INAUGURAL EDITORIAL OF HEAD AND NECK DISEASES CONFLUX

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Graphical Abstract

https://doi.org/10.71321/03q6j041
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INAUGURAL EDITORIAL OF HEAD AND NECK DISEASES CONFLUX

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Received: 2025-07-02 | Accepted: 2025-07-21 | Published online: 2025-08-10

Abstract

Head and Neck Diseases Conflux is a pioneering international journal dedicated to catalyzing interdisciplinary research and clinical innovation in head and neck medicine. Central to our mission is the integration of diverse medical specialties and fostering global academic collaboration as cornerstones of scientific advancement. The intricate anatomy of the head and neck region, encompassing complex sensory, neurological, and vascular systems, necessitates seamless collaboration among ophthalmologists, otolaryngologists, neurosurgeons, and allied specialists. The journal champions the full spectrum of translational research, bridging fundamental molecular discoveries with cutting-edge clinical applications including minimally invasive endoscopic techniques, artificial intelligence-enhanced diagnostics, novel cold plasma therapeutics, robotic-assisted surgical precision, and personalized 3D-printed implants. Through our commitment to cultivating future medical leaders and upholding the highest standards of academic rigor, we aim to accelerate transformative technologies in precision medicine, tissue engineering, regenerative therapeutics, and gene-editing applications. By promoting global partnerships and scientific discourse, Head and Neck Diseases Conflux aspires to make substantial contributions to advancing healthcare through evidence-based innovation and clinical excellence.

Keywords: head and neck medicine; collaboration; innovation.

Conflux · Integration · Innovation

The advancement of medical science has historically been driven by transcending conventional boundaries, integrating diverse scientific insights, and rigorously applying cutting-edge technologies. Situated at the strategic intersection of Eastern holistic traditions and Western biomedical precision, the journal *Head and Neck Conflux* has been established to catalyze groundbreaking discoveries, foster clinical innovation, and encourage rigorous interdisciplinary collaboration in the specialized domain of head and neck medicine.

Multidisciplinary Integration as a Foundation for Innovation

In contemporary medicine, transformative evolution is propelled by indispensable multidisciplinary synergy. Historically, journals such as *Nature* and *Science* pioneered the dissemination of influential research findings that have shaped medical science profoundly. In alignment with this esteemed tradition, *Head and Neck Conflux* explicitly seeks to bridge rigorous basic research with definitive clinical outcomes, addressing the unique and intricate challenges presented by head and neck pathologies.

The head and neck region, characterized by a dense convergence of sensory, neurological, vascular, and functional systems, inherently requires profound interdisciplinary collaboration. Clinical evidence consistently highlights that significant advances—ranging from precision orbital reconstruction and auditory rehabilitation to advanced minimally invasive skull base surgery—are predominantly achieved through collaborative efforts among ophthalmologists, otolaryngologists, neurosurgeons, and allied specialists. These integrated approaches continuously redefine clinical methodologies, elevate therapeutic standards, and substantially enhance patient outcomes.

From Fundamental Molecular Insights to Clinical Translation

Inspired by landmark journals such as *Cell*, which redirected biomedical research to molecular and cellular levels, and *Nature Medicine*, dedicated to translational advancements, *Head and Neck Conflux* emphasizes an integrated approach to translational research. Advanced methodologies, including minimally invasive endoscopic surgeries, artificial intelligence-driven diagnostic precision, innovative cold plasma

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oncology treatments, robotic-assisted surgical accuracy, and personalized 3D-printed implants, underscore our commitment to translating innovative research into meaningful clinical interventions.

These advancements profoundly reshape clinical paradigms. Molecular characterization of tumors now routinely informs personalized treatment strategies, significantly enhancing therapeutic effectiveness and improving patient prognosis. Precision-guided endoscopic techniques effectively mitigate risks historically associated with vascular complications, leveraging comprehensive anatomical and physiological knowledge. Furthermore, pioneering research into neural regeneration is achieving previously unattainable functional restoration, illustrating the critical role of translating fundamental molecular insights into clinical practice.

Nurturing Future Medical Leaders

The complexity of contemporary medical practice demands clinicians and researchers adept in advanced technologies, proficient surgical skills, and comprehensive integrative intellectual capabilities. *Head and Neck Conflux* proactively supports future medical leaders through structured mentorship programs, interdisciplinary training, and robust international academic exchanges. These initiatives aim to equip emerging medical professionals with the necessary skills to effectively navigate, innovate, and lead within increasingly intricate clinical and research environments.

Integrative Perspectives from Eastern and Western Medical Traditions

The progressive evolution of medical practice increasingly relies on the strategic integration of diverse historical, cultural, and technological insights. The proactive synthesis of Eastern holistic medical approaches with Western evidence-based precision medicine generates novel therapeutic paradigms. Engagement between emerging biomedical technologies—such as nanomedicine, genomic editing, and stem cell therapeutics—and traditional medical knowledge fosters significant opportunities for innovative global healthcare advancements.

Commitment to Academic Excellence and Intellectual Openness

Adhering unwaveringly to rigorous academic standards, *Head and Neck Conflux* mandates meticulous peer review, reproducibility of research findings, and empirical robustness. Concurrently, the journal fosters an environment conducive to intellectual openness and rigorous scientific debate. Embracing a philosophy championed by journals like *Science*, we maintain that disciplined, evidence-based discourse is fundamental for meaningful progress in medical science.

Strategic Vision for the Future

Advancements such as precision medicine, personalized therapeutic approaches, artificial intelligence integration, tissue engineering, regenerative medicine, and gene-editing technologies represent transformative forces reshaping contemporary clinical practice. Rapidly transitioning from conceptual aspirations into clinical realities, these innovations fundamentally alter diagnostic methods, therapeutic strategies, and patient outcomes within head and neck medicine.

Our Mission and Commitment

Head and Neck Conflux is dedicated to fostering integrative research, promoting clinical innovation, and facilitating interdisciplinary collaboration, honoring our historical legacy while proactively advancing future developments. The term "Conflux" symbolizes the integration of diverse knowledge streams, global academic partnerships, theory-practice convergence, and balance between tradition and innovation. Our unwavering dedication to scholarly rigor, scientific integrity, intellectual openness, and compassionate patient care underpins our ambition to significantly advance global head and neck medical practice.

Building upon our historical foundations and bolstered by multidisciplinary cooperation, we strive to propel *head and neck conflux* toward pioneering scientific discoveries and notable clinical milestones, substantially contributing to global healthcare advancement.

Abbreviations

None.

Author Contributions

Zhigang Huang: writing, prepare, create, and revise the article.

Acknowledgments

Thanks to all colleagues for supporting the sustainable development of Head and Neck Diseases Conflux.

Funding Information

None.

Ethics Approval and Consent to Participate

No ethics approval needed for this article.

Competing Interests

The authors declare that there is no conflict of interest regarding the publication of this article.

Data Availability

Not Applicable.

Clinical Effect of Partial Tonsillectomy in Preschool Children with OSAHS

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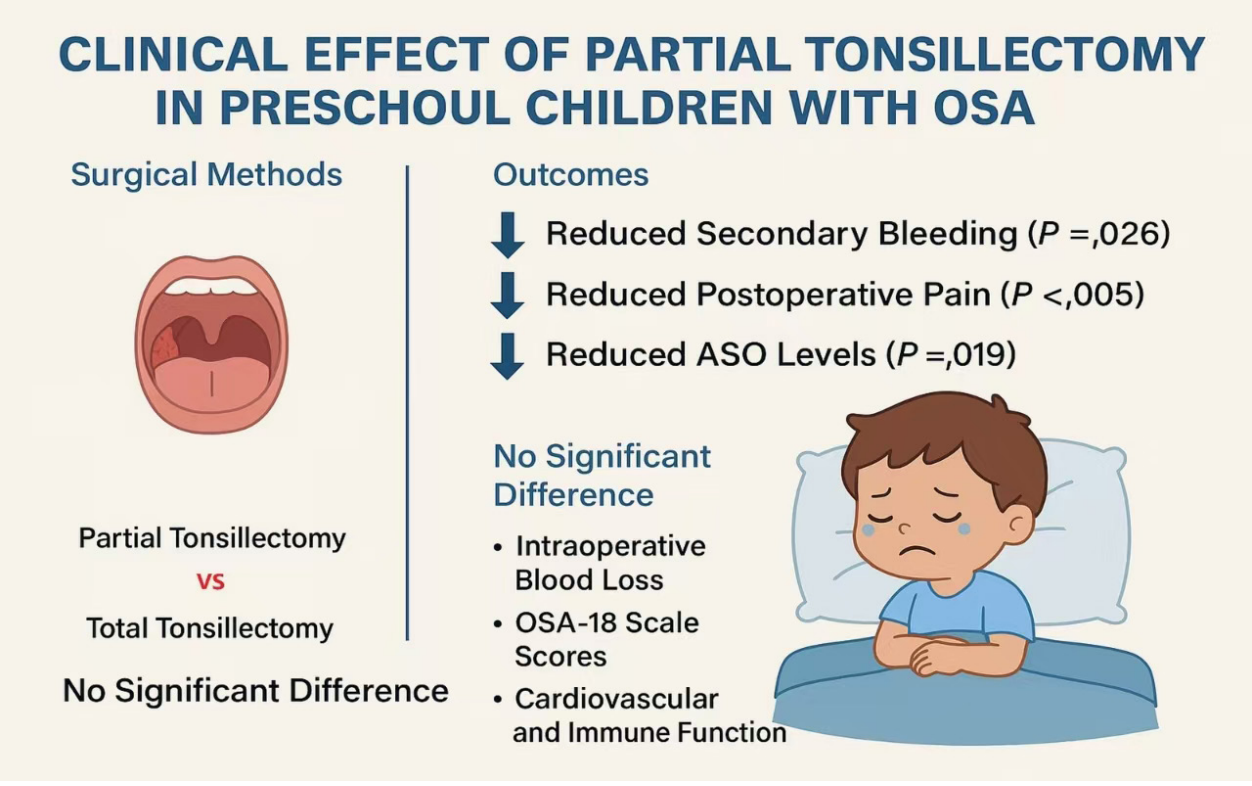
Graphical Abstract



https://doi.org/10.71321/8gkgjj02

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Research Article

Head and Neck Diseases Conflux

Clinical Effect of Partial Tonsillectomy in Preschool Children with OSAHS

Jinjin Yuan[1] , Jianqi Yi[1] , Yaling Liu[1] , Hongxia Fei[2] , Yonghao Wei[1*]

Received: 2025-06-07 | Accepted: 2025-07-18 | Published online: 2025-08-10

Abstract

Background: To explore the optimal surgical approach for preschool children with obstructive sleep apnea (OSA) by comparing changes in venous hematological parameters, Faces Pain Scale Revision (FPS-R) pain scale scores, and OSA-18 scale scores following two different surgical treatments.

Methods: A total of 83 preschool children with OSA were enrolled, with 42 assigned to the control group (total tonsillectomy with adenoidectomy) and 41 to the experimental group (partial tonsillectomy with adenoidectomy). Preoperative and postoperative (3-day) measurements included cardiovascular disease risk factors, immune-related indicators, perioperative blood loss, postoperative FPS-R pain scale scores, and OSA-18 scale scores.

Results: Comparison between the two groups revealed no significant differences in intraoperative blood loss, primary bleeding, pre- and post-treatment OSA-18 scale scores, C-reactive protein (CRP) levels, cardiovascular disease risk factors, or immune-related indicators (all $P > 0.05$). However, significant differences were observed in secondary bleeding ($P < 0.05$) and postoperative FPS-R pain scale grades ($P < 0.05$). In the control group, pre- and post-treatment antistreptolysin O (ASO) levels showed no significant difference ($P> 0.05$), whereas in the experimental group, ASO levels decreased significantly ($P < 0.05$).

Conclusion: Partial tonsillectomy demonstrated comparable efficacy to total tonsillectomy in terms of intraoperative blood loss, reduction of snoring symptoms, and improvement of airway patency, with both procedures achieving stable therapeutic outcomes. No significant differences were observed between partial and total tonsillectomy regarding short-term effects on cardiovascular disease risk factors or immune function. For preschool children with OSA, partial tonsillectomy was superior to total tonsillectomy in reducing postoperative pain, secondary bleeding, and ASO levels.

Keywords: preschool OSA; immune function indicators; FPS-R pain scale.

Introduction

Childhood obstructive sleep apnea (OSA) refers to a series of pathophysiological changes caused by frequent partial or complete upper airway obstruction during children's sleep, interfering with children's normal ventilation and sleep structure. Currently, relevant literature reports that the prevalence of children is between 1.2% and 5.7%, and its peak incidence occurs between 2-8 years old, and increases with the rising trend of childhood obesity [1]. As early as 2016, foreign scholars pointed out that OSA can cause cognitive and neuropsychological dysfunction, Attention-Deficit Hyperactivity Disorder (ADHD), learning problems and nocturnal enuresis in children, and can even affect the development of the cardiovascular system and increase the prevalence of cardiovascular events such as hypertension in adults [2].

It can be said that OSA seriously affects children's physical development, and the anatomical causes are mainly physiological hypertrophy of adenoids and tonsils [1]. Currently, academia believes that respiratory obstruction of the upper airway in children with OSA can be well improved through tonsillectomy or adenoidectomy [3]. In the body's immune system, the tonsils (palatine tonsils) and adenoids (pharyngeal tonsils) are important parts of the pharyngeal lymph ring. They are located at the entrance of the upper airway and digestive tract, serving as the first line of defense against food and foreign microorganisms and other antigenic substances in the air, playing the dual role of cellular and humoral immunity [4]. Due to the increasing number of food types and increasing mobility among preschool children between the ages of 3-6, the digestive tract and respiratory tract of the body will receive various exogenous stimuli at this stage, but the body's immune system has

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not yet matured [5], and the tonsils, as the body's first line of defense of immunity, can produce a large number of immune factors at this stage, which helps to stimulate the body to gradually establish a natural resistance and immune ecological balance. However, there is still few relevant literature on the changes in immune function and vascular disease risk factors caused by different surgical methods in preschool children with OSA. Therefore, this study collected anti-streptolysin O, cardiovascular disease risk factors, immune function and other indicators after treatment in preschool children with OSA after two different surgical methods to provide some theoretical support for the choice of surgical methods in preschool children with OSA.

Methods

General information

A group of preschool children diagnosed with OSA from November 2022 to November 2023 from the Department of Otolaryngology Head and Neck Surgery of the Affiliated Hospital of Jiujiang University were selected. 90 patients met the "enrollment criteria" and were randomly divided into a control group (total tonsillectomy) and an experimental group (partial tonsillectomy) with 45 patients in each. Among them, 3 children in the control group and 4 children in the experimental group withdrew from the study due to their refusal to test relevant blood indicators and improve relevant scale evaluation after surgery.

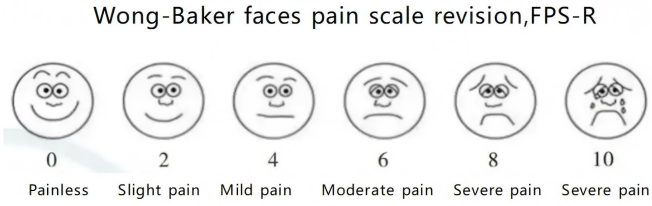
Inclusion criteria: 1. The age of the child is between 3 and 6 years old. The Body Mass Index (BMI) value was less than 25, snoring ≥ 3 nights/week, and portable sleep monitoring: apnea-hypopnea index (AHI) ≥ 1. Rule out other underlying diseases. The parents of the child have basic education level and have clear language expression and thinking. 2. According to the "Technical Standards for Standardized Treatment of Tonsil and Adenoid Low-Temperature Plasma Radiofrequency Ablation in Children" [3] for the grading of tonsil and adenoidal hypertrophy, the enrolled children met the requirements of degree III or IV of tonsil hypertrophy and degree III or IV of adenoidal hypertrophy. 3. No significant abnormalities were found in other routine preoperative examinations. The research content of this topic has been certified by the Ethics Committee of the Affiliated Hospital of Jiujiang University (approval number: NO. jjumer-b-2022-0612), and all parents of the children have signed the informed consent form.

Method

Surgical method: All enrolled children were transferred to the operating room before 9:00 AM on the day of surgery. During general anesthesia induction, anesthesiologists administered a single intravenous dose of fentanyl for analgesia. The children in the control group underwent total tonsillectomy with the capsule resected; the experimental group underwent partial tonsillectomy with the tonsillectomy preserved, the anterior and posterior arches preserved, and no mass tonsil tissue remained. All children underwent plasma ablation of hypertrophy of adenoids. The cutting instruments during the operation were plasma blades from Beijing Jesse Huizhong Technology Co.Ltd, and the operations were also completed by the same senior doctor.

Observation indicators: Fasting venous blood was collected before and on the 3rd day after surgery to measure anti-streptolysin O, cardiovascular disease risk factors (serum total cholesterol, triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, serum apolipoprotein A, serum apolipoprotein B, immune indicators (IgA, IgE, IgG, IgM, complement C3, complement C4), C-reactive protein (CRP), perioperative blood loss and postoperative OSA-18 scale scores of children in the two groups were counted This was because, considering the cognition and understanding level of children aged 3-6, we used Faces Pain Scale Revision (FPS-R) pain volume [3, 6] to assess the pain of children one day after surgery (Figure 1).

Figure 1. FPS-R pain volume. Pain levels assessed using the FPS-R scale pre- and post-operation.



Statistical analysis

All data were statistically analyzed using the statistical software SPSS29.0.20 system. The measurement data were expressed in Mean ± SD, the chi-square test was used, and the counting data were expressed in the number of cases. The contingency table analysis of non-parametric test was used. The comparison between the two groups before and after treatment was carried out using paired sample t-test. The comparison between the two groups was carried out using isolated sample t-test. The difference was $P < 0.05$.

Results

Two sets of basic data

The average age of the 42 children in the control group was 5.00±0.74 (years), the BMI was 18.14±3.52 (kg/m^2), and the average course of disease was 10.00±4.75 (months); the average age of the 41 children in the experimental group was 4.87±0.85 (years), the BMI was 18.80±3.59, and the average course of disease was 10.46±4.65 (months). There were no statistically significant differences between the two groups in terms of total number of people, ratio of male to female, average age, BMI value, average course of disease, AHI, degree of tonsils and adenoids enlargement ($P > 0.05$) (Table 1).

Perioperative bleeding profiles of the two groups

The treatment group showed a slightly higher mean volume (4.49 ± 1.05 mL) compared to the control group (4.43 ± 0.97 mL), with no significant difference ($P = 0.790$). For primary bleeding episodes, the control group had 4 cases versus 1 case in the treatment group, but this difference was not statistically significant ($P = 0.371$). In contrast, secondary bleeding events differed significantly between groups (9 cases in controls vs. 2 cases in treatment group, $P = 0.026$). This indicates that the treatment group had a statistically significant lower incidence of secondary bleeding compared to controls (Table 2).

Postoperative pain levels according to FPS-R grading

On postoperative day 1(Post-op Day 1), the control group showed mild pain: moderate pain = 15:27, while the treatment group demonstrated 34:7. On postoperative day 3(Post-op Day 3), the ratios were 10:32 (control) versus 26:15 (treatment). By postoperative day 10(Post-op Day 10), the distributions were 13:29 (control) and 23:18 (treatment). The treatment group exhibited significantly lower pain levels than the control group at all measured time points (postoperative days 1, 3, and 10), with all P-values <0.05, indicating statistically significant differences in pain experience between the two groups (Table 3).

The scores of OSA-18 scale in the two groups before and after treatment

The scores of OSA-18 scale in the two groups before and after treatment. The OSA-18 scale scores of the two groups gradually decreased on preoperative, postoperative 3 days and postoperative1 month (Post-op Month 1), but the P value compared between the two groups was greater than 0.05 (Figure 2), that is, there was no statistical difference in the OSA-18 scale scores between the two groups at each stage before and after treatment (Table 4).

Table 1. Comparison of two sets of basic data.

Group	n	Gender		Average age(Y)	BMI(kg/m2)	Average course of disease（months）	AHI	Degree of tonsil enlargement		Adenoid enlargement degree	
		Male	female					III	IV	III	IV
Control Group	42	28	14	5.00±0.74	18.14±3.52	10.00±4.75	5.56±2.46	32	10	33	9
Experimental Group	41	30	11	4.87±0.85	18.80±3.59	10.46±4.65	5.47±2.42	35	6	30	11
F/t	-0.449	0.417		0.694	-0.851	-0.449	0.174	1.122		0.331	
P	0.655	0.518		0.49	0.398	0.655	0.862	0.289		0.565	

Table 2. Perioperative bleeding profiles of the two groups.

Group	n	Intraoperative Blood Loss(mL)	Primary Bleeding		Secondary Bleeding	
			Bleeding	No Bleeding	Bleeding	No Bleeding
Control Group	42	4.43±0.97	4	38	9	33
Experimental Group	41	4.49±1.05	1	40	2	39
F/t	-0.449	-0.267	0.801		4.943	
P	0.655	0.79	0.371		0.026	

Table 3. Postoperative pain levels according to FPS-R grading.

Group	n	Post-op Day 1		Post-op Day 3		Post-op Day 10	
		Mild Pain	Moderate Pain	Mild Pain	Moderate Pain	No Pain	Mild Pain
Control Group	42	15	27	10	32	13	29
Experimental Group	41	34	7	26	15	23	18
F/t	-0.449	19.123		13.25		5.341	
P	0.655	＜0.001		＜0.001		0.021	

Changes of antistreptolysin O (ASO) in two groups before and after treatment

The mean value of ASO in both groups decreased before and after treatment. The P value in the control group was greater than 0.05, and the P value in the experimental group was 0.019(<0.05), which was statistically significant (Table 5).

Changes of CRP in two groups before and after treatment

The mean value of CRP in both groups increased before and after treatment and the P values were greater than 0.05 before and after treatment, which was not statistically significant (Figure 3, Table 6).

Changes in cardiovascular disease risk factor indicators before and after treatment in the two groups

The mean values of total cholesterol, triglyceride, low-density lipoprotein, and apolipoprotein B indicators in the two groups showed an upward trend before and after treatment, and the P values were all greater than 0.05. There was no statistical difference between the two groups before and after treatment; The mean values of high-density lipoprotein and apolipoprotein A1 in the two groups showed a downward trend before and after treatment, and the P values were all greater than 0.05. There was no statistical difference between the two groups before and after treatment (Table 7).

Figure 2. Scatterplot of OSA-18 scale scores in the two groups before and after treatment. Treatment efficacy was assessed by comparing OSA-18 scores between the two groups at preoperative, postoperative day 3, and postoperative month 1 time points, with P < 0.05 considered statistically significant.

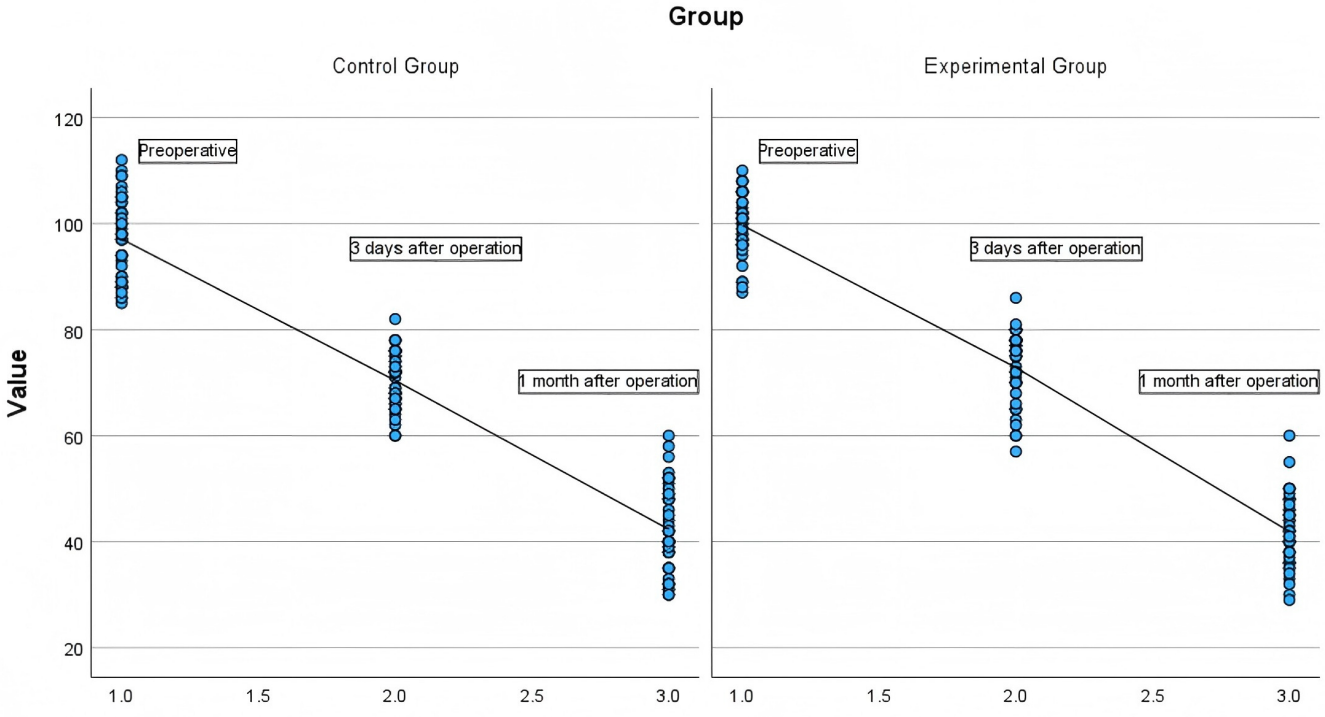


Table 4. Preoperative and Postoperative OSA-18 Scale Evaluations.

Group	n	Pre-op	Post-op Day 3	Post-op Month 1
Control Group	42	97.07±7.71	70.40±5.28	42.33±8.14
Experimental Group	41	99.68±5.74	72.73±6.72	41.90±6.69
T	-0.449	-1.753	-1.848	0.263
P	0.655	0.084	0.068	0.793

Table 5. ASO indicators before and after treatment in the two groups.

Test	Group	Pre-op	Post-op Day 3	T	P
ASO	Control Group	184.67±236.71	179.57±237.10	1.905	0.064
(IU/mL)	Experimental Group	94.94±116.82	89.11±110.25	2.441	0.019

https://doi.org/10.71321/8gkgjj02

Figure 3. Scatter plots of CRP values in the two groups before and after treatment. Inflammation status was assessed by comparing CRP values between the two groups at preoperative and postoperative day 3 time points, with P < 0.05 considered statistically significant.

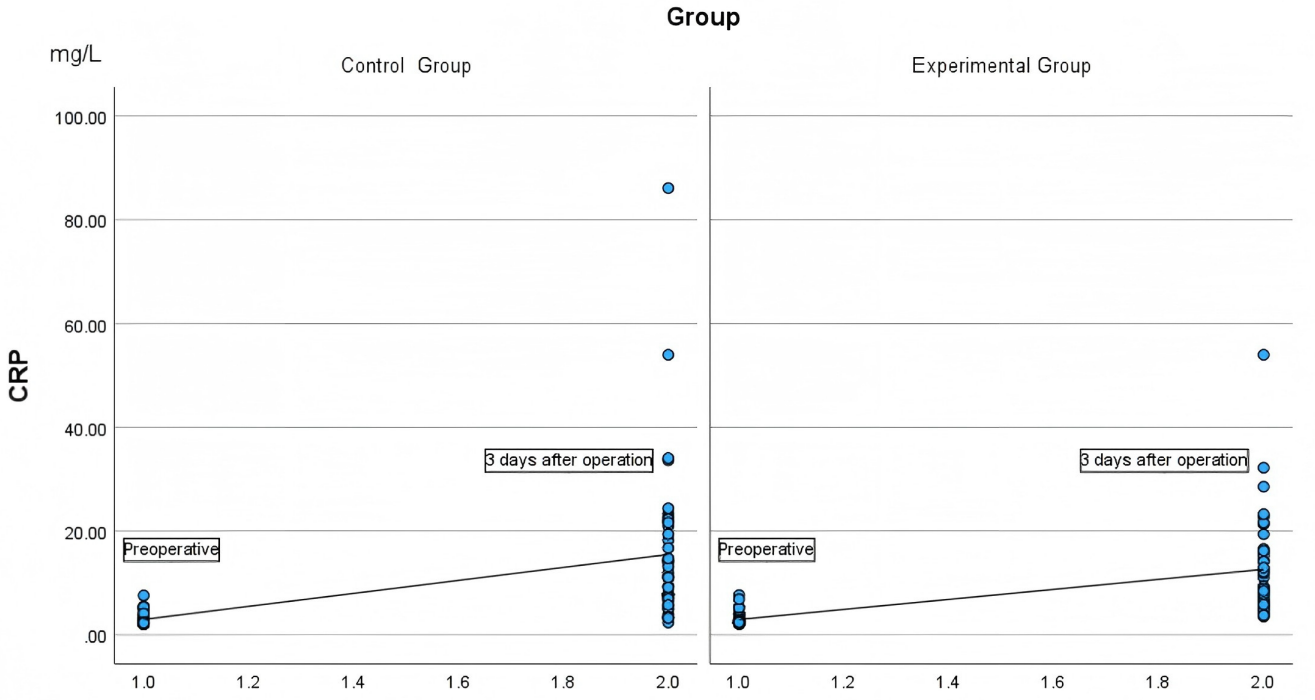


Table 6. CRP indicators before and after treatment in both groups.

Test	Time	Control Group	Experimental Group	T	P
CRP	Pre-op	2.98±1.26	2.97±1.24	0.047	0.963
(mg/L)	Post-op Day 3	15.48±15.11	12.62±9.67	1.027	0.307

Table 7. Cardiovascular disease risk factor indicators before and after treatment in group.

Test	Time	Control Group	Experimental Group	T	P
TC	Pre-op	4.13±0.64	4.33±0.83	-1.21	0.23
(mmol/L)	Post-op Day 3	4.42±0.74	4.62±0.97	-1.08	0.284
TG	Pre-op	0.854±0.35	0.98±0.43	-1.421	0.159
(mmol/L)	Post-op Day 3	1.14±0.32	1.19±0.35	-0.726	0.47
HDL	Pre-op	1.55±0.26	1.57±0.25	-0.328	0.744
(mmol/L)	Post-op Day 3	1.47±0.25	1.49±0.20	-0.327	0.744
LDL	Pre-op	2.30±0.43	2.46±0.56	-1.454	0.15
(mmol/L)	Post-op Day 3	2.53±0.48	2.66±0.66	-1.033	0.304
Apo-A1	Pre-op	1.37±0.18	1.36±0.16	0.064	0.949
(g/L)	Post-op Day 3	1.32±0.18	1.31±0.15	0.422	0.674
Apo-B	Pre-op	0.87±0.21	0.93±0.30	-0.97	0.335
(g/L)	Post-op Day 3	1.06±0.22	1.15±0.36	-1.342	0.183

Changes in immune-related indicators before and after treatment in the two groups

The mean values of IgA and IgG in both groups decreased before and after treatment, with P values greater than 0.05, that is, there was no statistical significance between IgA and IgG before and after treatment. The mean value of IgE in both groups increased after treatment, and the P value was greater than 0.05, that is, there was no statistical significance between the two groups before and after treatment in IgE. The mean values in both groups decreased after IgM immunization treatment, and the P values were less than 0.05, that is, the differences between the two groups before and after treatment were statistically significant (Figure 4). The mean values of complement C3 and complement C4 in both groups increased before and after treatment, and the P values were greater than 0.05, that is, there was no statistical significance between the two groups before and after treatment (Table 8).

Discussion

Research on the impact of tonsillectomy on immune function in children has long become a hot topic of clinical research in the academic community. Wang Xianghui and other scholars reported many years ago that after tonsillectomy in children, the incidence of chronic inflammation in the upper respiratory tract will increase, and symptoms such as foreign body sensation and dry throat discomfort will be prone to occur in adulthood [7]. It is recommended that for children without obvious inflammation of the tonsils, while surgically resolving the obstruction, some of the functions of the tonsils should be preserved as much as possible. In a 10-year follow-up study, Eviatar [8] confirmed that there was no significant difference in snoring, airway patency, daily diet and upper airway inflammation between children undergoing partial tonsillectomy and children undergoing total tonsillectomy, and stable results could be achieved.

The ages of 3 to 6 are preschool. During this period, children's height and weight continue to increase, their exercise ability continues to increase, and their curiosity about surrounding things and their ability to learn are also very strong. Therefore, this stage is a key stage for children's development stage.OSA is also a peak in preschool age. It will not only affect children's sleep quality, growth and development speed and the production of "adenoid features", but long-term hypoxia will also lead to activation of the nervous system and disorders of the endocrine system increase the probability of cardiovascular diseases, ADHD and emotional disorders in children [9]. With the rapid development of information transmission media, parents understand the importance of early intervention and early treatment of children with OSA. However, which surgical method is safer and has better results has always been a concern for parents.

This study used relevant literature as a reference, and used the indicators of total cholesterol, triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, serum

Figure 4. Box plots of immune-related indicators before and after treatment in the two groups. Treatment efficacy was evaluated by comparing serological immune markers (IgA, IgE, IgG, IgM, C3, and C4) between the two groups at preoperative and postoperative day 3 time points, with P < 0.05 considered statistically significant.

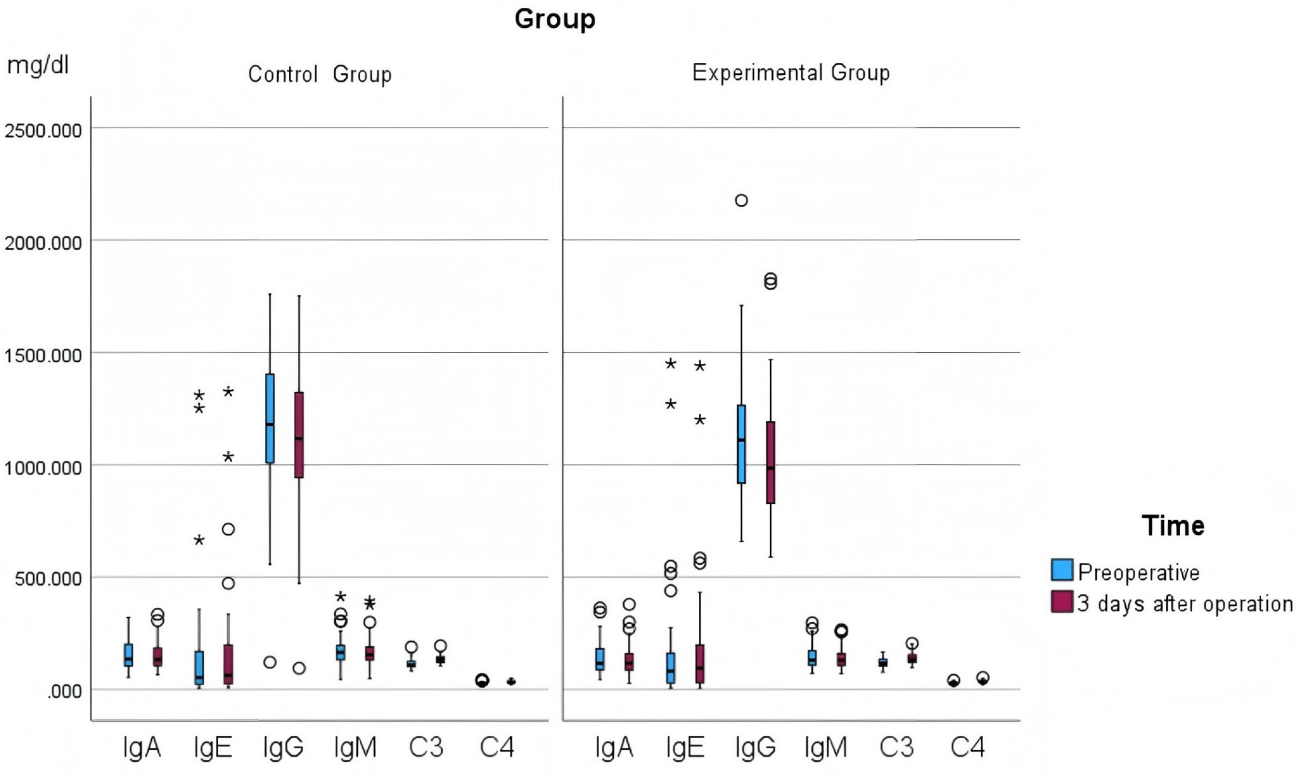


Table 8. Immunity-related indicators before and after treatment in the two groups.

Test	Time	Control Group	Experimental Group	T	P
IgA	Pre-op	152.73±68.85	139.51±75.19	0.836	0.406
(mg/dL)	Post-op Day 3	152.93±66.56	134.84±72.22	1.187	0.239
IgE	Pre-op	159.31±283.16	179.53±300.44	-0.315	0.753
(mg/dL)	Post-op Day 3	166.31±271.34	191.12±294.10	-0.4	0.69
IgG	Pre-op	1187.02±351.16	1108.05±293.43	1.11	0.27
(mg/dL)	Post-op Day 3	1126.57±335.46	1031.62±286.88	1.384	0.17
IgM	Pre-op	173.75±72.82	144.59±53.00	2.082	0.041
(mg/dL)	Post-op Day 3	170.77±70.58	139.01±48.65	2.382	0.02
C3	Pre-op	115.68±21.68	117.90±20.03	-0.484	0.629
(mg/dL)	Post-op Day 3	134.06±18.38	137.52±24.70	-0.727	0.469
C4	Pre-op	26.71±6.23	27.55±5.89	-0.627	0.532
(mg/dL)	Post-op Day 3	33.57±7.33	34.34±6.54	-0.507	0.614

apolipoprotein A1, and serum apolipoprotein B in serum blood test as entry points to study the risk-related factors of cardiovascular disease [10], and used IgA, IgE, IgG, IgM, complement C3 and complement C4 as entry points to study the indicators related to humoral immune function of the body [11]. The results of this study showed that there were no statistically significant differences in intraoperative blood loss and changes in OSA-18 scale scores before and after surgery between the control group and the experimental group. Three days after partial or total tonsillectomy, the mean values of total cholesterol, triglycerides, low-density lipoprotein, and apolipoprotein B showed an increasing trend, while the mean values of high-density lipoprotein and apolipoprotein A1 showed a decreasing trend, but they were all within the normal range, and there was no statistical significance between the two groups. Postoperative cardiovascular disease risk-related indicators in both groups of children tended to increase the possibility of cardiovascular disease. This may be related to the impact of preoperative fasting and general anesthesia on liver metabolic function in children, and may also be related to the stress response caused by surgical procedures on the body. Thinking further, this result coincidentally proves that for people with poor control such as coronary heart disease, hyperlipidemia and hypertension, the possibility of worsening cardiovascular and cerebrovascular diseases needs to be specifically explained before undergoing general anesthesia surgery.

In this study, IgA, IgG, and IgM showed a downward trend before and after treatment. This shows that no matter which kind of surgery is performed, the humoral immune function of children will decline in the short term after surgery, but within the normal range, which is consistent with the research results of Chengyong Zhou and other scholars [12]. In addition, the mean values of IgE, complement C3, complement C4, and CRP increased in both groups, and there was no statistically significant difference between the two groups. Serum IgE is generally related to age. The normal value in children is generally higher than that in adults. Its increase is mainly related to allergic diseases and immune system diseases; the increase of complement C3, complement C4, and CRP may all be related to the production of acute inflammation. Therefore, it is speculated that the increase in IgE, complement C3, complement C4, and CRP values after surgery may be related to the resection of tonsils and adenoids, the weakening of the body's immune defenses, and the inflammatory state of the body triggered by the trauma caused by the surgical operation.

There were no statistically significant differences in intraoperative blood loss and changes in OSA-18 scale scores before and after surgery between the control group and the experimental group in this study. This shows that there is no significant difference between partial tonsillectomy and total tonsillectomy in terms of intraoperative blood loss, postoperative improvement of airway patency, and reduction of nocturnal hypoxemia, and stable curative effects can be achieved. In this study, the ASO of both groups of children showed a downward trend after surgery, and the decrease in ASO in the partial tonsillectomy group was even more obvious. That is, for preschool children, partial tonsillectomy may be more beneficial to reducing ASO than total tonsillectomy. On the other hand, this may happen to verify the results of Shuai Wang et al.'s study [13]-partial tonsillectomy is more suitable for children of all ages with a history of repeated respiratory infections, and can reduce the impact on immune function., and reduce the rate of postoperative respiratory infection.

The postoperative FPS-R pain scale scores demonstrated significantly lower pain perception in children undergoing partial tonsillectomy compared to total tonsillectomy ($P<0.01$). This

reduction may be attributed to preservation of the tonsillar capsule during partial tonsillectomy, which minimizes exposure of submucosal vasculature and the pharyngeal constrictor muscles. Regarding postoperative hemorrhage, both primary bleeding (within 24 hours) and secondary bleeding (>24 hours) manifested only as blood-tinged sputum in all cases, which resolved spontaneously with ice-water gargles. Statistical analysis revealed significantly lower secondary bleeding rates in the partial tonsillectomy group (4.9% vs 21.4%, P=0.026), consistent with Qiu et al.'s findings demonstrating reduced bleeding risks with this technique [14]. We hypothesize that partial tonsillectomy's dual advantages – avoiding muscle exposure and reducing pain-related fluid/food avoidance – promote earlier nutritional recovery and wound healing, thereby decreasing secondary bleeding risks.

Conclusion

Partial tonsillectomy achieves comparable outcomes to total tonsillectomy in improving airway obstruction, cardiovascular parameters, and immune function, while offering superior benefits in reducing ASO levels (P = 0.019), postoperative pain (P < 0.005), and secondary bleeding rates (P = 0.026). For preschool OSA patients without chronic tonsillitis history, we recommend partial tonsillectomy when tonsillar hypertrophy is the primary etiology. This approach optimizes long-term health outcomes and alleviates parental concerns regarding postoperative complications.

Abbreviations

Apo-A1: Apolipoprotein A; **Apo-B**: Apolipoprotein B; **ADHD**: Attention-Deficit Hyperactivity Disorder; **AHI**: Apnea-hypopnea index; **ASO**: Antistreptolysin O; **CRP**: C-reactive protein; **C3**: Complement C3; **C4**: Complement C4; **FPS-R**: Faces Pain Scale Revision; **HDL**: High-density lipoprotein cholesterol; **LDL**: Low-density lipoprotein cholesterol; **IgA**: Immunoglobulin A; **IgE**: Immunoglobulin E; **IgG**: Immunoglobulin G; **IgM**: Immunoglobulin M; **OSA**: Obstructive Sleep Apnea; **BMI**: The Body Mass Index; **TC**: Total Cholesterol; **TG**: Triglycerides.

Author Contributions

The specific contributions to this study are as follows: **Yuan Jinjin**: Conceptualization, Methodology, Data curation, Writing – Original Draft. **Wei Yonghao**: Surgical technical support, Writing – Review & Editing. **Yi Jianqi**: Provision of critical study materials, Formal analysis, Discussion of results. **Liu Yaling**: Data curation, Validation. **Fei Hongxia**: Data curation, Validation. All authors have reviewed and approved the final manuscript for submission. **Wei Yonghao** (Corresponding Author) oversaw the overall coordination of the manuscript, finalized the draft, and managed submission-related matters.

Acknowledgements

We sincerely thank Doctor Wei Yonghao for his guidance on this research project and his assistance in data collection. We are also grateful to Yi Jianqi, Liu Yaling, and Fei Hongxia for their contributions to data gathering. Our special thanks go to the Affiliated Hospital of Jiujiang University for their support of this study.

Funding Information

Jiangxi Provincial Health Commission Science and Technology Program. Number: 202311512

Ethics Approval and Consent to Participate

This study was reviewed and approved by the Ethics Committee of Jiujiang University Affiliated Hospital (Approval No. jjumer-b-2022-0612). All research procedures involving human participants were conducted in accordance with the principles outlined in the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from all participants.

Competing Interests

The authors declare that they have no existing or potential commercial or financial relationships that could create a conflict of interest at the time of conducting this study.

Data Availability

Not Applicable.

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Research on the Incidence of High Jugular Bulb in the Lateral Position among Otitis Media Patients

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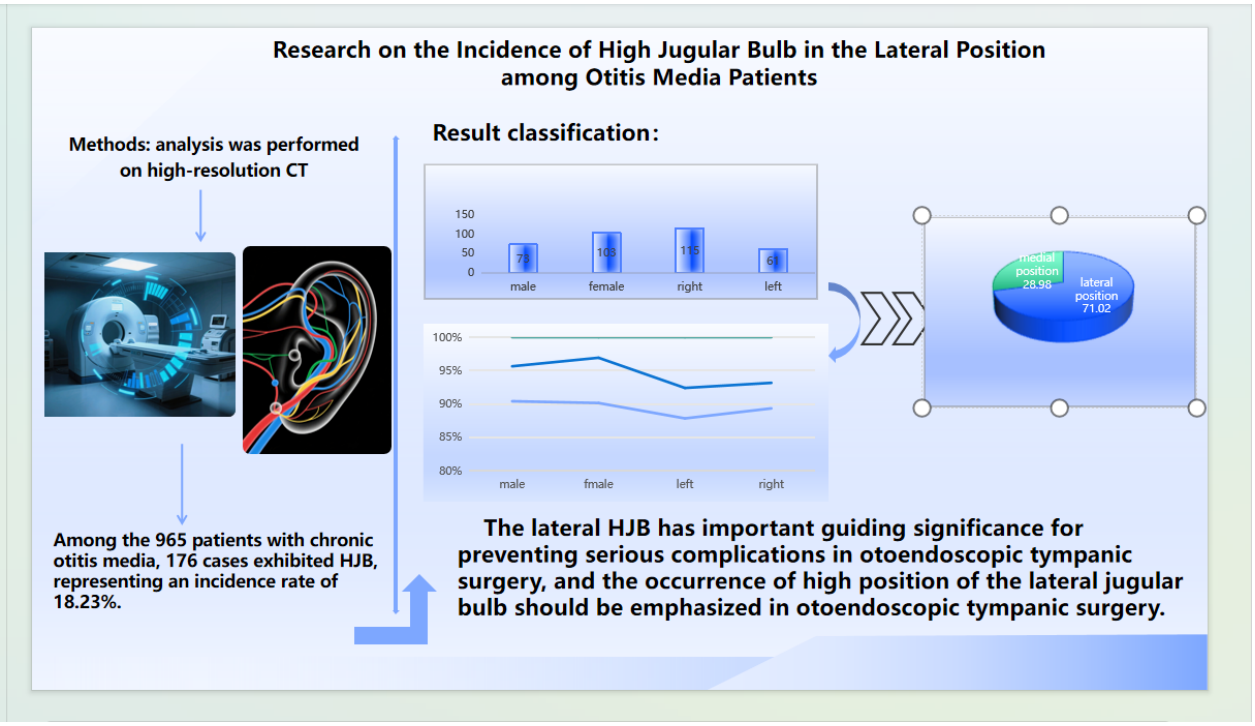
Graphical Abstract



https://doi.org/10.71321/kbecdm40

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Research Article Head and Neck Diseases Conflux

Research on the Incidence of High Jugular Bulb in the Lateral Position among Otitis Media Patients

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Received: 2025-06-13 | Accepted: 2025-07-16 | Published online: 2025-08-10

Abstract

Objective: This study aims to analyze the incidence of high jugular bulb (HJB), an anatomical variation, in patients with otitis media using high-resolution CT imaging in the lateral position.

Methods: A retrospective analysis was performed on high-resolution CT scans of the middle ear from 965 patients clinically diagnosed with otitis media between October 2018 and October 2023. The age range was 6 to 81 years, with a mean age of 47.11 years. The cohort included 387 male and 578 female patients. HJB was defined as the superior border of the jugular bulb extending beyond the inferior border of the basal turn of the cochlea. Using the lateral wall of the cochlear basal turn as the reference line, HJB was classified into medial and lateral types. In the lateral type, the jugular bulb was in proximity to the tympanic membrane, ossicular chain, or round window; in the medial type, it was adjacent to the cochlear aqueduct, vestibular aqueduct, or internal auditory canal. The presence of HJB was recorded, and gender and side distribution were analyzed.

Results: Among the 965 patients with chronic otitis media, 176 cases exhibited HJB, representing an incidence rate of 18.23%. Of these, 103 were female (58.52%) and 73 were male (41.48%), indicating a higher prevalence in females. Right-sided HJB occurred in 115 cases (65.34%), compared to 61 cases on the left (34.66%), suggesting a predominance on the right side. Lateral HJB was observed in 125 cases (71.02%), including five cases with direct exposure, whereas medial HJB was found in 51 cases (28.98%), demonstrating a significantly higher frequency of the lateral variant.

Conclusions: The findings indicate that HJB is more prevalent in females than males and more common on the right side than the left. Additionally, the lateral type occurs more frequently than the medial type. Given its anatomical significance, lateral HJB must be carefully evaluated during otoscopic tympanic surgery to prevent potentially serious complications. Special attention should be paid to identifying this variation preoperatively.

Keywords: Otitis media; High jugular bulb; Otoscope; Tympanic surgery.

Introduction

Chronic otitis media is a prevalent condition within the field of otorhinolaryngology. In recent years, as scientific knowledge has become more widespread, public awareness regarding the prevention and treatment of otitis media has improved significantly. Consequently, there has been a notable decrease in the number of patients suffering from severe otitis media or extensive lesions, with the majority now presenting with simple otitis media characterized by tympanic membrane perforation. As a result, the number of patients requiring traditional mastoidectomy has diminished, leading to a rapid advancement in otoscopic technology. Currently, minimally invasive otoscopic surgery has emerged as the primary surgical approach for chronic otitis media. The high jugular bulb (HJB) is a common anatomical variation of the temporal bone encountered in clinical practice, which holds considerable importance for otological surgery [1]. Notably, the lateral HJB variation can significantly impact the execution of otoscopic procedures. In particular, when there is a defect or thinning of the bone wall at the top or lateral aspect of the jugular bulb, the risk of complications during surgery increases. Inadequate management during the procedure can result in severe bleeding and may even pose a threat to the patient's life, often necessitating the termination of the surgery [2]. Therefore, accurately diagnosing HJB anatomical variations prior to otoscopic surgery is crucial for anticipating potential risks and challenges associated with the operation.

This report presents a retrospective analysis of HJB variations in patients with chronic suppurative otitis media, as identified through high-resolution CT scans of the middle ear, along with an assessment of the likelihood of high-position variations in the lateral position.

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Materials and Methods

General Information

A retrospective study was carried out involving 965 patients diagnosed with chronic suppurative otitis media who underwent high-resolution CT scans of the middle ear at the otorhinolaryngology-head and neck surgery outpatient department of Bozhou People's Hospital between October 2018 and October 2023. This study received approval from the Ethics Committee of Bozhou City People's Hospital and adheres to the principles outlined in the Helsinki Declaration. The ages of the patients ranged from 6 to 81 years, with an average age of 47.11 years.

Scanning Method

For the middle ear high-resolution thin-layer scanning, all patients received standard axial and coronal plain scans of the temporal bone. The scanning baseline was set at the orbitomeatal line, with a slice thickness of 0.5 to 1.0 mm, a matrix size of 512×512, and a range of /L: 4000/400 Hu to 800 Hu. Scanning was conducted continuously from 5 mm below the baseline to the upper edge of the petrous pyramid, followed by MPR coronal and sagittal three-dimensional reconstructions for assessment.

Diagnostic Criteria

The diagnosis of a high jugular bulb (HJB) was determined by the criterion that the upper edge of the jugular bulb was positioned above the lower edge of the cochlea's basal turn. The HJB was classified into medial high-position and lateral high-position based on the lateral wall of the cochlea's basal turn as a boundary. In the lateral high-position, the bulb was in contact with the tympanic membrane, ossicular chain, or round window, while in the medial high-position, it was in contact with the cochlear aqueduct, vestibular aqueduct, and internal auditory canal [15].

Statistical Method

Data analysis was performed using SPSS Statistics 20.0 software. For categorical data, the chi-square test was utilized for inter-group comparisons, with a significance level set at $P < 0.05$ to indicate statistically significant differences.

Results

The basic characteristics of patients with chronic otitis media.

Among the 965 patients with chronic otitis media included in the investigation and analysis, 176 patients had HJB, accounting for 18.23% of the total number of otitis media patients. Among the patients with HJB, there were 103 female patients, accounting for 58.52% of the total positive cases, and 73 male patients, accounting for 41.48%, with a higher proportion in females than in males. There were 115 cases of high - position on the right side, accounting for 65.34% of the total positive cases, and 61 cases of high - position on the left side, accounting for 34.66%, with a higher proportion on the right side than on the left side. There were 125 cases of lateral high - position, accounting for 71.02% of the total positive cases, among which 5 cases were exposed, and 51 cases were of medial high - position, accounting for 28.98%, with a higher incidence of lateral high - position than medial high - position.

The comparison of gender and left - right sides is shown in Table 1 below, and the difference was statistically significant.

Table 1. The comparison of gender and left - right sides.

	right high position	left high position
male	54	19
female	61	42
χ^2		4.104
p		0.043

The comparison of genders in lateral high - position and medial high - position is shown in Table 2 below, and the difference was statistically significant.

Table 2. The comparison of genders in lateral high - position and medial high - position.

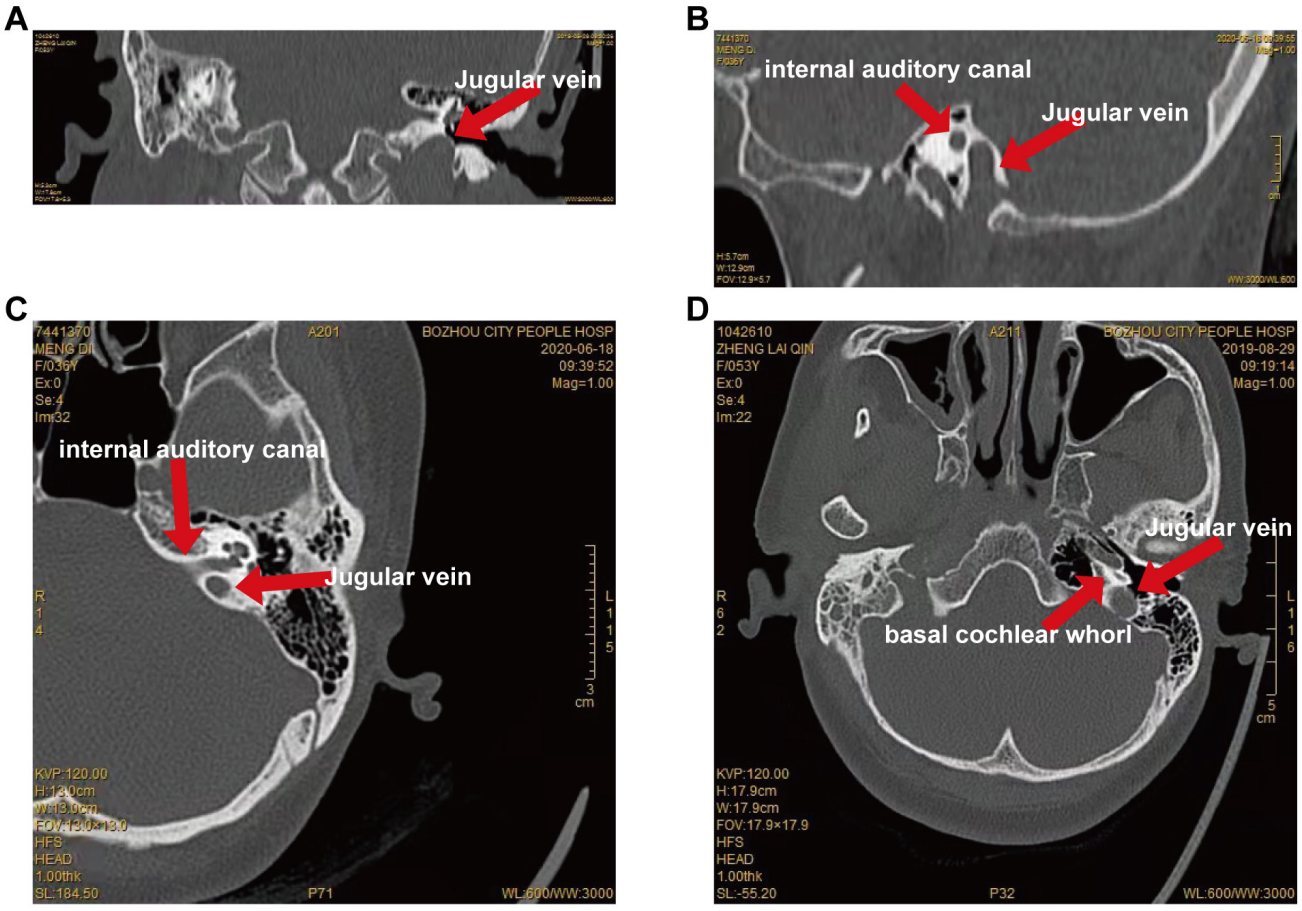
	male	female
Lateral position HJB	45	80
Medialis HJB	28	23
p		5.331
χ^2		0.021

Imaging Pictures of Typical Cases We listed some typical pictures to deepen the understanding of this disease. Such as thinning change of the lateral high - position of the jugular bulb (Fig. 1A), medial high - position change of the jugular bulb (Fig. 1B and 1C) and exposure change of the lateral high - position of the jugular bulb (Fig. 1D).

Discussion

The jugular bulb is situated in the jugular fossa beneath the petrous bone. A high jugular bulb (HJB) is a frequent vascular variation, with most instances being asymptomatic [3]. The reported prevalence of HJB, defined as a high-position jugular bulb that reaches or surpasses the level of the basal turn of the cochlea, ranges from 6% to 24%. In patients with chronic otitis media, the incidence is 20.3%. Ears affected by chronic otitis media are often more likely to have HJB, which is relatively common[4]. This study found an incidence of 18.23%, supporting previous findings. Additionally, the right internal jugular bulb was found to be higher than the left, possibly due to a right-sided dominance in venous vessels, as the right jugular bulb is typically larger. The occurrence of HJB was also higher in women than in men, potentially linked to estrogen levels, aligning with earlier research[5-7]. Furthermore, the analysis revealed that lateral HJB was more prevalent among otitis media patients compared to medial HJB, with some patients exhibiting lateral high-position alongside exposure.

Figure 1. Imaging Pictures of Typical Cases. **A Thinning Change of the Lateral High - position of the Jugular Bulb.** The bone is thin on the lateral side of the jugular vein bulb. **B and C Medial High - position Change of the Jugular Bulb. D Exposure Change of the Lateral High - position of the Jugular Bulb.**



HJB can exhibit three morphological variations: (1) A defect in the upper and lateral walls of the high-position jugular fossa, allowing the jugular bulb to protrude into the middle ear; (2) An incomplete bony covering of the high-position jugular bulb and its fossa; (3) The high-position jugular bulb and its fossa extending into the tympanic cavity from below, covered by a thin, complete bony plate [8]. Different locations and orientations of the high-position jugular bulb can lead to varying symptoms [9 - 14]. The jugular bulb can be categorized into medial high-position and lateral high-position based on its relation to the lateral wall of the basal turn of the cochlea. In the lateral high-position, the bulb contacts the tympanic membrane, ossicular chain, or round window, while in the medial high-position, it contacts the cochlear aqueduct, vestibular aqueduct, and internal auditory canal [15]. The position of HJB in the hypotympanum can be classified into two types: (1) The anterior-inferior quadrant of the tympanic isthmus; (2) The posterior-inferior quadrant of the tympanic isthmus. Both scenarios pose a risk of damaging the jugular bulb during middle-ear surgery, with the former often being injured during the dissection of inflammatory granulation tissue and the latter during the elevation of the tympanomeatal flap, which can tear the jugular bulb [16]. When the jugular bulb is positioned laterally and high, with thin surrounding bone, there may be just a soft tissue membrane between it and the surrounding area, and it could even extend into the posterior-inferior tympanum without any protection. In such situations, there is a high risk of injuring the jugular bulb and causing bleeding during ear surgery. Careless handling in this scenario can pose a serious risk to the patient's life [17].

For patients with otitis media who have a high jugular bulb (HJB), it is advisable to refrain from performing blind tympanic exploration, tympanic membrane incision, or blind tympanic membrane puncture [18]. Conducting a pre-operative high-resolution CT scan of the middle ear can help identify the lateral high position of the HJB, allowing otolaryngologists to better understand the patient's unique anatomical features and the specific characteristics of the lesion prior to tympanic surgery. This knowledge aids in selecting the most appropriate surgical approach and being aware of potential intraoperative risks, which can help prevent complications such as excessive bleeding during and after the procedure, as well as serious issues like intracranial hypertension, intracranial hemorrhage, sigmoid sinus thrombosis, and hemiplegia [19-20].

Conclusion

Consequently, it is crucial to focus on the lateral high-position

HJB variation prior to surgery, as it holds significant importance for otoscopic tympanic procedures.

Author Contributions

Qingjun Ji (**First Author**): writing original draft, prepare, create, or express the content for publication, especially in writing the initial draft, including substantive translation. **Chunbo Feng**: writing review and editing, prepare, create, or express the content for publication, especially in writing the initial draft, including substantive translation. **Li Wang**: writing review and editing, prepare, create, or express the content for publication, especially in writing the initial draft, including substantive translation. **Fuyou Xie**: writing review and editing, prepare, create, or express the content for publication, especially in writing the initial draft, including substantive translation. **Dapeng Li**: supervision, supervise and lead the planning and execution of research activities. **Wei Chai** (**Corresponding Author**): supervision, supervise and lead the planning and execution of research activities. All authors read and approved the final manuscript.

Acknowledgements

We would like to express our heartfelt appreciation to the Science and Technology Bureau of Bozhou City and the Research Fund of Bozhou People's Hospital for their invaluable assistance. We also extend our thanks to the Imaging Center of Bozhou People's Hospital for supplying the original image data, Dr. Li Dapeng from the Science and Education Department of Bozhou People's Hospital for his valuable advice on the thesis, and Director Chai Weike from the Department of Otorhinolaryngology Head and Neck Surgery of Bozhou People's Hospital for his steadfast support. Furthermore, we are thankful to Dr. Wang Li and Dr. Feng Chunbo from the same department for their helpful guidance on the thesis.

Funding Information

Funding: Key Research and Development Program Project of Bozhou Science and Technology Bureau, Anhui Province in 2023 (Project No.: bzzc2023053).

Ethics Approval and Consent to Participate

This study received approval from the Ethics Committee of Bozhou City People's Hospital and adheres to the principles outlined in the Helsinki Declaration.

Competing Interests

The authors declare that they have no existing or potential commercial or financial relationships that could create a conflict of interest at the time of conducting this study.

Data Availability

The data are available from the corresponding author on reasonable request.

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Research Article Head and Neck Diseases Conflux

Skull Base Lesions Extending Towards Multiple Compartments: The Role of Maxillary Swing Approach in the Endoscopic Era

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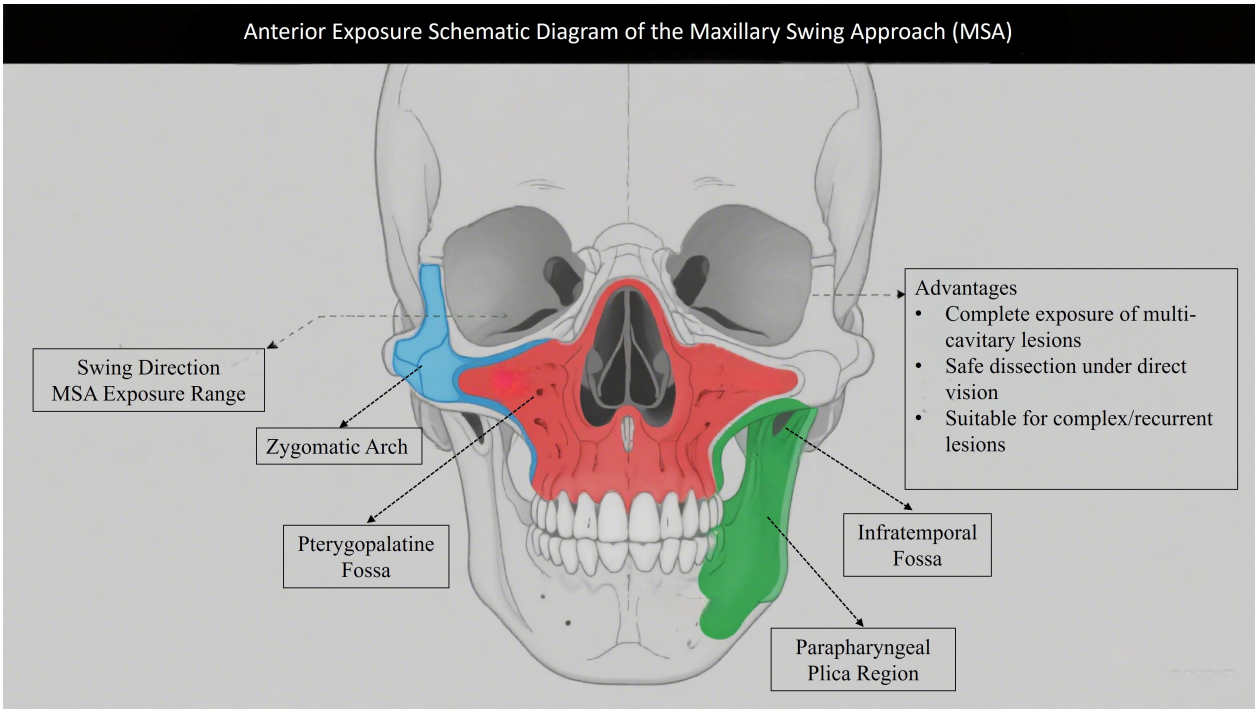
Graphical Abstract



https://doi.org/10.71321/yv68s106

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Research Article

Head and Neck Diseases Conflux

Skull Base Lesions Extending Towards Multiple Compartments: The Role of Maxillary Swing Approach in the Endoscopic Era

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Received: 2025-06-18 | Accepted: 2025-07-27 | Published online: 2025-08-10

Abstract

Objective: Although advances in endoscopic techniques, resection of complex lesions that occupying multiple compartments in the skull base still represents significant challenges, since surgical outcomes may be compromised by insufficient exposure and inappropriate techniques. The question of whether to perform endoscopic surgery or to use open craniofacial approach remains unresolved. Nevertheless, careful assessment of lesion characteristics must be carried out in selection of the appropriate trajectory.

Methods: Between May 2006 and November 2016, 16 patients experienced resection of extensive lesions in the skull base via maxillary swing approach. Data regarding clinical findings and technical considerations as shown in case illustrations were discussed.

Results: Complete resection was achieved in all patients. Pathological findings were diverse, while the majority were schwannomas (10 cases, 62.5%) followed by meningiomas (3 cases, 18.75%). The complications were managed as shown in case illustrations, and symptoms improved with time. The follow-up duration ranged from 49 to 177 months (median, 102 months), while 2 patients were lost. There was no postoperative mortality, and 1 patient who experienced a relapse of meningioma 72 months after surgery is still under observation due to asymptomatic status.

Conclusions: Our preliminary results suggest that the maxillary swing approach can be an alternative option in management of extensive, recurrent, and hypervascularized masses with fibrous or calcified consistency in the skull base, which may represent challenges for the endoscopic procedure. Future studies are required to demonstrate the surgical indications and efficiency.

Keywords: Maxillary swing approach; Skull base pathology; Technical considerations; Lesion characteristics.

Introduction

The extreme complexity of the skull base is associated with challenging regional anatomy and variable pathologies of lesions. Neoplasms arising from the paranasal sinuses, orbits, pterygopalatine fossa (PPF), infratemporal fossa (ITF), sellar or clivus may exhibit transdural growth pattern [1-4]. Moreover, a number of subdural masses can spread to the craniofacial region, exhibiting a more aggressive biological behavior. Technically, extirpation of lesions extending towards multiple compartments remains formidable because of proximity to vital neurovascular structures without adequate exposure [3, 5].

Controversy remains regarding the optimal surgical procedure for extensive lesions in the skull base [2, 3]. The maxillary swing approach has gained wide access in case of large tumors and obtained a complete resection in one-stage [3, 6-9]. However, since implementation of endoscopic techniques, surgeons would argue strongly against open surgery for tumors residing in the cranial fossa due to postoperative morbidity and unacceptable cosmetic results [6, 10, 11] Endoscopic surgery also provided data on series with excellent outcomes even when piecemeal resection was performed [11-15].

The characteristics of lesion is a major decision-making element of surgical approach. Full exposure of deep-seated extensive or recurrent tumors which distort the anatomical landmarks cannot be easily achieved through a narrow corridor [1, 8, 16] Surgical struggle to dissect lesions with significant fibrosis or calcification within the restrictive surgical cavity poses great risks to the vital neurovascular structures [3, 11]. Likewise, piecemeal resection may cause severe intraoperative bleeding from dissection planes of hypervascularized lesion remnant [11]. Therefore, the maxillary swing approach may be feasible under special circumstances.

Notably, indications of this approach have yet to be fully described in the endoscopic era, leaving the optimal treatment paradigm unresolved. In the present study, 16 patients with lesions occupying multiple compartments in the skull base underwent open surgery, and clinical data accompanied by technical considerations based on our experience as shown in

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case illustrations were reviewed and discussed.

Material and methods

Patient population

The study was approved by the ethical committee of the National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College. Informed consent was obtained from patients in our cohort.

Between May 2006 and November 2016, 16 patients suffering extensive lesions in the skull base underwent surgical treatment via the maxillary swing approach in our department. The clinical findings were summarized in Table 1. In this cohort, previous treatment was performed in 7 patients (43.75%) who experienced local relapse before admission to our hospital.

All surgeries were performed by a senior neurosurgical team with >10 years of experience in skull base surgery, including > 300 cases of open skull base surgery and endoscopic skull base surgery prior to the study period.

Preoperative neuroimaging

The maximum diameter of lesions ranged from 3.6 to 10.5cm (mean, 6.69 cm), while extension across the midline was found in 6 cases (37.5%). Notably, violation of the cavernous sinus (CS) was present in 9 cases (56.25%), and 6 patients (37.5%) harbored lesions occupying the subdural area. The lesions mostly exhibited aggressive features of bone destruction together with gross calcification on computed tomography (CT) scans (9 cases, 56.25%), and vivid contrast enhancement was seen on T1-weighted post-gadolinium magnetic resonance imaging (MRI) in 13 patients (81.25%).

Surgical procedure

After administration of general anesthesia, the patient was placed supine. Then the maxillary swing approach was performed using the standard procedure [2]. In general, a Weber-Ferguson incision was given followed by osteotomies to separate the maxilla from the zygomatic arch and pterygoid plates. Thereafter, the hard palate was divided in the center, favoring mobilization and reflection of the entire maxilla laterally. The nasopharynx, oropharynx, parapharyngeal space, fossa of Rosenmüller, PPF, ITF, sellar, and clivus could be widely exposed under direct visualization. Removal of the middle turbinate and posterior end of the nasal septum including the vomer displayed the contralateral compartments. Then extirpation of large extensive lesion was achieved using standard

Table 1. Demographics, clinical, and pathologic characteristics

Variables	Value
No. of eligible patients	16
Mean age, range (years)	48.5, 29-67
Gender, No. (%)	
Male	8 (50)
Female	8 (50)
Presenting symptoms, No. (%)	
Headache	6 (37.5)
Limitation of extraocular movements	6 (37.5)
Facial numbness/pain	5 (31.25)
Visual defects	5 (31.25)
Anosmia	5 (31.25)
Nasal stenosis/obstruction	4 (25)
Hear impairment	2 (12.5)
Facial deformity	2 (12.5)
Exophthalmos	1 (6.25)
Facial palsy	1 (6.25)

Local relapse before admission to our hospital, No. (%)	7 (43.75)
Previous treatment, No. (%)	
Transcranial surgery	4 (25)
Endoscopic surgery + radiotherapy	2 (12.5)
Endoscopic surgery + transcranial surgery	1 (6.25)
Mean maximum diameter, range (cm)	6.69, 3.6-10.5
Extension across the midline, No. (%)	6 (37.5)
Transdural growth pattern, No. (%)	6 (37.5)
CS invasion, No. (%)	9 (56.25)
Complete resection rate (%)	100
Pathology, No. (%)	
Schwannoma	10 (62.5)
Meningioma	3 (18.75)
MPNST (WHO Ⅲ)	1 (6.25)
Fibrous dysplasia	1 (6.25)
Simple cyst	1 (6.25)
Complications, No. (%)	
Facial numbness/pain	4 (25)
Dry eye	3 (18.75)
CSF leakage	2 (12.5)
Palatal fistula	2 (12.5)
Visual defects	1 (6.25)
Trismus	1 (6.25)
Epistaxis	1 (6.25)
Intracranial infection	1 (6.25)
Lost to follow-up, No. (%)	2 (12.5)
Median follow-up duration, range (month)	102, 49-177
Mortality (%)	0
Recurrence rate (%)	7.14 (1/14)

CS, cavernous sinus; MPNST, malignant peripheral nerve sheath tumor; CSF, cerebrospinal fluid.

microsurgical techniques after expanding surgical corridor bilaterally and posteriorly. Eventually, multilayer reconstruction of the skull base was carried out followed by repositioning of the maxillary osteocutaneous unit.

Surgical approach selection criteria

The decision to adopt the maxillary swing approach (MSA) was based on comprehensive evaluation of lesion characteristics and technical feasibility of alternative approaches. Specifically, MSA was preferred over endoscopic or other open approaches if the lesions met one or more of the following criteria: (1) Imaging features: maximum diameter >5 cm, cross-midline extension, cavernous sinus invasion, obvious calcification or fibrosis on CT/MRI; (2) Clinical features: recurrent lesions after previous surgery, hypervascularity on angiography, or firm consistency (fibrous/calcified) predicted to complicate piecemeal resection; (3) Technical limitations of endoscopy: inability to achieve sufficient exposure of multi-compartment involvement (e.g., simultaneous involvement of infratemporal fossa, pterygopalatine fossa, and clivus) or risk of uncontrollable bleeding during endoscopic dissection. These criteria were established through multidisciplinary team discussions (neurosurgery, otolaryngology, and radiology) and were consistent throughout the study period, rather than surgeon-dependent.

Results

Surgical aspects and pathological findings

Microscopically total resection was achieved in all patients. The complications noted in our study were as mentioned in Table 1 and managed as shown in case illustrations. The most common tissue diagnosis was schwannoma (10 cases, 62.5%) followed by meningioma (3 cases, 18.75%).

Follow-up

The median follow-up duration was 102 months (range, 49 to 177 months), but 2 patients were lost. These 2 patients were confirmed to have no residual tumor or severe complications at the 12-month postoperative visit before being lost to follow-up due to relocation. There was no mortality, while 1 patient who had meningioma experienced locoregional tumor recurrence 72 months after surgery, giving a recurrence rate of 7.14% (1/14). Observation and monitoring were recommended because of asymptomatic status.

Case illustrations

Case 1

A 29-year-old man initially presented with nasal obstruction and anosmia. Then he complained of blurring 8 months later, and was referred to our clinic because of precipitate bitemporal hemianopsia and severe exophthalmos. Preoperative T2-weighted MRI showed a large lesion with heterogeneous signal intensity in the skull base (Fig. 1A). Contrast enhancement was uneven, which depicted the cystic/necrotic areas within the hypervascularized mass growing inferiorly into the nasal sinuses, anteriorly into the orbits, posteriorly to the sellar, clivus, and petrous apex, bilaterally into the CS, and infiltrating the temporal lobes (Fig. 1B&C). Considering the difficulties in resection of the extensive and calcified lesion in a bloodless view and reconstruction of the skull base through a narrow corridor under endoscopic visualization, the modified maxillary swing approach was selected by expanding nasal osteotomy to the contralateral side. The bony-hard lesion was visualized and dissected along its capsule surface, struggling to keep the displaced and stretched cranial nerves within the CS intact. Pure circumferential stripping in a single piece along the brain-lesion interface was accomplished followed by reflection of frontotemporal scalp flap to harvest malleable autologous tissues for reconstruction (Fig. 1E). Postoperative CT scans confirmed complete removal of the lesion without intracranial hematoma or brain contusion (Fig. 1G). The diagnosis of fibrous dysplasia was finally confirmed by pathological analysis. The postoperative course was uneventful and the patient was discharged with improvement in visual function. He was followed up annually, and no recurrence was seen on contrast T1-weighted MRI (Fig. 1H-J).

Case 2

A 32-year-old man tolerated nasal obstruction, anosmia, and persistent facial numbness for 4 months, and sought medical attention when facial deformity was developed. Flattening of the left nasolabial fold and slightly mouth drooping were observed on admission. Preoperative CT scans showed a huge lesion centered at the left petroclival region destructing the petrous bone and occupying multiple craniofacial compartments (Fig. 2A). Significant enhancement of the extensive mass abutting the mandible and migrating into the subdural region on MRI (Fig. 2B-D) presented great challenges since sufficient exposure and complete resection in one-stage without severe bleeding could not be achieved solely from any approach. Therefore, the maxillary swing approach combined with the Kawase's approach were performed. After reflection of the maxilla laterally, the lesion was exposed and feeding arteries (probably the internal maxillary artery) were ligated and transected. The extracranial portion of the rubber-like multilobulated tumor was transected at its extension into the Meckel's cave using a scalpel because of fibrous consistency. Dissection continued through the petroclival region to the cerebellopontine angle (CPA) using the Kawase's approach, and remnant subdural segment was completely stripped away from the arachnoid membrane, allowing resolution of the mass effect on the brainstem. Following hemostasis and antibiotic irrigation of surgical field, multilayer reconstruction of skull base started with dura suture. Then the extradural area was packed with the temporalis fascia, periosteum, and pedicled temporalis muscle to reinforce dural repair. CT scans immediately after surgery demonstrated complete resection (Fig. 2E). The patient developed facial numbness and suffered temporary dry eye postoperatively. Intracranial infection secondary to cerebrospinal fluid (CSF) leak occurred 4 days after surgery, and was resolved by antibiotic therapy accompanied by lumbar drain. The final diagnosis based on histological findings was schwannoma. During follow-up period of 49 months, there was no evidence of recurrence (Fig. 2F-H).

Case 3

A 49-year-old woman suffered 3-year history of progressive headache, blurring, diplopia, and ptosis. On neurological examination, vision loss, partial cranial nerve (CN) III palsy, and complete CN VI palsy of the right eye were observed. T1-weighted post-gadolinium MRI revealed significantly homo-

geneous contrast enhancement of a lesion which involved the sellar, CS, clivus, parasellar area, and petroclival region (Fig. 3A-C). The endoscopic endonasal technique or extradural subtemporal transpetrosal access (Kawase's approach) was not recommended because severe bleeding due to tumor debulking and dissection across the cranial nerves might pose great risks to the patient. Standard maxillary swing procedure was carried out. After identifying superoposterior displacement of the cranial nerves, the tumor was peeled off along its capsule as a whole under an almost bloodless view (Fig. 3D). There was no surgical complication, and the tissue diagnosis was schwannoma. The patient was relieved of visual defects and extraocular movements limitation at follow-up, and MRI scans demonstrated no evidence of tumor growth (Fig. 3E&F).

Figure 1. Representative case of fibrous dysplasia harboring transdural growth pattern. Heterogeneous signal intensity on plain T2-weighted MRI in axial plane demonstrated an extensive lesion containing cystic/necrotic areas (**A**). Significantly uneven enhancement seen on T1-weighted post-gadolinium MRI in axial (**B**) and coronal (**C**) planes confirmed the hypervascularized lesion infiltrated the brain parenchyma. There was stone-like calcification in the core of the mass which also presented aggressive features of bone destruction on CT scans (**D**). After adequate exposure of retromaxillary area, complete excision of the lesion was accomplished followed by multilayer reconstruction of the skull base to prevent CSF leakage and obliterate surgical cavity using the temporalis fascia, pericranium, and muscle flap (**E**). The cosmetic results were acceptable without visible facial scars 3 months after surgery (**F**). Postoperative CT scans (**G**) and contrast T1-weighted MRI (**H-J**) exhibited the excellent outcomes. MRI, magnetic resonance imaging; CT, computed tomography. CSF, cerebrospinal fluid.

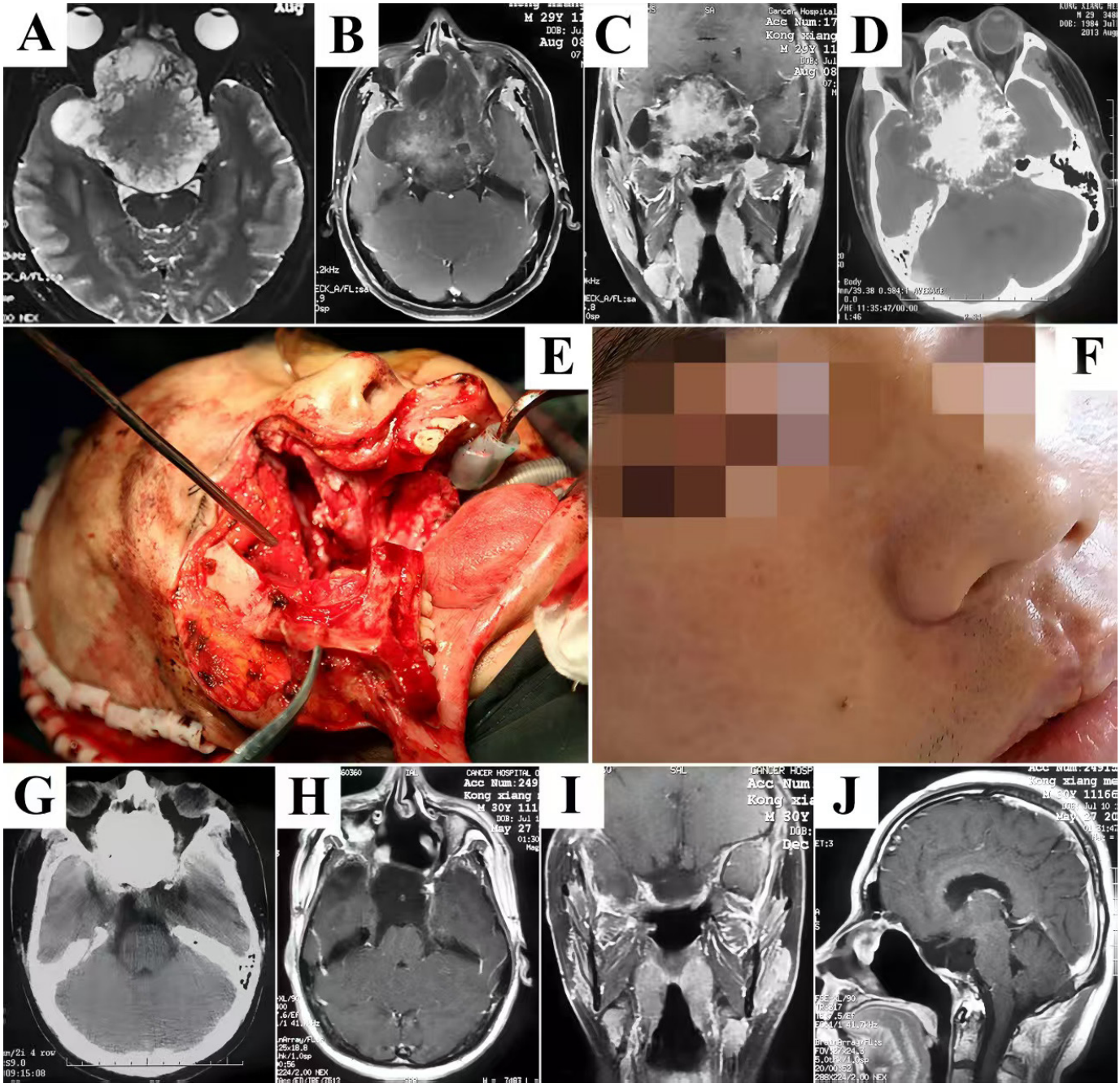
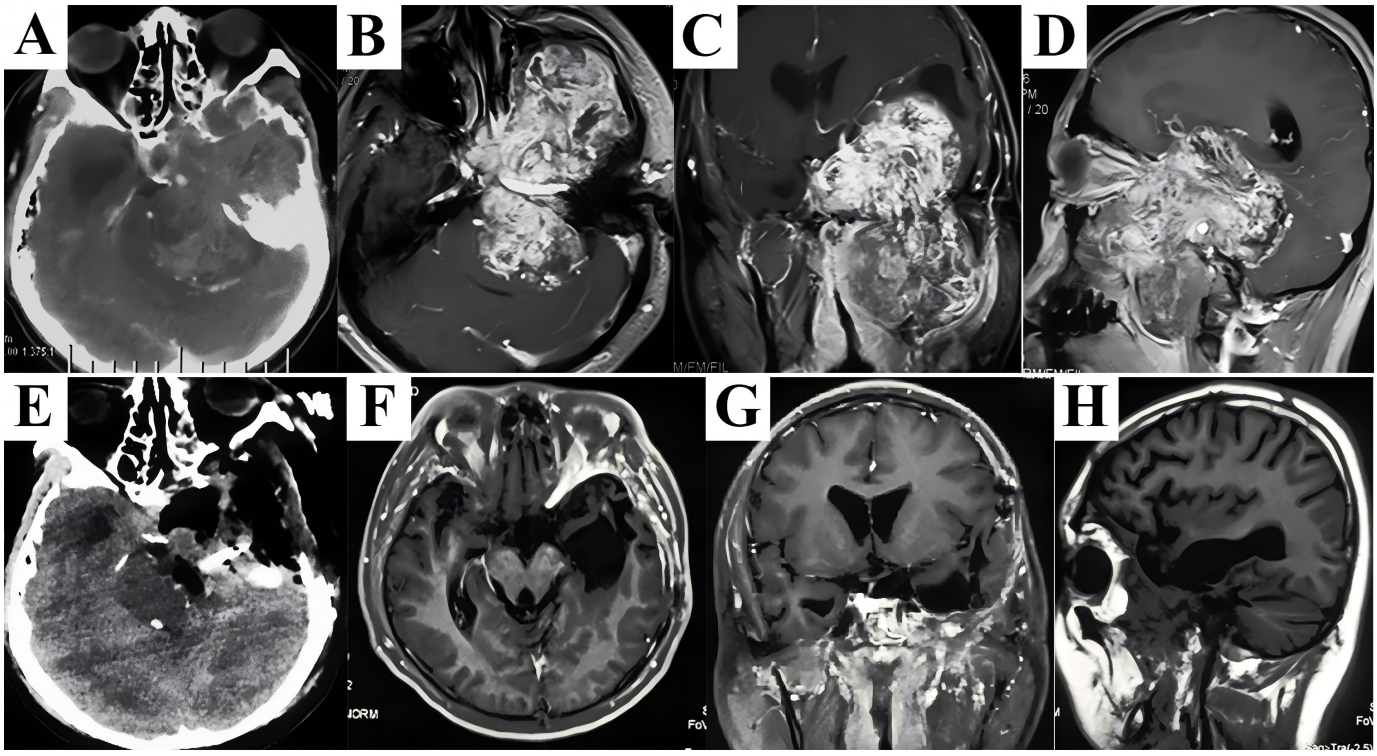


Figure 2. A combined craniofacial resection of the giant and rubbery schwannoma was performed. Preoperative CT scans revealed an extensive lesion destructed the petrous bone and migrated both anteriorly and posteriorly (**A**). Significant enhancement mixed with discrete hypointensity on contrast T1-weighted MRI in axial (**B**), coronal (**C**), and sagittal (**D**) planes probably demonstrated a hypervascularized lesion with features of fibrosis. After removal of the extracranial portion via maxillary swing approach, dissection proceeded along the intradural segment through the Kawase's approach to obtain a complete resection in one-stage, which was shown on CT scans immediately after surgery (**E**). Postoperative MRI detected no tumor recurrence during the follow-up period (**F-H**). CT, computed tomography; MRI, magnetic resonance imaging.



Case 4

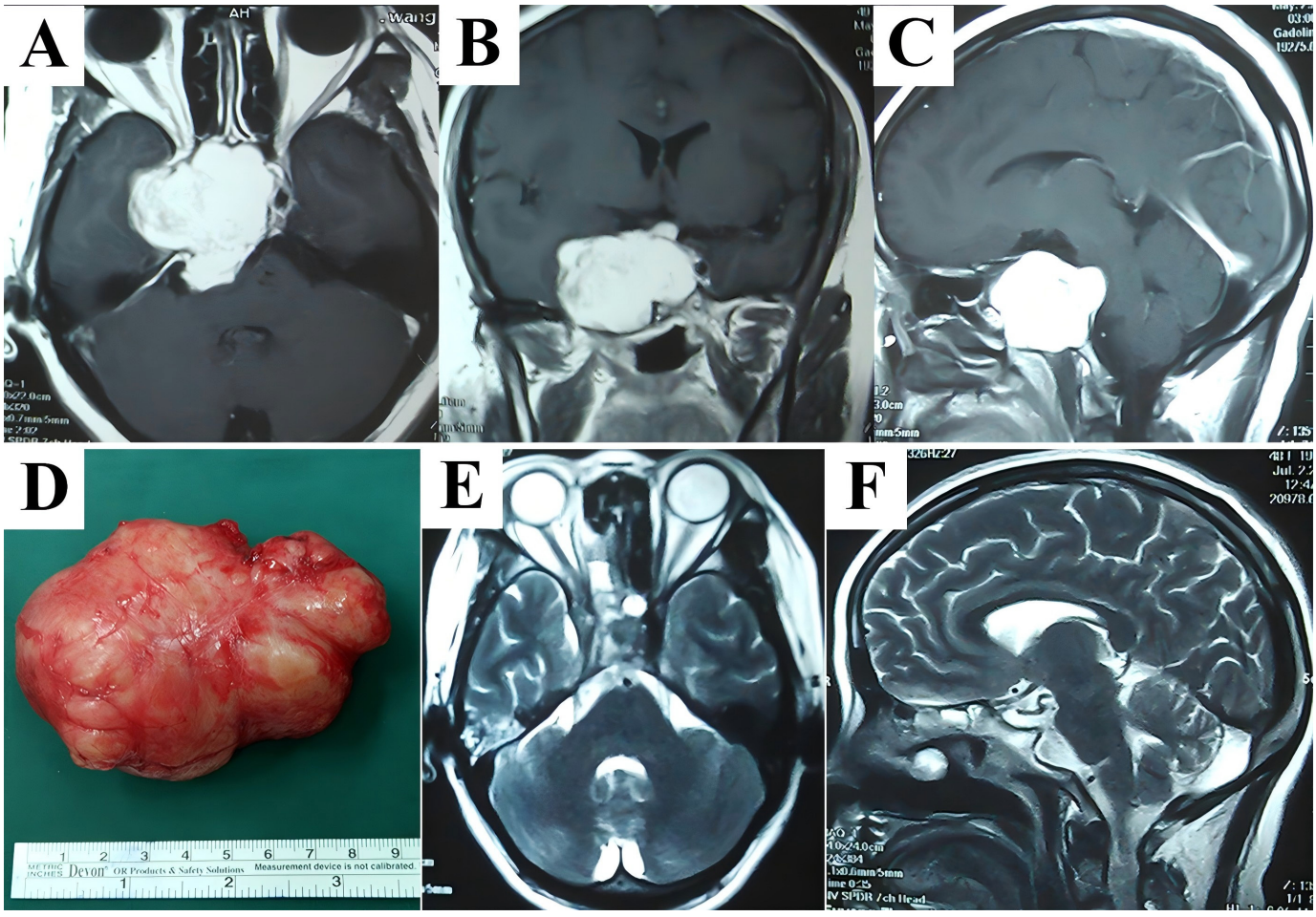
A 59-year-old man received transcranial surgery for skull base schwannoma 5 years ago. Although pathological examination found tumor exhibiting characteristics of active proliferation, he did not undergo postoperative radiotherapy. The major complaints for which he sought medical help included blurring, ptosis, limitation of extraocular movements. An extensive tumor occupying the parasellar area, Meckel's cave, temporal fossa, PPF, ITF, and parapharyngeal space was depicted in contrast T1-weighted MRI (Fig. 4A-C). The maxillary swing approach was selected, which could provide enhanced lateral exposure of the tumor that predominantly allocated within extracranial space. The recurrent tumor firmly adhered to the adjacent tissues and challenged the dissection planes. Under direct visualization, not only stripping of tumor from lateral wall of the CS in a single piece but confirmation of intact dura and negative margins by intraoperative fresh-frozen sectioning were performed to obtain local disease control (Fig. 4D). Postoperative MRI showed total resection of the tumor (Fig. 4E&F). The patient developed trismus and palatal fistula after surgery. He wore the obturator dental plate to facilitate swallowing, and the majority of the fistulae shrunk with time accompanied by improvement of the trismus. The patient who had a definitive histological diagnosis of the malignant peripheral nerve sheath tumor (MPNST) (WHO Ⅲ) refused to receive adjuvant radiotherapy. Fortunately, n o locoregional tumor recurrence was observed after a period of 129 months.

Discussion

The skull base represented a complex intersection between the sellar, clivus, petroclival region, orbits, PPF, ITF, paranasal sinuses, nasopharynx, etc [4, 17]. Extensive lesions may wholly occupy several compartments or even cross the midline towards the contralateral side in communication with subdural space, leading to the surgical frustration and therapeutic dilemma [10, 11]. Therefore, surgical approach is indispensable to provide excellent exposure of particular locations from various angles and allow for direct visualization of dissection planes [10].

The skull base lesions occupying multiple compartments have been reached by several open surgical techniques, such as Fisch pre-auricular infratemporal approach and Derome transbasal approach [18, 19]. Recently, there has been a trend away from traditional approaches towards endoscopic procedure which may improve visualization and achieve minimal invasion. The endoscopic techniques appear to have progressively supplanted open surgery for benign tumors involving the cranial fossa [6, 11]. Although piecemeal resection under improved endoscopic visualization can provide excellent outcomes [8, 14, 15], open surgery seems comparable in special circumstances including **i**) huge extensive masses occupying multiple compartments, **ii**) hypervascularized lesions exhibiting features of significant fibrosis or stone-like calcification, and **iii**) recurrent tumors firmly adhering to the adjacent tissues and distorting the anatomical landmarks.

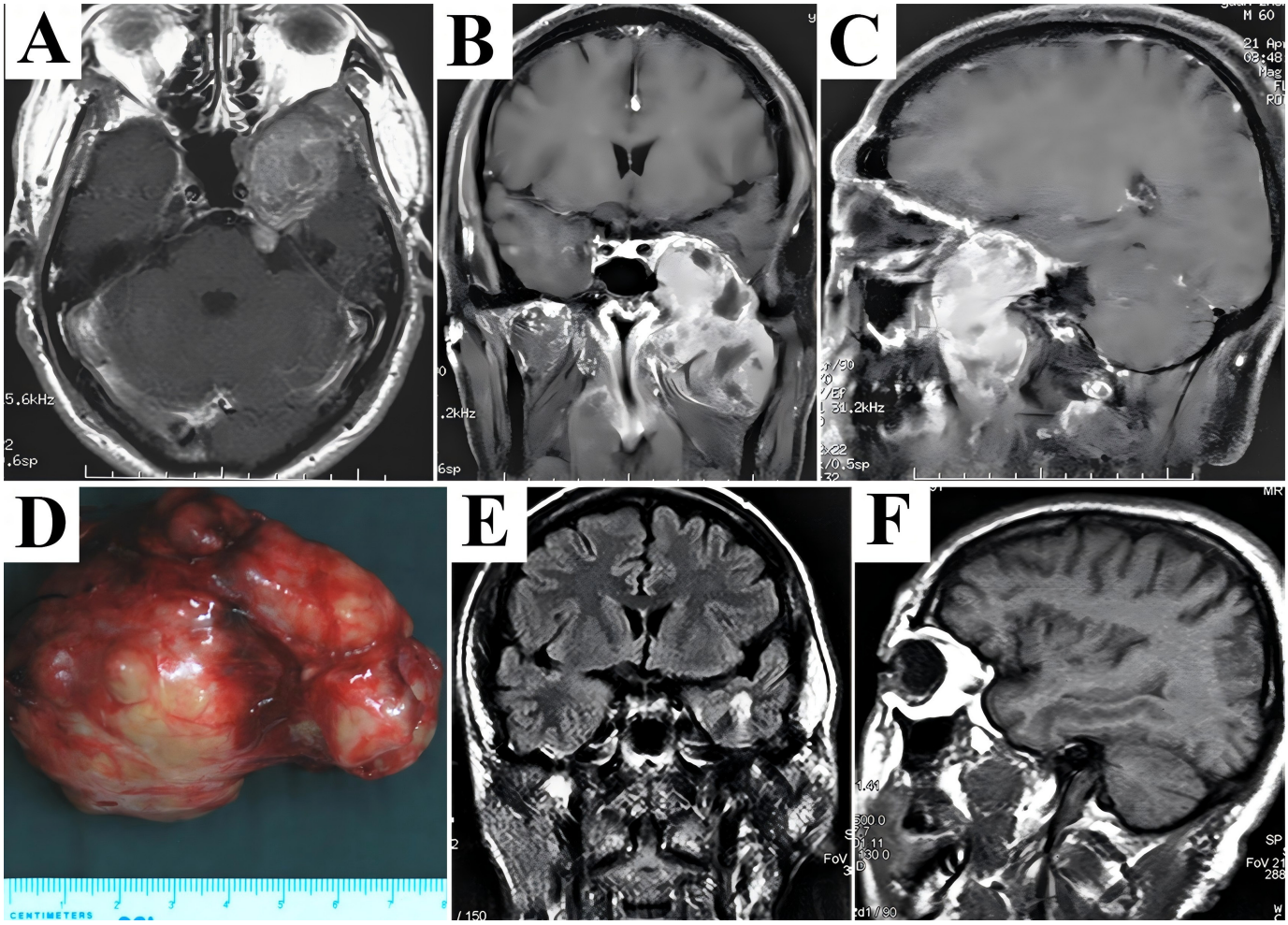
Figure 3. A hypervascularized schwannoma migrating across the midline to the contralateral side was totally resected as a whole. Vivid contrast enhancement was shown in T1-weighted MRI in axial (**A**), coronal (**B**), and sagittal (**C**) planes. The lesion was peeled off along its capsule surface in a single piece under an almost bloodless view. Histopathological examination of excised specimen (**D**) determined the diagnosis of schwannoma, and postoperative T2-weighted MRI in axial (**E**) and sagittal (**F**) planes demonstrated an absence of tumor. MRI, magnetic resonance imaging.



First successfully performed by Joseph Gensoul in 1827, the maxillectomy inspired Irwin Moore who practiced the lateral rhinotomy almost a century later, paving the way for addressing central skull base lesions [20]. In 1986, Hernández pioneered an access to the clivus and retromaxillary areas by temporary disarticulation of the maxilla attached to the cheek, which was then named maxillary swing approach [7, 21, 22]. The indications were expanded by Wei et al. who provided a sufficient exposure down to the level of the parapharyngeal space [7, 22]. The study period (2006-2016) coincided with rapid advances in endoscopic skull base techniques. During this period, our team gradually integrated endoscopic evaluation into preoperative planning: after 2012, endoscopic exploration was routinely performed for potential candidates, and MSA was reserved for lesions that failed endoscopic feasibility assessment (e.g., extensive calcification, firm adhesion to neurovascular structures, or multi-compartment involvement beyond endoscopic reach). This dynamic adjustment ensured that MSA was selected only when endoscopic approaches were deemed inadequate. More recently, in the endoscopic era, maxillary swing approach still enabled sufficient visual field and working space by performing osteotomies at the pterygoid plates, pterygoid process, zygomatic arch, and nasal septum, with possibilities of further identification of the contralateral compartments [3, 10, 21-24]. Comparative analysis with endoscopic outcomes for similar complex lesions further supports the niche role of MSA. Previous studies on endoscopic approaches for multi-compartment skull base lesions have reported gross total resection rates of 65-80% for large (>5 cm) or recurrent tumors, with higher complication rates (e.g., CSF leak in 15-25% and residual tumor in 10-20%) [11,14]. In contrast, our series achieved 100% gross total resection with manageable complications (e.g., CSF leak in 1 case, 6.25%), which may be attributed to MSA's advantage in direct visualization and circumferential dissection of hypervascular or fibrotic lesions. However, it should be noted that endoscopic approaches remain superior for small to medium-sized, non-calcified, and midline lesions with minimal extracranial extension, highlighting the complementary role of MSA in complex scenarios.

In the present study, we adopted the maxillary swing approach to address extensive lesions in the skull base. Based on our retrospective data, we consider that maxillary swing approach can be an alternative option to endoscopic surgery in some circumstances. **(i) Adequate visualization for extirpation of extensive lesions** - Surgical freedom and angle of attack are determined by the soft tissue and bony structures which

Figure 4. Recurrent MPNST (WHO Ⅲ) allocated in the skull base were completely resected via maxillary swing approach. A large and extensive tumor occupying multiple compartments including the parasellar area, Meckel's cave, temporal fossa, PPF, ITF, and parapharyngeal space as depicted in axial (**A**), coronal (**B**), and sagittal (**C**) contrast T1-weighted MRI exhibited heterogeneous enhancement due to necrosis or cystic degeneration. The patient experienced tumor resection in a piecemeal fashion before admission to our hospital. In contrast, following reflection of the maxilla, we identified and removed the recurrent tumor as a whole (**D**). Postoperative MRI confirmed total removal of the tumor (**E, F**). MPNST, malignant peripheral nerve sheath tumor; PPF, pterygopalatine fossa; ITF, infratemporal fossa; MRI, magnetic resonance imaging.



impede the maneuverability of instruments [1, 25]. Through a more restrictive corridor, reaching deeper and more lateral lesions which grow into multiple compartments as illustrated in Case 1 and 2 may be more difficult using the endoscopic techniques because surgical procedure is limited by the nares, nasolacrimal duct, and bony walls of paranasal sinuses [8, 25, 26]. In our series, the maxillary swing procedure has provided enhanced exposure as a result of lateral entry on the horizontal plane and direct anteroposterior angle of attack in the sagittal section. The line of vision on surgical cavity was straight in almost all cases. Furthermore, significantly augmented working space was achieved, decreasing surgical struggle caused by conflict between frustrated angled instrumentation. **(ii) Circumferential stripping of hypervascularized masses with fibrous or calcified consistency** - It has to be emphasized that, the choice of surgical approach should be partially determined by the characteristics of lesions [13]. Circumferential dissection of hypervascularized and hard mass as a whole is feasible since severe bleeding cannot be avoided effectively when performing piecemeal resection and few surgical instruments can provide fragmented debulking as shown in Case 2 and 3. Therefore, a widened approach should be used to facilitate devascularization and insure safe dissection of neurovascular structures [12-15]. In our study, the maxillary swing approach provided direct access to the fibrous or calcified lesions and sufficient margins around them which were then peeled off in a single piece, resulting in minimal blood loss. **(iii) Identifying dissection planes of recurrent tumors** - The anatomical landmarks of the cranial fossa have always been distorted after local relapse, particularly when patients experienced adjuvant therapy [13]. The recurrent tumors that are firmly adherent to the surrounding structures have challenged the dissection planes and represented an obstacle to the endoscopic procedure [12]. Following swing of the maxilla, we established a spacious access to identify tumor interface and detached the planes of adherence using sharp dissection, obtaining tumors eradication without dividing them. The negative surgical margins were confirmed by intraoperative fresh-frozen sectioning in case of malignant tumor (see Case 4).

Previously, the maxillary swing approach has been associated

with unacceptable aesthetic sequelae caused by prominent postoperative facial scars [8, 14, 16, 27]. The early embryological development of the face is accomplished by merging and fusion of the frontonasal process, maxillary processes, medial nasal processes, lateral nasal processes, and mandibular processes [28]. The merging and fusion sites such as the philtrum, sides and alae of the nose, and lateral canthus have a shortage of dermis [26, 28]. The dermal injuries have been identified as contributing to scar formation. Hence, these merging and fusion sites are potential regions where surgical incisions can be made with decreased likelihood of facial scars formation [8, 10, 26, 28]. In our series, we planned the Weber-Ferguson incision, and the cosmetic outcomes were acceptable since almost no visible facial scars could be found 3 months after surgery. Despite its advantages, MSA has inherent limitations: (1) Compared with endoscopic approaches, it is associated with longer operation time (mean 380 min in our series) and hospital stay (mean 14 days vs. 7-10 days for endoscopy); (2) Potential complications include trismus (1 case, 6.25%) and palatal fistula (1 case, 6.25%), which require prolonged rehabilitation; (3) It is technically demanding, requiring expertise in craniofacial reconstruction to avoid skull base defects. These limitations emphasize that MSA should be considered as a complementary rather than universal approach.

Although the maxillary swing approach is recommended for large extensive lesions allocated in the skull base, perioperative complications and prolonged recovery time call the principles of minimally invasive surgery in question particularly in the endoscopic era. In our retrospective study, patient selection bias may exist particularly in the beginning of the series. With regard to diverse pathologies of lesions, it is difficult to draw direct comparison of prognostic factors between different cohorts due to a limited number of patients. Future prospective randomized controlled trials comparing outcomes would better characterize this technique and demonstrate the surgical indications.

Conclusions

We have provided case illustrations and reviewed clinical data regarding the maxillary swing approach for skull base lesions. The preliminary results suggest that this open procedure can be used to supplement endoscopic surgery in management of huge, extensive, and hypervascularized masses with fibrous or calcified consistency. Sufficient exposure leads to complete excision in a single piece with acceptable morbidity and fair cosmetic results. Patients harboring recurrent tumors also benefit from this procedure.

Author Contributions

JW and HQ designed the study and revised the manuscript. HL and HC drafted the manuscript. QL and CF reviewed and revised the manuscript. All authors made substantial contributions to the study and approved the submitted version.

Acknowledgements

The authors also wish to thank Meng-Yan Zhang for technical assistance.

Funding Information

This study was supported by the CAMS Innovation Fund for Medical Sciences (2022-I2M-C&T-B-063), National Natural Science Foundation of China (No. 82472722) and Beijing Hope Run Special Fund of Cancer Foundation of China (No. LC2022B18).

Ethics Approval and Consent to Participate

All procedures performed in studies involving human participants were con-ducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1975 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all the patients included in the study.

Competing Interests

The authors declare that there is no conflict of interest regarding the publication of this article.

Data Availability

Not Applicable.

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Use of Autologous Hematopoietic Stem Cell Transplantation for a Patient with Primary Nasal NK/T-cell Lymphoma Combined with Hemophagocytic Syndrome

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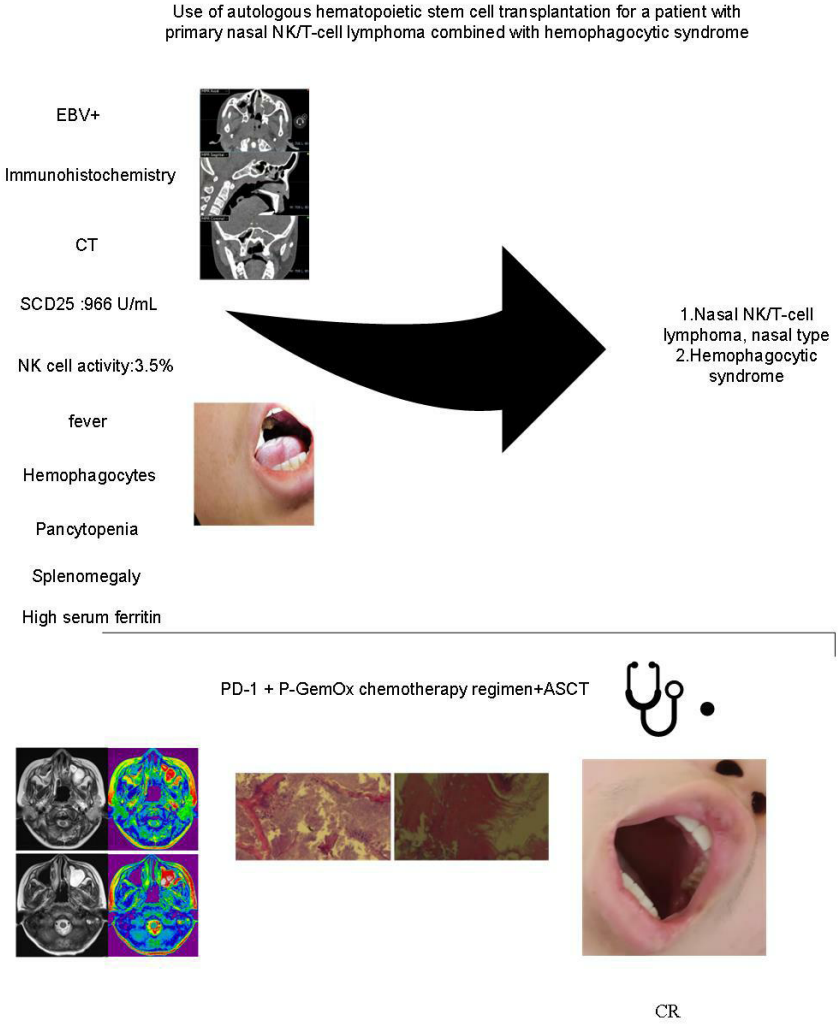
Graphical Abstract



https://doi.org/10.71321/sx17sm66

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Use of Autologous Hematopoietic Stem Cell Transplantation for a Patient with Primary Nasal NK/T-cell Lymphoma Combined with Hemophagocytic Syndrome

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Received: 2025-06-19 | Accepted: 2025-07-30 | Published online: 2025-08-10

Abstract

Extranodal NK/T-cell lymphoma, nasal type (ENKTCL-NT) is a type of primary nasal peripheral T-cell lymphoma, which is a rare type of non-Hodgkin's lymphoma, especially with hemophagocytic syndrome (HPS), and can easily lead to clinical misdiagnosis. The disease is dangerous, it progresses rapidly, and the treatment is ineffective. This article reports a case of ENKTCL-NT with HPS, which involves the primary nasal cavity invading the oral cavity. Patients attain improved remission outcomes with autologous hematopoietic stem cell transplantation (ASCT) in combination with chemotherapy. This paper reviews current domestic and international research and summarizes diagnostic and therapeutic approaches to enhance clinicians' comprehension of the disease.

Keywords: Extranodal NK/T-cell lymphoma, hemophagocytic syndrome, autologous hematopoietic stem cell transplantation.

Case report

We present a rare case of Extranodal NK/T-cell lymphoma, nasal type (ENKTCL-NT) involving the oral and maxillofacial region with HPS in a 14-year-old male. The patient initially presented with sinusitis-like symptoms but exhibited poor responsiveness to conventional treatment. He was subsequently diagnosed with Epstein-Barr virus (EBV)-positive T-cell proliferative disease at a renowned hospital in Shanghai. Positron emission tomography-computed tomography (PET-CT) revealed increased fluorodeoxyglucose (FDG) uptake in the cervical lymph nodes, and lymph node biopsy suggested lymphoma. ENKTCL-NT was confirmed via immunohistochemical analysis. Within months, the tumor rapidly progresses to involve the oral and maxillofacial region, leading to severe complications, including nasal and oral bleeding, hemorrhagic shock, and HPS. Given the aggressive nature of the disease, a multidisciplinary team consultation was conducted to confirm the diagnosis. The patient achieved complete remission (CR) following standard chemotherapy in combination with autologous hematopoietic stem cell transplantation (ASCT). Free skin grafting, performed by the Department of Stomatology, effectively restored the patient's facial appearance. ENKTCL-NT is a rare malignancy, particularly when accompanied by HPS. Its early clinical manifestations are often nonspecific, frequently leading patients to initially present in otolaryngology departments due to nasal symptoms. This case report details the successful application of chemotherapy combined with ASCT in the treatment of ENKTCL-NT with hemophagocytic syndrome (HPS), offering valuable insights for clinical management.

A patient (hospital ID: 1665984) who was a 15-year-old male was admitted to the Department of Pediatrics at Bozhou People's Hospital on June 4, 2025. Medical history: A patient with a four-day history of fever and cough was admitted to the Department of Pediatrics at Bozhou People's Hospital on November 3, 2023. A coronal CT scan of the paranasal sinuses revealed inflammation in the left frontal sinus, ethmoid sinus, sphenoid sinus, and maxillary sinus. Additionally, hypertrophy of the bilateral inferior turbinates and slight deviation of the nasal septum were noted. Sinusitis was suspected; however, no improvement was observed following anti-infective treatment. The patient was subsequently transferred to a pediatric medical center in Shanghai. There were some atypical lymphocytes in the patient's peripheral blood, and the patient was EBV positive; therefore, he was considered to have EBV-positive T-cell proliferative disease in the pediatric medical center in

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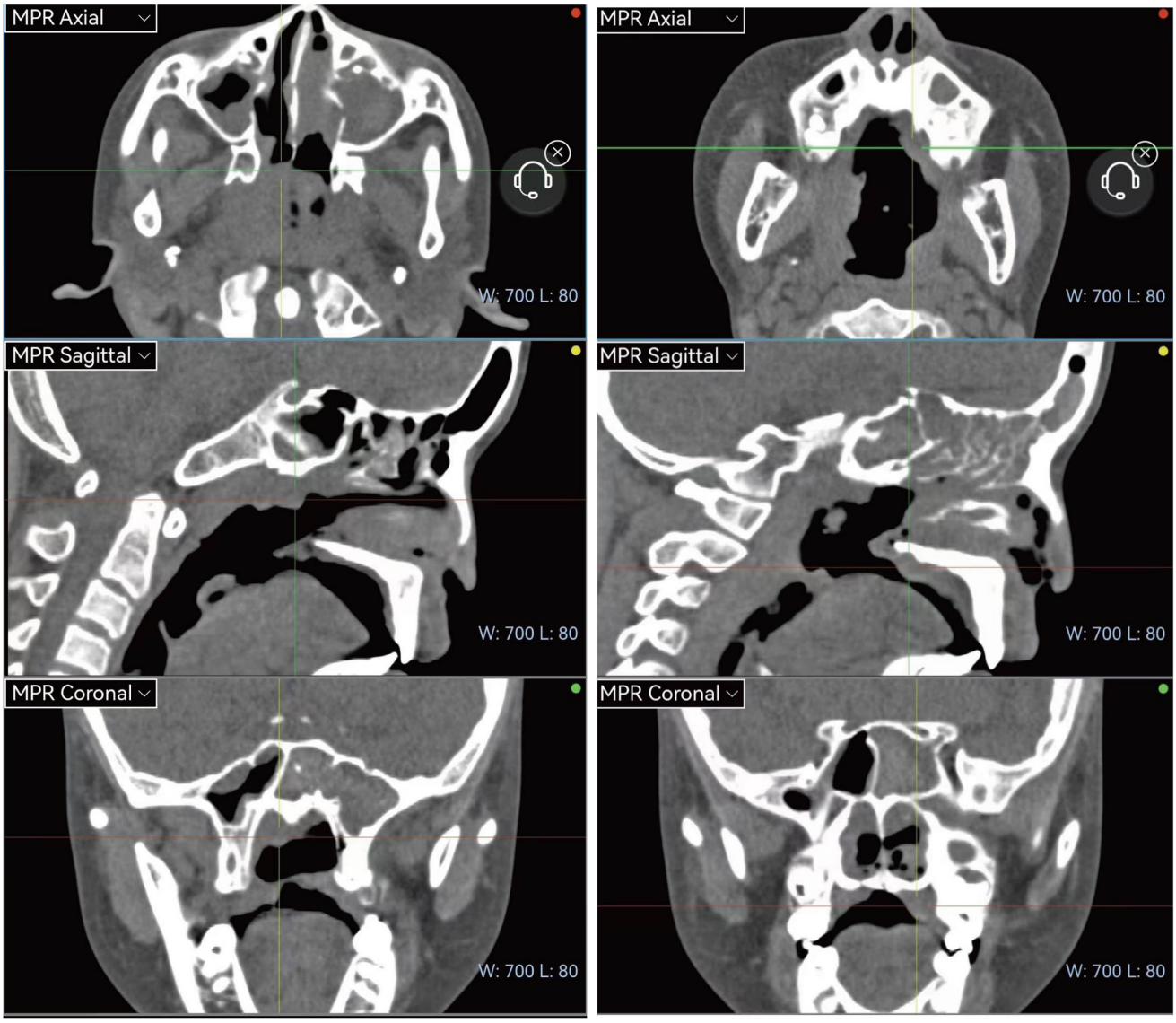
Shanghai. Further examination and treatment are recommended. However, the family declined this option because it was far from home and not convenient to take care of.

The patient was admitted to the PICU+NICU of our hospital due to oral bleeding on January 8, 2024. The diagnoses included (1) hemorrhagic shock and (2) EBV-positive T-cell proliferative disease in children. Following consultation with the otolaryngology department, tamponade compression was attempted to control the bleeding; however, the patient did not cooperate. Tracheal intubation and ventilator-assisted breathing were then initiated. Physical examination revealed swelling of the nasal mucosa, absence of most of the left soft palate with communication with the nasal cavity, visible blood clots, and significant oozing of blood. After sedation during intubation, further exploration of the oral and nasal cavities revealed no obvious signs of active bleeding. He was considered to have EBV-positive T-cell proliferative disease at the pediatric Medical Center in Shanghai. Therefore, PET-CT imaging is necessary, and PET-CT imaging demonstrated increased FDG metabolism in cervical lymph nodes in January 2024.

On January 22, 2024, nasopharyngeal CT revealed thickening of the soft tissue on the right posterior wall of the nasopharynx, slight narrowing of the right parapharyngeal space, and a soft tissue thickening shadow in the left palate with uneven density. No markedly enlarged lymph nodes were observed adjacent to the carotid sheath bilaterally (Figure 1). PET-CT combined with basic patient information, lymph node biopsy, and nasal mass biopsy revealed EBV-positive T-cell proliferative disease. Following consultation with the hematology department of our hospital, lymphoma was highly suspected, and immunohistochemical analysis was recommended for further evaluation. During the disease course, the patient pre-

Figure 1. CT of the patient showing thickening of the soft tissue in the right posterior wall of the nasopharynx, mild narrowing of the right parapharyngeal space, and thickening of the soft tissue in the left palate with heterogeneous density. No significant enlargement of the lymph nodes adjacent to the bilateral carotid sheaths was observed. The paranasal sinus mucosa is thickened, and flaky soft tissue density shadows are evident.



sented with recurrent fever, pancytopenia, and splenomegaly. If necessary, serum ferritin, blood lipids, NK cell activity, and soluble CD25 (SCD25) should be measured to determine the presence of HPS. Pathological examination of the nasal mass suggested NK/T-cell lymphoma. On January 17, 2024, immunohistochemistry results of the nasal mass revealed an unclear lymphoid follicular structure, with the following markers: ALK (-), BCL2 (-), BCL6 (-), CD2 (-), CD4 (-), CD8 (-), CD15 (-), CD20 (-), CD38 (-), CD56 (+), epithelial marker (EAM) positive, Ki-67 (85%), LCA (+), MPO (-), PAX5 (-), TDT (-), TIA-1 (+), and in situ EBER (70%+). Based on these findings, the patient was diagnosed with nasal-type NK/T-cell lymphoma (nasopharyngeal lesion). The laboratory results revealed that the SCD25 level was 966 U/mL, the NK cell activity was decreased (3.5%), and the ferritin level was >1675.56 ng/mL. Hemophagocytes were observed in peripheral blood smears. This study was performed in accordance with the latest diagnostic guidelines and standards. The final diagnosis included the following: 1. Nasal NK/T-cell lymphoma, nasal type (Lugano stage IV, NKTCL prognostic score 3, high-risk group)[1]; 2. Oral bleeding; 3. Hemorrhagic shock; 4. Hypoproteinaemia; 5. Hemophagocytic syndrome [6]. Following initial symptomatic management, including anti-infection therapy and volume expansion, patients with poor general conditions and those with HPS cannot tolerate the toxicity of high-intensity regimens. The use of a reduced-dose P-GemOx regimen can reduce the risk of bone marrow suppression and organ damage.

The patient underwent a reduced-dose P-GemOx chemotherapy regimen (gemcitabine 1 g on days 1 and 8; oxaliplatin 150 mg on day 1; pegaspargase 3500 IU on day 2), accompanied by active management of hemophagocytic syndrome. On February 16, 2024, the patient received a reduced-dose PD-1 + P-GemOx regimen, consisting of gemcitabine (1 g on days 1 and 8), oxaliplatin (150 mg on day 1), pegaspargase (3500 IU on day 2), and camrelizumab (200 mg on day 4). Hematopoietic stem cell mobilization was initiated on April 22, 2024, using the VP16 regimen (1.6 g/m^2, total dose 2.2 g). Peripheral blood stem cells were successfully harvested on May 5, 2024, yielding 200 mL of enriched product with a CD34+ cell count of 2105.28 cells/μl. The reduced-dose PD-1 + P-GemOx chemotherapy regimen was continued on June 3 and July 1, 2024. Beginning on August 10, 2024, the patient received BeEAM conditioning therapy (IBM: 1.5 m^2), including bendamustine (120 mg/m^2 , total dose 175 mg, administered on days −8 to −7), cytarabine (200 mg/m^2 , total dose 250 mg, on days −6 to −3), etoposide (200 mg/m^2 , total dose 250 mg, on days −6 to −3), and melphalan (140 mg/m^2 , total dose 200 mg, on day −2). Symptomatic and supportive care measures—hydration, alkalinization, and antiemetic therapy—were provided throughout the course. On August 18, 2024, 400 mL of stem cells were reinfused without complications, resulting in successful engraftment. The patient was subsequently discharged. Maintenance therapy with camrelizumab (200 mg every two months) was initiated on October 13, 2024.

The patient underwent extensive resection of the palatal lesion, free composite tissue transplantation, free skin grafting, full-thickness skin grafting, and tooth extraction at the Department of Stomatology at our hospital on January 8, 2025. A

Figure 2. Pathological examination of the patient's left mandible revealed the absence of tumor cells.

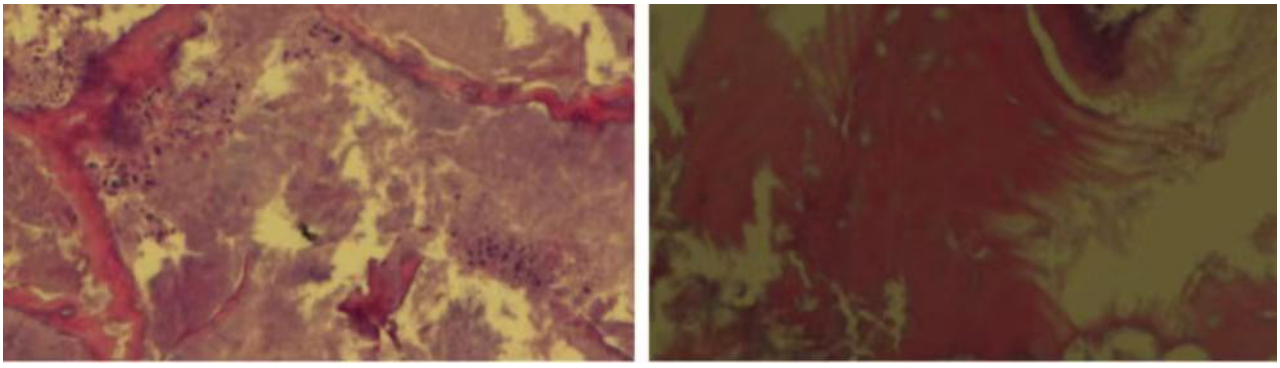
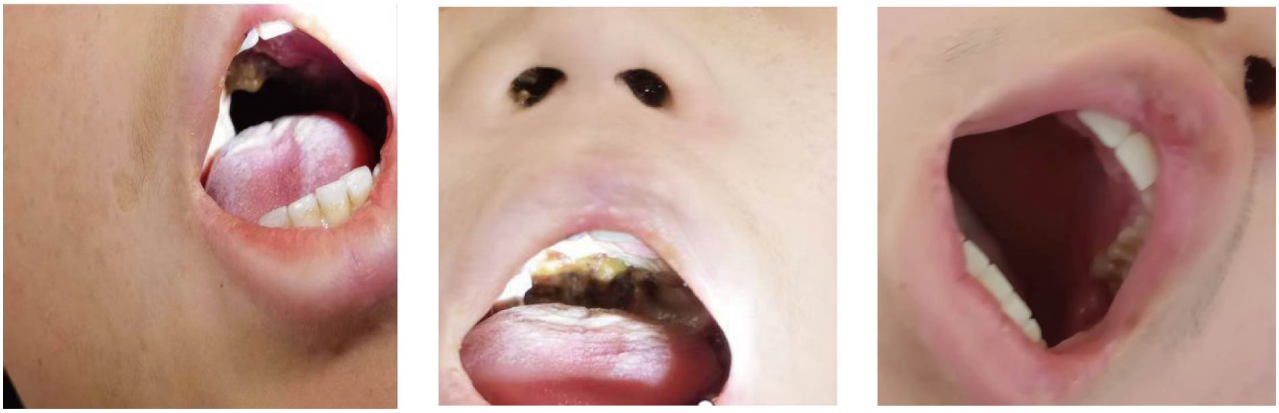
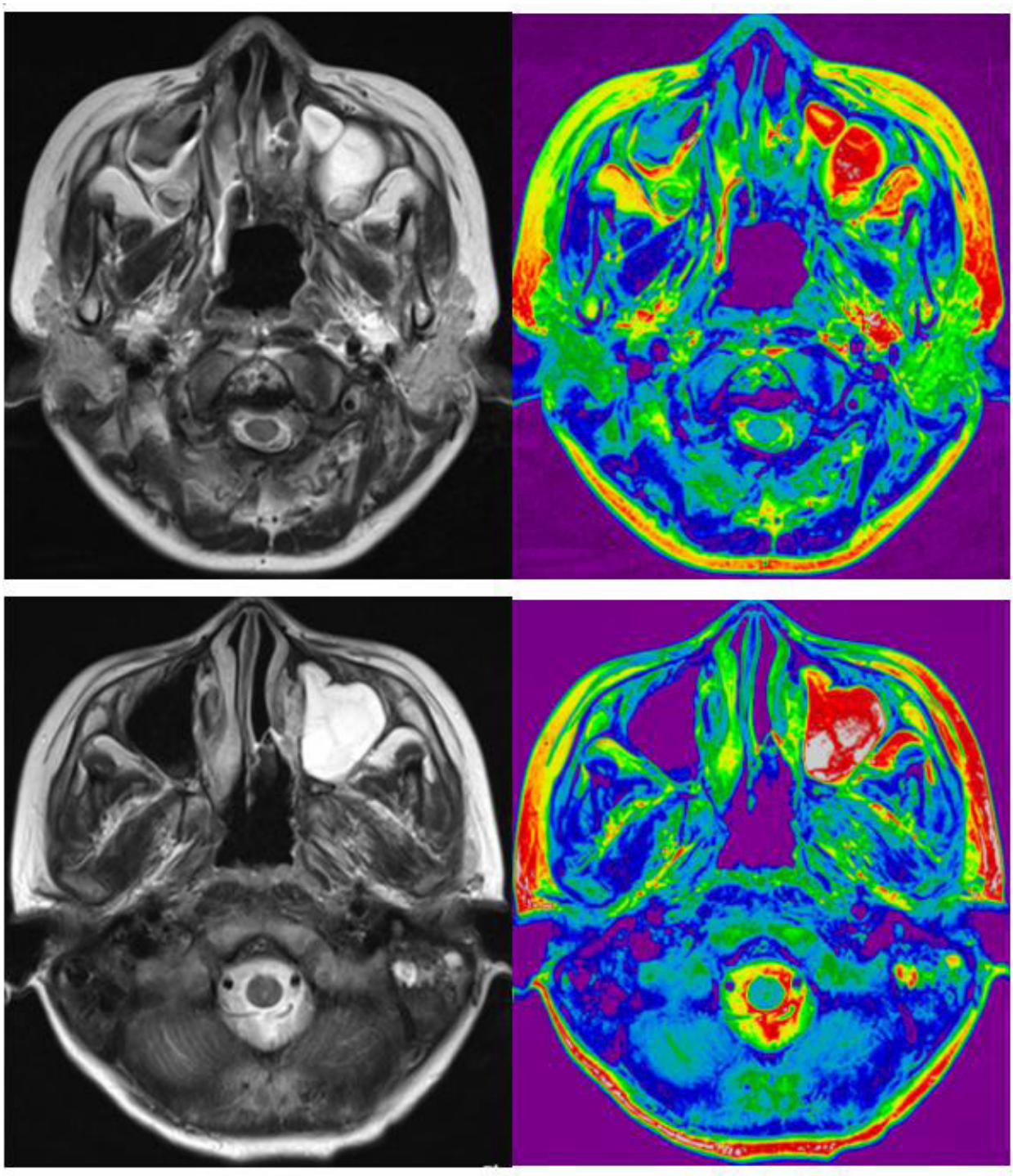


Figure 3. Prior to treatment, the patient's ulcerated maxilla exhibited communication with the nasal cavity, accompanied by a significant amount of yellow secretions and pus (as shown in the first two images). The third image illustrates the condition post-treatment.



pathological examination of the palate conducted on January 9, 2025, revealed degenerative osteoid tissue and extensive inflammatory necrotic tissue, with no evidence of malignancy (Figure 2). The surgical flap healed successfully without signs of infection. The patient has since shown favorable recovery, with satisfactory reconstruction of the nasal cavity and maxillofacial regions (Figure 3), and the treatment outcome was classified as CR. On March 11, 2025, due to localized swelling, the patient underwent a second resection of the left jaw under local anesthesia. Histopathological analysis of the left maxilla showed extensive infiltration of acute and chronic inflammatory cells within fibrous connective tissue covered by squamous epithelium, accompanied by granulation tissue hyperplasia. The focal areas exhibited mild lymphocytic enrichment, and occasional inflammatory exudates and necrotic-like tissues were observed. No neoplastic cells were identified in the pathological tissue (Figure 4), suggesting stable disease.

Figure 4. Significant reduction in tumor lesions observed via MRI before and one month after treatment (autologous hematopoietic stem cell transplantation combined with chemotherapy).



Discussion

ENKTCL-NT is a subtype of non-Hodgkin lymphoma and constitutes a specific form of peripheral T-cell lymphoma [1]. Lesions may involve the skin, oral cavity, gastrointestinal tract, and testes; however, rare cases have also been reported in atypical sites such as the eyes and heart. Patients presenting with ocular symptoms, including diplopia or visual disturbances, or with cardiac manifestations, such as chest tightness, pose significant diagnostic challenges. A definitive diagnosis often necessitates neuro-ophthalmological assessment, biopsy, and cardiac puncture [2]. The etiology of this disease is strongly associated with EBV infection. Accumulating evidence suggests that plasma EBV DNA load may serve as a valuable prognostic biomarker for ENKTCL-NT. Furthermore, clinical studies have established that ENKTCL-NT represents a highly aggressive malignancy with a well-documented pathogenic link to EBV infection The etiology of this disease is closely linked to EBV infection[3]. ENKTCL-NT remains a relatively rare lymphoma, with a higher incidence in East Asia and specific areas of Latin America. Evidence also points to a genetic predisposition to ENKTCL-NT, with notable ethnic and geographical patterns [4]. Consequently, diagnosing this condition in nonendemic areas poses significant challenges, often leading to underdiagnosis or misdiagnosis.

In this case, the tumor originated in the nasal cavity and subsequently invaded the oral cavity and upper jaw. Owing to the lack of noticeable symptoms in the early stages, the condition was initially overlooked. The patient sought medical attention at several hospitals and was initially misdiagnosed with sinusitis and other conditions. As the disease progressed, the patient developed oral and nasal bleeding, ultimately resulting in hemorrhagic shock due to massive hemorrhage. Early characteristic imaging findings of ENKTCL-NT, can facilitate the timely detection of the disease, underscoring the importance of identifying these radiological features. Studies indicate that about 25% of patients are accurately diagnosed with lymphoma on initial CT, around 50% are misdiagnosed, and the remaining 25% receive an indeterminate diagnosis [5]. PET-CT plays a vital role not only in the early identification of ENKTCL-NT but also in prognostic assessment. PET-CT demonstrated elevated FDG metabolism in the cervical lymph nodes, which prompted further biopsy and enabled a definitive diagnosis.

HPS is a rare disorder marked by an intense systemic inflammatory response resulting from persistent and ineffective immune activation, with hemophagocytosis serving as its defining characteristic. Common subtypes of HPS include localized aggressive hematological syndrome (LAHS), rheumatologic disease-related HPS, and EBV-associated HPS [6]. LAHS represents a highly aggressive and life-threatening clinical condition, characterized by rapid progression and a high likelihood of recurrence. The occurrence of ENKTCL-NT, in combination with HPS is extremely rare, and currently, no standardized diagnostic or therapeutic guidelines exist for this condition either nationally or internationally. Importantly, LAHS is associated with considerable mortality risk; a study involving 117 patients reported a median survival time of only 57 days. Additionally, the T/NK-LAHS subgroup exhibited a shorter median survival time compared to the B-LAHS subgroup, with survival durations of 52 days and 154 days, respectively [7]. Comprehensive treatment strategies incorporating radiotherapy have shown encouraging efficacy. Advanced radiotherapy techniques, such as volume-modulated arc therapy, provide both high therapeutic effectiveness and safety [8]. One case of splenic lymphoma-related HPS was treated using a comprehensive approach that involved a complex splenectomy in combination with chemotherapy, in the context of LAHS. The patient attained favorable clinical outcomes through timely splenectomy, followed by chemotherapy and steroid pulse therapy [9]. ASCT is frequently utilized as a subsequent therapeutic option following LAHS in combination with chemotherapy. Upon achieving disease remission, stem cell transplantation supports immune reconstitution and promotes hematopoietic recovery. ASCT is effective for both newly diagnosed and relapsed/refractory peripheral NK/T-cell lymphomas. Patients with ENKTCL-NT, particularly those with advanced-stage disease, generally face a poor prognosis.

Studies have shown that about 50% of newly diagnosed patients experience continued disease progression. Current research primarily focuses on identifying effective strategies for managing this condition and reducing relapse rates. First-line treatment combined with ASCT as consolidation therapy has been demonstrated to improve treatment efficacy and lower relapse rates. Moreover, L-asparaginase-based chemotherapy bridging ASCT has proven effective in managing ENKTCL-NT, especially in relapsed patients. In the treatment of lethal acute hemophagocytic syndrome, the timely administration of etoposide-based regimens to control hemophagocytosis, followed by ASCT upon achieving CR after chemotherapy, significantly extends progression-free survival [10]. In the present clinical case, a patient with ENKTCL-NT complicated by HPS exhibited a severe condition with rapidly progressing disease. After receiving combination chemotherapy and ASCT consolidation therapy, the patient achieved CR and remained free from recurrence during follow-up. Additionally, the patient showed favorable recovery following oral-nasal cavity and frontal facial reconstruction, underscoring a treatment approach that merits broader application.

Abbreviations

ENKTCL-NT: Extranodal NK/T cell lymphoma, nasal type; HPS: hemophagocytic syndrome; ASCT: autologous hematopoietic stem cell transplantation; PET-CT: Positron emission tomography-computed tomography; FDG: fluorodeoxyglucose; CR: complete remission; EBV: Epstein-Barr virus; VMAT: volume-modulated arc therapy; LAHS: localized aggressive hematological syndrome.

Author Contributions

Mingquan Xing(First Author): writing original draft, prepare, create, or express the content for publication, especially in writing the initial draft, including substantive translation. Chunbo Feng(CO-First Author):writing review and editing, prepare, create, or express the content for publication. Weixia Wu:Provide and verify imaging data.Help with literature search. English polishing. Yanrong Zhang:Help with literature search.

Revise the article. Siqi Zhang: writing review and revise the article. Xiaoxing Sun(CO-corresponding Author): supervision, supervise and revise the article. Hongfeng Ge(Corresponding Author):supervision, supervise and lead the planning and execution of research activities. All authors read and approved the final manuscript.

Acknowledgements

Thank you for the collaboration of our team and the support of the fund.

Funding Information

Funding: This work was supported by 1.Scientific Research Foundation of Anhui Medical University, No.2023XKJ090;2. Key research and development project of Bozhou Science and Technology Bureau,No.bzzc2024011;3.Key research and development project of Bozhou Science and Technology Bureau,No. bzzc2022013.

Ethics Approval and Consent to Participate

Bozhou Medical Ethics Review 2022 No. 25. The patient and his father provided written informed consent.

Competing Interests

The authors declare that they have no existing or potential commercial or financial relationships that could create a conflict of interest at the time of conducting this study.

Data Availability

Not Applicable.

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Cochlear Implantation in Patients with Age-Related Hearing Loss: A Bibliometric Analysis

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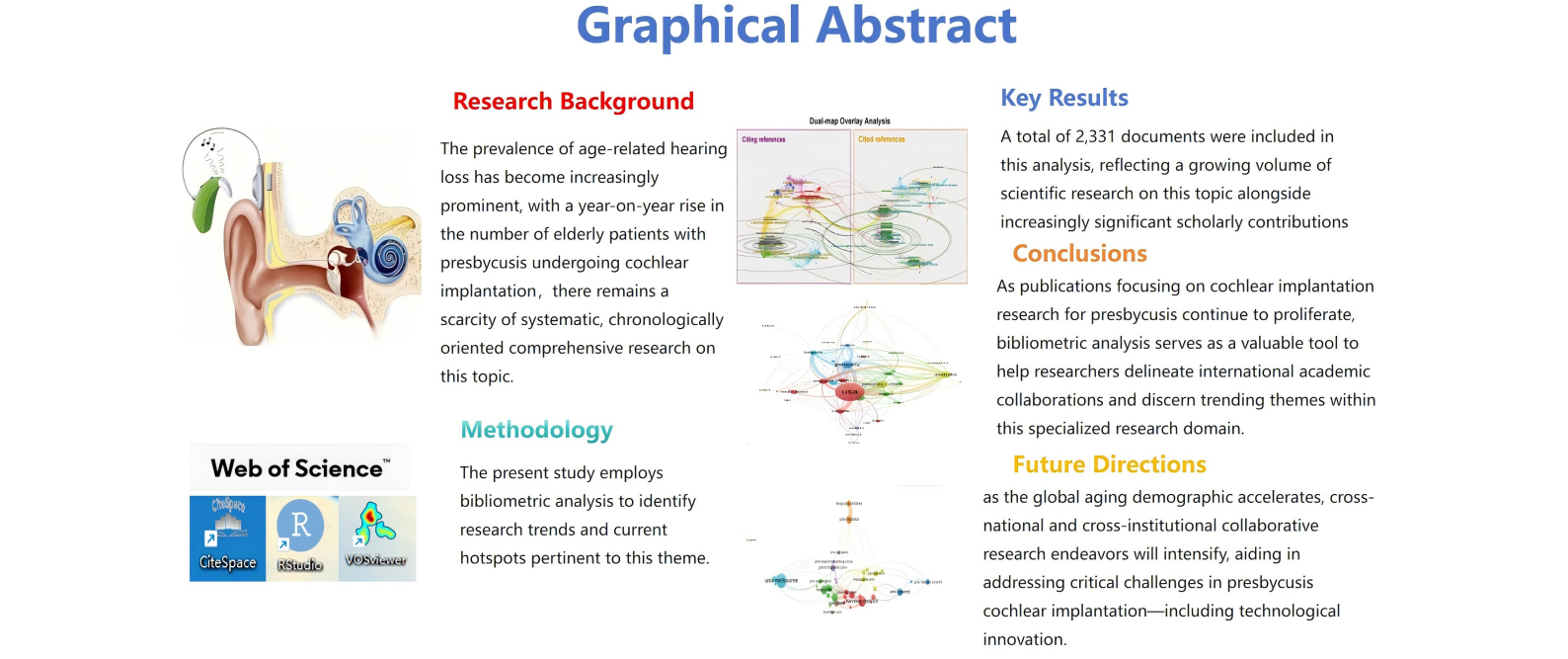
Graphical Abstract



https://doi.org/10.71321/e5ms7330

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Research Article Head and Neck Diseases Conflux

Cochlear Implantation in Patients with Age-Related Hearing Loss: A Bibliometric Analysis

Liuqing Zhang [1] **,** Guoying Han [1] , Yuxiang Wang [1] , Deshang Chen [1] , Yuefeng Han [1*]

Received: 2025-08-18 | Accepted: 2025-08-29 | Published online: 2025-09-11

Abstract

Background: The prevalence of age-related hearing loss has become increasingly prominent, with a year-on-year rise in the number of elderly patients with presbycusis undergoing cochlear implantation. Nevertheless, there remains a scarcity of systematic, chronologically oriented comprehensive research on this topic. The present study employs bibliometric analysis to identify research trends and current hotspots pertinent to this theme.

Methods: Relevant studies on cochlear implantation for presbycusis indexed in the Web of Science Core Collection database were retrieved, covering the period from January 1, 2005, to December 31, 2024. Employing bibliometric tools including Vosviewer, CiteSpace, and Bibliometrix R, systematic bibliometric statistical and visual analyses were conducted on the included research literature.

Results: A total of 2,331 documents were included in this analysis, reflecting a growing volume of scientific research on this topic alongside increasingly significant scholarly contributions. The United States maintains a leading position with 759 publications, while the University of Toronto System tops institutional rankings with 173 publications. At the author level, CARLSON MATTHEW L. leads with 40 publications, and MOBERLY AARON C. exhibits notable growth potential. In terms of research evolution, the field has progressively shifted from early investigations into etiological mechanisms toward a focus on clinical phenotypes, intervention strategies, and prognostic evaluation.

Conclusions: As publications focusing on cochlear implantation research for presbycusis continue to proliferate, bibliometric analysis serves as a valuable tool to help researchers delineate international academic collaborations and discern trending themes within this specialized research domain.

Keywords: Presbycusis; Age-related hearing loss; Cochlear implantation; Bibliometrics; Data visualization

Introduction

Presbycusis, also referred to as age-related hearing loss (ARHL), is primarily characterized by bilateral, progressive, and symmetric high-frequency hearing impairment. It may also be accompanied by tinnitus and difficulties in speech recognition [1]. With the advancement of socioeconomic development and the continuous extension of average human lifespan, the issue of population aging has intensified, and the prevalence of hearing loss among older adults has become progressively prominent. According to statistics from the World Health Organization (WHO), hearing loss has emerged as the third leading cause of disability in the elderly worldwide [2]. Presbycusis induces alterations in cognitive load and structural function of the brain. It not only impairs auditory perception but also precipitates a range of difficulties in daily communication and social interactions, resulting in reduced social participation. This, in turn, contributes to cognitive decline and dementia in older adults. Moreover, common comorbidities in the elderly—such as cardiovascular and cerebrovascular diseases—further exacerbate this progressive process [3]. Cochlear implantation is an effective therapeutic modality for patients with severe or profound sensorineural hearing loss. These patients tpicaiiy derive little to no benefit from hearing aids or experience suboptimal outcomes with such devices [4-6]. As cochlear implantation continues to gain widespread adoption, the number of presbycusis patients undergoing this procedure has been increasing year by year [7]. Accordingly, tracking research hotspots in cochlear implantation for presbycusis patients holds particular significance for predicting disease progression and optimizing patient prognosis.

Bibliometric analysis, as a data-intensive and robust approach for evaluating high-quality literature. It constructs a quantitative research paradigm for disciplinary exploration by applying mathematical and statistical techniques. It has the capacity to synthesize disparate transient research frontiers within a given field into a cohesive knowledge evolution roadmap, presented in an interactive and visual format to vividly elucidate the

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domain's intellectual landscape and emerging research trajectories [8-10]. However, there is a conspicuous paucity of bibliometric investigations specifically centered on presbycusis. To address this gap, the current study employs key bibliometric tools (Vosviewer, CiteSpace, and the Bibliometric R package) and Web of Science Core Collection data to pursue three specific objectives: (1) Analyze the spatiotemporal distribution of presbycusis cochlear implantation research (2005–2024), including tracking annual publication trends, comparing country/region output, and summarizing core institution/author characteristics. (2) Identify key research entities and hotspots: map country/institution/author collaboration networks to pinpoint leading contributors, and analyze keyword co-occurrence to clarify focus areas (e.g., cochlear implantation efficacy, cognitive impact, elderly rehabilitation). (3) Delineate theme evolution and frontier trends: via keyword citation burst analysis, trace temporal shifts in research focus (e.g., from basic mechanisms to clinical applications) and identify emerging topics for future studies. A comprehensive set of bibliometric statistical and visual analyses was conducted on the corpus to achieve these goals. Ultimately, this study aims to provide a data-driven foundation for understanding the current state of presbycusis cochlear implantation research and offer practical guidance for future clinical research and decision-making.

Materials and Methods

Data collection

Given the strengths of the Web of Science Core Collection (WoSCC)—which offers robust functionality and high-quality data—this study used the WOSCC for literature analysis [11, 12]. The Web of Science database was chosen owing to its comprehensive coverage of high-caliber, peer-reviewed research, encompassing a diverse array of journals across multiple disciplines [13].The WoSCC provides a more comprehensive range of citation data, which is critical for further enhancing the rigor of bibliometric analyses [14]. Relevant literature on cochlear implantation in presbycusis was retrieved from the core databases of Web of Science (WoS), including the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Emerging Sources Citation Index (ESCI).We, therefore, searched the database with the following search strategy: TS = ((presbycusis OR presbyacusis OR "age related hearing loss" OR "age induced hearing loss" OR "ARHL" OR "age-related hearing loss" OR "elderly hearing loss" OR "senile deafness"OR "sensorineural hearing loss") OR (("hearing impairment" OR "hearing loss" OR "hearing disorder" OR deaf OR deafness) AND ("old* people" OR "old* adult*" OR "the aged" OR "elderly people" OR "senior citizen*" OR "elderly"))) AND ("cochlear implant*" OR "cochlear prosthes*" OR “cochlear implantation”OR "bionic ear" OR "artificial cochlea" OR "CI device*" OR "electric acoustic stimulation" OR EAS OR "hybrid cochlear implant*" OR "auditory prosthes*" OR“cochlear implant surgery” OR “implantable cochlear device*”).In this study, the search timeframe was configured from January 1, 2005, to December 31, 2024, with the document type restricted to "Article" and the language limited to "English".

The bibliometric analysis tools used in this study include the BiblioMetrix R package, Vosviewer, and Citespace. Specifically, the BiblioMetrix R package was primarily used for quantitative analysis to evaluate and visualize various indicators, such as the distribution patterns of countries/regions and institutions, journal development trends, and author impact [15]. Vosviewer serves as a robust tool for co-occurrence analysis and collaborative network analysis; in particular, it was applied to reveal collaborative relationships among authors, countries, and institutions, as well as to elucidate the associations between various keywords [16]. Citespace, meanwhile, is a powerful tool for citation analysis and visualization, through which keywords exhibiting significant citation burst characteristics within the specified period were identified [17]. Relevant parameters were configured to cover time slices spanning from 2005 to 2024, with each slice representing a single year.

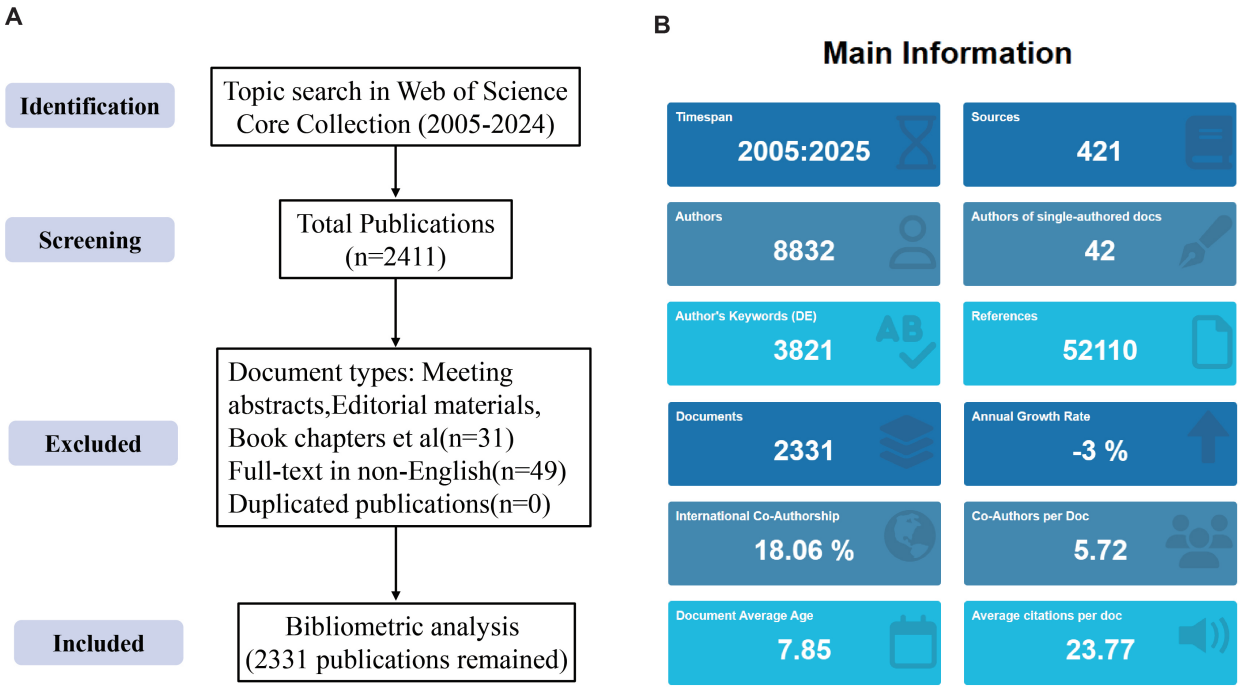
A topic-specific search was conducted using the aforementioned keywords to retrieve literature on cochlear implantation for age-related hearing loss published between 2005 and 2024.The keyword selection was designed to ensure comprehensive coverage of the research domain: it included (1) disease-specific terms for age-related hearing loss (e.g., "presbycusis," "ARHL," "senile deafness") to capture studies explicitly focusing on the condition; (2) population descriptors (e.g., "elderly people," "senior citizens") to include research that targets older adults with hearing loss but does not use "presbycusis" terminology; (3) intervention-related terms (e.g., "cochlear implant," "electric acoustic stimulation") to cover all major cochlear implantation technologies. This multi-dimensional keyword framework minimizes the risk of missing relevant studies due to terminology differences. The temporal scope was determined based on preliminary search results and practical research context: First, The volume of relevant literature from the early period is relatively limited, which not only lacks statistical representativeness but also fails to capture the mainstream research trends in this field. From a clinical technology perspective, cochlear implantation for elderly patients remained in the exploratory phase prior to 2005. It was only in the subsequent years that, driven by advancements in minimally invasive surgical techniques and the release of implant models tailored to the elderly population, research on this topic saw a marked increase. Consequently, excluding pre-2005 literature enables the analysis to focus on the mature, representative stage of research development—all while preserving the comprehensiveness of the study. To minimize errors arising from database updates, all data were downloaded on July 26, 2025. Duplicate records were excluded, and only English-language documents classified as "Articles" were included, with reviews, letters, and conference abstracts excluded from the analysis. Complete records and references were exported in "plain text" format for subsequent analytical procedures. The detailed analytical workflow is illustrated in Figure 1A.

Results

An overview of publications

Figure 1B presents a comprehensive overview of research trends in cochlear implantation among patients with presbycusis. A total of 2,331 articles were published between 2005 and 2024, involving 8,832 authors. Notably, 18.06% of these publications had international co-authors, underscoring the extent of global collaborative efforts in this field. On average, 5.72 researchers contributed to each article, highlighting the

Figure 1. Study selection and bibliometric dataset overview. (**A**) PRISMA-style flow diagram of record identification and screening in the WoSCC. The topic search (2005–2024; retrieved in 2025) yielded 2,411 records. After excluding non-article document types (meeting abstracts, editorials, book chapters and others; n = 31), non-English full texts (n = 49), and duplicates (n = 0), 2,331 publications were included for bibliometric analyses. (**B**) "Main Information" summary generated by Bibliometrix for the final dataset: 421 sources and 2,331 documents authored by 8,832 authors (42 single-authored papers), 3,821 author keywords (DE), and 52,110 references. Collaboration and impact indicators included an average of 5.72 co-authors per document, 18.06% international co-authorship, average document age of 7.85 years, average 23.77 citations per document, and an overall annual growth rate of −3%.



inherently collaborative nature of research in this domain. The cumulative number of references across all included studies reached 52,110, reflecting the extensive citation and cross-citation patterns within the literature. With an average document age of 7.85 years, the majority of research in this domain remains relatively recent.

As illustrated in the following figures, the volume of relevant publications has exhibited a sustained upward trend since 2005. Over the past two decades, the overall growth trajectory has remained ascending despite periodic fluctuations. Figure 2A, a bar chart, visually depicts both the annual article output and cumulative article count across years. A pronounced stepwise increase in cumulative publications is evident over time, effectively reflecting the continuous accumulation and steady expansion of research achievements within this domain. Figure 2B, a line graph, focuses on annual variations in publication numbers. As observed, while yearly article counts display modest fluctuations, the overarching trend remains distinctly upward. A regression fit equation is included in the figure, with a high R^2 value of 0.9596, indicating excellent model fitting and further validating the stability and reliability of the growth pattern. Notably, the cumulative number of publications in this field has accelerated markedly since 2015, signifying the expanding scope and growing academic attention to related research endeavors. Most prominently, publication numbers reached a peak in 2024, marking a landmark year of heightened research activity in the field. This surge not only underscores the intensified research enthusiasm among scholars but also highlights that "cochlear implantation for elderly patients with presbycusis" has emerged as a critical focus of contemporary scientific inquiry, with its clinical relevance and academic significance gaining increasing recognition within the scientific community.

Analysis of Countries, Institutions, and Authors

Table 1 presents a bibliometric analysis of cochlear implantation in elderly patients with presbycusis, delineating the contributions of the top 10 contributing countries in this research domain. The United States occupies the leading position with 759 publications, accounting for 32.6% of the total output, followed by China in second place with 188 publications (8.1%) and Germany in third with 163 publications (7%). These figures underscore the substantial research influence exerted by these nations in the field. In terms of collaboration patterns, the United States maintains a prominent role, leading with 668 single-country publications (SCP) and also ranking first with 91 multi-country publications (MCP).

Figure 3A illustrates the international collaboration patterns in the research field of cochlear implantation for elderly patients with presbycusis. The visualization map, generated using Vosviewer, depicts these collaborative patterns. In the map, nodes correspond to individual countries, with node size proportional to the number of publications originating from each country. Links between nodes denote co-authorship collaborations, where link thickness quantifies the strength of such partnerships—thicker links indicate more intensive aca-

Figure 2. Annual and cumulative publication trends (2005–2024). (**A**) Yearly articles (orange) and cumulative totals (blue) from WoSCC; the corpus reached 2,331 records by 2024 (217 in 2024). (**B**) Annual output with a third-order polynomial fit (y = −0.018x³ + 0.7668x² + 0.1719x + 44.289; R² = 0.9596), indicating a strong upward trend.

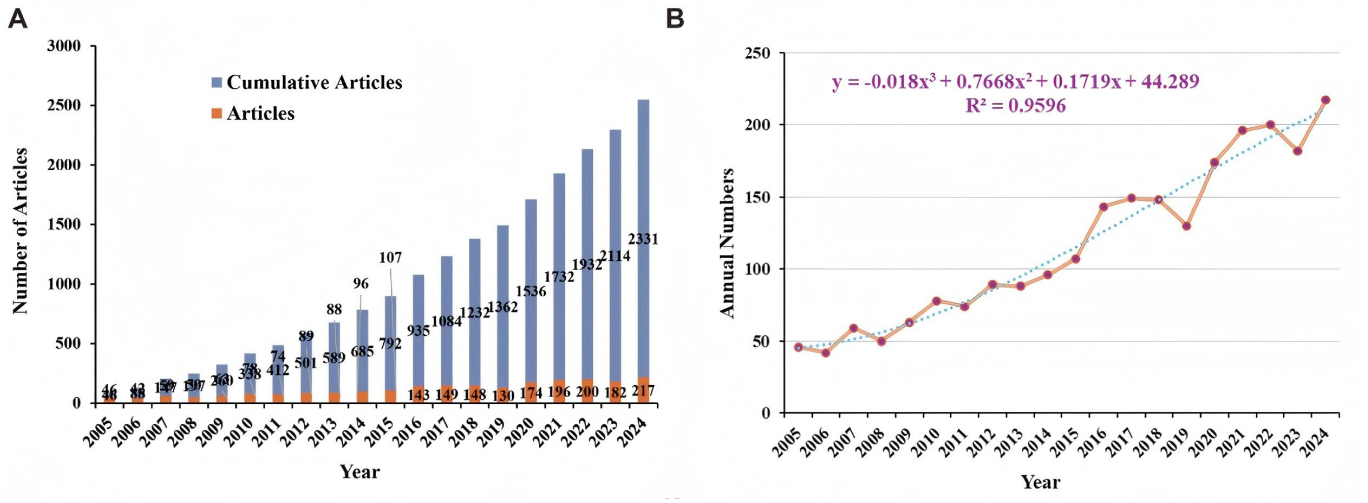


Figure 3. Collaboration networks of countries, institutions, and authors (VOSviewer). **(A)** Country co-authorship network. Node size indicates publication output; edge thickness indicates collaboration strength; colors denote clusters. **(B)** Institution co-authorship network with the same visual encodings. **(C)** Author co-authorship network; node size indicates output and edges indicate co-authorship strength.

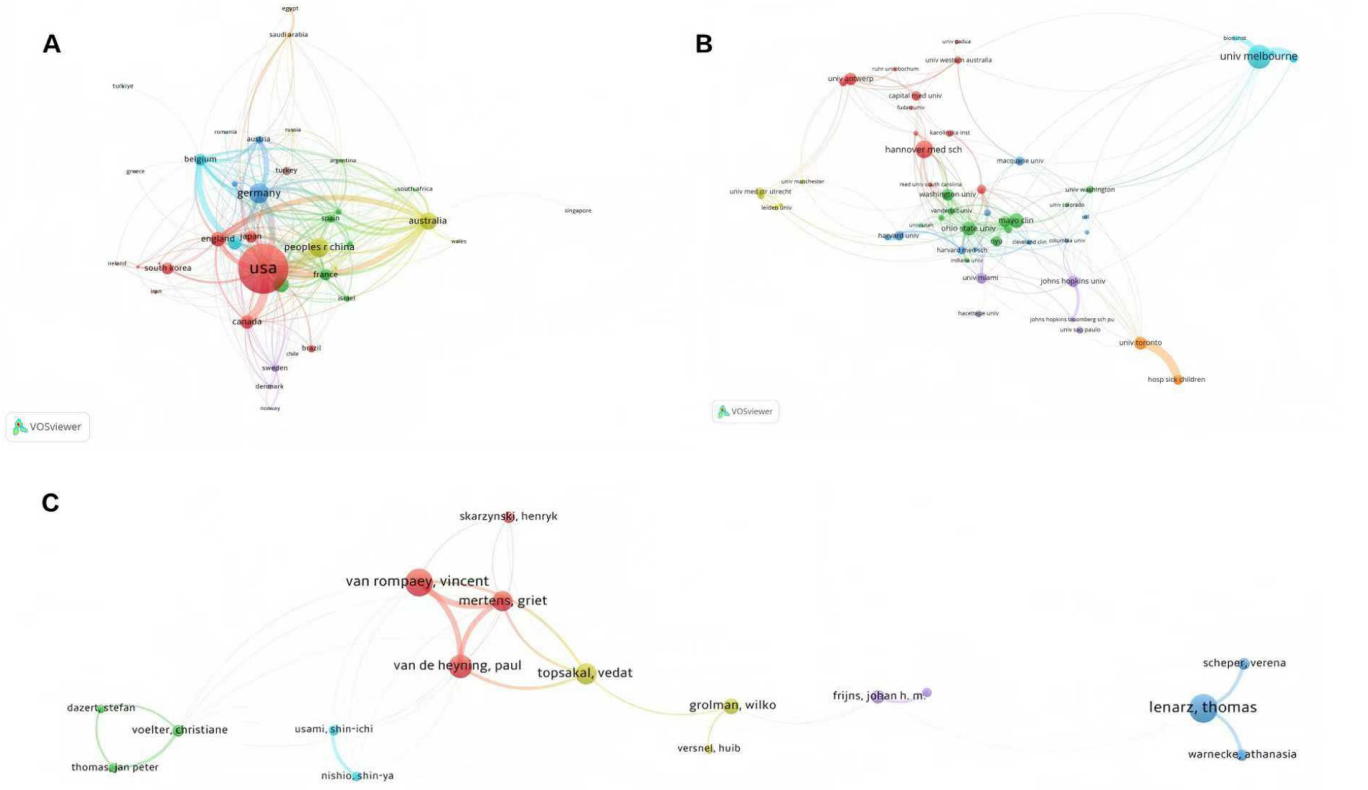


Table1. Top 10 Countries by Publication Output in Research.

Country	Articles	Articles%	SCP	MCP	MCP %
USA	759	32.6	668	91	12
CHINA	188	8.1	153	35	18.6
GERMANY	163	7	131	32	19.6
AUSTRALIA	124	5.3	86	38	30.6
ITALY	123	5.3	108	15	12.2
UNITED KINGDOM	95	4.1	69	26	27.4
NETHERLANDS	89	3.8	62	27	30.3
KOREA	87	3.7	80	7	8
JAPAN	85	3.6	82	3	3.5
CANADA	81	3.5	56	25	30.9

demic cooperation between connected countries. Colors are used to differentiate distinct research clusters, facilitating the identification of collaborative communities within the network. Additionally, the total link strength in the collaboration network serves as a metric to measure the frequency of cross-country co-authorship interactions, thereby reflecting the overall level of collaborative research activity in the field. Figure 3A specifically highlights 46 countries with a publication output of at least 11 articles. The United States, China, and Australia emerge as prominent contributors, underscoring their pivotal roles in advancing global research outcomes. Notably, robust collaborative ties exist between the United States, China, Canada, Australia, and other nations. This global collaborative network vividly reflects the international reach and inherently cooperative essence of research in the field of cochlear implantation for elderly patients with presbycusis.

Table 2 presents the top 10 institutions contributing to research on cochlear implantation for presbycusis. The University of Toronto System ranks first with 173 publications, followed by Harvard University (142 publications) and the Johns Hopkins University System (125 publications), underscoring their pivotal roles in driving advancements in this field. Derived from an analysis of 2,269 relevant institutions worldwide, Figure 3B visualizes the collaborative network among institutions engaged in research on cochlear implantation for elderly patients with presbycusis. This figure highlights 51 institutions that have published at least 15 articles in the field. Total link strength, which quantifies the frequency of co-authorship, provides valuable insights into the level of international collaboration in research on cochlear implantation for elderly patients with presbycusis.

This study identified a total of 31,909 authors who have contributed to research on cochlear implantation for elderly patients with presbycusis. Table 3 presents detailed profiles of the top 10 most impactful authors in this domain. CARLSON MATTHEW L. leads with 40 publications, closely followed by LENARZ THOMAS with 38 publications. Together, they constitute the "core high-productivity cohort" in the field, reflecting their sustained research output in presbycusis cochlear implantation and confirming their status as the most active contributors.SHEPHERD ROBERT K. ranks first with an h-index of 21, indicating that 21 of his core publications have each accumulated at least 21 citations. As a dual leader in both "high productivity and high impact" within the field, he has solidified his position as an academic authority. Notably, MOBERLY AARON C. demonstrates robust growth potential through his high m-index, emerging as a promising scholar warranting sustained attention in future research endeavors.

Figure 3C depicts the collaboration network among 46 authors who have each published at least 11 articles focusing on cochlear implantation in elderly patients with presbycusis. The total link strength within this network quantifies the frequency of co-authorship interactions between authors, thereby highlighting critical metrics in research collaboration dynamics. Notably, Vincent Van Rompaey, Griet Mertens, and Van de Heyning et al. emerge as leading collaborators, underscoring their pivotal role in facilitating international and interdisciplinary partnerships within this research domain.

Analysis of keywords

Figure 4A illustrates a network analysis of keyword co-occurrence. This network visualization depicts the co-occurrence patterns of keywords across the selected literature, where each node corresponds to a specific keyword and its size is proportional to the frequency of occurrence. Connections between nodes indicate co-occurrence within the same article, with thicker lines denoting stronger associative relationships. As shown in the figure, "children", "sensorineural hearing loss", and "cochlear implantation" form a tightly interconnected cluster, followed by their close associations with such keywords as "speech function", "performance", and "prognosis". The distinct interlinkage between quality of life, hearing loss, and impairment, revealed by the network analysis aligns with the growing

Table 2. Top 10 Institutions by Publication Output in Research.

Affiliation	Articles
UNIVERSITY OF TORONTO	173
HARVARD UNIVERSITY	142
JOHNS HOPKINS UNIVERSITY	125
UNIVERSITY OF ANTWERP	114
UNIVERSITY OF MELBOURNE	112
UNIVERSITY SYSTEM OF OHIO	102
MAYO CLINIC	100
HANNOVER MEDICAL SCHOOL	93
SEOUL NATIONAL UNIVERSITY (SNU)	88
HARVARD UNIVERSITY MEDICAL AFFILIATES	84

Table 3. Top 10 Most Impactful Authors.

Author	h_index	g_index	m_index	TC	NP	PY_start
SHEPHERD ROBERT K.	21	28	1.05	1435	28	2006
CARLSON MATTHEW L.	18	35	1.2	1257	40	2011
LENARZ THOMAS	18	33	0.9	1135	38	2006
GORDON KAREN A.	17	25	0.895	949	25	2007
PAPSIN BLAKE C.	17	28	0.895	970	28	2007
WISE ANDREW K.	17	19	0.895	1100	19	2007
MOBERLY AARON C.	15	23	1.5	679	23	2016
LIN FRANK R.	14	17	1	793	17	2012
BUCHMAN CRAIG A.	13	24	0.684	1015	24	2007
CUSHING SHARON L.	13	21	0.722	679	21	2008

international emphasis on the management of hearing disorders.

Over time, analyses of keyword citation bursts have illuminated key evolutionary trends in research priorities. The Figure 4B below illustrates the dynamics of the top 20 keywords with the strongest citation bursts over the past two decades: In the early period, terms related to etiological mechanisms predominated, such as "spiral ganglion neuron" and "neurotrophic factor," whose research momentum has gradually waned. In contrast, the explosive emergence of keywords centered on themes like "dementia," "intervention," and "impact" reflects the growing academic focus on assessing clinical manifestations and prognostic outcomes. For instance, a recent multicenter study on presbycusis demonstrated that the relationship between ARHL and cognitive impairment (CI) remains complex [18]. Another analysis based on long-term follow-up data confirmed that investigating the potential causal links between hearing loss, neural reorganization, and cognitive impairment could inform the development of novel interventions to mitigate both hearing loss and cognitive decline [19]. These trends indicate that research addressing the clinical manifestations and therapeutic strategies for presbycusis is increasingly gaining recognition.

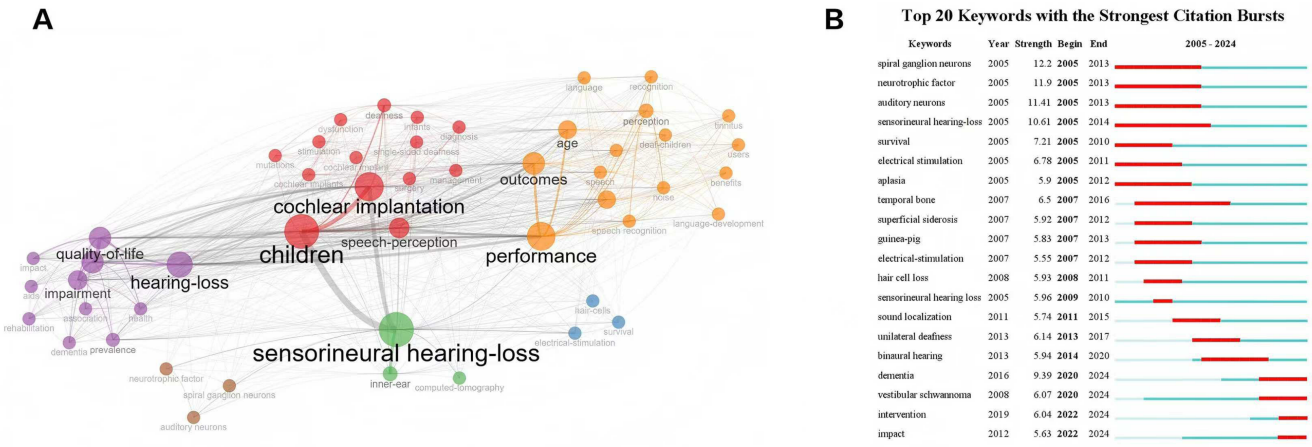
Figure 5A depicts the keyword co-occurrence network pertinent to this study. Different colors stand for distinct clusters, each containing a group of related keywords, which reflects the main research themes and hotspots in the field. It can be clearly observed that there are multiple key domains and hotspots in the research of presbycusis concerning cochlear implantation from 2005 to 2024. From hearing preservation and neuronal function to the enhancement of quality of life, these aspects indicate the research trend that has gradually evolved from the early exploration of etiological mechanisms to the aspects of clinical manifestations, intervention measures, and prognostic assessment.

Figure5B is a conceptual structure map generated via Multiple Correspondence Analysis (MCA), which is employed to visualize the semantic associations and conceptual clustering of keywords in the field of presbycusis research.Different colored areas in the figure represent distinct conceptual clusters, each containing a set of keywords that are closely related in terms of semantics or research topics. For instance, keywords in the green area such as "decline", "dementia", "isolation", and "health" primarily focus on the impacts of presbycusis on patients' cognition, mental health, and social life. Keywords in the red area like "cochlear implants", "rehabilitation", "outcome", and "quality-of-life" lay emphasis on research related to cochlear implant technology and its clinical applications as well as prognosis concerning the improvement of patients' quality of life. Keywords in the blue area including "auditory neurons", "neurotrophic factor", and "spiral ganglion neuron" are more involved in the neurobiological mechanism research of the auditory system.

Analysis of thematic evolution trends

Figure 6 presents a bibliometric analysis of cochlear implantation in presbycusis research from 2005 to 2024. The mulberry plot intuitively visualizes the data flow and interrelationships across different categories. In this figure, keywords (ID) are displayed on the left, authors (AU) in the middle, and countries involved in the research (AU_CO) on the right. Each keyword is connected to multiple authors via lines, indicating that these authors have published research on relevant topics. For example, "cochlear implants" is closely associated with several authors such as Lenarz, Thomas and Van Rompaey, Vincent, suggesting that these scholars have conducted in-depth research in the field of cochlear implantation. Each author is connected to one or more countries by lines, signifying that their research work is related to these countries. For instance, Lenarz, Thomas has close connections with the USA and Germany, indicating that he has made research contributions in both countries. By observing the flow direction and density of

Figure 4. Keyword landscape and burst terms (2005–2024). (**A**) VOSviewer keyword co-occurrence map. Node size indicates keyword frequency; edge thickness indicates co-occurrence strength; colors denote clusters. (**B**) CiteSpace top-20 keywords with the strongest citation bursts. Red segments mark burst periods within 2005–2024; the left column lists burst strength and start–end years.



the lines, we can identify that certain keywords have strong associations among specific countries and authors. For example, "sensorineural-hearing-loss" is prominent in the research of the United States and Australia, and the main authors involved include Papsin, Blake C. and Choi, Byung Yoon. This reflects the research dynamics of specific keywords among different regions and researchers.

Figure 7 is a time-series chart demonstrating the trend topics in the research field, which is intended to present the variation trends and occurrence frequencies of different research topics over time. In the chart, the horizontal axis represents years, while the vertical axis stands for research topics (Terms). The blue dots on the line segments indicate the term frequency of each topic in the corresponding year, with the size of the dots being proportional to the frequency. It can be seen from the chart that topics such as "dementia prevention" and "intervention" have witnessed a gradual increase in research attention in recent years. This also suggests that with the advancement of technology, researchers are paying more and more attention to the quantitative evaluation of the efficacy of cochlear implants, especially in terms of the role of cochlear implantation in alleviating dementia in presbycusis patients [20].

Discussions

In academic research, bibliometric analysis has become itself as an indispensable tool for providing comprehensive overviews and accurately identifying trends and hotspots within a research domain [21]. The study uses the widely recognized WoSCC database as its source of literature data [22]. The WoSCC is known for its exceptional quality and accuracy. To analyze research content pertaining to cochlear implantation in presbycusis, quantitative analytical software — including Vosviewer, CiteSpace, R Studio, and BiblioMetrix — was utilized in this investigation [23, 24].Through analyses of spatial-temporal distribution, regional collaboration patterns, author contributions, core literature, hot topics, and research boundary delineation—complemented by keyword co-occurrence analysis — we identified emerging research themes across distinct periods and elucidated the developmental trajectory of this research domain. Furthermore, we pinpointed the most cutting-edge advancements in current research on cochlear implantation for elderly patients with presbycusis. The findings of this bibliometric analysis offer valuable insights for guiding strategies related to cochlear implantation in elderly presbycusis populations, providing a comprehensive overview of emerging trends and key research areas that can inform future research endeavors and clinical advancements in this field.

After conducting an in-depth statistical analysis of the number of publications contributed by countries or regions in the research field of cochlear implantation for presbycusis, we observed that the United States occupies a preeminent position in this domain, maintaining a substantial lead in both SCP and MCP.The preeminent status of the United States in this area can be attributed to its significant investments in biomedical research, well-established academic infrastructure, and extensive international collaborative networks [25].Within the global national collaboration network, nations including the United States, China, and Australia emerge as key contributors. These countries have established robust collaborative partnerships with other nations, engaging in in-depth cooperation through mechanisms such as joint research initiatives, data sharing frameworks, academic exchange programs, and multicenter clinical trials [26]. This collaborative model facilitates the integration of global resources and enhances research efficiency. Such a worldwide cooperation network vividly exemplifies the international influence of research in the field of cochlear implantation for elderly patients with presbycusis, as well as its inherently collaborative essence.

At the institutional level, the University of Toronto system ranks first with 173 publications, followed by Harvard University and the Johns Hopkins University system. This highlights the pivotal role of these institutions in advancing the field. Additionally, a collaboration network map of various institutions has been constructed. We strongly recommend that research organizations across different countries strengthen mutual cooperation and communication to further promote the development of research on cochlear implantation for presbycusis. By leveraging each other's strengths, we aim to achieve great-

Figure 5. Keyword clusters and conceptual structure. (**A**) CiteSpace keyword co-occurrence clusters. Node size indicates keyword frequency; links indicate co-occurrence; colors/polygons denote clusters (#0 cochlear implantation, #1 spiral ganglion neurons, #2 cochlear implant, #3 hearing loss, #4 functional connectivity, #5 hearing preservation, #6 vestibular function). (**B**) Bibliometrix conceptual structure map of keywords, showing three domains: a neurobiology/stimulation cluster (blue; e.g., auditory neurons, spiral ganglion neurons, neurotrophic factor), a clinical outcomes/performance cluster (red; e.g., speech recognition, tinnitus, noise, benefits), and an epidemiology/quality-of-life cluster (green; e.g., older adults, dementia, quality-of-life, impact).

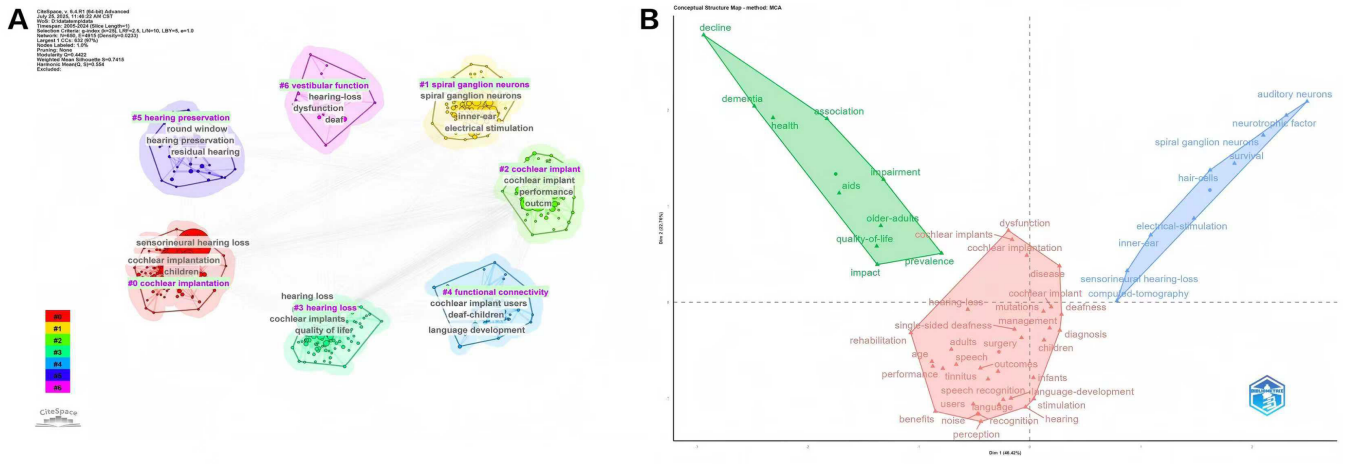


Figure 6. Three-fields map linking keywords–authors–countries (Bibliometrix). ID = author keywords; AU = authors; AU_CO = countries. Bar height indicates frequency; link width indicates the number of papers connecting the two nodes. Dominant topics include hearing loss, cochlear implantation, speech perception/recognition, performance, and quality-of-life. Central authors include Thomas Lenarz, Vincent Van Rompaey, Matthew L. Carlson, Paul Van de Heyning, Vedat Topsakal, and Griet Mertens; major contributing countries include the USA, Belgium, Canada, Australia, the Netherlands, Germany, and the UK.

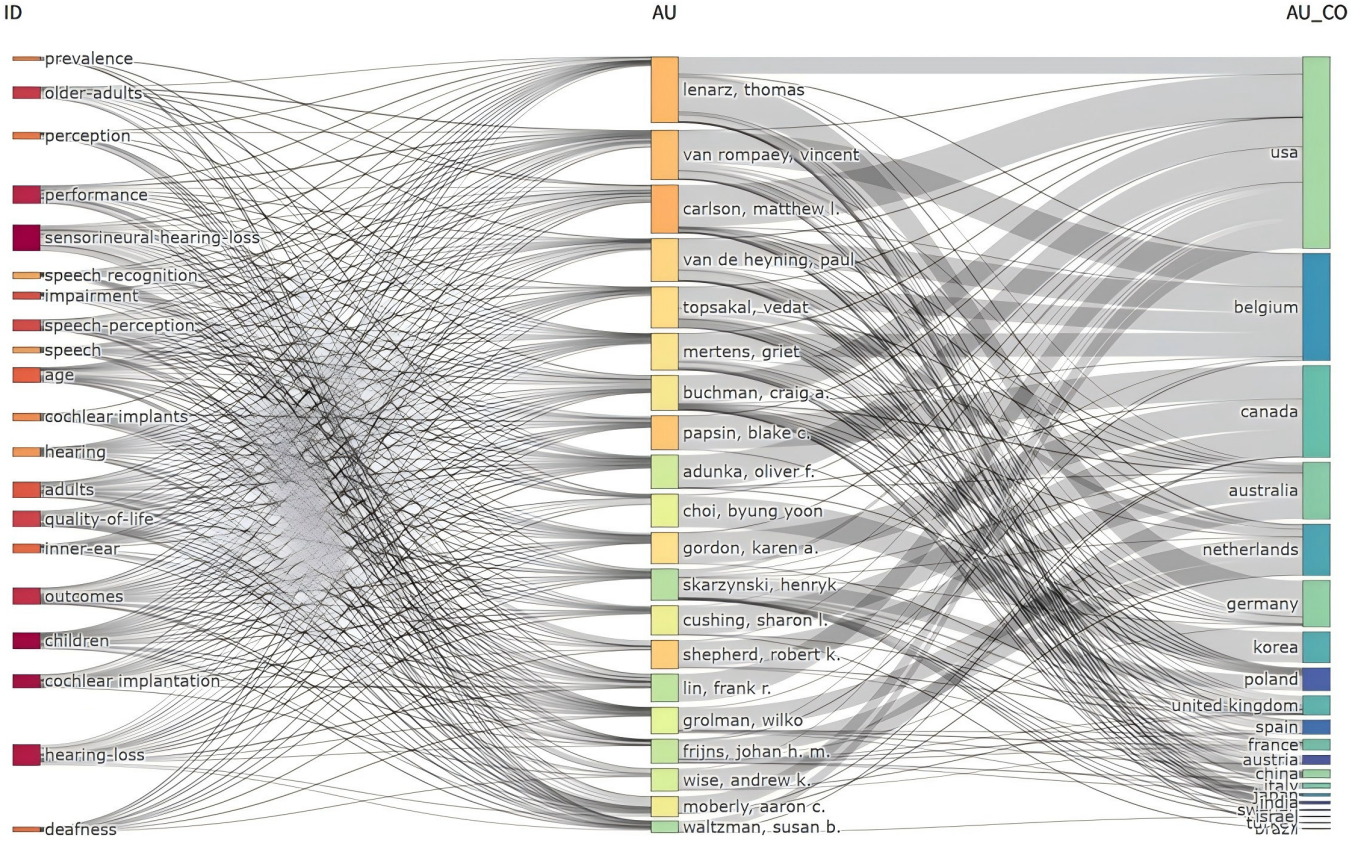
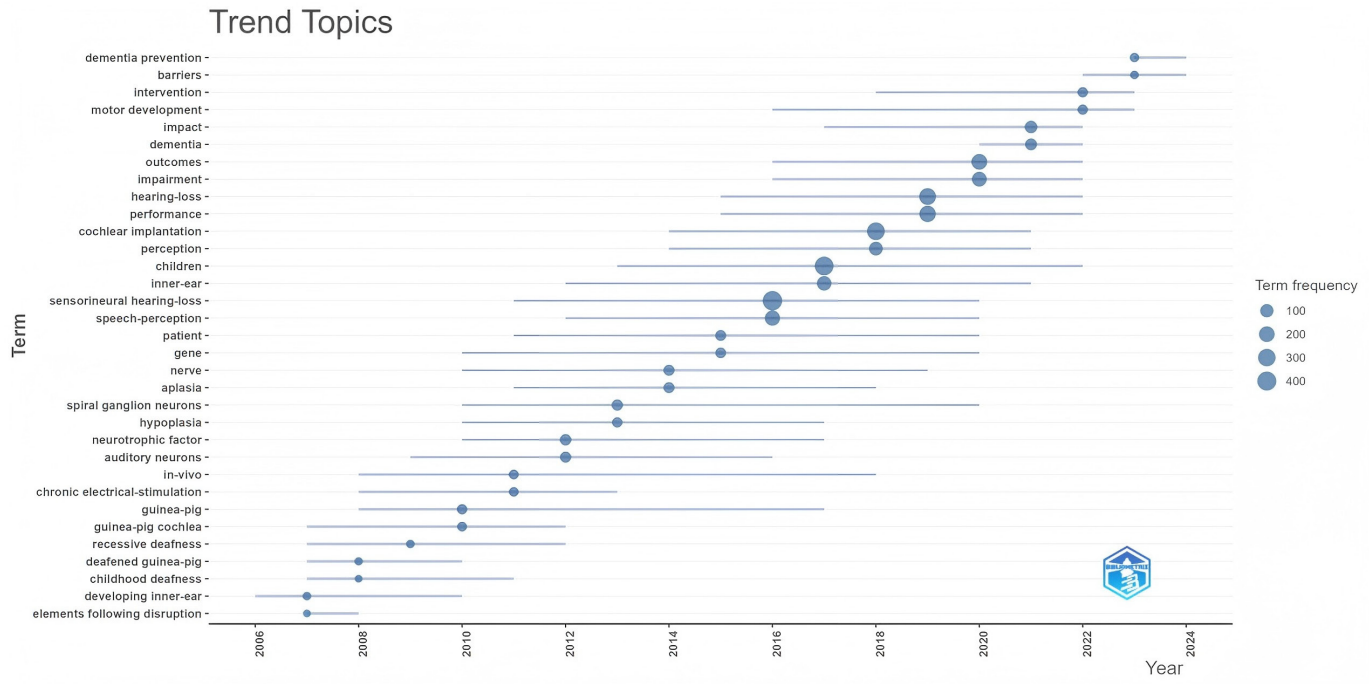


Figure 7. Trend topics over time (Bibliometrix). Each row is a term. The horizontal bar shows the active period (first–last year) in which the term appears; the dot marks the peak year, and its size indicates term frequency (legend at right). Early topics (≈2005–2012) emphasize animal/basic neurobiology (e.g., guinea-pig, spiral ganglion neurons, neurotrophic factor), while later topics shift toward clinical outcomes and aging comorbidities (hearing loss/cochlear implantation, performance/outcomes, dementia, intervention, barriers).



er breakthroughs in this field, while breaking down academic barriers to lay a more solid foundation for in-depth research on cochlear implantation in elderly patients with presbycusis.

From the perspective of author contributions, CARLSON MATTHEW L ranks as the most prolific contributor of relevant literature [27, 28], followed by LENARZ THOMAS [29]. This not only reflects their sustained scientific output in the domain of cochlear implantation for age - related hearing loss but also affirms their status as the most active contributors. SHEPHERD ROBERT K emerges as a “high - productivity and high - impact” scholar within this field [30].When considering the PY_start metric, it becomes evident that SHEPHERD ROBERT K and LENARZ THOMAS represent the senior scholars in the field. In contrast, MOBERLY AARON C, bolstered by a relatively high m - index, exhibits substantial growth potential and stands out as an emerging scholar deserving of ongoing attention in future research endeavor [31, 32]The interwoven academic trajectories of various authors have forged the research ecosystem network of this discipline. Senior scholars like SHEPHERD ROBERT K, leveraging long - term accumulations, have persistently delved into the integration of theoretical underpinnings and clinical practice, thus laying a robust foundation for the field. Highly productive authors such as CARLSON MATTHEW L and LENARZ THOMAS have expanded the research frontiers through a high - frequency output of findings, achieving successive breakthroughs in sub - areas including post - cochlear implantation rehabilitation regimens and multimodal evaluation systems. Emerging talents typified by MOBERLY AARON C have infused innovative dynamism into the field. This intergenerational succession and innovative relay have propelled research on cochlear implantation for age - related hearing loss toward greater precision, efficiency, and clinical relevance. Concurrently, it furnishes academic support for the optimization of the global hearing rehabilitation medical system. Additionally, the strong connectivity exhibited by these authors reflects their significant contributions to collaborative research efforts. It underscores the indispensable role of global cooperation in advancing cochlear implantation research for elderly presbycusis patients, illustrating how such alliances drive progress in the field.

In keyword analysis, the “keyword co - occurrence network” intuitively delineates the research structure within the domain of cochlear implantation. Centered on cochlear implantation, it extends to facets including the pathological mechanisms of hearing loss, quality - of - life outcomes, and prognostic trajectories. This reflects that technological innovation propels the enhancement of diagnostic accuracy and therapeutic efficacy, validating the pivotal role of technological advancement in facilitating the diagnosis and management of hearing impairment among the elderly. Additionally, burst citation analysis of keywords unveils the critical evolutionary trends across key research areas. More importantly, the bibliometric findings of this study are highly aligned with the critical shifts in clinical practice trends: Burst citation analysis of keywords reveals that early research was dominated by terms related to etiological mechanisms, such as "spiral ganglion neuron" and "neurotrophic factor"—a research focus that echoes the clinical need to "optimize cochlear implant design by clarifying the mechanisms of auditory nerve damage." In recent years, keywords including "dementia," "intervention," and "quality of life" have experienced explosive growth, a trend that reflects the transformation of the clinical paradigm from "merely restoring hearing function" to "pursuing comprehensive health management for elderly patients." These trends indicate that investigations

into the clinical phenotypes and precision treatment strategies for presbycusis are garnering escalating recognition [33]. The "conceptual clustering and cross - thematic association" offers a systematic panorama of research endeavors in the cochlear implantation sphere. Encompassing core diagnostic - therapeutic technologies, geriatric health - related concerns, and fundamental neuroscience mechanisms, it epitomizes the academic rationale that "clinical imperatives propel research expansion, while basic research reciprocally underpins clinical translation" [34].

The transformation and aggregation processes not only clarify the dynamic connections between research elements but also reveal the implicit logical thread underpinning the evolution of the field. For instance, the growing attention to "dementia prevention" and "intervention measures" reflects a shift in the research community from a narrow focus on "hearing function restoration" to an emphasis on "comprehensive health management for elderly patients" [35]. This aligns with the global healthcare demands driven by population aging [36].Simultaneously, the continuous aggregation of core authors and national research efforts around emerging themes accelerates the translation of research outcomes into clinical practice. These visualization tools thus serve not only as a retrospective summary of past research but also as a guide for identifying future priorities and potential collaboration avenues. Such systematic representation enables stakeholders—including researchers, clinicians, and policymakers—to gain a holistic understanding of the current research landscape. It further facilitates more strategic allocation of resources to address critical challenges in cochlear implantation for presbycusis, ultimately advancing both scientific inquiry and clinical impact in this specialized domain.

Limitations

The study has three primary limitations. First, data retrieval was limited to Web of Science; data from PubMed, Embase, and Scopus were not included. Notably, integrating data from multiple sources would require more sophisticated analytical methods, which presented practical constraints in the present study. Second, the search strategy may have inherent imperfections, potentially limiting the comprehensiveness of literature coverage. Third, researchers from China frequently publish their work in Chinese-language journals, which are not fully indexed in the selected databases. The omission introduces two distinct biases: in geographic analysis, single-center studies on cochlear implantation in elderly patients conducted by Chinese clinical institutions and containing valuable data such as surgical outcomes are excluded from the dataset, potentially underestimating these institutions' actual contributions to clinical research in the field. Additionally, in institutional collaboration analysis, Sino-international collaborative studies that are published in Chinese journals are not captured, which weakens the perceived collaborative ties between Chinese and international institutions and undermines the accuracy of the institutional collaboration network map. While this limitation cannot be fully addressed with the current dataset, future analyses could integrate Chinese academic databases to supplement non-English literature, thereby mitigating regional publication bias.

Conclusion

This study is the first bibliometric analysis of literature on cochlear implantation for presbycusis over the past two decades. Using visual analytics techniques, we systematically assessed research progress, accurately identified emerging research hotspots, and proposed future research directions. The current analytical findings reveal that the United States remains at the forefront of research in this domain, with its academic institutions and scholars playing a pivotal leadership role in driving advancements within the field. Over the past twenty years, developing nations, exemplified by China, have steadily increased research investment in this area, accompanied by gradual enhancements in their research capacity. Looking forward, we propose three specific directions for future research to address existing gaps and meet clinical needs: First, explore cognitive-auditory interaction mechanisms by conducting well-designed longitudinal cohort studies to quantify the causal relationship between cochlear implantation outcomes and cognitive changes in presbycusis patients, with cognition assessed via standardized scales and objective neuroimaging for comprehensive, accurate evaluation; second, advance personalized implantation protocols by establishing a risk stratification model for elderly candidates—integrating comorbidities, residual hearing, and baseline cognition—to optimize surgical timing and device selection; third, promote global equity in cochlear implantation access by conducting cross-sectional surveys in low and middle-income countries (LMICs) to identify region-specific barriers and collaborating with local partners to develop tailored solutions to reduce access disparities. Concurrently, as the global aging demographic accelerates, cross-national and cross-institutional collaborative research endeavors will intensify, aiding in addressing critical challenges in presbycusis cochlear implantation—including technological innovation, efficacy assessment, and equitable access to applications. This will ultimately provide more robust academic underpinnings to enhance the quality of life for elderly individuals with hearing impairment.

Abbreviations

SCIE, Science Citation In-dex Expanded; SSCI, Social Sciences Citation Index; ESCI, Emerging Sources Citation Index; ARHL, Age-Related Hearing Loss; EAS, Electric Acoustic Stimulation; CP, Same Country Partnership; MCP, Multiple Country Partnership; h_index, hirsch index; TC, Total Citations; NP, Number of Publications; PY_start, Publication Year Start; CI, Cognitive Impairment; MCA, Multiple Correspondence Analysis; LMICs, Low and Middle-Income Countries.

Author Contributions

Liuqing Zhang designed the study, collected and analyzed the data, and drafted the manuscript. Guoying Han translated the manuscript. Yuxiang Wang and Deshang Chen jointly assisted in data analysis. Corresponding author Yuefeng Han supervised the completion of the study and reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

Not Applicable.

Funding Information

Not Applicable.

Ethics Approval and Consent to Participate

Not Applicable.

Competing Interests

The authors declare that they have no existing or potential commercial or financial relationships that could create a conflict of interest at the time of conducting this study.

Data Availability

Not Applicable.

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