Facial and hearing outcomes in transmastoid nerve decompression for Bell's palsy, with preservation of the ossicular chain

Akira Inagaki | Mariko Takahashi | Shingo Murakami

Departments of Otolaryngology-Head and Neck Surgery, Graduate School of Medical Sciences and Medical School, Nagoya City University, Nagoya, Japan

Correspondence
Akira Inagaki, Departments of Otolaryngology-Head and Neck Surgery, Graduate School of Medical Sciences and Medical School, Nagoya City University, 1 Kawasumi, Mizuho-cho, Mizuho-ku, Nagoya City, Aichi 467-8601, Japan.
Email: ainagaki@med.nagoya-cu.ac.jp

Funding information
This work was supported by the Japan Society for the Promotion of Science grants to AI (No. 15H04990, 16K15724, 19K09896 and SM (16K11188).

Abstract

Objectives: Facial nerve decompression is a salvage treatment for Bell's palsy patients for whom a poor prognosis is anticipated with standard medical treatment. The transmastoid approach is a frequently performed approach, but it remains unknown if this surgery is effective when the ossicular chain is preserved. This study aimed to determine the efficacy of facial nerve decompression using the transmastoid approach in Bell's palsy.

Design, setting and participants: This retrospective study included patients who had undergone transmastoid facial nerve decompression with ossicular chain preservation and patients who met the criteria for surgery, but received only medical treatment between January 2007 and May 2019, at a single centre.

Main outcome measures: Attainment of House-Brackmann grade I at 12 months after onset of facial palsy.

Results: The recovery rate to House-Brackmann grade I in the decompression group in the early phase (≤18 days after onset) was higher than that of the medical treatment group, although the difference was not significant (70% vs 47%, P = .160). However, within this early surgery group, a subgroup of cases with ≥95% facial nerve degeneration demonstrated a significant improvement in recovery rate (73% vs 30%, P = .018). Among surgeries performed in the late phase (≥19 days), only a subgroup with ≥95% facial nerve degeneration was available for analysis, and the difference in recovery rate was not significant compared with medical treatment alone (26% vs 30%, P = 1.00). Post-surgical hearing evaluation demonstrated that average hearing deterioration was 1.3 dB which was non-significant, suggesting this procedure does not cause hearing loss.

Conclusions: Transmastoid facial nerve decompression with ossicular chain preservation in the early phase after symptom-onset is an effective salvage treatment for severe Bell's palsy with ≥95% facial nerve degeneration.
Bell's palsy is a peripheral facial nerve palsy of unknown aetiology. It is the most common cause of acute peripheral facial palsy, accounting for approximately 65% of acute facial palsy,3 with an annual incidence of 20-30 per 100 000 population.2 Steroid treatment starting at an equivalent prednisolone dose of 30-60 mg/d is generally effective for facial nerve palsy that is moderately severe at worst, such that 71% – 96% of patients with Bell's palsy are reported to have a favourable outcome.3-5 However, this standard of care can be inadequate for patients with high-grade facial palsy, and indeed, many patients in this group suffer sequelae.6,7 Once they do, they must also bear a significant burden not only physically, but also psychologically.8

The prognosis in patients with Bell’s palsy is most reliably predicted by the severity of degeneration of the facial nerve,9 which can be accurately evaluated by electroneurography (ENoG) within a time window from 3 to 21 days after onset.10 An ENoG value of ≤10%, indicating ≥90% facial nerve degeneration, is strongly associated with poor recovery.10,11 To salvage the facial nerve in patients with poor prognoses, previous studies suggest facial nerve decompression surgery is one of the most promising treatment options for this subset of patients.12-14

The concept of this treatment is to ameliorate pathological constriction of the facial nerve caused by facial nerve oedema, by surgically enlarging the facial canal, especially at its narrow segments.12 One strategy is the middle fossa approach, which explores this segment superiorly, so as to decompress the facial nerve through the meatal-labyrinthine segment. On the other hand, the transmastoid approach accesses the facial nerve laterally; however, this approach does not allow the surgeon to fully reach the proximal side of the meatal-labyrinthine segment. Therefore, it leaves a pathological constriction of several millimetres after surgery. A recent meta-analysis concluded that no significant efficacy is detected following transmastoid decompression while simultaneously noting that facial outcome data of early transmastoid decompression is lacking.14

Meanwhile, it has been reported that the most frequent complication accompanying the transmastoid approach is auditory involvement,15 causing a ~10 dB hearing deterioration postoperatively.16 One possible strategy to ameliorate this complication is to preserve and shift the ossicular chain during decompression instead of displacing the incus to approach the facial nerve medial to the incus body. If this strategy is feasible, intact ossicular joints can be expected to ameliorate hearing deterioration after surgery. To address these issues, we retrospectively studied 102 transmastoid decompression surgeries for Bell’s palsy, one of the largest series published to date, including surgeries performed in the early phase.

2 | MATERIALS AND METHODS

2.1 | Participants and setting

The study protocol was approved by the Institutional Review Board of Nagoya City University, with a waiver of informed consent (approval number 60-18-0001). Retrospective medical record review was performed on patients ≥18 years of age, who visited a tertiary referral centre, the otolaryngology clinic at Nagoya City University Hospital, Nagoya, Japan, from January 2007 to May 2019. Surgical candidacy for transmastoid facial nerve decompression surgery in Bell’s palsy was based on complete paralysis (House-Brackmann [HB] grade VI) with an ENoG value of ≤10% at 3 to 21 days after onset.10 The medical treatment group comprised patients who met the criteria for surgery, but were treated only with a dose of ≤410 mg of prednisolone or an equivalent. Inclusion and exclusion criteria for each group are summarised in Table S1 in the Supplementary Material.

For hearing outcome analysis in the surgical group with ossicular chain preservation, we included patients with a preoperative pure-tone average (PTA) threshold of ≤40 dB (air conduction at 0.5, 1, 2 and 4 kHz), and who were available for follow-up for up to 12 months, or until the level of postoperative deterioration became 5 dB or less.

2.2 | Surgical technique

A retroauricular incision was first made followed by elevation of the anterior dermal and musculoperiosteal flaps. Mastoidectomy, posterior tympanotomy and incus buttress removal were performed following the procedure described in a previous report.17 The posterior incudal ligament, lateral incudomalleal fold, lateral malleal...
fold and vertical fold were removed. After the deepest portion of the posterior wall anterior to the incus short process was drilled to achieve thinning of the posterior wall, with meticulous care not to touch the incus with the bar by carefully retracting the short process posteriorly (Figure 1A), the bony bridge between the tunnel created for posterior tympanotomy and the aditus ad antrum was removed by drilling. This procedure created some space anterior to the incus short process (Figure 1D), where the incus could then be shifted by gentle retraction of the incus body anteriorly to allow access to the proximal part of the facial nerve (Figure 1E), that is the section between labyrinthine and pyramidal segments (ossicular chain preservation technique). After removing the bone covering the pyramidal segment, the bone covering the perigeniculate area and the labyrinthine segment was drilled from the anterior side (Figure 1F). The anterior malleolar ligament was cut with an angled needle when necessary, to allow greater mobilisation of the ossicles.

If this approach did not work, we disarticulated only the incudostapedial joint (incudostapedial joint separation technique). Temporal incus removal (incus dislocation technique) was performed only if both of these approaches failed.

3 | RESULTS

3.1 | Feasibility of the ossicular chain preservation technique during facial nerve decompression

During the study period, 102 Bell's palsy patients underwent facial nerve decompression surgery. For the feasibility analysis of the ossicular chain preservation technique, 12 patients who received surgery via middle cranial fossa approach or were ≤17 years old were excluded from the analysis. Of the remaining 90 patients, 4 patients (4.4%) required incus dislocation and 9 patients (10%) received incudostapedial separation, leaving 77 patients (85.6%) who underwent facial nerve decompression with preservation of the ossicular chain. Thirty-one patients were excluded from further outcome analysis because they failed to meet inclusion criteria (Figure S1). Consequently, 46 patients (23 men and 23 women; mean age 40.3 ± 1.8 years, range 18-62 years) were included in the analysis below.

3.2 | Accessibility to proximal segments of the fallopian canal

We investigated accessibility to the meatal-labyrinthine segment in our series, to estimate the length of the bony canal that could not be decompressed with the transmastoid approach. In the present series, it was possible to expose the distal end of the labyrinthine segment to the mastoid segment of the facial nerve in all enrolled patients. Accessibility to the more proximal segment was variable, depending on anatomical features. The labyrinthine segments were approachable in only 54.3% (25/46) of patients. Among these, 43.5% (20/46) could be approached only to the proximal segment, and 10.8% (5/46) to the distal labyrinthine segment (Figure S2).
**Figure 2** Correlation between facial outcome and the degree of facial nerve degeneration and the interval between onset and surgery. Each symbol represents one patient’s facial outcome 12 months after facial paralysis onset. The x-axis represents the onset-surgery interval in days, and the y-axis represents the degree of facial nerve degeneration as observed via ENoG. Patients were divided into two subgroups: early surgery (decompression before day 18 post-onset, n = 20) and late surgery (after day 18 post-onset, n = 26). ENoG, electroneurography; HB, House-Brackmann

| TABLE 1 | Baseline characteristics and outcomes for patients with aggravated Bell’s palsy (ENoG ≤ 5%) receiving early transmastoid decompression (≤18 d) |
|---------|-------------------------------------------------------------------------------------------------------------------------------------|
|         | Aggravated Bell’s palsy patients (ENoG ≤ 5%)                                                                                         |
|         | Early transmastoid decompression (n = 15) (range)                                                                                 |
|         | Systemic steroid therapy (n = 20) (range)                                                                                          |
| Age (years) | 42.7 ± 3.5 (19-62) | 49.5 ± 3.9 (19-73) | P = .218^a |
| Male-to-female ratio | 5:10 | 7:13 | P = 1.00^c |
| ENoG (%) | 1.0 ± 0.2 (0-2.5) | 1.8 ± 0.4 (0-5.0) | P = .082^a |
| Total amount of systemic prednisolone (mg) | 392 ± 46 (0-570) | 546 ± 31 (410-810) | P = .007^b,^c |
| Recovery to HB grade I | 11/15 (73%) | 6/20 (30%) | P = .018^c,^* |
| HB grade at 12 mo | 1.40 ± 0.19 (I – III) | 2.00 ± 0.19 (I – IV) | P = .026^b,^* |

^aStudent’s t test.
^bMann-Whitney rank-sum test.
^cFisher’s exact test.
^*P < .05.
**P < .01.

| TABLE 2 | Baseline characteristics and outcomes for patients with aggravated Bell’s palsy (ENoG ≤ 5%) receiving late transmastoid decompression (≥19 d) |
|---------|-------------------------------------------------------------------------------------------------------------------------------------|
|         | Aggravated Bell’s palsy patients (ENoG ≤ 5%)                                                                                         |
|         | Late transmastoid decompression (n = 23) (range)                                                                                 |
|         | Systemic steroid therapy (n = 20) (range)                                                                                          |
| Age (years) | 40.2 ± 2.6 (19-56) | 49.5 ± 3.9 (19-73) | P = .047^a |
| Male-to-female ratio | 12:11 | 7:13 | P = .359^c |
| ENoG (%) | 0.9 ± 0.2 (0-4.0) | 1.8 ± 0.4 (0-5.0) | P = .091^b |
| Total amount of systemic prednisolone (mg) | 474 ± 50 (200-1140) | 546 ± 31 (410-810) | P = .059^b |
| Recovery to HB grade I | 6/23 (26%) | 6/20 (30%) | P = 1.00^c |
| HB grade at 12 months | 2.26 ± 0.18 (I – III) | 2.00 ± 0.19 (I – IV) | P = .257^b |

^aStudent’s t test.
^bMann-Whitney rank-sum test.
^cFisher’s exact test.
3.3 | The efficacy of early transmastoid decompression with preservation of the ossicular chain on facial recovery

In the middle fossa approach to facial nerve decompression, earlier decompression is more efficacious than delayed intervention. Therefore, in the present study, we investigated facial outcomes of early surgery (decompression before day 18 post-onset, n = 20) and late surgery (after day 18, n = 26) (Figure 2), and compared these subpopulations to medically treated patients receiving ≥410 mg of prednisolone or equivalent (n = 36).

Regardless of the higher dose of steroid administered in the medical treatment group (552 ± 10 mg vs 439 ± 44 mg, P = .033; Table S2), which potentially contributed to a better outcome, both recovery rate and final HB grade 12 months after onset were better in the early transmastoid decompression group, though the differences were not significant (70% vs 47% and 1.45 ± 0.17 vs 1.72 ± 0.28, P = .160 and .167).

We also analysed the efficacy of facial nerve decompression surgery on the subgroup presenting the most aggravated clinical picture, those with ≥95% facial nerve degeneration predicting a distinctly poor facial nerve outcome. The early decompression subgroup demonstrated a recovery rate of 73% (11/15), which was significantly better than that of the medical treatment group, 30% (6/20, P = .018; Table 1). The final HB grade of the early decompression subgroup was also significantly better than that of the medical treatment group (1.40 ± 0.19 vs 2.00 ± 0.19, P = .026). These observations suggest that early transmastoid decompression using the ossicular chain preservation technique is significantly beneficial for aggravated nerve degeneration in Bell’s palsy patients.

3.4 | Efficacy of late transmastoid decompression with preservation of the ossicular chain on facial recovery

Next, we analysed outcomes of late transmastoid decompression. Both ENoG values and steroid doses were significantly higher in the medical treatment group than the decompression group, suggesting that the outcome of the medical treatment group may be biased towards better outcomes (Table S3). This potential bias due to imbalance in covariates cannot be corrected by case matching due to the paucity of cases. Therefore, in the analysis of late intervention, we analysed only the subgroup presenting the most aggravated facial nerve degeneration (≥95%), where the imbalance of covariates, including ENoG value and steroid dose, was not significant (Table 2). In this subgroup, neither recovery rate (surgical 26% (6/23) vs medical 30% (6/20)) nor the final HB grade (2.26 ± 0.18 vs 2.00 ± 0.19) presented a significant difference between the groups (P = 1.00 and P = .257).

3.5 | Hearing outcomes of the ossicular chain preservation technique

To evaluate hearing outcomes of this surgical technique, we compared pre- and post-surgical 4 frequency pure-tone hearing threshold levels. Seven patients were excluded due to failure to meet the criteria (Section 2; Figure S3). With this metric, the average pre-surgical hearing threshold was 12.0 ± 0.9 dB, whereas post-surgery it was 13.3 ± 1.1 dB (n = 39, P = .465, t test, Figure 3).

4 | DISCUSSION

Here, we present outcomes of 46 patients who received transmastoid decompression with ossicular chain preservation, and demonstrate that this procedure is efficacious for patients with the most aggravated facial nerve degeneration when performed in the early phase (≤18 days after onset).

High-dose steroid treatment is a well-established option for severe Bell’s palsy to improve facial recovery. For example, an equivalent total dose of ≥450 mg prednisolone improves facial outcome in meta-analyses. In the present study, the medical treatment group received a higher dose of steroid than the surgical group. Regardless of this bias, recovery rates and HB grades were significantly better in the early surgery group among patients demonstrating ≥95% facial degeneration. These data suggest the efficacy of early transmastoid facial nerve decompression as a salvage treatment in this most severely affected subgroup.

We employed transmastoid decompression with preservation of the ossicular chain to ameliorate postoperative hearing deterioration. Unlike the standard technique with incus dislocation, the preserved incus in this transmastoid technique can sometimes prevent adequate visibility of the pyramidal and tympanic segments located medial to the incus body, and also hinder the versatility of...
nerves. Indeed, we were unable to preserve the chain in 15% of patients, but the preserved ossicular chain is not an impediment for approaching the meatal-labyrinthine segments and geniculate ganglion. These segments are reached through the epitympanum, and because its anterior path has a medial vector, the nerve anterior to the cochleariform process can be uncovered without disturbing the ossicular chain. Therefore, the decompression provided to the facial nerve was the same as in traditional transmastoid decompression with incus dislocation in all enrolled 46 Bell’s palsy patients in the present study. Indeed, the facial outcome was similar to that of transmastoid decompression with incus dislocation, albeit comparing outcomes between studies is challenging due to variability in reporting of facial nerve outcomes and subjectivity among clinicians.

With the transmastoid approach, access to the meatal-labyrinthine segment is limited. The segment was not as frequently approachable as a previous cadaveric study which reported that the distal labyrinthine segment was approachable in all temporal bones, and the proximal labyrinthine segment in 35% of temporal bones. In the present series, while the distal end of the labyrinthine segment was approachable in all cases, the distal meatal-labyrinthine segment was approachable in only 54.3% of the patients. The proximal meatal-labyrinthine segment could be decompressed only in 10.8% of patients. While transmastoid decompression greatly reduces the distance over which the facial nerve is constricted, of the 2.25 to 3-mm meatal-labyrinthine segment, a section of approximately 1 – 2.5 mm of the proximal meatal-labyrinthine segments remains un-decompressed, resulting in pathological constriction. This is likely to cause pathologies such as endoneurial oedema and nerve damage similar to those seen in an animal model of experimental nerve compression using a constriction device to compress a few millimetres of nerve segment.

In the present series, transmastoid decompression demonstrated significant efficacy only when surgery was performed in the early phase. This observation is consistent with previous reports regarding middle fossa decompression. Evidence from experimental studies suggests that the level of nerve degeneration is associated with the pressure and duration of nerve compression, supporting the finding that later surgeries cause poorer outcomes due to more severe damage to the facial nerve. However, due to the scarcity of cases and information about case-to-case variation in nerve pathologies, statistically defining a critical limit for surgery is currently impossible. Yet, judging from the recovery rate relative to duration in the present study (Figure 2), the critical limit could be later than that in the middle fossa approach (day 14) as reported by Yanagihara, who found significant benefits of decompression in the late phase, from days 15 to 30 post-onset.

The original, standard technique of facial nerve decompression via transmastoid approach requires incus dislocation, which results in a mean post-surgical hearing deterioration of 9.7 dB. To avoid this complication, several techniques have been proposed, such as bone cementing techniques that reduce the deterioration to 0.8 dB on average. Here, we performed transmastoid decompression with ossicular chain preservation in 85.6% of cases, while maintaining adequate visibility and versatility of instruments employed. This resulted in a non-significant 1.3-dB deterioration, which is comparable to that of the bone cementing technique. These results suggest that the ossicular chain preservation technique is a good treatment option to preserve hearing in candidates for transmastoid decompression.

The limitations of this study include its nonrandomised design, the lack of objective facial assessment and its small sample size due to the scarcity of patients meeting the criteria for surgical decompression which was reflected in the power calculations being less than the recommended level of 0.8 (Table S4). Nevertheless, the efficacy demonstrated in this study suggests that early transmastoid decompression is a reasonable treatment option in Bell’s palsy patients with aggravated facial nerve degeneration, especially in cases in which the middle fossa approach cannot be employed.

5 | CONCLUSION

We investigated one of the largest series of transmastoid decompression published to date. We demonstrated that early transmastoid decompression with preservation of the ossicular chain within 18 days of onset improves the recovery rate and the House-Brackmann grade. It was significant in patients with aggravated (≥95%) facial nerve degeneration. Furthermore, this procedure does not cause significant postoperative hearing deterioration. These findings suggest that this technique is a treatment option for Bell’s palsy patients with aggravated nerve degeneration in the early phase.

CONFLICT OF INTEREST
None.

AUTHOR CONTRIBUTIONS
Akira Inagaki and Shingo Murakami involved in conception and design and operating procedure. Akira Inagaki drafted the manuscript, analysed the data, interpreted the data and contributed to final approval. Mariko Takahashi collected the data, analysed the data and interpreted the data.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID
Akira Inagaki https://orcid.org/0000-0001-5560-9321

REFERENCES
1. Peitersen E. Bell’s palsy: the spontaneous course of 2,500 peripheral facial nerve palsies of different etiologies. Acta Otolaryngol. 2002;122(7):4–30.
2. Eviston TJ, Croxson GR, Kennedy PG, Hadlock T, Krishnan AV. Bell’s palsy: aetiology, clinical features and multidisciplinary care. J Neurol Neurosurg Psychiatry. 2015;86:1356–1361.
3. Sullivan FM, Swan IR, Donnan PT, et al. Early treatment with prednisolone or acyclovir in Bell's palsy. *N Engl J Med*. 2007;357(16):1598-1607.

4. Engstrom M, Berg T, Stjernquist-Desatnik A, et al. Prednisolone and valaciclovir in Bell's palsy: a randomised, double-blind, placebo-controlled, multicentre trial. *Lancet Neurol*. 2008;7(11):993-1000.

5. de Almeida JR, Al Khabori M, Guyatt GH, et al. Combined corticosteroid and antiviral treatment for Bell palsy: a systematic review and meta-analysis. *JAMA*. 2009;302(9):985-993.

6. Berg T, Bylund N, Marsk E, et al. The effect of prednisolone on sequelae in Bell's palsy. *Arch Otolaryngol Head Neck Surg*. 2012;138(5):445-449.

7. Fujiwara K, Furuta Y, Yamamoto N, Katoh K, Fukuda S. Factors affecting the effect of physical rehabilitation therapy for synkinesis as a sequela to facial nerve palsy. *Auris Nasus Larynx*. 2018;45(4):732-739.

8. Tseng C-C, Hu L-Y, Liu M-E, Yang AC, Shen C-C, Tsai S-J. Bidirectional association between Bell’s palsy and anxiety disorders: a nationwide population-based retrospective cohort study. *J Affect Disord*. 2017;215:269-273.

9. Fisch U. Prognostic value of electrical tests in acute facial paralysis. *Am J Otol*. 1984;5(6):494-498.

10. Guntinas-Lichius O, Volk G, Olsen K, et al. Facial nerve electrodiagnostics for patients with facial palsy: a clinical practice guideline. *Eur Arch Otorhinolaryngol*. 2013;270(7):1855-1874.

11. Baugh RF, Basura GJ, Ishii LE, et al. Clinical practice guideline: Bell’s palsy. *Otolaryngol Head Neck Surg*. 2013;149(3_suppl):S1-S27.

12. Fisch U. Surgery for Bell's palsy. *Arch Otolaryngol*. 1981;107(1):1-11.

13. Gantz BJ, Rubinstein JT, Gidley P, Woodworth GG. Surgical management of Bell's palsy. *Laryngoscope*. 1999;109(8):1177-1188.

14. Casaza GC, Schwartz SR, Gurgel RK. Systematic review of facial nerve outcomes after middle fossa decompression and transmastoid decompression for Bell's Palsy with complete facial paralysis. *Otol Neurotol*. 2018;39(10):1311-1318.

15. May M, Klein SR. Facial nerve decompression complications. *Laryngoscope*. 1983;93(3):299-305.

16. Kim SH, Jung J, Lee JH, Byun JY, Park MS, Yeo SG. Delayed facial nerve decompression for Bell's palsy. *Eur Arch Otorhinolaryngol*. 2016;273(7):1755-1760.

17. Yanagihara N, Gyo K, Yamamoto N, Katoh K. Transtemporal decompression of the facial nerve in Bell's palsy. *Arch Otolaryngol*. 1979;105(9):530-534.

18. Goin DW. Proximal intratemporal facial nerve in Bell's palsy surgery. A study correlating anatomical and surgical findings. *Laryngoscope*. 1982;92(3):263-272.

19. Yanagihara N, Hato N, Murakami S, Honda N. Transtemporal decompression as a treatment of Bell palsy. *Otolaryngol Head Neck Surg*. 2001;124(3):282-286.

20. Ge X-X, Spector GJ. Labyrinthine segment and geniculate ganglion of facial nerve in fetal and adult human temporal bones. *Ann Otol Rhinol Laryngol*. 1981;90(4_suppl):1-12.

21. Lundborg G, Myers R, Powell H. Nerve compression injury and increased endoneurial fluid pressure: a “miniature compartment syndrome”. *J Neurol Neurosurg Psychiatry*. 1983;46(12):1119-1124.

22. Yamamoto E, Fisch U. Experimentally induced facial nerve compression in cats. *Acta Otolaryngol*. 1975;79(3–4):390-395.

23. May M. Total facial nerve exploration: transtemporal, extralabyrinthine, and subtemporal indications and results. *Laryngoscope*. 1979;89(6):906-917.

24. Ghonim M, Shabana Y, Ashraf B, Salem M. Anatomical reposition of incus after transtemporal facial nerve decompression using bone cement: preliminary results in 17 patients. *Clin Otolaryngol*. 2016;41(1):95-99.

**SUPPORTING INFORMATION**

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Inagaki A, Takahashi M, Murakami S. Facial and hearing outcomes in transtemporal nerve decompression for Bell's palsy, with preservation of the ossicular chain. *Clin Otolaryngol*. 2021;46:325–331. [https://doi.org/10.1111/coa.13671](https://doi.org/10.1111/coa.13671)