of the cerebellopontine angle. *Handb Clin Neurol*. 2012;105:633-9. doi: 10.1016/B978-0-444-53502-3.00013-6
2. Springborg JB, Poulsgaard L, Thomsen J. Nonvestibular schwannoma tumors in the cerebellopontine angle: a structured approach and management guidelines. *Skull Base*. 2008 Jul;18(4):217-27. doi: 10.1055/s-2007-1016959
3. Lak AM, Khan YS. Cerebellopontine Angle Cancer. [Updated 2023 Jun 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559116/>
4. Izycka-Swieszewska E, Szurowska E, Kloc W, Rzepko R, Dubaniewicz-Wybieralska M, Skorek A, Drożyńska E, Stempniewicz M. Cerebellopontine angle tumours: radiologic-pathologic correlation and diagnostic difficulties. *Folia Neuropathol*. 2006;44(4):274-81
5. Apostolakis S, Karagianni A, Mylonakis I, Vlachos K. Mass phenomena from a cerebellopontine angle arachnoid cyst: case report. *Russian Journal of Neurosurgery*. 2022 Jun 12;24(2):62-5. doi: 10.17650/1683-3295-2022-24-2-62-65
6. Foscolo V, de Gennaro L, Murri A, Speranzon L, Signorelli F, Quaranta N, Messina R. Postoperative Impact of Pontocerebellar Angle Surgery on the Quality of Life in Patients with Vestibular Schwannoma. *Audiol Res*. 2022 Nov 17;12(6):635-643. doi: 10.3390/audiolres12060061
7. Yrysov KB, Shamshiev AT. [Results of surgical management for acoustic neurinomas using retrosigmoid approach]. *Vestnik Kazahskogo nacional'nogo medicinskogo universiteta*. 2015(2):470-2. Russian.
8. Yrysov KB, Mamytov MM. [Analysis of the outcomes of surgical treatment of acoustic neuromas]. *Journal of Siberian Medical Sciences*. 2010;(6):5. Russian.
9. Ebersold MJ, Harner SG, Beatty CW, Harper CM Jr, Quast LM. Current results of the retrosigmoid approach to acoustic neurinoma. *J Neurosurg*. 1992 Jun;76(6):901-9. doi: 10.3171/jns.1992.76.6.0901
10. Mamytov MM, Yrysov KB. [Preservation of the functions of the facial and auditory nerves in surgery for neuromas of the VIII nerve]. *Nauka o zhizni i zdorov'ye*. 2013(3):49-51.
11. Rhoton AL Jr. The cerebellopontine angle and posterior fossa cranial nerves by the retrosigmoid approach. *Neurosurgery*. 2000 Sep;47(3 Suppl):S93-129. doi: 10.1097/00006123-200009001-00013
12. Tatagiba M, Matthies C, Samii M. Microendoscopy of the internal auditory canal in vestibular schwannoma surgery. *Neurosurgery*. 1996 Apr;38(4):737-40. doi: 10.1097/00006123-199604000-00021