

ORIGINAL RESEARCH

Surgical treatments of superior semicircular canal dehiscence: A single-centre experience in 63 cases

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Abstract

Objective: Different procedures have been described to treat superior canal dehiscence. The present study aims to describe the results obtained with middle fossa approach, transmastoid approach, and round window reinforcement in a large series of patients.

Methods and Design: In this single-center retrospective study, we report the results of the procedures performed between 2006 and 2019 using the three main surgical approaches, middle fossa approach (MFA), transmastoid approach (TMA), and round window reinforcement (RWR). The outcome on cardinal cochlear and vestibular symptoms, audiometric results, and changes in cervical vestibular evoked myogenic potentials (cVEMPs) were analyzed. The patients were also interviewed 12 months to 13 years post-treatment to establish their overall satisfaction following surgery.

Results: Sixty-three patients were divided into three groups: 42 MFA; 12 RWR; 9 TMA. Postsurgical control rates exceeded 80% for the majority of symptoms in the MFA and TMA groups, and ranged from 11.1% to 83.3% for the RWR group. Over 90% of MFA or TMA patients and 60% of the RWR cohort were satisfied overall with their treatment. Hearing thresholds were intact following surgery in the MFA and TMA groups. There was one case of profound postoperative deafness in the RWR group.

Conclusion: MFA and TMA are both safe and effective techniques in the treatment of disabling SSCD. Since MFA is the more invasive technique, we suggest that TMA should be proposed as first-line treatment, temporal bone anatomy permitting. RWR outcomes are more variable in term of symptomatic control, and this option could be offered to patients at risk under general anesthesia.

Level of evidence: Level 4 evidence.

KEYWORDS

hearing loss, superior canal dehiscence, vertigo

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1 | INTRODUCTION

Superior semicircular canal dehiscence was described for the first time by Lloyd Minor in 1998, correlating vestibular symptoms triggered by sound and changes in middle ear or intracranial pressure, to defective coverage of the superior canal.¹ This dehiscence of the otic capsule creates a direct interface between the perilymph, the membranous canal, and the overlying dura-mater, which acts as third window (in addition to the physiological oval and round windows). The presence of this third window increases the difference in pressure between the two normal windows creating a low impedance pathway in the direction of the labyrinth via which acoustic energy is dissipated. The resulting loss of energy is illustrated by an increase in hearing thresholds in terms of air conduction. However, this mechanism also increases the transmission of bone vibrations to the perilymph fluids via the labyrinth, generating bone conduction hyperacusis.

The induced symptoms are heterogeneous but can be extremely disabling, combining cochlear signs such as autophony (which is an abnormally loud sensation of the sound produced by the patient's own voice and corporal noises) or pulsatile tinnitus, and vestibular signs including vertigo in response to sound (known as Tullio's phenomenon) or oscillopsia² (sensation that the surrounding environment is in motion although it is stationary, induced by sound and/or pressure changes). Surgical treatment is proposed in the event of disabling symptoms.³ The first surgical procedure was described by Minor and comprised plugging the canal via a middle fossa approach (MFA).⁴ This approach was subsequently widely used with different techniques for treating dehiscence (capping, resurfacing⁵). In 2008, Agrawal and Parnes suggested using the transmastoid approach (TMA) to access the superior canal—a slightly less invasive approach and one more familiar to otologists.⁶ Several series of TMA patients have reported similar results to those obtained with the MFA although this approach does not allow a direct view of the dehiscence. In 2002, Kartush et al introduced the window reinforcement technique via the external ear canal to suppress the effect of the third window, described in Silverstein et al.⁷ Their results were deemed satisfactory in 4 out of 6 cases treated, but subsequent studies carried out with this technique yielded variable results.⁸

1.1 | Objective

The purpose of this study is to present the results obtained with each of the three techniques in a single-center cohort of patients who underwent surgery due to symptomatic superior semicircular canal dehiscence.

2 | METHOD

2.1 | Ethical considerations

The local institutional review board approved this retrospective study (RnIPH 2021-03), declared by reference methodology of the French

National Commission for Informatics and Liberties (CNIL), and patients were informed that their codified data will be used for the study.

2.2 | Study design

All patients who underwent surgery for disabling superior semicircular canal dehiscence (SSCCD) between 2006 and 2019 in our tertiary referral center were included using the French Information Systems Medicalization Program database. The patients' data were then listed in a dedicated database and analyzed retrospectively. In our center, the clinical follow-up of patients treated for SSCCD systematically includes a postoperative visit at day 7, 2 months, and then between 6 months and 1 year after surgery. During the two latter visits, patients are systematically interrogated on the control of the following symptoms: subjective hearing loss, aural fullness, tinnitus (pulsatile or not), autophony, instability, dizziness induced by the sounds (Tullio's phenomenon) or by efforts, oscillopsia. Patients may report the symptom as worsened, unchanged, or improved. During the last visit, a pure-tone and a speech audiometry are systematically performed, and cervical vestibular Evoked Myogenic Potentials (cVEMPs) usually recorded. After 2013, some patients were also assessed using the Video-Head Impulse Test (VHIT) during pre- and/or postoperative visits.

2.3 | Participants

SSCCD was confirmed in all patients by high resolution computed tomography of the temporal bone (slice thickness: 0.6-1 mm, depending on the devices), reformatted in the plane of the SSC, with at least one disabling related cochlear (subjective hearing loss, fullness, tinnitus, autophony) or vestibular symptom⁹ (instability, Tullio's phenomenon, effort-induced vertigo, oscillopsia) and at least one objective test indicating the presence of a third window (videonystagmography [VNG] with pressure tests; cervical vestibular-evoked myogenic potentials [cVEMPs] with threshold study). Each patient in the cohort was assigned to the group corresponding to the surgical strategy selected (MFA, TMA, or RWR). Patients who were inadequately controlled and subsequently reassessed using another approach were analyzed a second time in the group for the second approach used. The choice of the approach was made basing on the results reported in the literature at the time of treatment. From 2007 to 2013, plugging by MFA was the most commonly reported treatment and all the patients were operated through this approach. Then, 12 patients were operated through the transcanal approach with reinforcement of the round window. After 2017, the TMA was proposed whenever the anatomical conditions made it feasible.¹⁰ When the anatomical characteristics of the dehiscence and the tegmen were unfavorable, a MFA was selected. The round window reinforcement was abandoned after 2016 because the results were judged unsatisfactory because they were too variable.

2.4 | Outcome measures, analysis

Symptomatic control was assessed between 6 and 12 months post-surgery for the cardinal cochlear and vestibular symptoms of SSCCD reported by participants prior to surgery using the following categories:

- Cochlear symptoms: subjective hearing loss, aural fullness, tinnitus, autophony.
- Vestibular symptoms: instability, sound- (Tullio) or effort-induced vertigo, oscillopsia.

The patients were questioned by the surgeon concerning the evolution of each of these symptoms if present preoperatively (worsened, unchanged, improved) and the possible onset of postoperative symptoms. The control rate was thus calculated for each symptom. For the purpose of this study, all the patients were interviewed by phone by the first author to assess their overall evolution regarding the SSCCD symptoms after surgery (worsened, unchanged, partially improved or completely improved) in the longer term (6 months to 13 years postoperatively).

Pure-tone hearing thresholds were measured for air conduction (AC) at 250, 500, 1000, 2000, 4000, and 8000 Hz and bone conduction (BC) at 250, 500, 1000, 2000, and 4000 Hz. Pure-tone average (PTA) was calculated on four frequencies (0.5, 1, 2, and 4 kHz) for the AC and the BC. The hearing thresholds were evaluated at the preoperative consultation, then at the 6 to 12 months visit after surgery. We collected preoperative and postoperative pure-tone thresholds for all the patients of the study.

cVEMPs were obtained with tone bursts of 500 Hz in descending thresholds from 100 dB HL to 60 dB HL (Neurosoft system). They were considered as abnormal when the threshold was <85 dB HL. This test was performed preoperatively, then 6 to 12 months after the surgery. cVEMPs thresholds were available for 58/63 ears preoperatively, and 51/63 postoperatively.

Preoperatively, 55 patients (55 ears over 63) had a VNG with pressure and Tullio's tests using the Ulmer's system (Synopsis), and performed standard vestibular testing (oculomotor testing, videonystagmography, rotational chair, caloric testing), testing for Tullio's phenomenon (500 Hz at 95 dB HL and 2000 Hz at 100 dB HL) and glottic Valsalva maneuvers for 10 seconds and repeated twice. These tests were considered as abnormal if ocular movements were registered during the maneuvers.

In 2013, the VHIT has been introduced in our pre- and postoperative assessment 6 to 12 months after surgery. The Ulmer's system (Synopsis) is used to evaluate the gain of the vestibulo-ocular reflex (VOR) for the three canals. The function of the superior canal was considered as normal if the gain was >0.7. Only 17 over 63 ears were evaluated preoperatively, 22 ears postoperatively, using the VHIT.

A descriptive statistical analysis of mean values and 95% confidence intervals was performed to study quantitative variables. Percentages were used to describe qualitative variables. Mean audiometric thresholds were compared between the pre- and

postoperative setting in each group using a Wilcoxon rank-sum test (XLStat for Excel) with a level of significance of $\alpha = .05$.

3 | RESULTS

3.1 | Baseline characteristics

During the study period, 54 patients underwent surgery (31 women and 23 men) including 7 bilateral procedures, and 2 patients underwent another surgery using a second approach (Table 1). No patient was lost in follow-up. In case of bilateral dehiscence, the most affected ear, based on symptoms and/or cVEMPs threshold, was chosen for the first procedure. We therefore examined the results recorded in 63 ears. The median age was 50, and the right/left ratio 1.03. The distribution of symptoms reported by patients on diagnosis is listed in Table 2. The most common symptom was instability (92.1%), followed by tinnitus (82.5%) and subjective hearing loss (81.0%). The hearing thresholds are presented in Table 3. Pressure or Tullio's testing on VNG was positive in 82% of cases when performed ($n = 55/63$). The mean cVEMPs threshold was 74.7 dB HL ($n = 58/63$; SD = 11.9), 8/58 did not present any threshold anomaly.

3.2 | Postsurgical clinical course

MFA was performed on 42 ears, RWR on 12 and TMA on 9. Thirty-eight MFA over the 42 were performed between 2007 and 2014, all the cases of RWR were operated between 2013 and 2016, and we began TMA to plug the canal from 2017. The average hospital stays were 5.12 days (SD = 1.29), 1.58 days (SD = 0.52), and 3.67 days (SD = 0.71), respectively. Results relating to cardinal symptoms control are presented in Table 2. A postoperative improvement was reported in more than 80% for all symptoms in the MFA and TMA groups (aural fullness: 24/25 (96.0%) and 4/5 (80.0%); tinnitus: 29/34 (85.3%) and 5/6 (83.3%); autophony: 17/20 (85.0%) and 7/7 (100.0%); Tullio's phenomenon: 14/17 (82.4%) and no patient complaining with this in the TMA group preoperatively; effort-induced vertigo: 16/20 (80.0%) and 4/4 (100.0%); oscillopsia: 13/16 (81.3%) and 5/6 (83.3%), respectively, in the MFA and the TMA groups), except for instability (29/37, 78.4% in the MFA group but 8/9, 88.9% in the TMA group) and subjective hearing loss (27/36, 75.0% in the MFA group; 3/6, 50.0% in the TMA group). With regard to instability, four MFA patients whose condition did not improve presented bilateral dehiscence and underwent secondary surgery in the opposite ear. In the RWR group, an improvement was reported in 47.1% of cases for cochlear symptoms (subjective hearing loss: 1/9, 11.1%; aural fullness: 3/7, 42.9%; tinnitus: 8/12, 66.7%; autophony: 4/6, 66.7%) and 74.1% for vestibular symptoms including 7/12 (58.0%) for instability control. The patients were interviewed by phone at the time of this study (6 months to 13 years after the surgery) and were asked to comment on overall improvement of the SSCCD symptoms following surgery. 38/42 (MFA patients (90.5%)

TABLE 1 Patients characteristics at baseline

Surgical technique		Global	MFA	RWR	TMA
n ears		63	42	12	9
Age	Median (min-max)	50 (23-81)	48 (23-71)	50 (33-81)	55 (33-68)
Sex gender	W/M ratio	1.34	1.5	1	2
Operated ear	R/L ratio	1.03	1	1.4	0.8
Year of surgery		(2007-2019)	(2007-2017)	(2013-2016)	(2017-2019)

Note: There was no significant difference between the three groups considering the age ($P = .3858$, Kruskal-Wallis chi-squared).

Abbreviations: L, left; M, men; max, maximum; MFA, middle fossa approach; min, minimum; n, number; R, right; RWR, round window reinforcement; TMA, transmastoid approach; W, women.

TABLE 2 Preoperative distribution of the major symptoms for the cochlear and vestibular categories, and their postoperative improvement

		MFA	RWR	TMA
Subjective hearing loss	n preoperative	36/42	9/12	6/9
	n improvement	27/36	1/9	3/6
	% improvement (CI95)	75.0% (61.9-88.1)	11.1% (0-28.7)	50.0% (17.3-82.7)
Aural fullness	n preoperative	25/42	7/12	5/9
	n improvement	24/25	3/7	4/5
	% improvement (CI95)	96.0% (90.1-100)	42.9% (14.9-70.9)	80.0% (53.9-100)
Tinnitus	n preoperative	34/42	12/12	6/9
	n improvement	29/34	8/12	5/6
	% improvement (CI95)	85.3% (74.6-96.0)	66.7% (40.0-93.3)	83.3% (59.0-100)
Autophony	n preoperative	20/42	6/6	7/9
	n improvement	17/20	4/6	7/7
	% improvement (CI95)	85.0% (74.2-95.8)	66.7% (40.0-93.3)	100%
Cochlear symptoms	% improvement	84.4% (73.36-95.34)	47.1% (18.82-75.30)	79.2% (52.64-100)
Instability	n preoperative	37/42	12/12	9/9
	n improvement	29/37	7/12	8/9
	% improvement (CI95)	78.4% (65.9-90.8)	58.3% (30.4-86.2)	88.9% (68.4-100)
Tullio's phenomenon	n preoperative	17/42	6/12	0/9
	n improvement	14/17	5/6	0/0
	% improvement (CI95)	82.35% (70.8-93.9)	83.3% (62.2-100)	—
Effort-induced vertigo	n preoperative	20/42	6/12	4/9
	n improvement	16/20	5/6	4/4
	% improvement (CI95)	80.0% (67.9-92.1)	83.3% (62.2-100)	100.0%
Oscillopsia	n preoperative	16/42	3/12	6/9
	n improvement	13/16	3/3	5/6
	% improvement (CI95)	81.3% (69.5-93.1)	100%	83.3% (59.0-100)
Vestibular symptoms	% improvement	80.0% (67.9-92.1)	74.1% (49.3-98.9)	89.5% (69.4-100)

Note: Results are presented in absolute values and percentages with the confidence interval around the mean.

Abbreviations: MFA, middle fossa approach; n, number of participants; RWR, round window reinforcement; TMA, transmastoid approach; (CI95), 95% confidence interval.

reported a (partial or complete) improvement compared to 9/9 TMA patients with three patients reporting a partial improvement in terms of symptoms. Conversely, 5/12 (41.0%) of RWR patients reported no improvement (Figure 1). Regarding the patients who underwent bilateral surgery, 7/7 initially underwent a MFA procedure. Three of these patients reported a complete improvement

after this initial procedure and the others 4/7 a partial improvement. All of the uncontrolled symptoms were vestibular in nature (instability 4/7; Tullio's phenomenon 2/7; oscillopsia and effort-induced vertigo 1/7). One MFA patient whose condition had not improved presented contralateral dehiscence but did not wish to undergo another surgery.

TABLE 3 Changes in hearing thresholds

		MFA	RWR	TMA
Bone conduction (BC)				
Preoperative PTA	m (sd)	17.86 dB HL (\pm 21.89)	19.2 dB HL (\pm 15.7)	15.0 dB HL (\pm 13.4)
	(CI95)	(11.24-24.48)	(10.32-28.03)	(6.25-23.75)
Postoperative PTA	m (sd)	18.7 dB HL (\pm 21.6)	33.2 dB HL (\pm 32.3)*	16.9 dB HL (\pm 12.6)
	(CI95)	(12.17-25.23)	(14.92-51.48)	(8.67-25.13)
Air conduction (AC)				
Preoperative PTA	m (sd)	32.7 dB HL (\pm 25.3)	24.8 dB HL (\pm 14.5)	23.6 dB HL (\pm 15.7)
	(CI95)	(25.05-40.35)	(16.60-33.00)	(13.34-33.86)
Postoperative PTA	m (sd)	29.3 dB HL (\pm 25.6)*	37.2 dB HL (\pm 30.9)*	26.4 dB HL (\pm 14.0)
	(CI95)	(21.56-37.04)	(19.72-54.68)	(17.25-35.55)
Evolution of high-frequency thresholds				
BC and AC 4 kHz worsening >10 dB	n	4/41	4/12	1/9
	% (CI95)	9.76% (0.67-18.84)	33.33% (6.66-60.01)	11.11% (0-31.64)
AC 8 kHz worsening >10 dB	n	7/41	4/12	2/9
	% (CI95)	17.07% (5.56-28.59)	33.33% (6.66-60.01)	22.22% (0-49.38)

Note: The means of the PTA in BC and AC are presented for each group with their standard deviations, and the 95% confidence intervals around the mean. Significant differences between preoperative and postoperative values are indicated by * ($P < .05$, Wilcoxon test). Patients with a worsening of more than 10 dB HL postoperatively are also presented, in absolute value and in percentage with the 95% confidence interval.

Abbreviations: dB HL, decibel hearing loss; m, mean; MFA, middle fossa approach; PTA, pure-tone average; RWR, round window reinforcement; sd, standard deviation; TMA, transmastoid approach; (CI95), 95% confidence interval.

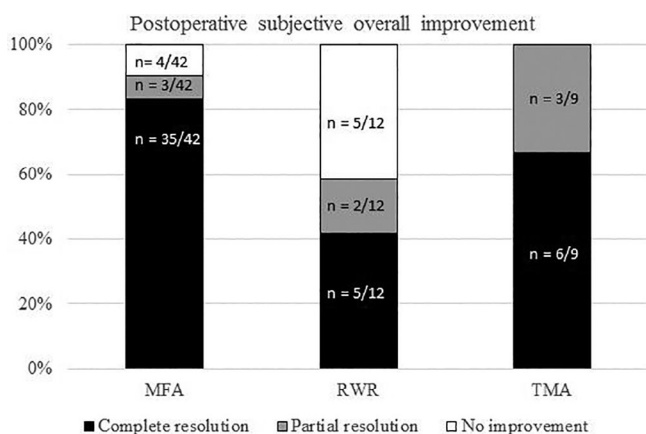


FIGURE 1 Long-term subjective overall improvement assessing through a phone interview conducted at the time of this study. Participants graded their overall improvement as “complete/partial/no overall improvement.” The results are presented in percentages with absolute value. Abbreviations: MFA, middle fossa approach; n, number of patients; RWR, round window reinforcement; TMA, transmastoid approach

Regarding hearing, PTA for AC and BC are presented in Table 3. There was no significant difference between mean pre- and postoperative values for the MFA (BC: +0.83 dB HL, $P = .693$) and TMA (BC: +1.94 dB HL, $P = .120$; AC: +2.79 dB HL, $P = .192$) groups, except for the statistical improvement in the mean AC thresholds in the MFA group (AC: -3.39 dB HL, $P = .02$). One patient in the RWR group developed cochleovestibular symptoms 10 days after surgery, which

led to profound hearing loss. A significant deterioration in the mean thresholds was therefore noted in this group following surgery (BC: +14.06 dB HL, $P = .008$; AC: +12.40 dB HL, $P = .049$). The number of patients whose hearing thresholds worsened by more than 10 dB HL at 4000 Hz in both BC and AC was 4/41 patients (9.8%) in the MFA group, 4/12 patients (33.3%) in the RWR group and 1/9 patients (11.1%) in the TMA group.

The cVEMPs evaluation ($n = 51/63$) showed a mean postoperative threshold of 86.47 dB HL (SD = 11). On an individual level, 11 patients maintained thresholds below 80 dB HL. In the MFA group, 6/42 (14.3%) maintained abnormal thresholds, but 5 of these 6 patients reported an overall improvement at the long term interview; 3/12 (37.5%) RWR patients maintained abnormal thresholds with no overall improvement in 2 of these patients. As regards the TMA group, the threshold did not revert to normal in 2/9 patients (22.2%) but overall long-term improvement were noted in both cases.

The VOR gain of the SSCC was measured pre and postoperatively using the VHIT for 8/42 ears in the MFA group, 10/12 in the RWR group and 4/9 in the TMA group. In the RWR group, 9/10 retained a normal gain for the superior canal. In the MFA group and in the TMA group, half of the ears studied pre and postoperatively showed a decrease in gain <0.7 for the superior canal (4/8 and 2/4, respectively).

4 | DISCUSSION

The treatment of SSCCD has gradually changed since it was first described by Minor in the early 2000s.⁴ Many studies have validated

surgery as standard treatment for symptomatic patients and report an overall success rate (defined as complete or partial disappearance of symptoms) of over 90%.¹¹

The MFA is most suited to the anatomy since it provides a direct view on the dehiscence and facilitates treatment of the bony defect. Furthermore, it facilitates the concomitant treatment of large tegmen defects when associated. Access nevertheless remains difficult when the dehiscence is located in the medial portion of the canal, behind, or even in contact with the superior petrous sinus.¹² This approach also poses a potential, albeit limited, risk of neurological complications.¹³ Several teams have shown that the use of an endoscope can limit temporal retraction and improve the view of the dehiscence particularly when the arcuate eminence defect is along a low-lying tegmen.¹⁴ No approach-related complications were observed in our series of MFA patients. Efficacy in terms of symptom control was established with an improvement in all symptoms, except subjective hearing loss, in almost 80% of cases.¹⁵ Our results are similar to those found in the literature with a control rate ranging from 75% for subjective hearing loss to 96% for fullness. In terms of maintained labyrinth function, some studies have not shown any significant worsening in cochlear and vestibular functions¹⁶ whereas others reported significant worsening of up to 36% in high-frequency hearing thresholds.¹⁵ Mean hearing thresholds were unchanged in our series but approximately 10% displayed sensorineural hearing loss at 4000 Hz.

The development of TMA in this indication has extended the treatment of SSCCD to more otolaryngology surgeons familiar with this approach. Several teams plug the canal on both the ampullated and nonampullated sides.^{6,17} In theory, this technique poses a greater risk of labyrinth complications compared to resurfacing. This is partly due to the risk of damaging the membranous labyrinth and due to the drilling close to the labyrinth.¹⁸ Moreover, it does not provide a direct view of the dehiscence and may be insufficient to treat multiple or large tegmen defects when associated. However, satisfactory results are still being recorded with TMA with control rates for hearing symptoms and induced vertigo above 80% with hearing thresholds maintained.¹⁷ These observations are consistent with the results recorded in our work. Despite having a small series ($n = 9$), symptom control exceeded 80% for all symptoms except subjective hearing loss. No complications were noted in this group and a shorter hospital stay was recorded compared to MFA.

Round window reinforcement via the transcanal approach heralds a return to a physiological model with two mobile windows.⁷ In their first patient series, postoperative sensorineural hearing loss was observed in 2 out of 3 patients with complete round window obturation. This technique was thus abandoned in favor of round window reinforcement. Significant improvements in symptoms in 4 out of 6 patients in the initial series, and then in all cochlear and vestibular symptoms, apart from the subjective hearing loss, in a multicentre study involving 19 subjects were documented with this technique.⁷ Among the studies investigating this alternative, Succar et al¹⁹ highlighted a subjective improvement in 64% of patients (9/14) and stable BC thresholds. In contrast, 50% of patients presented a decline of more than 10 dB HL in AC thresholds. In our series, 12 patients

underwent RWR surgery but this alternative was abandoned in 2016 given the random nature of the results obtained (overall improvement of less than 60%). In addition, one patient developed profound hearing loss secondary to postsurgical labyrinthitis confirmed by a labyrinthine hypersignal on the magnetic resonance imaging (MRI). This hearing loss persisted despite a systemic treatment by corticosteroids and antibiotics, followed by a revision surgical procedure to remove the material used to reinforce the round window, and apply dexamethasone, to reduce the local inflammatory phenomena. RWR remains a minimally invasive alternative⁸ and may be considered in patients at high anesthetic or surgical risk.

No meta-analysis could be carried out to effect a robust comparison of these different approaches²⁰ since the studies include mostly retrospective cases with few participants and variable endpoints from one study to the next. In their systematic review, Nguyen et al found that auditory symptoms were more often improved after MFA compared to TMA (72% vs 59%) without any difference for vestibular symptoms.¹⁵ However, fewer complications appear to have occurred with TMA and scenarios were less severe compared to MFA.²⁰ Depending on the anatomy, the authors advocate the transmastoid approach when the dehiscence is facing the superior petrous sinus. Conversely, in the event of a poorly pneumatized mastoid with low-lying tegmen, this technique is less comfortable than the MFA.^{5,12} On our site, TMA has gradually replaced MFA as first-line therapy subject to favorable anatomical conditions.

The study of VEMPs has largely demonstrated its interest as a diagnostic tool in the diagnosis of SSCCD, to support the presence of a third window. Abnormally low thresholds are generally found together with an abnormally increased amplitude. This is indicative of dehiscence-induced vestibular hypersensitivity.²¹ These anomalies may be linked to the size and location of the dehiscence.²² In most cases, thresholds revert to normal following surgery but this normalization does not always correlate with clinical improvement. In our series as in other studies,²³ normalization of cVEMPs is not strictly associated with clinical improvement, and vice versa. However, 80% of patients had both pre- and postoperative recording of cVEMPs, and the retrospective nature of our study limited the data completeness.

VHIT is another potentially useful technique for the diagnosis and postsurgical evaluation of these patients. It is used to analyze individual semicircular canal function. In our series, some patients experienced a significant change in terms of gain in the treated canal whereas normal function and no correlation with symptom changes were documented in others. According to a recent study evaluating the natural course of vestibular function after plugging through a MFA, a 20% decrease in superior canal function is immediately observed following surgery before reverting to normal.²⁴ This selective and transient hypofunction might be related to a loss of perilymph during plugging and to labyrinthine inflammation. Then, most of the patients normalized their VOR gain, which might reflect the persistence of the inertial flow of endolymph in the superior canal cupula, despite the obstruction in its arm. If some additional fibrosis spreads from the plugging site toward the ampulla, a permanent decrease of the VOR gain could be observed. Future works are needed to correlate the evolution of the vestibular symptoms, and the SSCC's function to the MRI characteristics.

5 | CONCLUSION

SSCCD is characterized by a constellation of cochleovestibular signs and symptoms, which expression is highly variable from one patient to another for reasons that remain unclear. However, surgical management of severely disabled patients has now been shown to be effective in controlling symptoms and to be safe. Three main approaches are described in the literature; we present in this work their respective results in our local cohort. Both MFA and TMA provide satisfactory results in terms of symptomatic control with hearing preservation, but since the MFA is more invasive, we propose the transmastoid approach as the first line of treatment, when the anatomy of the temporal bone allows it. The results obtained with window reinforcement were less satisfactory in our series, so we abandoned this approach in first intention, but it remains a feasible option in patients with high anesthetic risk.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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