



Sudden Sensorial Hearing Loss in Different Treatment Approaches

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Abstract

Background: Idiopathic sudden sensorial hearing loss (ISSHL), a condition characterized by hearing loss exceeding 30 dB HL in three consecutive audiometric frequencies within three days or less. This study aimed to evaluate the effectiveness of systemic, intratympanic, and combination steroid administration in the treatment of idiopathic sudden sensorial hearing loss (ISSHL).

Subjects and Method: A prospective clinical trial was conducted on 60 patients with severe (SSNHL) between January 2014 and April 2017. The patients were divided into three groups: oral steroid group, intratympanic steroid group, and mixed treatment group. IT injection by topical anaesthesia and dexamethasone injection twice a week for 2 weeks. The oral steroid group received 60 mg of prednisolone tapered over two weeks. The mean hearing levels were expressed as the average of hearing thresholds at 0.5, 1, 2, and 3 kHz (4-tone average). Complete recovery was defined as >30 dB and final hearing >25 dB, partial recovery >15 dB, slight improvement was >15 dB, and no improvement was <15 dB.

Results: A study of 60 cases with a 1:1.4 male-to-female ratio found that 40% of the participants had a 20-45 db hearing rate before the intratympanic injection. The remaining 60% had a 46-70 db rate, while 15% had a >70-90 db rate. The rate of hearing improvement was statistically significant before and after treatment. The third group (oral steroid and intratympanic steroid injection) showed greater improvement, with a mean of 28.360 + 12.753. However, no statistical significance was found between the three treatment modalities, as the P value >0.005.

Conclusion: The study found no significant differences in outcomes between oral and IT as a mixed treatments or apart for managing hearing loss, suggesting they can be equally effective. Further research is needed to understand long-term effects.

Keywords: Sudden; Sensorial; Hearing; Intratympanic Injection; Prednisolone

Introduction

Sudden sensorineural hearing loss (SSNHL) was first reported in 1944 by De Kleyn [1] and the most widely used definition is the one that is proposed by the US National Institute on Deafness and Other Communication Disorders (NIDCD). According to this, SSNHL is defined as greater than 30 dB HL of hearing loss in at least three consecutive audiometric frequencies occurring within 3 days or less [2].

The annual incidence of sudden sensory hearing loss in the United States is estimated to be 5-20 cases per 100,000 persons, with many cases likely going unreported. A South Korean study found a mean annual incidence of unilateral sudden sensorineural hearing loss (SSNHL) to be 17.76 slight cases per 100,000 population. The female-to-male distribution is equal, with a male preponderance at 53%. The peak incidence occurs in the sixth decade of life, with young adults having similar rates. The onset of bilateral SSNHL tends to occur at a younger age than the unilateral form [3-6]. To observe the aetiology of different diseases, various cases including autoimmune inflammation, viral cochleitis, and inner ear membrane rupture have been studied [7].

The most convincing causes are viral and vascular aetiologies. The natural background of SSNHL is still unknown; spontaneous recovery happens in almost 30% of cases and it will recover mostly during the first 2 weeks after its onset, and it contains partial response. Many factors seem to influence recovery; the degree of hearing loss, the audiogram pattern, the existence of vertigo, and the duration between the onset and treatment of SSNHL are probably the most important factors [8]. The treatment of (SSNHL) has been a topic of controversy, with no universally accepted protocol. Systemic steroids are the only agents with proven effectiveness, with a recovery rate of 49 to 89% in untreated patients [9].

However, systemic steroids are associated with side effects and are contraindicated in certain pathological situations. To address this, Intratympanic (IT) steroids treatment, first used in 1956 to relieve Meniere's disease symptoms, has become increasingly common in practice, especially in patients with contraindications or resistance to systematic steroids. IT steroids are also often used in rescue treatment for those who have failed regular treatments. Given the widespread application of IT steroids therapy, it is possible that it could be used as a first-line treatment for SSNHL [10].

Different therapies have been tried for SSNHL, none of which was effective. Hyperbaric oxygen, vasodilator drugs, agents that decrease blood viscosity and magnesium, are some examples of previously tested SSNHL treatments. Some studies present that steroids might be effective [8].

It is important to note that excessive doses of steroids might have systemic effects, making them unsuitable for all patients. Corticosteroids exhibit several methods of action, including anti-inflammatory effects, immunological suppression, membrane stability, enhanced perfusion, and modulation of ion balance [11].

However, the presence of contraindications and potential side effects of systemic steroids has prompted investigation into other methods of administering steroids directly into the cochlea. In 1996, Silverstein, *et al.* pioneered the use of intratympanic steroid perfusion as a therapy for sudden sensorineural hearing loss (SSHL) [12]. Subsequently, numerous investigations on this therapeutic method have been published in scientific literature [13], while the combination of intra-tympanic and systemic steroids has lately attracted the attention of doctors.

Nevertheless, the variety of the findings and the scarcity of prospective randomized controlled studies emphasize the necessity for additional study in this area. The aim of this study was to evaluate and compare the effectiveness of systemic, intratympanic, and combination steroid administration in the initial treatment of idiopathic sudden sensorineural hearing loss (ISSHL).

Subjects and Methods

Prospective, multicentre clinical trial, hearing test results of 60 patients with SSNHL who visited the Department of Otorhinolaryngology in Benghazi Medical Centre ALTAREK hospital, and Al Marj hospital between January 2014 and April 2017.

Inclusion criteria were

(1) 30 dB loss in three consecutive frequencies in <72 h, (2) normal otoscopic examination, (3) no history of chronic otitis media, (4) no history of trauma (head, acoustic, or barometric), (5) no history of Meniere's disease, hydrops, or fluctuating hearing loss, (6) no history of meningitis, (7) no history of prior ear surgery, (8) no history of radiation, (9) no exposure to ototoxic medications.

A total of 60 patients with SSNHL who met the inclusion criteria for initial therapy were selected to participate in the study. patients were divided into three groups: oral steroid group, intratympanic steroid group, and mixed treatment group (oral steroid and intratympanic dexamethasone injection).

The operative procedure of intratympanic steroid injection was performed under a microscope and with patient in supine position. After the surgeon confirmed the intact tympanic membrane and middle ear status, topical anaesthesia was administered with a cotton ball soaked with lidocaine 10% pump spray (Xylocaine), which was applied on the tympanic membrane for 20 min. While the patient tilted the head 45° to the healthy side, a 25-gauge spinal needle was introduced into the posterior inferior portion of membrane and dexamethasone, 8 mg/ mL were injected twice a week for 2 weeks [13].

The oral steroid group received 60 mg of prednisolone tapered over two weeks.

Outcome measure

Auditory function was determined by pure-tone audiometry; the mean hearing levels were expressed as the average of hearing thresholds at 0.5, 1,2, and 3 kHz (4-tone average) (PTA), according to the guidelines of the Committee on Hearing and Equilibrium of the American Academy of Otolaryngology — Head and Neck Surgery [14]. Auditory measurements were performed before and 1 month after the treatment, according to Siegel’s criteria for hearing improvement [15]. Complete recovery’ was defined as more than 30 dB hearing gain and as final hearing better than 25 dB, ‘partial recovery’ as more than 15 dB hearing gain and as final hearing between 25 and 45 dB, ‘slight improvement’ as more than 15 dB hearing gain but with a final hearing poorer than 45 dB, and ‘no improvement’ as less than 15 dB hearing gain and final hearing poorer than 75 dB [12].

Statistical analysis

The statistical analysis was performed using the SPSS software package (version 23). The graphs were created using Microsoft Excel software package (version 2013). The means of metric variables between two groups were compared with paired samples t test. To determine whether there were significant differences between the means of the three groups Friedman test was used. The means of quantitative variables within the same group at different points in time were compared with paired samples t test.

A difference was considered to be statistically significant when the p value was less than 0.05.

Results

Out of 60 cases, the ratio of males to females was 1:1.4. More than half of the sample had an age range of 36-45 years (figure 2).

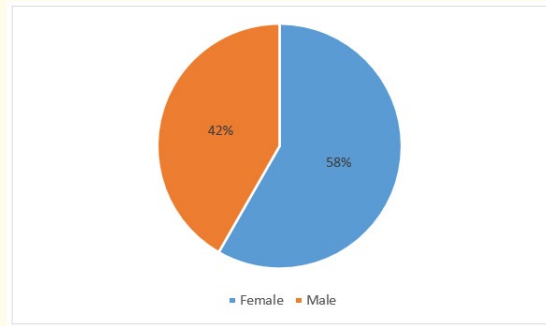


Figure 1: Male female ratio of the study participants.

The study population consisted of four age groups: 16-25 years, representing 10%, 26-35 years, accounting for 25%, 36-45 years, accounting for 46.7%, and finally 46-53 years, accounting for 18.3%, as shown in Table 1 and figure 2.

Age	No.	%
16-25	6	10
26-35	15	25
36-45	28	46.7
46-53	11	18.3
total	60	100

Table 1: Age groups of the study participants.

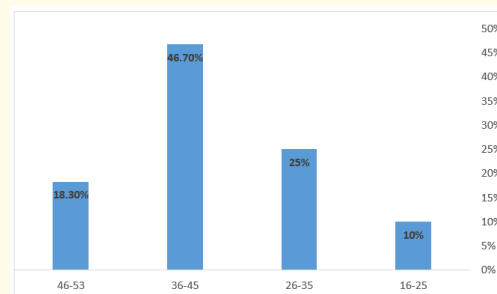


Figure 2: Age interval of the cases of audiometry.

Taking into account Siegel’s criteria for evaluating hearing improvement in the three groups, we found that before the intratympanic injection, none of them had a hearing rate of 20-45 db, and after the injection, 8 (40%) had a hearing rate of 20-45 db.

The number of 12 (60%) whose hearing rate was 46-70 db became 9 (45%) after the injection.

The number of people whose hearing rate was >70-90db before the intratympanic injection was 8 (40%), and after the injection it was 3 (15%).

The mean hearing for this group was 67.7 ± 8.9. There was also a statistically significant difference in the rate of hearing improvement before and after treatment.

There was also a statistically significant difference before and after treatment in the rate of hearing improvement for the group treated with systemic steroids.

There was also a statistically significant difference for the group that was treated with the combination treatment (intratympanic injection with oral steroid).

Table 2 shows the number of people in each hearing category according to the Siegel criterion before and after treatment of the three groups also show the mean of the hearing readings of the three groups.

Siegel’s criteria	GpI		GpII		GpIII		
	Pre I.T.Inj Dexame	Post I.T.Inj of Dexame	Pre oral Pred.	Post oral pred.	Pre oral Pred.	Post oral pred.	Post I.T. Inj of Dexame
	n = 20		n = 20		n = 20		
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
I-20-45db	0	8(40)	0	11(55)	1(5)	10(50)	10(50)
II-46-70db	12(60)	9(45)	14(70)	7(35)	8(40)	8(40)	6(30)
III->70-90db	8(40)	3(15)	6(30)	2(10)	7(35)	2(10)	4(20)
IV->90 DB	0	0	0	0	4(20)	0	0
Mean ± SD	67.7 ± 8.9	51.0 ± 16.5	64.9 ± 6.8	43.5 ± 15.3	73.1 ± 15.5	48.6 ± 15.2	44.7 ± 15.4
Difference between initial and pre-treatment PTA, mean SD (dB)	16.7± 7.6		21.4 ± 8.5		28.4 ± 0.2		

Table 2: Frequency of the Pre-and post- interventions differences among neurosensory deafness cases at Benghazi medical center.

I.T Inj = intratympanic injection , Dexame = dexamethasone, pred = prednisolone.

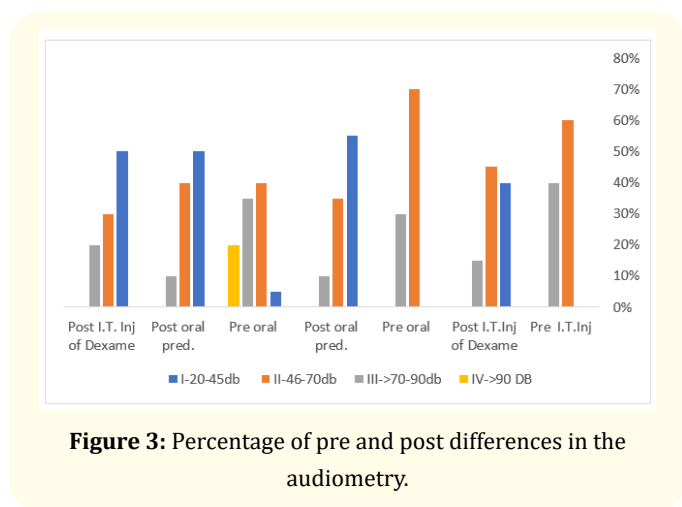


Figure 3: Percentage of pre and post differences in the audiometry.

As in Table 3, there are statistically significant differences before and after treatment for the three groups, and the amount of improvement was greater in favor of the third group (oral steroid and intratympanic steroid injection), as the mean was 28.360 ± 12.753. and the mean deference before and after the treatment was greater than the two approaches 28.4+0.2.

Comparing the treatment outcome of the three treatment modalities of the three groups found no statistical significance between them as the P value >0.05 (Table 4).

Pre and post pairs Mean		Paired Differences					T	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Group 1 (Pre oral pred - Post oral pred)	21.390	10.748	2.403	16.360	26.420	8.900	19	<0.001*
Pair 2	Group 2 (Pre I.T – Post I.T.Inj Dexam)	16.730	10.379	2.321	11.872	21.588	7.208	19	<0.001*
Pair 3	Group 3 (pre oral pred- post I.T Dexam)	28.360	12.753	2.852	22.391	34.329	9.945	19	<0.001*

Table 3: Comparison of the pre and post treatment outcome of the three groups separately.

I.T Inj = intratympanic injection, Dexam = dexamethasone, pred = prednisolone, * = statistical significance.

Group	N	Mean	S.D	Minimum	Maximum	Mean Rank	Chi-Square	P
Group 3	20	44.70	15.421	25	76	2.00	0.000	0.9
Group 2	20	50.98	16.518	23	75	2.00		
Group 1	20	43.49	15.312	23	74	2.00		

Table 4: Comparing the treatment out come between the three groups.

Discussion

Sudden sensorineural hearing loss (SSHL) is a serious ontological emergency that affects hearing and quality of life. It requires immediate treatment, and the duration between the onset and the start of treatment may affect the prognosis. Systemic steroid therapy is widely accepted as the first line of treatment, and a combination of systemic and intratympanic steroid treatments may be a new therapeutic strategy for SSHL [16].

This study documents the management of sudden sensorineural hearing loss at multiple hospitals, specifically in the cities of Benghazi and Al-Marj. All care providers noted that patients with ISSNHL were directed to a single practitioner who was responsible for providing the majority of intratympanic injections. The objective was to determine the optimal therapeutic approach for individuals who are unable to receive systemic steroid medication, by comparing the effectiveness of combined oral therapy with intratympanic injection, oral therapy alone, and intratympanic injection therapy alone. While the evidence supports both oral medication and concurrent or salvage intratympanic injection,

we now advocate concurrent therapy due to the lower risk of intratympanic injection as reported in the literature [17], and observed in our own practice.

There are several variables associated with IT therapy. The treatment approach involved administering three synchronous injections or salvage/delayed therapy to patients who presented after completing a course of oral steroids, as advised by the literature and practice guidelines [18]. In the present study almost every patient was administered four injections (two shoots by week). The concentration of steroids plays a crucial role in enhancing outcomes, as indicated by new retrospective data that demonstrates statistically significant improvement in post-treatment assessment (PTA) when using dexamethasone at a concentration of 24 mg/ml (compounded) compared to 10 mg/ml (stock) [19]. This increased dosage is also acknowledged in clinical practice guidelines [18]. In this study dexamethasone was 8 mg/ml due to its commercial availability, as the alternative needs compounding, has a short shelf life, and is not easily accessible.

Performing posttreatment audiograms prematurely may result in the failure to detect improvements in hearing over time. Experience, supported by existing literature, suggests that long-term audiometric outcomes can be significantly better than short-term results [20]. In the present study auditory measurements were performed before and 1 month after the treatment, according to Siegel's criteria for hearing improvement.

This study designed to assess patients within a month timeframe from the start in order to demonstrate a more pronounced effect relationship with the treatment. Literature suggest that treatment for SSHL is recommended for patients within three months of diagnosis, according to current clinical practice standards [18]. Some researchers in the literature may advise to continue to offer treatment to patients within a three-month timeframe, and also advise patients that the likelihood of improvement decreases as the period between onset and treatment increases [17].

The results of this study showed as there was an early intervention results in enhanced outcomes either for the oral steroid, or IT, or the combination oral+IT group. A study found that combining oral and IT therapy yielded comparable results. The study also revealed that individuals who received the treatment earlier had better outcomes, specifically those who experienced a minimum of a 30 decibel improvement in pure-tone average [16]. A previous study recommended establishing contacts with primary care physicians in direct referral network to facilitate rapid diagnosis, early administration of steroids, and timely referral of these cases. Using tuning fork identification, also known as the Rauch test, can help diagnose idiopathic sudden sensorineural hearing loss (ISSNHL) [17].

In this study hearing improvement in the group treated with IT injection was 21.4 ± 8.5 dB and the improvement was a statistically significant comparing before and after treatment response as the $P < 0.001$. A randomized clinical trial found that intratympanic steroid injections (ITSIs) can improve hearing by 10 dB or more in 44.4% of subjects who did not respond to traditional steroid therapy [21]. IT in sensorineural hearing loss can also improve hearing by an average of 9.7 dB. Previous studies have shown a response rate of 12% to 100%, and a high rate of spontaneous recovery from SSHL could impact the effectiveness of ITSIs as a second-line therapy [22].

A study investigating the effect of oral steroids comparing patients with sudden hearing loss based on treatment received found no significant differences in posttreatment outcomes. The study found that prompt treatment within 14 days of hearing loss onset was associated with better hearing outcomes, regardless of the amount of oral steroid used. However, only 35% of the sample experienced clinical improvement, which does not exceed the previously reported rates of spontaneous recovery of 45% to 65%. In this study the improvement of oral steroid was 16.7 ± 7.6 dB. And for the mixed therapeutic approach the improvement was 28.4 ± 0.2 Db.

While this study found a statistically significant difference in treatment response rates before and after each treatment approach separately ($P < 0.001$), there was no statistically significant difference between the three therapeutic approaches in treatment response rates ($p = 0.9$).

In the same field of the present study results a study comparing IT and systemic steroid treatment modalities for sensorineural hearing loss, overall, 88% of patients in group A (IT), and 86% in group B (systemic+IT) experienced complete or partial hearing recovery. There was no significant difference in hearing outcomes between IT dexamethasone and sequential IV plus IT treatments for severe sensorineural hearing loss ($P > 0.05$) [23]. There was no significant evidence suggesting that IT dexamethasone promoted hearing recovery than IV dexamethasone [23].

There was a In some studies, IT steroid treatment led to better outcomes than IV steroid treatment [24]. Another study suggested that the combination of systemic administration and IT injection may improve patient prognosis [25]. Which is somewhat similar to our results, as the rate of improvement in hearing before and after treatment was slightly greater in the group treated with the mixed treatment approach than IT alone.

A multicenter, randomized comparison of oral and intratympanic corticosteroids for primary therapy of idiopathic hearing loss found that the mean PTA difference was 10 dB greater for oral prednisone than for intratympanic steroid treatment. However, some subgroups showed a trend for better outcome with oral treatment [26]. But in the resent study the outcome was a little better with IT than oral steroid treatment.

Treatment of sudden sensorineural hearing loss with oral vs IT vs combination therapy is a topic of ongoing debate and research. Some studies suggest that oral therapy alone can be effective in restoring hearing function, while others argue that intratympanic (IT) injections of steroids directly into the middle ear may provide more targeted and immediate relief. Additionally, a combination therapy approach, involving both oral and IT treatments, has shown promising results in certain cases. Ultimately, the choice of treatment depends on various factors such as the severity of the hearing loss, the underlying cause, and the patient's individual response to different therapies. Therefore, a comprehensive evaluation by an ear, nose, and throat specialist is crucial in determining the most suitable treatment option for each patient.

Conclusion

Though oral steroid are superior in their effect comparing with IT steroid injection, but using IT steroid injection still have good effect in treating SSNH as shown in our study there were no statistically significant differences in outcomes between the three treatment approaches, suggesting that oral and IT treatments can be equally effective alone or combined in managing hearing loss. However, further research is needed to better understand the long-term effects and potential side effects of these treatment options. In the meantime, regular follow-up appointments and adjustments to the treatment plan may be necessary to ensure the best possible outcome for each individual patient.

Bibliography

- de Kleyn. "Sudden complete or partial loss of function of the octavus-system in apparently normal persons". *Acta Otolaryngology* 32.5-6 (1944): 407-429.
- "Disorders, National Institute on Deafness and Other Communication (NIDCD)". *NIH Sudden dea*, (2016).
- I Neeraj N Mathur, MBBS, MS, DNB, MAMS, FAMS Professor and Head, Department of ENT, Amrita Hospital and Amrita Institute of Medical Sciences, Faridabad. "Sudden Hearing Loss". Medscape, (2021).
- S H Kim., et al. "A trend in sudden sensorineural hearing loss: data from a population-based study". *Audiology and Neurotology* 22.6 (2018): 311-316.
- F T Shaia and J L Sheehy. "Sudden sensori-neural hearing impairment: a report of 1,220 cases". *Laryngoscope* 86.3 (1976): 389-398.
- SA Sara., et al. "Bilateral sudden sensorineural hearing loss". *The Journal of Laryngology and Otology* 128.S1 (2014): S8-S15.
- G J Gianoli and J C Li. "Transtympanic steroids for treatment of sudden hearing loss". *Otolaryngology Neck Surgery* 125.3 (2001): 142-146.
- N Berjis., et al. "Intratympanic dexamethasone injection vs methylprednisolone for the treatment of refractory sudden sensorineural hearing loss". *Advanced Biomedical Research* 5 (2016).
- KH Lee., et al. "Is Intratympanic Dexamathasone Injection Effective for the Treatment of Idiopathic Sudden Sensorineural Hearing Loss?". *Journal of Audiology and Otology* 19.3 (2015): 154-158.
- T Yang., et al. "Intratympanic vs systemic use of steroids as first-line treatment for sudden hearing loss: A meta-analysis of randomized, controlled trials.". *Journal of Otology* 16.3 (2021): 165-177.
- D M Barrs., et al. "Intratympanic steroid injections for intractable Meniere's disease". *Laryngoscope* 111.12 (2001): 2100-2104.
- H Silverstein., et al. "Intratympanic steroid treatment of inner ear disease and tinnitus (preliminary report)". *Ear, nose and Throat Journal* 75.8 (1996): 468-488.
- R Filipo., et al. "Intratympanic steroid therapy in moderate sudden hearing loss: a randomized, triple-blind, placebo-controlled trial". *Laryngoscope* 123.3 (2013): 774-778.
- LS Laura Bontempo., et al. "Clinical Practice Guideline: Sudden Hearing Loss (Update)". *American Academy of Otolaryngology-Head and Neck* (2019).
- I S Moon., et al. "Intratympanic Dexamethasone Is an Effective Method as a Salvage Treatment in Refractory Sudden Hearing Loss". *Otology and Neurotology* 32 (2011): 1432-1436.
- HP Wu., et al. "Intratympanic steroid injections as a salvage treatment for sudden sensorineural hearing loss: a randomized, double-blind, placebo-controlled study". *Otology and Neurotology* 32.5 (2011): 774-779.

17. JH Hara, *et al.* "Oral and intratympanic steroid therapy for idiopathic sudden sensorineural hearing loss". *Laryngoscope Investigation on Otolaryngology* 3.2 (2018): 73-77.
18. R J Stachler, *et al.* "Clinical practice guideline: sudden hearing loss". *Otolaryngology-Head and Neck Surgery* 146.3 (2012): S1-35.
19. TH Alexander, *et al.* "Dose Effect of Intratympanic Dexamethasone for Idiopathic Sudden Sensorineural Hearing Loss: 24 mg/mL Is Superior to 10 mg/mL". *Otology and Neurotology* 36.8 (2015): 1321-1327.
20. SW Yeo, *et al.* "Hearing outcome of sudden sensorineural hearing loss: long-term follow-up.". *Otolaryngology-Head and Neck Surgery* 136.2 (2007): 221-224.
21. G Plaza and C Herráiz. "Intratympanic steroids for treatment of sudden hearing loss after failure of intravenous therapy". *Otolaryngology-Head and Neck Surgery* 137.1 (2007): 74-78.
22. SD Rauch. "Intratympanic steroids for sensorineural hearing loss". *Otolaryngologic Clinics of North America* 37.5 (2004): 1061-1074.
23. J Huang, *et al.* "Differences in hearing recovery following intratympanic alone or intravenous dexamethasone with rescue intratympanic steroids for sudden sensorineural hearing loss: a randomised trial". *Clinical Otolaryngology* 46.3 (2021): 546-551.
24. Q Qiang, *et al.* "A comparison between systemic and intratympanic steroid therapies as initial therapy for idiopathic sudden sensorineural hearing loss: a meta-analysis". *Acta Otolaryngology* 137.6 (2017): 598-605.
25. SH Kim, *et al.* "Comparison of steroid administration methods in patients with idiopathic sudden sensorineural hearing loss: a retrospective observational study". *Clinical Otolaryngology* 40.3 (2015): 183-190.
26. SD Rauch, *et al.* "Oral vs Intratympanic Corticosteroid Therapy for Idiopathic Sudden Sensorineural Hearing Loss: A Randomized Trial". *JAMA* 305.20 (2011): 2071-2079.