

How long should the sudden hearing loss patients be followed after early steroid combination therapy?

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Abstract To evaluate the beginning time and the completion time of hearing improvement in patients with sudden hearing loss who were treated with combination therapy including oral steroid. From September 2006 to December 2007, 102 idiopathic sudden hearing loss patients who showed any ‘recovery’ in hearing according to the Siegel’s criteria after treatment were analyzed. Pure tone audiometries were performed on the pretreatment day and on the third, seventh, fourteenth post-treatment day, and on the first, second, third, sixth post-treatment month. The time of initial hearing improvement and the completion time of hearing improvement were analyzed. Of 102 patients who showed any improvement, cumulatively, 93.1% showed beginning of hearing improvement within 14 days after treatment. Complete recovery or an end of change was achieved in cumulatively 80.4% of the patients within 1 month after treatment and in 92.2% of the patients within 2 months after treatment. Prognosis can be predicted approximately 2 weeks after start of treatment because time of commencement shows plateau after 2 weeks in improved cases. Hearing should be followed-up for at least 2 months after treatment in patients who show incomplete or delayed hearing improvement.

Keywords Sensorineural hearing loss · Follow-up · Steroids

Introduction

Sudden hearing loss is abruptly developed sensorineural hearing loss, and its spontaneous recovery rate of up to 60% has been reported. It has been reported that most of the recovered cases showed recovery within 2 weeks after the onset of the disease [1, 2]. Medical treatment is known to improve the recovery rate [3]. Many controversies exist regarding treatment options for sudden sensorineural hearing loss, but medical therapy including steroids is considered as standard treatment modality [3–7]. In recent years, several long-term follow-up studies [8–10] have reported that start of recovery could be delayed by more than 1 month after the onset of the disease. However, few studies have examined the exact time point when hearing improvement begins and when hearing improvement ends.

In this study, the time of commencement of hearing improvement was analyzed after early combined therapy including oral steroids to predict the prognosis in idiopathic sudden hearing loss patients. The time of stabilization of hearing improvement after treatment was also analyzed to establish guidelines for the follow-up period.

Materials and methods

From September 2006 to December 2007, 152 patients visited Severance Hospital (Seoul, South Korea) with idiopathic sudden hearing loss within 10 days after onset and underwent hospitalization, combination treatment, and prospectively regular follow-up. 50 patients showed ‘no

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improvement' and 102 patients showed any 'recovery' after treatment according to Siegel's [11] criteria (Table 1). Among them, 102 patients who showed any 'recovery' were included in analysis.

The diagnosis of idiopathic sudden sensorineural hearing loss was based on clinical criteria: an acute onset of sensorineural hearing loss of higher than 30 dB over at least three contiguous frequencies of 0.25, 0.5, 1, 2, 3, 4, and 8 kHz, which may have occurred instantaneously or progressively over several days. Mean hearing levels were expressed as the average of hearing thresholds at 0.5, 1.0, 2.0, and 3.0 kHz (4-tone average). Subjects with medical or central nervous system conditions, including diabetes, hypertension, connective-vascular disease, vestibular schwannoma, and other conditions that could affect hearing recovery or selection of therapeutic methods were excluded. All the patients were subjected to a 10-day hospitalization and combination therapy consisting of oral steroids, intravenous heparin, and a satellite ganglion block starting within 24 h of their visit.

For oral steroids treatment, 60 mg of prednisolone (Solondo®, 5 mg/tablets, Yuhan Corp.) was orally administered for 5 days. For the next 5 days, the dose was gradually tapered. For anti-coagulative treatment, a daily dose of an intravenous infusion of 10,000 U of heparin for 10 days was administered with a blood coagulation test. A satellite

ganglion block was requested by the pain clinic of our institution, and was performed once a day for 10 days. For the procedure, patients were placed in a supine position and their shoulder area was slightly elevated, thus, the neck was extended. The anterior tubercle of the lateral process of the sixth cervical vertebra was palpated with a finger. Next, a 10-cc syringe with a 23-gauge needle was inserted in the same direction. Then, approximately 8 cc of 1% mepivacaine was injected.

All patients were followed-up in a same manner for a maximum period of 6 months after treatment by performing hearing tests. Pure tone audiometry was performed prior to the treatment and also on the third, seventh, and fourteenth day and the first, second, third, and sixth month after the start of treatment (Fig. 1). In patients whose hearing was completely recovered according to Siegel's [11] criteria, follow-up was discontinued even if 6 months had not elapsed.

The time point when patients showed a greater than 10-dB degree of hearing improvement with subjective hearing gain was defined as the time of commencement of hearing improvement. When three contiguous hearing measurements were consecutively identical on pure tone audiometry and no further improvements were observed, the initial time of measurement was defined as the time of stabilization. In cases where a complete recovery was achieved

Table 1 Siegel's criteria of hearing improvement

Type	Hearing recovery
I Complete recovery	Patients whose final hearing level is better than 25 dB regardless of the size of the gain
II Partial recovery	Patients who show more than 15 dB of gain and whose final hearing level is between 25 and 45 dB
III Slight recovery	Patients who show more than 15 dB of gain and whose final hearing level is poorer than 45 dB
IV No improvement	Patients who show less than 15 dB of gain

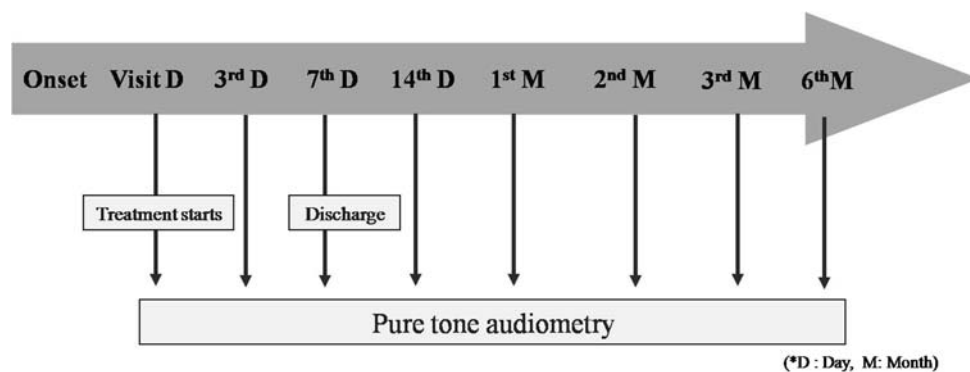


Fig. 1 All patients who were included in this review underwent prospectively scheduled pure tone audiometry test in a same manner. Tests were performed prior to the treatment and also on the third, seventh, and fourteenth day and the first, second, third, and sixth month after the

start of treatment. In patients whose hearing was completely recovered according to Siegel's [11] criteria, follow-up was discontinued even if 6 months had not elapsed

Table 2 General characteristics of patients who had idiopathic sudden sensorineural hearing loss

Clinical characteristics	
Age (years)	14–78 (51.4 ± 16.3)
Sex (male:female)	62:40
Site (right:left)	50:52
Initial hearing (dB HL)	86.5 ± 18.3
Period from onset to visit (days)	1–9 (3.1 ± 1.6)
Follow-up period (months)	1–6 (2.3 ± 1.4)

based on Sigel’s criteria [11], that time was defined as the time point of stabilization.

The time of commencement and time of stabilization of hearing improvement were analyzed.

The correlations between the degree of hearing improvement and time of hearing improvement were analyzed. The correlations between the severity of pretreatment hearing level and time of hearing improvement were also analyzed.

Statistical analyses were performed using an independent *t* test, paired *t* test, Wilcoxon signed rank test, and a linear regression test. A value of *P* < 0.05 was considered statistically significant.

Results

The patients consisted of 62 males and 40 females whose age distribution ranged from 14 to 78 years (mean 51.4 ± 16.3 years). All patients had unilateral hearing loss. The right and left sides were involved in 50 and 52 patients, respectively. The pretreatment hearing was 86.5 ± 18.3 dB HL. The maximum period elapsed from the time of onset of the disease until the outpatient visit was 9 days, with a mean value of 3.1 days. The follow-up period after treatment ranged from 1 to 6 months, with a mean period of 2.3 months (Table 2).

Final post-treatment hearing level was 37.7 ± 13.5 dB HL. Based on the final results of the pure tone audiometry,

patients were classified as three groups according to Sigel’s [11] criteria (Table 1). The group in which a complete recovery was achieved comprised 33 cases, the group in which a partial recovery was achieved comprised 40 cases, and the group in which a slight recovery was achieved comprised 29 cases (Table 3).

The time of hearing commencement after treatment ranged from 1 day to 2 months. A statistical analysis of accumulated patient data showed that hearing improvement started on the third day in 27 patients (29.4%), the seventh day in 72 patients (70.6%), the fourteenth day in 95 patients (93.1%), and the first month in 101 patients (99.0%) (Fig. 2). The time of stabilization ranged from 7 days to 6 months. A statistical analysis of accumulated patient data showed that hearing improvement ended in 2 weeks in 29 patients (28.4%), in 1 month in 82 patients (80.4%), in 2 months in 94 patients (92.2%), and in 3 months in 101 patients (99.0%) (Fig. 3).

The severity of the pretreatment hearing loss level and the time of commencement were significantly correlated (*R* = 0.507, *P* = 0.000). The correlation between the severity

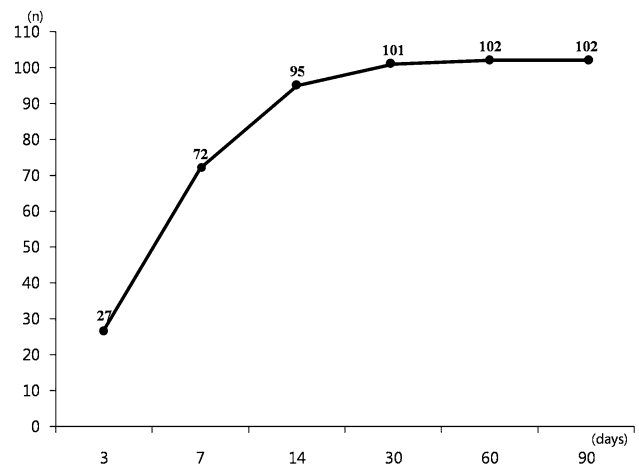


Fig. 2 The time point when hearing improvement begins. The dots indicate the cumulative number of patients who show the beginning of the hearing improvement at the time from treatment start. The time of commencement get to plateau from 2 weeks after the start of treatment

Table 3 The degree of a hearing improvement after steroid combination therapy

Sigel’s type	Total number of patients (%)	Recovery rate according to time of commencement (n)		Recovery rate according to time of stabilization (n)	
		≤2 weeks	>2 weeks	≤2 months	>2 months
I	33 (32.4)	32	1	31	2
II	40 (39.2)	38	2	36	4
III	29 (28.4)	25	4	27	2
Degree of hearing improvement (dB)	48.8 ± 13.5	50.1 ± 13.5	38.1 ± 8.0	47.1 ± 13.4	49.7 ± 19.8

The degree of a hearing improvement was also analyzed based on the time of commencement (*P* = 0.02) and time of stabilization (*P* = 0.102)

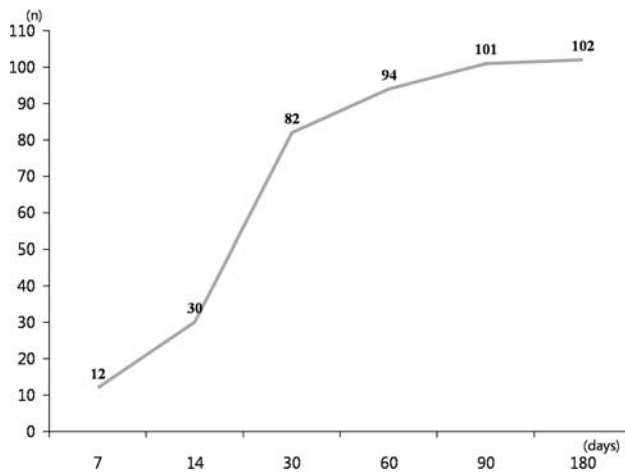


Fig. 3 The time point when hearing improvement stops. The dots indicate the cumulative number of patients who show the completion of the hearing improvement at the time from treatment start. The time of stabilization get to plateau from 2 months after the start of treatment

of pretreatment hearing loss level and the time of stabilization was also statistically significant ($P = 0.018$, $R = 0.291$) (Fig. 4).

The correlation between the degree of hearing improvement and the time of commencement was analyzed. Because the graph of time of commencement showed plateau from 2 weeks after treatment start, that time was used as a cutoff value. Based on the cutoff value of 2 weeks, the degree of hearing improvement was significantly different in the group which a recovery was started within that time compared to the group which a recovery was started after

that time ($P = 0.02$). The graph of time of stabilization showed plateau from 2 months, so that time was used as a cutoff value. In patients with a recovery, based on the cutoff value of 2 months, there were no significant differences in the degree of hearing recovery between the group in which recovery stabilized within 2 months and the group in which recovery stabilized after 2 months ($P = 0.102$) (Table 3).

Discussion

Although many studies have investigated sudden sensorineural hearing loss, the focus of these studies has been on changes of hearing, prognostic factors, and the effect of various treatment modalities. Few studies have elucidated the time of commencement or time of stabilization of hearing improvement. In clinical situation, if the hearing does not show any change despite treatment, it is hard to predict the prognosis during treatment. It is also hard to decide when to stop following up if the hearing is slowly improved but is not achieved the complete recovery. This study mainly focused on these problems. It was reported that the critical point was 7–10 days in sudden hearing loss to get the proper effect of treatment [8]. So, in this study, patients whose period elapsed from onset to outpatient visit was more than 10 days were excluded.

Chon et al. [9] conducted a 2-month follow-up pure tone audiometry in 78 patients with profound type sudden sensorineural hearing loss and reported that 14% of the subjects experienced delayed recovery of hearing after 1 month. Yeo et al. [8] conducted a 3-month follow-up pure tone

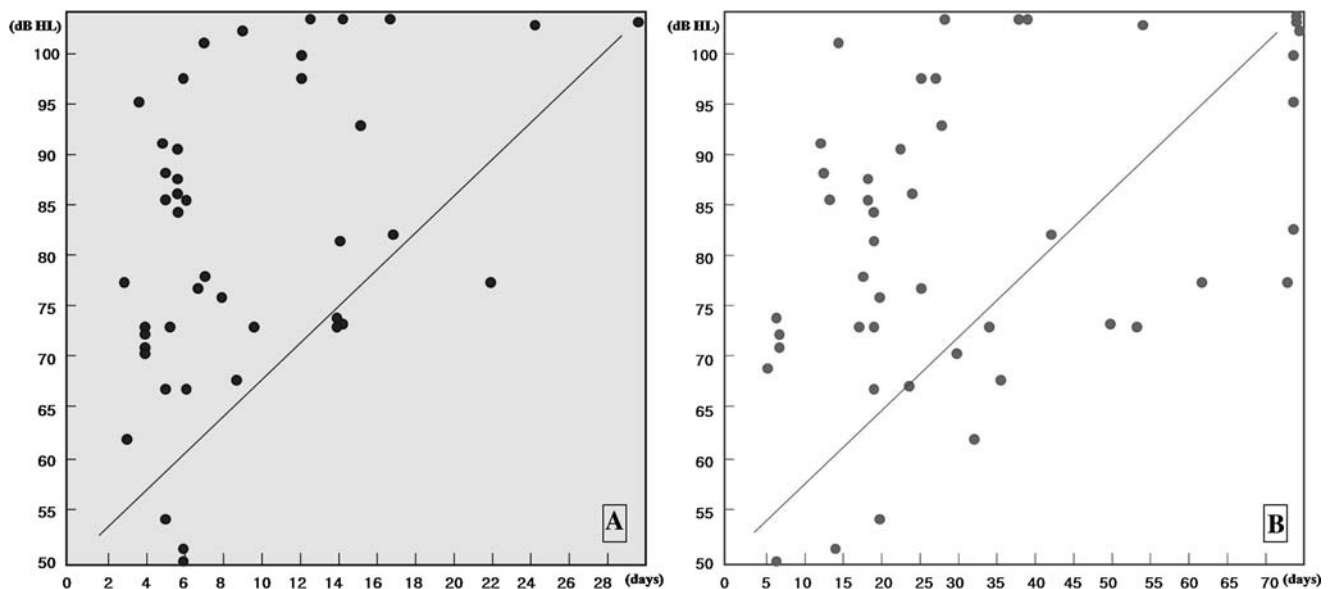


Fig. 4 Correlation between severity of pretreatment hearing and point of time that hearing change starts and stops. **a** There was strong correlation ($P = 0.000$, $r = 0.507$) between the time of commencement

and severity of onset hearing. **b** There was positive correlation ($P = 0.018$, $r = 0.291$) between the time of stabilization and severity of onset hearing

audiometry in 156 patients with sudden sensorineural hearing loss who were hospitalized and were treated using combination therapy including an oral steroids and reported that 9.9% of patients had a delayed recovery after 1 month. Based on these reports, a long-term follow-up and active drug therapy are needed in cases where complete recovery is not achieved. Furthermore, the reports indicate the possibility that the efficacy of intratympanic steroid injection (ITI) as a salvage treatment was overestimated [7, 12, 13], suggesting that the time point for ITI as salvage treatment must be adjusted to approximately 1 month after patient discharge. In this study, 1% of patients showed start of improvement after 1 month and 19.6% of patients showed more progress in improvement after 1 month. This result agreed with previous reports in estimating the effect of ITI therapy.

Chon et al. [9] reported that 63% of patients with profound type sudden sensorineural hearing loss showed a response to treatment within 2 weeks after the onset of the disease and reported that patients who responded within 2 weeks showed more significant improvement in hearing compared to patients who responded after 2 weeks from onset [9]. In this study, an analysis of the time of commencement of hearing improvement after treatment was performed. The recovery of hearing cumulatively started before 2 weeks in 93.1% of patients and the time of commencement showed plateau after 2 weeks. Based on the cutoff value 2 weeks, the group with the start of recovery within 2 weeks showed more significant improvement in hearing compared to the patients with the start of recovery after 2 weeks from the start of treatment. These results indicate that a prognosis can be predicted by whether the time of commencement is appeared or not on the time of week 2 from start of treatment.

In this study, the proportion of patients who showed stabilization of hearing after more than 1 month from the start of treatment was 19.6%. This figure was higher than the figure reported by Chon et al. [9] or Yeo et al. [8]. Two months after early steroid combination treatment, 7.8% of patients showed no stabilization of hearing and exhibited a delayed recovery and the time of stabilization showed plateau after 2 months. The time of stabilization was not correlated with the degree of hearing improvement. Based on these results, a follow-up longer than 2 months is needed with the expectation of persistent delayed improvement of hearing in cases where complete recovery was not achieved after treatment.

Conclusions

A prognosis for sudden sensorineural hearing loss can be predicted approximately 2 weeks after the start of treatment. In cases where hearing improvement is delayed and/or a complete recovery is not achieved, a follow-up should be performed for at least 2 months.

Conflict of interest statement There is no financial relationship with the organization that sponsored the research.

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