The Journal of International Advanced Otology

J Int Adv Otol 2018; 14(1): 77–84 • DOI: 10.5152/iao.2018.4601

Original Article

Patients Over 60 Years of Age Have Poor Prognosis in Facial Nerve Decompression Surgery with Preserved Ossicular Chain

Norio Kondo, Yukie Yamamura, Manabu Nonaka

Department of Otolaryngology, Tokyo Women's Medical University, Tokyo, Japan

ORCID IDs of the authors: N.K. 0000-0001-8594-6628; Y.Y. 0000-0002-7564-2775; M.N. 0000-0001-5444-7500

Cite this article as: Kondo N, Yamamura Y, Nonaka M. Patients over 60 years of age have poor prognosis in auditory ossicles connection preserved facial nerve decompression surgery for severe peripheral facial nerve palsy of Bell's palsy and Ramsay Hunt syndrome. J Int Adv Otol 2018; 14(1): 77-84.

OBJECTIVE: We report our retrospective study of the recovery rate of auditory ossicles preserved facial nerve decompression surgery via the transmastoid approach in cases of both an electroneurography score of <10% and a Yanagihara score of ≤8 in Bell's palsy and Ramsay Hunt syndrome.

MATERIALS and METHODS: We retrospectively reviewed 47 patients who we were able to follow-up for more than 6 months following the onset of palsy. The recovery rate was defined by the Japan Society for Facial Nerve Research or the Yanagihara score.

RESULTS: Twelve months after palsy onset, the recovery rate was 48.8% (20/41) for all patients, 65.2% (15/23) for patients with Bell's palsy, and 27.8% (5/18) for patients with Ramsay Hunt syndrome. Comparing the clinical efficacy of surgical treatment at 12 months after palsy onset, we observed a statistically significant effect of age. Comparing the Yanagihara scores of patients aged <60 years with those of patients aged ≥60 years revealed that patients aged ≥60 years had significant poor prognosis, particularly in patients with Ramsay Hunt syndrome, which showed a very low recovery rate (14.3%). We also analyzed six other factors, but none showed statistical significance.

CONCLUSION: The clinical efficacy of surgical treatment of Ramsay Hunt syndrome was inferior to that of Bell's palsy, which is consistent with previous reports. There was a statistically significant difference in the Yanagihara score between patients aged <60 years and those aged ≥60 years. Particularly, patients with Ramsay Hunt syndrome aged ≥60 years have a very low recovery rate.

KEYWORDS: Facial palsy, Facial nerve decompression surgery, Yanagihara score, Bell's palsy, Ramsay Hunt syndrome

INTRODUCTION

Peripheral facial nerve palsy is caused by several factors and diseases. Bell's palsy and Ramsay Hunt syndrome are the most common types of peripheral facial palsy. Bell's palsy is generally of viral origin, particularly cause by the herpes simplex virus, and has a good prognosis [1]. In contrast, Ramsay Hunt syndrome is caused by the varicella-zoster virus and has a poor prognosis compared to Bell's palsy [2]. There are severe cases of both diseases, and insufficient recovery can result in facial deformity and functional disorder. In these diseases, neural edema occurs first and leads to ischemia of the facial nerves. Facial nerve decompression surgery is performed in severe cases to release the facial nerve from compression and hypoxia [3]. However, solid clinical evidence in support of surgery is lacking. Here we report our retrospective study of the clinical efficacy of facial nerve decompression surgery via the transmastoid approach in severe cases of Bell's palsy and Ramsay Hunt syndrome.

MATERIALS and METHODS

Patients

Between August 2011 and July 2015 (4 years), 53 patients with severe peripheral facial palsy diagnosed with Bell's palsy or Ramsay Hunt syndrome were treated by auditory ossicles preserved facial nerve decompression surgery at the Department of Otolaryngology of Tokyo Women's Medical University. We retrospectively reviewed the findings of 47 postoperative patients we were able to follow-up for

This study was presented at the 27th Annual Meeting of the Japan Society for Head and Neck Surgery, 2 February 2017, Tokyo, Japan.

Corresponding Author: Norio Kondo; kondo.norio@twmu.ac.jp

Submitted: 19.10.2017 • **Revision Received:** 17.12.2017 • **Accepted:** 20.12.2017 •**Available Online Date**: 16.03.2018

more than 6 months after the onset of palsy (27 men and 20 women, aged between 20 and 75 years). The present study was approved by the Institutional Ethics Committee. Owing to the retrospective design of the study, informed consent was not necessary in the present study. We performed statistical comparisons for 41 of those patients we were able to follow-up for 12 months after the onset of palsy (21 men and 20 women, aged between 20 and 75 years). We used the Yanagihara facial nerve grading system to assess the severity of facial nerve palsy.

Table 1. The Yanagihara facial nerve grading system

	Scale of rate		
1. At rest	0 (complete palsy)	2 (partial palsy)	4 (normal)
2. Wrinkle forehead	0	2	4
3. Blink	0	2	4
4. Closure of eye lightly	0	2	4
5. Closure of eye tightly	0	2	4
6. Closure of eye on involved side only	0	2	4
7. Wrinkle nose	0	2	4
8. Whistle	0	2	4
9. Grin	0	2	4
10. Depress lower lip	0	2	4

Diagnosis and Clinical Procedure

We diagnosed Bell's palsy in patients with only peripheral facial palsy or facial palsy with ear pain but no eruption of the ear or sensory hearing loss. We diagnosed Ramsay Hunt syndrome in patients with peripheral facial palsy accompanied by eruption of the ear and/or sensory hearing loss. With both diagnoses, we first performed conservative treatment with steroids and antivirals. We assessed the severity of facial palsy using the Yanagihara facial nerve grading system (Table 1) [4]. Before treatment, we performed the following examinations and recorded the clinical data: pure tone audiometry, stapedial reflex test, electrogustometry, brain magnetic resonance imaging, and past history. Approximately 10 days after the onset of facial nerve palsy, electroneurography (ENoG) was performed. We measured ENoG at the orbicularis oris muscle. ENoG score was calculated as the ratio of the peak to peak amplitude of the maximal action potential of the affected side compared with that of the normal side. Surgery was indicated by the presence of both an ENoG score of <10% and a Yanagihara score of ≤8. In addition, surgery was performed on patients who had a Yanagihara score of ≥10, had a score of <10% in each of multiple ENoG tests, or expressed a strong desire for surgery. Before surgical treatment, all patients underwent temporal bone computed tomography to enable the evaluation of the facial nerve paths and temporal bone anatomy.

Surgical Procedure

We used the transmastoid approach for the auditory ossicles pre-

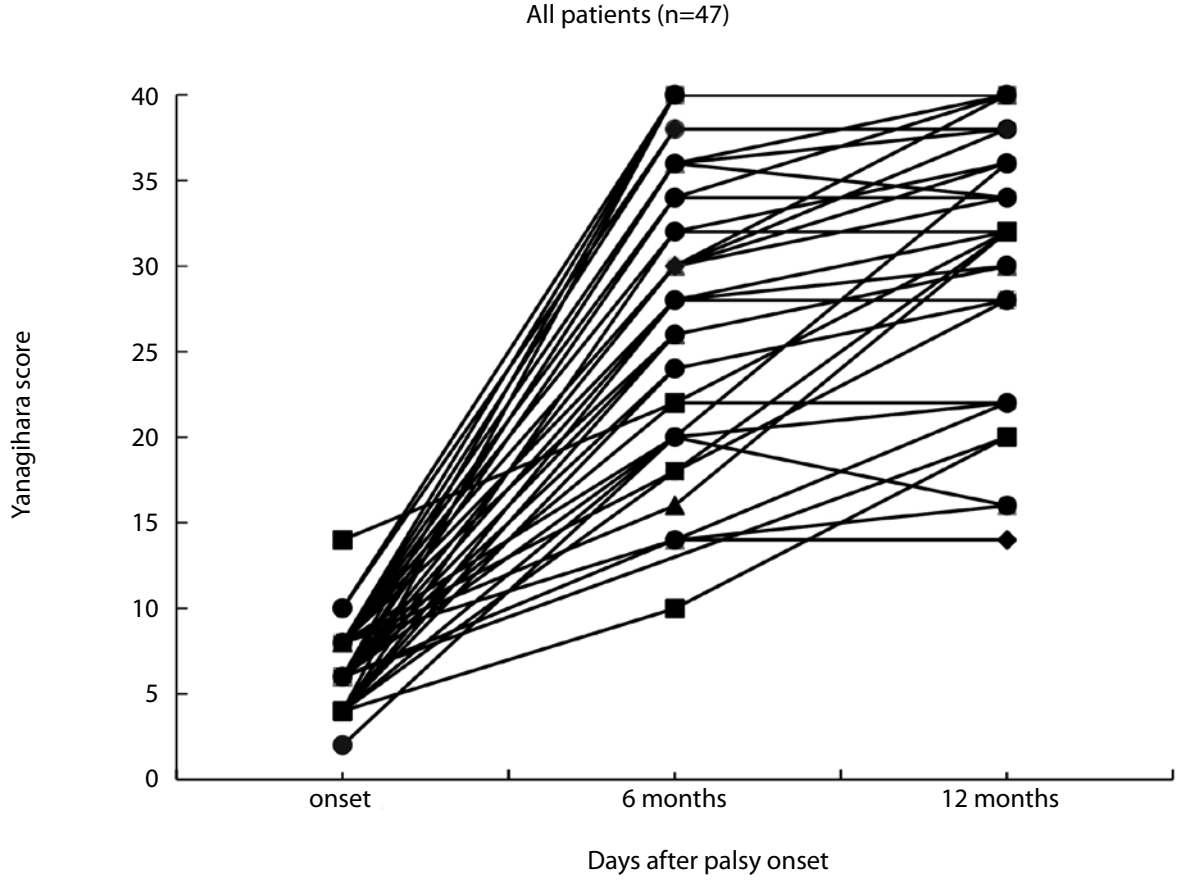

Figure 1. The clinical efficacy in all patients, as evaluated by the Yanagihara score

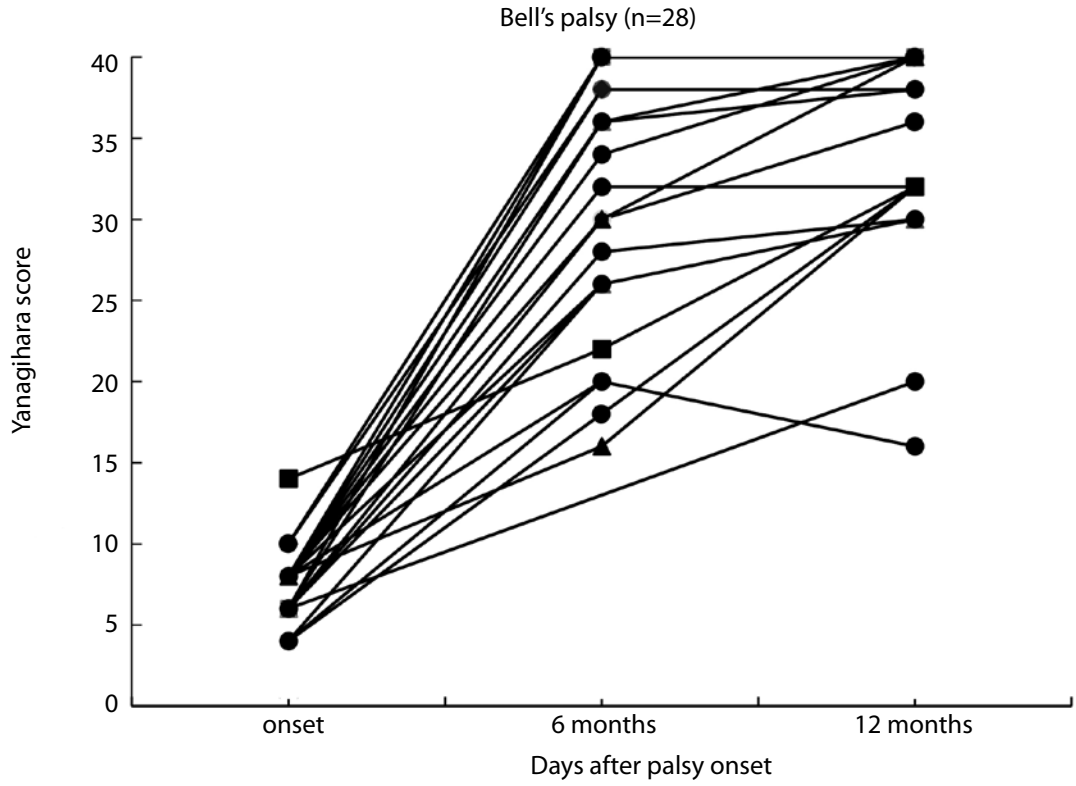

Figure 2. The clinical efficacy in patients with Bell's palsy, as evaluated by the Yanagihara score

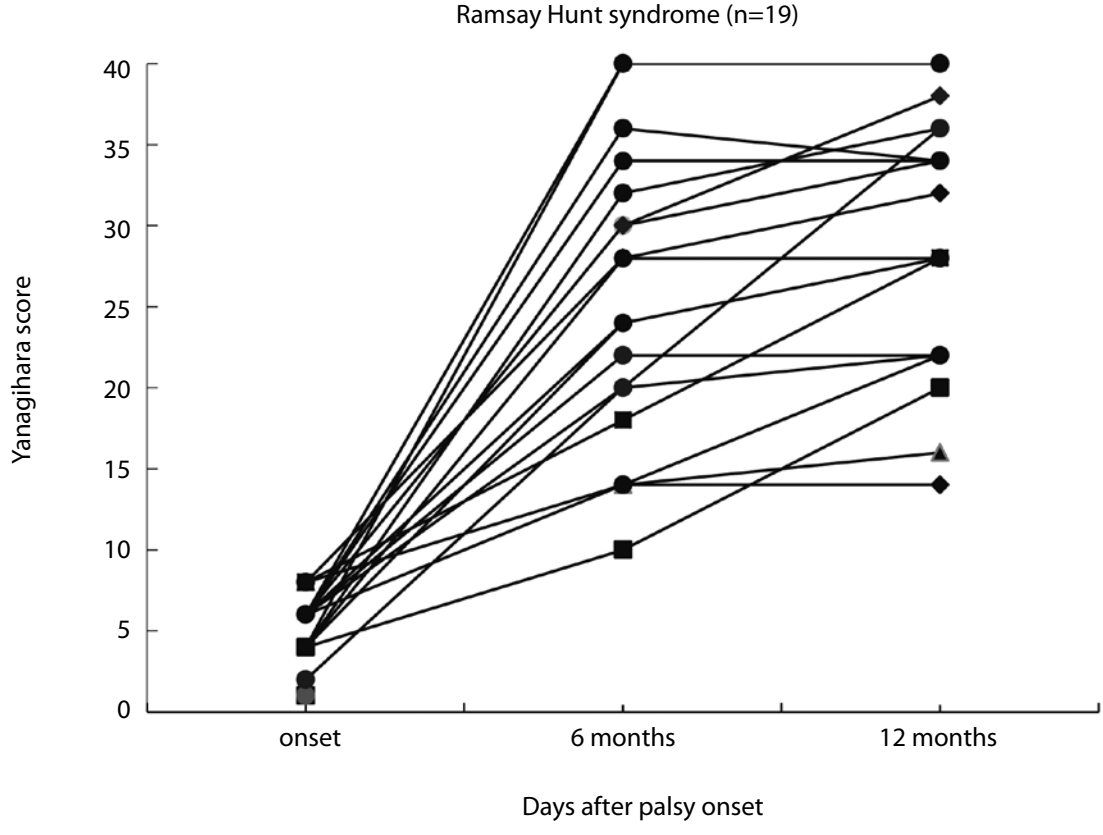

Figure 3. The clinical efficacy in patients with Ramsay Hunt syndrome, as evaluated by the Yanagihara score

Table 2. The clinical efficacy of patients at 6 months and 12 months after the onset of palsy

		6 months after onset	12 months after onset
All patients	Yanagihara score	28.6 (n=46)	32.5 (n=41)
	Recovery rate (%)	30.4 (14/46)	48.8 (20/41)
Bell's palsy	Yanagihara score	31.0 (n=27)	35.2 (n=23)
	Recovery rate (%)	40.7 (11/27)	65.2 (15/23)
Ramsay Hunt syndrome	Yanagihara score	25.2 (n=19)	29.1 (n=18)
	Recovery rate (%)	15.8 (3/19)	27.8 (5/18)

served facial nerve decompression surgery. After mastoidectomy, the vertical portion of the facial nerve was exposed, but the auditory ossicles were not touched. Next, we performed posterior tympanotomy and decompressed the facial nerve canal up to the horizontal portion of the facial nerve, as near as possible to the geniculum ganglion, without removing or disturbing the incus. Subsequently, the facial nerve was covered with gelatin impregnated with dexamethasone 1.65 mg, and the wound was closed.

Postoperative Evaluation

We recorded postoperative complications and evaluated the clinical efficacy using the Yanagihara facial nerve grading system. "Recovery" from facial palsy was defined as achieving a Yanagihara score of ≥36 points with no observation of synkinesis [5]. We followed the postoperative patients for up to 12 months following the onset of palsy, unless the patients chose not to continue. Upon recovery, no further follow-ups were conducted, even when 12 months had not passed since the onset of palsy. The recovery rate was calculated. We collected the following patient information: age at onset, number of days from onset of facial palsy to surgery, ENoG value, presence of a stapedial reflex, steroid concentration used in the conservative treatment before surgery, and status of diabetes mellitus. We performed stratified analysis to determine if any of those patient's factors correlated with the surgical efficacy (Yanagihara score and recovery rate).

Statistical Analysis

We used the independent chi-square test and Fisher's exact probability test to compare recovery rates and Student's t-test for the other factors. Statistical significance was set at $p<0.05$.

RESULTS

The 47 patients followed up for more than 6 months after the onset of palsy comprised 28 patients with Bell's palsy and 19 patients with Ramsay Hunt syndrome. Figure 1 shows the clinical efficacy in all patients, as evaluated by the Yanagihara score. Figure 2 shows the efficacy in patients with Bell's palsy, whereas Figure 3 presents the data for the Ramsay Hunt syndrome. Six months after palsy onset, the recovery rate for all patients was 30.4% (14/46; one patient was evaluated at 12 months after palsy onset and not at 6 months). The recovery rate for patients with Bell's palsy was 40.7% (11/27; one patient was evaluated at 12 months and not at 6 months), whereas it was 15.8% (3/19) for patients with Ramsay Hunt syndrome. Twelve months after palsy onset, the recovery rate for all patients was 48.8% (20/41), whereas it was 65.2% (15/23) for patients with Bell's palsy and 27.8% (5/18) for patients with Ramsay Hunt syndrome. These results show that the Yanagihara scores tended to be better at 12 months after palsy onset than at 6 months (Table 2). Therefore, we used the data from 12 months after the onset of palsy for stratified analysis of the patient factors and the clinical efficacy (Table 3).

Table 3. Statistical correlation with diseases and other factors

	Yanagihara score (Mean)	p	Recovery rate (%)	p
Diagnosis				
Bell's palsy (n=23)	35.2	**0.011***	65.2	**0.017***
Ramsay Hunt syndrome (n=18)	29.1		27.8	
Age (years)				
<60 (n=28)	34.4	**0.028***	57.1	0.081
≥60 (n=14)	28.6		28.6	
Bell's palsy				
<60 (n=16)	37.0	**0.046***	75.0	0.146
≥60 (n=7)	30.0		42.9	
Ramsay Hunt syndrome				
<60 (n=11)	30.7	**0.306**	36.3	**0.267**
≥60 (n=7)	26.6		14.3	
Age <60 years				
Bell's palsy (n=16)	37.0	0.005*	75.0	0.027*
Ramsay Hunt syndrome (n=12)	30.5		33.3	
Age ≥60 years				
Bell's palsy (n=28)	31.1	0.379	42.9	0.279
Ramsay Hunt syndrome (n=28)	26.2		14.3	
ENoG				
0% (n=29)	31.4	0.143	41.4	0.141
>0% (n=12)	35.3		66.7	
Stapedial reflex test				
Negative (n=34)	32.7	0.765	52.9	0.240
Positive (n=7)	31.7		28.6	
Interval from onset to surgery				
<15 days (n=18)	33.0	0.742	50.0	0.890
≥15 days (n=23)	32.2		47.8	
Interval from onset to surgery				
<22 days (n=32)	33.3	0.277	50.0	0.768
≥22 days (n=9)	30.0		44.9	
Pre-surgical treatment				
Stennert's protocol (n=12)	34.0	0.869	58.3	0.821
Prednisolone 60 mg/day (n=13)	34.4		53.8	
Diabetes mellitus				
No (n=32)	33.1	0.371	53.1	0.294
Yes (n=9)	30.4		33.6	

We used the independent chi-squared test and Fisher's exact probability test to compare recovery rates and Student's t-test for the other factors. Statistical significance was set at $p<0.05$. Bold data *$p<0.05$

Patients with Bell's palsy showed a significantly higher recovery rate than patients with Ramsay Hunt syndrome (Bell's palsy: 65.2% and

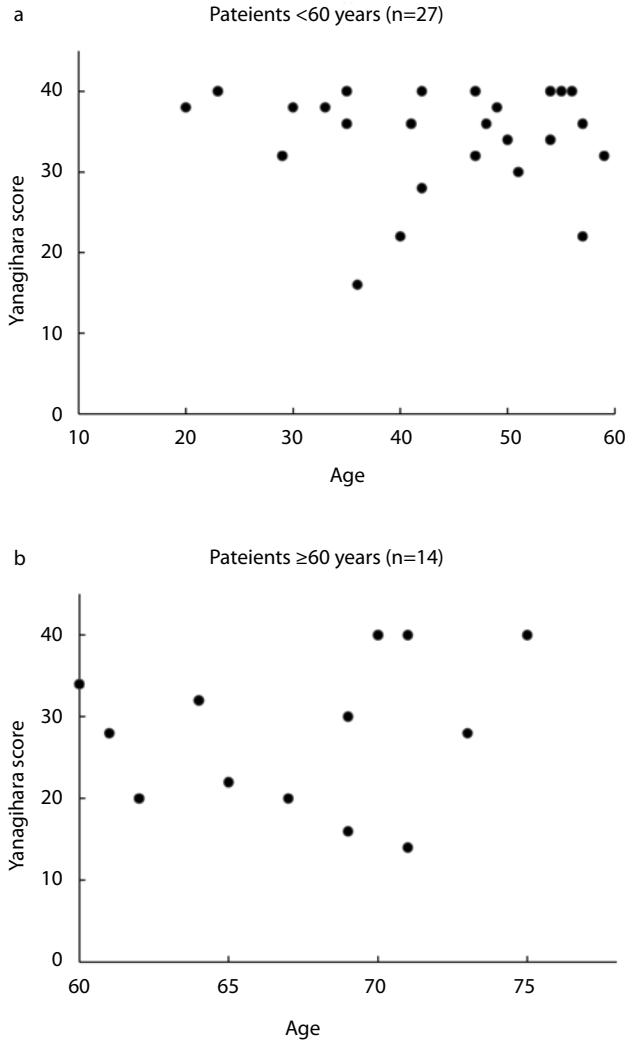

Figure 4. a, b. The clinical efficacy in patients aged <60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (a). The clinical efficacy in patients aged ≥60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (b).

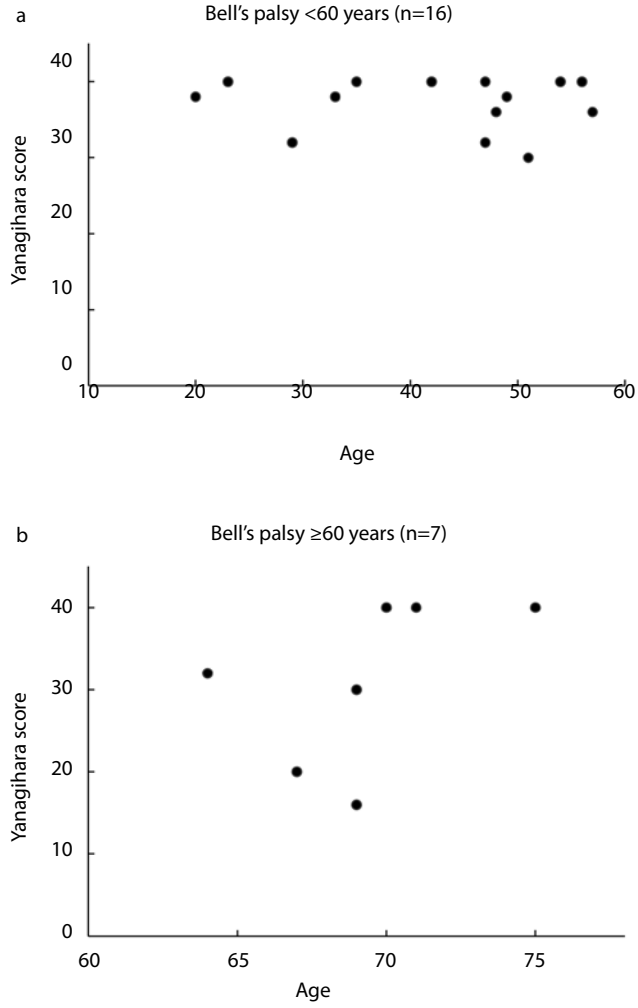

Figure 5. a, b. The clinical efficacy in patients with Bell's palsy aged <60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (a). The clinical efficacy in patients with Bell's palsy aged ≥60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (b).

Ramsay Hunt syndrome: 27.8%; p=0.017). In terms of the Yanagihara score, patients with Bell's palsy (average: 35.2) showed a significantly higher score than patients with Ramsay Hunt syndrome (average: 29.1; p=0.011).

With regard to age, the recovery rate did not differ significantly between patients aged <60 years (57.1%; 16/28; Figure 4a) and patients aged ≥60 years (28.6%; 4/14; p=0.081; Figure 4b). However, the Yanagihara score was significantly higher in patients aged <60 years (average: 34.4 years; Figure 4a) than in patients aged ≥60 years (average: 28.6 years; p=0.028; Figure 4b).

There was no age-dependent statistically significant difference in the recovery rates of patients with Bell's palsy. The recovery rate of patients aged <60 years was 75.0% (12/16; Figure 5a), whereas that of patients aged ≥60 years was 42.9% (3/7; p=0.136; Figure 5b). On the other hand, the Yanagihara score was significantly higher in patients aged <60 years (average: 37.0; Figure 5a) than in patients aged ≥60 years (average: 30.0; *p*=0.046; Figure 5b).

In patients with Ramsay Hunt syndrome, there was no significant difference between the recovery rates at different ages. The recovery rate in patients aged <60 years was 36.3% (4/11) (Figure 6a), whereas that in patients aged ≥60 years was 14.3% (1/7; p=0.267) (Figure 6b). The mean Yanagihara score also showed no significant difference between the age groups: 30.7 in patients aged <60 years (Figure 6a) and 26.6 in patients aged ≥60 years (p=0.306; Figure 6b).

Next, we compared the recovery rates between patients with Bell's palsy and those with Ramsay Hunt syndrome. In patients aged <60 years, patients with Bell's palsy showed a significantly higher recovery rate than patients with Ramsay Hunt syndrome (Bell's palsy: 75.0%, 12/16 and Ramsay Hunt syndrome: 33.3%, 4/12; p=0.027) (Figures 5a and 6a). Patients with Bell's palsy also showed higher mean Yanagihara scores than patients with Ramsay Hunt syndrome (Bell's palsy: 37.0 and Ramsay Hunt syndrome: 30.5; p=0.005) (Figures 5a and 6a).

Table 3 shows the results of our stratified analysis of various patient clinical factors (ENoG, presence of stapedial reflex, number of days

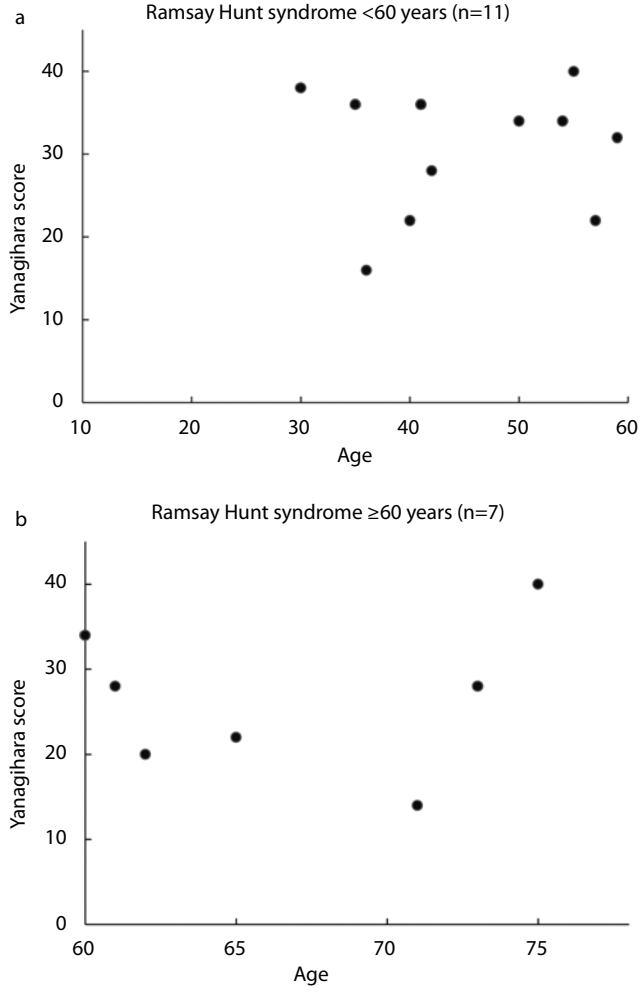

Figure 6. a, b. The clinical efficacy in patients with Ramsay Hunt syndrome aged <60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (a). The clinical efficacy in patients with Ramsay Hunt syndrome aged ≥60 years at 12 months after the onset of palsy, as evaluated by the Yanagihara score (b).

from onset of palsy to surgery, pre-surgical treatment, and diabetes mellitus) and clinical efficacy (Yanagihara score and recovery rate). No statistically significant differences were found.

Surgical complications were observed in two patients. One patient complained of vertigo; nystagmus was observed, but there was no hearing loss. The other patient complained of dysgeusia, but facial palsy recovered completely.

DISCUSSION

The efficacy of surgical treatment for facial nerve palsy is controversial, and evidence supporting its indication is lacking [6, 7]. Most reports of this treatment are from non-blinded studies, and the number of cases is limited. Several surgical approaches have been used, and no single surgical method has been established [3, 8-10]. Facial nerve palsy is not a fatal disease, and there is no established evidence supporting the use of surgical treatment. To justify this treatment, it is necessary to avoid surgical complications. One possible surgical complication is hearing loss [11]. We performed surgery using the transmastoid approach and decompressed the horizontal portion of the facial nerve as close to the geniculum ganglion as possible without removing or disturbing the incus.

In Japan, the Yanagihara facial nerve grading system is used more frequently than the House-Brackmann grading system to evaluate facial palsy. Hato et al. [12] reported that the Yanagihara facial nerve grading system can determine the probability of complete recovery of facial nerve palsy within 1 week after its onset. Engstrom et al. [13] observed that the clinical identification of patients with Bell's palsy is more accurate with the Yanagihara facial nerve grading system than with the House-Brackmann grading system. In consideration of those studies, we used the Yanagihara facial nerve grading system to clinically evaluate our patients and decide whether or not surgery was indicated.

In Japan, the clinical efficacy of treatment of facial palsy is generally evaluated at 6 months after its onset [4]. However, in a Northern European study on the effects of steroids and anti-viral drugs on Bell's palsy, patients were followed up for more than 1 year [5]. Fujiwara et al. [14] reported that synkinesis becomes worse after 6 months following the onset of palsy, and they suggested that patients should be followed for more than 12 months to assess the degree of synkinesis. In the present retrospective study, we followed our patients for 12 months after palsy onset, unless the patients chose not to continue. We were able to follow-up 46 patients at 6 months after the onset of palsy and 41 patients again at 12 months after the onset of palsy. Comparing the clinical efficacy of surgical treatment at 6 months and 12 months after palsy onset, both the recovery rate and the Yanagihara score tended to show a better outcome at 12 months after palsy onset.

Generally, results from 6 months after palsy onset are used to compare the recovery rates on the Yanagihara score (recovery=≥36 points). Here, we used the recovery rates based on the Yanagihara score (recovery=≥36 points) at 6 months after palsy onset for comparison with the earlier reported findings of surgical results. Yanagihara et al. [15] reported that the recovery rate of Bell's palsy is 44.8% (26/58). Yamano et al. [16] noted that the recovery rate of Bell's palsy is 45.0% (9/20) and that of Ramsay Hunt syndrome is 25.0% (2/8). Iizuka et al. [17] reported that the recovery rate of Bell's palsy is 25.0% (1/4) and that of Ramsay Hunt syndrome is 0% (0/4). Muto et al. [18] revealed that the recovery rate of Ramsay Hunt syndrome is 16.7% (1/6). Therefore, our results for the recovery rates of all patients at 6 months after surgery are consistent with those of earlier findings.

Our study findings are also in agreement with earlier reports in reporting that the efficacy of surgical treatment as well as conservative treatment is inferior for Ramsay Hunt syndrome compared with Bell's palsy [15-17].

Several prognostic factors have been reported for peripheral facial palsy. Smith et al. [19] reported that the significant factors include age, initial severity of palsy, and time taken for spontaneous improvement. Hyden et al. [20] noted that the final degree of healing correlates well with the initial electromyogram, stapedial reflex test, and electrogustometry findings. Fujiwara et al. [21] observed that the Yanagihara score at 1 week correlates with non-recovery in multivariate analysis, whereas the other factors such as age, gender, side of palsy, diabetes mellitus, and hypertension did not. Most studies concerning facial nerve decompression surgery, however, focus on the surgical procedure and clinical efficacy, with no mention of prognostic factors.

As noted earlier, our comparison of the clinical efficacy of surgical treatment at 6 months and 12 months following palsy onset found that both the recovery rate and the Yanagihara score tended to show a better outcome at 12 months. Therefore, we analyzed potential prognostic factors

using data collected at 12 months. There was a statistically significant difference between the Yanagihara score in patients aged <60 years and those aged ≥60 years. In addition, in patients aged ≥60 years, there was no statistically significant difference in the Yanagihara score or recovery rate between Bell's palsy and Ramsay Hunt syndrome. These results show that for patients aged ≥60 years, both patients with Bell's palsy and Ramsay Hunt syndrome tend to have a poor prognosis. However, in patients aged <60 years, statistically significant differences were found for both the Yanagihara score and the recovery rate between patients with Bell's palsy and Ramsay Hunt syndrome. Patients with Bell's palsy aged <60 years had a good prognosis (Yanagihara score, 37.0 and recovery rate, 75.0%). However, the prognosis tended to be poor for patients aged ≥60 years; in particular, patients with Ramsay Hunt syndrome showed a very low recovery rate (14.3%). Although the reason for the differences of prognosis between patients aged <60 years and those aged ≥60 years is unclear, the immune response may be concerned with these results in proportion to age.

Based on these results, we are inclined to positively recommend facial nerve decompression surgery for patients with Bell's palsy who are aged <60 years. However, patients with Ramsay Hunt syndrome remain problematic, particularly when aged ≥60 years.

Some novel approaches have been tried in an effort to improve the clinical efficacy of severe facial palsy. Hato et al. [22] reported the efficacy of basic fibroblast growth factor using a new drug delivery system in patients with severe Bell's palsy. However, considering the low recovery rate of Ramsay Hunt syndrome, particularly in patients aged ≥60 years, the efficacy of these novel attempts appears to be limited. Accordingly, vaccination against herpes zoster virus to prevent development of Ramsay Hunt syndrome may be the most effective approach. In Japan, herpes zoster virus vaccination in adults is not supported by public funds, but we hope that this status will be changed, particularly for advanced-age patients.

Our stratified analysis of various patient clinical factors (ENoG, presence of a stapedial reflex, number of days from onset period between the onset of palsy to surgery, pre-surgical treatment, and diabetes mellitus) and clinical efficacy (Yanagihara score and recovery rate) found no statistically significant correlations. As mentioned earlier, the electrophysiological examination and the stapedial reflex test were identified as the prognostic factors in conservative treatment of peripheral facial nerve palsy but these factors showed no statistical significance in the present study. The appropriate time for surgery was reported as within 2 weeks or within 2 months of palsy onset [3, 23, 24]. We performed facial nerve decompression surgery within 1 month of onset, and the clinical efficacy did not differ within that time frame.

Our operative procedure led to only two patients with surgical complications (4.2%; vertigo and dysgeusia). Hearing loss was not observed. May et al. [11] reported an air-bone gap of 15 dB or greater in 14% of patients and sensorineural loss, primarily at the 4000 and 8000 cycles, in 51% of patients. Peripheral facial nerve palsy is not a fatal disease; therefore, our policy is to avoid surgical complications and the risk of ossicle damage. To that end, the clinical efficacy of our procedure was similar to previously reported results, and surgical complications were very rare.

CONCLUSION

The present study demonstrated the clinical efficacy of the auditory ossicles preserved facial nerve decompression surgery for patients with Bell's palsy and Ramsay Hunt syndrome. Similar to previous studies, the clinical efficacy of surgical treatment of Ramsay Hunt syndrome was inferior to that of Bell's palsy. There was a statistically significant difference in the Yanagihara score between patients aged <60 years and those aged ≥60 years. Patients aged ≥60 years tend to have a poor prognosis, particularly those with Ramsay Hunt syndrome, for which the recovery rate was very low. Treatment of Ramsay Hunt syndrome, particularly in patients aged ≥60 years, remains to be a problem.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Tokyo Women's Medical University (Decision Date: 29.11.2016/Decision No: 4178).

Informed Consent: Informed consent is not necessary due to the retrospective nature of the study.

Peer-review: Externally peer-reviewed.

Author contributions: Concept - N.K., N.M.; Design - N.K., N.M.; Supervision - N.M.; Resource - N.K., N.M.; Materials - N.K., N.M.; Data Collection and/or Processing - N.K., Y.Y.; Analysis and/or Interpretation - N.K., Y.Y.; Literature Search - N.K.; Writing - N.K.; Critical Reviews - Y.Y., N.M.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. McCormick DP. Herpes simplex virus as a cause of Bell's palsy. Lancet 1972; 1: 937-9. [CrossRef]
2. Devriese PP, Moesker WH. The natural history of facial paralysis in herpes zoster. Clin Otolaryngol Allied Sci 1988; 13: 289-98. [CrossRef]
3. Gantz BJ, Rubinstein JT, Gidley P, Woodworth GG. Surgical management of Bell's palsy. Laryngoscope 1999; 109: 1177-88. [CrossRef]
4. Yanagihara N. Grading of facial palsy. Facial Nerve Surgery Aesculpius. Birmingham, AL 1977.
5. Japan Society of Facial Nerve Research. Committee on judgement of treatment outcome. Tentative proposal for treatment outcome criteria of peripheral facial nerve palsy. Facial N Res Jpn 1995; 15 :227-30.
6. Grogan PM, Gronseth GS. Practice parameter: Steroid, acyclovir, and surgery for Bell's palsy (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology 2001; 56: 830-6. [CrossRef]
7. McAllister K, Walker D, Donnan PT, Swan I. Surgical intervention for the early management of Bell's palsy. Cochrane Database Syst Rev 2013; 16: CD007468. [CrossRef]
8. Marc HH, Tessa AH. Etiology, diagnosis, and management of facial palsy: 2000 patients at a facial nerve Center. Laryngoscope 2013; 124: E283-93.
9. Takeda T, Takebayashi S, Kakigi A, Nakatani H, Hamada M. Total decompression of the facial nerve- superior prelabyrinthine cell tracts approach. ORL J Otorhinolaryngol Relat Spec 2009;71 suppl 1:112-5. [CrossRef]
10. Cannon RB, Gurgel RK, Warren FM, Shelton C. Facial nerve outcomes after middle fossa decompression for Bell's palsy. Otol Neurotol 2015; 36: 513-8. [CrossRef]
11. May M, Klein SR. Facial nerve decompression complications. Laryngoscope 1983; 93: 299-305. [CrossRef]
12. Hato N, Fujiwara T, Gyo K, Yanagihara N. Yanagihara facial nerve grading system as a prognostic tool in Bell's palsy. Otol Neurotol 2014; 35: 1669-72. [CrossRef]
13. Engstrom M, Jonsson L, Grindlund M, Stalberg E. House-Brackmann and Yanagihara grading score in relation to electroneurographic results in the time course of Bell's palsy. Acta Otolaryngol 1998; 118: 783-9. [CrossRef]
14. Fujiwara K, Furuta Y, Nakamaru Y, Fukuda S. Comparison of facial synkinesis at 6 and 12 months after the onset of peripheral facial nerve palsy. Auris Nasus Larynx 2015; 42: 271-4. [CrossRef]

15. Yanagihara N, Hato N, Murakami S, Honda N. Transmastoid decompression as a treatment of Bell palsy. Otolaryngol Head Neck Surg 2001; 124: 282-6. [CrossRef]
16. Yamano K, Katsumi S, Esaki S, Murakami S. Retrospective study of facial nerve decompression. Facial N Res Jpn 2011; 31: 33-4.
17. Ilzuka T, Furukawa M, Narui Y, Ikeda K. Efficacy of facial nerve decompression. Facial N Res Jpn 2007; 27: 180-2.
18. Mutou T, Tsuji K, Takebayashi H, Sakagami M. Efficacy of facial nerve decompression in Ramsay Hunt syndrome. Facial N Res Jpn 2003; 23: 108-9.
19. Smith IM, Heath JP, Murray JA, Cull RE. Idiopathic facial (Bell's) palsy: a clinical survey of prognostic factors. Clin Otolaryngol Allied Sci 1988; 13: 17-23. [CrossRef]
20. Hyden D, Sandstedt P, Odkvist LM. Prognosis in Bell's palsy based on symptoms, sign and laboratory data. Acta Otolaryngol 1982; 93: 407-14. [CrossRef]
21. Fujiwara T, Hato N, Gyo K, Yanagihara N. Prognostic factors of Bell's palsy: prospective patient collected observational study. Eur Arch Otorhinolaryngol 2014; 271: 1891-5. [CrossRef]
22. Hato N, Nota J, Komobuchi H, Teraoka M, Yamada H, Gyo K, et al. Facial nerve decompression surgery using bFGF-impregnated biodegradable gelatin hydrogel in patients with Bell palsy. Otolaryngol Head Neck Surg 2012; 146: 641-6. [CrossRef]
23. Fisch U. Surgery for Bell's palsy. Arch Otolaryngol 1981; 107: 1-11. [CrossRef]
24. Li Y, Sheng Y, Feng GD, Wu HY, Gao ZQ. Delayed surgical management is not effective for severe Bell's palsy after two months of onset. Int J Neurosci 2016; 126: 989-95.[CrossRef]