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The incidence and risk factors of facial nerve dysfunction after acoustic neuroma surgery: A systematic review and meta-analysis

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Abstract

Background: Facial nerve injury is a common complication after acoustic neuroma surgery, and there is currently a lack of clear evidence-based evidence. We conducted this systematic review and meta-analysis to explore the incidence and risk factors of facial nerve dysfunction (FNF) after acoustic neuroma (AN) surgery through meta-analysis, providing evidence-based basis for clinicians to predict and identify high-risk groups of FNF at an early stage. *Methods:* We searched multiple databases including PubMed, Web of Science, Cochrane Library, CNKI, and Wan fang electronically for literatures on the incidence and risk factors of FNF after AN surgery from the establishment of the databases to December 2024. The quality of the literatures was evaluated, and statistical analysis was performed using R 4.4.1 software after data extraction. *Results:* A total of 2,631 patients from 17 included literatures were analyzed. The results of meta-analysis showed that the incidence of FNF after AN surgery was 16% (95%CI: 0.11, 0.21). Larger tumor diameter [OR = 1.85, 95%CI (1.38 - 2.47), P < 0.0001], cystic tumors [OR = 2.22, 95%CI (1.43 - 3.45), P = 0.0004], a longer disease course [OR = 1.23, 95%CI (1.08 - 1.40), P = 0.0017], severe adhesion between the tumor and the facial nerve [OR = 5.45, 95%CI (3.67 - 81), P < 0.0001], peritumoral edema [OR = 3.22, 95%CI (1.71 - 6.07), P = 0.0003], total tumor resection [OR = 1.32, 95%CI (1.09 - 1.59), P = 0.0044], and preoperative gamma knife treatment [OR = 5.87, 95%CI (1.79 - 19.25), P = 0.0035] were the risk factors for FNF after AN surgery. The response of intraoperative facial nerve electromyography (EMG) to a 0.05 mA stimulation ≥ 100 microvolts [OR = 0.26, 95%CI (0.08 - 0.87), P = 0.0281] was a protective factor for FNF after AN surgery.
Conclusion: The existing evidence indicates that the incidence of FNF after AN surgery is 16%. Larger tumor diameter, cystic tumors, a longer disease course, severe adhesion between the tumor and the facial nerve, peritumoral edema, total tumor resection, and preoperative gamma knife treatment are the risk factors for FNF after AN surgery, while the response of intraoperative facial nerve EMG to a 0.05 mA stimulation ≥ 100 microvolts is a protective factor. Limited by the quantity and quality of the included literatures, the conclusions of this study still need to be confirmed by more high-quality studies.

Keywords: Acoustic neuroma, facial nerve function, risk factors, meta-analysis.

INTRODUCTION

Acoustic neuroma (AN), originating from the acoustic nerve sheath, is one of the most common intracranial tumors, accounting for 80% - 95% of tumors in the cerebellopontine angle region. It usually occurs in middle-aged people, with a peak incidence between 30 and 50 years old, and is rare in those under 20 years old, without significant gender differences.[1,2] AN is located deep in the skull and adjacent to the brainstem, an important central nervous system structure. When the tumor grows, it can affect the central structures that control important functions. AN first affects the

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patient's hearing. As the tumor further enlarges, it can cause facial sensory disturbances and even compress the brainstem, posterior cranial nerves, and cerebellum, threatening vital central structures. Surgery is the conventional treatment method for this disease, aiming at complete tumor resection while preserving FNF. However, facial nerve injury after surgery remains one of the most common complications, seriously affecting the patient's social function and quality of life.[3-6] Early assessment and prediction of the risk of FNF after AN surgery and timely identification and screening of high-risk groups are of great significance for the rehabilitation and prognosis of patients' FNF. At present, China and international studies on the risk factors of FNF after AN surgery are mainly based on investigations and reviews, lacking clear evidence-based evidence. Therefore, this study aims to explore the incidence and risk factors of FNF after AN surgery through meta-analysis, providing evidence-based basis for clinicians.

METHODS

Data source and search strategy

Databases including PubMed, Web of Science, Cochrane Library, CNKI, and Wanfang were searched electronically from the establishment of the databases to December 2024. The search was conducted using a combination of subject terms and free words, and the references of the included studies were also traced. Chinese search terms included: acoustic neuroma, vestibular schwannoma, postoperative, facial nerve, eighth cranial nerve, prognosis, risk factors, influencing factors, etc. English search terms included: Acoustic neuroma, vestibular schwannoma, postoperative period, facial nerve, Cranial nerve VIII, prognosis, risk factors, influence factor, etc. Taking PubMed as an example, the search strategy was: ((((“Prognosis”[Mesh]) OR (((((Prognoses) OR (Prognostic Factors)) OR (Prognostic Factor)) OR (Factor, Prognostic)) OR (Factors, Prognostic))) AND ((“Postoperative Period”[Mesh]) OR (((Period, Postoperative) OR (Periods, Postoperative)) OR (Postoperative Periods)))) AND (Search: ((((((((((((((((((((Nerve, Facial) OR (Seventh Cranial Nerve)) OR (Cranial Nerve, Seventh)) OR (Nerve, Seventh Cranial)) OR (Seventh Cranial Nerves)) OR (Cranial Nerve VII)) OR (Cranial Nerve VIIs)) OR (Nerve VIIs)) OR (Nerve VII)) OR (Nervus Facialis)) OR (Nervus Faciali)) OR (Nervus Intermedius)) OR (Nervus Intermedius of Wrisberg)) OR (Wrisberg Nervus Intermedius)) OR (Nerve of Wrisberg)) OR (Wrisberg Nerve)) OR (Marginal Mandibular Nerve)) OR (Mandibular Nerves, Marginal)) OR (Mandibular Nerve, Marginal)) OR (Marginal Mandibular Nerves)) OR (Nerve, Marginal Mandibular)) OR (Nerves, Marginal Mandibular)) OR (Marginal Mandibular Branch))) AND (((Acoustic Neuroma) OR (Acoustic Neuromas)) OR (Neuromas, Acoustic)) OR (Schwannoma, Acoustic)) OR (Acoustic Schwannoma)) OR (Acoustic Schwannomas)) OR (Schwannomas, Acoustic)) OR (Neurinoma, Acoustic)) OR (Acoustic Neurinoma)) OR (Acoustic Neurinomas)) OR (Neurinomas, Acoustic)) OR (Neurilemoma, Acoustic)) OR (Acoustic Neurilemoma)) OR (Acoustic Neurilemomas)) OR (Neurilemomas, Acoustic)) OR (Schwannoma, Vestibular)) OR (Schwannomas, Vestibular)) OR (Vestibular Schwannomas)) OR (Vestibular Schwannoma)) OR (Acoustic Tumor)) OR (Acoustic Tumors)) OR (Tumor, Acoustic)) OR (Tumors, Acoustic)) OR (Neurilemmoma, Acoustic)) OR (Acoustic Neurilemmoma)) OR (Acoustic Neurilemmomas)) OR (Neurilemmomas, Acoustic)) OR (Neurinoma of the Acoustic Nerve)) OR (Neuroma, Acoustic, Unilateral)) OR (Melanocytic Vestibular Schwannoma)) OR (Melanocytic Vestibular Schwannomas)) OR (Schwannoma, Melanocytic Vestibular)) OR (Schwannomas, Melanocytic Vestibular)) OR (Vestibular Schwannoma, Melanocytic)) OR (Vestibular Schwannomas, Melanocytic)) OR (Cerebellopontine Angle Acoustic Neuroma)) OR (Acoustic Neuroma, Cerebellopontine Angle)) OR (Angle Tumor)) OR (Angle Tumors)) OR (Tumors, Angle)) OR (Tumor, Angle)) OR (Cerebellopontine Angle Tumor)) OR (Angle Tumors, Cerebellopontine)) OR (Angle Tumor, Cerebellopontine)) OR (Cerebellopontine Angle Tumors)) OR (Tumor, Cerebellopontine Angle)) OR (Tumors, Cerebellopontine Angle)).

Literature inclusion and exclusion criteria

Inclusion criteria: ① The study subjects were patients who underwent AN resection; ② The incidence and/or risk factors of FNF were reported, and OR values and 95%CI were provided or could be obtained through data conversion; ③ The outcome variable was evaluated using the House-Brackmann (H-B) grading scale for FNF prognosis. Grade I, II, and III were defined as good prognosis; Grade IV, V, and VI were defined as poor prognosis.[7] The assessment time of FNF was 1 week, half a year, one year, or more; ④ Cohort studies. Exclusion criteria: ① Unable to obtain

the full text; ② Duplicate publication or study subjects from the same sample; ③ Incomplete study data; ④ Non-Chinese or English; ⑤ The quality evaluation result of the literature did not meet the standard.

Literature screening and data extraction

Two researchers independently screened, extracted data, and cross-checked the retrieved literatures according to the inclusion and exclusion criteria. If there were differences, they would discuss or consult a third party to resolve. The content of data extraction from the included literatures included authors, publication year, study region, sample size, number of cases of FNF, and related risk factors.

Literature quality evaluation

The Newcastle-Ottawa Scale (NOS) was used to evaluate the quality of cohort studies. The NOS consists of 8 items in 3 dimensions, including study subject selection, comparability between groups, and outcome measurement. The total score is 9 points, with 0 - 4 points being low-quality studies and ≥ 5 points being medium-to high-quality studies.[8,9]

Statistical analysis

Statistical analysis was performed using R 4.4.1 software. The combined effect size was represented by OR values and 95%CI. The heterogeneity test among the included study results was analyzed using the χ^2 test, and the degree of heterogeneity was quantitatively judged by I^2. When $P \geq 0.10$ and $I^2 \leq 50\%$, it indicated that the heterogeneity was small, and the fixed-effect model was used for Meta-analysis; when $P < 0.10$ and/or $I^2 > 50\%$, it indicated that there was heterogeneity, and the random-effects model was used for Meta-analysis. In this study, sensitivity analysis was performed by switching between the fixed-effect model and the random-effects model to evaluate the stability of the Meta-analysis results. Egger's test and funnel plots were used to analyze the publication bias of risk factors with a literature quantity ≥ 10. The test level was $\alpha = 0.05$. When there was heterogeneity, subgroup analysis was required to explore the source of heterogeneity.

RESULTS

Literature search results

A total of 7,049 relevant literatures were initially retrieved from the databases. After excluding 2,340 duplicate literatures, 4,555 irrelevant literatures were excluded by browsing the titles and abstracts. After reading the full texts, 137 literatures were excluded due to inconsistent research topics, inability to extract data, data duplication, and low literature quality. Finally, 17 literatures were included (Figure 1).

Basic characteristics and literature quality evaluation results of the included literatures

The basic characteristics of the 17 included literatures are shown in Table 1. The NOS scores of the included literatures ranged from 6 to 9 points, indicating that the overall quality of the included literatures was relatively high.

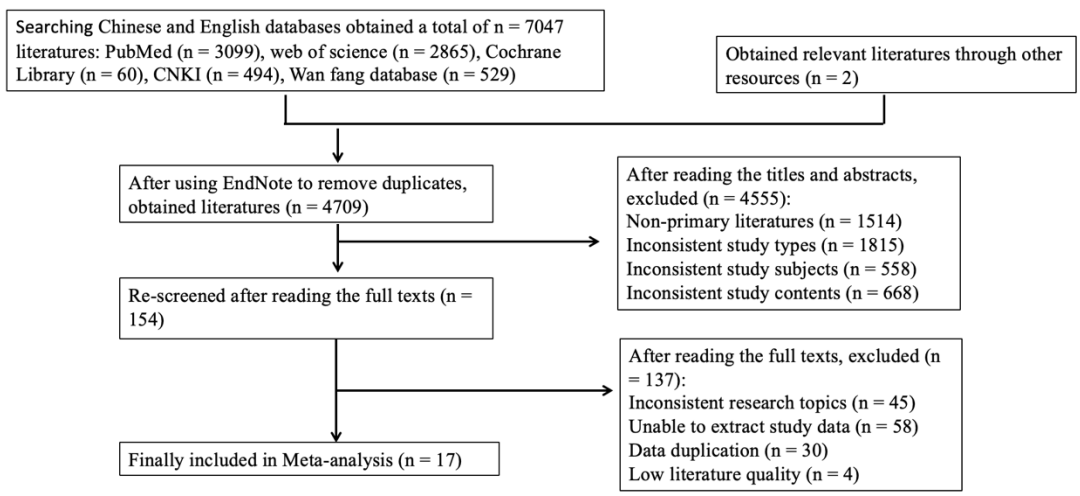

Figure 1. Flow chart of literature screening.

Table 1: Basic characteristics of the included literature

Included Literature	Publication Year	Country	Sample Size	Incidence of FNF [cases (%)]	Risk Factors	Literature Evaluation Quality Score
Feng *et al.*[10]	2015	China	64	17 (26.5)	①③⑤	6
Meng *et al.*[11]	2017	China	164	24 (14.6)	②③④⑥	7
Ren *et al.* [12]	2018	China	72	19 (26.4)	③④	8
Tao *et al.*[13]	2020	China	115	24 (20.8)	③④⑦	8
Tawfik *et al.*[14]	2020	USA	290	7 (2.4)	①②③⑧⑨	7
Song *et al.*[15]	2021	China	95	14 (14.7)	③⑥	8
Zhang *et al.*[16]	2021	China	54	16 (29.6)	③④⑥	6
Grinblat *et al.*[17]	2021	Italy	389	45 (11.6)	⑧	8
Wang *et al.*[18]	2022	China	57	7 (12.3)	③④⑦	6
Lu *et al.*[19]	2022	China	108	34 (31.5)	③④⑥	7
Zhang *et al.*[20]	2022	China	129	32 (24.8)	①③⑨	7
Zhu *et al.*[21]	2022	China	171	21 (12.3)	⑥	8
Ren *et al.*[22]	2023	China	295	97 (32.9)	①②③④⑧⑨⑩	9
Wang *et al.*[23]	2023	China	102	13 (12.7)	④⑧⑩	8
Macielak *et al.*[24]	2023	USA	100	12 (12)	①②⑧⑪⑫	8
Xiao *et al.*[25]	2024	China	120	9 (7.5)	③④⑤⑦	7
Harris *et al.*[26]	2024	USA	306	33 (10.78)	⑧⑩⑪⑫	9

Note: Risk factors: ① Age; ② Gender; ③ Larger tumor diameter; ④ Cystic tumor; ⑤ Longer disease course; ⑥ Severe adhesion between the tumor and the facial nerve; ⑦ Peritumoral edema; ⑧ Total tumor resection; ⑨ Preoperative gamma knife treatment; ⑩ Response of intraoperative facial nerve electromyography (EMG) to 0.05 mA stimulation ≥ 100 microvolts; ⑪ Translabyrinthine approach; ⑫ Poor HB function immediately after surgery

Meta-analysis of the incidence of FNF after AN surgery

This study included a sample size of 2,631 cases. The results of the Meta-analysis showed that there was a statistically significant difference among the studies (I^2 = 89.0%, P < 0.001). Using the random-effects model to combine the results, the incidence of FNF after AN surgery was 16% (95%CI: 0.11, 0.21) (Figure 2).

Heterogeneity analysis of incidence of postoperative FNF disorders in AN patients

Through meta-regression analysis, the results of the 17 studies included in this investigation demonstrated high heterogeneity (I^2 = 92.60%, p < 0.0001). However, the moderating variables explained only 0.23% of the heterogeneity (R^2 = 0.23%). Subgroup analysis based on follow-up duration (1 week, 6 months, ≥1 year) showed no significant effect on heterogeneity (p = 0.4088). The effect sizes varied considerably across studies (0.02–0.33), further confirming the presence of heterogeneity (see Figure 3). Thus, the incidence of FNF impairment after AN surgery exhibited significant heterogeneity, but follow-up duration did not account for this variation. Future studies should explore other potential factors (e.g., postoperative management, baseline patient characteristics) that may contribute to the observed heterogeneity.

Summary of meta-analysis results of risk factors for FNF after AN surgery

Through systematic analysis of the included literature, we identified 12 potential influencing factors. Among these, the following factors demonstrated significant heterogeneity: patient age (P = 0.0199, I^2 = 65.8%), tumor diameter (P < 0.0001, I^2 = 87.7%), cystic tumor features (P < 0.0001, I^2 = 84.4%), and intraoperative facial nerve electromyography response ≥100 μV to 0.05 mA stimulation (P = 0.0035, I^2 = 82.3%).

Given the substantial heterogeneity observed across studies for these factors, we performed

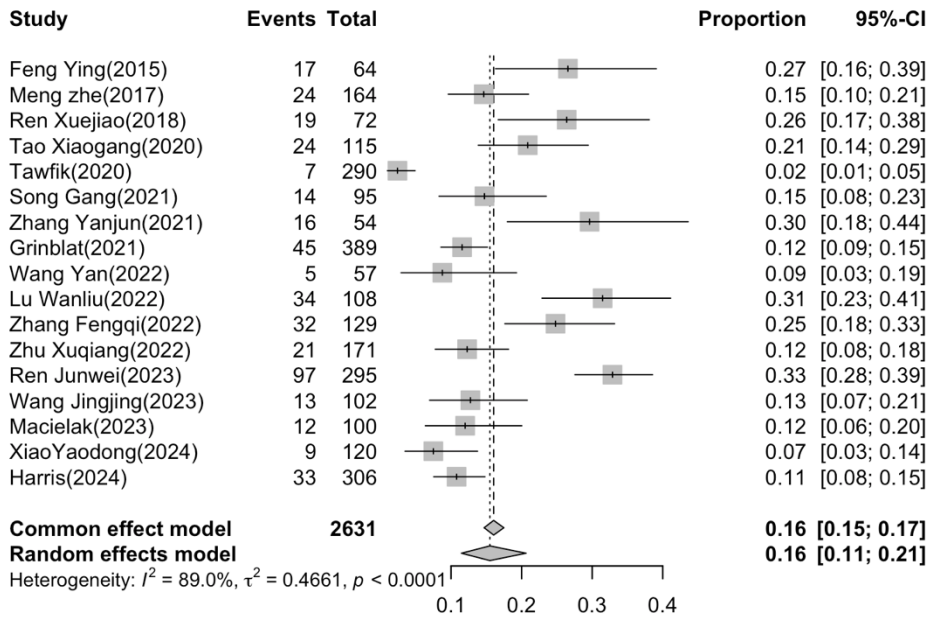

Figure 2. Meta-analysis of the incidence of facial nerve dysfunction after AN surgery.

subgroup analyses using a random-effects model, stratified by the timing of postoperative FNF impairment assessment. For the remaining studies that did not exhibit significant heterogeneity, a fixed-effects model was applied.

This differentiated model selection strategy enhances the accuracy and reliability of the results while accounting for the varying degrees of heterogeneity among different influencing factors across studies. The results showed that: (1) Patient-related factors: The results of the Meta-analysis showed that age [OR = 1.01, 95%CI (0.99 - 1.01), P = 0.3088] and gender [OR = 1.21, 95%CI (0.91 - 1.63), P = 0.2114] were not correlated with FNF after AN surgery. (2) Disease-related factors: The results of the Meta-analysis showed that larger tumor diameter [OR = 1.85, 95%CI (1.38 - 2.47), P < 0.0001], cystic tumors

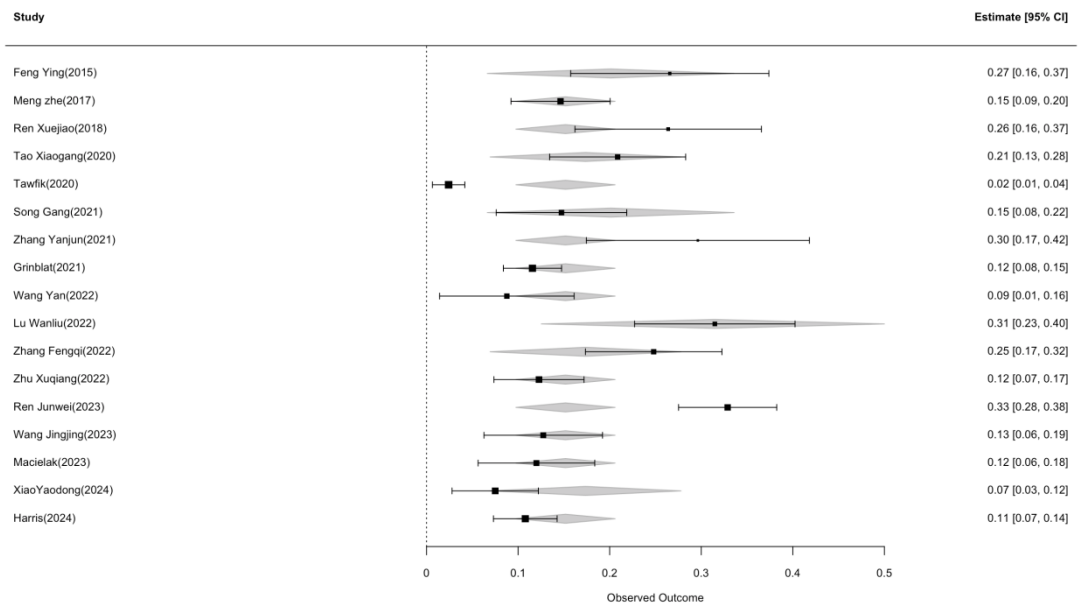

Figure 3. Heterogeneity analysis of FNF impairment incidence after AN surgery.

[OR = 2.22, 95%CI (1.43 - 3.45), P = 0.0004], a longer disease course [OR = 1.23, 95%CI (1.08 - 1.40), P = 0.0017], severe adhesion between the tumor and the facial nerve [OR = 5.45, 95%CI (3.67 - 8.1), P < 0.0001], and peritumoral edema [OR = 3.22, 95%CI (1.71 - 6.07), P = 0.0003] were risk factors for FNF after AN surgery. (3) Treatment-related factors: The results of the Meta-analysis showed that total tumor resection [OR = 1.32, 95%CI (1.09 - 1.59), P = 0.0044] and preoperative gamma knife treatment [OR = 5.87, 95%CI (1.79 - 19.25), P = 0.0035] were risk factors for FNF after AN surgery; the response of intraoperative facial nerve EMG to 0.05 mA stimulation ≥ 100 microvolts [OR = 0.26, 95%CI (0.08 - 0.87), P = 0.0281] was a protective factor for FNF after AN surgery; translabyrinthine approach [OR = 1.46, 95%CI (0.62 - 3.42), P = 0.3866] and poor HB function immediately after surgery [OR = 2.26, 95%CI (0.93 - 5.49), P = 0.0722] were not correlated with FNF after AN surgery (Table 2).

Sensitivity analysis

Sensitivity analysis was performed by switching between the fixed-effect model and the random-effects model. The combined OR values and their 95%CI of the 12 risk factors were calculated under both models, and the results showed no significant change, indicating that the combined results had good stability and high reliability (Table 3).

Publication bias

Egger's test was performed on the larger tumor diameter as a risk factor, and the results showed the existence of publication bias (t = 3.61, P = 0.0047). Therefore, the included literatures in this study may have a certain degree of publication bias. Taking the larger tumor diameter as an example,

Table 2: Results of Meta-analysis on the risk factors for facial nerve dysfunction after AN surgery

Influencing Factors	Number of Included Studies	Heterogeneity Test		Meta-analysis Results		
		I^2(%)	P	OR(95%CI)	Z	P
Patient-related factors						
Age	5	65.8	0.0199	1.01 (0.99~1.01)	1.02	0.3088
Gender	4	0.0	0.4171	1.21 (0.91~1.6)	1.25	0.2114
Disease-related factors						
Larger tumor diameter	12	87.7	<0.0001	1.85 (1.38~2.47)	4.12	<0.0001
Cystic tumors	9	84.4	<0.0001	2.22 (1.43~3.45)	3.55	0.0004
Longer disease course	2	46.5	0.1717	1.23 (1.08~1.40)	3.14	0.0017
Severe adhesion between the tumor and the facial nerve	5	6.8	0.3678	5.45 (3.67~8.1)	8.38	<0.0001
Peritumoral edema	3	0.0	0.7126	3.22 (1.71~6.07)	3.61	0.0003
Treatment-related factors						
Total tumor resection	6	14.8	0.0257	1.32 (1.09~1.59)	2.84	0.0044
Preoperative gamma knife treatment	2	0.0	0.6934	5.87 (1.79~19.25)	2.92	0.0035
Response of intraoperative facial nerve EMG to 0.05 mA stimulation ≥ 100 microvolts	3	82.3	0.0035	0.26 (0.08~0.87)	-2.20	0.0281
Translabyrinthine approach	2	0.0	0.8554	1.46 (0.62~3.42)	0.87	0.3866
Poor HB function immediately after surgery	2	86.5	0.0065	2.26 (0.93~5.49)	1.80	0.0722

Table 3: Sensitivity analysis of risk factors

Risk Factors	Random-effects Model [OR, 95%CI]	Fixed-effects Model [OR, 95%CI]
Age	1.01 (0.99~1.04)	1.01 (0.99~1.01)
Gender	1.21 (0.91~1.63)	1.21 (0.91~1.63)
Larger tumor diameter	1.85 (1.38~2.47)	1.13 (1.09~1.18)
Cystic tumors	2.22 (1.43~3.45)	1.07 (1.01~1.13)
Longer disease course	1.34 (0.94~1.93)	1.23 (1.08~1.40)
Severe adhesion between the tumor and the facial nerve	5.45 (3.67~8.1)	5.45 (3.67~8.1)
Peritumoral edema	3.22 (1.71~6.07)	3.22 (1.71~6.07)
Total tumor resection	1.43 (1.06~1.92)	1.32 (1.09~1.59)
Preoperative gamma knife treatment	5.87 (1.79~19.25)	5.87 (1.79~19.25)
Response of intraoperative facial nerve EMG to 0.05 mA stimulation ≥ 100 microvolts	0.26 (0.08~0.87)	0.57 (0.44~0.74)
Translabyrinthine approach	1.46 (0.62~3.42)	1.46 (0.62~3.42)
Poor HB function immediately after surgery	2.26 (0.93~5.49)	1.76 (1.37~2.26)

the Egger plot and the funnel plot corrected by the trim-and-fill method were drawn (Figure 4 and Figure 5).

DISCUSSION

FNF after AN surgery is the result of the synergy of multiple factors. The included literatures in this study showed that the incidence of FNF after AN surgery was 16% (95%CI: 0.11, 0.21). Despite the problem of heterogeneity, the results of sensitivity analysis and subgroup analysis still showed good stability of this result. The results of subgroup analysis showed that the occurrence of FNF after AN surgery may vary depending on the assessment time. In future clinical studies, patients with the same time period for prognosis assessment can be further collected to improve the accuracy and reliability of postoperative FNF.[27] Since FNF can have a serious impact on the social function and psychology of patients, it is crucial to clarify the incidence and risk factors of FNF after AN surgery for early prevention and intervention.

Patient-related factors

The results of this Meta-analysis showed that age [OR = 1.01, 95%CI (0.99 - 1.01), P = 0.3088] and gender [OR = 1.21, 95%CI (0.91 - 1.63), P = 0.2114] were not correlated with FNF after AN surgery. The lack of correlation between gender and FNF after acoustic nerve surgery is supported by most literatures.[22,26] This study suggests that age is not correlated with FNF after AN surgery, but this result may be controversial because some studies have shown that the older the patient, the higher the risk of FNF after surgery.[28-30] The possible mechanism is that as the patient's age increases, the elasticity of the intracranial blood vessels decreases, which requires more precise and accurate surgical operations. In addition, the increase in age also affects the recovery speed of the body, resulting in a prolonged recovery time of the facial nerve after surgery.[29]

Disease-related factors

The results of this Meta-analysis demonstrated that larger tumor diameter [OR = 1.85, 95%CI (1.38 - 2.47), P < 0.0001], cystic tumors [OR = 2.22, 95%CI (1.43 - 3.45), P = 0.0004], a longer disease course [OR = 1.23, 95%CI (1.08 - 1.40), P = 0.0017], severe adhesion between the tumor and the facial nerve [OR = 5.45, 95%CI (3.67 - 8.1), P < 0.0001], and peritumoral edema [OR = 3.22, 95%CI (1.71 - 6.07), P = 0.0003] were risk factors for FNF after AN surgery.(1) The larger the tumor diameter, the poorer the postoperative FNF.[30,31] The possible mechanism is that when the tumor is larger, the tension on the facial nerve increases, which further aggravates the compression and adhesion of the facial nerve,

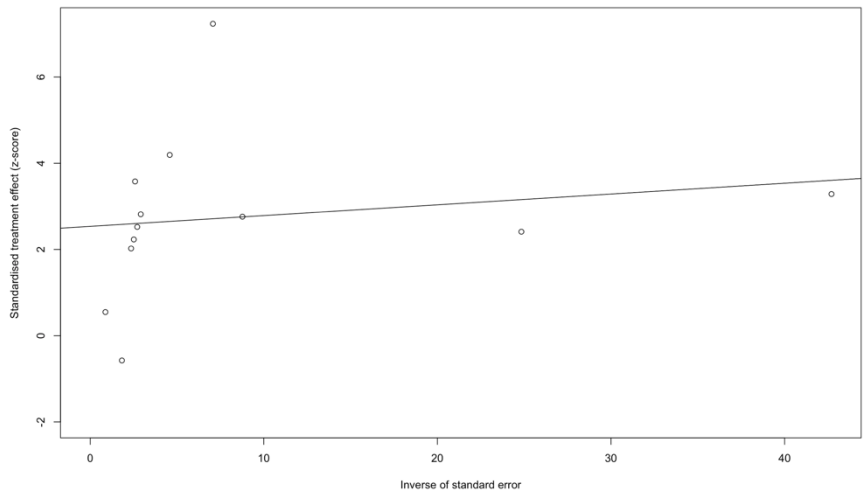

Figure 4 Egger plot with larger tumor diameter as a risk factor.

ultimately leading to the obstruction of the local blood supply of the facial nerve, resulting in gradual ischemia, degeneration, and necrosis. Even if the facial nerve is anatomically preserved, the long-term recovery effect of FNF after surgery cannot be improved. In addition, when the tumor diameter increases, the surgical operation space becomes smaller, increasing the frequency of traction of the facial nerve and easily causing damage.[22] (2) Compared with non-cystic AN, patients with cystic AN have a higher risk of FNF.[30,32] The possible mechanism is that cystic AN is widely considered to be more invasive, and its proliferation activity is higher than the average level, so it will accelerate tumor growth. At the same time, the matrix metalloproteinase-2 (MMP-2) produced in the cyst will destroy the tumor nerve barrier, aggravate the adhesion between the tumor and the facial nerve and the compression of the surrounding tissues, thus increasing the traction and damage of the facial nerve during the operation.[25] (3)The mechanism of the influence of the disease course on FNF may be that the tumor will continue to grow with the increase of the disease course, resulting in a longer compression time of the nerve and a worse prognosis of the facial nerve.[17] (4) The closer the adhesion between the tumor and the facial nerve, the more serious the damage to the arachnoid anatomical plane between them, thus increasing the operation time and traction injury. In addition, surgical operations will affect the microcirculation of the facial nerve, and even if there is no obvious anatomical abnormality, it will also have an adverse impact on FNF. (5) The growth and proliferation of the tumor will lead to peritumoral edema, which will significantly increase the space-occupying effect of AN, increase the intracranial pressure,

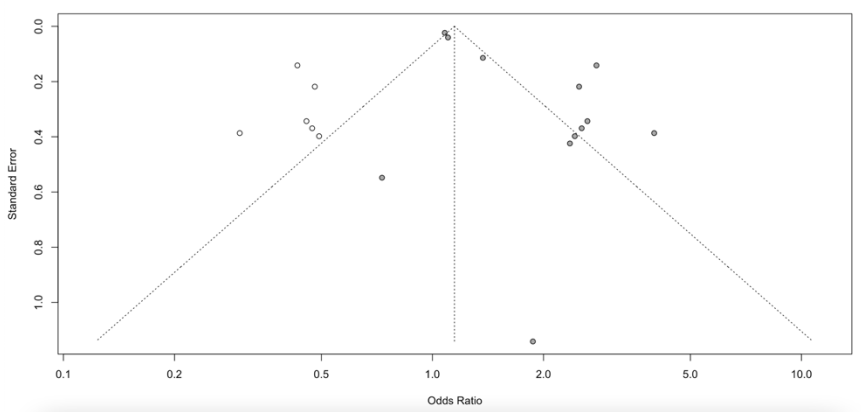

Figure 5 Calibration funnel plot with larger tumor diameter as a risk factor.

reduce the cerebral blood flow, thereby reducing the metabolism of brain cells around the tumor and the blood supply of the facial nerve, and the inflammatory factors released in the edema area will also damage the facial nerve.[33]

Treatment-related factors

The results of this meta-analysis showed that total tumor resection [OR = 1.32, 95% CI (1.09 - 1.59), P = 0.0044] and preoperative gamma knife treatment [OR = 5.87, 95% CI (1.79 - 19.25), P = 0.0035] were risk factors for FNF after AN surgery; the response of intraoperative facial nerve electromyography (EMG) to a 0.05 mA stimulation ≥ 100 microvolts [OR = 0.26, 95% CI (0.08 - 0.87), P = 0.0281] was a protective factor for FNF after AN surgery; translabyrinthine approach [OR = 1.46, 95% CI (0.62 - 3.42), P = 0.3866] and poor HB function immediately after surgery [OR = 2.26, 95% CI (0.93 - 5.49), P = 0.0722] were not correlated with FNF after AN surgery. (1) During total tumor resection, the surgical operation range is large, and the traction and separation of the tumor and surrounding tissues are more extensive, which easily damages the nourishing blood vessels and nerve fibers of the facial nerve and causes mechanical damage to the facial nerve, thus increasing the risk of FNF injury.[34,35] (2) The main mechanisms by which preoperative gamma knife treatment increases the risk of poor FNF include: during gamma knife treatment, radiation may directly damage the facial nerve fibers and their nourishing blood vessels, resulting in ischemia, edema, and degeneration of the facial nerve; in addition, the inflammatory reaction and swelling of the tumor tissue after treatment can compress the facial nerve; at the same time, gamma knife treatment may cause local tissue fibrosis, restricting the movement and nutrient supply of the facial nerve, and thus affecting FNF.[36,37] (3) The response of intraoperative facial nerve EMG to a 0.05 mA stimulation ≥ 100 microvolts is a protective factor. The underlying mechanisms are as follows. Firstly, it indicates that the facial nerve fibers are relatively intact and the myelin sheath functions normally, demonstrating a strong tolerance to surgical procedures. Secondly, it implies that the blood supply is sufficient and the microcirculation is stable, which is conducive to repairing damage. Thirdly, it suggests that the nerve conduction ability is normal and the excitability is stable, facilitating the restoration of normal function after surgery and reducing the probability of dysfunction.[26] (4) The translabyrinthine approach and poor HB function immediately after surgery were not correlated with FNF after AN surgery. Although some studies have suggested that different surgical approaches and poor HB function immediately after surgery can affect the prognosis of FNF after AN surgery, further verification with larger sample sizes and prospective studies is required.[26,38-40]

This study has several limitations: (1) Only published Chinese and English literatures were included, and literatures in other languages were not included, which may lead to publication bias; (2) The number of literatures included for some exposure factors was small, and it was unable to clarify whether there was an association with FNF after AN surgery, resulting in large heterogeneity among the studies. Therefore, caution should be exercised when interpreting and applying the results; (3) The assessment time of some exposure factors for FNF after surgery was not unified, which may lead to the inability to combine effect sizes and loss of information. Therefore, more large-sample, high-quality prospective cohort studies are needed in the future to further clarify and verify the risk factors for FNF after AN surgery.

In conclusion, the existing evidence shows that the incidence of FNF after AN surgery is 16%. Larger tumor diameter, cystic tumors, a longer disease course, severe adhesion between the tumor and the facial nerve, peritumoral edema, total tumor resection, and preoperative gamma knife treatment are risk factors for FNF after AN surgery, while the response of intraoperative facial nerve EMG to a 0.05 mA stimulation ≥ 100 microvolts is a protective factor. Limited by the quantity and quality of the included literatures, the conclusions of this study still need to be confirmed by more high-quality studies.

DISCLOSURE

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