



Comparison of different intratympanic steroid injection protocols in the treatment of sudden sensorineural hearing loss

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Abstract

Objective: There is no consensus regarding treatment modalities for idiopathic sudden sensorineural hearing loss. The aim of this study was to evaluate the clinical and audiological outcomes of three-dose versus five-dose intratympanic dexamethasone administration as an adjunct to systemic steroid therapy in patients with sudden sensorineural hearing loss.

Methods: We retrospectively analyzed data from 30 patients diagnosed with sudden sensorineural hearing loss between 2022 and 2025 who received combined oral steroid therapy and intratympanic dexamethasone. Patients were divided into two groups: 20 received three intratympanic injections, and 10 received five injections. Pure tone audiometry (PTA) and speech discrimination scores (SDS) were measured before treatment and within 10 days after completion of therapy. Changes in audiological outcomes were compared between the two groups.

Results: The mean age was 47.3 years in the three-dose group and 48.6 years in the five-dose group. Tinnitus was present in all patients, and vertigo in 20%. PTA improvement was 16.1 ± 10.4 dB in the three-dose group and 14.7 ± 11.5 dB in the five-dose group ($p > 0.05$). The mean SDS improvement was $10.7\% \pm 14.6$ in the three-dose group and $6.9\% \pm 11.5$ in the five-dose group ($p > 0.05$). Overall PTA improvement rates were 28.23% and 23.28%, while SDS improvements were 30.94% and 43.81% for three- and five-dose groups, respectively. No statistically significant differences were observed between protocols.

Conclusion: Both three- and five-dose intratympanic dexamethasone regimens, when added to systemic steroids, yielded significant hearing improvements in patients with sudden sensorineural hearing loss. However, increasing the number of injections did not confer additional benefit. These findings suggest that a lower-dose regimen maybe sufficient, reducing procedural risks and patient discomfort. Larger, randomized controlled trials are needed to establish standardized dosing protocols.

Keywords: Sudden sensorineural hearing loss, intratympanic steroid, dexamethasone, pure tone audiometry, speech discrimination score

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Introduction

Sudden sensorineural hearing loss (SSNHL) is a frightening experience for individuals [1]. Although there is no definitive treatment for the condition, systemic or intratympanic steroid therapies are often considered in the early stages; however, recent studies have reported questionable findings regarding their superiority over placebo [2,3,4]. SSNHL is defined as a hearing loss greater than 30 dB at three consecutive frequencies developing in less than three days. It usually results in unilateral hearing loss [4]. Its incidence in the general population ranges between 5–30 per 100,000 per year; however, the true incidence is thought to be higher since many cases remain undiagnosed [5]. Although the disease can occur in all age groups, it is most frequently seen between the ages of 40 and 60, and it affects both genders at similar rates [6].

Among treatment approaches, the most common method is systemic corticosteroid therapy; however, the high rates of spontaneous recovery and the lack of significant superiority over placebo have increased doubts about the effectiveness of corticosteroid treatment [2,3,7,8]. Steroids contribute to the reduction of cochlear edema and the preservation of auditory function through their anti-inflammatory and immunosuppressive effects. Nevertheless, in clinical practice, the potential side effects and complications of steroid therapy must be considered. To avoid these risks, intratympanic steroid injection is regarded as an alternative to systemic steroid use. Intratympanic steroid administration provides the advantage of delivering the drug at a high concentration directly to the inner ear, thereby reducing the risk of systemic side effects [9,10]. Dexamethasone is the most commonly used agent for intratympanic steroid therapy, followed by methylprednisolone.

Autoimmunity, vascular injury, and viral pathologies have been suggested as possible factors in the pathogenesis. Diagnosis is based on a detailed history, physical examination, audiological evaluation, and, when necessary, imaging studies [8]. The likelihood of spontaneous remission is high. Although the superiority of oral steroid treatment over placebo has not been proven, and its effect on the natural course of the disease has not been demonstrated, it is still recommended as a treatment option. At this point, intratympanic treatments stand out because they provide a higher localized dose of medication and help prevent severe systemic side effects of steroid treatment, such as femoral head aseptic

necrosis, which may develop even after a single dose [2,3].

The true incidence of sudden hearing loss is thought to be underestimated due to the high rate of spontaneous recovery, while the exact number of patients recovering spontaneously remains unknown [11,12]. On a global scale, it is one of the few causes of reversible hearing loss. However, the frequent occurrence of spontaneous remission and the potential comorbidity risks of the proposed treatments raise doubts about the necessity of initiating treatment. In our clinic, in addition to routine oral steroid administration, intratympanic steroid application is also performed routinely, with different authors applying intratympanic steroid therapy at varying frequencies. Many studies have shown that intratympanic dexamethasone in combination with oral steroid therapy is more beneficial than systemic steroid therapy alone. However, variations in intratympanic dexamethasone protocols prompted us to conduct this study.

The aim of this research was to investigate the clinical and audiological changes in patients treated for sudden hearing loss with oral steroid therapy plus intratympanic steroid administration given in either three or five doses.

Materials and Methods

This study was designed as a retrospective analysis of patients who received combined oral steroid and intratympanic dexamethasone therapy for sudden hearing loss in our clinic between 2022 and 2025. A total of 30 patients were included, of whom 20 received three doses and 10 received five doses of intratympanic dexamethasone. The Ethics Committee of Giresun Training and Research Hospital approved this study (BAEK-17).

The allocation of three or five intratympanic steroid injections was primarily influenced by patients' continuation with therapy, with the number of doses not being predetermined. Initial pure tone audiometry (PTA) thresholds, the severity of hearing loss, and accompanying symptoms(e.g., vertigo, tinnitus) were considered in dose planning.

As part of the treatment protocol, intratympanic steroid injections were administered at specific intervals. In

the three-dose and five-dose protocols, injections were administered with a one-day interval, either every other day or three times per week. Dexamethasone was the most frequently used steroid, with methylprednisolone considered as an alternative.

Following administration, patients were monitored with audiological tests at predetermined intervals to assess changes in hearing levels. In our study, tests were performed before intratympanic dexamethasone treatment, and on the 3rd and 5th days after the start of treatment.

Pure tone audiometry (PTA) was used to assess hearing thresholds. This test determined patients' hearing thresholds at various frequencies, and pre- and post-treatment results were compared. Measurements were made at key frequencies (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz) using pure tones transmitted via air and bone conduction. The hearing threshold, expressed in decibels (dB), indicated the lowest sound level a patient could perceive. Mean PTA values and speech discrimination scores before and after treatment were calculated to evaluate changes in hearing loss.

Statistical analyses were performed using SPSS version 31.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean \pm standard deviation. The normality of the data distribution was assessed using the Shapiro–Wilk test. Changes in pure tone audiometry (PTA) thresholds and speech discrimination scores were compared between groups using the independent samples t-test when the assumption of normality was satisfied, and the Mann–Whitney U test when it was not. Differences between sex, dose groups (three vs. five injections), and age groups (<50 and \geq 50 years) were analyzed using these methods. Correlations between age and changes in PTA and speech discrimination scores were evaluated with the Pearson correlation coefficient for normally distributed data or the Spearman rank correlation coefficient for nonparametric data. A p-value of <0.05 was considered statistically significant.

Results

A total of 30 patients diagnosed SSNHL and treated with a combination of oral steroids and intratympanic dexamethasone were included in the study. Half of the patients (50%) were male and half were female. The mean age was 47.3 years in the three-dose group and 48.6

years in the five-dose group. At presentation, tinnitus was present in all patients, and vertigo was reported by six patients (20%). Of the total sample, 20 patients (66.6%) received three doses of intratympanic dexamethasone therapy (ITDT), while 10 patients (33.3%) received five doses. Regarding gender, the three-dose group consisted of 12 males (60%) and 8 females (40%), while the five-dose group included 6 males (60%) and 4 females (40%). The gender proportions were therefore identical across both treatment groups.

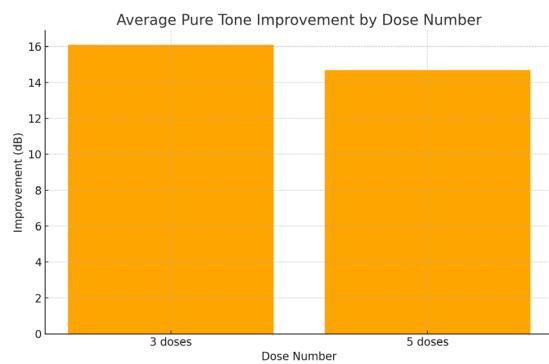


Figure 1: The changes in patients' PTA scores before and after treatment.

Speech discrimination scores improved by an average of $10.7 \pm 14.6\%$ in the three-dose group and $6.9 \pm 11.5\%$ in the five-dose group. Percentage improvements were 30.94% and 43.81% respectively, with no statistically significant difference between the groups (p-değeri: 0.928). Figures 1 and 2 show the changes in patients' PTA and speech discrimination scores before and after treatment.

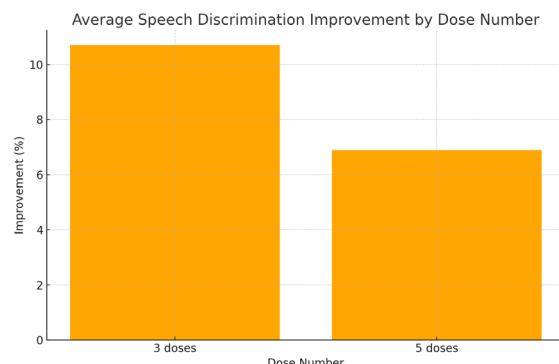


Figure 2: the changes in patients' speech discrimination scores before and after treatment.

Although younger patients showed greater improvement in PTA levels compared to older patients, this difference was not statistically significant ($p = 0.660$). Likewise,

no significant difference in PTA improvement was observed between male and female patients ($p = 0.219$). Analysis by dose group revealed individual variability in treatment response in both groups, suggesting that hearing recovery is influenced by patient-specific factors.

Overall, intratympanic steroid administration, whether given as three or five doses, resulted in significant hearing improvements, but increasing the number of doses did not yield additional benefit.

Discussion

Sudden sensorineural hearing loss remains an otologic condition with an etiology that is not fully understood, and its clinical management continues to be debated. It is most commonly defined as a sensorineural hearing loss of at least 30 dB at three consecutive frequencies, developing within three days or less [4,7]. Possible etiologic factors include viral infections, vascular disorders, autoimmune processes, trauma, and metabolic disturbances [7]. However, in 70–90% of cases, the cause is idiopathic [8]. This high idiopathic rate complicates the standardization of treatment protocols and has led to numerous studies comparing different therapeutic approaches.

Previous studies have evaluated the efficacy of systemic corticosteroids, intratympanic steroid injections, hyperbaric oxygen therapy, hemodilution, vasoactive agents, and various combination regimens [13,14]. Systemic corticosteroid therapy remains the cornerstone of SSNHL treatment due to its anti-inflammatory, immunosuppressive, and membrane-stabilizing effects [15]. Prednisolone and methylprednisolone are commonly used and have been shown to improve hearing in a significant proportion of patients. However, the lack of superiority over placebo in some studies has been attributed to high rates of spontaneous remission, which increases the debate regarding the necessity of corticosteroid therapy. Moreover, systemic administration carries risks such as hypertension, hyperglycemia, and gastrointestinal complications [9]. This has further increased doubts regarding systemic therapy and generated growing interest in intratympanic steroid therapy, which delivers high drug concentrations directly to the cochlea while minimizing systemic side effects [16]. The round window membrane provides a direct diffusion pathway into the perilymph, allowing therapeutic concentrations to be achieved with relatively low doses.

Intratympanic steroids are often considered a salvage treatment in cases resistant to oral therapy; however, current evidence shows that these agents may also be beneficial when administered earlier, even in moderate hearing losses, and in some cases may provide results comparable to systemic therapy alone. Our findings are consistent with this concept: both three-dose and five-dose regimens produced clinically meaningful improvements in PTA and speech discrimination scores. However, no statistically significant difference was observed between protocols, suggesting that increasing the number of injections may not provide additional benefit.

Various prognostic factors have been identified in the literature, including the degree of initial hearing loss, audiogram configuration, age, and comorbidities. Younger age, low-to-mid frequency involvement, and the absence of systemic diseases have been associated with better recovery [17]. In our study, although no statistically significant correlation between age and improvement was detected, younger patients tended to show greater recovery, consistent with previous reports. Inflammatory biomarkers such as neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and mean platelet volume (MPV) have also been investigated as prognostic indicators [18,19,20,21], possibly reflecting the role of inflammation and microcirculatory disturbances in the pathophysiology of SSNHL.

Another notable feature of SSNHL is spontaneous recovery, with reported rates ranging from 32% to 65% within the first two weeks without active treatment [6]. This makes it difficult to distinguish true treatment effects from placebo responses in clinical trials. Nevertheless, most clinical guidelines recommend initiating treatment immediately after diagnosis to maximize recovery potential, although consensus is lacking [8].

The American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) guidelines recommend systemic steroids as the first-line therapy, reserving intratympanic injections for patients who fail to respond or have contraindications to systemic use [6]. However, evidence from combination therapy studies, such as that by Skarżyńska et al. (2022), has demonstrated a synergistic benefit when systemic and intratympanic steroids are used together, particularly in improving speech discrimination and high-frequency hearing. Hyperbaric oxygen therapy, although beneficial

when used early in combination with steroids, has not demonstrated sufficient efficacy as monotherapy [13].

Our study supports the role of intratympanic steroids as an effective adjunct to systemic therapy. The lack of significant difference between the three-dose and five-dose protocols suggests that a lower-dose regimen may be equally effective, potentially reducing patient discomfort and procedural risks. Reported complications of intratympanic injections include tympanic membrane perforation, transient vertigo, worsening of tinnitus, and, rarely, ossicular chain injury; however, these events are generally infrequent and manageable [8].

Conclusion

Sudden sensorineural hearing loss (SSNHL) is a clinical condition with mostly unknown etiology. In this study, we compared two different intratympanic dexamethasone protocols—three doses versus five doses—administered in addition to systemic steroid therapy in patients diagnosed with SSNHL. Our findings demonstrated that both protocols resulted in significant improvements in pure tone thresholds and speech discrimination scores, but increasing the number of injections did not provide a statistically significant advantage. The mean PTA improvement was 28.23% in the three-dose group and 23.28% in the five-dose group, while speech discrimination scores improved by 30.94% and 43.81%, respectively.

These results suggest that intratympanic steroid administration can provide additional benefit to systemic therapy regardless of dose number, and may be a valuable treatment option in cases where systemic steroids are contraindicated or when rapid adjunctive intervention is required. Since no significant difference was observed between the two regimens, adopting a lower-dose protocol may reduce procedural risks and patient discomfort while maintaining efficacy.

Our findings are consistent with current literature supporting intratympanic steroids as a safe and effective adjunctive therapy in SSNHL. However, the lack of consensus regarding optimal dosing frequency and treatment duration highlights the need for larger randomized controlled trials with long-term follow-up to establish standardized protocols.

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Ethical Declaration: Ethics approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of Giresun Üniversitesi Tıp Fakültesi with decision number 16.04.2025/01

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