

Therapeutic Effect of Intratympanic Methylprednisolone in Sudden Sensorineural Hearing Loss: A Prospective Observational Study

Sharad Paudel,^{*,1} Anup Acharya,¹ Bilash Shrestha,¹ Pratiksha Ghimire²

ABSTRACT:

Introduction: Sudden sensorineural hearing loss (SSNHL) is an otological emergency requiring prompt treatment. Intratympanic steroid therapy delivers a high concentration of steroid directly into the inner ear while minimizing systemic adverse effects. Despite its routine use, outcomes of intratympanic methylprednisolone therapy have not been documented in our setting. This study evaluated its therapeutic effect in SSNHL patients treated in routine clinical practice. **Methods:** This hospital-based prospective observational analytical study was conducted in the Department of ENT at Lumbini Medical College from June 2025 to May 2026. Forty patients with SSNHL who received intratympanic methylprednisolone (40 mg in 1 mL) as part of routine care were included. Each received four injections over 15 days. Hearing thresholds were assessed using pure tone audiometry before treatment and at one month after treatment, using 3-frequency (500, 1000, 2000 Hz) and 4-frequency (500, 1000, 2000, 4000 Hz) averages. Improvement was defined as a hearing gain of ≥ 10 dB in the 3-frequency PTA. **Results:** Improvement was observed in 35 patients (87.5%). The mean 3-frequency PTA improved from 60.3 ± 6.6 dB to 49.8 ± 10.2 dB (mean gain 10.4 ± 7.8 dB; $p < 0.001$). The mean 4-frequency PTA improved from 62.0 ± 6.0 dB to 52.3 ± 9.9 dB (mean gain 9.7 ± 6.5 dB; $p < 0.001$). No vertigo, perforation, or infection occurred. **Conclusions:** Intratympanic methylprednisolone therapy resulted in significant hearing improvement in patients with SSNHL treated in routine clinical practice, with a favorable safety profile.

Keywords: Intratympanic methylprednisolone; Pure Tone Audiometry; Steroid therapy; Sudden Sensori-Neural Hearing Loss.

Submitted: 29 July 2026

Accepted: 16 September 2026

Published: 24 September 2026

1 - Department of ENT Head & Neck Surgery, Lumbini Medical College, Palpa, Nepal

2 - College of Nursing, Lumbini Medical College, Palpa, Nepal

*Corresponding Author:

Sharad Paudel

e-mail: Sharadpaudel123@gmail.com

ORCID: <https://orcid.org/0009-0006-4205-9918>

How to cite this article:

Paudel S, Acharya A, Shrestha B, Ghimire P. Therapeutic Effect of Intratympanic Methylprednisolone in Sudden Sensorineural Hearing Loss: A Prospective Observational Study. *J Lumbini Med Coll.* 2026;14(2):6 pages. DOI: 10.22502/jlmc.v14i2.581. Epub: 2026 September 24.

INTRODUCTION

Sudden sensorineural hearing loss (SSNHL), first described by Kleyne in 1944, is an otologic emergency that requires prompt intervention.¹ It is defined as a sensorineural hearing loss of ≥ 30 dB across at least three consecutive frequencies, occurring within 72 hours. The estimated annual incidence is 5–20 cases per 100,000 population. When no identifiable cause is found after adequate investigation, it is classified as idiopathic SSNHL (ISSNHL), which accounts for approximately 90% of cases.² Approximately 10–15% of cases are associated with identifiable causes such as Ménière's disease, trauma, autoimmune disorders,

and infections, while about 1% are attributed to retrocochlear disorders such as vestibular schwannoma, demyelinating diseases, and stroke.³

Various treatment modalities have been reported, including vasoactive agents, hyperbaric oxygen therapy, antiviral medications, and vitamin supplementation. Each of these approaches has been subject to debate, and no universally accepted standard protocol exists. Steroid therapy, administered either systemically or via intratympanic route, alone or in combination, is considered the cornerstone of treatment for SSNHL. Systemic steroid therapy is associated with significant adverse effects and contraindications, making local steroid therapy a preferable option in many cases.⁴

Spontaneous recovery has been reported in approximately 32–65% of SSNHL cases.² Corticosteroids are currently the most commonly used pharmacological agents in the acute treatment of SSNHL, as they are believed to promote hearing recovery through their anti-inflammatory effects. Oral steroid therapy has been assessed in several retrospective studies demonstrating hearing recovery following treatment. However, interest in intratympanic steroid injection has grown considerably.⁵ Current clinical practice guidelines recommend the use of oral or systemic corticosteroids and/or salvage intratympanic steroid injections, which have been shown to have comparable efficacy when used adjunctively.⁶

Dexamethasone is the most commonly used steroid in intratympanic steroid therapy, followed by methylprednisolone. Studies have shown that methylprednisolone achieves the highest concentration and persists for the longest duration in both the perilymph and endolymph compared with dexamethasone and hydrocortisone. The concentration of methylprednisolone decreases gradually and remains detectable in the perilymph for up to 24 hours, whereas dexamethasone and hydrocortisone are detectable only for up to six hours following middle ear injection.⁵

Despite its routine use, the outcomes of intratympanic methylprednisolone therapy have not been systematically documented at our center. This study therefore aimed to evaluate the therapeutic effect of intratympanic methylprednisolone in patients with sudden sensorineural hearing loss treated in routine clinical practice.

METHODS

This was a hospital-based prospective

observational analytical study conducted in the Department of ENT at Lumbini Medical College from June 2025 to May 2026. Ethical clearance was obtained from the Institutional Review Committee (IRC) of Lumbini Medical College (Ref: 04/25/0000.01). Informed written consent was taken from each participant.

The study population consisted of all patients diagnosed with SSNHL who received intratympanic methylprednisolone as part of routine clinical management during the study period. A total of 40 patients were included. A non-probability convenience sampling technique was used to enroll all eligible patients.

SSNHL was diagnosed based on a sensorineural hearing loss of ≥ 30 dB across at least three consecutive frequencies, occurring within 72 hours, with an air-bone gap of ≤ 15 dB at the tested frequencies to exclude a significant conductive component.¹ Any air-bone gap at 4 kHz was interpreted with caution given the known prevalence of false air-bone gaps at this frequency in patients with sensorineural hearing loss.⁷

All patients who received intratympanic methylprednisolone injection for SSNHL during the study period and had available pre- and post-treatment Pure Tone Audiogram (PTA) results were included. There was no age restriction; however, all patients who received the injection were adults aged 18 years or above. Patients who did not complete follow-up PTA were excluded from analysis. Pregnant or lactating women were excluded from receiving the injection unless they provided written informed consent. Patients with a known allergy to methylprednisolone were also excluded from receiving the injection. These were clinical decisions made by the treating physician as part of routine care, not research-imposed exclusion criteria.

At our center, intratympanic methylprednisolone is administered at a dose of 40 mg in one mL, with patients generally receiving four injections over 15 days at an interval of 3–4 days. The injections are performed by ENT consultants or residents under consultant supervision. We generally perform the procedure of intratympanic injection of methylprednisolone for SSNHL in our center by placing the patient in a supine position with the head turned 45 degrees away from the affected side and the affected ear facing upwards. Two sprays of 10% xylocaine are directed postero-superiorly to the deep canal wall for topical anesthesia. Under video otoscopic guidance, the injection is performed at

the antero-inferior aspect of the tympanic membrane using a 25-gauge spinal needle. A volume of 0.5 mL is injected, or until visible bulging of the tympanic membrane is observed, confirming successful delivery into the middle ear. Following injection, the patient remains supine with the head slightly turned so that the affected ear faces upwards for 30 minutes, and is instructed to avoid swallowing, talking, chewing, or head movement during this period. All tympanic membrane punctures are assessed for healing at the 1-month follow-up visit from the first injection.

No systemic steroids, antivirals, hyperbaric oxygen therapy, vasodilators, vitamins, or other adjunctive therapies were given concurrently with intratympanic methylprednisolone injections. Intratympanic methylprednisolone was the only treatment received by these patients for SSNHL.

The primary outcome was improvement in hearing, defined as a hearing gain of ≥ 10 dB in the 3-frequency PTA (500, 1000, 2000 Hz).⁸ Secondary outcomes included the 4-frequency PTA (500, 1000, 2000, 4000 Hz).

Audiological assessment was performed using the MA-42 audiometer (Maico Diagnostics GmbH, Germany). PTA results were plotted on a standard reporting form. The mean air conduction threshold was calculated using two standard averaging methods: the 3-frequency average (500 Hz, 1000 Hz, and 2000 Hz), which is the most widely used metric in clinical audiology, and the 4-frequency average (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz), which is utilized in epidemiological and population-based studies as well as for occupational hearing screening. These hearing thresholds were compared before treatment and at one month after treatment.

Clinical and demographic data were extracted from OPD records and PTA reports using a standardized data extraction form. Variables extracted included chief complaints such as hearing loss and ear fullness, duration of symptoms to confirm fulfillment of the SSNHL definition, and pre- and post-treatment PTA findings.

All data were entered into Microsoft Excel 2007 and analyzed using PSPP 2.1.1. The Shapiro-Wilk test was used to assess normality of the differences between pre- and post-treatment PTA values. Paired sample t-test was used to compare pre- and post-treatment PTA values. Chi-square and Fisher's exact tests were used to assess associations between categorical variables. A p-value of < 0.05 was considered statistically significant.

RESULT

A total of 40 patients with sudden sensorineural hearing loss were included in the study. The mean age was 42.3 ± 12.1 years (range 19–68 years). Among them, 22 patients (55.0%) were male and 18 patients (45.0%) were female, showing a slight male predominance. All cases were unilateral: 17 patients (42.5%) had left-sided hearing loss and 23 patients (57.5%) had right-sided hearing loss. All patients presented within two weeks of symptom onset, with a mean duration of 5.3 ± 3.1 days (range 1–14 days).

Improvement, defined as a hearing gain of ≥ 10 dB in the 3-frequency PTA,⁸ was observed in 35 patients (87.5%), while five patients (12.5%) showed no improvement. Among the patients who improved, 19 (54.3%) were male and 16 (45.7%) were female. Among those who did not improve, 3 patients (60.0%) were male and two patients (40.0%) were female.

There was no statistically significant association between sex and treatment outcome following intratympanic methylprednisolone therapy. Chi-square analysis demonstrated no significant difference between male and female patients regarding hearing improvement (Pearson Chi-square = 0.06, df = 1, $p = 0.8$). Fisher's exact test also showed no significant association ($p = 1.0$).

3-Frequency PTA Analysis: The mean pre-treatment PTA calculated using three frequencies (500 Hz, 1000 Hz, 2000 Hz) was 60.3 ± 6.6 dB, whereas the mean post-treatment PTA decreased to 49.8 ± 10.17 dB. The mean difference between pre-treatment and post-treatment PTA values was 10.4 ± 7.8 dB. The improvement was statistically significant ($t = 8.5$, df = 39, $p < 0.001$), with a 95% confidence interval ranging from 8.0 to 13.0 dB.

4-Frequency PTA Analysis: The mean pre-treatment PTA calculated using four frequencies (500 Hz, 1000 Hz, 2000 Hz, 4000 Hz) was 62.0 ± 6.0 dB, whereas the mean post-treatment PTA decreased to 52.3 ± 9.9 dB. The mean difference was 9.7 ± 6.5 dB. This improvement was statistically significant ($t = 9.4$, df = 39, $p < 0.001$), with the 95% confidence interval ranging from 7.6 to 11.8 dB.

All tympanic membrane punctures were healed at the 1-month follow-up visit from the first injection. No vertigo, perforation, or infection occurred. Two patients developed severe pain after the injection, which resolved within 30 minutes without intervention.

DISCUSSION:

Sudden sensorineural hearing loss is considered an otological emergency, and prompt treatment is essential to improve hearing outcomes. Intratympanic steroid therapy has gained increasing acceptance as an effective treatment modality because it allows delivery of a high concentration of steroid directly into the inner ear while minimizing systemic adverse effects. The present study evaluated the effectiveness of intratympanic methylprednisolone therapy in patients with SSNHL and demonstrated significant improvement in hearing thresholds following treatment. Reported side effects of intratympanic steroids include vertigo, otalgia, nystagmus, otitis media, tinnitus, injection site pain, and persistent tympanic membrane perforation.⁹ However, in the present study, no vertigo, perforation, or infection occurred, and only two patients developed severe pain after injection that resolved within 30 minutes without intervention.

In the present study, the majority of patients showed improvement after intratympanic methylprednisolone therapy, with 87.5% of patients demonstrating hearing recovery. This finding supports the therapeutic role of intratympanic steroids in the management of SSNHL. Berjis et al.¹⁰ reported a comparable improvement rate following intratympanic methylprednisolone therapy, with a mean hearing gain similar to that observed in our study. Similarly, Gupta et al.¹¹ found significant improvement in hearing with methylprednisolone therapy. These findings are consistent with our observation that intratympanic methylprednisolone produces meaningful hearing recovery in patients with SSNHL.

Several studies have also investigated the role of combining intratympanic steroids with systemic steroids. Aliyeva et al.¹² and Gonzalez et al.¹³ reported that combining intratympanic steroids with systemic steroids did not provide additional benefits in treating severe and profound SSNHL. In contrast, Chrysouli et al.¹⁴ found that adding intratympanic steroids to systemic corticosteroid therapy significantly improved hearing recovery in patients with idiopathic SSNHL, and Sialakis et al.¹⁵ reported that systemic steroid therapy was inferior to combined steroid therapy. These conflicting findings suggest that the benefit of combination therapy may depend on the severity of hearing loss at presentation. It is important to note that the present study evaluated intratympanic methylprednisolone as monotherapy, and therefore our findings apply

specifically to intratympanic treatment alone rather than to combination regimens.

The mechanisms underlying the therapeutic effect of intratympanic steroids have been described by Sampaio et al.¹⁶ and Kuo et al.,¹⁷ who suggested that local steroid administration may reduce cochlear inflammation, improve microcirculation, and decrease immune-mediated inner ear damage. Intratympanic administration achieves higher perilymph steroid concentrations compared to systemic administration, thereby enhancing anti-inflammatory and immunosuppressive effects within the cochlea. Methylprednisolone, in particular, has been shown to penetrate the round window membrane effectively and may help reduce cochlear edema and oxidative stress, leading to recovery of auditory function.

The timing of intervention is also an important determinant of outcome. Kennedy et al.⁶ reported that earlier initiation of intratympanic steroid therapy following SSNHL symptom onset significantly predicted increased pure-tone average recovery ($p < 0.001$), and that steroid efficacy becomes significantly low when given after 18 days of onset. In our study, all patients presented within two weeks of symptom onset and received treatment within this window, which may partly explain the high rate of improvement observed. Early administration of intratympanic steroids therefore appears beneficial for SSNHL.

The demographic profile of the study showed a slight male predominance, with males accounting for 55% of cases. However, treatment outcomes were comparable between male and female patients. Statistical analysis demonstrated no significant association between sex and hearing improvement following treatment, suggesting that sex does not significantly influence the effectiveness of intratympanic methylprednisolone therapy. Similar observations have been reported in earlier studies where demographic factors such as sex were not found to be significant predictors of hearing recovery.¹²

Assessment of hearing thresholds using pure tone audiometry demonstrated significant improvement after treatment. When PTA was calculated using three frequencies (500 Hz, 1000 Hz, and 2000 Hz), the mean hearing threshold improved from 60.3 ± 6.6 dB before treatment to 49.9 ± 10.2 dB after treatment. The mean hearing gain of 10.4 dB was statistically significant ($p < 0.001$). When PTA was calculated using four frequencies (500 Hz, 1000

Hz, 2000 Hz, and 4000 Hz), the mean PTA improved from 62.0 ± 6.0 dB to 52.3 ± 9.9 dB, with a mean hearing gain of 9.69 dB, which was also statistically significant ($p < 0.001$). The 3-frequency improvement exceeded the 10 dB threshold generally accepted as clinically meaningful, whereas the 4-frequency improvement fell marginally below this threshold. This discrepancy may be attributed to the inclusion of 4 kHz, where false air-bone gaps and greater test-retest variability are known to occur in patients with sensorineural hearing loss.⁷ These findings indicate that intratympanic methylprednisolone therapy contributes to meaningful hearing recovery in patients with SSNHL, consistent with the findings of Berjis et al.¹⁰

Tarkan et al.¹⁸ found that intratympanic methylprednisolone and dexamethasone have no superiority over each other in the primary treatment of patients with SSNHL. This suggests that the choice between these two steroids may not substantially affect outcomes, although further evaluation in larger populations is needed to establish the comparative effectiveness of intratympanic methylprednisolone in SSNHL.

One important advantage of intratympanic steroid therapy is its favorable safety profile, consistent with the findings of Tarkan et al.¹⁸ As the medication is delivered locally, systemic side effects associated with oral or intravenous steroids can largely be avoided. This makes intratympanic therapy especially useful in patients with diabetes mellitus, hypertension, peptic ulcer disease, or other conditions where systemic steroid use may be contraindicated. Intratympanic therapy may be considered as either primary treatment or salvage therapy in patients who fail to respond adequately to systemic steroids.

Despite the positive findings, this study has several limitations. The sample size was relatively small, and the study lacked a control group for comparison. As spontaneous recovery occurs in

approximately 32–65% of SSNHL cases,⁵ some of the improvement observed in this study may reflect natural recovery rather than the effect of treatment alone. In addition, long-term follow-up was not performed, limiting the assessment of sustained hearing recovery over time. The use of non-probability convenience sampling may have introduced selection bias. Other prognostic factors such as duration of symptoms before treatment, severity of initial hearing loss, presence of tinnitus or vertigo, and associated comorbidities were not analyzed in detail. With only five patients showing no improvement, multivariate analysis could not be performed, and the study was underpowered for subgroup analyses. Future studies with larger sample sizes, randomized controlled designs, and longer follow-up periods are recommended to further validate the effectiveness of intratympanic methylprednisolone therapy in SSNHL.

CONCLUSIONS

Intratympanic methylprednisolone therapy resulted in significant hearing improvement in patients with SSNHL treated in routine clinical practice, with a favorable safety profile. These findings support its use as a treatment option for SSNHL. However, randomized controlled trials with larger sample sizes and longer follow-up are needed to confirm these results and to distinguish treatment effects from spontaneous recovery.

Conflict of Interest:

Anup Acharya and Pratiksha Ghimire did not take part in editorial decisions.

Ethical Consideration:

Ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the authors.

Funding: None.

REFERENCES

- Kleyn AD. Sudden complete or partial loss of function of the octavus-system in apparently normal persons. *Acta Otolaryngol.* 1944;32(5-6):407-429. DOI: [10.3109/00016484409119921](https://doi.org/10.3109/00016484409119921)
- Chandrasekhar SS, Tsai Do BS, Schwartz SR, Bontempo LJ, Faucett EA, Finestone SA, et al. Clinical practice guideline: sudden hearing loss (Update). *Otolaryngol Head Neck Surg.* 2019;161(1_suppl):S1-S45. PMID: [31369359](https://pubmed.ncbi.nlm.nih.gov/31369359/) DOI: [10.1177/0194599819859885](https://doi.org/10.1177/0194599819859885)
- Rai S, Koirala K, Sherpa P. Effectiveness of early treatment with steroids in outcome of sudden sensorineural hearing loss. A study from Western Nepal. *Nepalese Journal of ENT Head and Neck Surgery.* 2018;5(2):5-7. DOI: [10.3126/njenthns.v5i2.19403](https://doi.org/10.3126/njenthns.v5i2.19403)
- Zhao D, Tong B, Wang Q, Hellstrom S, Duan M. A comparison of effects of systemic and intratympanic steroid therapies for sudden sensorineural hearing loss: A meta-analysis. *J Otol.* 2016;11(1):18-23. PMID: [29937806](https://pubmed.ncbi.nlm.nih.gov/29937806/) DOI: [10.1016/j.joto.2016.02.002](https://doi.org/10.1016/j.joto.2016.02.002)
- Kepekci AH. Effect of intratympanic steroid therapy in sudden sensorineural hearing loss: Our clinical experience. *Medicine Science.* 2024;13(4):861-5. DOI: [10.5455/medscience.2024.08.093](https://doi.org/10.5455/medscience.2024.08.093)
- Kennedy DJ, Williams E, Wolf L, Golden J, Lana A, Wiefels M, et al. Intratympanic steroid administration and predictors of recovery in sudden sensorineural hearing loss. *PLoS One.* 2025;20(10):e0332809. DOI: [10.1371/journal.pone.0332809](https://doi.org/10.1371/journal.pone.0332809)
- Margolis RH, Eikelboom RH, Johnson C, Ginter SM, Swanepoel DW, Moore BCJ. False air-bone gaps at 4 kHz in listeners with normal hearing and sensorineural hearing loss. *Int J Audiol.* 2013;52(8):526-532. PMID: [23713469](https://pubmed.ncbi.nlm.nih.gov/23713469/) DOI: [10.3109/14992027.2013.792437](https://doi.org/10.3109/14992027.2013.792437)
- Suzuki H, Hashida K, Nguyen KH, Hohchi N, Katoh A, Koizumi H, et al. Efficacy of intratympanic steroid administration on idiopathic sudden sensorineural hearing loss in comparison with hyperbaric oxygen therapy. *Laryngoscope.* 2012;122(5):1154-1157. PMID: [22447636](https://pubmed.ncbi.nlm.nih.gov/22447636/) DOI: [10.1002/lary.23245](https://doi.org/10.1002/lary.23245)
- Haynes DS, O'Malley M, Cohen S, Watford K, Labadie RF. Intratympanic dexamethasone for sudden sensorineural hearing loss after failure of systemic therapy. *Laryngoscope.* 2007;117(1):3-15. PMID: [17202923](https://pubmed.ncbi.nlm.nih.gov/17202923/) DOI: [10.1097/01.mlg.0000245058.11866.15](https://doi.org/10.1097/01.mlg.0000245058.11866.15)
- Berjis N, Soheilipour S, Musavi A, Hashemi SM. Intratympanic dexamethasone injection vs methylprednisolone for the treatment of refractory sudden sensorineural hearing loss. *Adv Biomed Res.* 2016;5:111. PMID: [27403406](https://pubmed.ncbi.nlm.nih.gov/27403406/) DOI: [10.4103/2277-9175.184277](https://doi.org/10.4103/2277-9175.184277)
- Gupta S, Gyawali BR, Pradhananga RB, Rayamajhi P. Role of short course intravenous methylprednisolone in the management of sudden sensorineural hearing loss. *International Journal of Otorhinolaryngology and Head and Neck Surgery.* 2021;7(2):217-20. DOI: [10.18203/issn.2454-5929.ijohns20210063](https://doi.org/10.18203/issn.2454-5929.ijohns20210063)
- Aliyeva A, Edizer DT. Efficacy of intratympanic steroid therapy for severe and profound sudden sensorineural hearing loss. *American Journal of Otolaryngology.* 2024;45(2):104170. DOI: [10.1016/j.amjoto.2023.104170](https://doi.org/10.1016/j.amjoto.2023.104170)
- Gonzalez FA, Del Carmen Zapata M, Ruiz de Erenchun Lasa I, Torres IS, Lacabe MU, Aguirre MSB, et al. Intratympanic steroid therapy as a salvage treatment for sudden sensorineural hearing loss after the unsuccessful therapy with systemic steroids. Our experience in 86 patients. *The Egypt Journal of Otolaryngology.* 2026;42:42. DOI: [10.1186/s43163-026-01018-2](https://doi.org/10.1186/s43163-026-01018-2)
- Chrysouli K, Kollia P, Papanikolaou V, Chrysovergis A. The effectiveness of intratympanic steroid injection in addition to systemic corticosteroids in the treatment of idiopathic sudden sensorineural hearing loss. *American Journal of Otolaryngology.* 2023;44(4):103872. DOI: [10.1016/j.amjoto.2023.103872](https://doi.org/10.1016/j.amjoto.2023.103872)
- Sialakis C, Iliadis C, Frantzana A, Ouzounakis P, Kourkouta L. Intratympanic versus systemic steroid therapy for idiopathic sudden hearing loss: A systematic review and meta-analysis. *Cureus.* 2022;14(3):e22887. PMID: [35399426](https://pubmed.ncbi.nlm.nih.gov/35399426/) DOI: [10.7759/cureus.22887](https://doi.org/10.7759/cureus.22887)
- Sampaio AFBS, Monsanto RDC, Jorge JJ Jr, Borges GC. Steroids for the prevention of sensorineural hearing loss secondary to acute otitis media: A systematic review. *Int Arch Otorhinolaryngol.* 2026;30(2):1-13. PMID: [42040180](https://pubmed.ncbi.nlm.nih.gov/42040180/) DOI: [10.1055/s-0045-1811640](https://doi.org/10.1055/s-0045-1811640)
- Kuo LK, Wu JL, Li YL, Hsu HJ. Clinical efficacy of intratympanic steroid injection for treating idiopathic sudden sensorineural hearing loss. *J Chin Med Assoc.* 2024;87(3):328-33. PMID: [38289277](https://pubmed.ncbi.nlm.nih.gov/38289277/) DOI: [10.1097/jcma.0000000000001061](https://doi.org/10.1097/jcma.0000000000001061)
- Tarkan Ö, Dağkiran M, Sürmelioglu Ö, Özdemir S, Tuncer Ü, Doğrusöz M, et al. Intratympanic methylprednisolone versus dexamethasone for the primary treatment of idiopathic sudden sensorineural hearing loss. *J Int Adv Otol.* 2018;14(3):451-55. PMID: [30431012](https://pubmed.ncbi.nlm.nih.gov/30431012/) DOI: [10.5152/iao.2018.4871](https://doi.org/10.5152/iao.2018.4871)